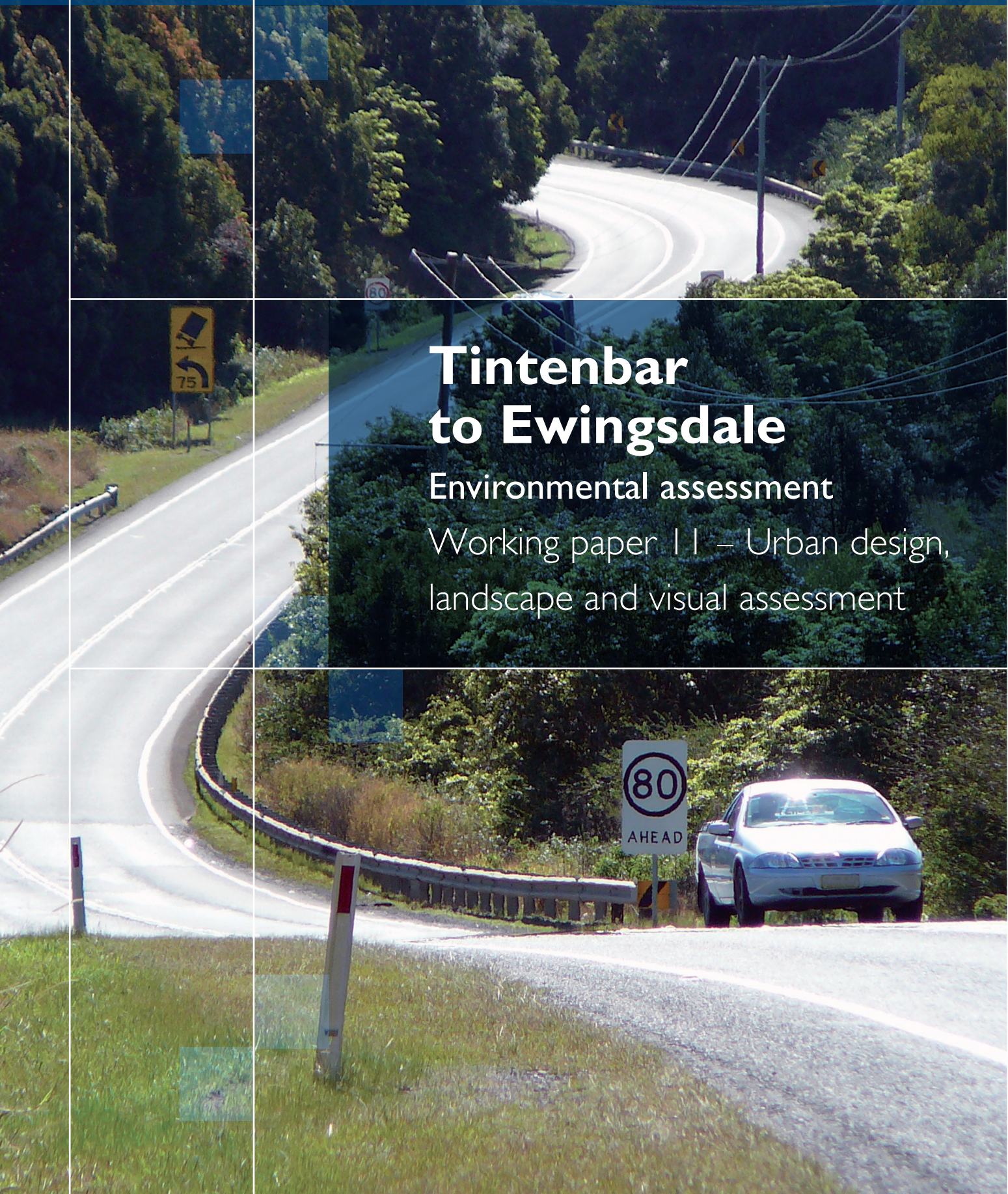




Tintenbar to Ewingsdale

Environmental assessment

Working paper I I – Urban design,
landscape and visual assessment



Working Paper 11
Urban Design, Landscape and Visual Assessment

Prepared for the

NSW Roads and Traffic Authority

Pacific Highway Upgrade
Tintenbar to Ewingsdale

By

SPACKMAN  **MOSSOP**

Rev 07

10 June 2008

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REPORT STRUCTURE AND EXECUTIVE SUMMARY

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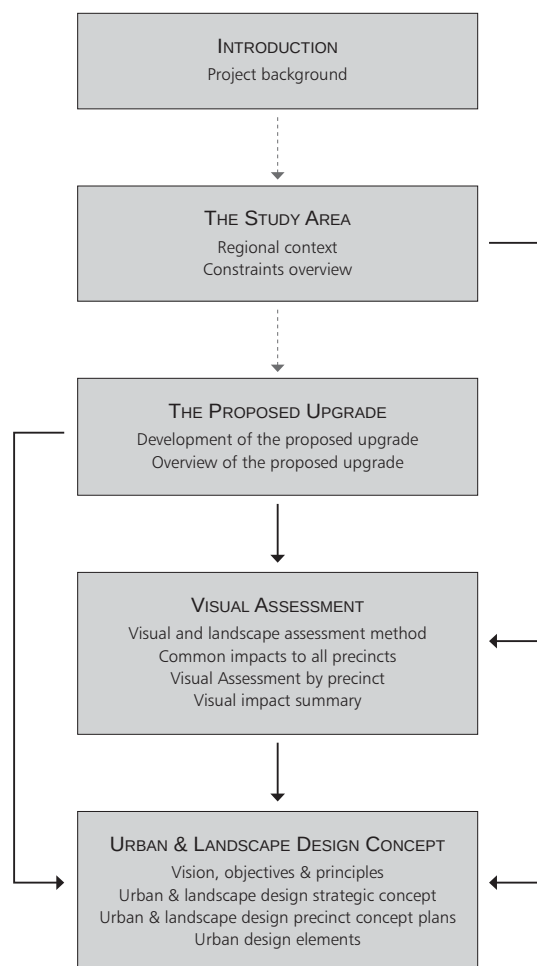
This "Urban Design, Landscape and Visual Assessment" working paper has been prepared by Spackman & Mossop, as part of the environmental assessment of the proposed upgrade of the Pacific Highway between Tintenbar and Ewingsdale. Spackman & Mossop were commissioned by ARUP on behalf of the RTA and are one of a range of subconsultants contributing to the environmental assessment of the proposed upgrade.

This working paper specifically addresses the visual and landscape issues associated with the proposed upgrade, by undertaking a visual assessment of the proposed upgrade and providing urban and landscape design directions for future stages of the proposed upgrade. In doing so, it has incorporated the Director General's requirements for the visual assessment component of the environmental assessment, as well as feedback received from the RTA's urban design section.

This working paper has been divided into the following sections (refer to flow chart "Report Structure"):

1. Introduction
2. The Study Area
3. The Proposed Upgrade
4. Landscape and Visual Impact Assessment
5. Urban and Landscape Design Concept

More detail on these sections and respective key findings is provided on the following pages.



*Flow Chart 1:
Structure of the "Urban Design, Landscape
and Visual Assessment" working paper*

1. Introduction

The "Introduction" gives a brief overview of the background to this working paper and the proposed upgrade of the Pacific Highway between Tintenbar and Ewingsdale. It further defines the study area for this working paper.

Key Findings

The decision to upgrade the Pacific Highway between Tintenbar and Ewingsdale dates back to 1996, when the NSW and Federal Government made a joint commitment to upgrade the remaining sections of the Pacific Highway to a four lane, dual carriageway road.

The detailed planning for the project commenced in 2004, and Spackman & Mossop were engaged by ARUP on behalf of the NSW Roads and Traffic Authority (RTA) to undertake urban and regional landscape design and visual assessment services. The design for the proposed upgrade was developed since then, through an iterative planning process involving a wide range of specialist consultants, government agencies and community stakeholders.

2. The Study Area

This section places the study area in its regional context and provides an overview of the study area, by describing existing conditions including the area's landform, vegetation and settlement patterns. This is followed by an overview of constraints to the proposed upgrade of the Pacific Highway. These include statutory constraints provided by the policy and legislative framework and the landscape and visual constraints arising out of the existing conditions of the study area.

Key Findings

The study area is located in the Northern Rivers region of New South Wales. It is an area widely appreciated for its high scenic quality and visual diversity, including by locals and visitors to the area. Set against a backdrop of coastal plains, local coastal ranges such as the elevated plateau that dominates much of the study area provide the dominant visual feature in the landscape. The dramatic landform of the study area combines with its long agricultural history and limited levels of urban development to create a varied scenic landscape of high lifestyle and (eco) tourism value which continues to attract growing numbers of people to live and visit.

The highly scenic character of the study area, its relaxed lifestyle and the importance of tourism to the local economy result in a high level of sensitivity with regard to any proposed changes to the landscape.

The landform, vegetation and settlement patterns of the area further combine to define the visual and landscape constraints to the proposed upgrade. These include the land use, settlement and circulation patterns which influence the perception of viewers likely to see the proposed upgrade, and the interplay between the landform and vegetation cover which determines the degree to which the proposed upgrade will be able to be seen, based on its elevation relative to other parts of the study area and the degree to which it would be concealed by vegetation.

Statutory constraints to the proposed upgrade are provided in the recognition of the importance of the scenic escarpment through its inclusion in a scenic protection zone in both the Byron Bay and Ballina Local Environmental Plan.

3. The Proposed Upgrade

This section provides an overview of the major features of the proposed upgrade of the Pacific Highway between Tintenbar and Ewingsdale. They are the proposed alignment, proposed interchanges or changes to existing interchanges and changes to local vehicular access and circulation. The section further includes a brief overview of the process of developing the design.

Key Findings

The proposed upgrade would replace the existing two-lane highway and provide a new alignment for the Pacific Highway between Tintenbar and Ewingsdale that is completely independent from the existing highway. The existing highway would be retained as a local access route.

Commencing at the Ross Lane interchange (proposed to be constructed as part of the Ballina bypass project), the proposed upgrade would follow a gently meandering alignment through the undulating agricultural plateau, remaining in relatively close vicinity to the existing highway for much of its route. The exception would be the section between the existing Bangalow bypass and St Helena Road, where the proposed highway would run through the Tinderbox Valley significantly to the east of the existing highway. The proposed upgrade would pass under a tunnel in the St Helena ridge before emerging alongside the existing highway on the

Ewingsdale spur. It would join the existing dual carriageway at the Ewingsdale interchange.

The proposed upgrade would involve the construction of one new interchange at Ivy Lane, as well as modifications to existing interchanges at Ross Lane, Bangalow and Ewingsdale. A number of local access roads would be required to re-connect properties with the existing highway, where current direct access to the highway would be lost. Generally speaking this would affect properties on the western side of the existing highway between Ross Lane and Emigrant Creek and north of St Helena Road, and properties on the eastern side of the existing highway between Emigrant Creek and the Bangalow interchange. Properties along the existing highway north of the Bangalow interchange would not be affected.

4. Landscape and Visual Impact Assessment

This section is dedicated to the assessment of the likely visual impact of the proposed upgrade on the visual environment of the study area. A detailed visual assessment method was developed for the project, based on common visual assessment practice and adapted for the particular conditions of the study area. Adaptations specifically related to the development of a method which would permit assessment in a quantitative manner, in order to provide a frame of reference to the highly individualistic nature of visual perception which often leads to differing opinions with regard to the degree of visual impact.

The description of the visual assessment method is followed by an assessment of the likely visual impact of the proposed upgrade. The study area was divided into five precincts which roughly correspond to visual catchments along the proposed upgrade. The precincts are Knockrow, Emigrant Creek, Bangalow, Tinderbox Creek Valley and Ewingsdale. Following a brief discussion of common impacts across the study area (including temporary visual impacts), the visual assessment is presented on the basis of these largely visually contained precincts. This has enabled the working paper to focus on local issues and discuss the proposed upgrade at a greater level of detail than would otherwise be possible.

The assessment includes a description of the existing character of each precinct, a detailed description of the works associated with the proposed upgrade of the Pacific Highway and the visual assessment of these works consisting of a discussion of the visual effect of the proposed works, the visual sensitivity of viewers and the resulting likely visual impact.

The detailed discussion of the precincts is followed by a summary of the visual impact which gives consideration to the cumulative effects of the proposed upgrade across all precincts and in terms of the scenic and landscape qualities of the study area.

Key Findings

Based on the outcomes of the quantitative assessment, the visual impact of the proposed upgrade on the various precincts in the study area ranges between 'moderate' (Knockrow, Emigrant Creek and Ewingsdale precincts) and 'moderate to high' (Bangalow and Tinderbox Creek Valley precinct). These ratings reflect the corresponding local conditions, the scale of the proposed road infrastructure and the extent of visibility from surrounding viewpoints within each precinct's setting. They further provide a good indication of the physical magnitude of the proposed upgrade and of the number and kinds of viewers.

However, the quantitative focus of the assessment does not fully reflect the likely visual impact on the existing highly scenic and intricate landscape pattern. Further, it does not address the cumulative impact of the proposed upgrade on the study area as a whole.

Considering the overall visual effect of the proposed upgrade on the nature of the landscape in the study area, it is likely that the proposed upgrade will remain a dominant feature in the landscape, with mitigation measures only partially able to mitigate its large scale. Combined with the area's acknowledged scenic qualities, its growing popularity as a place to live and visit and the resulting high visual sensitivity of viewers, the cumulative visual impact of the proposed upgrade is likely to be in the high to moderate range.

5. Urban and Landscape Design Concept

The urban and landscape design concept outlines a series of measures to integrate the proposed upgrade into the visual and landscape setting of the study area, with the aim of making a positive contribution to the landscape through which the proposed upgrade passes. A key feature of this is the identification of urban and landscape design measure that will assist in the reduction of the identified visual impacts associated with the proposed upgrade. In order to achieve this, an overall urban design vision and urban and landscape design principles and objectives are developed for the proposed upgrade, based on the RTA's *Pacific Highway Urban Design Framework*, and the existing conditions of the study area.

These are followed by the urban and landscape design concept which consists of several components:

- > **the urban and landscape design strategic concept**, addressing issues of landmarks (both natural and constructed features), corridor landscaping and the location and degree of importance, from an urban design and visual point of view, of major road infrastructure elements such as bridges, overbridges, tunnel portals and noise walls.
- > **an urban and landscape design concept plan for each visual assessment precinct**, outlining key issues for consideration in future design stages as well as specific design recommendations for various points along the route. These are informed by the findings of the visual impact assessment.
- > a discussion of **urban design elements**, providing design principles for the further development and detailed design of elements including bridges, overbridges, tunnel portals and noise barriers.

All components of the urban and landscape design concept address the experience of the motorist on the proposed upgrade as well as the experience of viewers in the study area.

Key Findings

The urban design vision for the proposed upgrade is provided by the RTA's *Pacific Highway Urban Design Framework*:

"A sweeping, vegetated highway, providing panoramic views to the Great Dividing Range and the rivers, forests, farmlands, and coastline of the Pacific Ocean. Sensitively designed to fit into the landscape and be unobtrusive. Characterised by simple, attractive road infrastructure."

The strategic concept identifies the following features as major landmarks along the proposed upgrade: the coastal plains, the St Helena ridge, the Byron Creek floodplain, 'Arundel', the Emigrant Creek crossing, the Knockrow escarpment and the Ross Lane escarpment.

Major road infrastructure elements identified by the strategic concept include interchanges and new intersections, major cuttings, bridges, overbridges, tunnel portals and noise barriers. They represent the most visible components of the proposed upgrade, as far as viewers in surrounding areas are concerned. Their detailed design will therefore make an important contribution to the way in which the proposed upgrade will be perceived by viewers in the study area. Further, a number of these elements are also situated in identified landmark locations along the route, rendering their design

resolution even more important from an urban design and visual point of view.

This is reflected by a 'design hierarchy' developed for road infrastructure elements. The most important elements from an urban and visual point of view are the bridges across Emigrant and Byron Creeks, the tunnel portals in the scenic escarpment, the noise barriers near Bangalow and on the exposed Ewingsdale spur and the major cutting through 'Arundel'.

The corridor landscape strategy outlined in the strategic concept builds on the existing pattern of planting, natural vegetation and open landscapes in the study area, to create a rhythm of open and enclosed landscapes along the proposed upgrade that provide an interesting experience for the motorist and respect prevailing landscape patterns, thereby reducing the level of visual contrast between the road corridor and the surrounding landscape.

In terms of the detailed urban and landscape design concept plans prepared for each visual assessment precinct, each precinct presents a number of individual challenges and associated specific design recommendations. However, there are a number of key infrastructure items as well as a number of recurring issues which, from an urban design and visual point of view, would justify a design review and/ or require careful design consideration during the next design stages:

Key Infrastructure Items

> **Tunnel (and portal) design**

The tunnel under the St Helena ridge is prominently located in the side of the scenic escarpment and represents a major landmark. The current proposal involves major excavation of the natural hillside and is likely to require major engineering works to stabilise cutting faces. This outcome is not sympathetic to the identified visual significance of the scenic escarpment and its landmark status along the proposed upgrade. Consideration should therefore be given to reviewing the tunnel design with the aim of increasing the length of the tunnel. This would reduce the scale of excavation works and associated hard engineering measures which in turn would significantly reduce the visual impact of the tunnel portals.

> **Bridge design**

The bridges along the proposed upgrade will be large and important structural elements with the potential to significantly influence the perception of the visual impact of the proposed upgrade as a whole. Developing detailed designs (including construction methods) that result in refined, transparent and elegant structures reflective of the highly scenic nature of the study area will therefore be of great importance. The most desirable outcome would be

one of a consistent approach to bridge design and construction along the route, ideally featuring a haunched design with a minimal number of spans. This may also result in less environmental disturbance due to longer spans and fewer piers, and may prove economically competitive and justifiable due to continuity advantages.

If this approach is not considered to be feasible, it will be important for bridge design and construction to correspond to the degree of visual and urban design importance identified in the strategic concept. The visually most important bridges are those at Emigrant Creek and Byron Creek, followed by 'Yarrenbool Place' and then at Skinners Creek and Tinderbox Creek. Prioritising design and expenditure in this way would ensure that the more prominent bridges and those in major landmark locations reflect the importance of their setting.

> Noise barrier design

Limited information on the design details of noise barriers was available at the time of this working paper, in particular with regards to the exact length, height and location relative to the proposed upgrade. However, as noise barriers in a predominantly rural environment and one as scenic as the elevated plateau are likely to be perceived as highly unusual, the design of noise barriers should aim to reduce their visibility as much as possible, in order for the landscape to remain the dominant visual feature. This could be achieved through densely landscaped earth mounds or hard engineering structure such as a vertical noise walls, provided the later would be accompanied by dense planting on both sides.

Recurring Design Issues

> Reduce the visual impact of parallel areas of hard pavement

Several locations along the proposed upgrade feature a large number of parallel roadways, including around the Ross Lane, Bangalow and Ewingsdale interchange. The large amount of parallel hard pavement areas would create a high level of contrast with the rural nature of the study area. Planting, including planting of trees and shrubs, between the separate roadways should be maximised, in order to visually break up the area of hard pavement visible from any one area or viewpoint and thereby reduce its visual impact.

Further, road design development should seek to minimise hard paved areas as much as possible, in particular where pavement would only be required in the case of future road widening or the potential provision of additional traffic movements at intersections in the future. In shoulders, consideration should also be given to the use of alternative materials and/ or textures that reduce the width of the uniform driving surface.

> Vertically independent carriageways

The north and southbound carriageway of the proposed upgrade in its current form are designed to be parallel, in terms of both their vertical and horizontal alignment. The urban and landscape design concept plans identify a number of locations with the potential to provide vertically independent carriageways. Generally, these are sections of the proposed upgrade between major infrastructure elements such as bridges which would require the carriageways to be at the same elevation.

Vertical separation of carriageways offers the potential to reduce the motorway character of the proposed upgrade, reducing the potential visual effect of the proposed upgrade and providing a more diverse and interesting driving experience. It further has the potential to reduce the need for cut and fill along the route, by matching individual carriageway levels more closely to the natural landform.

> Shaping of cuttings and embankments

The proposed upgrade involves a large amount of earthworks along much of the route and which contribute to the identified visual effect and visual impact. In particular cuttings have a potentially great visual impact, as their shape is frequently observed silhouetted against the skyline. A sharply defined edge would contrast strongly with the gently rolling character of the natural landscape, and cuttings should therefore be shaped in a way that reduces this contrast and allows cuttings to tie with the natural shape of the landscape.

Similarly, embankments should be 'graded out' at the bottom, to reduce the visual impact of an obvious junction between fill embankments and the natural landform.

Combined with the establishment of vegetation over time, this will assist in reducing the 'artificial' character of cuttings and embankments.

> Cutting and embankment stabilisation/ revegetation

In addition to the shape of cuttings and embankments, their successful long term stabilisation and revegetation will be a critical factor influencing the character of the proposed upgrade and the degree of contrast between the road corridor and the surrounding landscape.

Consideration should be given to the angle of cutting and embankment slopes with regard to short and long term soil stability, the potential for plants to successfully establish and long term maintenance (issues include mulch or small rocks being washed onto the road pavement). Close liaison with geotechnical specialists is recommended in order to identify the need for and best means of soil stabilisation to ensure good long-term vegetation cover.

> Protect the character of the existing highway

There are a number of locations along the proposed upgrade where the proposed road reservation abuts the existing highway alignment and where construction activities may impact on existing established roadside vegetation, including boundary hedges, avenues and other stands of trees. Retaining and protecting roadside vegetation along the existing highway is important from the point of view of minimising the degree of visual change associated with the proposed upgrade and in maintaining the attractive driving experience along the existing highway, for both locals and visitors to the area. Detail design and construction works should therefore aim to maximise the retention of this vegetation and, where this is not possible, reinstate vegetation following completion of the works. Reinstated vegetation should be of sufficiently established size to compensate for the loss of roadside vegetation in the short term.

> Severed plantations

Plantations and in particular macadamia plantations, are a defining feature of the study area's visual and landscape character. The retention of stands of macadamia trees should therefore be maximised as much as possible. The issue arises where existing plantations are being severed by the proposed upgrade, leaving isolated stands of established trees that are nevertheless not directly affected by the construction of the proposed upgrade. Retaining such stands of trees is especially important within a context of aiming to reduce the degree of visual change in parts of the landscape not directly affected by the construction of the proposed upgrade.

