GREAT WESTERN HIGHWAY UPGRADE
MOUNT VICTORIA TO LITHGOW
FORTY BENDS UPGRADE

Review of Environmental Factors
Technical Paper 7
Landscape Character & Visual Impact Assessment

DOC. NO UL-704-C

OCTOBER 2012
Great Western Highway Upgrade
Mount Victoria to Lithgow Alliance
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CONTENTS

CONTENTS ........................................................................................................................................................... V

List of figures ........................................................................................................................................................ VI
List of plates ........................................................................................................................................................ VI

EXECUTIVE SUMMARY ..................................................................................................................................... VII

1. INTRODUCTION ........................................................................................................................................... 1

1.1 Purpose ..................................................................................................................................................... 1
1.2 Background ................................................................................................................................................ 1
1.3 Forty Bends upgrade ................................................................................................................................. 2
1.4 Study method .......................................................................................................................................... 3

2. CONTEXTUAL ANALYSIS ......................................................................................................................... 5

2.1 Location .................................................................................................................................................. 5
2.2 Existing conditions .................................................................................................................................. 6

3. THE PROPOSAL ........................................................................................................................................... 11

3.1 Overview of the proposal ......................................................................................................................... 11
3.2 Landscape and Urban Design Works ..................................................................................................... 12

4. LANDSCAPE AND URBAN DESIGN STRATEGY ................................................................................... 13

4.1 Overview ................................................................................................................................................ 13
4.2 Urban design vision ................................................................................................................................ 13
4.3 Urban design objectives and principles ................................................................................................. 13
4.4 Urban design and landscape elements ................................................................................................. 14
4.5 Urban design and landscape recommendations .................................................................................... 16

5. LANDSCAPE AND URBAN DESIGN CONCEPT ................................................................................... 19

6. LANDSCAPE CHARACTER IMPACT ..................................................................................................... 27

6.1 Landscape character assessment methodology ..................................................................................... 27
6.2 LCZ 1: Forty Bends (East) .................................................................................................................... 30
6.3 LCZ 2: Whites Creek valley ................................................................................................................... 32
6.4 LCZ 3: Forty Bends (West) .................................................................................................................. 34
6.5 Summary of landscape character impacts ............................................................................................ 36

7. VISUAL IMPACT ....................................................................................................................................... 37

7.1 Visual impact methodology .................................................................................................................... 37
7.2 Key viewpoints ........................................................................................................................................ 39
7.3 Summary ............................................................................................................................................... 52

8. MITIGATION STRATEGY ............................................................................................................................ 53

9. CONCLUSION .............................................................................................................................................. 55

REFERENCES ................................................................................................................................................... 57
LIST OF FIGURES

Figure 1.1: Forty Bends proposal ......................................................................................................................... 2
Figure 1.2: Impact Assessment Grading Matrix ..................................................................................................... 4
Figure 2.1: Regional context of the study area .......................................................................................................... 5
Figure 2.2: Local context of the study area ................................................................................................................ 5
Figure 2.3: Landform and topography of the study area .......................................................................................... 7
Figure 2.4: Geology and hydrology .......................................................................................................................... 7
Figure 2.5: Ecology of the study area ......................................................................................................................... 9
Figure 2.6: Heritage values ....................................................................................................................................... 9
Figure 2.7: Cultural and scenic values ...................................................................................................................... 10
Figure 5.1: Landscape Plan and Cross section at Station 30800. .............................................................................. 20
Figure 5.2: Landscape Plan and Cross section at Station 31400. .............................................................................. 21
Figure 5.3: Landscape Plan and Cross section at Station 31700. .............................................................................. 22
Figure 5.4: Landscape Plan and Cross section at Station 32100. .............................................................................. 23
Figure 5.5: Landscape Plan and Cross section at Station 32600. .............................................................................. 24
Figure 5.6: Landscape Plan and Cross section at Station 33140. .............................................................................. 25
Figure 5.7: Elevation of bridge over Whites Creek, looking south .............................................................................. 26
Figure 6.1: The three Landscape Character Zones (LCZ’s) .................................................................................. 29
Figure 6.2: Landscape Character Impacts Summary .............................................................................................. 36
Figure 7.1: The Visual Envelope Map (VEM) .......................................................................................................... 38

