Appendix D

Urban design and visual impact assessment

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M1 Princes Motorway Improvements

Picton Road to Bulli Tops

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Executive Summary

Roads and Maritime Services (Roads and Maritime) proposes to upgrade the M1 Princes Motorway between Picton Road and Bulli Tops by the widening and in places realignment of both north and south bound to facilitate improvements in road safety and efficiency.

The proposal involves road widening and realignment of the M1 Princes Motorway from a four lane divided road (two lanes in each direction), to a six lane divided road (three in each direction) between Picton Road to about 50 metres north of the M1 / Appin Road diverge at Bulli Tops and extends over a distance of 8.3 kilometres.

The project components consist of:

- Widening (online) of the existing road from four lanes to six lanes for the majority of its length; and
- Realignment (offline) to the east of the existing road to provide six lanes, including:
  - the formation of two new significant cuttings at either end of the alignment, and
  - the construction of a large fill south of Bellambi Creek

This Visual Impact, Landscape Character and Urban Design assessment has been prepared as part of the Review of Environmental Factors (REF) currently being completed for the proposal and aims to identify the strategies to manage impacts to the environment during construction and operation of the proposal. As part of this process the impacts of the works will be assessed and a framework provided to assist in the mitigation of these impacts as part of the detailed design of the proposal. In doing so a landscape design vision and clear objectives will be established to ensure the design responds to its context and the language of upgrades to either side of the proposal.

The report provides an outline of the physical and cultural landscape context of the site. The way in which these attributes come together has been reviewed to define the Character Zones of the corridor. As part of this process three character zones have been identified and assessed in terms of impact. These character zones reflect the natural community through which they pass.

1) Character Zone 1 - Northern Section
2) Character Zone 2 – Bellambi Creek Valley
3) Character Zone 3 – Southern Section

The findings of this process revealed that the proposal will generally have a low- moderate impact on landscape character with this rising to moderate where the alignment has been straightened resulting in a new footprint for the road. These changes consist of two significant new cuttings at either end of the alignment and a new large fill embankment in the middle just beyond Bellambi Creek.

Visually 11viewpoints were assessed, of which the majority were views from within the corridor. The impact of the proposal upon the views was generally assessed to be low. This reflects the degree of screening provided by the natural communities and the absence of development immediately adjoining the corridor. Five areas however were identified of low to moderate impact. These were associated with the establishment of a new alignment at the northern end of the corridor near Bulli Tops, the southern end north of Picton Road and a fill section south of Bellambi Creek.

Having assessed the route and identified the issues which the project poses in terms of integration a discussion of methods to mitigate these issues is discussed. This covers approaches to treatment of cuttings, retaining walls, barriers, verges, drainage, surplus material and revegetation. This is then pulled together in the form of an overall Urban Design and Landscape strategy. This strategy describes the general integration approaches, the key impact locations and the opportunities posed which could be used to mitigate the impact of the design outcome as the project moves to design development.

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1 INTRODUCTION

1.1 Background

The study area for the M1 Princes Motorway Improvements proposal is located at Mount Ousley, New South Wales approximately 70 kilometres south of Sydney and 10 kilometres from Wollongong central business district (CBD). The M1 Princes Motorway provides a strategic regional link on the Sydney – Wollongong National Land Transport Network corridor servicing local and commuter traffic, passenger and freight transport and is a major route for tourism. Refer Regional Context Plan (Figure 1).

The Roads and Maritime Services (Roads and Maritime - formerly Roads and Traffic Authority, RTA) are proposing to upgrade the M1 Princes Motorway to improve road safety and efficiency along the Motorway. The upgrade involves road widening at Mount Ousley and realignment of the M1 Princes Motorway from a four lane divided road (two lanes in each direction), to a six lane divided road (three in each direction).

For the purposes of this report the study area reaches beyond the immediate extent of the proposed works footprint to assess the broader landscape character of the area and the likely points from which the proposal would be visible. Refer to the Local Context Plan (Figure 2).

The section of M1 Princes Motorway between Bulli Tops and Picton Road interchange is a problematic section of road. The road environment is a divided multi-lane road, located in a 100 km/hr speed zone along a rolling and sweeping alignment with steep grades. The road services a high proportion of heavy vehicles transporting freight between Port Kembla, Sydney, and collieries in the Illawarra. Presently there are no slow travel lanes leading to travel efficiency and safety issues. These are compounded by a high frequency of inclement weather and fog events, which reduce visibility. The proposal is needed to improve road safety and traffic flow along this heavily used route.

1.2 Purpose of Report

The report has two key purposes:

1. To provide input and advice on the development of the proposed design solution in an integrated environment.
2. To undertake a landscape character and visual assessment of the preferred option for inclusion in the REF.

The landscape character and visual impact assessment fills two main function, defined in the Environmental Impact Assessment Practice Note: Landscape Character and Visual Impact Assessment (EIA No.4)

> *"1. To inform the development of the preferred route and concept design so that the proposal can avoid and minimise impacts up front. It must be commenced early in the environmental impact assessment (EIA) process to achieve this goal and integrate with the design process.*

2. To inform the RMS, other agencies and the community about the landscape character and visual impact of the proposal and what avoidance, management and mitigation strategies would be implemented."

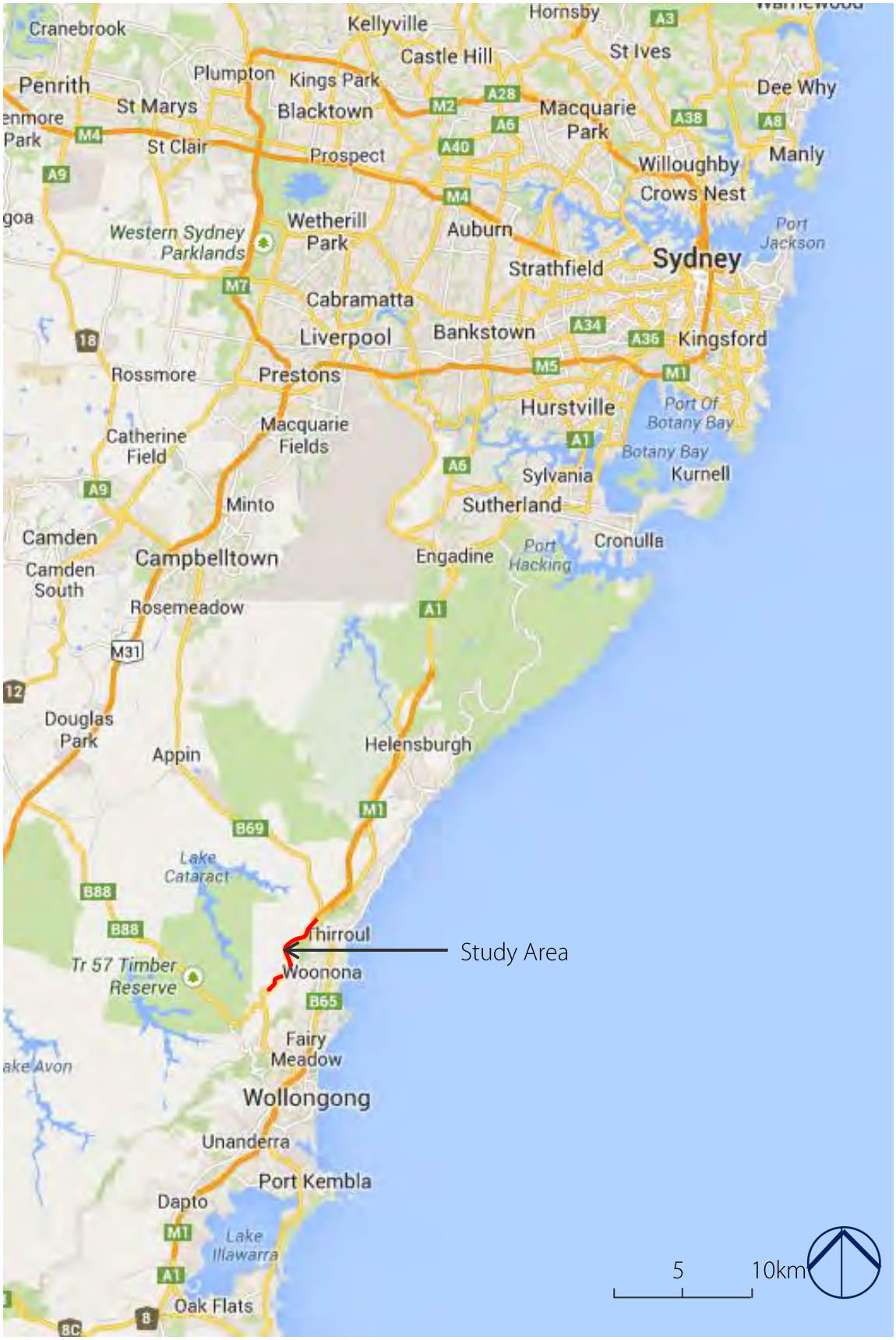


Figure 1 – Regional Context Plan (Source: Googlemaps, 2014)

In addressing the landscape character and visual assessment of the project, the guide differentiates between the two categories of assessment with them defined as follows:

> *" landscape character assessment - the impact on the aggregate of an area's built, natural and cultural character or sense of place and visual assessment – the assessment of impact on views.*
>
> *Landscape character and visual assessment are equally important. Landscape character assessment helps determine the overall impact of a project on an area's character and sense of place. Visual impact assessment helps define the day to day visual effects of a project on people's views."*

The report has been structured in such a way that it defines the context, character and visual catchments of the proposal, identifies the critical issues which have informed the design selection and the approaches to mitigate against them.

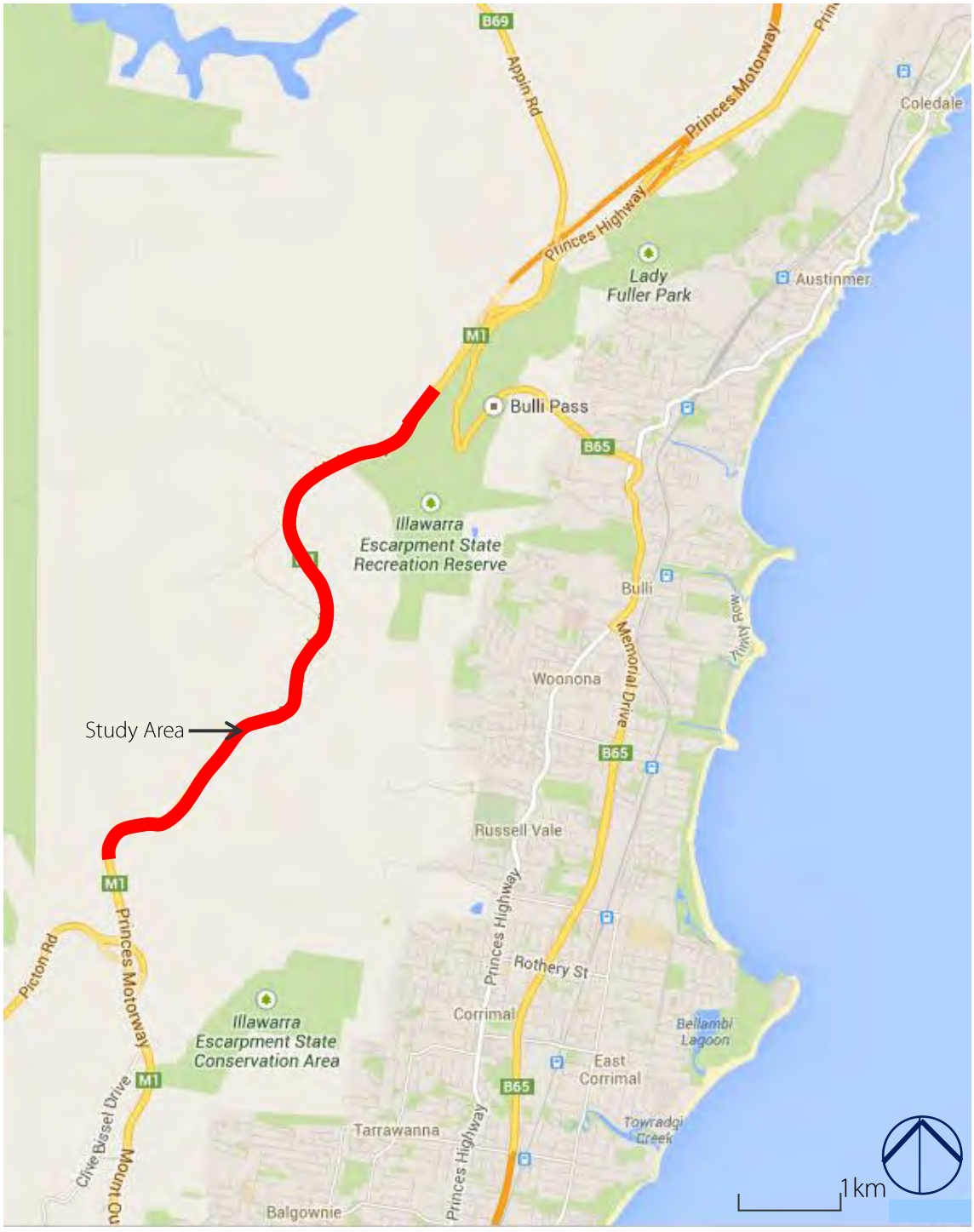


Figure 2 – Local Context Plan (Source: Googlemap, 2014)

1.3 Project Description

The proposal involves road widening and realignment of the M1 Princes Motorway from a four lane divided road (two lanes in each direction), to a six lane divided road (three in each direction) between Picton Road to about 50 metres north of the M1 / Appin Road diverge at Bulli Tops and extends over a distance of 8.3 kilometres.

The project components consist of:

- Widening (online) of the existing road from four lanes to six lanes from:
  - Picton Road interchange to 600 metres north of Picton Road
  - 1.65 kilometres north of Picton Road to the Fire Trail 7 access location
  - On both sides of the existing road from Fire Trail 7 access location for about 370 metres beneath the Endeavour Energy high voltage stanchions
  - To the west of the existing road for a distance of about 200 metres, from about 370 metres to 570 metres north of Fire Trail 7 access location
- Realignment (offline) to the east of the existing road to provide six lanes from:
  - 600 metres north of Picton Road to 1.65 kilometres north of Picton Road
  - 2.7 kilometres north of Picton Road to 70 metres south of Bellambi Creek bridge
- Widening of Bellambi Creek bridge to provide six lanes from 70 metres south to 30 metres north of the bridge
- Provision of a three metre wide (northbound) and three metre wide (southbound) shoulder
- Posted vehicle speed limit of 100 kilometres per hour
- Expansion of the road surface area including the replacement of safety barriers, relocation of road signage and infrastructure (such as permanent variable message signage)
- Re-alignment and earthworks including bank stabilisation works and conservation measures
- Re-alignment of 400m radius curve to 600+m radius at north end and earthworks including bank stabilisation works and conservation measures.
- Installation of ITS infrastructure

Construction of the proposal would be undertaken in two stages. Stage 1 of the proposal has been successful in securing funding under the Commonwealth's Infrastructure Investment Programme (previously the Nation Building 2 (NB2) program). Funding is to be jointly provided by the NSW Government and the Australian Government, with a contribution of $42M each. Subject to project approval, Stage 1 construction would commence in 2016 and be delivered over a 24 month construction period, during and outside of normal working hours. Construction of Stage 2 would be subject to future funding.

1.4 Project Objective

The proposal objectives are:

- Improve travel time and efficiency by providing additional lane capacity
- Improve road safety through enabling enhanced separation of slower moving and faster moving vehicles
- Provide for safe road and utility maintenance and access
- Minimise impacts to National Parks and Wildlife, Sydney Catchment Authority or third party lands
- Increase reliability into and out of the Illawarra region and port of Port Kembla, including for general freight, larger restricted access vehicles and high performance vehicles.

1.5 Urban and Landscape Design Objectives and Principles

In order to address the impacts of the proposed works, a number of key objectives have been developed to define the nature and parameters of the landscape character and visual impact mitigation recommendations, developed to ensure that the project design responds appropriately to its context.

The objectives and guiding principles are applicable for all design disciplines and have been developed to assist the development of the concept design and are to be carried through to detailed design and construction to ensure a unified and consistent approach to the development of the proposed works.

The following objectives and associated principles are proposed to inform the development of the Climbing Lanes proposal.

Objective 1

Provide a road that is responsive to and integrated with the landscape

Principles:

- New road formation to continue/ follow/ emulate the qualities and characteristics of the existing formation
- Adopt changes to the alignment which are consistent with that of the existing route ie an alignment which is responsive to the undulating landform of the corridor, following rigelines, spurs etc.
- Integrate road embankments with adjacent landscape by grading out and varying slopes and varying fence boundaries and planting areas, in response to site context
- Integrate the road landscape into existing vegetation patterns. Continue bands of planting and where appropriate avoid linear strip planting of trees and shrubs along highway.
- Minimise the potential impacts to the Illawarra Escarpment Scenic Conservation Area (IESCA) particularly at the northern end of stage 2.

Objective 2

Provide a well vegetated, natural road reserve to reinforce the existing qualities of the highway corridor as a highway through Bushland

Principles:

- Provide a densely planted highway: Native seed all disturbed landscape areas and supplement with planting
- For seeding and tubestock planting, endemic species of local provenance should be used wherever they can be sourced
- Where vertical rock cuttings are constructed/ widened ensure sufficient space at the base of cuttings to allow planting and seeding to be established and thrive, (i.e. two metres minimum space), especially where it is likely that an engineered slope stabilisation treatment would be needed
- If cuttings are unable to incorporate planting at base ensure that the treatment of the face addresses the ongoing stability and performance of the cutting.

Objective 3

Provide an enjoyable and interesting highway

Principles:

- Create a varied sequence of views and enclosure to match the existing spatial patterns of the landscape. Reinforce planting in wooded sections of highway and keep views available in open sections of highway
- Where views are available consider the selection of species to maintain view corridors such as low growing groundcovers and shrubs
- To maximise open views use wire rope barrier types where possible, taking into account engineering issues, safety requirements, and clearance zones and retaining existing vegetation
- On retaining wall structures, where engineering parameters allow, the use of double rail barriers instead of solid walls/ parapets or walls with one rail is desirable so that the road user is visually connected to the surrounding environment through which they travel.

Reference Documents

In addition to the above project specific objectives and principles, the concept design should be informed by the following Roads and Maritime design guidelines:

- Road Design Guidelines
- Landscape Guidelines, April 2008
- Beyond the Pavement, Urban Design Policy, Procedures and Design Principles, January 2014
- Shotcrete Design Guidelines, June 2005.
- Bridge Aesthetics - Design Guidelines to improve the aesthetics of bridges in NSW, 2012

Figure 3 – Guideline Covers

2 PROJECT CONTEXT

2.1 Location

The study area for the M1 Princes Motorway Climbing Lanes proposal is located between Mount Ousley and Bulli, New South Wales approximately 70 kilometres south of Sydney and 10 kilometres north-west of Wollongong CBD within the local government area (LGA) of Wollongong City Council. Refer Regional Context Plan (Figure1).

The broader landscape character of M1 Princes Motorway is that of a landscape defined predominantly by open woodland (lowland and coastal forest) on moderately undulating topography of the Woronora Plateau. The woodland provides a semi-enclosed character to the road with only occasional breaks of open grassland areas associated with creek and drainage lines and power line easements.

2.2 Land Use

Land uses surrounding the proposal site is limited to existing M1Princes Motorway and Picton Road interchange and associated road corridor disturbed from clearing and previous road works, vegetated areas which form part of the Upper Nepean River Sub-Catchment, and power substation adjacent to Bellambi Creek.

The Upper Nepean River Sub-Catchment is located within the Sydney Drinking Water Catchment and is administered by the Sydney Catchment Authority as a Special Area (Metropolitan Special Area) under State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011(Refer Figure 4). This reveals that the entire alignment falls within the Catchment.

Within the study area, to the west of the M1 Princes Motorway, the catchment includes Allen Creek, Bellambi Creek and Cataract Creek and a series of smaller tributaries which drain in a westerly direction towards Lake Cataract. Both Bellambi and Cataract Creeks extend beyond the alignment crossing from the east to the west. The waters of the entire catchment of these two creek systems form part of the Sydney Water catchment.

The Illawarra Escarpment (State Conservation Area) is located adjacent to and along the corridor from just north of the Bellambi Creek crossing, north of Charlesworth Dam and is used for a range of recreational activities such as bush walking and picnics. The majority of public activities occur north of Bulli Pass in the area around Sublime Point.

Other infrastructure and surrounding land uses include Charlesworth Dam, Telstra utilities, power lines and power substation.

The landuse of an area is defined either at a state and local government level or both. The following planning documents relate to the site and its use.

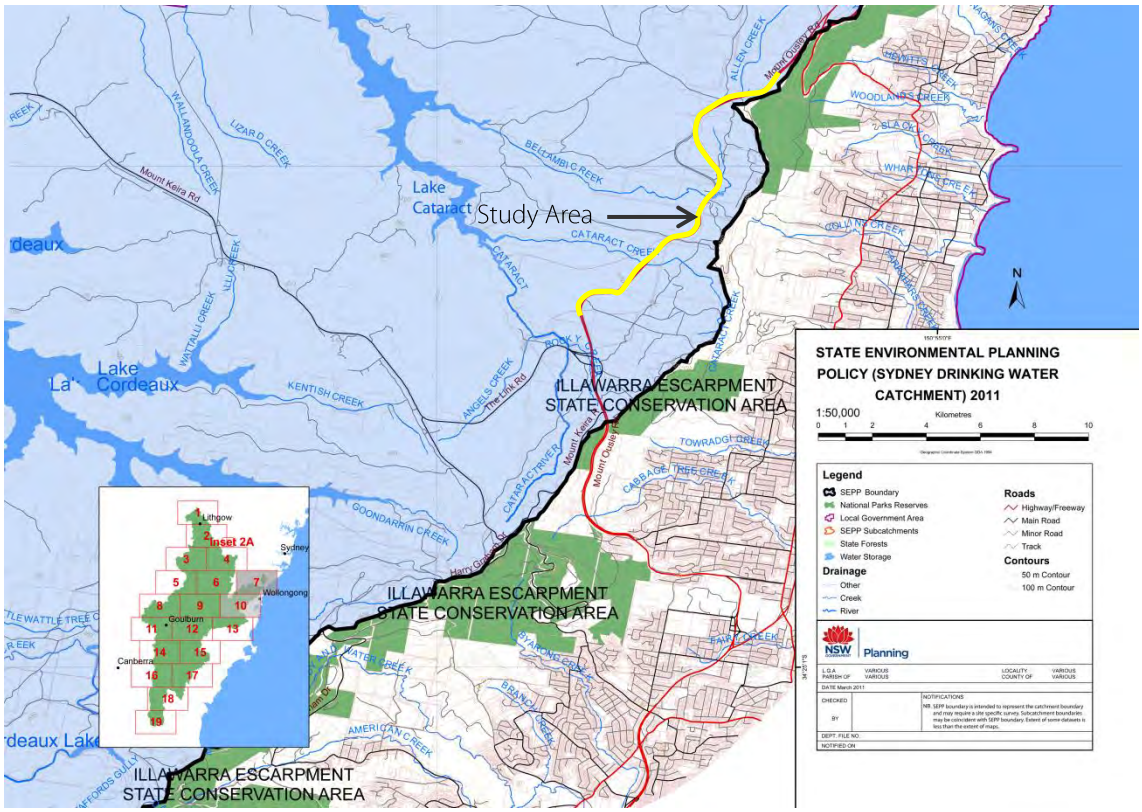


Figure 4 – Sydney Drinking Water Catchment, 2011

2.2.1 Wollongong Local Environmental Plan 2009

The Wollongong Local Environmental Plan 2009 (LEP 2009) is the relevant local planning instrument for the area which defines landuse. This identifies the site as Infrastructure and Environmental Protection (refer Figure 5) which are defined as:

Zone SP2 Infrastructure

1. *Objectives of zone*

- To provide for infrastructure and related uses.
- To prevent development that is not compatible with or that may detract from the provision of infrastructure.
- To provide for key transport corridors.