While the issue of residual lands and their future uses is addressed in a separate working paper, continuing discussions with affected and neighbouring land business owners would be important from a visual point of view, in order to maximise the degree to which the existing visual landscape character can be retained.

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1. introduction

PROJECT BACKGROUND

2

In 2004, Spackman & Mossop were commissioned by ARUP on behalf of the RTA to provide Urban and Regional Landscape Design and Visual Assessment services for the Pacific Highway Tintenbar to Ewingsdale upgrade Project.

The project involved the identification of constraints to upgrading the Pacific Highway in the study area, the identification and preliminary assessment of a number of route options, and the selection of a preferred route. This working paper represents the final stage in the route selection phase which is the environmental assessment of the proposed upgrade.

This working paper contains the visual impact assessment of the proposed upgrade and includes an urban and landscape design concept to integrate the proposed upgrade with the landscape of the study area.

The Pacific Highway provides the major component of the principal national highway link between Sydney and Brisbane and the many coastal communities in between. From its beginning at Hexham near Newcastle and its end at Tweed Heads on the Queensland border, it consists of some 700 kilometres of road which traverse a highly varied and scenic landscape, characterised by its location between the eastern seaboard and the Great Dividing Range. It passes a large number of coastal communities many of which provide popular holiday destinations, as well as passing through natural bushland areas, floodplains and varied agricultural landscapes which include pastures and many different crop plantations. Occasionally, spectacular glimpses to the Pacific Ocean open up along the route.

In 1996, the NSW and Federal Government announced their joint commitment to upgrade the Pacific Highway to provide a double-lane divided road. The upgraded Pacific Highway will reduce travel times, meet increasing traffic demand and provide for safer travel along the route. Investigations into upgrading the Pacific Highway between Tintenbar and Ewingsdale commenced in 2004. Since then, a preferred route for the proposed Highway upgrade was developed through an iterative planning process involving a range of specialist consultants, government agencies, communities, community groups and individuals. The urban design and visual assessment advice provided throughout this process project has contributed to the selection of the preferred route for the proposed Pacific Highway upgrade in the study area (the proposed upgrade).

This "Urban Design, Landscape And Visual Assessment" working paper has been prepared by Spackman & Mossop as part of the Environmental Assessment of the proposed upgrade of the Pacific Highway between Tintenbar and Ewingsdale. It addresses the Director-General's requirements for the environmental assessment of the proposed upgrade, prepared under Section 75F of the *Environmental Planning and Assessment Act 1979*.

The working paper presents an overview of the general visual and landscape issues and constraints which were identified in the process of developing the proposed upgrade. This is followed by a detailed urban design, landscape and visual assessment of the proposed upgrade, based on a number of site visits and field investigations and complemented by a review of relevant literature and the analysis of 2004 aerial photographs and topographic maps.

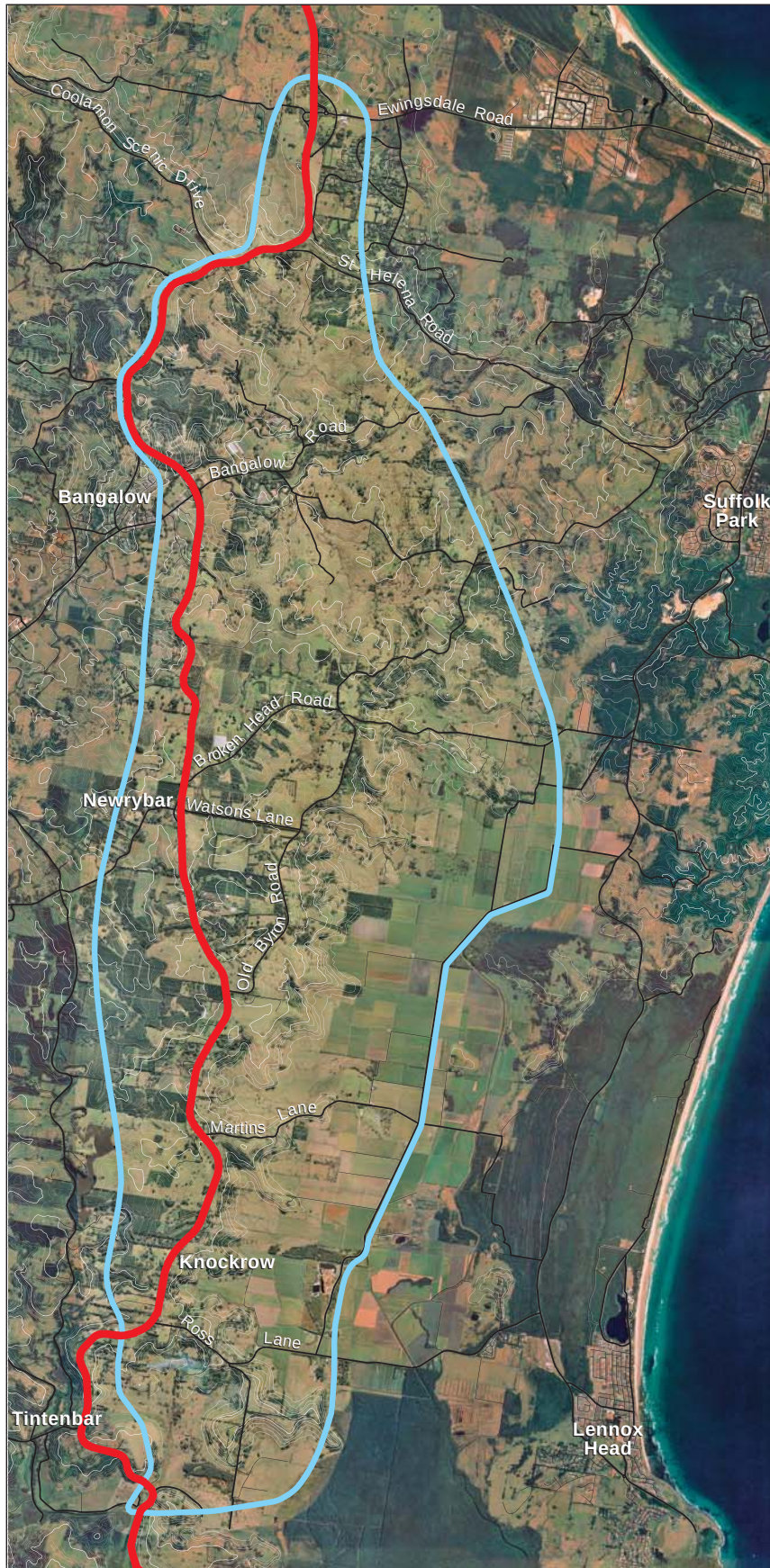


Illustration 1:
Study Area for the proposed upgrade of the Pacific Highway between Tintenbar and Ewingsdale

2. the study area

REGIONAL CONTEXT

6

The study area for the Pacific Highway upgrade, Tintenbar and Ewingsdale is located on the NSW North Coast, in the region centred around Lismore and commonly known as the Northern Rivers. The Northern Rivers Region stretches from the Clarence River to the Queensland border, and from the coastline to the foothills of the Great Dividing Range (refer Illustration 2). The study area is contained in the northern half of the Region, between Ballina in the south and Byron Bay in the north, both of which are important regional centres, in terms of population numbers as well as in terms of the range of services and facilities they offer.



Illustration 2
The Northern Rivers Region of NSW

The Northern Rivers Region contains a wide array of natural features which contribute to the high scenic qualities and diversity for which it is appreciated by locals and visitors alike. They include the coastal landscapes of beaches and rocky headlands, the broad meandering coastal rivers for which the region is named, and rugged rainforest mountain ranges such as the Night Cap Ranges, Mt Warning and the Border

Ranges, which have been included on the World Heritage List since 1986.

Of these features, Mt Warning (refer Illustration 3), named by James Cook in 1770, as a warning to seafarers of the numerous treacherous reefs along the coast, provides the major scenic landmark feature in the region around the study area. It can be widely seen from within the study area as well as from the surrounding hills and coastline.

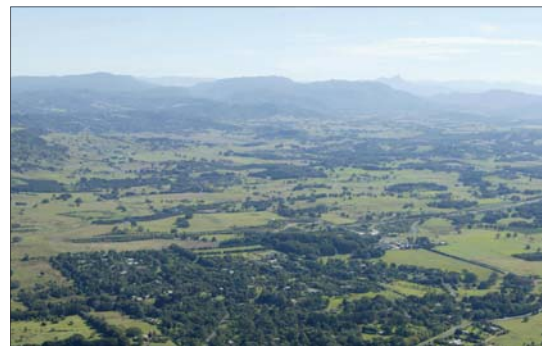


Illustration 3
Ewingsdale, the Coastal Flats and Mt Warning in the Background

South of Murwillumbah and in the study area, the Great Dividing Range recedes from the coast, relative to other parts of Eastern Australia (refer to Illustration 4). Because of this, local coastal ranges and headlands become the prominent elevations in the area, acting as major landscape features. Examples of these include ranges and coastal headlands such as Brunswick Heads, Cape Byron, Broken Head and the escarpment within the study area which forms the edge of a plateau elevated above the coastal plains in the hinterland of Byron Bay.



Illustration 4
Regional Topographic Map of north-eastern NSW

The escarpment dominates much of the study area, both physically, by providing a relatively sudden drop in elevation, and visually, by providing visual containment to the coastal landscape. Views from these prominent land forms are as important as views of them.

While the image of the Lighthouse on Cape Byron is the landscape icon for the area (refer Illustration 5), the views from Cape Byron and the escarpment over the coastal hinterland, the mountain ranges including Mt Warning and the sweeping curve of the coastline of Byron Bay are memorable images of this scenic area (refer to Illustrations 6 and 7 respectively).

From its earliest settlement associated with timber getting, dairying and whaling, to farming for sugar cane, tropical fruits and nuts, coffee and tea, and the more recent development of an eco-tourism industry, the region's development owes much to its varied natural landscape features and scenic character. Together with the area's relaxed country lifestyle, the scenic nature and recreational potential of the natural environment continue to attract large numbers of people to the area, both in terms of visitors and new residents.

This has created a rich and diverse culture which manifests itself in the many local artists such as film makers, poets, musicians and writers, as well as a variety of festivals and performances. It is further complemented by the recent establishment of a knowledge-based industry focusing on education, science and research.

The new establishment of this kind of industry is typically successful in areas characterised by high lifestyle values, drawing on them to continue to attract people away from bigger centres. It is for these values, including environmental, and community values, that the area is well known and appreciated.



Illustration 5
Cape Byron Lighthouse



Illustration 6
The Bay as seen from Bangalow Road on the Escarpment



Illustration 7
The Bay and Hinterland as seen from Cape Byron

DESCRIPTION OF THE STUDY AREA

8

The highly scenic character of the Byron Bay hinterland combined with the importance of tourism in this section of the North Coast, makes the proposed upgrade of the Pacific Highway between Tintenbar and Ewingsdale sensitive from both an urban design and visual perspective.

Before attempting to identify the potential visual impact of the proposed upgrade, it is necessary to understand the current visual and landscape character of the study area, as well as the sensitivity of people with regard to changes in this character. As outlined in the visual assessment method later in this working paper, these will have a direct bearing on the potential visual impact of identified highway upgrade options. Apart from the nature of the development itself, the landform and vegetation cover of the area will be important in determining the potential visual effect of an upgraded highway, whereas land use and settlement patterns will determine how sensitive people in the area will be to changes in the landscape and visual environment.

LANDFORM

The majority of the study area is located on an elevated plateau which is defined by a steep escarpment on its northern and eastern edges (refer to Illustration 8), falling to a relatively flat coastal plain.

The escarpment that separates the plateau areas and the coastal flats is aligned roughly parallel to the coast, running in a north-easterly to south-westerly direction. The escarpment rises above the coastal plain, generally increasing in height from about 70m above sea level in the south of the study area to over 190m above sea level at Granuaille Hill, above McLeods Shoot Lookout in the north of the study area. It provides a dominant landform feature in the locality, accounting for much of the area's scenic quality.

The coastal plain or coastal flats (refer to Illustration 9) are located between the coastal dunes and headlands and the escarpment. The coastal flats vary in width from a 4-5km wide plain near Ross Lane to a series of relatively narrow valley floors north of Midgen Flat Road, where the escarpment draws to within 2km of the coast and rises to more than 130m above sea level. A similar coastal plain is located north-east of the study area, extending north from the foot of the escarpment near Byron Bay.

On their eastern side the coastal flats are contained by a series of low coastal ridges and headlands such as Broken Head and Lennox Head, all of which offer views back to the escarpment. While the escarpment is the dominant landscape

feature defining the western edge of the coastal landscape, the distance to it and the remainder of the study area when viewed from the coast is too great to provide the viewer with the kind of detail that would make it possible to identify individual elements or smaller-scale changes to the landscape (refer to Illustration 10). Much of the study area is concealed behind the escarpment when seen from the coast. Where local high points can be seen above the escarpment, the distance from the coast is too great to permit a detailed reading of the landscape.



Illustration 8
The Escarpment rising above Cane Fields in the Coastal Flats



Illustration 9
The Landscape of the Coastal Flats

The landscape of the elevated plateau is characterised by a steeply undulating landform dissected by numerous watercourses (refer to Illustration 11). As a result of this, the escarpment itself as well as the ridges and higher slopes on the plateau are exposed to many viewpoints. Conversely, the lower slopes and valleys of the plateau are often concealed from many viewpoints in the locality. The elevated areas within the study area also provide expansive regional views towards the Pacific Ocean and inland. Many properties situated on the upper slopes of the escarpment in particular, enjoy spectacular and uninterrupted views towards the Pacific Ocean and across the coastal flats, headlands and ridges (refer to Illustration 12).

VEGETATION

On the elevated plateau, the combination of a subtropical climate and highly rich and productive soils produces a lush cover of both indigenous and exotic vegetation, interspersed by more open areas of paddocks or plantations. A recurring feature along the current highway is the significant number of macadamia tree plantations whose grid arrangements provide a unique character to the local agricultural landscape (refer to Illustration 13). The types and degree of vegetation cover combined with the steeply undulating landform results in a highly diverse and scenic landscape.

The escarpment slopes are generally steeper and less suitable for agriculture, resulting in a combination of open grassed paddocks with clumps of exotic and native trees, the latter primarily on the steeper slopes. The coastal flats, by contrast, are characterised by geometric patterns of crops of mostly sugar cane. In recent years a number of macadamia plantations have also been planted at the foot of the escarpment as well as in the coastal flats and local elevated areas within the coastal flats.

These are interspersed with stands of trees often associated with remnant swamps or wetlands, and the geometric arrangements of reed-lined trenches and drains that enable the cultivation of these low-lying lands. The height of crop and tree stands in this flat landscape commonly obscures any views from the flats to the surrounding landscape, including the escarpment, until such times when crops are harvested (refer to Illustration 14).

SETTLEMENT PATTERNS

The settlement pattern within and adjacent to the study area is a mixture of small towns and villages with relatively closely settled rural properties in the surrounding areas. Bangalow is the largest town in the study area and located on its western edge. It is situated on the intersection of the Old Pacific Highway alignment and the North Coast rail line. Newrybar is a small village on the Pacific Highway which services the local area. Ewingsdale in the north is a relatively recent subdivision on the lower escarpment slopes overlooking Byron Bay.

Residential properties outside of these towns concentrate along the local roads through the study area, creating small hamlets close to the roads' edges which often follow the ridge lines of the high plateau (refer to Illustration 15).



*Illustration 10
View towards the Escarpment from Lennox Head*



*Illustration 11
Exposed Hills and Ridges of the Elevated Plateau*



*Illustration 12
View of the Coastal Flats from the top of the Escarpment*



*Illustration 13
Macadamia Plantations on the Elevated Plateau*



*Illustration 14
Cane Fields in the Coastal Flats*

A number of recent residential subdivisions are evident in the area, complementing more traditional rural housing and taking advantage of the spectacular rural and coastal views (refer to Illustration 16). With the exception of towns like Suffolk Park and Lennox Head (which are outside of the study area), the densities of residences on the coastal flats and the escarpment's slopes are substantially lower than on the ridge lines of the elevated plateau area.

This is due primarily to the steep slopes and soil instability on the escarpment, and flooding and "soft soils" on the flats. The attraction of panoramic views of the surrounding landscape and in some cases the ocean, also explain the higher settlement densities on the elevated plateau areas.



Illustration 15
Cluster of Rural Residential Housing along Broken Head Road



Illustration 16
Recent Subdivision in Wood Crescent, off Coopers Shoot Road

CONSTRAINTS OVERVIEW

The analysis comprises two sets of constraints. Firstly, constraints imposed by the legislative framework with regard to land use and scenic or landscape protection, and secondly, constraints as a result of the existing visual landscape character in the area, which will determine the degree of visual effect and visual sensitivity of the proposed upgrade. Both sets of constraints are discussed in more detail in the following sections.

POLICY CONTEXT AND LEGISLATIVE FRAMEWORK

The local Councils of Byron and Ballina have Scenic Protection Zones that cover a number of landscape features, including the escarpment areas in and adjacent to the study area (refer to Illustration 17 “Scenic Escarpment – Protection Through Land Use Zoning”). Areas contained within the Environmental Protection (Scenic/ Escarpment) Zone (Zone 7(d)) of the Ballina Local Government Area would not be affected by the proposed upgrade.

The objectives for the Scenic/ Escarpment Zone (Zone 7(d)) within the Byron Local Government Area are:

- a) to protect and enhance the scenic qualities of the Shire of Byron which enhance the visual amenity by controlling the choice and colour of building materials, position and bulk of buildings, access roads and landscaping,
- b) to prohibit development within the zone that is likely to have a visually disruptive effect on the scenic quality and visual amenity of the Shire,
- c) to enable development for certain purposes where such development would not have a detrimental effect on the scenic quality and visual amenity of the Shire,
- d) to minimise soil erosion from escarpment areas and prevent development in geologically hazardous zones, and
- e) to enable the careful control of noxious plants and weeds by means not likely to be significantly detrimental to the native ecosystem.

Although much of the prominent escarpment is covered by the Scenic Escarpment Zones, there are some sections of the escarpment which are not covered by this zoning but are of equally high scenic value (refer to Illustration 17 “Scenic Escarpment – Protection Through Land Use Zoning”).

Despite this gap, however, the inclusion of the much of the escarpment under the Scenic Protection Zone should be interpreted as a sign that the prominence of the escarpment and its importance as a landscape feature in the area is recognised in and appreciated by the local community. The visual prominence of the escarpment means that the extent and nature of development occurring along it will be particularly influential in determining the overall visual character of the area. The escarpment provides the backdrop to the coastal landscape and therefore significantly shapes the way the whole area is perceived. In contrast, other areas, such as those in the coastal flats or on the elevated plateau are much less exposed and consequently have greater capacity to absorb development without affecting the overall landscape character.

In this context, areas not included in the Scenic Escarpment zone should not be regarded as having lesser scenic qualities, and zoning boundaries should not be interpreted as providing the only measure to guide the appropriate location of developments with potentially significant visual and landscape impacts. Instead, the zoning reflects the local desire to maintain a perception of the area as a rural dominated landscape with strong scenic and lifestyle values, rather than of a landscape dominated by residential housing.

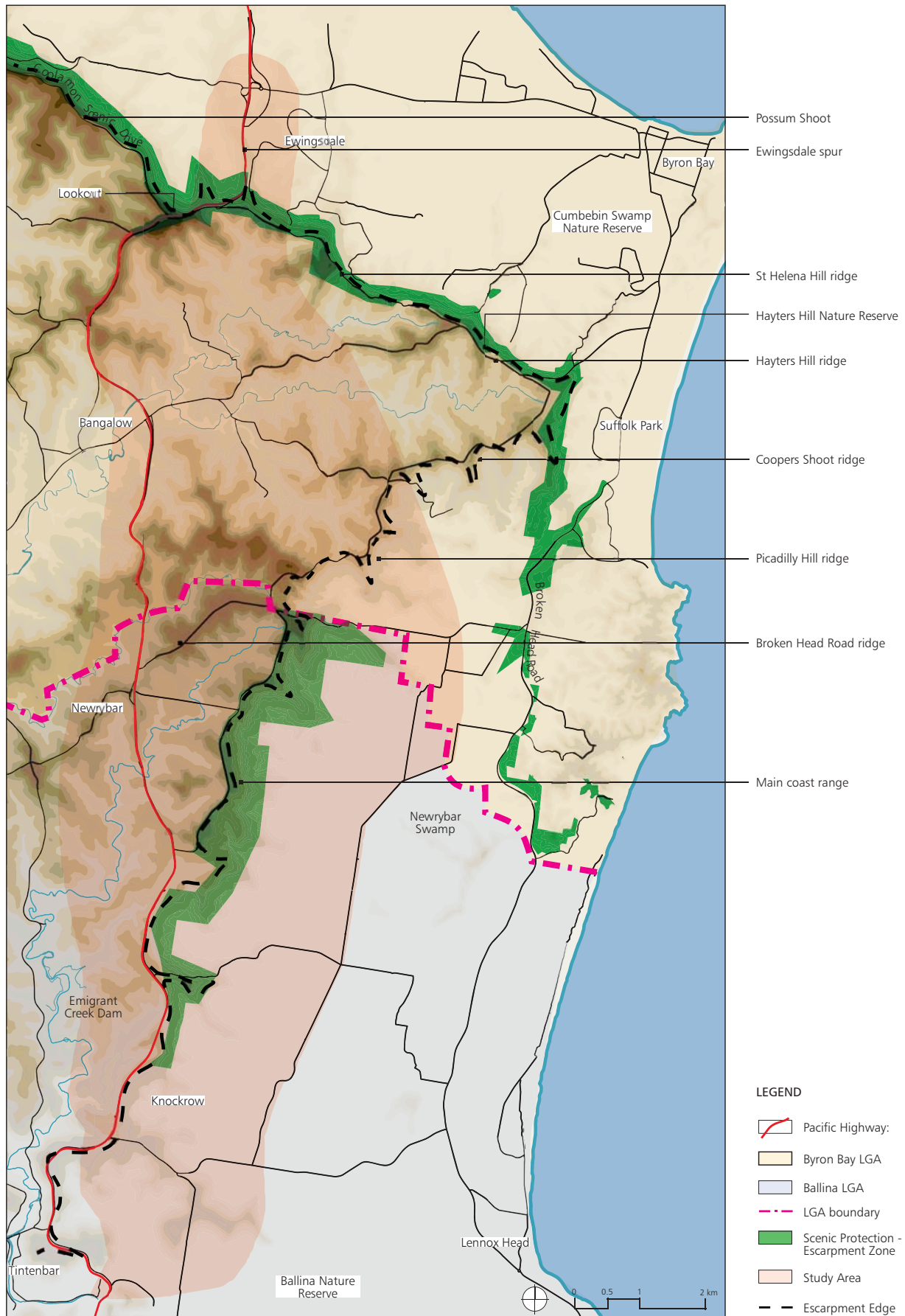


Illustration 17:
Scenic Escarpment - Protection Through Land Use Zoning

VISUAL AND LANDSCAPE CONSTRAINTS CLASSIFICATIONS

As discussed in previous sections, the whole region including the study area is considered to have high scenic (visual) and landscape values. While certain landscape features are more prominent than others, it is the diversity of landscape types and characters and the relationships between them that contribute to the overall landscape and visual experience of the area.