LIST OF PLATES

Plate 2.1: Typical landform of the study area, viewed from Podleys Pedestal .............................................................. 6
Plate 2.3: Narrabeen Group sandstones underlie the distinctive escarpment of Hassans Walls .................................... 6
Plate 2.4: Extensive stands of dry sclerophyll forest occur on the slopes of Hassans Walls ....................................... 8
Plate 2.5: Forty Bends Road, the alignment of Mitchell’s original road ..................................................................... 8
Plate 2.6: View south from Podleys Pedestal ............................................................................................................ 8
Plate 4.6: Simple and elegant bridge structure with rock abutments (photo RMS) ...................................................... 14
Plate 4.7: Rock lined drainage channel. Provide dark grey colour to concrete mix. (photo RMS) ............................ 15
Plate 4.8: Existing gabion wall filled with basalt at the side of the highway. Weldmesh (steel) baskets would provide a neater finish than the wire baskets shown here .............................................................................. 16
Plate 6.6: Character image within LCZ 1 .................................................................................................................. 30
Plate 6.7: Character image within LCZ 2 .................................................................................................................. 32
Plate 6.8: Character image within LCZ 3 .................................................................................................................. 34
Plate 7.1: Viewpoint 1 ............................................................................................................................................ 40
Plate 7.2: Viewpoint 2 ............................................................................................................................................ 41
Plate 7.3: Viewpoint 3 ............................................................................................................................................ 42
Plate 7.4: Viewpoint 4 ............................................................................................................................................ 43
Plate 7.5: Viewpoint 5 ............................................................................................................................................ 44
Plate 7.6: Viewpoint 6 ............................................................................................................................................ 45
Plate 7.7: Viewpoint 7 ............................................................................................................................................ 46
Plate 7.8: Viewpoint 8 ............................................................................................................................................ 47
Plate 7.9: Viewpoint 9 ............................................................................................................................................ 48
Plate 7.10: Viewpoint 10 ....................................................................................................................................... 49
Plate 7.11: Viewpoint 11 ....................................................................................................................................... 50
Plate 7.12: Viewpoint 12 ....................................................................................................................................... 51
EXECUTIVE SUMMARY

Roads and Maritime Services of NSW (RMS) is seeking approval for the Great Western Highway Upgrade at Forty Bends (the proposal). The proposal would include the realignment of about 2.8 kilometres of the Great Western Highway at Forty Bends. This Landscape Character and Visual Impact Assessment Report has been prepared as part of the Review of Environmental Factors (REF) process to address the visual and landscape character issues associated with the proposal, to introduce measures to minimise its potential impact, and to provide direction for future detail design and documentation work.

The study area is predominantly characterised by an undulating plain surrounded by steep escarpment of Hassans Walls to the north. This undulating plain is incised by a series of drainage lines that feed into Whites Creek and then to Coxs River. The northern side of the study area comprises densely vegetated forest areas on the slopes of Hassans Walls. Rural properties comprising open paddocks with vegetated creeklines are located to the south. Rural houses are located on the ridgelines adjacent to local roads. Padleys Pedestal on the Hassans Walls escarpment, is a popular lookout for Lithgow locals and tourists.

Landscape and Urban Design

A landscape and urban design strategy and concept are provided in Chapters 4 and 5. The landscape and urban design strategy identifies a number of design objectives to be developed and implemented, in relation to the intervention of the road in the landscape and the suite of roadside elements that require careful design. The objectives reflect the most important goals to be achieved as a result of the proposal, taking into account not only the corridor itself but also its relationship with surrounding areas.

The landscape and urban design concept is presented in plan and cross section format and is an overall strategy that broadly describes the urban and landscape design approach.

Landscape Character

Landscape character impact assessments are provided in Chapter 6. Landscape character assessment determines the impact of the proposal on the aggregate of built, natural and cultural aspects that make up an area and provide its unique sense of place. Although the overall character of the study area is quite similar, the Contextual Analysis identifies three landscape character zones. The landscape character impact assessment identifies that the proposal would have a moderate to high to moderate character impact. As all zones have a similar scenic quality, the greatest impacts are found in the areas where the scale of the proposal is more substantial, for example, the twin bridges over Whites Creek in zone 2 and the extensive retaining walls in zone 3.

Visual Assessment

Visual impact assessment is provided in Chapter 7. Visual impact helps define the day to day visual effects of a proposal on people’s views. It is based on the assessment of a number of selected key viewpoints that are rated according to the sensitivity of the view and the magnitude of the proposal within that view. The locations and directions of the chosen viewpoints are representative of the range of viewpoints both within and beyond the road corridor. A total of 12 key viewpoints form the basis of the visual impact assessment.

Out of the 12 selected viewpoints, visual impact ratings were determined as follows:

- Six viewpoints have High to Moderate visual impact;
- Six viewpoints have Moderate visual impact.
Ratings of High to Moderate impact occur where the proposal is viewed from a sensitive area, such as the lookout at Hassans Walls, or where the magnitude of the proposal is greater, for example, retaining walls and the bridge over Whites Creek, affect local residents. The remaining Moderate impacts result from a variety of conditions including distance from the proposal and the category of viewer being a road user.