2. *Permitted without consent*

- Building identification signs

3. *Permitted with consent*

- The purpose shown on the Land Zoning Map, including any development that is ordinarily incidental or ancillary to development for that purpose; Advertising structures; Business identification signs; Child care centres; Community facilities; Recreation areas; Recreation facilities (indoor); Recreation facilities (major); Recreation facilities (outdoor); Respite day care centres; Roads

4. *Prohibited*

- Any development not specified in item 2 or 3

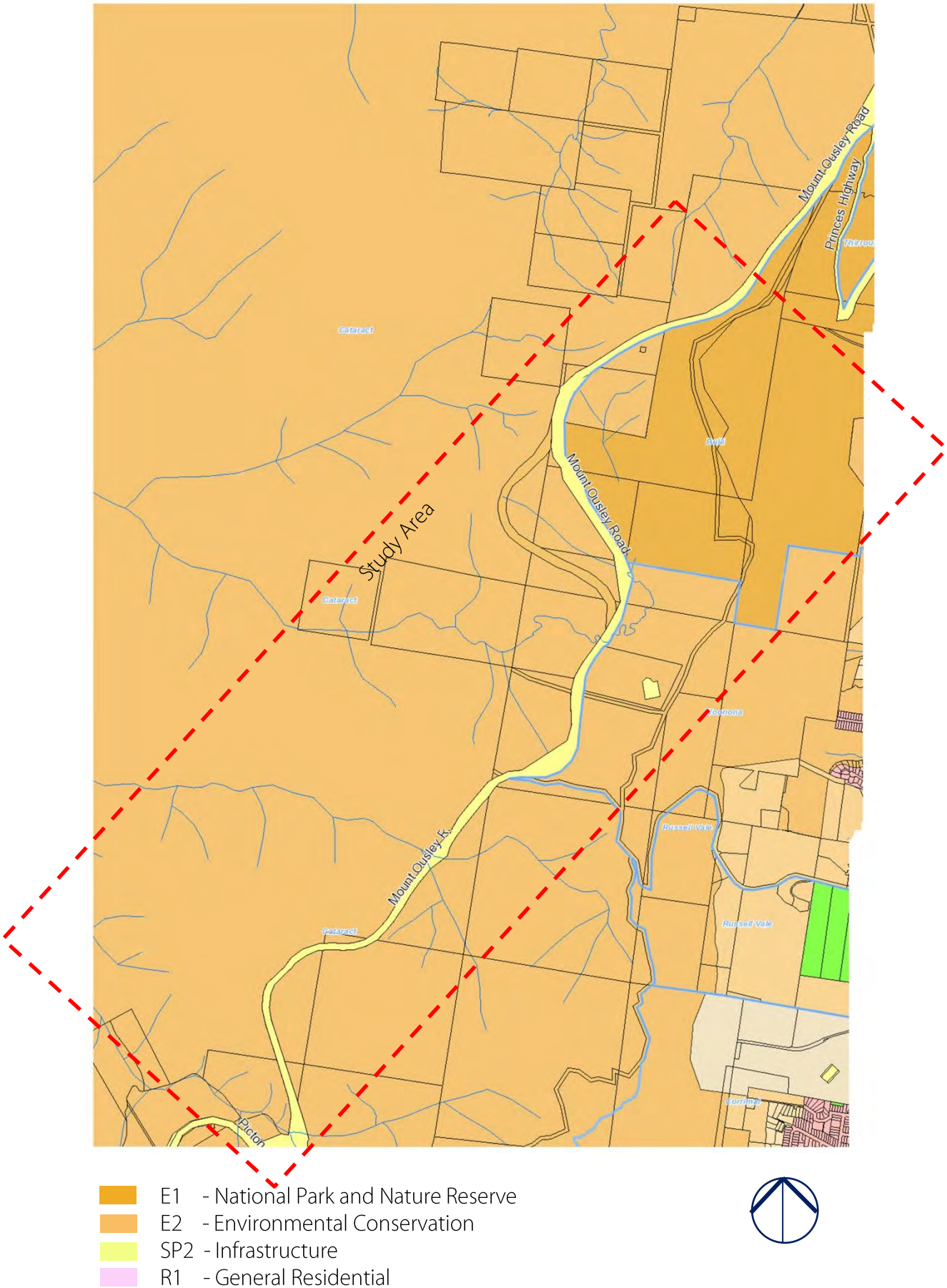


Figure 5 – Wollongong LEP, 2009

Zone E2 Environmental Conservation

1. *Objectives of zone*
   - To protect, manage and restore areas of high ecological, scientific, cultural or aesthetic values.
   - To prevent development that could destroy, damage or otherwise have an adverse effect on those values.
   - To retain and enhance the visual and scenic qualities of the Illawarra Escarpment.
   - To maintain the quality of the water supply for Sydney and the Illawarra by protecting land forming part of the Sydney drinking water catchment (within the meaning of State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011) to enable the management and appropriate use of the land by the Sydney Catchment Authority.
2. *Permitted without consent*
   - **Nil**
3. *Permitted with consent*
   - Environmental facilities; Environment protection works; Extensive agriculture; Recreation areas
4. *Prohibited*
   - Business premises; Hotel or motel accommodation; Industries; Multi-dwelling housing; Recreation facilities (major); Residential flat buildings; Restricted premises; Retail premises; Seniors housing; Service stations; Warehouse or distribution centres; Any other development not specified in item 2 or 3

2.2.2 State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011

The aims of this Policy are:

- to provide for healthy water catchments that will deliver high quality water while permitting development that is compatible with that goal, and
- to provide that a consent authority must not grant consent to a proposed development unless it is satisfied that the proposed development would have a neutral or beneficial effect on water quality, and
- to support the maintenance or achievement of the water quality objectives for the Sydney drinking water catchment.

The presence of a drinking water catchment means that the site is sensitive to change particularly in relation to runoff and its management. This is an important consideration which would inform both construction methodology but also the way in which storm water is managed.

The proposal needs to respond to the planning parameters ensuring that its development respects the scenic qualities of the environment through which is passes.

2.3 Landform and Hydrology

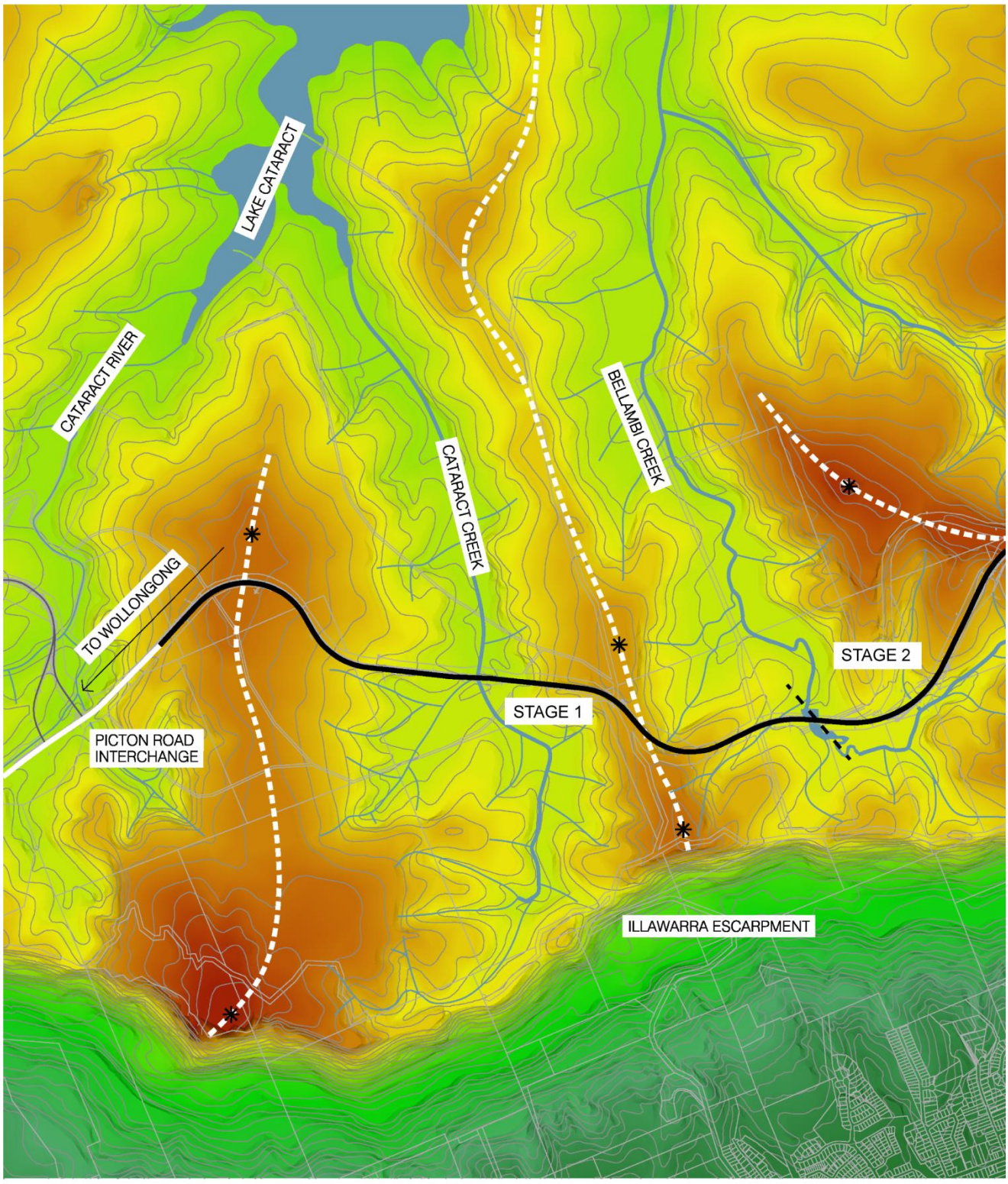
The study area is located on the highly scenic undulating landform of the Woronora Plateau and varies, in distance from the face of the Illawarra Escarpment ranging from 85 metres to1.5 kilometres to its east.

The existing M1 Princes Motorway is moderately undulating as it winds up and down the plateau. Natural elevations within the study area vary from approximately 310 to 445 metres above sea level (ASL). The alignment is generally located on terrain with a slope range between 0^0 and 10^0 and has generally been aligned to follow spur and ridge lines, refer Figures 6 and 7.

A number of permanent drainage lines and significant water bodies including Allen Creek, Bellambi Creek and Cataract Creek are located within the study area to the west of M1 Princes Motorway which drains in a westerly direction towards Lake Cataract. (Refer Figure 6)

Lake Cataract is a Sydney Catchment Authority drinking water supply dam. As such the project is located in a highly sensitive environment and must satisfy the requirements of the Sydney Catchment Authority (SCA) to minimise the potential of the project to impact on the water quality and environment of the Lake Cataract catchment. (SCS 2012)

Currently runoff from M1 Princes Motorway which includes sediments is directed into the catchment by a series of table drains or formed culverts.



LEGEND

- PROPOSED ALIGNMENT
- EXISTING ALIGNMENT
- RIDGES
- CREEKLINES
- HIGH POINTS

HEIGHT

0.0000m
50.0000m
100.0000m
150.0000m
200.0000m
250.0000m
300.0000m
300.0000m
350.0000m
400.0000m
450.0000m

Scale

0 250 500 1250m

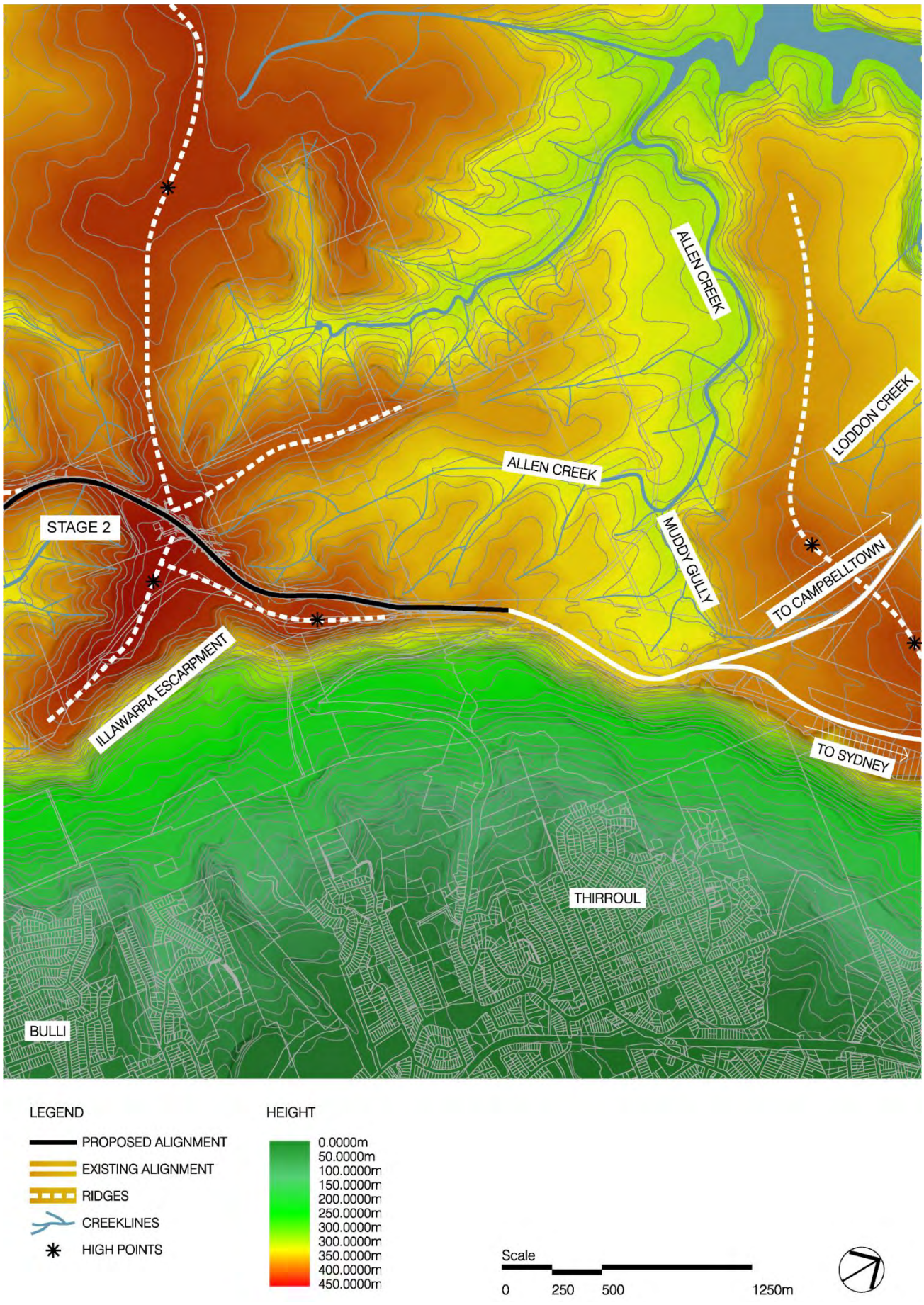
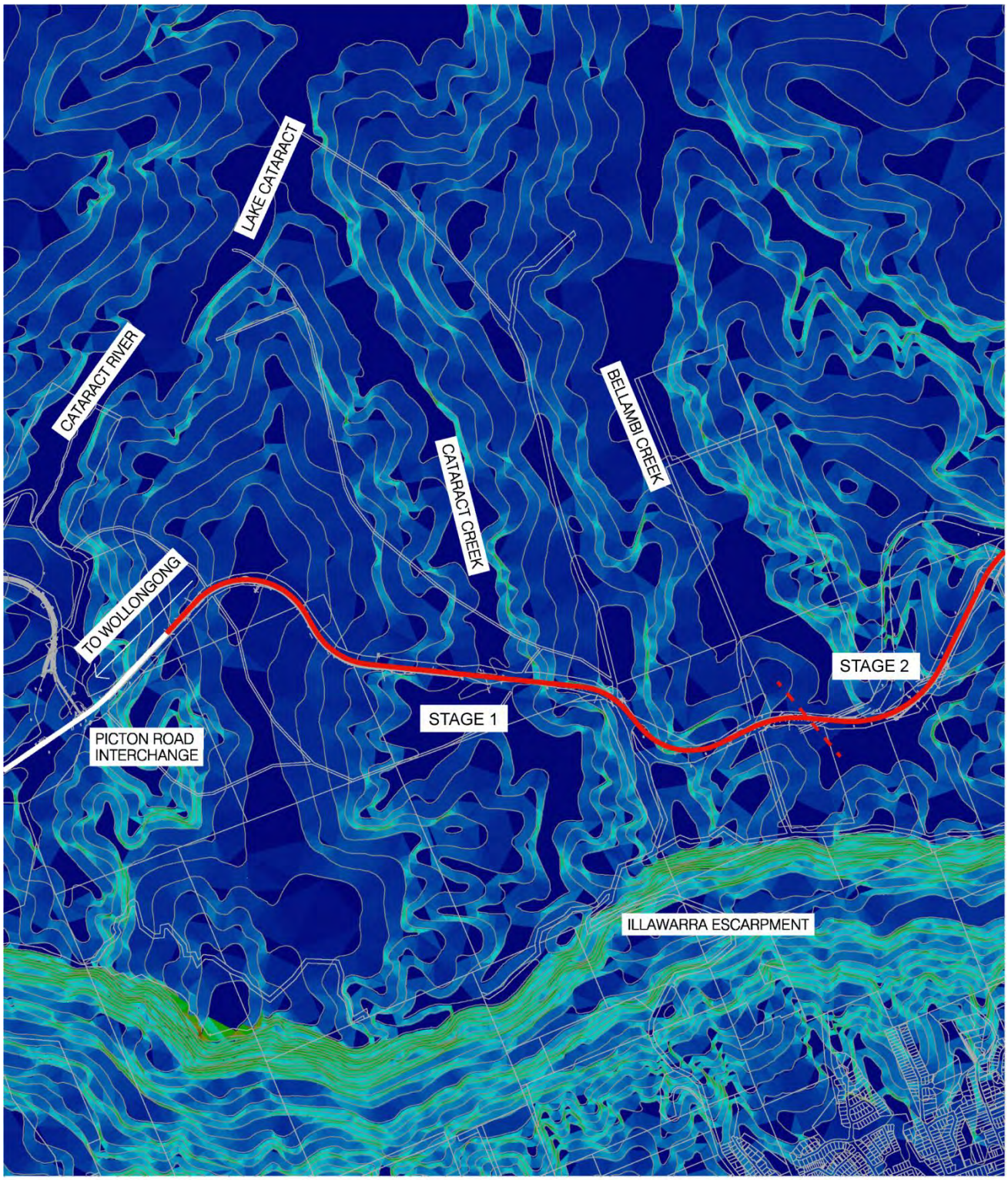


Figure 6 –Topography and drainage



LEGEND

PROPOSED ALIGNMENT

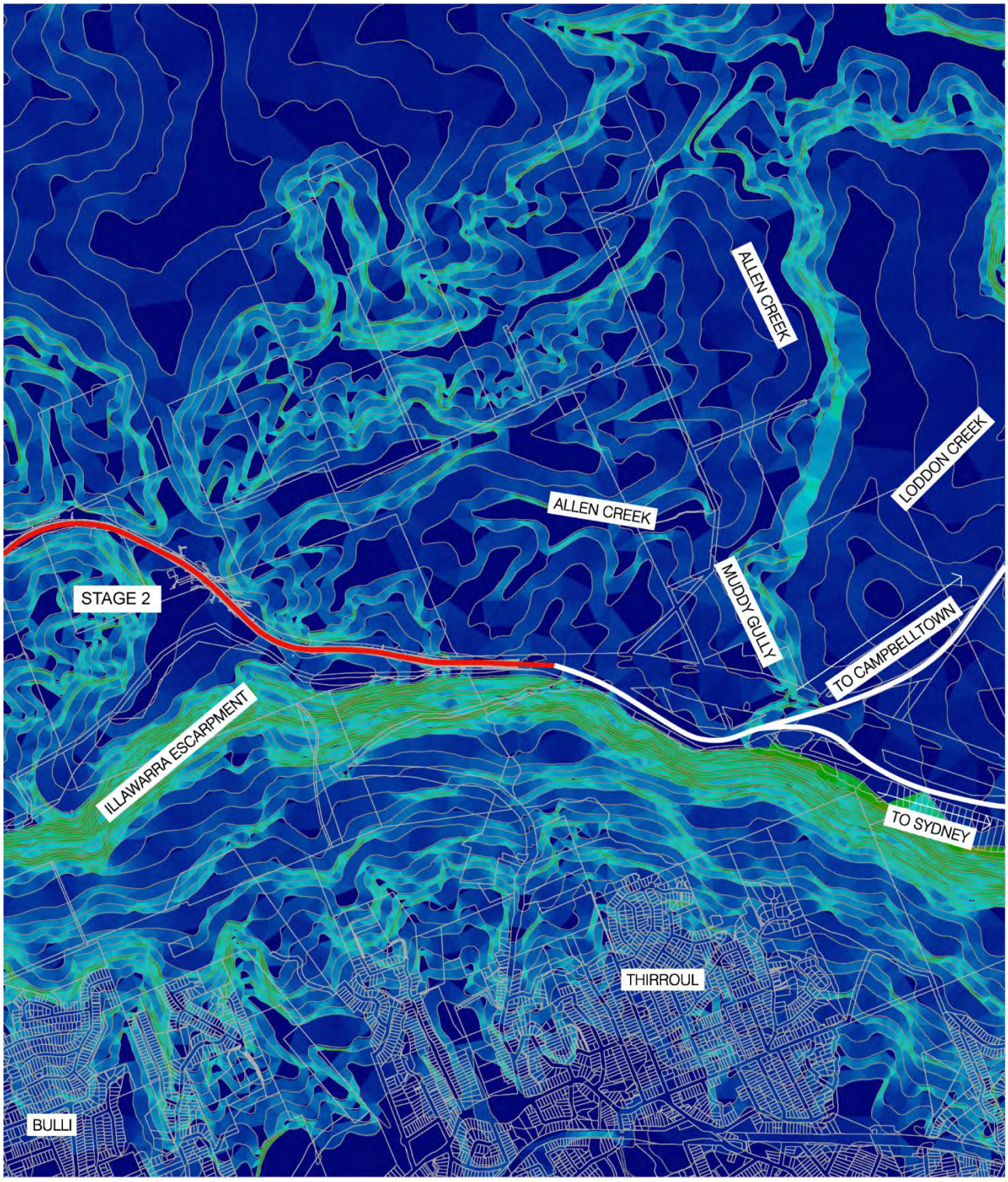
EXISTING ALIGNMENT

SLOPE

0°
2.5°
5°
10°
15°
20°
90°

Scale

0 250 500 1250m



LEGEND

PROPOSED ALIGNMENT

EXISTING ALIGNMENT

SLOPE

0°
2.5°
5°
10°
15°
20°
90°

Scale

0 250 500 1250m

Figure 7 –Slope Mapping

All works therefore have the potential to impact the water quality entering this system. How water is captured and treated before entering this system needs to be considered within the design. Design elements that may be required include sediment basins, swales and other water sensitive design structures.