The visual and landscape constraints below are presented and described with regard to assessing the potential visual impact of the proposed upgrade (refer to section "Visual Impact Assessment"). As the visual impact will be a measure of the visual effect of the proposal and the visual sensitivity of viewers, the constraints take into consideration the relationship between the physical features of the landscape and the degree to which people in different areas are likely to be sensitive to changes in the landscape and visual environment.

As will be discussed in the visual assessment method later in this working paper, the visual effect will be partly determined by the characteristics of the visual and landscape setting, while the sensitivity of viewers will be determined by the land use, settlement and circulation patterns of the study area.

The constraints categories and their relationship to the visual assessment method are:

Constraints Category	Visual Assessment Parameter
Landform and Visual Exposure	Define the Visual Effect
Land Cover and Visual Absorption Capacity	
Land Use, Settlement and Circulation Patterns	Define the Sensitivity of Viewers to Changes in the Visual Environment

These categories are illustrated by the accompanying maps and described in the following sections.

Landform and Visual Exposure

The 'Landform and Visual Exposure' map (Illustration 18) defines areas of exposed hills and ridges that are visually sensitive to road construction. These include ridge lines, spurs and hills located on the elevated plateau, as well as the visually exposed face of the escarpment, which is one of the major scenic landmarks of the area as discussed earlier on.

Road construction through these hills and ridges would potentially require large cuttings and embankments that would create a strong visual effect and may be widely visible to both local residents and tourists travelling through the area. The visual impact of large cuttings in ridge lines would be particularly difficult to ameliorate.

The lower slopes and valley floors below the ridges offer lesser constraints. Cut and fill embankments would still be required and might be substantial in some areas. However, from the point of view of visual exposure of the route, the undulating landform of the lower slopes and valley floors offers some opportunities to create a road alignment which would be less visible across large sections of the study area. An alignment winding around the lower slopes would be more readily concealed by intervening landform, resulting in a road which would be less exposed to viewers in the area, especially when seen from a distance. Overall, such an alignment would be more readily absorbed into the landscape.

In contrast, earthworks associated with road construction in the coastal flats would primarily consist of elevated fill embankments to avoid flood-prone areas. However, the flat and open landform would result in the road being exposed to elevated viewpoints, particularly from roads and properties along the edge of the escarpment.

As can be seen on the map (Illustration 18), the study area features a complex landform pattern across the central and western parts. This illustrates the difficulty in selecting a route that will not cut through a number of these exposed hills and ridges. The map also illustrates the relative ease of following the edge of the coastal flats near the foot slopes of the escarpment. However, connecting with the existing highway alignment at Ewingsdale, would require the route to cut through the exposed escarpment in the vicinity of either the Picadilly Hill ridge or Coopers Shoot as well as at the St Helena ridge.

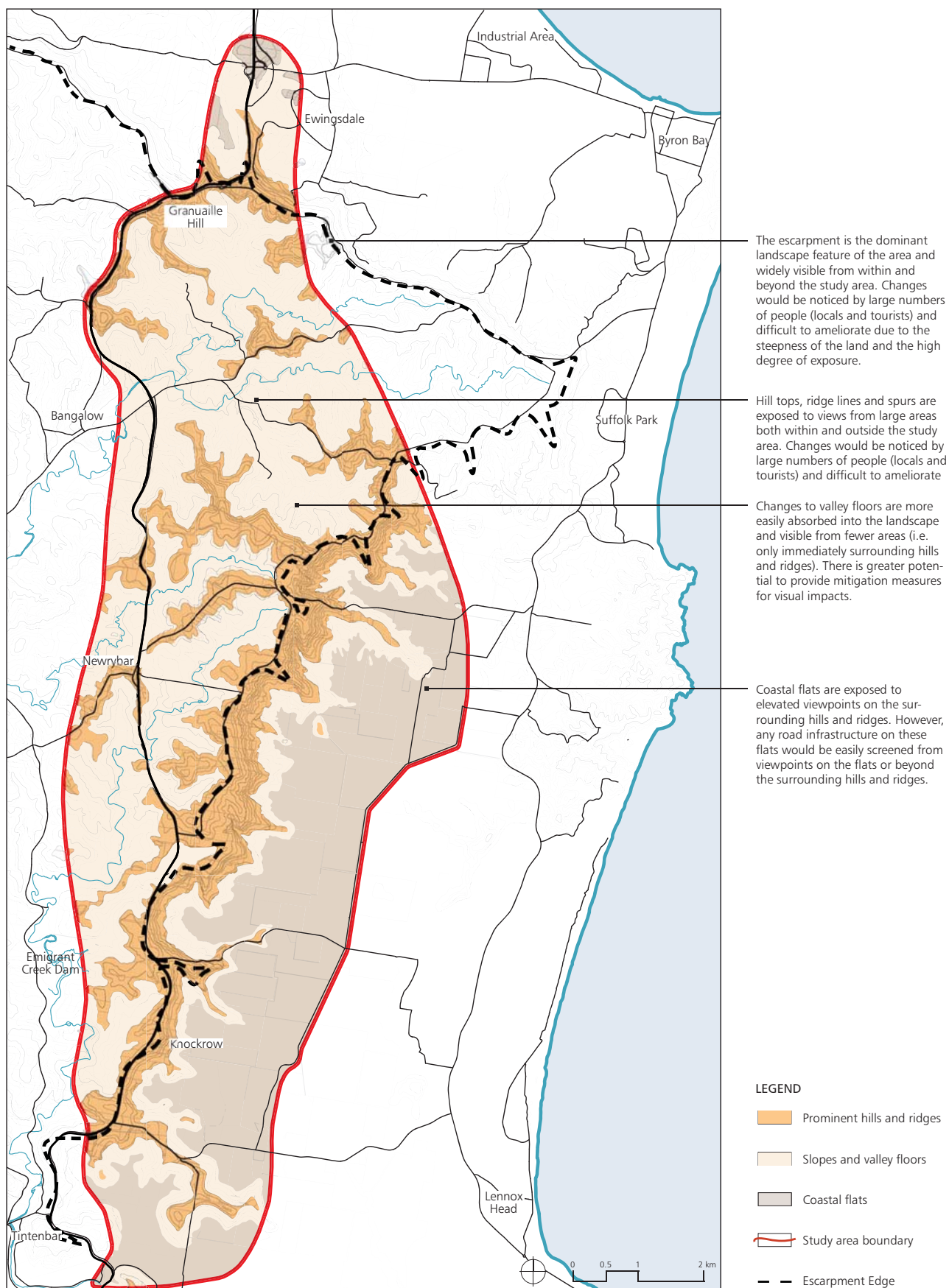


Illustration 18:
Landform and Visual Exposure

Land Cover and Visual Absorption Capacity

The “Land Cover and Visual Absorption Capacity” map (Illustration 19) illustrates the varied and strongly patterned landscape of the study area, which influences the visual impact of a potential road. This complex pattern is a result of the contrast between the open landscape of grazing paddocks and cane fields, and a variety of vegetated areas. The latter include clusters or rows of indigenous trees located predominantly along creek and road corridors, and exotic trees associated with private properties or macadamia plantations and fruit farms.

Generally, any road alignment bisecting areas of dense tree cover would create a strong contrast and corresponding high visual impact, particularly when viewed from areas elevated above the road. The highest impact would result from bisecting more structured patterns such as macadamia tree plantations, whereas irregular patterns of indigenous trees create a more complex landscape pattern that can generally visually absorb the road better.

An alignment in cleared paddocks and cane fields will have less visual contrast and impact than in a densely treed area, however the openness of these areas will expose the new alignment to a wide range of viewpoints.

An alignment that follows the edge between plantations and cane fields or open paddocks would greatly reduce the visual effect on the overall landscape setting, especially when seen from elevated areas.

Finally, the areas of tree cover between the viewer and the road alignment can reduce the visual effect of a new road alignment, particularly when viewed from the lower slopes, valley floors and coastal flats due to the screening effect of the intervening trees.

Land Use, Settlement and Circulation Patterns

Land use, settlement and circulation patterns are important in the visual assessment, as they provide an indication of a number of different viewing areas as well as activities people may be engaged in. This in turn influences the way in which people view the landscape and how they would respond to changes in it, determining the degree of visual sensitivity towards any highway upgrade option.

The primary viewing areas across the landscape are illustrated on the ‘Land Use, Settlement and Circulation Patterns’ map (Illustration 20). They include the various roads occurring in and adjacent to the study area, towns and villages, clusters of semi rural housing and recent residential subdivisions of rural land, as well as isolated homesteads. The most sensitive areas to visual change are those with the greatest number of potential viewers and those viewers who are either engaged in recreational activities (tourists) or are local residents. Workers on rural properties or in urban settings are likely to be less sensitive to changes in their visual environment.

Of the roads in the area, the existing highway is a primary tourist route that would be most sensitive, grading down to the minor roads and local access roads as the least sensitive to changes in outlook. The larger population centres of Byron Bay, Lennox Head, Suffolk Park, Bangalow, Ewingsdale and Newrybar would be the areas of greatest sensitivity whilst the isolated rural homesteads would be the lowest sensitivity to change.

There are less residences and connecting through roads on the coastal flats and this reduces the visual sensitivity of these areas in comparison to the plateau areas. However the escarpment areas that overlook the coastal flats, have numerous residences situated along the ridges and upper slopes and these would be highly sensitive to the alignment of the highway in an area which currently has limited road infrastructure and features prominently in their outlook.

As previously discussed, the zoning of substantial areas of the escarpment as Scenic Protection highlights the importance of the escarpment area to the community as well as the corresponding high levels of sensitivity to a change in the appearance of these areas. The areas of escarpment not zoned Scenic Protection are also of high scenic value and are likely to be equally highly valued by the community.

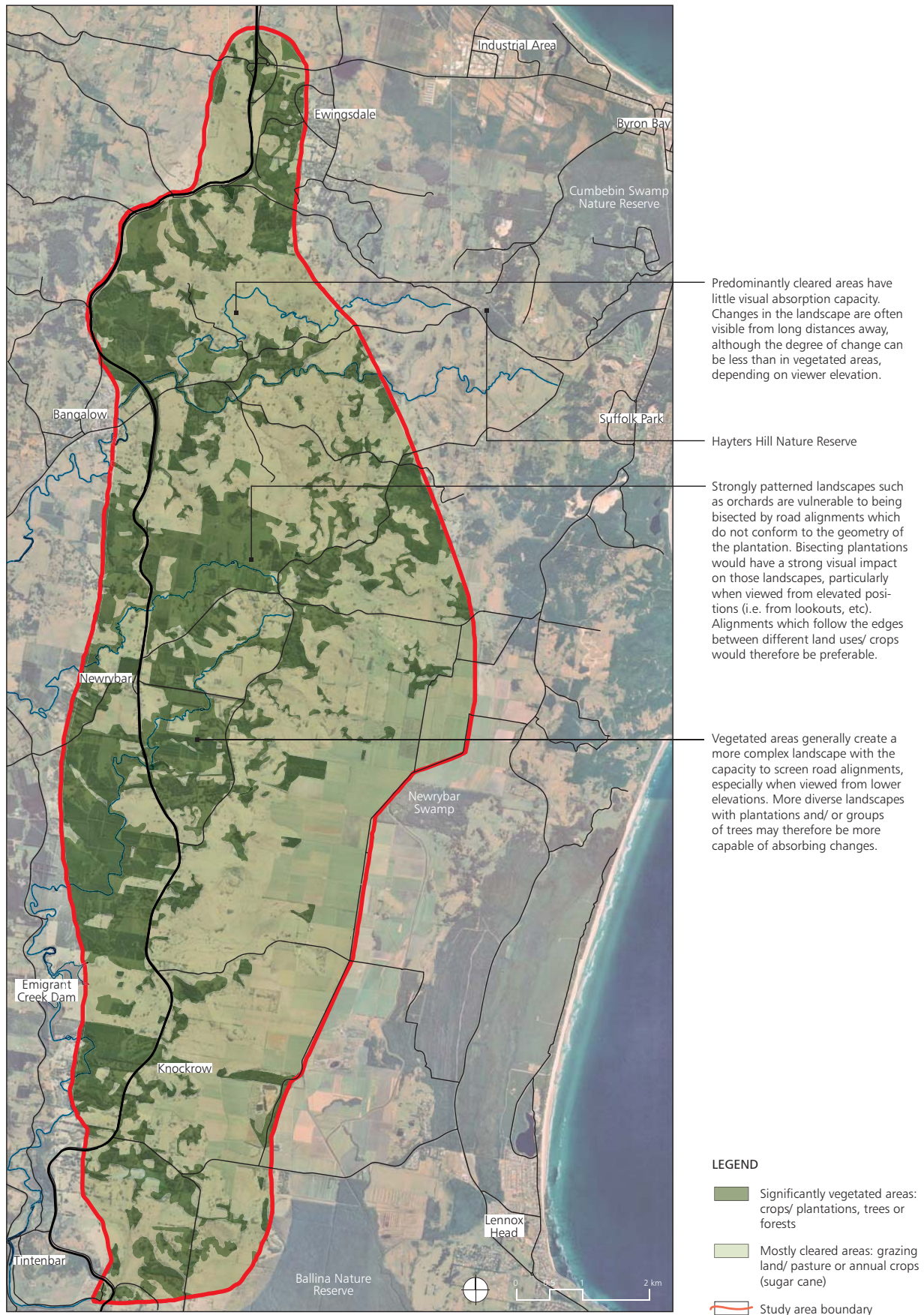


Illustration 19:
Land Cover and Visual Absorption Capacity

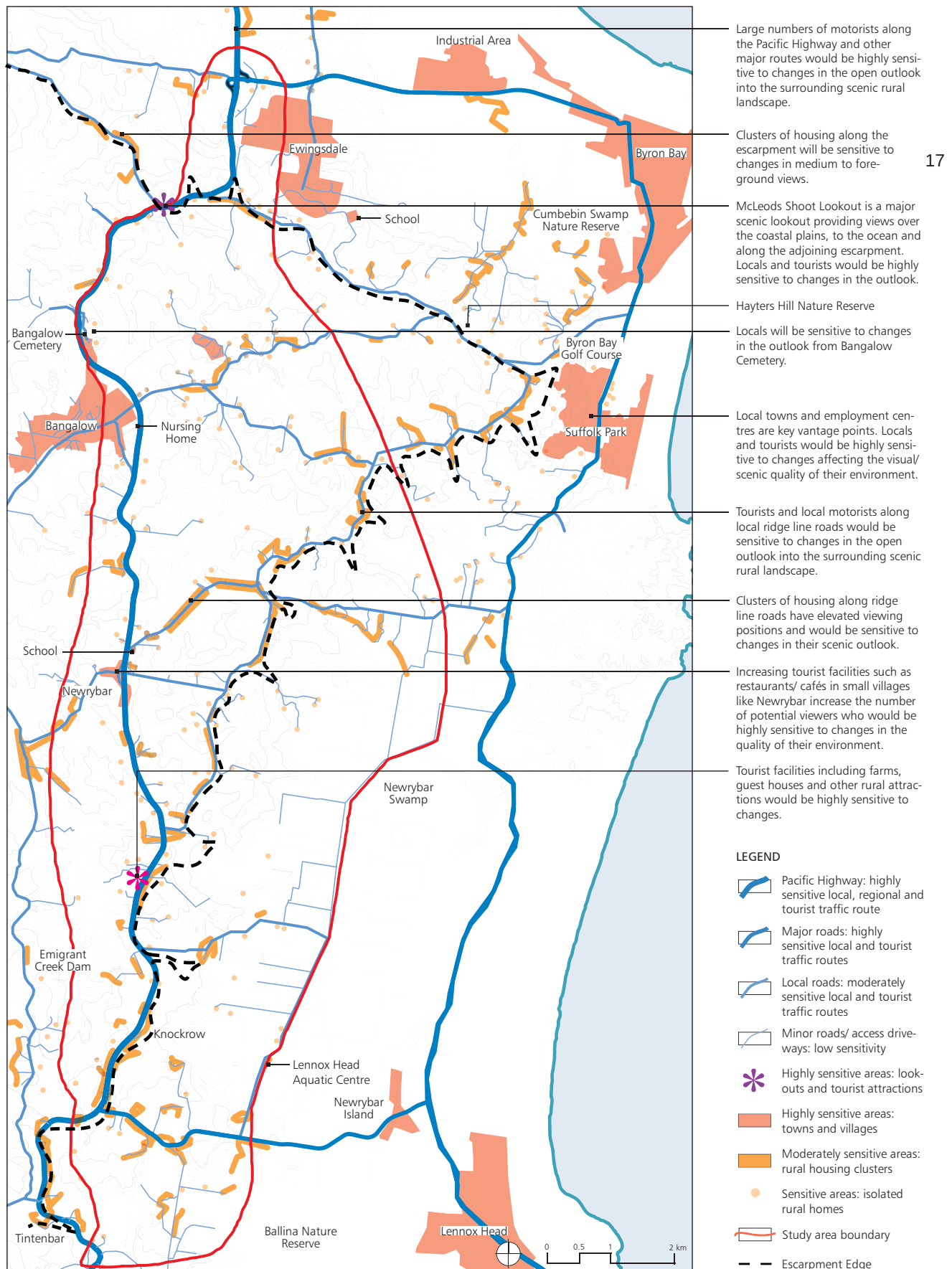


Illustration 20:
Land use, Circulation and Settlement Patterns

3. the proposed upgrade

This section gives an overview of the proposed upgrade.

It briefly outlines the process of identifying the route for the proposed upgrade, and provides an overview of the proposed upgrade, in terms of its alignment, the location and types of interchanges and local access and vehicular circulation arrangements.

DEVELOPMENT OF THE PROPOSED UPGRADE

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The selection and preparation of the concept design for the proposed upgrade has involved a detailed process of planning and site investigations, since the intention to upgrade the Pacific Highway between Tintenbar and Ewingsdale to a two-lane dual carriageway was announced in 2004.

This process was described in detail in the *Route Options Development Report* and the *Preferred Route Report* (both by ARUP), which were previously publicly displayed. In summary, the process included preliminary investigations such as the identification of both constraints and evaluation criteria, which were agreed with the study team and led to the identification of initial highway upgrade route corridors. Assessment of route corridors against the evaluation criteria resulted in the determination of potentially feasible options. Evaluation criteria included a series of design principles developed to minimise visual and landscape impacts, ensuring that urban design, landscape and visual issues were considered early in and as an integral part of the route selection and development process. Further studies were then carried out, together with initial design work. This resulted in a number of refinements to the options, the review of which led to the determination of a short list of four options which were publicly displayed. Short listed options underwent a preliminary assessment process which resulted in the identification of the preferred route in September 2006.

Since its public display in late 2006, minor changes and amendments have been made to the preferred route, largely as a result of the need to review access arrangements, and as a response to engineering issues and to community and stakeholder feedback.

The preparation of this "Urban Design, Landscape and Visual Assessment" working paper, as part of the Environmental Assessment under Part 3A of the *Environmental Planning and Assessment Act 1979*, considers and builds on the results of the studies undertaken during the route selection process, as well as on the existing conditions.

OVERVIEW OF THE PROPOSED UPGRADE

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ROUTE ALIGNMENT

The Proposal would provide a four lane dual carriageway between Ross Lane and the Ewingsdale interchange which meets the RTA's highway design criteria for a 110 kilometres per hour design speed. The road reservation of the upgraded highway would vary in width, depending on the requirements for interchanges, cuttings, embankments and local access roads, with a minimum width of about 120 metres.

The upgraded highway would replace the existing two lane highway. It would significantly deviate from the existing highway alignment, the geometry of which is largely sub-standard, a fact which is reflected in the larger than average accident rate. However, the existing Pacific Highway would be retained as a local link road between Tintenbar and Ewingsdale, enabling local residents to make short trips without having to use the upgraded highway.

At the southern end of the study area, the proposed upgrade would tie in with the proposed Ballina bypass, at the Ross Lane interchange. At the northern end of the study area, the proposed highway upgrade would tie in with the existing four lane dual carriageway highway which commences at the Ewingsdale interchange.

Starting at the Ross Lane interchange, the upgraded highway would follow the top of the escarpment parallel to the existing highway, deviating slightly further west from it in the Knockrow area. The distance between the existing highway alignment and the upgraded highway would increase north of Martins Lane and the property 'Kilrush' (property 53), accommodating the Ivy Lane interchange west of the existing highway alignment. The upgraded highway would then follow a gently meandering alignment through the undulating agricultural landscape of the elevated plateau. Approximately three quarters of a kilometre south of Newrybar, the alignment would pass under the existing highway and continue its course through the elevated plateau, maintaining the integrity of the core of Newrybar Village. It would remain relatively close to the existing highway until the alignment reaches the Bangalow interchange. After the interchange, the upgrade would deviate significantly from the existing highway, cutting through the Tinderbox Creek Valley and adjoining valleys. It would partly climb the St Helena ridge before entering a tunnel which avoids the steepest section of the ridge line. The upgraded highway would emerge from the tunnel on the Ewingsdale spur, a long spur leading off the scenic escarpment. The upgrade would run parallel to the existing highway again, but on a lower vertical alignment.