**Mitigation Strategy**

A mitigation strategy is provided in Chapter 8. It has been developed during the concept design to mitigate landscape character and visual impacts and may be refined in the ongoing development of the design. Through the careful design of all road elements, including embankments, bridges, retaining walls, road furniture and planting, a solution can be developed that would minimise impacts on the existing landscape character of this section of the Great Western Highway.
I. INTRODUCTION

1.1 PURPOSE
This Landscape Character and Visual Impact Assessment Report has been prepared for the Roads and Maritime Services of NSW (RMS), by Spackman Mossop Michaels (SMM) as part of the Review of Environmental Factors (REF) for the proposed upgrading of Great Western Highway at Forty Bends. The proposal extends from between 470 metres east of Forty Bends Road and 250 metres west of McKanes Falls Road, South Bowenfels in the Lithgow Local Government area (LGA). This document is a technical paper that supports the REF being prepared by the Mount Victoria to Lithgow Alliance (MV2L Alliance). Spackman Mossop Michaels has worked on this proposal in conjunction with members of the Alliance, the RMS Urban Design Section and other RMS specialist advisors.

The report documents the landscape character and visual impacts of the proposal and has been prepared as part of the planning approval process. It aims to facilitate an integrated urban design and engineering design outcome for the proposal at this section of the Great Western Highway, through the utilisation of visual impact assessment to identify and summarise the visual and landscape character opportunities and issues within the study area, which in turn guided the development of the concept design process by avoiding or mitigating potential impacts wherever possible.

1.2 BACKGROUND
The Great Western Highway is the principal road transport link connecting the Central West region of New South Wales (NSW), the Blue Mountains and Sydney. The highway is an important freight transport corridor and is also used by thousands of commuters each day travelling between Sydney and the towns and villages along its length. The highway also provides a vital connection for tourists to many popular destinations within the region including various Blue Mountains tourist towns and villages, Greater Blue Mountains World Heritage Area, the Hartley Valley, Jenolan Caves and, further west, towns such as Mudgee, Orange and Bathurst.

Since May 2008, the Australian and NSW Governments have been investigating an area between Mount Victoria and Lithgow to determine the preferred route of an upgrade for the Great Western Highway. The Mount Victoria to Lithgow Great Western Highway upgrade is part of both governments’ commitment to improve road safety and accessibility to communities in the Blue Mountains and Central West.

The Mount Victoria to Lithgow upgrade was announced in 2008 and forms part of the Penrith to Orange Transport Strategy (1998), the Sydney – Dubbo Corridor Strategy (2007) and the Central West Transport Needs Study (2009).

The objectives of the proposal, which have guided the development of the draft concept design, were to:
• Improve road safety.
• Improve road freight efficiency.
• Cater for the mix of through, local and tourist traffic.
• Be sensitive to the areas natural environment, heritage and local communities.

Following on from this work, the study area, known as Forty Bends (Revised Section 5), was identified as a priority for further design work, and associated environmental assessments.
1.3 FORTY BENDS UPGRADE

RMS is proposing to upgrade the Great Western Highway at Forty Bends, approximately 5.5 kilometres south of Lithgow. The proposal would include the realignment of about 2.8 kilometres of the Great Western Highway from a point about 470 metres east of the eastern end of Forty Bends Road to a point about 250 metres west of McKanes Falls Road (the proposal). An overview of the proposal is shown in Figure 1.1.

The proposal forms part of a series of ongoing upgrades of the Great Western Highway. The Great Western Highway is the main road link between Sydney and Lithgow and beyond to the Central West of New South Wales. The Great Western Highway serves as:

- A key freight route between Sydney and the central west of NSW, including the timber industry in the Oberon area.
- A tourist route with destinations including the Blue Mountains, historic Hartley, Jenolan Caves, Mudgee and Bathurst.
- A connection between the many towns and villages along its length.

The proposal is needed to improve the road safety and traffic capacity along this section of road and would be consistent with other road improvement activities along the Great Western Highway. The existing alignment has a limited number of opportunities for passing.

Key features of the proposal are described in Section 3 of this report.

Figure 1.1: Forty Bends proposal
1.4 STUDY METHOD

The landscape character and visual impact assessment and the finalisation of the concept design has been an iterative process which has enabled the concept design to be refined progressively, thereby reducing and mitigating the potential visual impact wherever possible.