2.4 Geology and Soils

Geology and soil conditions influence the design and response in terms of visual outcomes and selection of appropriate landscape and urban design treatments as they relate to rock strength and ability to support vegetation.

The soils present within the area surveyed have been mapped by Hazelton and Tillie (1990) which identified three different Soil Landscape Groups. These include Lucas Heights Group located at the Picton Road off-ramp; Narrabeen Sandstone to the north on the lower slopes; and Hawkesbury Sandstone on the upper slopes.

The Hawkesbury Sandstone geological unit supports thin, sandy soils with dry sclerophyll forest, whilst the Narrabeen soils support wet sclerophyll forests and rainforests. (LeskryK 2010).

Geology of the cuttings is variable along the length of the proposal with sandstone broken by seams of weaker stone. (Refer Figure 8)

Figure 8 – a) Sandstone cutting with vegetation growing in weaker seams b) weaker stone and soil incursions

2.5 Flora

The native vegetation along the present alignment and within the study area comprises a mosaic of moist eucalypt forest and rainforest on the steep slopes and in the gullies, and open-woodland/forest and upland swamps on the plateau. The quality of vegetation within and adjoining the alignment is mostly moderate to good. Some areas, predominantly the valleys have been cleared and are dominated by pasture grasses and annual weeds.

The Woronora, O'Hare's and Metropolitan Catchment, and Illawarra Escarpment vegetation mapping undertaken by NPWS (2002 and 2003) identifies eleven plant communities within the study area (refer to Figure 10). They are:

- Coachwood Warm Temperate Rainforest
- Escarpment Edge Silvertop Ash Forest
- Exposed Sandstone Scribbly Gum Woodland
- Moist Blue Gum - Blackbutt Forest
- Moist Gully Gum Forest
- Sandstone Gully Peppermint Forest
- Tall Open Blackbutt Forest
- Tall Open Peppermint – Blue Gum Forest
- Upland Swamps: Banksia Thicket (EEC)
- Upland Swamps: Fringing Eucalypt Woodland (EEC)
- Upland Swamps: Sedgeland – Heath Complex (EEC)

Four of these communities are dominant within or adjacent the alignment. These are:

- Tall Open Blackbutt Forest
- Escarpment Edge Silvertop Ash Forest
- Moist Blue Gum - Blackbutt Forest
- Exposed Sandstone Scribbly Gum Woodland

A small incursion of Upland Swamp has been identified in the southern section. This community has been assessed as part of an Endangered Ecological Community -the Coastal Upland Swamp. Loss of a smaller scale swamp and partial loss of a larger scale swamp will occur as part of the project and is separately assessed as a part of the biodiversity investigation in the REF.

The make-up of these communities has been recorded by SMEC as part of the Biodiversity Study, 2014. These are summarised below.

Tall Open Blackbutt Forest

Located in Character Zones 1 and 3 this community is located on rich soils on gentle to steeply sloping terrain and moist gullies. It is characterised by a mature eucalypt canopy consisting mainly of *Eucalyptus pilularis* (Blackbutt) and *Syncarpia glomulifera* (Turpentine). There mid-storey layer is moderately dense and is comprised of shrubs to two metres including *Leptospermum polygalifolium* (Yellow Tea-tree), *Notelaea longifolia forma longifolia* (Large Mock-olive*), Leucopogon lanceolatus*, *Synoum glandulosum* (Scentless Rosewood) and *Doryanthes excelsa* (Gymea Lily). Groundcovers is dominated by *Lomandra longifolia* (Spiny-headed Mat-rush), *Pteridium esculentum* (Common Bracken) and *Calochlaena dubia* (Rainbow Fern). Climbers such as *Hibbertia dentata* (Trailing Guinea Flower) are also common. (Refer Figure 9).

Figure 9 – Tall Open Blackbutt Forest

Escarpment Edge Silvertop Ash Forest

Located on the flatter ridge-top areas, this vegetation community is a moderately tall open forest or woodland. The dominant canopy species are *Eucalyptus sieberi* (Silvertop Ash), *Eucalyptus piperita* (Sydney Peppermint), *Syncarpia glomulifera*, and *Corymbia gummifera* (Red Bloodwood). A variety of shrubs occur in the mid-storey including *Banksia serrata* (Old Man Banksia) *B. spinulosa* (Hairpin Banksia), *Leucopogon lanceolatus* and *Persoonia linearis*. Rushes, grasses and herbs make up the groundcover, including Lomandra *longifolia*, *Patersonia glabrata* (Leafy Purple-flag), *Entolasia stricta* (Wiry Panic) and *Lepidosperma laterale*. (Refer Figure 11a)

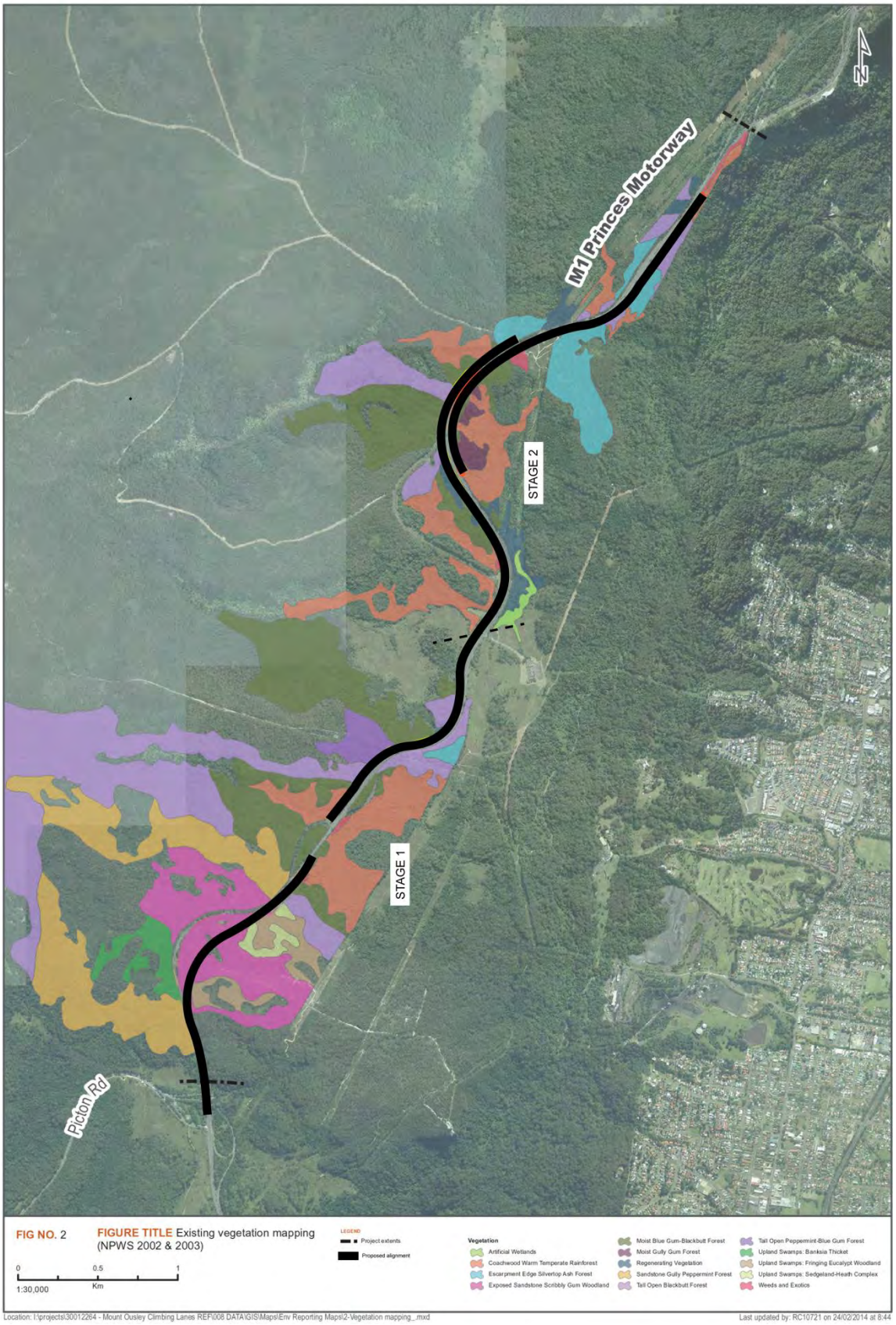


Figure 10 – Vegetation Mapping

Moist Blue-gum Blackbutt Forest

This community occupies rich soils on steep slopes and protected moist gullies. Consisting of a tall mature eucalypt canopy composed mainly of *Eucalyptus pilularis*, *Syncarpia glomulifera*, *Eucalyptus saligna* (Sydney Blue Gum) and *E. saligna x botryoides*. The predominantly warm temperate rainforest understorey is moderately dense consisting of *Synoum glandulosum*, *Doryphora sassafras* (Sassafras) and *Cryptocarya glaucescens* (Jackwood). Climbers such as *Stepahania japonica var. discolour* (Snake Vine), Tylophora *barbata* (Bearded Tylophora), and *Smilax australis* (Lawyer Vine) are common. The groundcover is predominantly *Dichondra repens* (Kidney Weed), *Pseuderanthemum variabile* (Pastel Flower) and *Oplismenus imbecillus*, with dense patches of *Goodenia ovata* (Hop Goodenia). (Refer Figure 11b).

Figure 11 –a) Escarpment Edge Silvertop Ash Forest; b) Moist Blue Gum Blackbutt Forest

Upland Swamp: Tea-tree Thicket

This community occurs as an isolated pocket, to the east of the alignment and occupies shallow depressions of sandy and periodically water-logged soils on the plateau surface. The community consists of a tall closed scrub or closed heath with the occasional emergent eucalypt. Shrub species include *Leptospermum polygalifolium*, *L. juniperinum* (Prickly tea-tree), *Banksia ericifolia* (Heath-leaved Banksia). The groundcover is dominated by *Gleichenia dicarpa* (Pouched Coral Fern), *Gleichenia microphylla* (Scrambling Coral fern), *Schoenus brevifolius* (Zig-zag Bog-rush), Baumea *teretifolia* and *Empodisma minus* (Spreading Rope-rush).

Exposed Sandstone Scribbly Gum Woodland

Located on the flatter ridge-top areas at the southern end of the study area, this community forms an open woodland on sandstone soils. Dominant canopy species are *Eucalyptus sieberi* (Silvertop Ash), *Eucalyptus racemosa* (Narrow-leaved Scribbly Gum) and *Corymbia gummifera* (Red Bloodwood). A variety of shrubs occur in the mid-storey including *Banksia serrata* (Old Man Banksia) *B.ericifolia*, and *Leptospermum trinervium* (Flaky-barked Tea-tree). Rushes, grasses and herbs make up the groundcover, including *Lomandra glauca*, *Anisopogon avenaceous* (Oat Speargrass), *Patersonia glabrata* (Leafy Purple-flag), *Lomandra glauca* (Pale Mat-rush) and *Caustis flexuosa* (Curly Wig). (Refer Figure 12)

Figure 12 – Exposed Sandstone Scribbly Gum Woodland

An understanding of these communities and their distribution will assist in the development of the landscape revegetation for the corridor, the method used and species make up. The presence of a moist vegetation community will see the opportunity for seeding reduced due to the nature and form of seed of these plants.

Weeds

The general condition of the corridors vegetation is good with weed incursion limited, a product of parts of the road being in cut and the vegetation community located above the alignment protected in part from disturbance and weed ingress. Despite the relative condition of the vegetation three species of Class 4 noxious weeds as listed in the Wollongong LGA have been identified in the study area as follows:

- Lantana (*Lantana camara*)
- Blackberry (*Rubus fruticosus*)
- African Lovegrass (*Eragrostis curvula*)

The disturbance of the corridor by mechanical vegetation removal, earthworks and increased human activity during construction has the potential to facilitate spread of weeds. Care will need to be taken to ensure that there are strategies and precautions in place to contain the extent and spread of these weeds.

Figure 13 – a) Crofton weed amongst others on fill slope; b) lantana within disturbed corridor under power line easement

3 ASSESSMENT METHODOLOGY

This section of the report aims to review the proposed works assessing the visual impact and effect on the landscape character of the area.

The RTA Visual Impact and Environmental Impact Assessment Guidance Note: Guidelines for landscape character and visual impact assessment, 2013 sets out two main purposes of landscape character and visual impact assessment:

"To inform the development of the preferred route and concept design so that the proposal can avoid and minimise impacts up front.

To inform the Roads and Maritimes managers, other agencies and the community about the landscape character and visual impact of the proposal and what mitigation strategies would be implemented."

And defines visual impact assessment and landscape character assessment as follows:

"Landscape character assessment - the assessment of impact on the aggregate of an area's built, natural and cultural character or sense of place are equally important and visual assessment - the impact on views.

Landscape Character and Visual assessment are equally important. Landscape character assessment helps determine the overall impact of a project on an area's character and sense of place. Visual impact assessment helps define the day to day visual effects of a project on people's view.

This dual assessment will help differentiate options, improve route alignment decisions and improve design outcomes."

3.1 Landscape Character and Impact Assessment

To assess the landscape character a number of stages are undertaken to understand the context and the implications of the works. These include the defining of character zones (zones of similar spatial or character properties), and the analysis of changes to these zones as a result of the proposed widening.

Landscape character is defined as:

> *"The combined quality of built, natural and cultural aspects that make up an area and provide its unique sense of place."*
>
> (EIA No.4 Guidelines, 2013).

The proposal is assessed in terms of its impacts on these character zones and the impact ranked in terms of sensitivity to change. This assessment differs from a visual assessment in that it assesses the overall impact of a project on an area's character and sense of place.

3.2 Visual Impact Assessment

Visibility

The view fields of a road corridor are composed of static receptors i.e. those that adjoin the corridor and mobile receptors those that travel along the corridor. The impacts of the two groups are unique in that the time and frequency of the exposure differ. The extent from which views can be obtained is referred to as the view catchment.

Static Receptors

Static receptors occur within the visual catchment of the corridor i.e. they are points, which have a view of or can be viewed from the corridor. The corridor of the proposal is visually defined by both the topography and vegetation, which adjoins the corridor.

Mobile Receptors

Mobile receptors are the users of the corridor, in this instance vehicles and cyclists that travel along part or all of the alignment, and the potential walkers in the Illawarra Escarpment Scenic Catchment Area. Their experience of the space is short term.

3.3 Landscape Character and Visual Assessment Matrix

Landscape character and visual assessment are equally important. Landscape character assessment helps determine the overall impact of a project on an area's character and sense of place including all built, natural and cultural aspects, covering towns, countryside and all shades between. Visual impact assessment helps define the day to day visual effects of a project on people's views.

To quantify these impacts it is important to assess two qualities in relation to landscape character or view point these are: - Sensitivity and Magnitude

> *"**Sensitivity** refers to the qualities of an area, the type number and type of receivers and how sensitive the existing character of the setting is to the proposed change. For example a pristine natural environment will be more sensitive to change than a built up industrial area.*
>
> ***Magnitude** refers to the nature of the project. For example a large interchange would have a very different impact on landscape character than a localised road widening in the same area."*
>
> (EIA No.4 Guidelines, 2013).

As part of the process of assessment the Roads and Maritime Services has adopted a matrix which combines rankings of sensitivity with magnitude of change in order to determine the overall impact of the proposal. This has been used to inform the undertaking of the Landscape Character and Visual Assessment. Refer Table 5.1.

Table 1 – Landscape Character and Visual Assessment Matrix

		Magnitude			
		High	*Moderate*	*Low*	*Negligible*
Sensitivity	*High*	High Impact	High - Moderate	Moderate	Negligible
	Moderate	High - Moderate	Moderate	Moderate - low	Negligible
	Low	Moderate	Moderate – low	Low	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

4 LANDSCAPE CHARACTER AND VISUAL ASSESSMENT

4.1 Landscape Character Assessment

The proposal runs through a section of the Illawarra Escarpment of largely naturally vegetated communities. The alignments character is defined by the topography and the way in which the alignment has responded to it. The alignment is sinuous and undulating, and generally defined by a native tree canopy all of which influences the safety of the alignment and is in part the driver of the project.

Despite the relative consistency of the alignment three character zones, refer Figure 14, have been identified which represent different challenges and issues which need to be responded to in the design development of the proposal.

These character zones primarily relate to the vegetation communities and are as follows:

4) Character Zone 1 - Northern Section
5) Character Zone 2 – Bellambi Creek Valley
6) Character Zone 3 – Southern Section

This section of the report reviews the physical attributes of the character zones and the potential impacts of the proposal on this.

4.1.1 Character Zone 1 – Northern Section

This character zone can be broken into two halves defined by the topography and its subsequent impact on vegetation communities along the alignment.

Zone 1A – Is a north facing slope characterised by a drier forest community dominated by a mix of Tall Open Blackbutt Forest, occurring in the lower section and Escarpment Edge Silvertop Ash as the road rises to the ridge. At the ridge top the corridor is cut by an electrical easement.

Zone 1B – is a south facing slope and is characterised by a wetter forest community in the form of the Moist Blue-gum Blackbutt forest which aligns the road as it descends into the valley of Bellambi Creek.

The ridge dividing the two halves is marked by the presence of a large electrical stanchion, and its easement to either side of the corridor. The presence of the easement sees vegetation cleared and a gap in the canopy created in order to reduce the disruptions and potential risks of trees in relation to power lines. This point forms a clear division in the character of this section of the corridor.

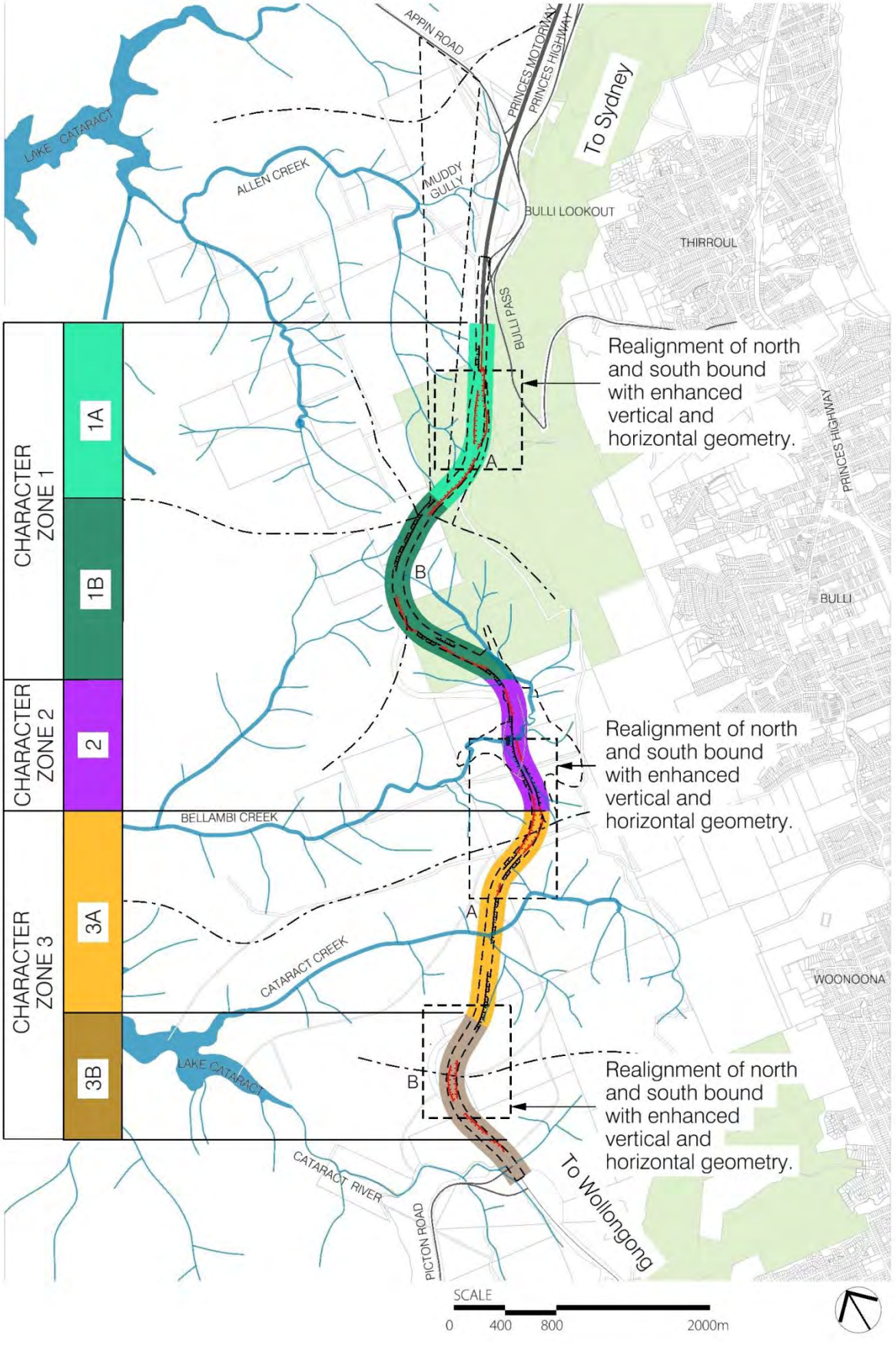


Figure 14 – Landscape Character Map

Table 2 – Character Zone 1A and 1B – Northern Section

Attribute	Description	Impact
Landform	The landform rises from 380m near Bulli Pass to 440m at the electricity easement which marks the ridge top at this point before descending into the Bellambi Creek Valley.	The impacts of the proposal sees a significant increase in cut extent to the east of the present alignment before the road ties in to the existing alignment in front of the stanchion
Vegetation	Vegetation condition is variable but largely in moderate to good condition. Three dominant communities occur within this section. Tall Open Blackbutt Forest, occurring in the lower section of the north facing slope and Escarpment edge silver top ash as the road approaches the ridge. The south facing slope is characterised by Moist Blue-gum Blackbutt	Vegetation will be cleared along eastern edge of the alignment with the realignment of the corridor to the east some 70m. This impacts the Illawarra Escarpment State Recreation Reserve
Hydrology	Located along ridges and spurs of the escarpment the alignment occurs at the headwaters of a number of creeks. Half of this zone drains to the north into Allen Creek and half drains south into Bellambi Creek	No impact
Land-use	Alignment is defined SP2 West of the alignment is Sydney Water Catchment East is Environmental Conservation	The proposal impacts the Environmental Conservation area of the Illawarra Escarpment State Recreation Reserve requiring a change in use.
Built form	Electricity stanchions are the dominant element beyond the road form which is characterised by pavement, median barrier, and sandstone cuttings	Increase in pavement area, modification to cuttings, and a significant new cutting is required as part of the proposal. A retaining wall is also proposed west of the alignment.
Spatial Quality	Alignment is defined by the canopy of the vegetation, to the east this enclosure is reinforced by the presence of a cutting	The proposal has the potential to influence the spatial quality as a result of revised alignment and the removal of vegetation and containment of views within the new cutting.
Sensitivity	The area is defined by the alignment and vegetation. Limited distant views are available from the adjoining road network in particular, Appin Road. The viewers of the alignment are essentially the occupants of the vehicles on the alignment or adjoining roads and consequently transitory in nature. **The sensitivity of the alignment is consequently considered to be low.**	
Magnitude	The proposal adopts a new alignment of some 30 metres width which removes one of the bends in the present road geometry improving the geometry to a level consistent with the highway to the north. This results in a formation set 15 metres to the east of the existing and a total footprint of 50 metres for the road and cuttings. The result of this is a new cutting, clearance of vegetation within the new footprint and the need to revegetate the existing alignment. In addition the smoothing of the alignment removes the undulating sinuous character of road. **The magnitude of change has been assessed as high**.	