INTERCHANGES

The proposed upgrade includes a number of modifications to the grade-separated interchanges at Bangalow, Ewingsdale and Ross Lane, as well as the construction of a new grade-separated interchange at Ivy Lane. Together, these interchanges would provide access between the local road system and the upgraded highway. The following provides an overview of the proposed interchange works. More detailed information on the proposed works is provided in the urban design, landscape and visual assessment section of this working paper, under the relevant precinct chapters.

- > Ross Lane interchange (Precinct One)
A northbound on-ramp and southbound off-ramp would be added to the interchange.
- > Ivy Lane interchange (Precinct Two)
A new interchange would be provided at Ivy Lane, consisting of a northbound on-load ramp and a southbound off-load ramp. An associated underpass would provide access to properties in this area.
- > Bangalow interchange (Precinct Three)
The existing interchange would be reconstructed, modifying the existing off-load ramp and constructing a new northbound off-load ramp for the upgraded highway, both of which would be connected to Bangalow Road via a roundabout and short link road. A new southbound on-load ramp onto the upgrade would also be provided.
- > Ewingsdale interchange (Precinct Five)
Modifications to the interchange would include the diversion of the existing highway alignment to connect the upgrade to the existing dual carriageway, replacing the existing southbound loop on-ramp with a direct on-ramp, and changes in the configuration of existing roundabouts.

LOCAL VEHICULAR ACCESS AND CIRCULATION

In order to minimise conflict between local traffic and regional traffic on the Pacific Highway, local vehicular access to the upgraded highway would be limited. The existing highway alignment would be retained and complemented with a series of local access roads, in order to provide an alternative local link between Tintenbar and Ewingsdale, and to maintain access to local properties.

The following is a brief overview of the proposed amendments to local access arrangements:

- > Ross Lane to Carney Place
A local access road would be provided on the western side of the upgraded highway, commencing at the existing highway alignment just south of the Ross Lane interchange.
- > Carney Place to Macadamia Castle
A local access road would be provided on the western side of the upgraded highway, with a new intersection on the existing highway alignment approximately half way between Carney Place and Martins Lane.
- > Ivy Lane
Access to properties off Ivy Lane would be provided via a short local access road on the western side of the upgraded highway and via the upgraded road infrastructure associated with the proposed Ivy Lane interchange.
- > 'Yarrenbool Place'
Access to 'Yarrenbool Place' (property 89) and property 92 would be provided by two short access roads connecting to the existing highway on either side of a tributary to Emigrant Creek.
- > Emigrant Creek
Around Emigrant Creek, the existing highway would be diverted to pass under a bridge constructed over the creek. Consequently, access roads and driveways off the existing highway would be upgraded and realigned.
- > Watsons Lane
Access to properties off Watsons Lane would be maintained by the construction of an underpass.
- > Broken Head Road and 'Claremont'
A bridge over the upgraded highway would be constructed in Broken Head Road. Access to the two severed portions of 'Claremont' (property 160 and 168) and to property 176 would be via two short access roads on either side of the bridge.

- > 'Picadilly Park' and 'Arundel'
Access to 'Picadilly Park' (property 199), 'Arundel' (property 198), and properties 183, 186, 191 and 193 would be provided by a bridge over the upgraded highway and associated local access road on the eastern side of the upgrade. The two severed portions of 'Arundel' would be connected by a separate private underpass.
 - > Ballina Road to Bangalow Road
Access to properties on the eastern side of the upgraded highway would be provided via a local access road off Bangalow Road.
 - > Tinderbox Road
Tinderbox Road would be realigned to pass under the upgraded highway adjacent to Tinderbox Creek. There would be no changes to local access arrangements off this road.
 - > Plantation Drive, Ewingsdale
The upper reach of Plantation Drive would be realigned further east, maintaining access to property 371 on the St Helena ridge.
 - > 'Araluen' (property 394)
An access road would be provided off Myocum Road, replacing the existing access and underpass off the Old Pacific Highway.
- Access arrangements to other properties located along and off the existing highway alignment would not be affected by the proposed upgrade and would be retained in their current form, including access to
- properties east of the existing highway between Ross Lane and Emigrant Creek.
 - properties to the west of and along the existing highway between Emigrant Creek and the Bangalow bypass.
 - properties along the existing highway north of the Bangalow interchange.

4. landscape and visual impact assessment

This section is dedicated to the visual assessment of the proposed upgrade. It has been broken down according to several steps involved in the visual assessment:

> **Visual and Landscape Assessment Method**

Provides an overview of the method used. The assessment of the proposed upgrade has involved both a quantitative and qualitative assessment. In particular the quantitative assessment involved a number of steps and calculations that are explained in detail and in their relation to the qualitative assessment

> **Urban Design, Landscape and Visual Assessment Precincts**

Outlines the location and boundaries of the five precincts that the study area was divided into for the purposes of the visual assessment.

> **Potential Impacts common to all Precincts**

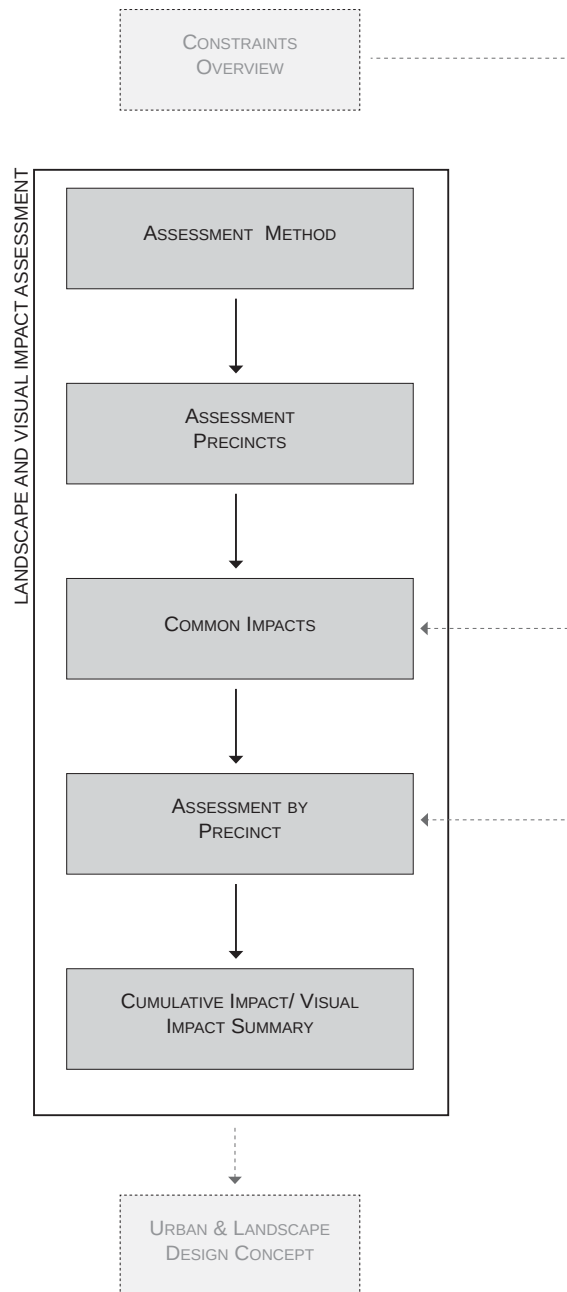
Provides a brief overview of visual issues associated with the upgrade across all precincts, the most important of which is the introduction of a major new infrastructure element into the rural landscape. Also briefly addressed temporary construction impacts.

> **Visual Assessment by Precinct**

Includes a description of the existing landscape and visual character of each precinct, an overview of the proposed upgrade accompanied by an annotated plan and the visual assessment of the proposed upgrade within each precinct. It involves a discussion of the likely visual effect of the works, the likely visual sensitivity of viewers and the resulting visual impact, based on the quantitative assessment.

> **Visual Impact Summary**

Summarises the visual effect, visual sensitivity and resulting visual impact for each precinct, based on the quantitative assessment. It is complemented by a discussion which considers the effect of the proposed upgrade on the specific visual quality of the landscape of the area, over and above its physical magnitude and in terms of the cumulative impact across all precincts.



VISUAL IMPACT

The visual impact of the proposed upgrade is determined by considering both the visual effect of the proposed works and the visual sensitivity of surrounding areas, as determined by surrounding land use areas from which the proposed upgrade would be visible and by the viewers likely to see it. The following diagram illustrates how various combinations of visual effect and visual sensitivity will produce high, moderate or low visual impact levels.

		VISUAL EFFECT LEVEL					
		High	High to Moderate	Moderate	Moderate to Low	Low	
VISUAL SENSITIVITY LEVEL	High	High impact	High impact	High to Moderate	High to Moderate	Moderate impact	
	High to Moderate	High impact	High to Moderate	High to Moderate	Moderate impact	Moderate impact	
	Moderate	High to Moderate	High to Moderate	Moderate impact	Moderate impact	Moderate to Low	
	Moderate to Low	High to Moderate	Moderate impact	Moderate impact	Moderate to Low	Moderate to Low	
	Low	Moderate impact	Moderate impact	Moderate to Low	Moderate to Low	Low impact	

Illustration 21
Visual Impact Assessment

For the purposes of this environmental assessment, existing site conditions and the likely visual effect and visual sensitivity of viewers have been described in a qualitative manner. This has been based on the authors' experience in the field of visual assessment and work on projects of a similar nature, as well as on widely adopted and accepted visual assessment methods. While these methods aim to provide a consistent and unbiased approach to visual assessment, the highly individualistic nature of visual perception still often leads to differing opinions with regards to the magnitude of the visual impact of a proposed development.

In order to address this issue and for reasons of consistency with the process that lead to the identification of the preferred route for the proposed upgrade, an attempt has been made at quantifying the visual assessment for the proposed upgrade. The method for doing so is described below, together with a general overview of the determination of the visual effect and the visual sensitivity.

VISUAL EFFECT

The visual effect is the expression of the visual interaction between a proposed development and the existing visual environment surrounding it. The visual effect can also be expressed as the level of visual contrast between the Highway upgrade and the visual setting within which it would be placed. It considers the relationship of factors such as form, line, colour and texture between a proposed development and the surrounding environment.

Generally speaking, a high visual effect would result where a development would be a major element and would contrast strongly with the existing landscape. Several factors might contribute to such an effect, such as poor or visually exposed siting of the development, poor integration into the landscape or a lack of screening such as provided by vegetation or topography. In situations where the existing environment is heavily modified by the proposed development, a high visual effect would also result.

A moderate visual effect would occur where a proposed upgrade is visible and contrasts with the landscape, but is integrated with it to some degree. For example, some form of visual screening or visual integration with the surrounding setting was provided through the way in which the development was positioned in relation to the surrounding landscape.

A low visual effect would occur if there was minimal visual contrast and a high level of integration of form, line, shape, pattern, colour or texture values between the development and the existing environment. Alternatively, it would be the case where a development results in only a low level of visual modification to the surrounding landscape and the existing visual setting.

The existing conditions of the surrounding environment itself will partly determine the degree of visual effect of a development. A description of the existing environment therefore forms an integral part of assessing the likely visual effect of a development. A level landscape with little vegetation cover will offer little opportunity to conceal a development. More

complex landscapes with varied topography and vegetation cover provide greater opportunities to site a development in a way which reduces its visual exposure. The potential exists to "nestle" a development into hills or behind ridges or take advantage of vegetation cover in surrounding properties, hiding the development from a range of viewpoints, rather than it being exposed all around. These factors were discussed in the "Constraints Overview" section of this working paper and are also described in more detail as part of the visual assessment in this section.

In order to arrive at a quantitative assessment of the visual effect of the proposed upgrade, the visual effect was considered to be an expression of the scale of the proposed infrastructure, combined with the degree of its exposure or visibility from surrounding areas, as determined by the local topography and vegetation cover. While this does not differentiate between different landscape types such as rural or urban areas, it is appropriate in providing a relative measure of the likely visual effect, based on the consistent rural landscape along the proposed upgrade.

Visual Effect	=	Scale of the Infrastructure	x	Visual Exposure
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Scale of the Infrastructure

The scale of the infrastructure of the proposed upgrade has been measured by considering the size of cuttings and fill embankments required along the route (vertical scale), as well as by the size of the road reservation required to accommodate the upgrade (horizontal scale).

Scale of the Infrastructure	=	Size of cuttings and embankments (vertical scale)	x	Size of the Road Corridor (horizontal scale)
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Cuttings and Embankment Sizes

The size of cuttings and embankments is a suitable indicator for the degree of change to the landscape, as they are representative of the degree to which the upgraded highway will "fit" into the existing landscape, which in turn will determine the visual effect of the proposed upgrade on the area.

Generally, the taller cuttings and embankments are, the greater their prominence and subsequent visual effect on the character of the landscape. In order to measure this effect, six categories of cuttings and embankment sizes have been defined and ranked, according to their height. Tallest cuttings

and embankments receive the highest ranking as they generally have the greatest visual effect. Because of their elevation above the natural landform, bridges have been treated as if they were fill embankments. Local road bridges over the upgraded highway were included in the calculations in the same way.

The ranges are as follows:

- 1) Insignificant cuttings and embankments: 0 to 0.5m tall.
- 2) Minor cuttings and embankments: 0.5m to 2m tall.
- 3) Noticeable cuttings and embankments: 2m to 5m tall.
- 4) Large cuttings and embankments: 5m to 10m tall.
- 5) Very large cuttings and embankments: 10m to 20m tall.
- 6) Major cuttings and embankments: greater than 20m tall.

Segments of route inside the tunnel would not be visible to viewers in the study area and these segments have been rated with a factor of 0. The effect of the tunnel portals in the quantitative assessment calculation is represented by the size of the cuttings leading up to the portal, with the actual tunnel opening being of comparatively minor scale.

The score for cuttings and embankments is derived by multiplying the length of route within each category (expressed as a percentage of the route length within the relevant precinct) with the ranking for that category, and then adding up the scores for all categories.

For example, 10 per cent of a precinct may consist of category one cuttings and embankments, 15 per cent of category two cuttings and embankments, 60 per cent of category three, 10 per cent of category four and 5 per cent of category five. The cuttings and embankment score for the precinct would be

$$0.1 \times 1 + 0.15 \times 2 + 0.6 \times 3 + 0.1 \times 4 + 0.05 \times 5 = 2.85$$

Road Reservation Area

The size of the road reservation is a reflection of the overall footprint required by the proposed upgrade, including interchanges, local access roads, and the area taken up by cuttings and fill embankments. It provides an indication of how much of the existing predominantly rural landscape is "lost", as well as of the horizontal scale of the proposed upgrade, in particular with regard to the amount of hard pavement or engineered cuttings and embankments. The size of the road reservation and therefore the visual effect of the proposed upgrade would be greater where it would result in the co-location of several roadways in close proximity, as

a large amount of hard pavement would create a large contrast with the existing rural landscape.

The score for the corridor footprint is derived by dividing the area of road reservation (within a precinct) by the length of the upgraded highway corresponding to it. In order to arrive at a score compatible with other calculations, the figure was multiplied by 10.



Illustration 22:
Approximation of the "actual visual catchment" of the proposed upgrade, representing a conservative estimate with the area from where the proposed upgrade would be able to be seen likely to be smaller.

For example, the size of the road reservation within a precinct may be 0.65 square kilometres, with a corresponding length of the proposed upgrade of 4.2 kilometres. The Corridor Footprint Score for the precinct would be:

$$(0.65 : 4.2) \times 10 = 1.01$$

Scale of the Infrastructure Score

Using the above example, the final score for the Scale of the Infrastructure would be:

$$2.85 \times 1.01 = 2.88$$

Visual Exposure

The degree or area from which the proposed upgrade can be seen from surrounding areas (the visual catchment) is determined largely by the interplay of local topography and vegetation cover. For the purposes of this environmental assessment, a "seen area" analysis was undertaken, using GIS systems to calculate visual catchments for each precinct, based on the local topography. Vegetated areas (including natural vegetation and agricultural plantations) would restrict views of the upgrade from those areas and were deducted from the "seen areas" to arrive at the "actual visual catchment" (refer to Illustration 22). While this method does not differentiate between different types of vegetation cover in the landscape and their respective visual quality, it nevertheless provides a suitable indication of the degree of exposure of the proposed upgrade. As discussed earlier, the visual quality of the landscape is generally high throughout the study area, and a differentiation into areas of differing landscape quality was not considered necessary within the quantitative assessment.

Finally, the "actual visual catchment" remains a conservative approximation of the areas from where the proposed upgrade may be able to be seen, as it does not consider the effect of vegetated areas in terms of blocking views to the proposed upgrade where they lie between the viewer and the upgrade. The area from where the proposed upgrade would be able to be seen is therefore likely to be smaller than the shaded area shown in Illustration 22.

As details are harder to discern and the development would take up a smaller portion of the view, the visual effect of the proposed upgrade would generally be smaller as the viewing distance increases. Rankings were therefore applied to the area identified as within the "actual visual catchment". Viewing distances within the closest proximity to the proposed

upgrade receive the highest ranking, where as background views receive a 0 ranking. The rankings are as follows:

- 0) Background: the upgrade is able to be seen from a distance greater than three kilometres.
- 1) Middleground: the upgrade is able to be seen from a distance between 600 metres and three kilometres
- 3) Foreground: the upgrade is able to be seen from a distance between 100 metres and 600 metres
- 5) Close proximity : the upgrade is able to be seen from within 100 metres of the centreline of the upgrade.

These distances were measured from the centre of the median of the proposed upgrade, taken to be indicative of the centre of the proposed road infrastructure.

The Visual Exposure score would be derived by multiplying the actual visual catchment area within each distance range with the relevant ranking factor. The results for all distance ranges would be added and then divided by the length of the upgraded highway within the Precinct.

For example, the length of the upgraded highway may be 4.2 kilometres within a precinct and have an actual visual catchment of 4.6 square kilometres, 1.8 square kilometres of which is located at a distance of three kilometres or more from the proposed upgrade, 1.3 square kilometres of which is located between 600 metres and three kilometres, 1.25 square kilometres of which is located between 600 metres and 300 metres, and 0.25 square kilometres is located within 100 metres of the proposed upgrade centreline. The Visual Exposure Score would be:

$$(1.8 \times 0 + 1.3 \times 1 + 1.25 \times 3 + 0.25 \times 5) : 4.2 = 3$$

Visual Effect Score

Using the above example, the final Visual Effect Score would be

$$2.88 \times 3 = 8.64$$

The Visual Effect Scores were ranked as follows:

Visual Effect Score	Visual Effect Ranking
0 - 3	Low
3 - 6	Low to moderate
6 - 9	Moderate
9 - 12	Moderate to high
> 12	High

Using the quantitative assessment method, the Visual Effect of the above example would be considered to be moderate.

VISUAL SENSITIVITY

Visual sensitivity is a measure of how critically a change to the existing landscape would be viewed from various areas and users. The visual sensitivity of a proposed development therefore depends on the type of viewers and surrounding land uses likely to see the proposed development, as well as on the visual characteristics of the existing environment. Tourists or people using recreational areas, for example, would use the surrounding landscape as part of their leisure experience and will view change to the landscape more critically than for example industrial or agricultural workers. Similarly, viewers are likely to be highly sensitive to development in natural or previously undeveloped areas and less sensitive to developments in areas which are already highly developed or widely considered to be of lesser scenic quality, such as industrialised areas.

In terms of the quantitative assessment, the visual sensitivity was considered to be an expression of the number of potential viewers in the area, combined with the distance between viewers and the proposed upgrade. Similar to the visual effect, this represents a relative measure of the visual sensitivity of viewers in the study area that does not take into consideration the particular values that viewers might assign to the landscape. These have been described in previous sections of this working paper. Since they will also influence the perception of the overall visual impact of the proposed upgrade, they also form part of a qualitative discussion in the "Visual Impact Summary" following the quantitative visual assessment.

Similar to the visual effect, the sensitivity of viewers within close proximity would be larger than that of viewers seeing the upgrade from a large distance. The same rankings have therefore been applied, assigning the highest ranking to viewers within the closest proximity, whereas background viewers have received a 0 ranking, due to the smaller portion of the view affected by the upgrade when seen from a larger distance. The rankings are as follows:

- 0) Background views: viewers seeing the proposed upgrade from a distance greater than three kilometres.
- 1) Middleground views: viewers seeing the proposed upgrade from a distance between 600 metres and three kilometres

- 3) Foreground views: viewers seeing the proposed upgrade from a distance between 100 metres and 600 metres
- 5) Close proximity views: viewers seeing the proposed upgrade from within 100m of the centreline of the upgrade.

As for the visual effect, distances were measured from the centre of the median of the proposed upgrade.

The visual sensitivity score would be derived by calculating the number of buildings (households) and the length of local road within each distance range. Household numbers were multiplied by 2.9, to arrive at an approximation of the actual number of viewers (based on the average number of people living in households in the area, according to 2006 Census data.) For townships (Newrybar, Bangalow), the number of lots within each distance range was counted, again multiplied by 2.9 to arrive at an approximation of actual viewer numbers.

Finally, the sum of road kilometre length and viewer numbers was multiplied by the relevant ranking factor, to arrive at a score for each distance range. The scores were divided by 100, in order to arrive at a score compatible with the figures for other calculations, then added up to arrive at the final visual sensitivity score for the precinct.

For example, with a precinct there may be 15 residential dwellings or lots and one kilometre of local roads within close proximity of the proposed upgrade, 63 residences and 1.8 kilometres of local roads within the foreground range, 43 residences and 6.1 kilometres of local road within the mid-ground range, and 51 residences and 8.2 local road kilometres in the background range. The Visual Sensitivity score would be

$$((15 \times 2.9 + 1) * 5 + (63 \times 2.9 + 1.8) * 3 + (43 \times 2.9 + 6.1) * 1 + (51 \times 2.9 + 8.2) * 0) : 100 = 9.07$$

Visual Sensitivity Score

Using the above example, the final Visual Sensitivity Score would be 9.07.

The Visual Sensitivity Scores were ranked as follows:

Visual Sensitivity Score	Visual Sensitivity Ranking
0 - 5	Low
5 - 10	Low to moderate
10 - 15	Moderate
15 - 20	Moderate to high
20 - 25	High

Using the quantitative assessment method, the Visual Sensitivity of the above example would be considered to be low to moderate.