The method used to undertake this study follows ‘Guidelines for Landscape Character and Visual Impact Assessment’ (RMS, 2009) and is summarised as follows:

- Undertaking an initial site visit and field investigation, reviewing relevant literature, analysing aerial photographs, topographic maps to understand the study area;
- Reviewing the engineering and urban and landscape concept designs on a regular basis, and other supporting material to gain an appreciation of the proposal;
- Defining landscape character through a study area analysis, including a detailed site investigation;
- Identifying and describing landscape character zones and evaluating the proposal’s impact on them;
- Identifying the visual catchment of the proposal for the visual impact assessment;
- Selecting viewpoints within the visual catchment representing a range of different land uses;
- Evaluating the visual impact of the Forty Bends proposal by comparing the sensitivity of viewpoints and the magnitude of the impact of the proposal upon them to provide an overall impact rating as indicated by the Impact Assessment Grading Matrix (Figure 1.2); and
- Identifying further urban design and landscape opportunities and methods of mitigating adverse visual impacts for consideration in the detail design phase of the proposal (Chapter 8).

The method used to assess landscape character impact is described in Chapter 6 and visual impact is described in Chapter 7.
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Figure 1.2: Impact Assessment Grading Matrix.
2. CONTEXTUAL ANALYSIS

2.1 LOCATION

The study area for this Landscape Character and Visual Impact Assessment Report is located on the Great Western Highway south of Lithgow, beyond the western edge of the Blue Mountains, approximately 135 kilometres west of Sydney (Figure 2.1).

The Forty Bends proposal is approximately 2.8 kilometres in length, extending from 470 metres east of the eastern end of Forty Bends Road to 250 metres west of McKanes Falls Road, South Bowenfels (Figure 2.2).
2.2 EXISTING CONDITIONS

2.2.1 Landform & Topography

The Great Western Highway has been constructed to follow the undulating topography of the study area, winding between River Lett Hill to the south and the escarpment of Hassans Walls to the north (refer to Figure 2.3). Even though there has been a moderate degree of modification to the landscape (in terms of cut and fill embankments), particularly to the northern side of the road, the associated visual impact of the road on the surrounding countryside is relatively low. This is also helped by the relatively narrow footprint of the existing carriageway, consisting of only one lane in each direction, with occasional deceleration or turning lanes and gravel shoulders.

The terrain of the wider landscape surrounding the study area is predominantly characterised by an undulating plain surrounded by the steep escarpment of Hassans Walls to the north. This undulating plain is incised by a series of drainage lines that feed into Whites Creek and then to Coxs River.

2.2.2 Geology and Hydrology

The underlying geology of the study area is a key contributor to its dramatically varying topography. Narrabeen Group sandstone and Illawarra Coal Measures (shale) underlie the distinctive escarpment and massive sandstone cliffs at Hassans Walls that have been strikingly etched by weathering. To the south, the landscape is underlain by the Shoalhaven Group (siltstone and conglomerate) on the upper slopes, and the Kanimbla Banolith (granite) further to the south.

The study area is located within the Coxs River catchment, a sub catchment of the larger Hawkesbury-Nepean catchment and Warragamba catchment, which supplies Sydney’s drinking water. The hydrological pattern of the study area is dominated by Whites Creek, which flows directly into the Coxs River. Its headwaters originate on the southern side of the Hassans Walls escarpment (refer to Figure 2.4).

2.2.3 Climatic Factors

The occurrence of frost and ice is common during the winter months in the vicinity of the study area. The incidence of frost and ice on the road surface at this location is directly attributable to a combination of: long periods in the winter months when the road surface remains in shadow during daylight hours; the effects of cold air drainage during calm winter nights; and consistently high relative humidity levels due to dense vegetation nearby. Fog is another climatic factor that occurs in the study area during colder months.

Plate 2.1: Typical landform of the study area, viewed from Padleys Pedestal.

Plate 2.3: Narrabeen Group sandstones underline the distinctive escarpment of Hassans Walls.
Figure 2.3: Landform and topography of the study area.

Figure 2.4: Geology and hydrology.
2.2.4 Biodiversity
The vegetation within the study area consists mainly of dry sclerophyll or open woodland on the higher sections on the slopes of the Hassans Walls escarpment where the soils are sandy and well drained. To the south of the Great Western Highway, the woodlands have generally been cleared (except in the gullies) revealing the undulating landforms that are now covered by open grasslands and agricultural land (refer to Figure 2.5).

2.2.5 Heritage
There are a number of items close to the study area that have been identified as having heritage significance (Casey & Lowe, June 2012). These include Forty Bends Road that follows the alignment of Mitchell’s original road and a number of properties (refer to Figure 2.6).

There is one registered Aboriginal archaeological site located within the study area and one adjacent to the study area (Comber Consultants, June 2012). This site was discovered during test excavation of eight Potential Archaeological Deposits (PADs) during December 2011 and January 2012. Sites of Aboriginal cultural significance are also located in the study area (refer to Technical Papers 2 and 3).