Summary

The character of the zone is defined by the vegetation of the corridor and the geometry of the alignment. The proposal is for a new alignment with corresponding changes in alignment form and landscape character. Its impact based on the sensitivity and magnitude of the works has been assessed as moderate.

Figure 15 – a) Zone 1A – enclosed corridor defined by Tall Open Blackbutt Forest with Escarpment Edge Silvertop Ash beyond b) Zone 1B - Moist Blue-gum Blackbutt forest lines the corridor.

4.1.2 Character Zone 2 – Bellambi Creek Valley

This character zone is consistent in its makeup throughout. It is characterised by the valley of Bellambi Creek and its associated revegetation. The valley has been cleared in the past and now provides a sense of openness which contrasts with the sense of enclosure of the zones to either side, refer Figures 16 and 17.

Table 3 – Character Zone 2 – Bellambi Creek Valley

Attribute	Description	Impact
Landform	The Bellambi Valley is a relatively flat valley within the alignment. It is approximately 1.25kilometres wide and at an elevation of 330m or below.	Alignment shifts to the east, at the southern end, introducing new fill embankments.
Vegetation	Vegetation has largely been cleared as part of previous landuse. It is dominated by grasses and annual weeds with sporadic native trees.	Minor clearance works due to the change in alignment opens up views to the valley due to clearance of vegetation that defines the corridor.
Hydrology	Dominated by the Bellambi Creek it also incorporates Charlesworth Dam to the west of the alignment.	Limited impact as bridge is widened to accommodate the additional lanes.
Land-use	Alignment is defined SP2 West of the alignment is Sydney Water catchment	No change.
Built form	Electricity stanchions and switching yard are the dominant element beyond the road form which is characterised by pavement, median barrier.	Increase in pavement area, as alignment shifts east expanding disturbed corridor and views to switching yard.
Spatial Quality	Alignment contrasts with that of much of this section of the corridor providing opportunities for views across the valley and along transmission easements beyond.	Views expanded as alignment shifts to the east, removing roadside vegetation and opening up views.
Sensitivity	The area is defined by the alignment and vegetation; in this instance a slightly more open character defined by the ridges and trees set beyond the alignment. The viewers of the alignment are essentially the occupants of the vehicle and consequently transitory in nature. The expansion of the corridor to the east provides a slightly more open character than that which currently exists. **The sensitivity of the alignment is consequently considered to be low.**	
Magnitude	The change in alignment at the southern end of this character zone changes both the definition of the road corridor but also its scale. **The magnitude of impact has been assessed as moderate.**	

Summary

The works involve realignment of the highways alignment in the southern half and minor widening in the north. The degree of change experienced within this zone has been assessed as moderate to low.

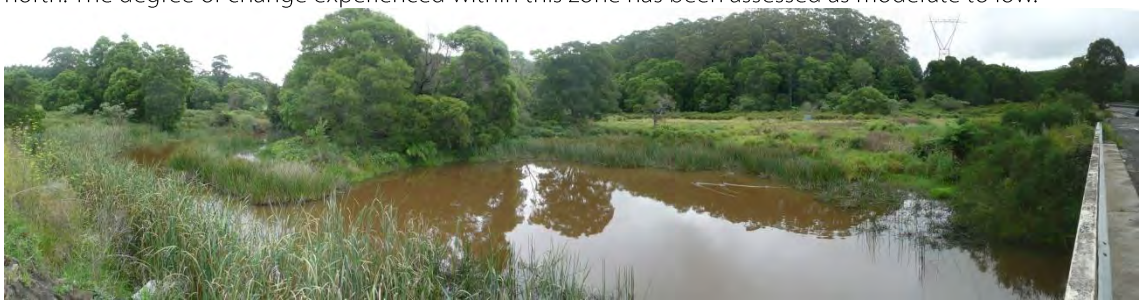


Figure 16 – View looking over Charlesworth Dam

Figure 17 –View looking along alignment to the south.

4.1.3 Character Zone 3 - Southern Section

Like character zone 1, this character zone can be broken into two halves defined by the topography and its subsequent impact on vegetation communities along the alignment.

Zone 3A – Is defined by the valley of Cataract Creek and a forest community dominated by a mix of Tall Open Blackbutt Forest , refer Figure 18, and moist Blue Gum Blackbutt forest, occurring in the lower section associated with the creekline.

Figure 18 – Zone 3A - Tall Open Blackbutt Forest defines the corridor.

Zone 3B is located on the southern ridge top defined by exposed sandstone Scribbly Gum Woodland. The crest of this southern ridge to the Cataract Creek valley clearly defines this community. This community also coincides with the realignment of the corridor to the east at its southern most limits.

Figure 19 – Zone 3B - Exposed Sandstone Scribbly Gum woodland defines the corridor.

Table 4 – Character Zone 3 - Southern Section 3A and 3B

Attribute	Description	Impact
Landform	Traversing a small ridge which separates Bellambi Creek from the Cataract Creek catchment this section crosses the valley of Cataract Creek at RL 310m before rising to a high point of 390m and descending to the south where it joins into the Picton Road intersection works	Realignment of the northern half as it rises out of the Bellambi valley introduces a large fill east of the alignment. In the southern half realignment introduces a new cutting east of the present alignment easing geometry and grades.
Vegetation	Cataract Creek valley is dominated by the Tall open blackbutt forest to the north of this section before the alignment moves up onto the ridge and transitions to exposed sandstone scribbly gum woodland.	Vegetation will continue to define the corridor with clearing to the edge of the corridor to meet the expanded or new footprint.
Hydrology	Cataract Creek is the dominant watercourse within this section	No change
Land-use	Alignment is defined SP2 East and West of the alignment is Sydney Water Catchment	The realignment moves the alignment into a section of the Sydney Water Catchment area beyond the defined corridor
Built form	The road form is characterised by pavement, median barrier, and sandstone cuttings	Increase in pavement area and construction of new cuttings and fill embankments to east of the existing.
Spatial Quality	Alignment is defined by the canopy of the vegetation, to the east this enclosure is reinforced by the presence of a cutting	For much of the alignment a slight increase in corridor width corresponds to a reduction in the sense of enclosure. The new cutting introduces a completely new element but retains a sense of enclosure.
Sensitivity	The area is defined by the alignment and vegetation. The viewers of the alignment are essentially the occupants of the vehicle and consequently transitory in nature. **The sensitivity of the alignment is consequently considered to be low**.	
Magnitude	The scale of change south of Cataract Creek consists of three elements - a change in alignment and construction of new fill at the approach to Cataract Creek, minor widening through the central section and a new alignment at the southern end. This latter element has the greatest impact **magnitude of change is consequently considered moderate to high.**	

Figure 20 – Picton Road Acceleration works

Summary

The proposed changes results in three new sections of road alignment elements and an expanded corridor width, which will impact the scale and character of the alignment. The overall impact on the landscape character is consequently considered to be moderate.

4.2 Landscape Character Impact Assessment Summary

The overall character of the environment through which the road passes is not going to change substantially. The alignment proposed follows that of the existing highway for much of the route with realignment occurring in three distinct and localised areas. The overall character of the experience however remains that of a major highway set within a largely forested landscape.

The two largest impacts relate to the realignment and introduction of new cuttings. The first at the start of the alignment just south of Bulli Tops and the second at the southern end at the ridge above Picton Road. Both see the establishment of a new alignment and substantial cuttings and are considered to have a moderate impact.

The following summarises this change.

Table 5 – Summary of Landscape Character Assessment

Character Zone	Sensitivity	Magnitude	Impact
Zone1	Low	High	Moderate
Zone 2	Low	Moderate	Moderate - Low
Zone 3	Low	Moderate - High	Moderate

4.3 Visual Impact Assessment

The potential visual impact assessment of the proposed climbing lanes has been assessed in relation to a number of key viewpoints and group of viewpoints. It is based on the existing landuse pattern and development adjoining the motorway corridor.

The assessment method has involved:

- Defining the scale of the proposed works
- Identification of key visual envelops, viewpoints and groups of viewpoints from which the proposal is visible
- Assessment of the level of impact on the proposed viewpoints from the proposal.

4.3.1 Visual Envelop Mapping

A detailed field and desktop assessment of the alignment was undertaken to determine the area from where the project is visible as defined in the Visual Envelop Plan, (Figure 21). The visibility of the Motorway is primarily from the corridor itself. It is influenced primarily by landuse, vegetation and topography.

The zoning of all the land to the west of the alignment as part of the Sydney Water Catchment removes any likely hood of views to the west. To the east the land is a mix of State Conservation Area which is only accessible by foot and Sydney Water Catchment, so also has a very limited likelihood of visibility. From outside the motorway the dominant view receptors are other roads which have the potential to lookout over the alignment. These vantage points occur at relatively large distances from the corridor and so are likely to have minimal visual impact.

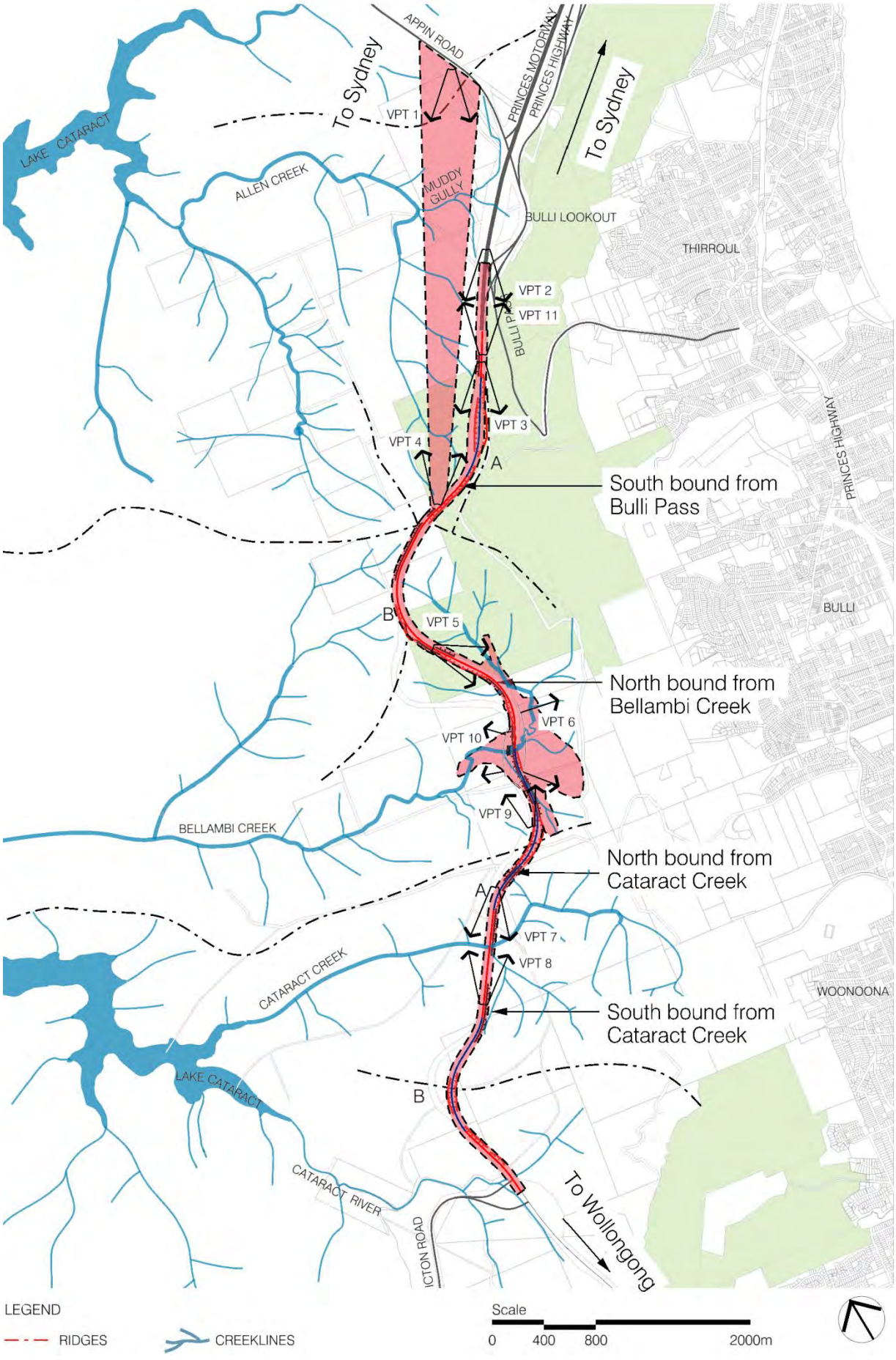


Figure 21 – Visual Envelop Map

4.3.2 Key Viewpoints

Vpt 1 – Appin Road Highway overbridge

Views: Distant views across the valley, some 2.6 kilometres, are provided from the Appin Road Bridge over the Motorway. The presence of the overhead power lines provides the opportunity to view the existing and proposed alignments which are identifiable by moving traffic. These views are in part filtered by vegetation along the roads edge, refer Figures 22 and 23.

Sensitivity: **Sensitivity has been assessed as low** – due to the product of the transitory nature of the viewer, the power lines within the view and the distance from the site.

Magnitude: The proposals will see the exposure of the new cutting to the viewer at Appin Road. The distance of the viewer, however, is such that the impacts of the works will be limited as is illustrated by the present condition, refer figure 22. Despite distance moderating the impact the initial contrast in colour of the exposed rock and scale of the cut will make this element discernible on the skyline. Its impact none the less is **considered to be low**.

Figure 22 – View from Appin Road Overbridge

Figure 23 – Zoomed view from Appin Road Overbridge

Vpt 2 – View South from Bulli Tops

Views: This view is defined by the adjoining vegetation, its proximity to the escarpments edge and the ridge which terminates the view, (figure 24). Views are limited along the motorway although a sense of being near the edge of the escarpment is gained by the limited depth of the vegetation to the east of the alignment. The sinuous nature of the alignment heading south from this point is evident within the view.

Sensitivity: The existing motorway dominates the view and is the view point. **The proposal is consistent with this character and so the view point is considered to have a low sensitivity.**

Magnitude: The proposal would see the realignment of the road corridor to the east by up to 70 metres with corresponding impacts on the ridge top and the way the road relates to it. This change will initially be emphasised by the clearing required to construct the works and the scale of the cut.
The impacts of these changes are considered to be moderate.

Figure 24 – View point 2 at start of the south bound climbing lanes

Vpt 3 – View within a small sub catchment between the start of this section of works and the ridge associated with the power easement.

Views: A contained valley defined by cutting and vegetation to the east and vegetation to the west as depicted in Figure 25. The character of the view is defined by the sinuous alignment of the road in response to the topography.

Sensitivity: **The sensitivity of this view point is assessed as low**. This reflects the existing motorways prominence within the view and the lack of external viewpoints.

Magnitude: **The magnitude of change would be moderate**
This sees an expansion in road pavement by nominally 10 metres. It also sees a straightening of the alignment to achieve an improved road geometry, resulting in a cutting flanking either side of the corridor. This changes the experience of the viewer (the road user).

Figure 25 – View point 3 within defined catchment of minor saddle of the south bound climbing lanes

Vpt 4 – Main Ridge and Power Easement Character Zone 1

Views: Views are available from the alignment across the valleys to the north-west, these views are expansive extending over 3 kilometres to the next ridge line. They are impacted however by the presence of the power line easement and its structures as depicted in the images captured in Figure 26. They are also brief as a result of the travelling speed of the observer.

Sensitivity: **Has been assessed as low** – the distant nature of the view and the impact of the power lines on these views limits the sensitivity of the viewer to the proposal.

Magnitude: **Has been assessed as Low** – while the scale of pavement of the road will be increased the impact on the distant views is minimal due to the scale and distance of the views. The design is constrained at this point by the electric stanchions which cannot be economically moved.

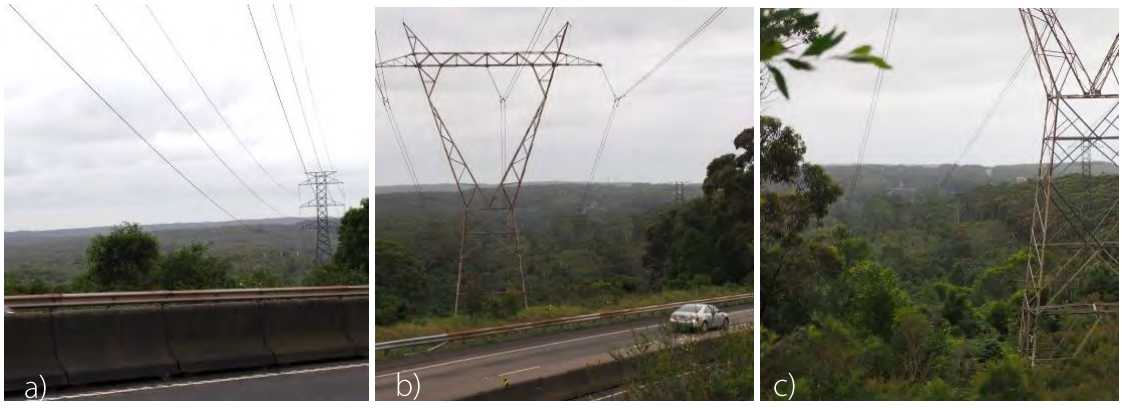


Figure 26 – a, b, and c Views along easement corridors provide panoramic vistas across the Sydney Water Catchment and its native forests

Vpt 5 Descent to Bellambi Creek

Views: The descent to Bellambi Creek reinforces the sense of enclosure experienced for much of the route. Tall vegetation flanks the corridor and a vegetated ridge at the opposite side of the valley terminates the view, (Figure 27).

Sensitivity: **The sensitivity of this view point is Low** – the existing motorway dominates the view and is defined by forested edges which open out in the distance.

Magnitude: **The magnitude of the proposed works has been assessed as Low**. The proposal sees the expansion of the road pavement by 10 metres, generally distributed to either side of the corridor. The expansion of the corridor will be emphasised by the additional clearing required to construct the works.

Figure 27 – a) and b) View point five – views towards the cleared valley of Bellambi Creek

Vpt 6 Bellambi Creek Valley

Views: This is the only section of the corridor where there is a sense of openness and views of cleared lands refer Figures 28 a) and b). The view is interrupted by a series of power easements which crisscross the landscape converging on a switching yard which is relatively concealed within a fold within the valley. The view is defined as a basin type formation in which views beyond the valley are contained by a ridge on all sides.

Sensitivity: **The sensitivity of the alignment at this viewpoint has been assessed as low** – The viewpoint provides views of a cultural landscape defined by ridges or vegetation. The modified nature of the landscape provides a level of robustness which keeps the sensitivity low.

Magnitude: The proposal sees an expansion of the road cross-section and to the south the realignment to the east of the present highway. This later realignment will increase the openness of views as vegetation defining the corridor is removed. Drainage basins may be installed but are unlikely to form a significant visual element within the landscape generally being located below the alignment. **The magnitude of the proposal has consequently been assessed as moderate.**

Figure 28 – a) and b) Partially cleared Valley of Bellambi Creek

Vpt7 View approaching the Cataract Creek Valley

Views: The descent to Cataract Creek, Figure 29, reinforces the sense of enclosure experienced for much of the route. Tall vegetation flanks the corridor and a vegetated ridge at the opposite side of the valley terminates the view. The straight nature of the corridor in this section emphasises the undulating nature of the alignment overall.

Sensitivity: Vegetation dominates the edges and distant views, with the alignment a dominant element in the foreground to distant views. **The sensitivity has consequently been assessed as low.**

Magnitude: **The scale of change is minimal in relation to the scale of landscape in which the road sits and the magnitude has therefore been assessed as low**. The alignments use is already defined and so the widening will have limited long term impact.

Figure 29 – View point 7 defined corridor views across the Cataract Creek Valley

Vpt8 View from the southern ridge as the road descends towards Cataract Creek

Views: The view is dominated by vegetation both flanking the alignment and as part of the distant views, depicted in Figure 30.