VISUAL IMPACT SCORE

Based on the above examples, the visual effect of the proposed upgrade in a precinct would be moderate. The visual sensitivity of the precinct would also be moderate. The visual impact of the proposed upgrade within the precinct would therefore be considered to be moderate (refer to Illustration 21).

MITIGATION MEASURES

Mitigation measures are visual treatments that are recommended to mitigate the visual impacts of a proposed development. They include ways to lessen the visual effect of the proposed upgrade itself and identify treatments near critical view areas to reduce the visual impacts of a proposed development.

Mitigation measures will be addressed in the "Urban and Landscape Concept Design" section of this working paper.

URBAN DESIGN, LANDSCAPE AND VISUAL ASSESSMENT PRECINCTS

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The landscape and visual impact assessment identifies the potential impacts of the proposed upgrade on its setting. The motorists' experience of the highway journey is considered in the 'Urban and Landscape Design' section of this Working Paper.

The landscape and visual impact assessment involves an analysis of the site in terms of the existing landscape and visual character of the study area surrounding the proposed upgrade, and an analysis of the visual prominence and visual effect of the proposed works. Based on this analysis, any potential impacts are identified and any necessary mitigation measures are recommended in the 'Urban and Landscape Design Concept' section later in this working paper.

The visual impact of the proposed upgrade is determined by evaluating the visual effect of the proposed works, in the context of the visual sensitivity of viewers in the area, as described in the visual assessment method in section 1 of this report.

For the purposes of discussion of the proposed upgrade works, the study area along the route of the proposed upgrade has been broken down into five precincts (refer to Illustration 23). The precincts roughly correspond to visual catchments in the area and allow for a more detailed discussion of the visual character of each precinct, of the proposed works within it and of the sensitivity of viewers that would be able to see the proposed upgrade.

The five precincts are:

- 1 Knockrow (Ross Lane to Martins Lane)
- 2 Emigrant Creek (Martins Lane to Broken Head Road)
- 3 Bangalow (Broken Head Road to Byron Creek)
- 4 Tinderbox Creek Valley (Byron Creek to St Helena ridge)
- 5 Ewingsdale (St Helena ridge to Ewingsdale interchange)

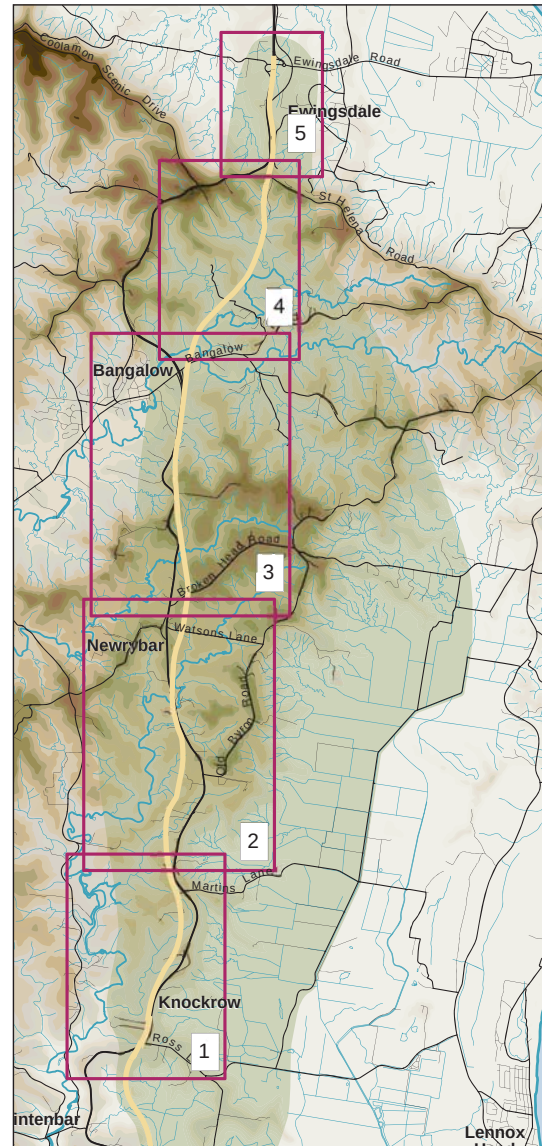


Illustration 23:
Key Plan - Visual and Landscape Impact Assessment Precincts

POTENTIAL IMPACTS COMMON TO ALL PRECINCTS

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A NEW ELEMENT IN THE RURAL LANDSCAPE

The major visual change resulting from the proposed upgrade and affecting all precincts would be the introduction of the new dual carriageway highway into a highly scenic rural landscape. This landscape, while highly developed for agricultural purposes, has retained limited levels of development in general. In particular infrastructure development has been limited, with the majority of local roads retaining a low key rural road character. Local conditions, in particular the local topography, have determined the design of local roads. This is reflected in the gradients along those roads and the radii of curves in their alignment, which in turn influence the speed of travel and, to a degree, contribute to the poor safety record of the existing highway.

In addition to giving a major part of the landscape over to the development of a new roadway, the design approach for the upgraded highway in many respects is the reverse. Though the desire to fit the upgraded highway into the landscape was one of the criteria that informed the route selection process, meeting the design standards and requirements for a major national highway will invariably require adjustments to the landscape to accommodate the route.

As a result, significant modifications are required to the landscape as part of the proposed upgrade. In particular, cut and fill embankments would be an almost continual feature along the upgraded highway.

In addition, local land use and agricultural development has occurred in conjunction with the pattern of local roads and other local topographic features. The provision of an upgraded highway requires deviating from the existing highway alignment in order to achieve the desired design criteria. The proposed highway would therefore bisect the landscape along an alignment which does not correspond to the pattern of subdivision and development of the area. The wide and smooth hard pavement of the proposed highway and its engineered curves, cuttings and embankments would be in stark contrast with the highly textured agricultural landscape of the elevated plateau which has largely retained its natural landform. This would make the upgraded highway easily perceived as an imposition onto the existing landscape. It would be particularly reflected in the sometimes odd and ever-changing angles established between existing landscape features such as plantations and the upgraded highway.

As a major new highway, the proposed upgrade would also be highly prominent in the rural landscape. This would especially be the case in the southern half of the study area, and at its northern end where the upgraded highway would

follow an alignment of generous meanders in close proximity to the existing highway alignment, with the two alignments crossing or 'touching' in several locations. This creates a high level of interaction and visibility between the two roadways, which will characterise much of the study area. The design of the upgraded highway and of urban and landscape design elements in the study area will be of particular importance in this context, in order to achieve an outcome which recognises the importance of the relationship between the existing highway and the proposed upgrade. The design measures outlined in the "Urban and Landscape Concept" section later in this working paper aim to enhance the experience of road users on both routes, as well as to mitigate the potential impacts of the large increase in road infrastructure on viewers in surrounding areas.

TEMPORARY IMPACTS DURING CONSTRUCTION

Temporary impacts of construction works would be common to all precincts. They would include the generally short-term visual impacts of the construction works themselves, and the short to medium impacts in the period immediately following construction until landscape design measures grow and take effect in ameliorating some of the impacts of construction works on the landscape.

Short-term visual impacts during construction would include:

- > The location and/ or construction of temporary batching plants.
- > The prominence of construction machinery.
- > Frequent construction vehicle movements along the local road system.
- > Construction fencing.
- > Temporary erosion and sediment control measures such as sedimentation basins and fences.
- > The location of material stockpiling and construction yards in the study area.

Temporary impacts remaining for a period of time following construction completion include the visual impacts of bare cutting faces and fill embankments, until planting and revegetation works become established.

VISUAL ASSESSMENT - PRECINCT 1: KNOCKROW

ROSS LANE TO MARTINS LANE, CHAINAGE 134,750 TO 138,000

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EXISTING LANDSCAPE AND VISUAL CHARACTER

The landscape in the Knockrow precinct is highly scenic and diverse. Being located at the edge of the elevated plateau escarpment with views towards the Pacific Ocean in the east, it has a particularly expansive character. It is one of the relatively few sections along the Pacific Highway which permits ocean views. These are particularly spectacular south of Martins Lane when travelling south. In contrast, the western portion of the precinct sets the tone for the character of much of the landscape in remaining Precincts. This landscape is located on the undulating high plateau with its characteristic mix of strongly patterned agricultural landscapes and open pastures, complemented by rural residential housing and farmsteads located off the local access roads.



*Illustration 24:
Aerial Overview of the Knockrow precinct*



*Illustration 25 - 29:
Character Images of the Knockrow precinct: view towards the Pacific Ocean from the existing highway, the agricultural hinterland, view towards the Pacific Ocean from Martins Lane West, and Highway frontage and plantations in 'Clovelly Grove'*

THE PROPOSED UPGRADE

The proposed Tintenbar to Ewingsdale Pacific Highway upgrade would commence at the Ross Lane interchange which would be constructed as part of the proposed Ballina bypass Highway upgrade. It will be a grade-separated interchange featuring a northbound off-ramp and a southbound on-ramp. The existing Pacific Highway will be realigned with a bridge over the upgraded highway with a roundabout located on either side of the bridge terminating the on- and off-ramps. As part of the Tintenbar to Ewingsdale upgrade, a northbound on-ramp and a southbound off-ramp would be added to the interchange. The latter would connect to the existing highway approximately 1 kilometre north of Ross Lane. As a result of the proposed upgrade, the Ross Lane interchange would provide for vehicle movements in all directions.

North of the Ross Lane interchange, the upgraded highway would be located to the west of and closely aligned with the existing highway alignment, with the distance between the existing and upgraded highway slightly increasing in the northern half of the precinct. As a result, access from properties on the western side of the upgrade to the existing highway alignment would no longer be possible, affecting properties 5, 6, 7, 10, 13, 16, 22, 30, 32 and 36. A new, approximately 1.2 kilometre long local access road would be provided on the western side of the upgraded highway, commencing from the roundabout on the western side of the Ross Lane interchange and providing access to properties 5, 6, 7, 10, 13, 16 and 22.

Access to properties off Martins Lane West would also be no longer possible, affecting properties 39, 40, 48 and 52 in this precinct. A new local access road would be provided servicing these properties and others to the west of the upgraded highway in the Emigrant Creek precinct. The local access road would be connected via an underpass under the upgraded highway to a straight stretch of the existing highway alignment between Carney Place and Martins Lane East. The local access road would be about 2.4 kilometres long.

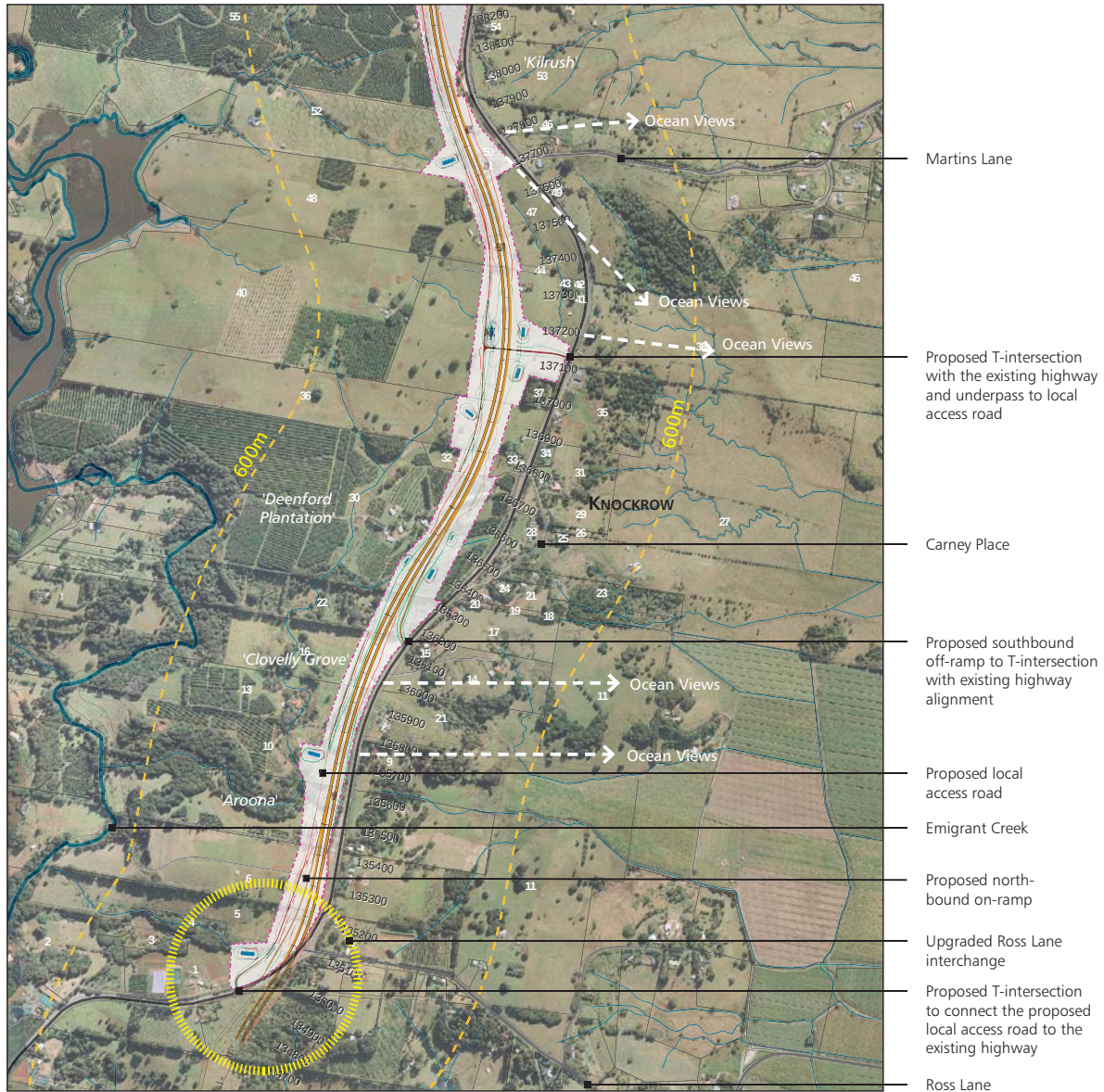
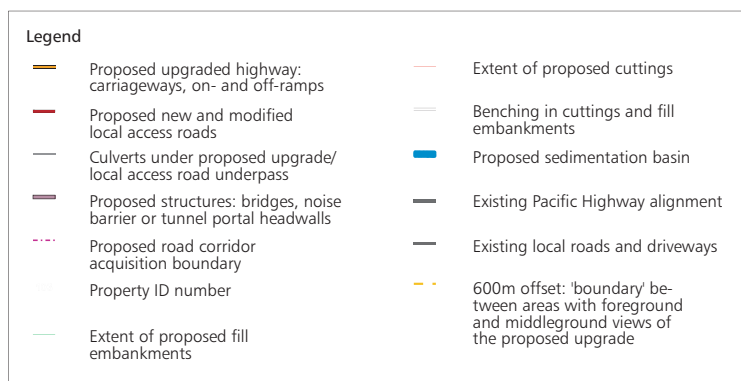


Illustration 30:
Overview of the proposed upgrade in precinct 1



VISUAL ASSESSMENT

Visual Effect

The proposed upgrade would result in a notable increase in road infrastructure in this precinct, in particular in the area immediately north of the Ross Lane interchange where there would be a large number of parallel roadways, including the local access road, northbound on-ramp, the upgraded highway and the existing highway alignment. The provision of individual cuttings for some of these will assist in reducing the overall visual effect of the large number of roadways in close proximity to one another and associated expanse of pavement.

Further, while there would be a large amount of road infrastructure at the Ross Lane interchange, the majority of this would be in place prior to construction works for the upgraded highway, including the two roundabouts, and the changes to the existing highway alignment, crossing over the upgraded highway on a new bridge structure. The new local access roads on the western side of the upgrade further increase the amount of road infrastructure in the precinct.

Another area where the increase in road infrastructure would be highly visible would be in areas where both the new local access road and the upgraded highway would be located on fill embankments so that they would be relatively exposed to views from the existing highway alignment.

The intersection of the proposed local access road and the existing highway alignment approximately half way between Carney Place and Martins Lane would be a noticeable new element, but would be of relatively small scale.

The construction of the upgraded highway would further affect the visual character of the precinct through the severance of agricultural properties. Apart from the introduction of a new infrastructure element in the landscape, specific effects would be the loss of macadamia plantations in 'Deenford Plantations' (property 30) and in Martins Lane West (property 45), as well as the prominence of cuttings and fill embankments associated with the upgrade. These would be highly noticeable when seen from both affected properties and beyond, but especially in the area between Carney Place and Martins Lane West. This section of the upgraded highway would be located on large fill embankments through relatively open countryside. It would therefore be widely exposed to views, in particular from the existing highway alignment which in this area features only limited roadside vegetation. In other sections within the precinct, the upgraded highway

would be located in cuttings which would make it less visually prominent from the surrounding landscape. However, the cuttings themselves would have a potentially significant visual effect, especially large cuttings or where soil conditions and poor slope stability would require engineered stabilisation measures such as benching, retaining walls, rock netting or shotcreting.

In terms of effects on individual properties, local access driveways are currently small in scale. They are terminated by the existing highway alignment and property owners are able to enjoy views into the landscape beyond the existing Pacific Highway. As a result of the proposed upgrade and associated earthworks, the views along many access driveways would be blocked instead by fill embankments. This would affect the vistas along these driveways and the respective experience of affected property owners.

Another effect of the proposed upgrade would be the loss of property boundary plantations along the edge of the existing highway alignment, which currently make an important contribution to the landscape character of the precinct (refer to Illustration 29).

Scale of the Infrastructure

Size of Cuttings and Embankments

Cutting/ Embankment Height	Ranking	Length (m)	% within precinct	Score
0-0.5m	1	148	4.6	0.05
0.5-2m	2	565	17.4	0.35
2-5m	3	1,020	31.4	0.94
5-10m	4	1,109	34.1	1.37
10-20m	5	407	12.5	0.63
>20m	6	0	0	0
Total		3,250		3.33

Road Corridor Size

Corridor Size (km ²)	Length of Highway (km)	Score
0.414	3.25	1.27

Total Score for Scale of the Infrastructure

$$3.33 \times 1.27 = 4.23$$

Visual Exposure

Viewing Distance	Ranking	Actual Viewshed Area (km ²)	Score
Adjacent	5	0.39	0.60
Foreground	3	0.71	0.66
Middleground	1	3.52	1.08
Background	0	0.83	0
Total		5.46	
Total Visual Exposure Score			2.34

Total Visual Effect Score

$$4.23 \times 2.34 = 9.90$$

The quantitative assessment indicates that the visual effect of the proposed upgrade on this precinct would potentially be moderate to high due to earthworks required and the duplication of parallel road infrastructure required to maintain local road access, combined with the degree of visibility of the works.

Visual Sensitivity

The proposed upgrade would be visible from the existing highway alignment and from new local access roads. Viewers would include local residents and tourists both of which are likely to be highly sensitive to visual changes in the landscape. However, the quantitative assessment indicates that the overall number of potential viewers is limited by the comparatively few roads and buildings which would be within close proximity of the proposed upgrade. The visual sensitivity of this precinct is therefore likely to be low to moderate.

Viewing Distance	Ranking	Buildings (#)	Road lengths (km)	Score
Adjacent	5	20	0.32	2.92
Foreground	3	25	2.42	2.25
Middleground	1	49	7.94	1.50
Total Visual Sensitivity Score				6.66

Visual Impact

The quantitative assessment indicates that the visual impact of the proposed upgrade in this precinct would likely to be moderate due to the moderate to high visual effect and the low to moderate visual sensitivity of viewers in the precinct. The visual impact may be able to be decreased slightly through the implementation of mitigation measures outlined in the "Urban and Landscape Design Concept" section of this working paper.

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VISUAL ASSESSMENT - PRECINCT 2: EMIGRANT CREEK

MARTINS LANE TO BROKEN HEAD ROAD, CHAINAGE 138,000 TO 142,800

40



*Illustration 31:
Aerial Overview of the Emigrant Creek precinct*

EXISTING LANDSCAPE AND VISUAL CHARACTER

Similar to the first precinct, the character of the landscape in this precinct is highly scenic and visually diverse, being located on the elevated plateau and in close proximity to the top of the plateau escarpment. The landscape along both the upgraded highway and the existing highway alignment is characterised by the strongly patterned agricultural landscapes. Plantations are complemented by a limited amount of open pasture areas and rural residential housing and farmsteads located off the local access roads.

In the southern half of the precinct, there are open panoramic views towards the Pacific Ocean on the eastern side, where the existing highway alignment closely follows the top of the escarpment. In contrast, sections of the precinct north of Old Byron Road are set back from the top of the escarpment where views are limited to the short or middle distance by the interplay of topography and vegetation. The scenic qualities of this area are derived from the rich agricultural landscape alone. Around the Emigrant Creek crossing, views are particularly limited as the landscape is fairly contained within a series of valleys and enclosed by denser stands of vegetation along the creeks and watercourses. The Macadamia Castle is a major local landmark in the precinct, as well as an important tourist attraction.



*Illustration 32 - 36:
Character Images of the Emigrant Creek precinct: view towards the Pacific Ocean from the existing highway, the agricultural hinterland, patterned macadamia groves, the Macadamia Castle, and the enclosed landscape around the Emigrant Creek crossing*

THE PROPOSED UPGRADE

For about two thirds of the precinct, the proposed upgrade would be located to the west of the existing highway, before crossing over it north of Emigrant Creek. Most of the upgraded highway would be well set back from the existing highway alignment, with the exception of the area around the Emigrant Creek crossing where the existing highway and the upgraded highway would be closely aligned and parallel to one another.

In the vicinity of Emigrant Creek, the existing highway would be diverted for a length of about half a kilometre, to pass under the upgraded highway. The upgraded highway would pass over the realigned road and the creek at the same time, with a separate bridge provided for each carriageway. The bridge in the northbound carriageway would have a length of about 180 metres, and the bridge in the southbound carriageway would be about 165 metres long, requiring a minimum of four spans each.