2.2.6 Cultural & Scenic Values
Defining the experience of the drive along the Forty Bends section of the Great Western Highway are a number of factors which combine to give the road a unique character and therefore represent a set of values associated with the journey. These values derive mainly from the visual and ecological characteristics of the road corridor and surrounding landscape.

Overall, the visual character of the study area is characterised by a mix of rural/ agricultural and remnant indigenous landscapes to the south, and the imposing Hassans Walls escarpment. Extensive stands of remnant and regenerating trees on both sides of the road corridor are a major feature of the journey and provide a visually pleasant driving experience with opening and closing views extending south and east over the Hartley Valley to the western edge of the Blue Mountains. Much of the motorist’s experience when travelling along the Great Western Highway relies on the ‘borrowed’ landscape outside the road corridor, particularly to Hassans Walls and the varying rural landscape to the south (refer to Figure 2.7).

For much of its length, this section of the Great Western Highway currently consists of a three lane road (one for each direction plus overtaking lane) which in its current configuration, curving horizontal and rolling vertical alignment and adjoining land uses, creates a distinct “country road” character.
Figure 2.5: Ecology of the study area.

Figure 2.6: Heritage values.
2.2.7 Land Use
There are two distinct land uses and settlements adjacent to the study area. To the north, the remnant indigenous vegetation, that is a part of Hassans Walls Reserve dominates. The southern side consists of rural and rural residential properties. The settlement pattern generally reflects the historically central role of the Great Western Highway as many residential properties are located in relatively close proximity to the highway, and on the ridges to the south.

2.2.8 Utilities
The major service utility in the study area is the 132kV transmission line that crosses the Great Western Highway between Daintree Close and McKanes Falls Road and is highly visible as it cuts across the valley in a south easterly direction.

2.2.9 Transport Network
The existing transport infrastructure in the area is dominated by the existing Great Western Highway with a number of local roads providing access to local residents. McKanes Falls Road provides access to the south, linking with Jenolan Caves Road.

Local employment opportunities are provided by agricultural operations, forestry and the mining industry. Some residents travel to the major town centres of Lithgow and Katoomba for employment whilst others commute to Sydney. Consequently, there are many daily local traffic movements within the study area and between the study area and employment centres, including heavy freight vehicle movements.

Figure 2.7: Cultural and scenic values.
3. THE PROPOSAL

3.1 OVERVIEW OF THE PROPOSAL

RMS is proposing to upgrade the Great Western Highway at Forty Bends, approximately 5.5 kilometres south of Lithgow. The proposal would include the realignment of about 2.8 kilometres of the Great Western Highway from a point about 470 metres east of the eastern end of Forty Bends Road to a point about 250 metres west of McKanes Falls Road (the proposal).

- The proposal has been developed based on the concept design that has been prepared using the available information and current design standards and criteria for the Great Western Highway upgrade program. Some elements of the design may be further refined during detailed design. The key elements of the Construction of a new road alignment consisting of generally three lanes with two lanes eastbound to the east of Whites Creek and two lanes westbound to the west of Whites Creek. Lane widths would be 3.5 metres with shoulder widths typically varying between 1.0 metres and 2.5 metres. The upgrade alignment would diverge up to 40 metres south of the existing Great Western Highway in the vicinity of Whites Creek.

- The design speed for the alignment would be 100 kilometres per hour east of McKanes Falls Road and 80 kilometres per hour west of McKanes Falls Road. The posted speed limit for the whole of the new highway alignment would be 80 kilometres per hour.

- Widening of the existing alignment predominantly to the south of the Great Western Highway. The total proposal footprint of the widening works would vary from about 40 metres to 90 metres.

- A central median along the length of the proposal of varying widths, ranging up to 9.5 metres. Carriageways would be separated by a combination of vegetated, depressed and paved medians.

- Construction of new twin, five-span bridges, about 150 metres in length across Whites Creek. The new bridges would comprise four lanes, each 3.5 metres in width, with two lanes carrying traffic in each direction. The total width of the two bridges would be about 30 metres. Shoulders on the bridges would be between 2.5 and 3.25 metres (off-side) and 1.0 metres on the near side.

- Rehabilitation works along the existing alignment of Whites Creek following the removal of the redundant section of the existing Highway. This would include creating a rehabilitated, natural creek bed in this location linking the existing alignment of Whites Creek prior to passing under the new Whites Creek bridge.

- Upgrades to four existing local road intersections, including two intersections with Forty Bends Road, Daintree Close and McKanes Falls Road, to provide connection to the upgraded highway and property access points. Upgrades would include minor widening and u-turn facilities located along the western end of Forty Bends Road and about 150 metres south of the intersection of the Great Western Highway and McKanes Falls Road.