Sensitivity: The alignment is dominated by and enclosed by the landscape which surrounds it. **The sensitivity of this landscape due to its scale and expansiveness has consequently been assessed as low**.

Magnitude: The sense of vegetation extending as far as the eye can see is a strong influence on the visual composition. The widening of the alignment will have limited impact on changing the sense of this. The realignment however will reduce the tightness of the bend and produce a more lineal experience. Despite this the vegetated nature of the adjoining landscape will remain the dominant visual experience. **The magnitude of change is therefore considered to be low.**

Figure 30 –View point 8 sense of enclosure and visual catchment between ridges

Vpt 9 Northbound approach to Bellambi Creek

Views: Views begin to open up as you descend into the Bellambi Creek Valley, Figure 31. Vegetation on the eastern edge thins first before the valley flattens and opens up on both sides of the alignment. The view is terminated by the vegetated ridge to the north.

Sensitivity: The visibility of this area is limited to the road user or service authorities. Services cross the alignment and vegetation has been cleared. **The sensitivity of this section has consequently been assessed as low.**

Magnitude: The pavements footprint is already wider than required by the present alignment and/or site clearing has occurred, as a result of the history of the roads changing alignment and needs. The proposal will see a shift in the roads footprint to the east providing a more open view across the valley to the vegetated ridge beyond. This will change the sense of enclosure and provide a more panoramic view. **Its impact is considered to be moderate.**

Figure 31 – View point 9 approach to Bellambi Creek

Vpt 10 View west of Bellambi Creek Bridge

Views: A view looking west down Bellambi Creek valley, Figure 32. Beyond the road edge the waters of Charlesworth Dam, occupy the mid-ground before the creekline narrows and is flanked by native vegetation. This vegetation terminates views as the adjoining ridge lines converge.

Sensitivity:, The landscape has been altered by development of the road, the Charlesworth Dam and the clearing of native vegetation. **The impact of the proposal is considered to be low.**

Magnitude: The proposal sees limited change in the existing pavement footprint as excess pavement occurs in this zone due to the intersecting of old and new alignments. Any change in the alignment is to the east of this view and so the view will remain unchanged. **The works proposed are consequently minimal and the impact has been assessed as negligible.**

Figure 32 – Bellambi Creek Valley looking west

Vpt 11 View Northbound towards Bulli Tops and beyond

Views: This view looks north toward Bulli Tops, Figure 33, and is located at the northern most end of the works. Its elevated position enables distant views to be obtained of the Bulli Lookout buildings and the alignment of the Princes Motorway as it heads north and Appin Road as it peels off to the west.

Sensitivity: From within the corridor the view quality is defined by the existing vegetation cover and heavily influenced by the existing alignment. **The sensitivity of this section is considered low**. Views back from the points noted are also low as a result of the distance and vegetation between the site and the viewer.

Magnitude: The magnitude of the change in proposal represents a substantial change in view as the alignment moves eastward some 15 metres from the present alignment and requires a footprint of some 50+ metres to accommodate the revised alignment and its cuttings. **Its impact has been assessed as moderate.**

Figure 33 – View to Appin Road

4.4 Visual Impact Assessment Summary

Generally the proposal represents a low visual impact. There are limited viewers beyond the road way user and the character of the corridor is not proposed to change substantially from the existing. The accompanying table illustrates these findings.

Table 6 – Visual Impact Assessment Summary

View point	Sensitivity	Magnitude	Impact
Vpt 1	Low	Low	Low
Vpt 2	Low	Moderate	Low - moderate
Vpt 3	Low	Moderate	Low - moderate
Vpt 4	Low	Low	Low
Vpt 5	Low	Low	Low
Vpt 6	Low	Moderate	Low - moderate
Vpt 7	Low	Low	Low
Vpt 8	Low	Low	Low
Vpt 9	Low	Moderate	Low - moderate
Vpt 10	Low	Negligible	Negligible
Vpt 11	Low	Moderate	Low - moderate

A number of options were reviewed prior to the development of the preferred proposal. The proposal has since been reviewed in detail and in the majority of instances has been determined as has having a low level of visual impact. This reflects the design intent, which has been to generally widen within the existing corridor while addressing key geometry shortcomings through three focused areas of offline works.

It is these later elements that provide the most significant visual change within the proposed works. All are limited in their visibility from the public domain, including walkers within the Illawarra Escarpment Scenic Catchment Area and are only experienced from the road corridor itself. They have consequently been assessed as of moderate impact as a result of the low visibility. The development of a link track along the Escarpment to Mount Keira has not been assessed as it is yet to be formalised.

4.5 Conclusion

The landscape character and visual impact for the proposed alignment has generally been assessed as being of low impact. This reflects the established nature of the corridor, the limited visibility of the corridor beyond the corridor itself, and the fact that change is generally to either side of the existing alignment in an area that has the capacity to absorb this increase in pavement.

The areas where this is not the case ie where a completely new alignment has been adopted offline occur primarily at the northern and southern ends of the corridor. The greatest areas of visual and landscape character change occurs, between Bulli and Bellambi Creek, and at the southern end of the corridor where new structures off line are proposed. The impacts of these areas, has been assessed as moderate for both visual and landscape character due to the high level of change that is proposed. As illustrated in Figure 21 the view catchment is constrained and so apart from road users the number of people/viewpoints impacted by the project would be limited.

5 MITIGATION STRATEGIES

The proposed works are both incremental in nature increasing the general road width through the addition of lanes and the modification of curve geometry and substantial introducing completely revised geometry off line from the existing. The works are consequently a combination of interventions in the existing character of the road as well as wholesale change. The detail of how these changes are addressed will be critical to the maintenance of the present road feel and character so that the best values are preserved. In order for this to be achieved care needs to be taken with a number of elements within the corridor. This includes the design and finishing of:

- Cuttings
- Retaining Walls
- Barriers
- ITS Gantries
- Verges
- Drainage, and
- Revegetation

The designs concept status limits the ability to fully determine the exact nature of a number of these elements. This mitigation section provides a range of approaches which will enable the issues to be addressed in a manner which integrates the design outcome with its surrounds.

5.1 Cuttings

Cuttings form a key component of the character of the existing alignment. Generally they are relatively small in scale, being less than 1 bench high (approximately 8m) and occur generally as a cut face on one side of the alignment only or as a combination of slope and rock cutting, (Figure 34).

Figure 34 – Existing rock cutting within the alignment

The proposal generally requires the widening of cuttings as well as the construction of new cuttings. In addressing the approach to cuttings it will be important to consider the character of what exists and how the construction methodology can work with this to maintain or enhance the influence of the cuttings on the road character.

5.1.1 Form of cutting

The impact of the expansion of the existing cuttings will be a consequence of the following:

- Profile of the cutting
- Change in scale of the cutting, and
- Treatment (finishing) of the cutting.

Profile

The profile of the cut needs to consider a number of issues including stability, safety, buildability and maintenance, environmental impact, and the visual implications of the proposal. The profile adopted will be informed by these issues.

The profile of many of the existing cuttings is near vertical with slope 0.25 (horizontal):1 (vertical). The ability to retain a near vertical face will be determined by the rock strength. In many instances this may not be possible while still retaining the relationship to the road and meeting the standards required today. In order to address the potential issues which may be encountered by todays engineering standard requirements a number of scenarios are proposed.

1) Retain steep profile but set back from road edge – this would provide space for rock fall to occur without or with a reduced need for other interventions in the slopes treatment. It would also permit the installation of plantings to moderate the scale of the cut.

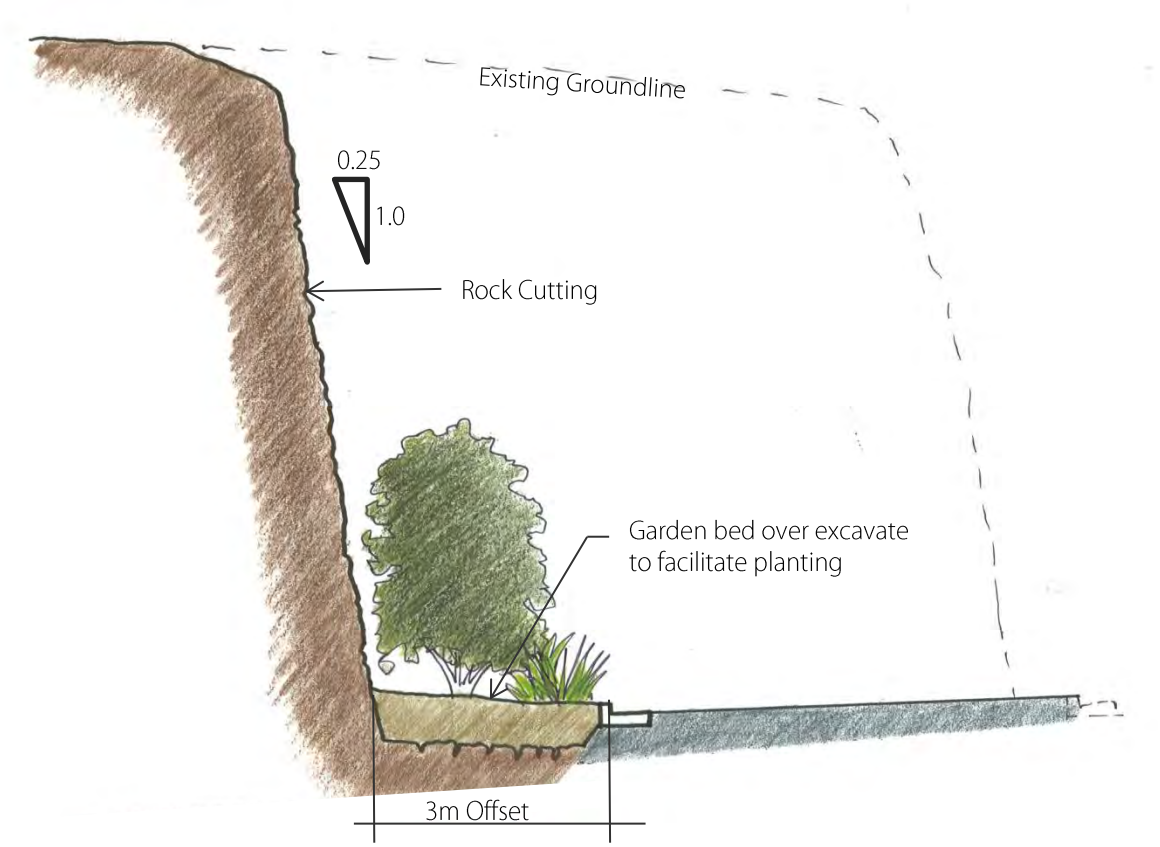


Figure 35 – Section Profile - Option 1 Vertical cut with offset from road

Figure 36 – Existing cutting on Woodford bends with planting to base of cutting

2) Accurate mapping of the cuts face to determine stabilisation treatments. This would enable the selection of treatments which when applied address the particular issues of the face without the use of one treatment fits all approach. This approach would adopt treatments such as patch/seam shotcreting, rock bolting etc. This method would allow the cuts face to be closer to the alignment but would have a higher level of intervention which may result in aesthetic issues or ongoing maintenance risks. Finalisation of treatments in the design phase is not possible and can only be reached once the face is exposed and the risk assessed.

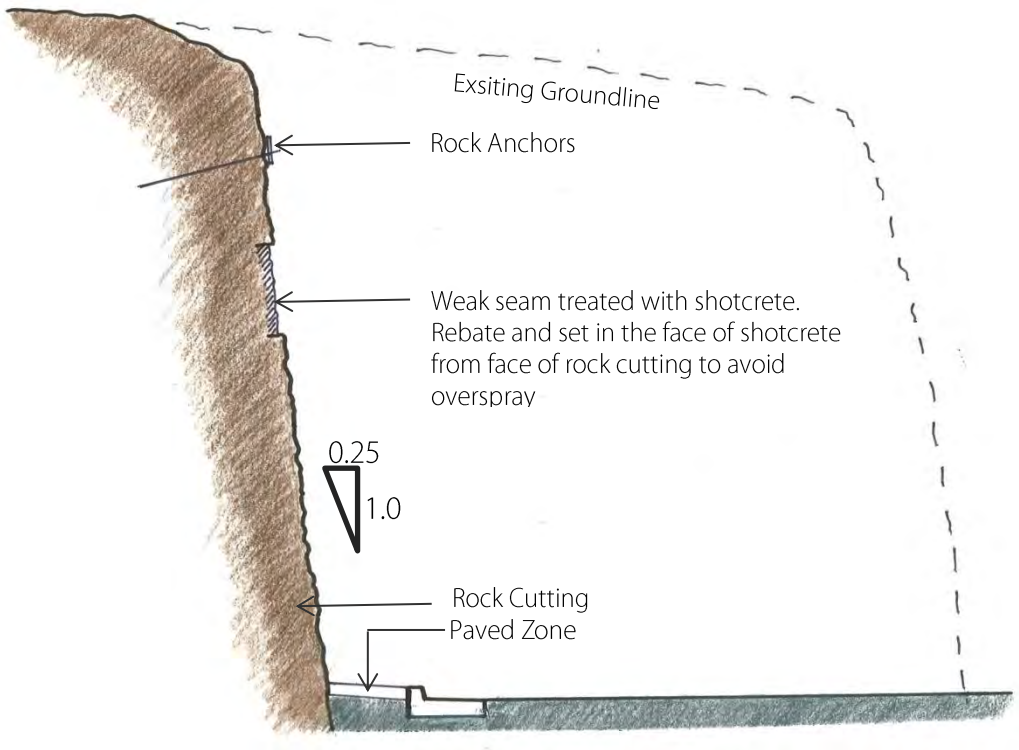


Figure 37 – Section Profile - Option 2- Vertical Cut with Stabilisation

3) Lay back the rock so that it is at an angle where rock fall is no longer an issue. This would adopt a rock face with a slope ratio of 1.5 H: 1 V.

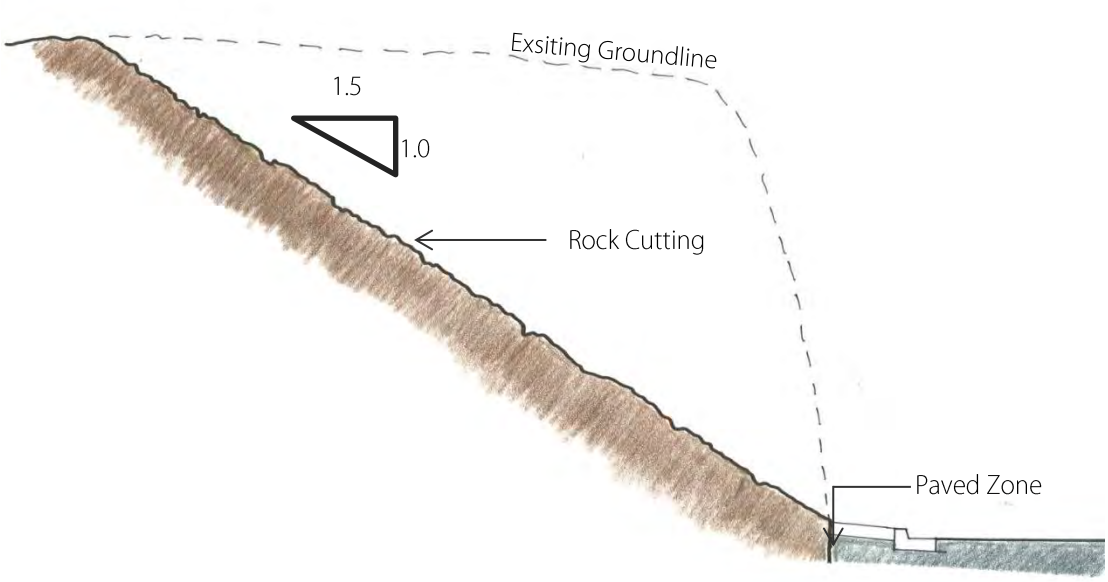


Figure 38 – Section Profile - Option 3

Whatever the profile the transition from a stone to vegetated embankment of 2 h: 1v needs to be considered. This transition should be a smooth and gradual profile, enabling integration with the adjoining landform.

Leading edge treatment

The leading edge of the top of the cut plays an important role in the overall appearance of the cut, particularly where the cutting has been cut near vertical. This edge is influenced by its interface with residual soil profiles and whether it is stable without treatment. The design of this edge needs to consider the stability of this element and how this is handled. Two methods are considered appropriate.

The first and preferred method is the cleaning of the leading edge down to solid rock and creating a small ledge before battering back into the natural ground at a maximum slope of 2h:1v. and revegetating.

The second treatment would be the use of shotcrete. The issue with the use of shotcrete is the achievement of an appropriate colour match and form as the rock rolls back into the adjoining landform. Methods for managing the use of shotcrete are discussed in 5.13.

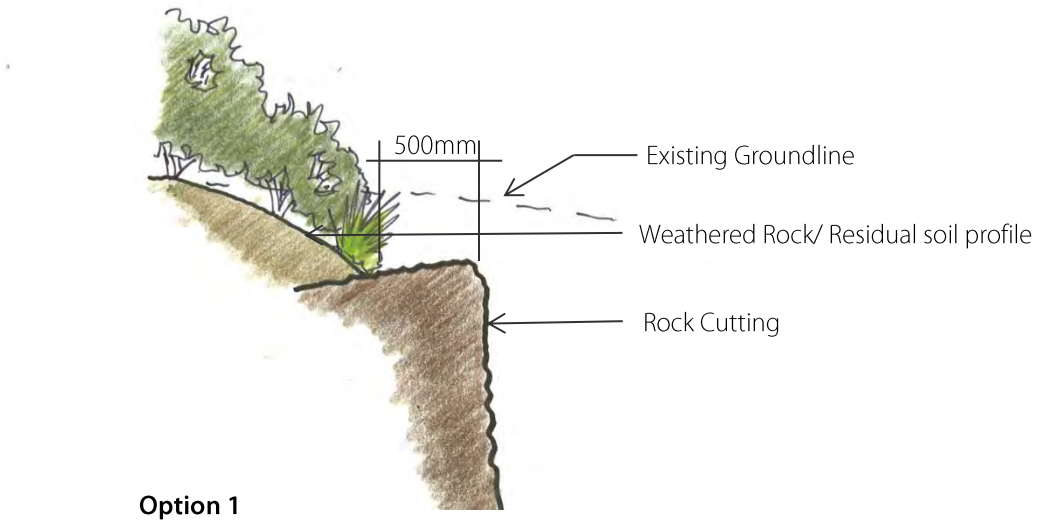


Figure 39 – Interface treatment to top of cutting – Option 1

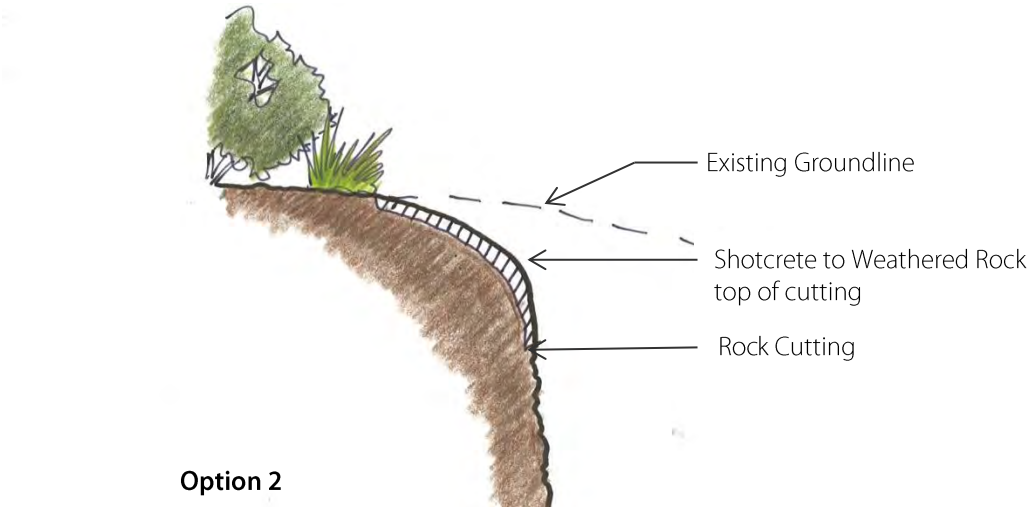


Figure 40 – Interface treatment to top of cutting – Option 2

5.1.2 Method of cutting

A number of differing methods for the cutting are possible. The method selected needs to reflect the work constraints of a road under traffic and the need to balance the extent of environmental clearance. The final treatment needs to establish a stable and manageable face which meets the expectations of the road users and relevant authorities.

Line Drilling

The existing cuttings for much of the M1 Princes Motorway have been line drilled and split, reflecting the ability to access the corridor during the initial construction of the alignment. (Refer Figure 40)

The proposed works could continue this treatment, retaining the character of the cuts with vertical drill marks and coarsely textured face.

Issues associated with this method would be:

- gaining access to the top of the cut for the entire length and its impact on clearing extents, as a result of a need for construction tracks suitable for drilling rigs and a suitable working platform; and
- the ability to manage the removed face adjacent to live traffic.

The latter issue is common to whatever method is used although the level of difficulty in managing this may vary.

Figure 41 – Existing cutting within the alignment. Vertical ribbing evident along the cut face reflects the line drilling along the cut plane.

Erkat Header

The limited access may make the use of a header an appropriate treatment. These essentially grind back or mill the rock face leaving a picked face appearance to the rock which is relatively even and consistent, refer Figure 41, which illustrates the finish of cuttings along the recently upgraded M2 Motorway. The use of a header potentially would enable the working on the cut face from the road way simplifying the cutting and removal process and potentially retaining a tighter footprint.

Figure 42 – Erkat treated cut face of the M2motorway. An Erkat header was used to cut back the face of this embankment under traffic to minimise the extent of lane closures. The header provides a textured face with defined scatch mark pattern to the stone face

5.1.3 **Shotcrete**

Shotcrete is a treatment applied to a batter to address the fretting or gradual erosion of a cut rock face or to provide structural support and consists of a sprayed on concrete and mortar. Its use is defined in the Roads and Maritime Services Shotcrete Design Guidelines, 2005. In this document three approaches are discussed: avoid, minimise, and improve appearance. These strategies are to be approached in the order in which they fall. That is to avoid the use of shotcrete by designing out the potential need for it. If this can't be done minimise the extent to which it needs to be done and if this is in a high profile area then improve the appearance of the application either by the addition of colour additives, texture or both to assist in the blending of its treatment.

The present alignment has minimal use of shotcrete and this principle should be taken forward. To some extent the quality of the rock is already understood as the cuttings exist and are to be expanded rather than constructed new (except in the case of option 3 in Bulli Pass to Bellambi Creek section).