Following the Emigrant Creek crossing, the upgraded highway would continue on the eastern side of the existing highway alignment, crossing Watsons Lane at right angles approximately 270 metres east of Newrybar Village. It would approach Broken Head Road after sweeping around in gentle curve on the eastern side of the Newrybar Public School. In order to reduce noise impacts on the school, a noise barrier would be provided on the western side of the upgraded highway and be approximately 400 metres long.

As part of the proposed upgrade, a grade-separated interchange would be provided at Ivy Lane, featuring of a southbound off-ramp and a northbound on-ramp. Both ramps would be connected to Ivy Lane via a roundabout. The two roundabouts would be linked by an extension of Ivy Lane under the upgraded highway. A local access road would commence at the western roundabout and provide access to properties currently serviced by Ivy Lane (property 73, 81, 82 and 85). The western properties severed by the upgraded highway in the southern part of the precinct (properties 55, 58, 60, 62 and 70) would be accessed via the local access road commencing between Carney Place and Martins Lane in precinct One.

In the vicinity of Emigrant Creek, changes to access arrangements would include two short access roads from the existing highway alignment to properties 89 ('Yarrenbool Place') and 92 on the western side of the upgraded highway. The access roads would be located on the south and north sides respectively of an unmade creek and dam. They would be bridged by twin bridges with a length of about 130 and 115 metres long for the north- and southbound carriageway

respectively. Indicative bridge layouts developed to demonstrate that functional requirements can be achieved indicate that a minimum of four spans would be required for each bridge. Access to property 101 would also be reconfigured, with a new local access road constructed off the realigned existing highway.

Watsons Lane would also be reconfigured to pass under the upgraded highway. The low clearance of the culvert under the upgrade would no longer permit heavy vehicles to use this route.

Though it would be wholly contained between the existing highway alignment and the proposed upgrade and a part of the property would need to be acquired, the built structure of the Macadamia Castle and its role as a tourist destination would not be directly affected by the proposal, from a visual point of view. Due to the intervening effects of existing vegetation at the rear of the Castle, the upgraded highway would not be visible from the site of this popular tourist attraction.

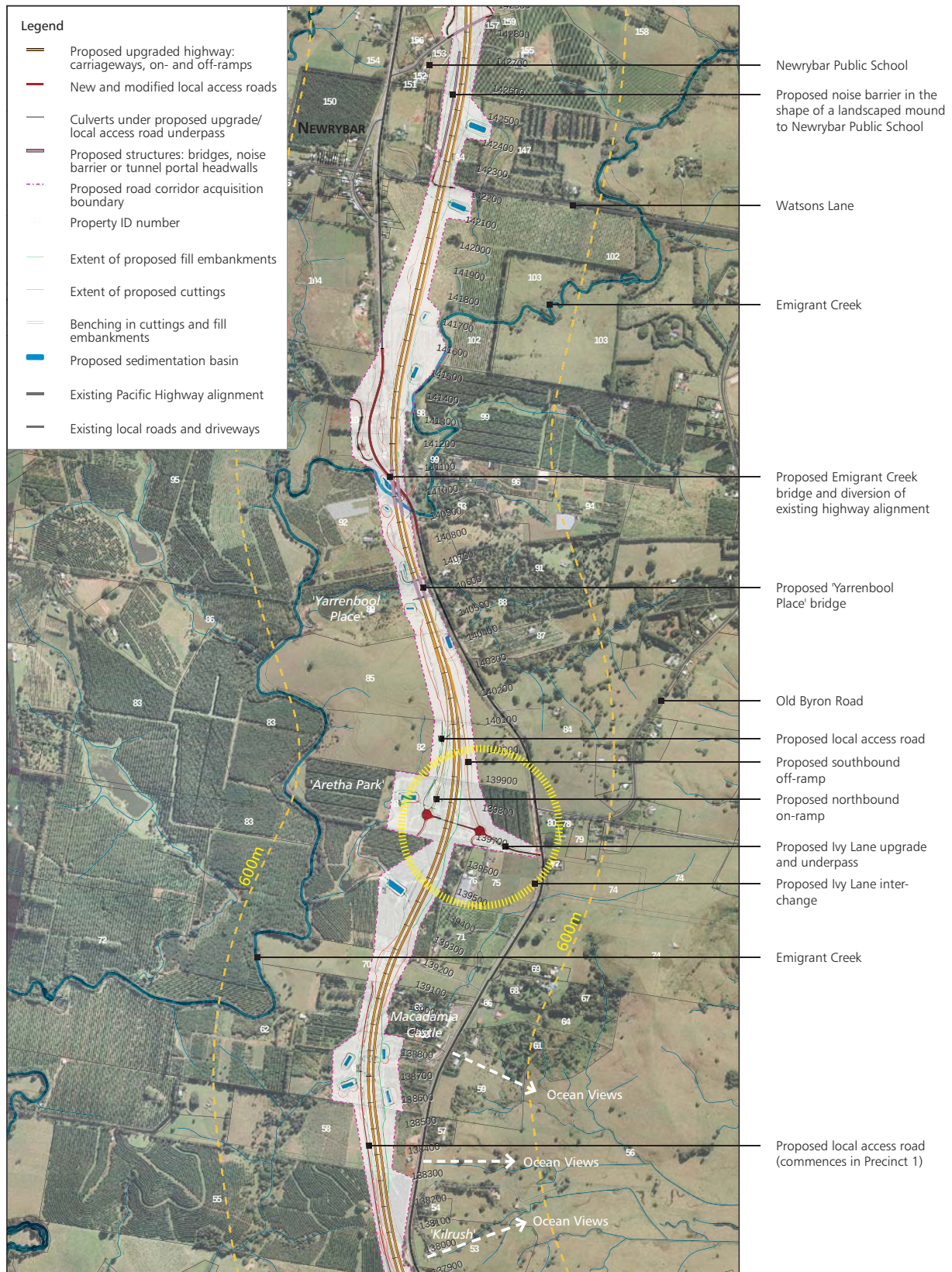


Illustration 37:
Overview of the proposed upgrade in Precinct 2

VISUAL ASSESSMENT

Visual Effect

Major visual changes specific to the precinct would be result from the construction of the creek crossings and associated works including the realignment of the existing highway near Emigrant Creek, the construction of the Ivy Lane interchange, the removal of vegetation, including agricultural plantations, and the large cuttings and fill embankments required to achieve a satisfactory vertical road alignment. Road infrastructure beyond the upgraded highway itself would be limited compared to other precincts, with this precinct requiring relatively few new or amended local access arrangements.

Works at Emigrant Creek would be of significant scale. They would include the realignment of the existing highway, including lowering of the alignment to allow the upgrade to pass over it, and the construction of fill embankments leading up to the creek crossing. The approximately 180 and 165 metres long twin bridges in the upgraded highway, spanning both the realigned existing highway and Emigrant Creek would be significant new structures. Further, a major cutting would be required on the southern approach to Emigrant Creek and would be clearly visible from the existing highway alignment. The overall visual effect of the Emigrant Creek crossing itself would be somewhat reduced by the location of the works in the Emigrant Creek Valley. While the valley is visually relatively well contained, much of the existing heavy vegetation cover is closely aligned with the existing highway and would need to be removed. While visibility of the Emigrant Creek crossing is currently limited as a result, following the proposed upgrade the crossing would be more widely exposed to views, in particular from the west, unless vegetation is reinstated in this area.

The twin underpasses and bridge over the Emigrant Creek tributary near 'Yarrenbool Place' would represent another highly noticeable visual change, being located immediately alongside the existing highway alignment.

The construction of the Ivy Lane interchange, associated roundabouts, underpass and local access roads on the western side of the upgraded highway would introduce a significant amount of road infrastructure in this part of the precinct, representing a notable visual change. With the exception of the off-ramp, these are all located on fill embankments, adding to the visual prominence of the infrastructure. However, the location of the interchange just offset from the

ridge line and the irregular pattern of vegetation in the area would conceal it to a degree, lessening its visual effect.

The construction of the proposed upgrade would result in a reduction in the area covered by macadamia plantations between Martins Lane and Old Byron Road, on the western side of the existing highway. This would be highly noticeable, as plantations currently about the existing highway alignment and provide a pleasant visual experience with their highly textured foliage and strict grid arrangement that provides a constantly changing pattern to the passing viewer (refer to Illustration 34). Following the proposed upgrade, plantations in this area would be confined to the western side of the upgraded highway. In addition to losing the experience of driving along the edge of the plantations, the plantations currently restrict views and their removal would expose the upgraded highway more widely to views from the existing highway alignment. In particular when approaching the Macadamia Castle from the south, both the upgraded highway and local access road would be highly visible as they cut through the rural landscape below the ridge line along which the existing highway is located (refer to Illustration 38).



Illustration 38:
The elevation and sweep of the existing highway alignment on the southern approach to the Macadamia Castle will make the proposed upgrade highly visible to motorists along this route.

North of Emigrant Creek, the upgraded highway would sever existing macadamia and coffee plantations. This would be noticeable from a number of locations within the precinct, including the existing highway and the proposed upgrade, from Old Byron Road, Watsons Lane and from within the affected properties themselves. The effect would be exaggerated by the changing angles created between the wide sweeping curves of the upgraded highway and the strong grid pattern of the plantations. The resulting conflicting geometries would make it obvious that the upgraded highway was imposed on the pre-existing agricultural landscape.

With regard to earthworks, the proposed upgrade in this precinct would traverse a series of valleys and ridge lines and as a result would require significant earthworks along much of the route to achieve a satisfactory vertical alignment. In particular, a number of large cuttings are required around the Macadamia Castle and the Ivy Lane interchange, near the Emigrant Creek crossing and north up to Watsons Lane. The construction of the noise barrier near Newrybar Public School in the shape of a landscaped earth mound would represent a further noticeable modification to the natural landscape. Provided the mound is successfully vegetated and well designed to integrate with the natural landform and the cutting under Broken Head Road, its visual effect may be able to be reduced over time and as vegetation matures.

The size of the cuttings and fill embankments together with the severing of properties throughout much of the precinct would result in a notable visual effect, in particular on the affected land holders. The proposed upgrade would feature prominently when seen from their properties. This would be exacerbated by the fact that additional trips would be needed to be made by these land holders who would need to use the new local access road and the existing highway alignment to travel between the severed halves of their properties.

Cuttings and fill embankments would also be noticeable from parts of the local road system.

Scale of the Infrastructure

Size of Cuttings and Embankments

Cutting/ Embankment Height	Ranking	Length (m)	% within precinct	Score
0-0.5m	1	145	3.0	0.03
0.5-2m	2	780	16.2	0.32
2-5m	3	1,328	27.7	0.83
5-10m	4	1,746	36.4	1.46
10-20m	5	800	16.7	0.83
>20m	6	0	0	0
Total		4,800		3.47

Road Corridor Size

Corridor Size (km ²)	Length of Highway (km)	Score
0.789	4.8	1.64

Total Score for Scale of the Infrastructure

$$3.47 \times 1.64 = 5.69$$

Visual Exposure

Viewing Distance	Ranking	Actual Viewshed Area (km ²)	Score
Adjacent	5	0.26	0.27
Foreground	3	1.26	0.79
Middleground	1	1.29	0.27
Background	0		0
Total		2.72	
Total Visual Exposure Score			1.33

Total Visual Effect Score

$$5.69 \times 1.33 = 7.57$$

The quantitative assessment indicates that the visual effect of the proposed upgrade on this precinct would potentially be moderate due to the visual effect associated with the road and creek crossings, the Ivy Lane interchange and the severing of the agricultural landscape. The relatively visually well contained nature of the precinct reduces the visual effect of

the proposed works by limiting areas from which they would be able to be seen.

Visual Sensitivity

The quantitative assessment indicates that the visual sensitivity of this precinct is likely to be moderate, as sections of the proposed upgrade within this precinct would be exposed to a potentially large number of viewers who would be able to see the upgraded highway from the existing highway alignment, local access roads, local residences and properties and possibly from Newrybar Public School. Limited glimpses may also be possible from the Harvest Café terrace in Newrybar, where a large number of people currently enjoy the outlook beyond the existing highway and into the agricultural landscape to the east. Viewers would include local residents, workers on rural properties and tourists. In particular the large number of local residents and tourists likely to be able to see the proposed upgrade are likely to be highly sensitive to visual changes in the landscape.

Viewing Distance	Ranking	Build-ings (#)	Road lengths (km)	Score
Adjacent	5	17	1.05	2.52
Foreground	3	112	4.07	9.87
Middleground	1	54	4.45	1.61
Total Visual Sensitivity Score				13.99

Visual Impact

The quantitative assessment indicates that the visual impact of the proposed upgrade in this precinct would likely to be moderate due to the moderate visual effect and the moderate visual sensitivity of viewers in the precinct. The visual impact may be able to be decreased slightly through the implementation of mitigation measures outlined in the "Urban and Landscape Design Concept" section of this working paper.

VISUAL ASSESSMENT - PRECINCT 3: BANGALOW

BROKEN HEAD ROAD TO BYRON CREEK, CHAINAGE 142,800 TO 147,000

46



*Illustration 39:
Aerial Overview of the Bangalow precinct*

EXISTING LANDSCAPE AND VISUAL CHARACTER

The character of the landscape in this precinct is characterised by its central location on the elevated plateau, well away from the edge of the escarpment. It differs from the previous two precincts insofar as it is influenced by the township of Bangalow and associated infrastructure including the Bangalow bypass and the Bangalow interchange. Outside of Bangalow, there is a population cluster along Broken Head Road.

The landscape is undulating and visually diverse, as a result of the interplay between topography and vegetation. Portions of the precinct around Lawlers Lane and near Broken Head Road feature strongly patterned agricultural plantations, while other areas are characterised by open pasture landscapes, including areas in the Byron Creek floodplain. The floodplain is fairly broad and contrasts in character with the more steeply sloping hills and ridges that dominate much of the elevated high plateau. Views around the floodplain are more open and the area is also relatively exposed to views from elevated areas, such as the parts of Bangalow township north of the railway line. In contrast, views within much of the remainder of the precinct are much more limited, as a result of the interplay between topography and vegetation.



*Illustration 40 - 45:
Character Images of the Bangalow precinct: plantations around Broken Head Road, the mix of open and vegetated landscape, 'Arundel', view from Bangalow Reservoir, significant roadside vegetation along the Bangalow bypass and view towards 'Arundel', the flat landscape around Byron Creek crossing*

THE PROPOSED UPGRADE

The upgraded highway would be located to the west of the existing highway alignment, sweeping through a large cutting underneath Broken Head Road before straightening in direction and heading towards the existing highway alignment which it meets at the southern end of the existing Bangalow bypass. Here, the northbound carriageway would merge onto the existing southbound carriageway of the Bangalow bypass. The northbound carriageway of the Bangalow bypass would be retained as an extension of the existing highway alignment, providing one lane in each direction. The southbound carriageway of the proposed upgrade would be constructed immediately to the east of the existing Bangalow bypass. At the height of the existing off-ramp, the upgrade would continue in a straight alignment, diverging from the Bangalow bypass, before sweeping in a north-easterly direction across the Byron Creek floodplain and towards the Tinderbox Creek Valley.

The proposed upgrade would involve major modifications to the existing Bangalow bypass and interchange. In addition to transforming the existing southbound carriageway into the northbound carriageway for the upgraded highway, the existing off-ramp would be removed and a new roundabout constructed on the northern carriageway of the existing bypass. The roundabout would serve to merge the separated carriageways of the Bangalow bypass onto two lanes and feed into a new link road onto Bangalow Road. A new off-load ramp from the upgraded highway would also connect to this roundabout. The existing southbound on-ramp would be relocated further east, connecting Bangalow Road with the upgraded highway. In order to protect outlying residential areas in Bangalow, such as the 'Clover Hill' estate from the acoustic impacts noise associated with the proposed upgrade, a noise barrier would be provided on the western side of the existing highway.

As a result of the proposed upgrade, properties to the east of the existing highway alignment and the Bangalow bypass would no longer retain direct access to the existing highway (properties 205 and 207). Instead, an approximately 1.2km long local access road would be constructed parallel to and on the eastern side of the upgraded highway. Access to properties 183, 186, 191, 193, 198 ('Arundel') and 199 ('Picadilly Park') further south would be provided via a bridge over the upgraded highway and a local access road. It would connect to the existing highway in approximately the same location as the existing property access road. A private underpass would link the two severed portions of 'Arundel'.

A second bridge over the upgraded highway would be constructed in Broken Head Road where the upgrade would be located in a deep cutting. Two new short roads would provide access to the severed property 'Claremont' (property 160), north of Broken Head Road.

Other major new infrastructure elements in the precinct would be the two sets of twin bridges which would be constructed over Skinners Creek and over Byron Creek and the railway line. The bridges at Skinners Creek would be about 190 metres long and are likely to require a minimum of five and four spans for the north- and southbound carriageway respectively. The length of the bridges over Byron Creek would be about 190 metres and 180 metres for the north- and southbound carriageway respectively, with each bridge likely to require five spans. A relatively short set of twin bridges of about 60 metres length would also be required over Bangalow Road. Initial design investigations have indicated that these bridges will require three separate spans.

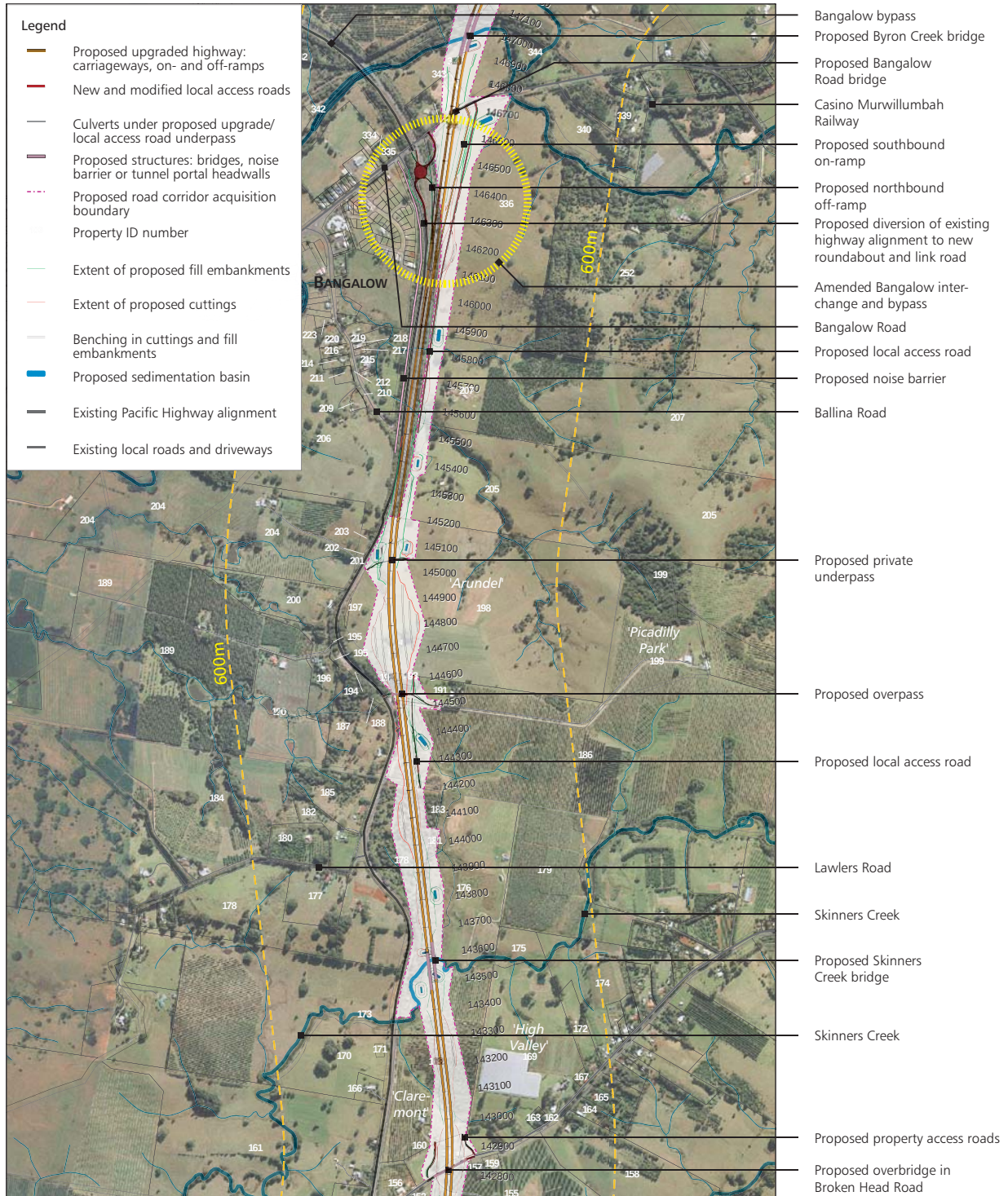


Illustration 46:
Overview of the proposed upgrade in precinct 3

VISUAL ASSESSMENT

Visual Effect

The major visual changes in the Bangalow precinct would be associated with the significant amount of earthworks in the precinct, specifically the major cutting through 'Arundel' (property 198), the works around the existing Bangalow bypass, the crossing of Broken Head Road and the severing of agricultural plantations.

The proposed upgrade in this precinct would traverse a series of valleys and ridge lines, requiring significant earthworks along much of the route to achieve a satisfactory vertical alignment. In particular, large cuttings would be required near Broken Head Road and north through properties 160 and 168. A particularly large cutting would be required near 'Arundel', through properties 192, 193 and 198 and would also represent a significant visual change in the landscape, slicing through a natural hill top. Being set against the skyline, it is widely exposed to views, especially from the north. Areas from which the cutting would be able to be seen include elevated parts of the Bangalow township, such as areas from Rankin Drive or other areas north of the railway line, and parts of the St Helena ridge. In addition to the significant vertical size of these cuttings, cutting angles of repose would need to be relatively flat, therefore occupying a large footprint. Substantial fill embankments would also be required in the Byron Creek floodplain.

Similarly, the large cuttings near Broken Head Road and the bridge itself would result in notable visual changes that would be highly visible from Broken Head Road and the residences and other properties located along it.

The proposed works around the Bangalow interchange would be significant due to the large increase in road infrastructure, including the pavement surfaces of the four parallel roadways (the north- and southbound carriageway of the upgraded highway, the realigned existing highway on the current northbound carriageway of the Bangalow bypass and the proposed new local access road), on- and off-ramps, roundabout and additional bridges over Bangalow Road and Byron Creek.