- New or improved access from the existing highway to nine properties along the length of the proposal. The proposal includes provision of new or reconstructed driveways to retain existing property access.

- Closure and relocation of two intersections of Forty Bends Road with the Great Western Highway. These include:
  - Closure of the existing intersection at the eastern end of Forty Bends Road to general traffic (except for emergency vehicles) and a new cul-de-sac constructed on Forty Bends Road.
  - Relocation of the existing intersection at the western end of Forty Bends Road to a point about 200 metres west of the existing intersection.

- Five major cuts 14 metres to 19 metres in height located on the northern side of the proposed alignment.

- Five major fill embankments 10 metres to 15 metres in height located predominantly on the southern side of the proposed alignment.

- Three retaining walls would be required at the following locations:
  - Retaining wall 1 – between approximate chainages 32080 and 32190 (about 110 metres long and up to 7.0 metres high).
> Retaining wall 2 – between approximate chainage 32560 and 32725 (about 165 metres long and up to 5.6 metres high).
> Retaining wall 3 – between approximate chainage 33040 and 33240 (about 200 metres long and up to 7.0 metres high).
> Removal of about 300 metres of redundant Great Western Highway pavement from about 100 metres east of Whites Creek to about 200 metres west of Whites Creek, and associated culvert. This would include rehabilitation works to link this area to the existing alignment of Whites Creek.
> Construction of three temporary and five permanent construction basins in addition to temporary access tracks along the length of the proposal.
> Construction of nine new culverts along the length of the proposal to manage cross-drainage flows and six new culverts across access roads and service roads as part of the proposal. One existing culvert would be retained at the western end of the proposal. A total of 23 existing drainage culverts under the Great western Highway would be either decommissioned or removed.
> Measures to mitigate the formation of black ice, including the relocation of the road alignment to the south away from the Hassans Walls escarpment in key locations and an active maintenance program.
> A main compound site located east of the western end of Forty Bends Road, in addition to smaller stockpile areas along the length of the proposal during construction.
> A combination of wildlife crossing structures, which would include three fauna underpasses (box culverts), canopy rope bridges at Whites Creek and the western underpass and glider poles located at Whites Creek and near the western fauna underpass.
> Relocation and/or temporary diversion of existing underground utilities including water, powerlines and telephone cables.
> Construction of 9 new culverts along the length of the proposal to manage cross-drainage flows. One existing culvert would be retained at the western end of the proposal and a total of 23 existing drainage culverts would be either decommissioned or removed.
> Measures to mitigate the formation of black ice, including the relocation of the road alignment to the south away from the Hassans Walls escarpment in key locations and an active maintenance program.
> A main compound site located east of the western end of Forty Bends Road, in addition to smaller stockpile areas along the length of the proposal during construction.
> A combination of wildlife crossing structures, which would include two fauna underpasses (box culverts), canopy rope bridges at Whites Creek and glider poles located at Whites Creek and near the western fauna underpass.
> Relocation and/or temporary diversion of existing underground utilities including water, powerlines and telephone cables.

### 3.2 LANDSCAPE AND URBAN DESIGN WORKS

In addition to the key engineering works previously outlined, the following landscape and urban design works would be undertaken as part of the proposal:

> Clearing of existing roadside trees and other vegetation in some locations to provide adequate space for the proposed road widening works;
> Landscape revegetation works, including trees, shrubs and groundcovers to medians, cut and fill batters, roadside areas, and water quality basins;
> Construction of three new retaining walls on the northern side of the highway;
> The installation of urban design elements such as wire rope barriers, fencing and signage.
4. LANDSCAPE AND URBAN DESIGN STRATEGY

4.1 OVERVIEW

In any road upgrade proposal, the experience of the road user and viewer is significantly improved through careful consideration of all design disciplines and elements. In urban design, it is important that design objectives are identified, developed and implemented, in relation to the intervention of the road in the landscape and the suite of roadside elements that require careful design. These elements include cut and fill batters, walling, drainage structures, bridges, fences and barriers, planting and landscaped surfaces.

The objectives reflect the most important goals to be achieved as a result of the proposal, taking into account not only the corridor itself but also its relationship with surrounding areas. These would be implemented in accordance with the RMS document Beyond the Pavement (RMS 2009) performance themes of safety, cost effectiveness and sustainability.

4.2 URBAN DESIGN VISION

The following vision statement articulates the desired outcome for the proposal.

The planning and design of the highway upgrade aims to respond to its rural context, retaining a driving experience that facilitates the appreciation of the unique landscape within and beyond the road reservation.