The likely use of shotcrete is to address seams of weakness within the present rock profile. This can usually be well integrated into the design if a number of principles are followed.

1. Seams of weakness should be over excavated to accommodate the shotcrete and to provide a small rebate. The provision of a rebate provides a shadow line and a clean line between the natural stone and the shotcrete.
2. Avoid overspray – shotcrete should be kept within the desired zone by masking the cut to ensure that a clear distinct delineation exists between the existing rock and the shotcrete.
3. Colour should be used to reflect the colour of the seam, which is being strengthened, or the adjoining rock. Care needs to be taken to select a colour which compliments the stone. This decision needs to take into account that both shotcrete and stone will weather and that this weathering may not be consistent.

Shotcrete may also be required to address the leading edge of the cut. This interface often is a weaker rock and requires additional treatment to provide durability. Like seams there are a number of steps which can be taken to minimise the degree to which this detracts from the cut face. Generally this issue is localised and so the use of colour and texture can often provide an effective treatment. The strategies defined in Cuttings however should be followed in preference to such treatments.

Figure 43 – Shotcrete treatments a) and b) depict seam treatments to sandstone cut face on M2 and the M1 Princes Motorway respectively. c) Depicts the treatment of an entire rock face and the issues associated with such a strategy with a relatively even and consistent finish to the face. This is an unacceptable outcome.

5.1.4 Alternate stabilisation methods

In some instances the outcome that shotcrete offers will not achieve the overall objective of the design for the project. In such instances shotcrete may be used as part of structural support with this faced in another material to provide a permanent and stable treatment. This may include the use of stone pitching or facing; or the use of faux rock.

Stone pitching or facing.

Stone pitching or facing has been used on a number of projects to tie the appearance of the rock face together to avoid the visual impact of another material. This facing could be in the form of a face block which is laid in courses (refer Figure 44) or it could be in the form of random pieces which come together to form a random pattern (refer Figure 45).

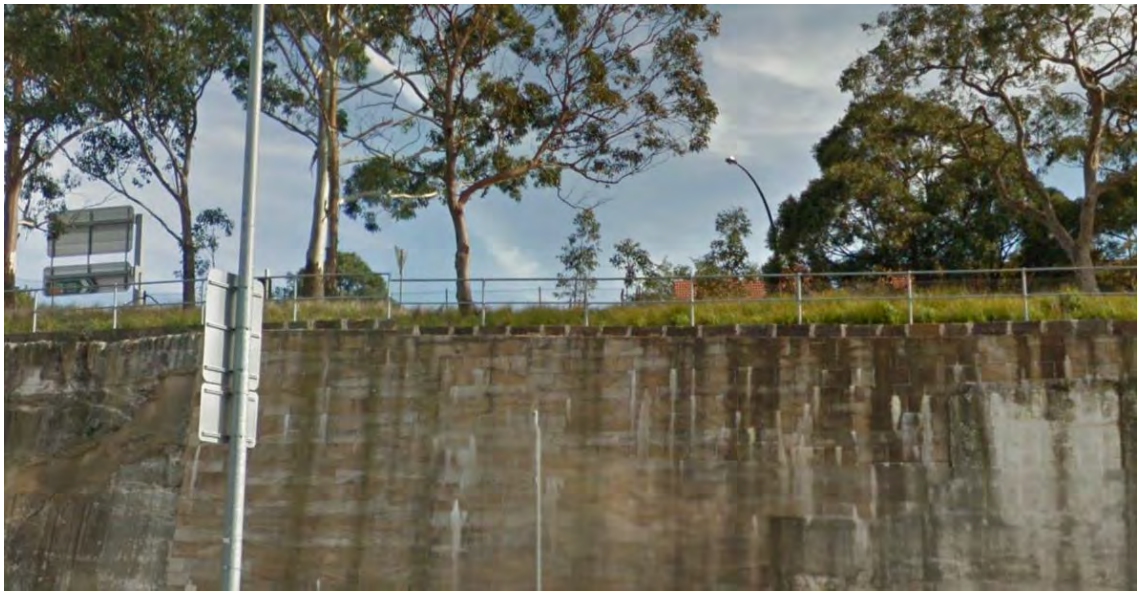


Figure 44 – Warringah Freeway (Source: Google Street View)

Figure 45 – Stone cladding to pile wall with shotcrete face, Wentworth Falls

Faux Rock

If the area of unstable rock is localised faux rock treatments can produce an acceptable finish. Such instances are small cut faces (Figure 46); or the interface at the top of cuttings between weathered rock and stable rock (Figure 47)

This consists of a layering process to the shotcrete with standard shotcrete laid down and then built up with a specialist treatment comprising colouring and working to create a finish which matches that of the adjoining stone. It is a labour intensive process and requires the services of a skilled applicator.

Figure 46 – Faux rock on the M2Motorway

Figure 47 – Faux Rock on leading edge of cutting at Wentworth Falls

5.2 Retaining walls

The use of retaining walls in most instances will relate to fill slopes. Retaining walls may be used to limit the extent of disturbance and the potential of fill slopes chasing the slope downhill. The visibility of such walls is limited to those beyond the road or below its level. For this alignment the potential for views is consequently limited due to the absence of both public roads and dwellings beyond the corridor. Despite this it is important that an appropriate form and colour of wall is considered to minimise its impact.

At this stage in the design the nature of the wall is not fully defined and so principles related to the treatment of the wall have been provided along with examples of how this might work.

These are:

- Use a colour and texture which enables the wall to recede into the background. It is recommended that colours should be natural and subdued colours such as dark greys which pick up on the shadows of the adjoining vegetation
- Treatments should consider the potential to address graffiti
- Construction methodology should be consistent for the alignment. Where structural requirements dictate a variation in method or form the method should be complimentary with the other designs.
- Solution should limit maintenance requirements.

Figure 48 – a) and b) Exposed aggregate finish to Reinforced Earth wall below the Great Western Highway

5.3 Barriers

The constrained nature of the corridor and its geometry has seen median barriers introduced for much of the study areas length. These are generally a rigid concrete barrier of nominally 800mm height. Their colour breaks up the expanse of the road and reinforces the geometry of the road, leading the driver along its length.

Barriers within the verge are primarily a 'w' beam, which are introduced as and when the geometry or embankment forms dictate.

Bridge barriers are inconsistent with current design standards but are unlikely to be changed as the alignment does not dictate the addition or variation to the present bridge form.

Figure 49 – a) rigid concrete barrier, and b) removable concrete barrier.

New barriers

The design of the new barrier within the median may need to be increased in height to 1100mm. This has the potential to have a greater visual impact on the road user due to its increased scale and the sense of enclosure this creates and the way it makes the road user feel.

To avoid increasing the sense of enclosure an alternative to the rigid concrete barrier could include the use of a double steel rail within the median barrier in a way similar to that used at the Woodford Bends in the Blue Mountains, refer Figure 50.

Figure 50 – Double Rail median barrier used on the Woodford Bends, Great Western Highway, The Blue Mountains.

5.4 Intelligent Traffic Systems (ITS)

Intelligent Traffic Systems are proposed as part of the Projects development in the form of Variable Message Signage (VMS). VMS are signs that display electronically generated messages and are deployed along the mainline to provide traveller information to motorists. Typically these VMS are mounted on a cantilever outreach and are six metres wide with either a monochrome or colour display. The signs have a full graphics capability and display four lines of 18 characters including letters, numbers and symbols, with each character being 400mm high.

Figure 51 – VMS sign on the M5 Motorway (Source: Roads and Maritime Services)

ITS placement

The key factors taken into consideration when placing a VMS and other electronic signage include:

- Sight distance
- Proximity to decision points
- Proximity to change in the road environment
- Proximity to the other roadside infrastructure
- Background behind the sign
- Visual impact on sensitive receivers.

Where possible the ITS and associated communication and power conduits would be located to provide easy access for installation and maintenance and also to minimise the disturbance of any vegetation and other sensitive environmental features

Visual Impacts of ITS

The location of the ITS system has not been determined. So an assessment is not possible, rather an understanding of the impacts potentially associated with this signage and its mitigation are discussed. The components of the proposal that may cause potential visual impacts include:

- VMS gantries – These structures would have a six metre clearance and may span either a single carriageway or in some instances both carriageways.
- VMS gantry maintenance bays – These would have a visual impact within the motorway corridor requiring a localised expansion of the paved area

Strategies to address the impacts of the VMS signage include:

- Simple refined gantry structure to support sign
- Locating sign where it is not visible on the horizon but rather has a backdrop
- Locating sign so as to minimise disturbance beyond the footprint of the road itself

5.5 Verge treatment

The verge treatment for the alignment has an impact on the ongoing maintenance and overall appearance of the corridor. The present treatment at the base of rock cuttings provides a neat and durable solution. This consists of filling behind the concrete kerb with concrete to the face. This intern reduces the potential for weeds, the need for maintenance of vegetation immediately adjacent the carriageway, and provides a solid foundation to step onto if within the breakdown lane. (Refer Figure 52.)

Figure 52 – Verge to base of cutting.

The treatment of verges along other sections of the alignment varies according to the conditions of the site.

Vegetated cuttings

The treatment of the verge, where vegetated cuttings adjoin the road, sees the landscape treatment extend to back of kerb. This zone to the back of the kerb or gutter is managed as part of the roads maintenance regime and is dominated by grasses.

Fills

On Fill embankments the verge generally includes a barrier to protect against vehicle run off down and over the embankment. The zone behind barrier is slashed as part of the maintenance in order to remove unwanted growth and to ensure the barrier is exposed to passing traffic. Trees are set beyond the deflection point of the barrier.

Figure 53 – Typical fill embankment and verge treatment.

5.6 Drainage

The existing alignment occurs within a high rainfall area influenced by its proximity to the edge of the escarpment. The current alignment has a mix of kerb and gutter, gutters or just surface flows over embankments.

Drainage along the corridor is currently managed through the presence of kerbs and gutters which concentrate flows to either a piped or surface flow system. At present there are no obvious water quality controls in place for the alignment.

The potential to incorporate water quality controls as part of the proposed works within the main valleys of Bellambi and Cataract Creeks will be addressed during detailed design. This may be in the form of dry basins or swales adopting Water Sensitive Urban Design techniques to address the presence of these water quality control elements within the natural landscape.

Where the increased surface water runoff presents a risk to sensitive waterways, risk of localised flooding or has the potential to impact on public infrastructure, water quality controls will be considered. This may require new basins or swales, the form of the basin or swale should be responsive to its context, should be natural in form and informal in shape.

This may include the following initiatives:

- Soft engineering/ green engineering solutions – ie where landscape treatments are used in lieu of concrete or heavy armouring to establish a natural appearance to the overall infrastructure
- Forms which reflect that of the natural landscape – ie avoiding formal geometric shapes to basins
- Minimisation of the number of basins to avoid issues associated with access and maintenance and to minimise the overall footprint of the corridor.
- Use of bioswales in lieu of basins where water quality is the primary objective
- Avoidance of concrete lined channels and where necessary the use of colouring to avoid visual impacts associated with these elements
- Fencing of water quality controls should be avoided if possible due to the relative isolation from residential and/or public buildings

5.7 Surplus Material Management

The scale and nature of the works is likely to result in a surplus of material from excavation. The integration of this material within the corridor addresses both cost and environmental concerns regarding disposal. The extent of this issue is not yet resolved and so the following principles have been developed to inform the consideration of potential sites and strategies to address this.

Surplus material should be integrated with the road formation. This can be achieved through:

- Easing of batter slopes to provide a smoother, flatter slope which adjoins with the adjacent landform.
- Integrating surplus material mounding with the adjoining landform at the cut fill interface through the creation of false cuts.
- Avoiding the use of freestanding mound.
- Use of the former road alignment, where no longer required, to reinstate the natural landform profile or a profile which can be blended with the adjoining landscape.

5.8 Revegetation

The revegetation strategy for the alignment is essentially one of reinstatement of the existing vegetation community through which the alignment passes. A number of community types have been identified and the composition defined in Chapter 2. The revegetation palette should reflect these communities.

The method of reinstatement needs to be responsive to the widening nature of the work. This would include reinstatement of the disturbed ground by hydromulch or compost blanket application. The method of reinstatement should reflect the stability of the site and the environmental risk associated with the reinstatement.

Soil and Mulch management will play an important role in the success of the revegetation works. Areas should be assessed for the presence of weeds prior to the stripping of site topsoil. Where weeds are present the soil should be managed and either be capped or disposed of. Mulch won from site may be used as part of the soil improvement and management process including use for erosion control and as a mulch.

A testing regime of the soil for the corridor should be established and form part of a reuse strategy for mulch and soil materials.

Seed should be collected from the corridor or its immediate environs and should be of endemic native species. Planning for the collection of seed should occur early to ensure sufficient quantity of appropriate species is available.

6 URBAN DESIGN AND LANDSCAPE STRATEGY AND RESPONSE

6.1 Urban Design and Landscape Strategy

The landscape and urban design response is informed by the context described in the earlier chapters and the mitigation measures outlined in the preceding chapter.

The proposed strategy consequently adopts the dominant character of the alignment including the geology through its cuttings and vegetation communities and which occur along the alignment. These communities reflect the geology, hydrology and aspect of the site and consequently are best adapted to restore the margins of the road corridor. By adopting such a strategy the sense of enclosure that defines the current alignment would be maintained.

Landscape treatments will be responsive to the existing visual environment ensuring that where the corridor opens and provides views of the adjoining landscape that these are retained. Care however will also be taken to manage views from outside the alignment to the alignment. This will be of particular importance at the northern end of the corridor where views of the alignment have been identified.

The key strategies adopted can be summarised as follows:

- Reinforce eucalypt forest communities to enhance screening and provide greater stability to landscape.
- Planting and seeding works is to be responsive to and compliant with road safety requirements for clear zones.
- Maintain views where they exist to provide a sense of progression and of the landscape through which the road passes.
- Manage noxious weeds as part of the upgrade process by implementation of a focused lantana management plan.
- Management and treatment of batter slopes needs to be responsive to the existing character and the constraints of the rock type. The use of shotcrete should be avoided and/or minimised.
- Retaining walls needs to be responsive to context, reflecting adjacent materials where in cut or considering the need to blend with their surroundings where retaining fill.
- Treatment of the median barrier needs to consider the need for openness, while providing a degree of headlight control and an appropriate level of safety.
- Signage needs to be located with due consideration to existing and proposed planting.

6.2 Landscape Sequence

The alignment traverses a sinuous, undulating corridor which follows the ridges and spurs. Its low points reflect the key drainage corridors that pass across the alignment. The vegetation responds to the differing hydrology, aspect and topography along the corridor. Within the alignment a general sense of enclosure is experienced which would be carried forward in the upgrade.

The following landscape strategy illustrates the key landscape responses to be implemented to achieve the proposed outcome, (Figure 54). The strategy responds to the 3 character zones of the site. Generally the response has been to reinforce reinstate the existing vegetation communities adjacent to the works.

6.2.1 Character Zone 1

Character Zone 1 is located just south of Bulli Lookout and extends between Ch. 17050 and Ch. 13500. This section of the corridor has one of the greatest impacts of the alignment which occurs between Ch. 17000 and Ch16000 where the alignment moves east of the current alignment creating a new cutting, refer Figure 55. This introduces a significant cutting up to two tiers high, the tallest cut within the present alignment. The lower portion of the batter slope is proposed as 1.5 horizontal:1 vertical. This provides a slope which is unlikely to need shotcrete or other stabilisation methods but is flatter in grade than most rock cuttings within the existing alignment. Opportunities to steepen would provide benefits in terms of footprint and consistency with the existing alignment but would need to be balanced with the potential need for stabilisation treatments. The upper batters are flattened enabling the establishment of landscape and the blending of the profile with the adjoining vegetation community.

An important element of the mitigation of this new element is the management of the cut itself and the way this interfaces with the former road alignment. This will require both the removal of the former road and its revegetation. As part of this process the reshaping of the landform would be desirable in order to reinstate the profile which was removed in the construction of the former alignment and its cuttings. These works are required both to reinforce the new alignment and to enhance the environmental outcomes of the works.

Just beyond these works at Ch. 15900 a large fill is proposed to the western embankment. This profile chases the slope and the opportunity to avoid this by the creation of a toe wall or steepening of the slope profile should be explored in order to reduce the disturbance.

For the next kilometre south the alignment and its improvements result in minor adjustments within the corridor. These changes represent minimal change and are managed easily within the mitigation techniques proposed in chapter 5.

Ch. 14700 to 14400 a large fill slope is to be developed predominantly to the west of the alignment, refer figure 56. The slope proposed partially fills a small valley resulting in both the clearing of vegetation and the need for its re-establishment. The introduction of a wall to shorten the slope and minimise disturbance would result in the need for a substantial structure and is not a viable alternative.

Revegetation of both the lands adjoining the new alignment and the former alignment are a key element of the mitigation strategy softening the impact by reinstating the vegetation lost as a result of the construction process. Ch. 17050 and Ch. 16000 is characterised by the Tall open Blackbutt forest community, (defined in Chapter 2.5). The impact to the east will be limited by the extent of cut and the need to minimise impacts on the adjoining Nature Reserve. The critical area of reinstatement through this zone is consequently the former alignment. Reinstatement works within this zone will enhance the legibility of the alignment, and reduce the visual impacts visible from the north at Appin Road.

From the crest at Ch15500, there is a change in the vegetation as the aspect of the slopes change and a wetter forest community is established. This is reflected in a changed in forest community to a Moist Blue Gum Blackbutt Forest, (defined in Chapter 2.5). This extends from here to the commencement of Character Zone 2. This landscape type would be used for the revegetation works associated with the minor widening of the corridor within this portion of the route.

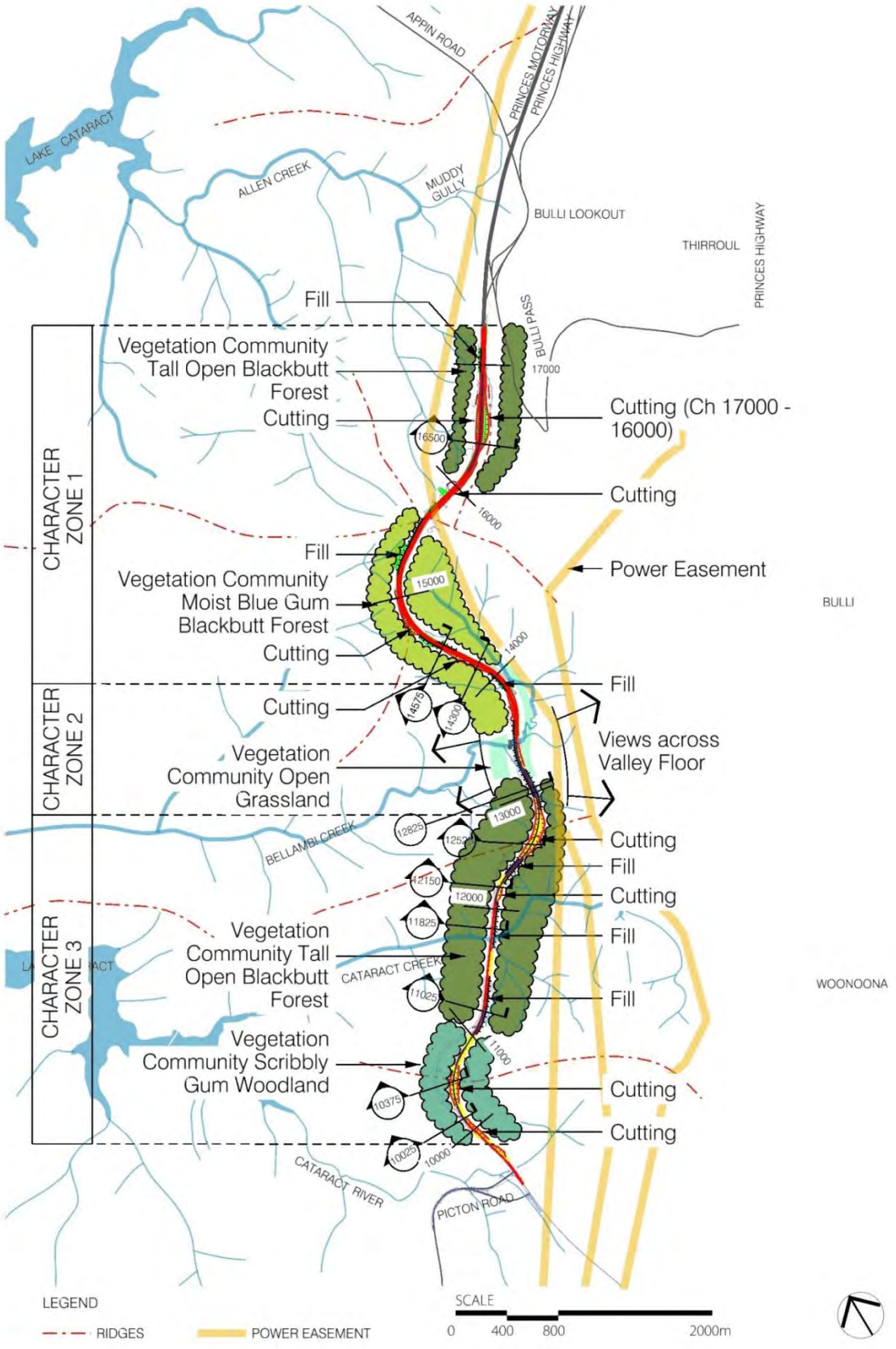


Figure 54 – Landscape and Urban Design Strategy

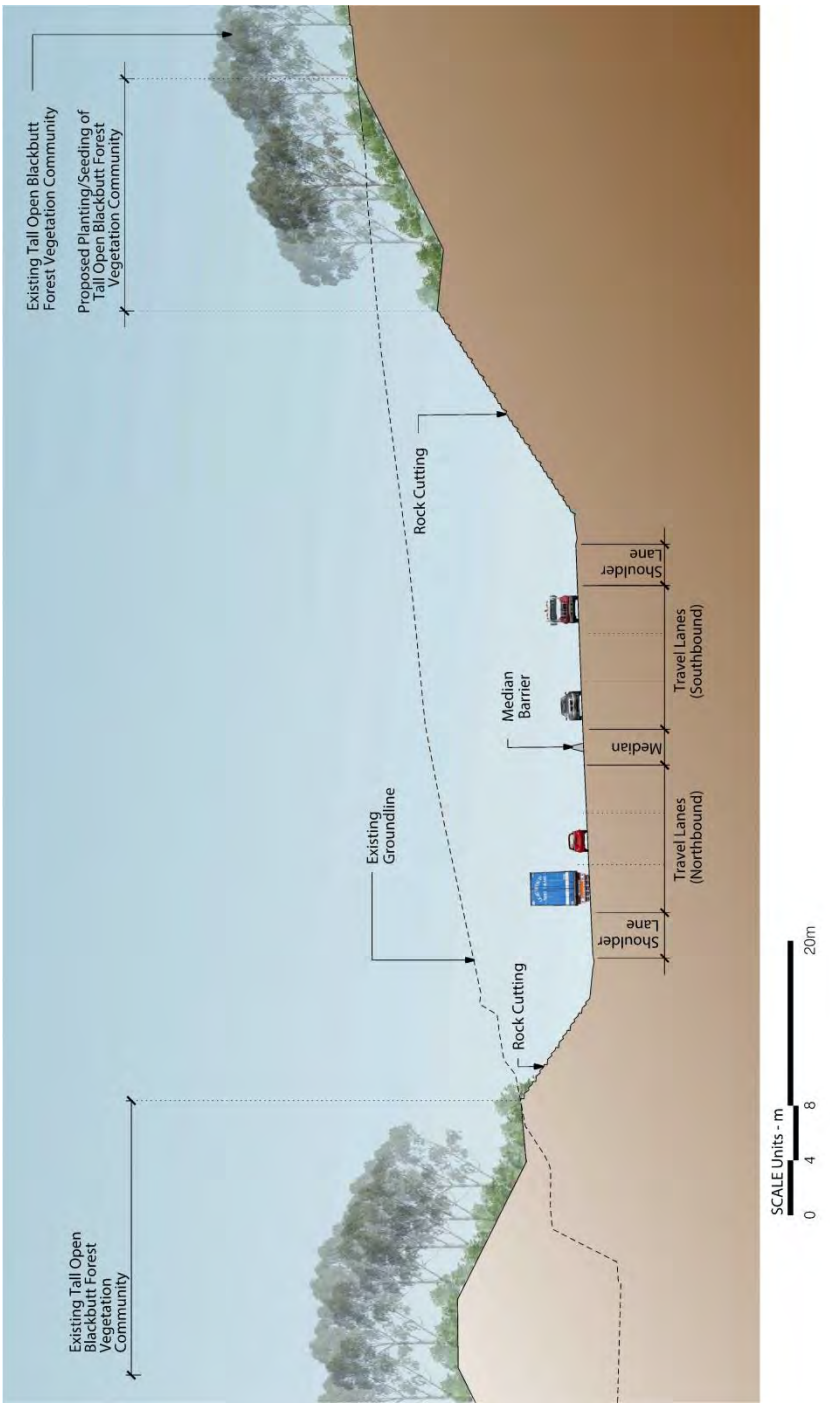


Figure 55 – Cross section Cutting - Ch 16500.