Further increasing the degree of visual change in this area would be the removal of roadside vegetation lining the eastern side of the existing highway alignment and Bangalow bypass, in what would be the median strip of the upgraded highway. This vegetation is particularly dense and well established and its removal would alter the outlook from the

existing highway alignment, opening up views towards the east. These views would be largely dominated by the hard pavements associated with the upgraded highway and the new local access road. In addition to representing a highly noticeable loss, it would also expose the upgrade works and existing highway alignment to views from a larger area than is currently the case. The narrow distance between the different road- and carriageways limits the potential for landscaping or other measures that would provide visual separation or screening.

Visual effects around the Bangalow interchange would be further increased by the construction of a noise barrier on the western side of the existing highway, required to provide noise amelioration to residents of outlying residential areas in Bangalow, including the 'Clover Hill' estate. While the final form of the noise barrier has not been determined, it is likely to require the removal of significant established vegetation on the western side of the existing highway. The cumulative effect of these works would be the complete removal of vegetation along what is currently a densely vegetated road and visually pleasant road corridor (refer to Illustration 44).

The twin bridges over Byron Creek and the railway line would constitute a significant infrastructure element, with a length of up to 190 metres and a height of about 24 metres above the floodplain. The relatively open and exposed location of the bridge and associated large fill embankments in the floodplain of Byron Creek would exacerbate the visual effect, with little screening provided by either the landform or vegetation cover. In this naturally flat landscape, the large fill embankments in particular would be highly noticeable as a 'foreign' object in the landscape. The height of the bridge would also readily reveal the construction method of the bridge, including the numerous piles that are likely to be required. Initial design investigations have indicated that piles are likely to be staggered which will result in a more solid appearance of the two bridges when seen from surrounding areas. While the bridge over Bangalow Road would be significantly shorter, its visual effect would be similar as it is equally raised above the natural floodplain level, and readily exposed to viewers driving along Bangalow Road, which is important as one of the main entry and arrival points at the township.

A second instance of major twin bridges would need to be constructed over Skinners Creek and would be about 190 metres long. They would be almost parallel to the existing highway alignment and within close proximity to it. Its significant elevation above the natural valley floor, together with the earthworks associated with the structure, would make it a visually noticeable and therefore important infrastructure element in the precinct. Because of this, the detailed design

resolution of the bridge would have a significant bearing on its visual effect when seen from surrounding areas or the existing highway.

Another visual effect of the proposed upgrade results from the severing of a number agricultural crop areas on the eastern side of the existing highway alignment. Affected crops would include macadamia plantations in properties 73, 81, 102, 134, 147, 160, 168 ('Claremont') and 186 ('Picadilly Park'), as well as coffee plantations south of Broken Head Road (property 155). The visual effect of severed plantations, in particular of severed macadamia plantations, would be highly noticeable from the proposed upgrade, from Broken Head Road and from within the affected properties themselves. North of Broken Head Road where macadamia plantations are largely set out in fairly straight rows either perpendicular or parallel to existing roads, the visual effect of severed plantations would be exaggerated by the changing angles between the upgraded highway alignment and the strong grid pattern of the plantations. The resulting conflicting geometries would make it obvious that the upgraded highway was imposed on the pre-existing agricultural landscape.

Scale of the Infrastructure

Size of Cuttings and Embankments

Cutting/ Embankment Height	Ranking	Length (m)	% within precinct	Score
0-0.5m	1	1,077	25.6	0.26
0.5-2m	2	607	14.4	0.29
2-5m	3	879	20.9	0.63
5-10m	4	967	23.0	0.92
10-20m	5	709	16.9	0.84
>20m	6	139	3.3	0.20
Total		4,200		2.94

Road Corridor Size

Corridor Size (km ²)	Length of Highway (km)	Score
0.495	4.2	1.18

Total Score for Scale of the Infrastructure

$$2.94 \times 1.18 = 3.47$$

Visual Exposure

Viewing Distance	Ranking	Actual Viewshed Area (km ²)	Score
Adjacent	5	0.50	0.59
Foreground	3	1.24	0.88
Middleground	1	4.45	1.06
Background	0	0.20	0
Total		6.38	
Total Visual Exposure Score			2.54

Total Visual Effect Score

$$3.47 \times 2.54 = 8.81$$

The quantitative assessment indicates that the visual effect of the proposed upgrade on this precinct would potentially be moderate due to the high visual effect associated with the road and creek crossings and the severing of the agricultural landscape, combined with the high degree to which the works would be exposed to views from within and beyond the precinct.

Visual Sensitivity

The quantitative assessment indicates that the visual sensitivity of this precinct is likely to be high, as much of the proposed upgrade would be exposed to viewing by a potentially large number of local residents and tourists, both of which would be highly sensitive to changes in the landscape. The proposed upgrade would be highly visible from local roads such as the existing highway alignment (including the Bangalow bypass), the new local access road, Bangalow Road and Broken Head Road. A potentially large number of viewers would also be able to see the works associated with the upgraded highway from parts of Bangalow, in particular from areas in close proximity to the upgrade such as around Ballina Road, and from higher lying areas north of the railway line. Other potential viewers would include farm workers and local residents on properties east of the upgraded highway and along Broken Head Road.

Viewing Distance	Ranking	Build-ings (#)	Road lengths (km)	Score
Adjacent	5	16	1.09	2.37
Foreground	3	129	2.42	11.30
Middleground	1	406	10.77	11.88
Total Visual Sensitivity Score				25.55

Visual Impact

The quantitative assessment indicates that the visual impact of the proposed upgrade in this precinct would likely to be moderate to high due to the moderate visual effect and the high visual sensitivity of viewers in the precinct. The visual impact may be able to be decreased slightly through the implementation of mitigation measures outlined in the "Urban and Landscape Design Concept" section of this working paper.

VISUAL ASSESSMENT - PRECINCT 4: TINDERBOX CREEK VALLEY

BYRON CREEK TO ST HELENA RIDGE, CHAINAGE 147,000 TO 150,200

52



*Illustration 47:
Aerial Overview of the Tinderbox Creek Valley precinct*

EXISTING LANDSCAPE AND VISUAL CHARACTER

The landscape in this precinct is characterised by the undulating and open grassed hillsides of the valleys along Tinderbox Creek and its tributaries. The southern part of the precinct features the floodplains of Byron and Tinderbox creeks which are fairly broad compared to the more steeply undulating landscape of much of the elevated plateau and the Tinderbox Creek Valley. The predominant agricultural land use in this area is grazing, however, there are a limited number of macadamia plantations around the perimeter of the valleys. Open grazing paddocks are interspersed with individual trees or clumps of vegetation along the creeks. The precinct is visually highly contained, being surrounded by the steeper ridge lines along which the main local roads are located, including the existing highway alignment, St Helena Road and Bangalow Road. The St Helena ridge is particularly high and steep. As discussed earlier in this working paper, it forms the northern edge of the elevated plateau and is a part of the scenic escarpment identified and protected under the Byron Bay Local Environmental Plan.



*Illustration 48 - 53:
Character Images of the Tinderbox Creek Valley precinct: the Tinderbox Creek floodplain, view into the valley from Tinderbox Road, the piggery and rural yards off Tinderbox Road, view into the precinct from 'Byron View' (off St Helena Road), and views into the precinct from St Helena Road, above the proposed tunnel portal*

THE PROPOSED UPGRADE

After diverting from the existing Bangalow bypass alignment south of Byron Creek, the proposed upgrade would sweep in a north-easterly direction, between Tinderbox Creek and macadamia plantations in 'Jelbon Leigh' (property 349). It would then continue to closely follow the edge between the Tinderbox Creek floodplain and the foot of adjacent hills, before sweeping northwards towards the St Helena ridge along the valley floor of a northern tributary to Tinderbox Creek. About 140m south of St Helena Road, the upgraded highway would enter an approximately 340m long tunnel under the St Helena ridge. A separate tunnel would be provided for each carriageway. A major visual element associated with the tunnel would be the twin portals constructed in the side of the St Helena ridge. Construction of the portals is likely to involve an engineered head wall. In addition, major excavation works would be required in the side of the St Helena ridge, extending about 150 metres south of the tunnel portals and resulting in cuttings of major scale leading up to the portals. Due to the size and steepness of the cuttings, they are likely to require engineered stabilisation measures.

The proposed upgrade would further involve the construction of two major sets of twin bridges in the precinct, one over Byron Creek (discussed in precinct 4 above), and another over a tributary to Tinderbox Creek, just south of Tinderbox Road. The latter bridges would be approximately 145 metres long and elevated about 11 metres above the natural ground level. They are likely to require a minimum of three spans each.

The works around Tinderbox Creek would further involve the diversion of a short section of Tinderbox Road to pass under the upgraded highway alongside the Tinderbox Creek tributary.

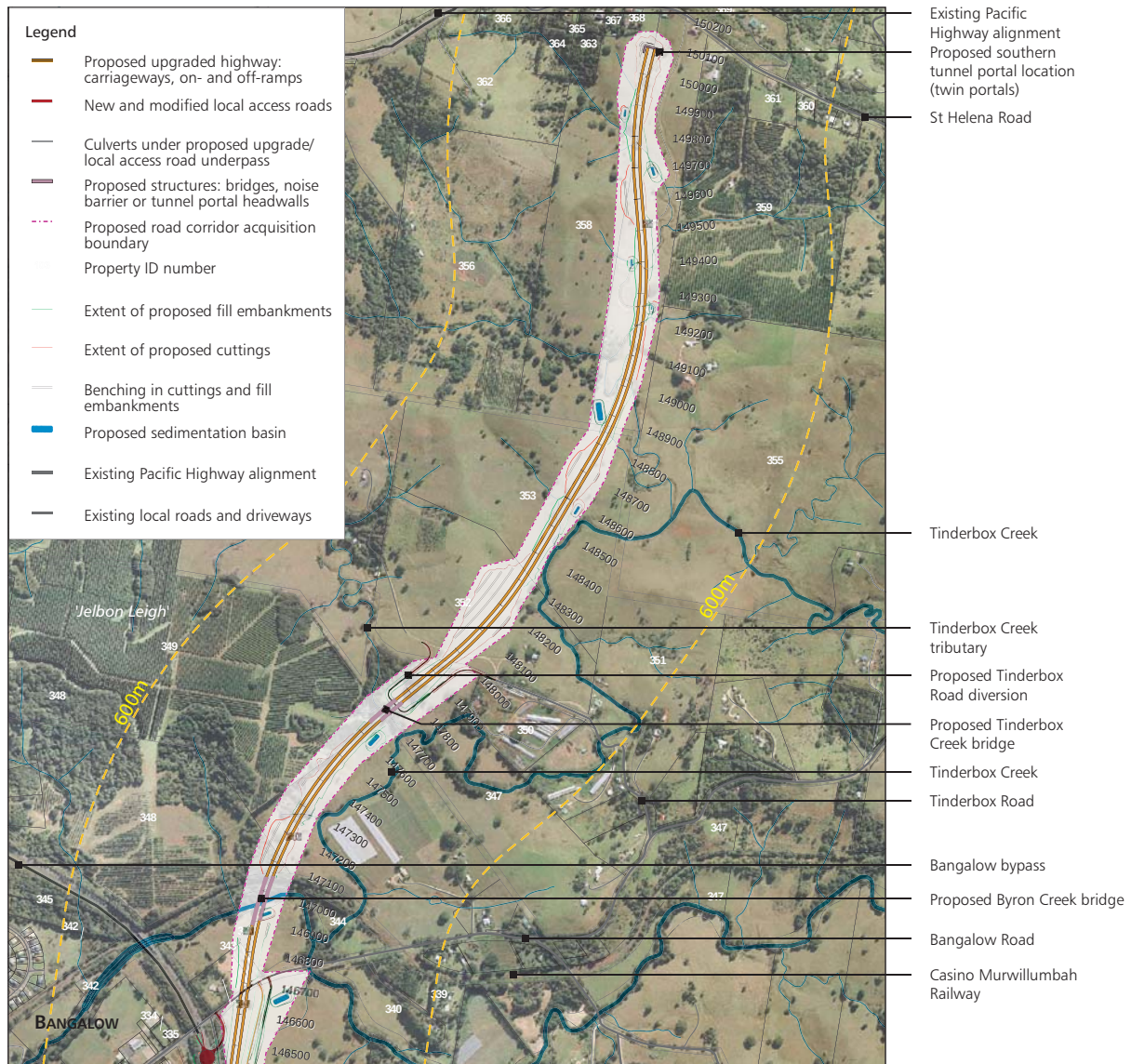


Illustration 54:
Overview of the proposed upgrade in precinct 4

VISUAL ASSESSMENT

Visual Effect

Major visual changes in the Tinderbox Creek Valley precinct result from the large size of cuttings, from the construction of the tunnel portals and the construction of the bridge over the Tinderbox Creek tributary and associated Tinderbox Road diversion.

Significant earthworks would be required for much of the precinct, with major cuttings needed north of Tinderbox Road and around the tunnel portal. The cutting on the tunnel approach would result in a major visual change to the character of the existing hillside, due to its significant height, the extent of excavation of the natural hillside, the steep nature of the cutting faces and the need for benching to improve stability. The steep cutting faces are likely to present challenges to revegetation, and are therefore likely to require 'hard' engineering stabilisation measures which would result in a stark contrast to the existing grazing landscape (refer to Illustration 53).

While the magnitude of cuttings associated with the portal construction provides an indication of the potential visual effect of the portal in quantitative terms, the actual visual effect on the surrounding landscape may be greater. It would be determined to a significant degree by the final design and detail treatment of the tunnel approach and portals. Recommendations on the design of the tunnel portals are provided in the "Urban and Landscape Design Concept Plan" section of this Working Paper.

In addition, the landscape of the precinct is fairly open and would readily expose the upgrade and associated works to viewers on surrounding properties and local ridge line roads.

While road infrastructure in this precinct would be minimal beyond the upgraded highway itself, the diversion of Tinderbox Road and the construction of the bridge over the Tinderbox Creek tributary would result in a notable visual change. While the design of the bridge has the potential to reduce the visual effect of the structure, its visibility would generally be limited to immediately surrounding areas, due to the landform and vegetation cover along the creeks in the vicinity of the proposed bridge and road diversion.

Scale of the Infrastructure

Size of Cuttings and Embankments

Cutting/ Embankment Height	Ranking	Length (m)	% within precinct	Score
0-0.5m	1	246	7.07	0.08
0.5-2m	2	594	18.6	0.37
2-5m	3	897	28.0	0.84
5-10m	4	701	21.9	0.88
10-20m	5	645	20.1	1.01
>20m	6	118	3.7	0.22
Total		3,200		3.17

Road Corridor Size

Corridor Size (km ²)	Length of Highway (km)	Score
0.429	3.2	1.34

Total Score for Scale of the Infrastructure

$$3.17 \times 1.34 = 4.25$$

Visual Exposure

Viewing Distance	Ranking	Actual Viewshed Area (km ²)	Score
Adjacent	5	0.463	0.70
Foreground	3	1.691	1.54
Middleground	1	2.868	0.87
Background	0	0.49	0.00
Total		5.51	
Total Visual Exposure Score			3.11

Total Visual Effect Score

$$4.25 \times 3.11 = 13.22$$

Overall, quantitative assessment indicates that the visual effect of the proposed upgrade on this precinct would potentially be high.

Visual Sensitivity

The proposed upgrade in this precinct would be able to be viewed mainly by Tinderbox Creek Valley residents and farm workers. In general farm workers may be less sensitive to visual changes than residents whose view from private properties would be affected. While the remote nature of the Tinderbox Creek Valley is likely to further increase the sensitivity to changes in the level of development, the overall number of viewers are comparatively low, due to the sparse level of settlement and associated road systems.

Tourists may also be able to obtain glimpses of the upgraded highway, when travelling along the ridgeline roads that surround the valley, in particular St Helena Road and Bangalow Road. However, most of these views would be fairly distant.

Therefore, the quantitative assessment indicates that the overall visual sensitivity of this precinct is likely to be low to moderate.

Viewing Distance	Ranking	Buildings (#)	Road lengths (km)	Score
Adjacent	5	0	0.35	0.02
Foreground	3	47	1.73	4.14
Middleground	1	37	3.97	1.11
Total Visual Sensitivity Score				5.27

Visual Impact

The quantitative assessment indicates that the visual impact of the proposed upgrade in this precinct would likely to be moderate to high due to the high visual effect and the low to moderate visual sensitivity of viewers in the precinct. The visual impact may be able to be decreased slightly through the implementation of mitigation measures outlined in the "Urban and Landscape Design Concept" section of this working paper.

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VISUAL ASSESSMENT - PRECINCT 5: EWINGSDALE

ST HELENA RIDGE TO EWINGSDALE INTERCHANGE, CHAINAGE 150,200 TO 152,250

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*Illustration 55:
Aerial Overview of the Ewingsdale precinct*

EXISTING LANDSCAPE AND VISUAL CHARACTER

The landscape in this precinct is characterised by the dramatic change in elevation between the coastal flats and the St Helena ridge. The St Helena ridge forms the northern edge of the elevated plateau and is particularly tall and steep. As discussed earlier, the visual importance of the ridge is reflected in its inclusion in the "Scenic Protection - Escarpment" zone in the Byron Bay Local Environmental Plan.

The St Helena ridge offers many spectacular lookout opportunities over the coastal landscape to the north. The most formal of these is the McLeods Shoot Lookout at the junction of the existing highway alignment and Coolamon Scenic Drive.

From the escarpment, the landscape quickly drops down towards the coastal lowlands. The exception is formed by the spur off the main ridge line that supports the existing highway, providing a relatively gradual descent. The western side of the spur is generally open and grassy permitting wide-ranging views, while the heavily treed village of Ewingsdale is located on the eastern side of the spur, screened from views from the existing highway alignment by a noise wall and mature vegetation.



*Illustration 56 - 62:
Character Images of the Ewingsdale precinct: the Ewingsdale spur from St Helena Road (above proposed portal), views towards the Pacific from the existing highway, view towards the highway from Woodford Lane, proposed portal location, Ewingsdale interchange from the north, and Ewingsdale spur from Coolamon Scenic Drive*

THE PROPOSED UPGRADE

The upgraded highway would emerge from the tunnel in the St Helena ridge below and to the eastern side of the existing highway. It would then descend the spur between the existing highway and Plantation Drive in Ewingsdale, prior to merging onto the existing dual carriageway at the Ewingsdale interchange. A section of the existing highway south of the interchange would need to be diverted to the west where it would be connected to a new roundabout at the end of Myocum Road. The southern reaches of Plantation Drive would also need to be realigned to a location further east.

A number of modifications to the Ewingsdale interchange would form part of the proposal. The existing southbound loop on-ramp would be replaced with a direct on-ramp and the southbound off-ramp would be modified to allow Woodford Lane to be connected to the existing roundabout in the future. The roundabout at the end of Myocum Road on the western side of the interchange would be able to accommodate the connection of a direct northbound on-ramp in the future, to replace the current loop on-ramp. A new access road into 'Araluen' (property 394) would be provided to the west of the diverted existing highway, also commencing at the Myocum Road roundabout. It would replace the existing access and underpass off the Old Pacific Highway.

Further modifications to the local road system as part of the proposed upgrade would include the realignment of the upper reaches of Plantation Drive, maintaining access to property 371 on the St Helena ridge while accommodating a large fill batter supporting the upgraded highway.

The existing noise wall between the existing highway and Ewingsdale would be replaced with a new noise barrier between the proposed upgrade and the settlement which would be in the shape of a landscaped earth mound east of the upgraded highway.

The major new element in this precinct would be the tunnel under the St Helena ridge, with a separate tunnel provided for each carriageway. The tunnel portal would be located in a prominent location in the side of the St Helena ridge, about 200 metres north of St Helena Road and to the east of the existing highway. The entrance to the tunnel would consist of twin portals most likely set into an engineered head wall and set within a large cutting excavated about 100 metres into the natural hillside in order to reduce the overall length of the tunnel. Due to the height and steepness of the cuttings leading up to and surrounding the portal, they are likely to require engineered stabilisation measures.

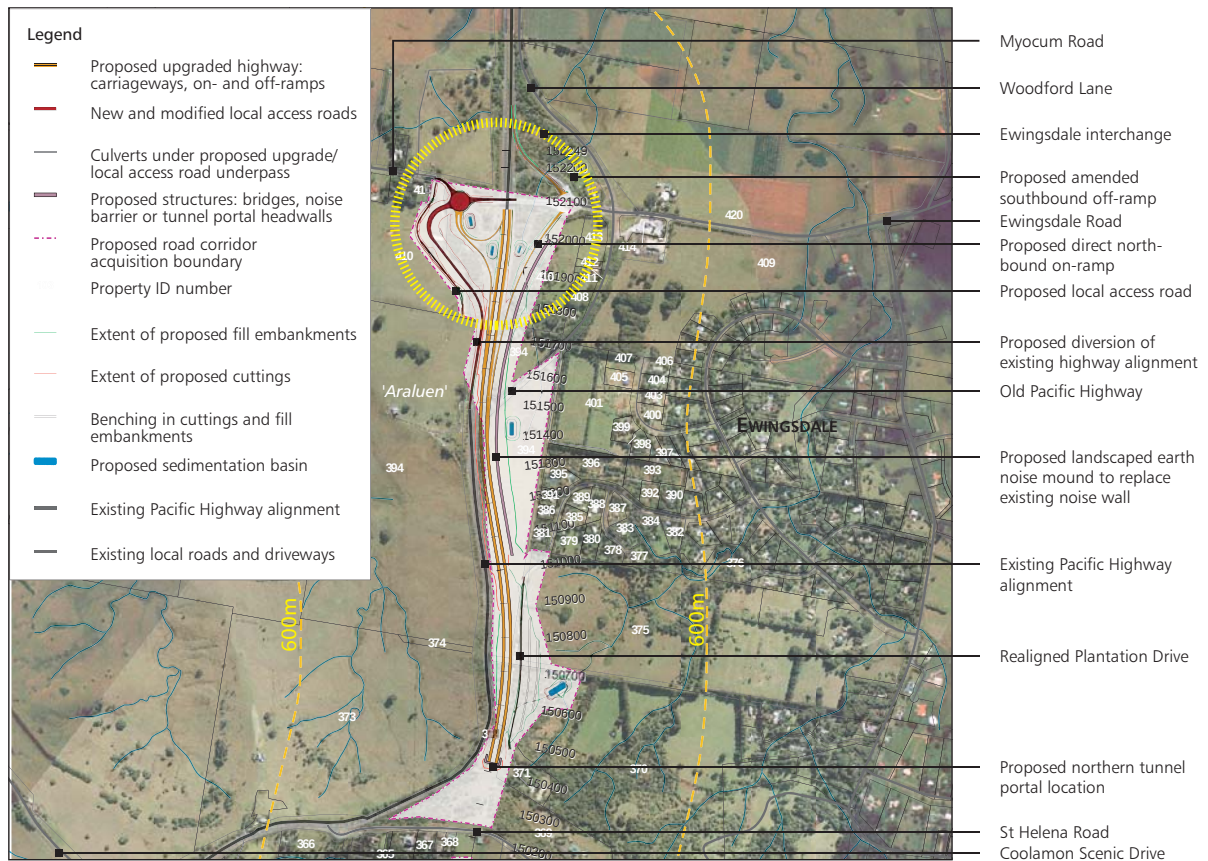


Illustration 63:
Overview of the proposed upgrade in precinct 5

VISUAL ASSESSMENT

Visual Effect

Major visual changes specific to the fifth precinct result from the large increase in road infrastructure on the Ewingsdale spur, the associated large fill embankments and the construction of the tunnel portals and associated excavation works.