4.3 URBAN DESIGN OBJECTIVES AND PRINCIPLES

Based on the landscape character and visual impact assessment in Chapters 6 and 7, and the context of the urban design vision outlined above, the following urban design objectives and corresponding principles have been identified:

**Objective 1: Protect and enhance existing views, character, heritage and cultural values of the corridor.**

- Retain and reinforce the unique landform and landscape character of the route.
- Maintain and enhance key heritage and cultural landmarks along the route.
- Retain existing view corridors, particularly at elevated points, to establish a sense of place for the journey along the Great Western Highway.
- Control the placement of any utilities in the corridor and locate underground where possible to enhance views and maximise planting opportunities.

**Objective 2: Provide a flowing road alignment that is responsive to, and integrated with the natural and built landscape.**

- Physically, and where possible, visually separate carriageways to reduce horizontal scale and perceived road corridor width: utilise medians and verges to maximise retention of existing trees, revegetation potential and break up wide pavement surfaces.
- Devise a planting / revegetation strategy that takes into account the long-term visual quality and biodiversity of the areas adjoining the proposal.
- Protect creeks and creek banks by maximising tree retention and planting at creek crossings.
- Minimise the size of water quality basins and site in locations where it is feasible for basins built during construction to remain post construction.
Objective 3: Develop a simple and unified palette of elements and details that are attractive, easily maintained and fits sensitively into the specific landscape character of this area.

- Standard road elements may include road furniture (safety barriers, pedestrian and shared path fencing, bus stops, street lighting, signage) retaining walls, shared paths, bridges and noise walls.

4.4 URBAN DESIGN AND LANDSCAPE ELEMENTS

The types of urban design and landscape elements required for this proposal are:

- Bridge structure and fill embankments where the new highway would be situated above the existing ground, requiring the road to be elevated.
- Cuttings and retaining walls where the new highway would be situated below the existing ground, requiring excavation.

In particular, some principles have been developed for the following elements which are to be utilised in this proposal:

Retaining Walls

- The use of retaining walls should be minimised wherever possible. Only use walls if there is insufficient land or where geological instability restricts the use of natural cuttings. Wall finishes should be appropriate for the particular area where they are proposed. Refer to the summary table for details of proposed retaining walls.

Bridges

- Provide simple and elegant structures designed in accordance with the RMS Bridge Aesthetics Guidelines.
- Disturbance to the creek bed and riparian vegetation zone should be minimised; maximise natural light levels beneath the bridge; and locate bridge superstructure away from the creek.
- Ensure that a neat and simple transition is provided between the bridge rail and the road safety barrier.

Plate 4.6: Simple and elegant bridge structure with rock abutments (photo RMS).
Culverts
> Provide concrete headwalls and wing walls with horizontal banding.
> Where possible provide steel grating within the median to allow natural light to reach the watercourse. Allow for fish and fauna passage where required.
> Place large boulders in a random formation around culverts to reduce embankment scour and improve visual character.

Water quality structures and drainage channels
> Basins should be designed and shaped so that they would resemble farm dams to help integrate them into the existing agricultural setting.
> Basins required during construction only should be decommissioned and revegetated once they are no longer required.
> Drainage channels should be designed to visually integrate with their surroundings. Those at the top of cutting benches should be rock lined while visible roadside channels and channels in the median should be vegetated.

Fencing
> Maintain a consistent scale and rhythmic use of fencing elements.

Lighting Fixtures
> Generally limit lighting to major intersections and points of interest only to retain the rural nature of the road corridor.

Ecology
> Retain existing woodland planting where possible.
> Use endemic species on batters to compliment existing vegetation batters and reduce the visual impact of earthworks.
> Reinstate disturbed areas of riparian vegetation where possible. Maximise riparian vegetation under watercourse crossings to encourage fauna connectivity.
> Adhere to ecological requirements outlined in specialist reports.

Landscape Treatments
> Lay back the top batter of cuttings and tie back into the existing landform. Revegetate the top of the profile to blend with the existing landscape.
> Provide additional tree planting to both sides of the highway to reinstate the enclosed woodland character of the corridor. Provide breaks in the planting to allow views over the rolling pasture lands.
> Provide frangible planting within clear zones.
> Provide planting in the medians to break up the expanse of hard surface and reduce headlight glare.

Plate 4.7: Rock lined drainage channel. Provide dark grey colour to concrete mix. (photo RMS).
4.5 URBAN DESIGN AND LANDSCAPE RECOMMENDATIONS

The urban design and landscape recommendations are as follows:

Summary of retaining walls and proposed finishes.