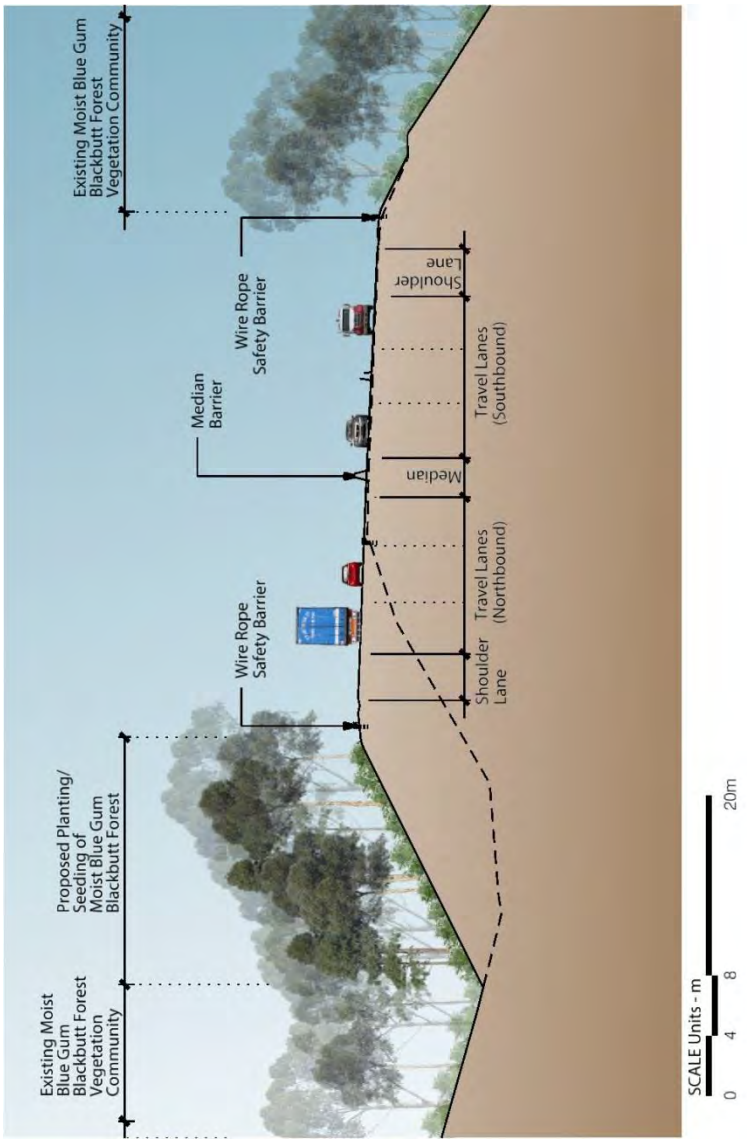


Figure 56 – Cross section Fill - Ch.14575.

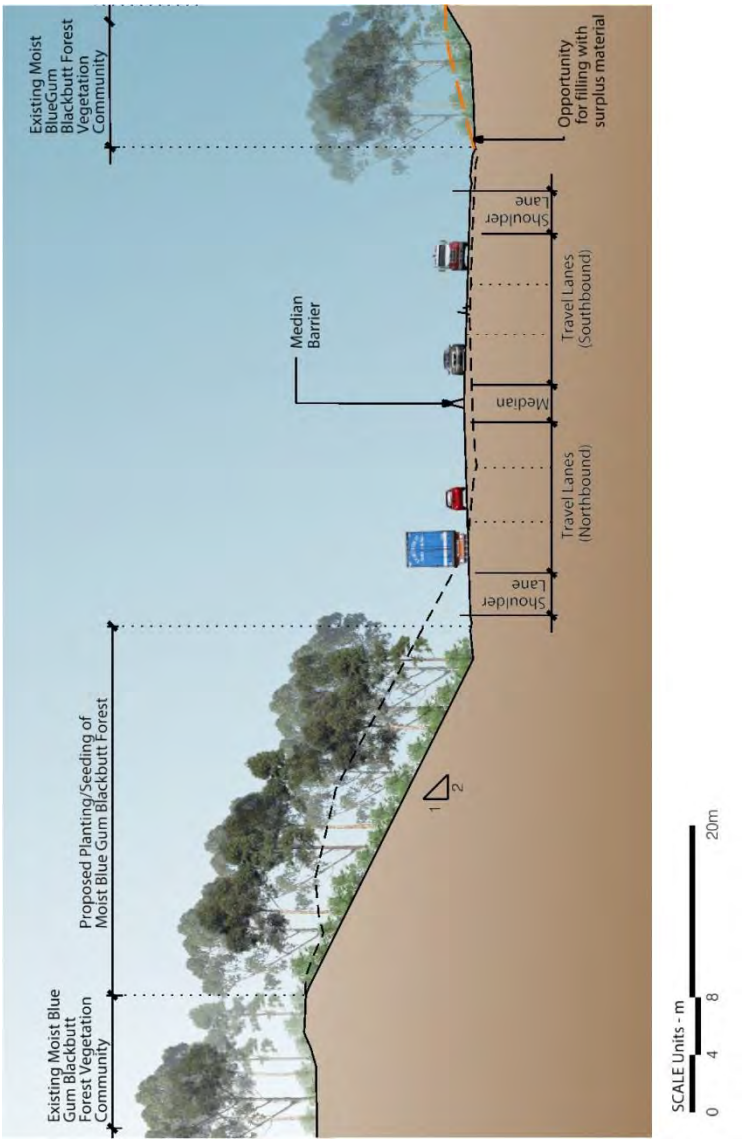


Figure 57 – Cross section Fill - Ch.14300.

6.2.2 Character Zone 2

Character Zone 2 extends between Ch. 14000 and Ch. 13000 and is a unique sections of the corridor as the alignment opens up and provides views across a predominantly grassland section terminated by the ridgelines of the undulating landscape to the east of the alignment.

Impacts within in this section of the corridor are minor as the alignments footprint is largely contained within the existing alignment or extends only marginally beyond the existing extent of the formation.

The landscape response through this section is focused on the retention of views and has adopted an open grassland community reflecting the sedgeland grassland which exists within the valley. This community while not natural reflects the history of uses of the site and provides a welcome break in the enclosed canopy which characterises the remainder of the alignment.

6.2.3 Character Zone 3

Character Zone 3 extends from Ch. 13000 to Ch. 9760 and is similar to much of the preceding works, having limited impact with only minor increases in alignment footprint. Two significant changes are proposed where the alignment is straightened and a new section of the alignment constructed off line.

The alignment initially sees a small expansion in the cutting at Ch 12825, figure 58. This expansion in footprint is only minor and does not impact on the character. As the alignment progresses south the impact increases initially as a new cut is formed, Ch 12525 - figure 59, before it transitions completely off line and onto a fill embankment at Ch 12150 (Figure 60), which is built beyond the side slope of the ridge.

Opportunities to reduce the footprint and scale of this new formation are limited by the topography of the site. The vegetation community throughout this section is consistent with that at the northern end of the alignment Tall Open Blackbutt Forest. Reinstatement of fill embankments will seek to reinforce the present sense of enclose through the re-establishment of the adjoining community.

One of the most significant changes in alignment occurs, where a substantial fill is proposed to achieve the smoother, straighter alignment of the road. The alignment transitions back and by Ch 11825 (Figure 61) the proposed alignment largely corresponds with the existing with some increase in footprint. This relationship to existing alignment continues through to 10500 and is depicted in figure 62.

A new alignment resulting in a substantial cut is proposed between ch 10500 and 10000. This cutting has the lower batter slope set at a slope of 1.5 horizontal: 1 vertical, reflecting a lesser strength rock, refer figures 63 and 64. The treatment of cuttings is to be consistent with the recommendations in Chapter 5 which provide strategies to address the variability of the rock strata. If rock is heavily weathered the potential to stabilise with vegetation should be considered as this reduces the ongoing maintenance requirements of such slope and reduces the visual impact. Vegetation should only be installed if it is considered that a stable slope treatment can be achieved. The planting of trees as part of this process should be avoided.

This southern most cutting occurs within a unique section of the corridor as the vegetation community transitions to Scribbly Gum Woodland. Any revegetation works should reflect this change adopting a composition similar to that defined in Chapter 2.5 for this community.

The overall revegetation strategy should be informed by the relevant vegetation communities as indicated in the strategy plan Figure 54 and the plant species list attached Appendix A.

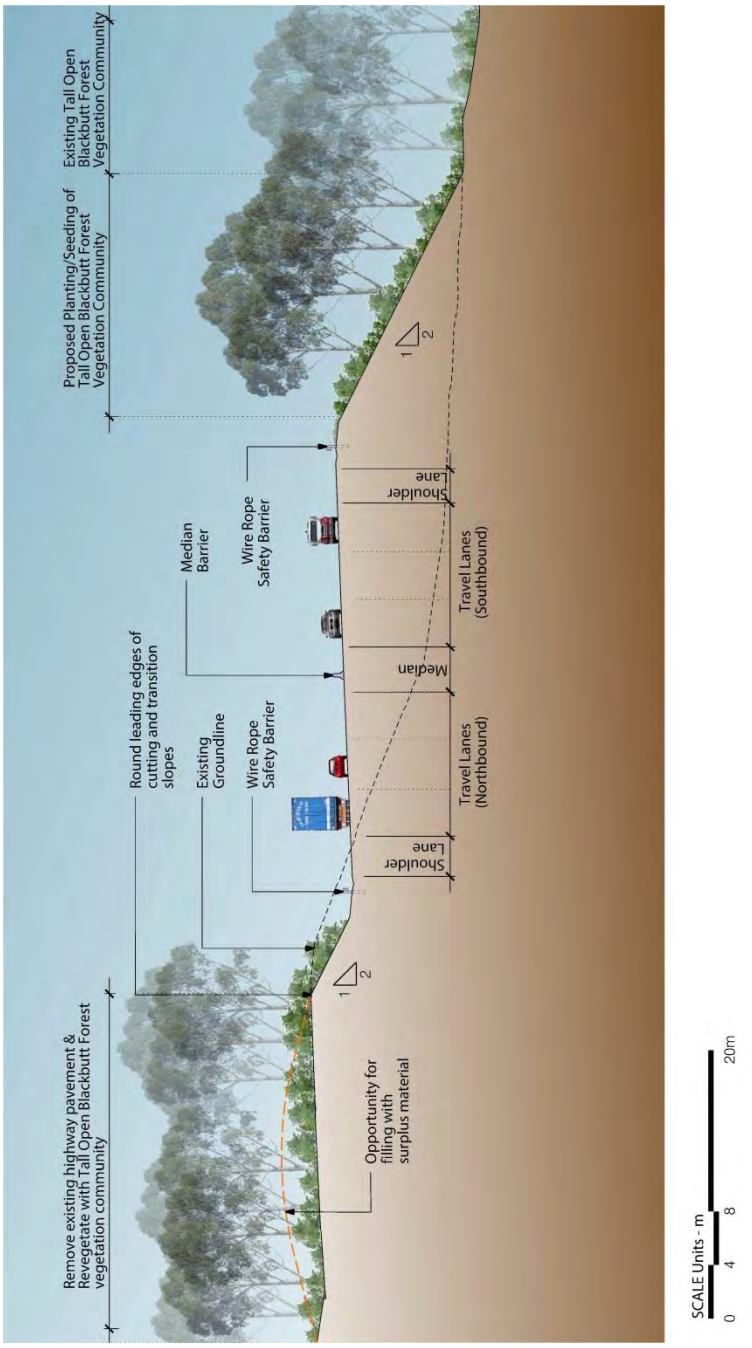


Figure 58 – Cross section Cutting - Ch12825.

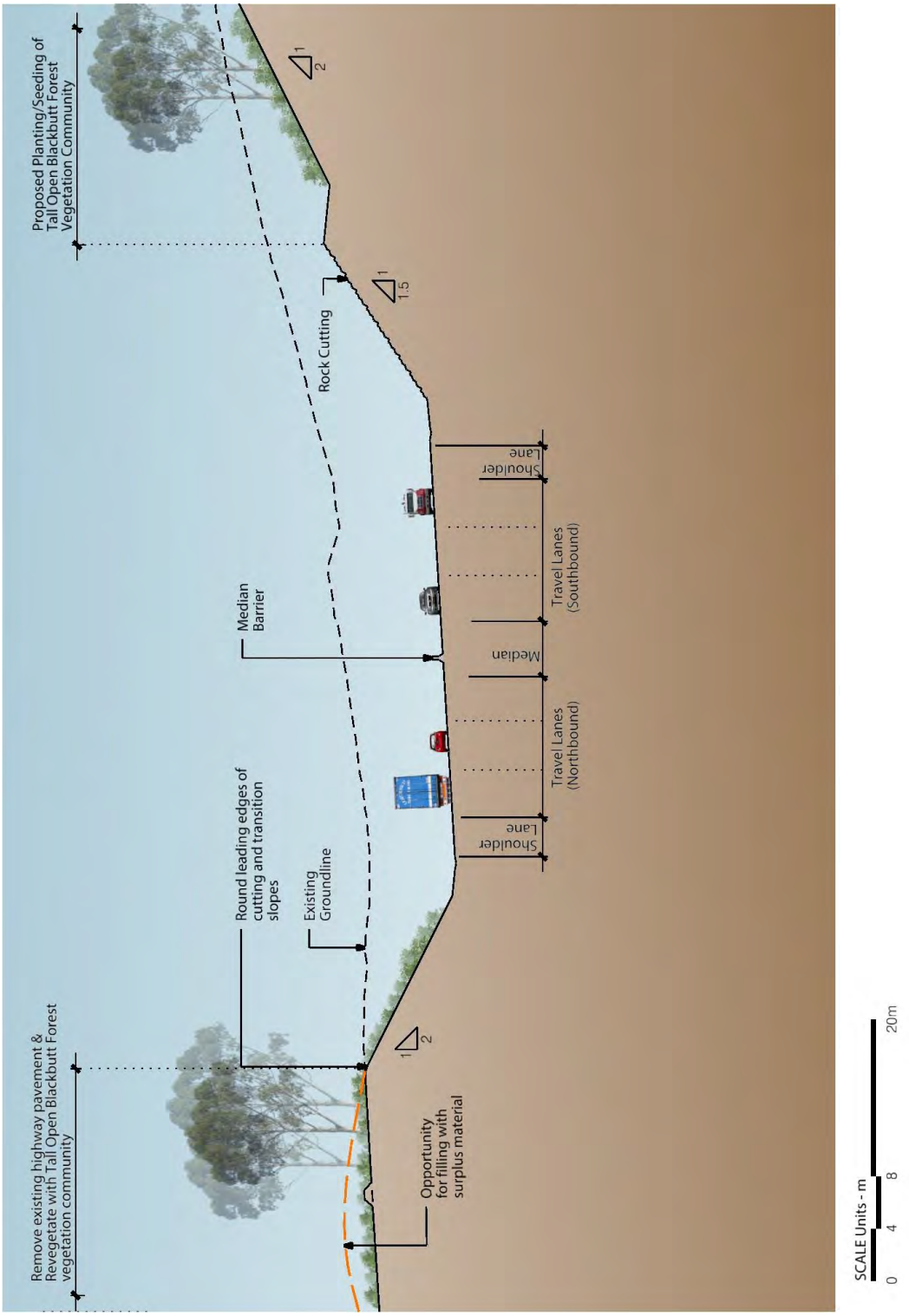


Figure 59 – Cross section Cutting - Ch12525.

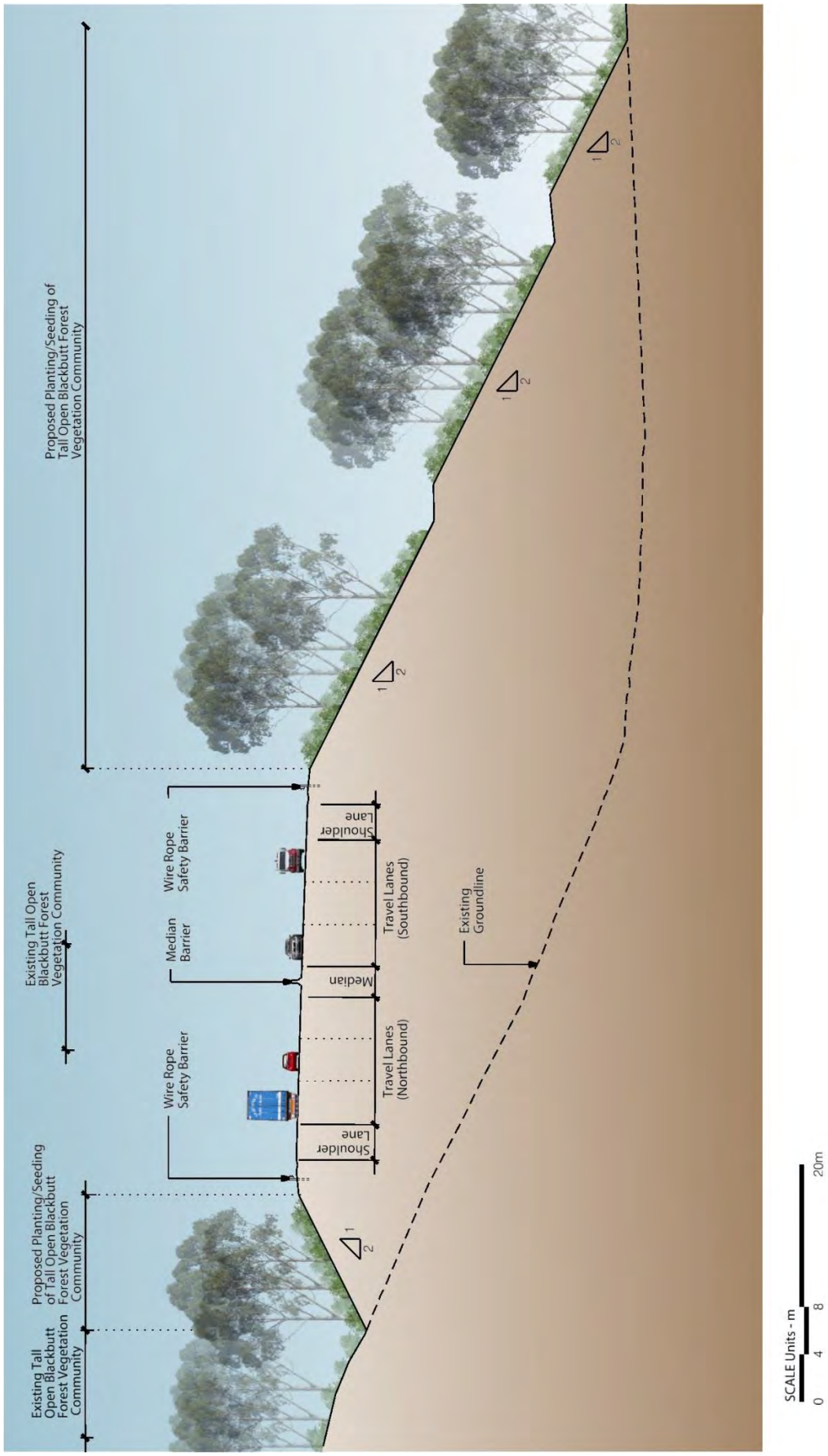


Figure 60 – Cross section Fill - Ch12150.

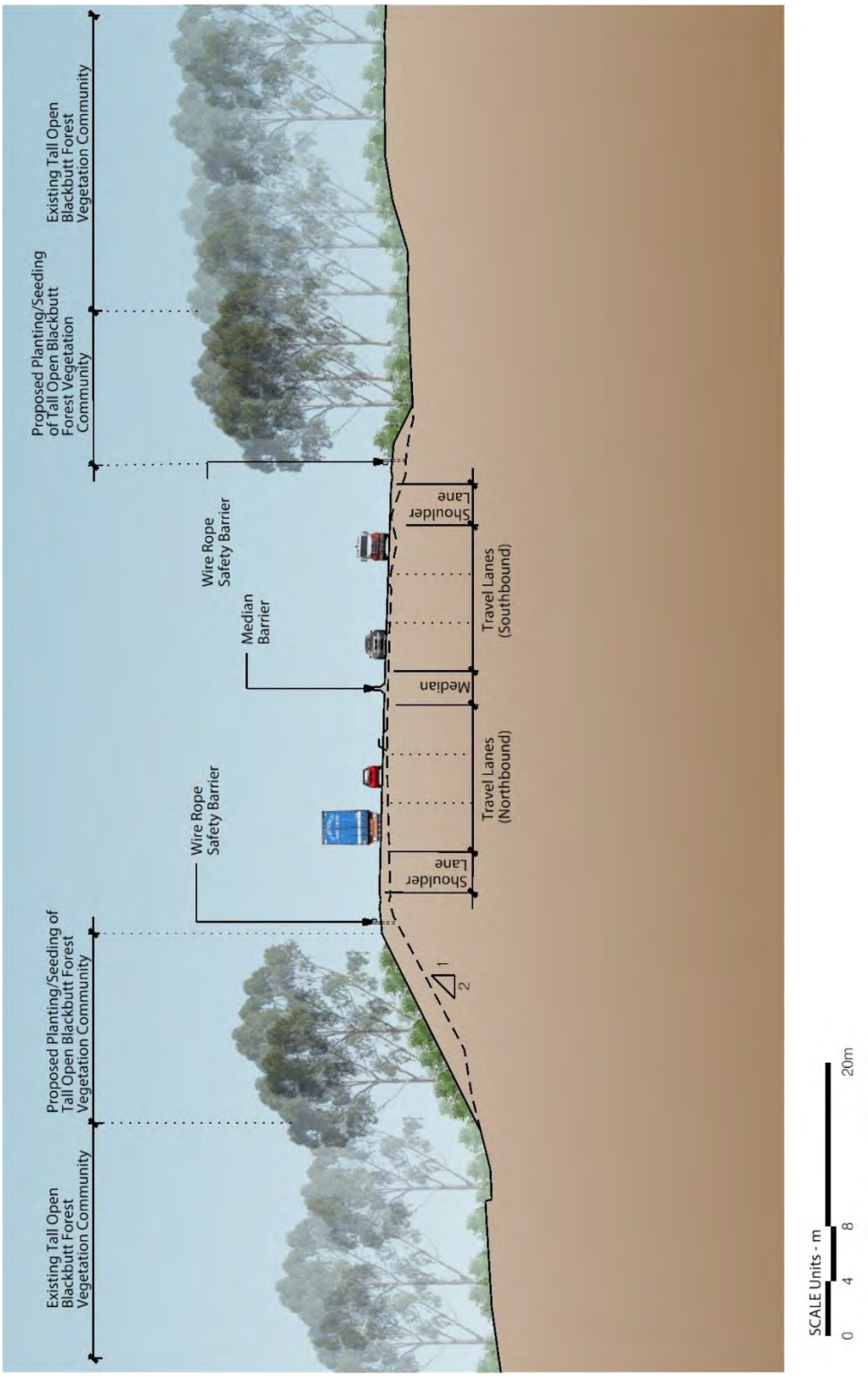


Figure 61 – Cross section Fill - Ch11825.

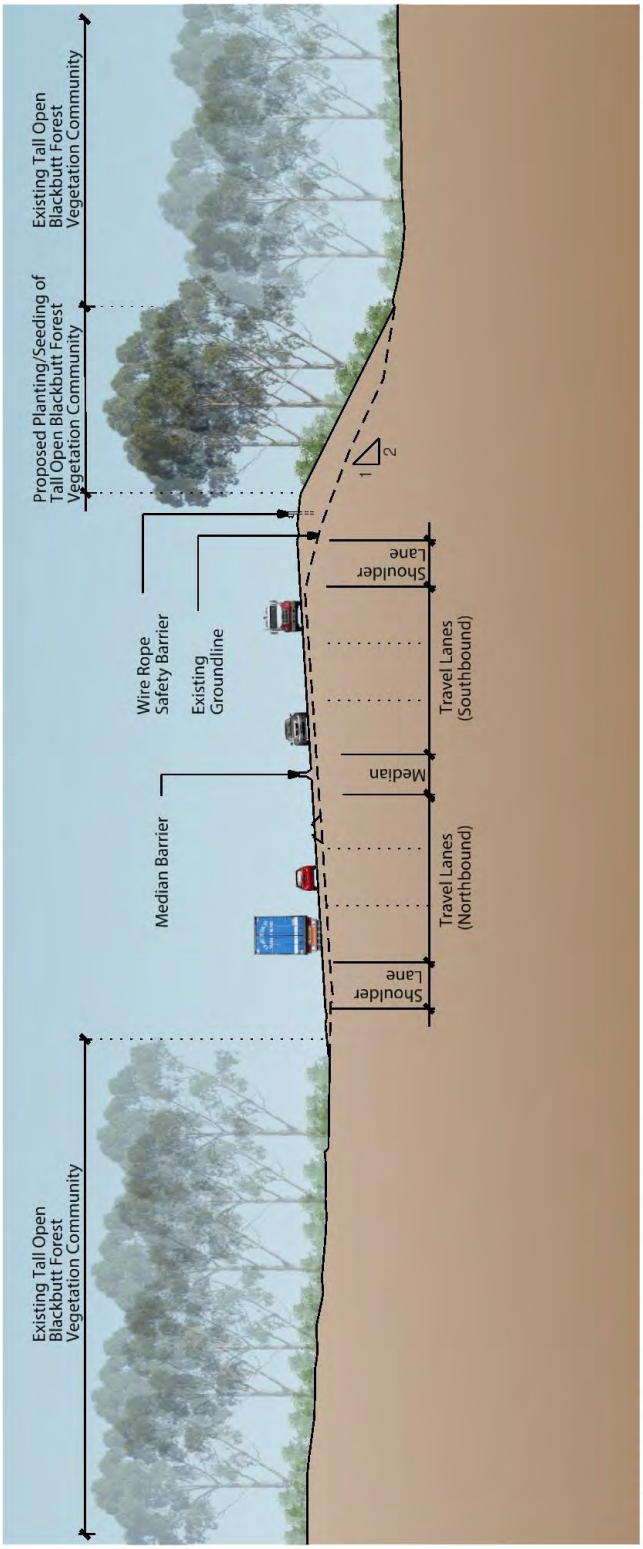


Figure 62 – Cross section Fill - Ch11025.

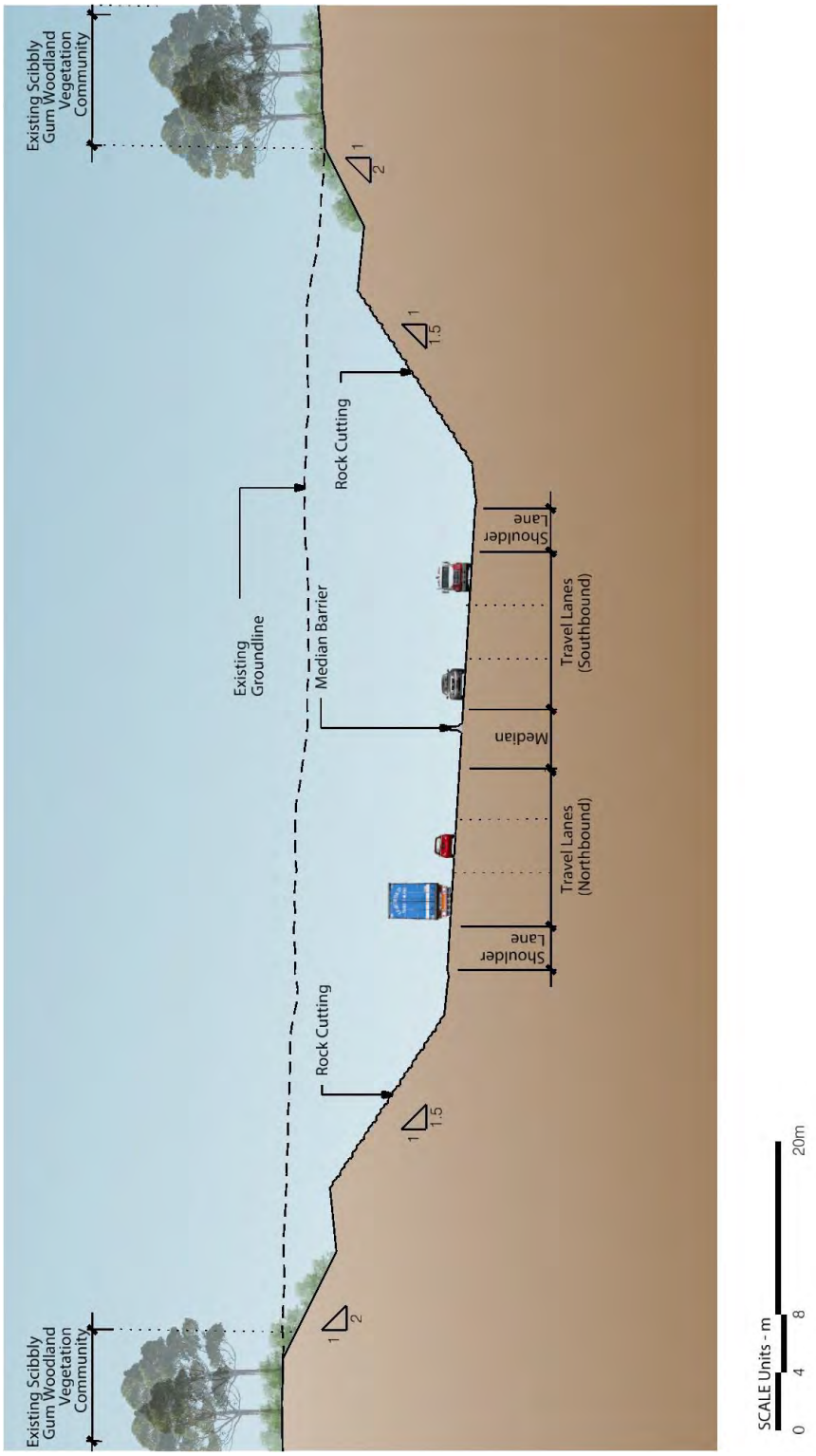


Figure 63 – Cross section Cutting - Ch10375

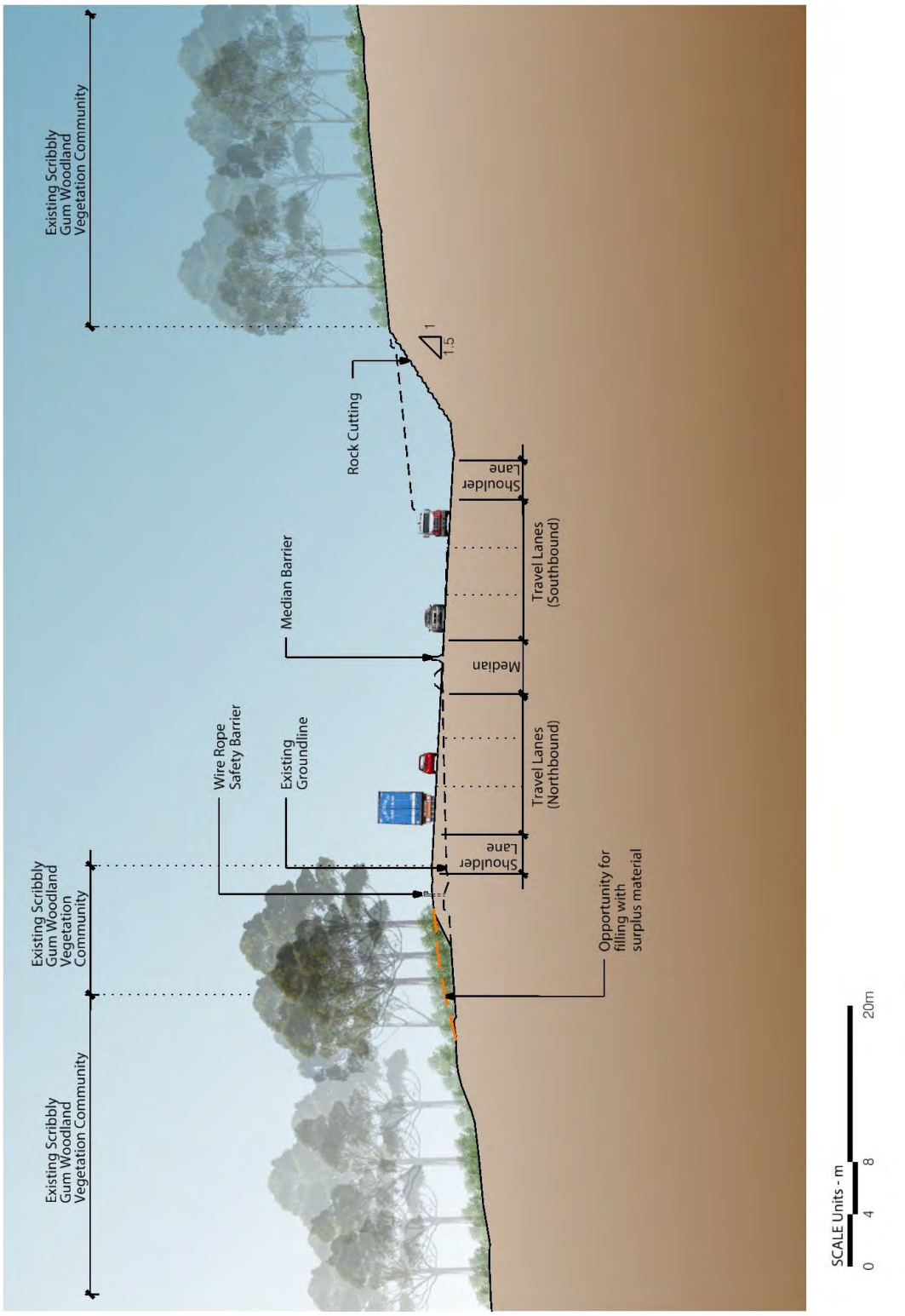


Figure 64 – Cross section Fill and Cutting - Ch10025

7 CONCLUSION

The proposal is generally for the widening of the existing alignment of the M1Princes Motorway, between Bulli Pass and the Intersection with Picton Road. The works entail both the realignment and expansion of the existing alignment width by nominally 10m. This involves the following elements: clearing of vegetation to either side of the existing road corridor, widening of some of the stone cuttings with potential increase in height, the widening of fill batters with the potential requirement for retaining structures to enable the reduction in footprint; and the replacement of the central median barrier. Three sections of the alignment are proposed to be realigned clear of the existing road within a new alignment in order to enhance the geometry of the road to improve safety and efficiency.

The nature of the works, has been assessed as having an incremental increase in impacts on the landscape character and views of the corridor. This impact has consequently been determined as being low in relation to both the scale and sensitivity of the impacts on landscape character and visual attributes. Where the alignment has shifted such as occurs at the northern end of the corridor at Ch. 17000 and Ch16000, or at the south 10500 to 10000 a more significant impact is experienced and this has been assessed as moderate.

A variety of mitigation strategies has been discussed and defined which can be used to address the impact of the options and are to be used in developing the detailed designs. A landscape and urban design strategy has been defined which pulls these mitigation measures into an overall response for the alignment, clearly identifying critical areas of focus so that the implementation of the integration strategy achieves an overall cohesive identity for the Highway corridor.

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9 APPENDICES

Vegetation Species within the corridor

Scientific Name	***Common Name***
Acacia binervata	Two-Veined Hickory
Acacia longifolia	Sydney Golden Wattle
Acacia stricta	Straight Wattle
Acacia suaveolens	Sweet Wattle
Acacia ulicifolia	Prickly Moses
Acmena smithii	Lillypilly
Actinotus minor	Lesser Flannel Flower
Allocasuarina littoralis	Black She-oak
Amperea xyphoclada	Broom Spurge
Anisopogon avenaceous	Oat Speargrass
Aotus ericoides	
Asplenium flabelliifolium	Necklace Fern
Baloskion gracile	
Banksia ericifolia	Heath-leaved Banksia
Banksia serrata	Old-man Banksia
Banksia spinulosa	Hairpin Banksia
Baumea teretifolia	
Climbing Apple Berry	Billardieria mutabilis
Hairy Apple Berry	Billardiera scandens
Gristle Fern	Blechnum cartilagineum
Variable Bossiaea	Bossiaea heterophylla
Calochlaena dubia	Rainbow Fern
Cassinia longifolia	
Cassytha glabella	Slender Devil's Twine
Cassytha pubescens	Devil's Twine
Caustis flexuosa	Curly Wig
Caustis pentandra	Thick Twist Rush
Ceratopetalum apetalum	Coachwood
Cissus antarctica	Kangaroo Vine, Water Vine
Clematis aristata	Old Man's Beard
Clematis glycinoides	Headache Vine
Clerodendrum tomentosum	Hairy Clerodendrum
Commelina cyanea	Native Wandering Jew
Conospermum ellipticum	
Coronidium elatum	
Corymbia gummifera	Red Bloodwood

Scientific Name	*Common Name*
Cryptocarya glaucescens	Jackwood
Cryptostylis sp.	Tongue Orchid
Cyathea australis	Rough Tree Fern
Cynodon dactylon	Couch Grass
Dampiera stricta	Dampiera
Darwinia grandiflora	
Desmodium rhytidophyllum	
Desmodium varians	Slender Tick-trefoil
Dianella caerulea	Blue Flax-lily
Dianella longifolia	Blueberry Lily
Dichondra repens	Kidney Weed
Dillwynia retorta	Diploglottis australis
Native Tamarind	Doryphora sassafras
Sassafras	Doryanthes excelsa
Gymea Lily	Drosera spatulata
	Endiandra sieberi
Corkwood	Elaeocarpus reticulatus
Blueberry Ash	Empodisma minus
Spreading Rope-rush	Entolasia marginata
Bordered Panic	Entolasia stricta
Wiry Panic	Epacris pulchella
Wallum Heath	Eucalyptus botryoides
Bangalay	Eucalyptus pilularis
Blackbutt	Eucalyptus piperita
Sydney Peppermint	Eucalyptus racemosa
Scribbly Gum	Eucalyptus saligna
Sydney Blue Gum	Eucalyptus saligna/botryoides
Sydney Blue Gum/Bangalay	Eucalyptus sieberi
Silvertop Ash	Eupomatia laurina
Bolwarra	
Eustrephus latifolius	Wombat Berry
Gahnia aspera	Rough Saw-sedge
Gahnia melanocarpa	Black-fruit Saw-sedge
Geitonoplesium cymosum	Scrambling Lily
Gleichenia dicarpa	Pouched Coral Fern
Gleichenia microphylla	Scrambling Coral Fern
Glycine clandestina	
Gonocarpus teucrioides	Germander Raspwort
Goodenia heterophylla	
Goodenia ovata	Hop Goodenia
Gymnostachys anceps	Settlers' Twine
Hakea dactyloides	Finger Hakea
Hakea laevipes	
Hakea sericea	Needlebush
Hardenbergia violacea	Purple Coral Pea
Hibbertia aspera	Rough Guinea Flower
Hibbertia dentata	Trailing Guinea Flower
Hibbertia empetrifolia	Guinea Flower
Hydrocotyle bonariensis	
Imperata cylindrica	Blady Grass
Isopogon anemonifolius	Broad-leaf Drumsticks
Isopogon anethifolius	Narrow-leaf Drumsticks
Jacksonia scoparia	Dogwood
Lambertia formosa	Mountain Devil
Lasteropsis microsora	Creeping Shield Fern
Lepidosperma filiforme	
Lepidosperma laterale	Variable Sword-sedge

Scientific Name	*Common Name*
Lepyrodia scariosa	
Leptospermum juniperinum	Prickly Tea-tree
Leptospermum polygalifolium	Yellow Tea-tree
Leptospermum trinervium	Flaky-barked Tea-tree
Leucopogon lanceolatus	
Lindsaea linearis	Screw Fern
Livistona australis	Cabbage Tree Palm
Lomandra cylindrica	Needle Mat-rush
Lomandra filiformis	Wattle Mat-rush
Lomandra glauca	Pale Mat-rush
Lomandra longifolia	Spiny-headed Mat-rush
Lomandra obliqua	Mat-rush
Lomatia silaifolia	Crinkle Bush
Lycopodium deuterodensum	Bushy Clubmoss
Melaleuca squarrosa	Scented Paperbark
Microlaena stipoides	Weeping Grass
Monotoca scoparia	
Morinda jasminoides	Sweet Morinda
Notelaea longifolia	Large Mock-olive
Notolaea venosa	Veined Mock-olive
Opercularia aspera	Coarse Stinkweed
Oplisemenus imbecillus	Creeping Beard Grass
Pandorea pandorana	Wonga Wonga Vine
Panicum simile	Two-colour Panic
Parsonsia straminea	Common Silkpod
Passiflora herbertiana	Native Passionfruit
Patersonia glabrata	Leafy Purple-flag
Patersonia sericea	Silky Purple-flag
Pellaea falcata	Sickle Fern
Persoonia hirsuta	Hairy Geebung
Persoonia levis	Broad-leaved Geebung
Persoonia linearis	Narrow-leaved Geebung
Persoonia mollis subsp nectans	
Pittosporum multiflorum	Orange Thorn
Pittosporum undulatum	Sweet Pittosporum
Platysace linearifolia	
Poa labillardieri	Tussock
Pseuderanthemum variabile	Pastel Flower
Pteridium esculentum	Bracken
Pultenaea linophylla	
Pyrrosia rupestris	Rock Felt Fern
Rapanea sp	
Rytidosperma tenuius	
Rubus parvifolius	
Sarcopetalum harveyanum	Pearl Vine
Schoenus brevifolius	Zig-zag Bog-rush
Schoenus melanostachys	Black Bog-rush
Selaginella uliginosa	Swamp Selaginella
Senecio sp	
Smilax australis	Lawyer Vine
Smilax glyciphylla	Sweet Sarsparilla
Solanum prinophyllum	Forest Nightshade
Solanum stelligerum	Devil's Needles
Stephania japonica	Snake Vine
Sticherus lobatus	Umbrella Fern
Syncarpia glomulifera	Turpentine
Synoum glandulosum	Scentless Rosewood

Scientific Name	*Common Name*
Tasmannia insipida	Brush Pepperbush
Tetrarrhena juncea	Wiry Ricegrass
Trochocarpa laurina	Tree Heath
Tylophora barbata	Bearded Tylophora
Veronica plebeia	Trailing Speedwell
viola hederacea	Ivy-leaved Violet
Viola sieberiana	
Xanthorrhoea resinifera	Grass tree
Xanthosia pilosa	Woolly Xanthosia
Xanthosia tridentata	Rock Xanthosia
Xylomelum pyriforme	Woody Pear
Zieria pilosa	Hairy Zieria
Zieria smithii	Sandfly Zieria
Zieria laevigata	Smooth Zieria