<table>
<thead>
<tr>
<th>REFERENCE NUMBER</th>
<th>START STATION</th>
<th>DESCRIPTION</th>
<th>LENGTH (m)</th>
<th>MAX. HEIGHT (m)</th>
<th>PROPOSED WALL TYPE (STRUCTURAL)</th>
<th>RECOMMENDED FINISH</th>
</tr>
</thead>
<tbody>
<tr>
<td>RW52 32080</td>
<td></td>
<td>Wall in cut above eastbound verge at Forty Bends Road / Daintree Close intersection.</td>
<td>110</td>
<td>7</td>
<td>Soldier pile wall</td>
<td>Rock type finish that blends with the landscape. Design of retaining wall and material to be confirmed during detailed design. Where space permits, revegetate between the toe of the wall and the roadway to reduce wall visibility.</td>
</tr>
<tr>
<td>RW53 32560</td>
<td></td>
<td>Wall in cut above eastbound verge.</td>
<td>164</td>
<td>6</td>
<td>Soldier pile wall</td>
<td>Rock type finish that blends with the landscape. Design of retaining wall and material to be confirmed during detailed design. Where space permits, revegetate between the toe of the wall and the roadway to reduce wall visibility.</td>
</tr>
<tr>
<td>RW53 33040</td>
<td></td>
<td>Wall in cut above eastbound verge at McKanes Falls Road intersection.</td>
<td>200</td>
<td>7</td>
<td>Soldier pile wall</td>
<td>Rock type finish that blends with the landscape. Design of retaining wall and material to be confirmed during detailed design. Where space permits, revegetate between the toe of the wall and the roadway to reduce wall visibility.</td>
</tr>
</tbody>
</table>

Plate 4.8: Existing gabion wall filled with basalt at the side of the highway. Weldmesh (steel) baskets would provide a neater finish than the wire baskets shown here.
Revegetation.

Revegetation works would reinforce the existing vegetation communities as identified in the Great Western Highway Upgrade Mount Victoria to Lithgow Alliance, Corridor Study - Biodiversity (Mount Victoria to Lithgow Alliance, October 2011).

<table>
<thead>
<tr>
<th>MAP UNIT</th>
<th>COMMUNITY</th>
<th>CANOPY SPECIES</th>
<th>DOMINANT SHRUB SPECIES</th>
<th>COMMON GROUNDCOVER SPECIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAP UNIT 1</td>
<td>Blaxland’s Stringybark - Mountain Gum Open Forest</td>
<td>Eucalyptus blaxlandii, Eucalyptus cypellocarpa</td>
<td>Persoonia linearis, Bursaria spinosa subsp. lasiophylla, Lomatia myricoides, Leptospermum polygalifolium</td>
<td>Poa sieberana, Pterostylis reflexa, Acianthus exsertus, Gonocarpus tetragnus, Hardenbergia violacea</td>
</tr>
<tr>
<td>MAP UNIT 2</td>
<td>Silvertop Ash Open Forest</td>
<td>Eucalyptus sieberi</td>
<td>Podolobium illicifolium, Persoonia linearis, Leucopogon lanceolatus, Hibbertia obtusifolia, Daviesia ulicifolia</td>
<td>Joycea pallida, Poa sieberana, Dianella revoluta, Lamandra glauca, Stackhuisia manogyna, Billardiera scandens</td>
</tr>
<tr>
<td>MAP UNIT 3</td>
<td>Ribbon Gum Grassy Woodland</td>
<td>Eucalyptus viminalis</td>
<td>Acacia melanoxylen, Pteridium esculentum, Persoonia linearis</td>
<td>Poa sieberana, Themeda australis, Austrodanthonia spp., Hydrocotyle laxifolia, Microlaena stipoides</td>
</tr>
<tr>
<td>MAP UNIT 4</td>
<td>Modified Habitats</td>
<td>To match existing species if significant, otherwise plant species to match adjacent Map Unit.</td>
<td>To match adjacent Map Unit species.</td>
<td>To match adjacent Map Unit species.</td>
</tr>
</tbody>
</table>

Summary of twin bridges over Whites Creek.

<table>
<thead>
<tr>
<th>START STATION</th>
<th>LENGTH OF DECK (m)</th>
<th>NUMBER OF PIER</th>
<th>MAX. PIER HEIGHT (m)</th>
<th>ALLOWED FOR IN STRUCTURAL DESIGN</th>
<th>FURTHER URBAN DESIGN RECOMMENDATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TWIN BRIDGES OVER WHITES CREEK</td>
<td></td>
<td></td>
<td></td>
<td>GIRDERS TYPE</td>
<td>PIER TYPE</td>
</tr>
<tr>
<td>31.660</td>
<td>150</td>
<td>4</td>
<td>15</td>
<td>Blade pier with integrated headstock. Pier and headstock 1700mm wide.</td>
<td>Spill through at both abutments. Provide stone pitching to the spill through abutments, preferably using rock excavated from the site, otherwise use a grey basalt rock.</td>
</tr>
</tbody>
</table>

URBAN DESIGN STRATEGY