The construction of the upgraded highway adjacent to the alignment of the existing highway would approximately double the amount of road infrastructure on the Ewingsdale spur. Similarly, roadway infrastructure would increase noticeably around the Ewingsdale interchange, as a result of the diversion of the existing highway alignment and the provision of the additional access road. However, the scale of the infrastructure around the interchange is already significant, helping to reduce the degree to which the changes would be perceived as modifying the existing landscape.

The works on the Ewingsdale spur on the other hand would result in a more significant visual change, in particular the tunnel portals and associated cuttings, and the large fill embankments located along the eastern side of much of the upgraded highway. Construction of the latter would also require the removal of roadside vegetation on the eastern side of the existing highway which currently provides visual screening from Ewingsdale. A stand of vegetation immediately north of the tunnel portal would also need to be removed and the loss of vegetation on the prominent spur would be highly noticeable.

In addition, the cutting on the tunnel approach would represent a major visual change to the character of the St Helena ridge, due to its significant height, the steep nature of the cutting face and the need for benching and other stabilisation measures. The engineering works required around the tunnel portal would be in stark contrast to the existing vegetated landscape character. These works would also be highly visible, being exposed to views from the St Helena ridge and from the coastal lowlands below.

Scale of the Infrastructure

Size of Cuttings and Embankments

Cutting/ Embankment Height	Ranking	Length (m)	% within precinct	Score
0-0.5m	1	600	29.4	0.29
0.5-2m	2	412	20.2	0.40
2-5m	3	334	16.3	0.49
5-10m	4	298	14.6	0.58
10-20m	5	215	10.5	0.53
>20m	6	185	9.1	0.54
Total		2,050		2.30

Road Corridor Size

Corridor Size (km ²)	Length of Highway (km)	Score
0.384	2.05	1.87

Total Score for Scale of the Infrastructure

$$2.30 \times 1.87 = 4.30$$

Visual Exposure

Viewing Distance	Ranking	Actual Viewshed Area (km ²)	Score
Adjacent	5	0.241	0.59
Foreground	3	0.878	1.28
Middleground	1	1.027	0.50
Background	0		0
Total		2.15	
Total Visual Exposure Score			2.37

Total Visual Effect Score

$$2.37 \times 4.30 = 10.19$$

Overall, the quantitative assessment indicates that the visual effect of the proposed upgrade on this precinct would potentially be moderate to high.

Visual Sensitivity

The upgraded highway and associated works would be readily visible from sections of local roads including the existing highway alignment, St Helena Road, Myocum Road and Coolamon Scenic Drive, as well as from the upgraded highway itself. Potential viewers would include local residents and tourists. The works would also be visible from McLeods Shoot Lookout, a popular tourist destination and rest stop which offers spectacular panoramic views over the coastal lowlands, the Pacific Ocean and mountain ranges in the background. Cape Byron is the other major lookout and tourist destination in the area, however, its distance from the proposed upgrade is so large that it would be difficult to see the upgraded highway (also refer to Illustration 7).

The residential area of Ewingsdale is in relatively close proximity to the proposed upgrade, as reflected in the number of buildings in the middleground distance. However, overall building numbers in the precinct are comparatively low and views from Ewingsdale to the proposed upgrade are limited by the topography of the area as well as the existing vegetation cover.

The quantitative assessment indicates that the overall visual sensitivity of this precinct is therefore likely to be low to moderate.

Viewing Distance	Ranking	Buildings (#)	Road lengths (km)	Score
Adjacent	5	2	0.33	0.31
Foreground	3	52	1.37	4.57
Middleground	1	119	2.06	3.47
Total Visual Sensitivity Score				8.34

Visual Impact

The quantitative assessment indicates that the visual impact of the proposed upgrade in this precinct would likely to be moderate due to the moderate to high visual effect and the low to moderate visual sensitivity of viewers in the precinct. The visual impact may be able to be decreased slightly through the implementation of mitigation measures outlined in the "Urban and Landscape Design Concept" section of this working paper.

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VISUAL IMPACT SUMMARY

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The visual impact assessment of the proposed upgrade described above represents an assessment based on five precincts and with a strong quantitative focus. The results of these assessments are summarised in the following table:

Precinct	Visual Effect	Visual Sensitivity	Visual Impact
1. Knockrow	High to moderate	Moderate to low	Moderate
2. Emigrant Creek	Moderate	Moderate	Moderate
3. Bangalow	Moderate	High	High to moderate
4. Tinderbox Creek Valley	High	Moderate to low	High to moderate
5. Ewingsdale	High to moderate	Moderate to low	Moderate

The predicted visual impacts for each precinct reflect the corresponding local conditions. They further reflect the scale of the road infrastructure within each precinct's setting and the extent of visibility from surrounding viewpoints. However, the quantitative precinct assessment does not reflect the cumulative effect of the visual impact on the study area as a whole.

Neither does the quantitative focus of the assessment fully reflect the likely visual impact of the proposed upgrade, in terms of its effects on the existing intricate landscape pattern, though it does provide a good indication of the physical magnitude of the proposed upgrade and of the number and kinds of viewers.

The assessment of the likely visual impact of the proposed upgrade however needs to go beyond physical magnitude to consider the proposal in terms of its effects on the visual quality of the landscape.

The scenic qualities of the landscape within and surrounding the study area are well recognised by residents and visitors alike. The growing popularity of the region as a place to live and to take a holiday is testament to the accepted beauty of the area's landscape and resulting lifestyle.

The combination of steep rolling topography and lush stands of vegetation encompassing areas of open and green paddocks creates an appealing natural setting. Layered over this setting is a relatively small scale pattern of rural development which conforms to the varied form of the natural features of the area. This layering of rural and natural elements produces

an intricate cultural landscape pattern where neither element dominates the other.

Settlements nestle into valleys and hillsides. Roads wind along ridge lines and around hills, through dense stands of vegetation and over watercourses. As a consequence, the landscape varies continuously and reveals changing characteristics to the traveller passing through the area.

The overall visual effect of the proposed upgrade on this kind of landscape is considered to be quite profound. The standard design requirements for a modern four lane dual carriageway motorway, with relatively gentle gradients and wide sweeping curves, introduces an entirely new form of infrastructure into the area. Where the existing road and rail infrastructure and pattern of subdivision respond to the constraints of the local topography and therefore become an integrated part of the overall composition of the landscape, the proposed upgrade will by necessity, override these constraints. As a result, the upgraded highway will become the dominant element cutting a relatively straight path through this varied landscape, overriding its existing patterns of development.

The upgrades highway would be a piece of infrastructure of a scale which will be perceived as visually dominant across the length of the majority of the study area. Although the long term benefits of landscape plantings will modify the visual effects of the proposed upgrade to a degree, the overall width and comparatively straight alignment will not enable it to integrate into the landscape as the existing roads have done. The steepness and geotechnical composition of many cuttings will further limit the potential for and likely success of benefits of landscape design treatments.

Based on the acknowledged scenic qualities of the region and the corresponding purpose for living in and travelling to the area, the visual sensitivity of the viewers, including both those travelling along the upgraded highway and those seeing it from surrounding areas, will be generally in the high to moderate range.

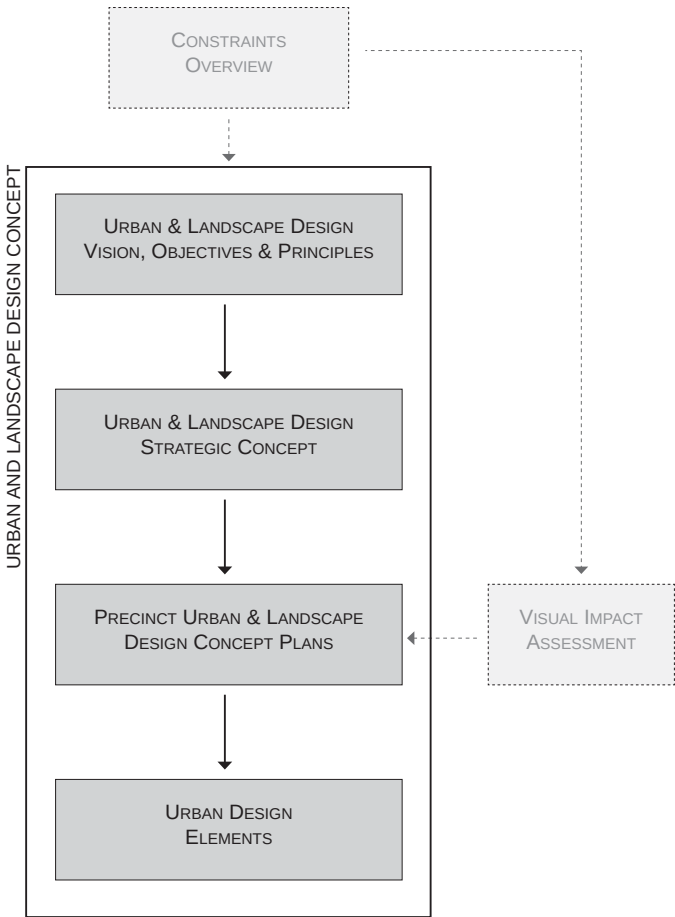
As a consequence the cumulative visual impact of the upgraded highway is likely to be of a high to moderate level. Over time the visual impacts of the upgraded highway will be partially mitigated by the treatments proposed along its length (refer to the "Urban and Landscape Design Concept" section of the working paper). However, the scale of the road in this landscape will remain a visually dominant feature. It will therefore substantially and irrevocably change the visual character of the areas through which it passes.

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5. urban and landscape design concept

This section is dedicated to the urban and landscape design concept for the proposed upgrade. It involves the following components:

- > **Urban and Landscape Design Vision, Objectives and Principles**
Identifies the Vision, Objectives and Key Design Principles for the proposed upgrade, based on the RTA's *Pacific Highway Urban Design Framework*.
- > **Urban and Landscape Design Strategic Concept**
Developed in response to the existing site conditions and the Vision, Objectives and Principles for the proposed upgrade, it provides the overall strategic direction for the proposed upgrade. The Strategic Concept consists of three equally important components:
A plan identifying major landmarks and natural features, a plan identifying proposed road infrastructure elements and hierarchy of importance in design terms, and a corridor landscape strategy plan outlining the general approach to landscape works along the proposed upgrade.
- > **Precinct Urban and Landscape Design Concept Plans**
Provide specific design recommendations for each precinct, based on existing site conditions and incorporating the strategic concept. Recommendations further address the findings of the visual assessment, in order to reduce or mitigate the identified visual impact. A discussion of key issues for further design development is included in each precinct.
- > **Urban Design Elements**
Provides a discussion of major road infrastructure elements along the proposed upgrade, including design principles for the detailed design of those elements during future design stages.



The first step in the development of an urban and landscape concept design for the proposed upgrade is the definition of a revised set of urban and landscape design objectives and principles. These build on the urban and landscape design objectives and principles developed for the project in the early stages of route selection, while addressing more detailed urban and landscape design issues identified in the above assessment section.

The context for the development of urban and landscape design principles and objectives, as well as for the proposed upgrade in general has been established in the '*Pacific Highway Urban Design Framework*'. This *Framework* is the unifying document providing urban design guidelines for the large number of upgrade projects along the Pacific Highway.

As highlighted in the *Framework*, the Tintenbar to Ewingsdale portion of the Pacific Highway upgrade is an important section of the overall route between Hexham and Tweed Heads. With much of the Pacific Highway characterised by the mountains and foothills of the Great Dividing Range and the broad rivers and coastal floodplains, the Tintenbar to Ewingsdale section stands out as particularly memorable as one of the few stretches of road from where glimpses of the Pacific Ocean can be seen.

Despite the highly memorable character of the Tintenbar to Ewingsdale section, the overarching objective of the *Pacific Highway Urban Design Framework* is for individual upgrade projects to form an integral component of the Pacific Highway, as the major coastal arterial highway spine from Hexham to Tweed Heads. At the same time, the *Framework* is a broad strategic document and requires interpretation in order to arrive at outcomes that address and suit the particular conditions along the proposed Tintenbar to Ewingsdale upgrade.

According to the *Pacific Highway Urban Design Framework*, the vision for this road is "based on the creation of a scenic highway - a highway that will keep people aware (and perhaps awake) and interested in their surroundings, and create an unfolding panorama of this special part of Australia" (p 24).

Specifically, the vision for the Pacific Highway has been summarised as follows:

"A sweeping, vegetated highway, providing panoramic views to the Great Dividing Range and the rivers, forests, farmlands, and coastline of the Pacific Ocean. Sensitively designed to fit into the landscape and be unobtrusive. Characterised by simple, attractive road infrastructure (p 24)."

Based on this vision, the *Pacific Highway Urban Design Framework* provides a series of urban design objectives to inform both the route selection and concept design stages of any upgrades proposed along the Pacific Highway.

These objectives have provided the basis for the development of the urban and landscape design concept for the proposed upgrade of the Pacific Highway between Tintenbar and Ewingsdale, having been weighted and interpreted to suit the particular local conditions of the study area.

The table on the following pages provides an overview of the urban design objectives set out in the *Pacific Highway Urban Design Framework* and of the way they have been interpreted and integrated into the proposed Tintenbar to Ewingsdale Pacific Highway upgrade.

Pacific Highway Urban Design Framework Objective	Discussion and Project Response	Key Urban and Landscape Design Principles
Objective 1: <i>Provide a flowing road alignment that is responsive and integrated with the landscape.</i> Applying to road alignment decisions as well as the road design, the alignment should flow and respond to the shape of the landform and patterns of natural and farmed vegetation cover.	Urban and landscape design objectives and principles to address issues of flowing alignment and responsiveness to the shape of the landform were developed during the route selection process for the proposed upgrade and have influenced the development of the concept design for the proposed upgrade. However, this remains an important issue to address during future detailed design stages.	- Shape cuttings to correspond to natural landforms. - Revegetate cuttings and embankments to maintain the character of undulating green hills against the horizon line.
	The natural and farmed vegetation cover along the proposed Tintenbar to Ewingsdale upgrade is one of the major features of the study area, as well as a key factor in the area's highly scenic character. Responding to the existing landscape character is an objective of particular importance for the proposed upgrade.	- Protect significant stands of roadside vegetation. If retention is not possible reinstate plantings in nearby locations. - Design roadside plantings to reflect adjoining landscape and vegetation patterns in order to integrate the road landscape, create a varied sequence of views and enclosure and reduce the linear effect of the upgraded highway. - Design landscape plantings to correspond to existing species.
Objective 2: <i>Provide a well vegetated, natural road reserve.</i> A road corridor in the lush forested landscape of the north east coast of NSW should be well-vegetated in the interest of road user enjoyment, landscape integration and biodiversity protection and recovery.	This objective is similar to Objective 1 with regard to the need to integrate the road corridor with the existing landscape character.	- Reduce the visibility of the proposed upgrade from townships, farms and homesteads. - Reduce the visibility of the proposed upgrade from the local road system.
	The revegetation of the road corridor to enhance the natural environment and mitigate against the impacts on existing native stands of vegetation is an important ecological objective.	- Undertake ecological restoration in areas of lowland rainforest and riparian areas where they remain within the road reserve. - Select plant species to maximise wildlife habitat connectivity, particularly under creek crossings.

Pacific Highway Urban Design Framework Objective	Discussion and Project Response	Key Urban and Landscape Design Principles
Objective 3: <i>Provide an enjoyable interesting highway with varied views and vistas of the landscape and pleasant restful places to stop.</i> The Pacific Highway is a long road, it takes a considerable time to drive and there is a tendency for drivers to make long duration journeys. Consequently the drive should be an enjoyable and memorable road user experience. This will help shorten the perception of the journey and keep drivers alert.	The provision of an enjoyable and interesting highway experience with varied views and vistas was considered during the route selection process and formed an integral component of route selection. It has further informed the development of the "Urban and Landscape Design Concept" outlined in this working paper. The identified key design principles should guide further design development.	- Maintain and protect key vistas and long-distance views and maximise the potential for views to existing landmarks and other prominent features. - Vary the degree of enclosure and openness along the upgraded highway, to provide visual interest and enjoyment and reduce the potential for driver fatigue. - Maintain a diverse and scenic driving experience along the existing highway alignment.
Objective 4: <i>Value the communities and towns along the road.</i> It is important to ensure the road upgrade is considerate of the towns and communities along the route. This can be achieved through sensitive planning of the road alignment to avoid visual and noise impacts. However this is not always possible and in some cases it is of value to have a close relationship between the road and community. [...] It should not be forgotten that the local vernacular of farms, field boundaries, local roads, established businesses and residences is an important cultural aspect of the landscape and the journey.	Issues of noise and visual impact on local towns and communities have been considered during the route selection process. The "Urban and Landscape Design Concept" contained in this working paper further addresses these issues. Detailed design principles for the design of noise barriers are provided in the section called "Urban Design Elements". Reducing the visual impact of the proposed upgrade is an important aspect of valuing towns and communities along the proposed upgrade who value the high visual quality of the study area. As discussed earlier in this working paper, the area's high scenic and lifestyle values are some of the main reasons people chose to live in and visit the area.	- Preserve the small scale character of the existing highway and other local roads. - Reduce areas of wide uninterrupted areas of pavement. - Reduce the visual effect of the vertical dimension of infrastructure elements associated with the proposed upgrade including bridges, cuttings, embankments and noise barriers.

Pacific Highway Urban Design Framework Objective	Discussion and Project Response	Key Urban and Landscape Design Principles
Objective 5: <i>Provide consistency-with-variety in road elements.</i> Where appropriate consistent road design and road furniture will help unify the highway and reduce the perception of clutter. This will allow the road user to better appreciate the passing landscape. It will also make the driving experience simpler and more comfortable. Conversely, a road, which is inspired by the character and distinctiveness of the local context, will add variety to the journey and help keep drivers interested and aware.	A discussion on appropriate road design and road furniture, including design principles, is provided in the section on "Urban Design Elements".	Refer to the section on "Urban Design Principles."
Objective 6: <i>Provide a simplified and unobtrusive road design.</i> The road design should be as simple as possible, refined to the basic elements of road and bridge with all other details designed out, simplified or hidden.	Road design formed an integral component of the route selection process for the proposed upgrade. The design of the proposed upgrade represents the result of a collaborative effort of the project team, incorporating engineering and urban design constraints as well as the constraints identified by other specialist consultants on the project team. This objective is further addressed through the recommendations of the "Urban and Landscape Design Concept" which provides detailed design principles for the further development of the road urban design elements to guide the design development stages (refer to "Urban Design Elements"). Simplifying the road design will also make it easier for the motorist to enjoy the surrounding landscape, to appreciate local landmarks and thereby assist in orientation.	- Develop a simple and robust design aesthetic appropriate to highway infrastructure.

Building on the urban and landscape design vision, objectives and principles, an urban and landscape design concept was developed for the proposed Highway upgrade. It consists of a strategic concept plan, precinct urban and landscape design concept plans and recommendations for urban design elements.

The aim of the urban and landscape design concept for the proposed upgrade is to provide a road design outcome that is consistent with the remainder of the Pacific Highway, while making a positive contribution to the landscape through which it passes. In particular, the urban and landscape design concept seeks to reduce the visual impacts associated with the proposed upgrade and to enhance the motorists experience of the journey.

The design of road engineering elements in this context will be of particular importance, as they will determine the degree to which the road is perceived to 'fit' in the surrounding landscape, as well as the degree to which this landscape can be enjoyed by the road user.

While the visual assessment has identified the potential visual effects and associated likely visual impact of the proposed upgrade, the perception of the upgraded highway's visual impact, in particular of the long term visual impact, will be greatly influenced by the design quality of the road elements.

For example, the visual impact of a very large cutting will be very different depending on the treatment of the cutting face, illustrated by the contrast between a successfully revegetated and well maintained cutting face on one hand and a cutting face stabilised with shotcrete on the other. Similarly, the attention given to detail in the design of major structures such as bridges, overbridges, noise walls or tunnel portals will determine the way in which these structures are perceived, and whether they will be seen as making a positive contribution to the landscape, or as detracting from the highly scenic landscape. To this end, a series of recommendations for further consideration in future design development stages has also been developed.

The urban and landscape design strategic concept provides the framework for the development precinct urban and landscape design concept plans in this working paper and for the development of detailed concept designs for the proposed upgrade in the period following the environmental assessment. It does this by setting the overall strategic direction for the proposed upgrade, by identifying the key issues to be considered in the development of detailed designs and by nominating the major elements requiring design input along the route.

There are several components to the urban and landscape design strategic concept:

- > Major Landmarks and Natural Features.
- > Proposed Road Infrastructure Elements.
- > Corridor Landscape Strategy.

MAJOR LANDMARKS

Landmarks (refer to Illustration 64) will be key natural features along the route, which are likely to be the particularly memorable moments on the journey. They include major topographic features such as prominent ridge lines or floodplains, as well as areas that offer panoramic views of the surrounding countryside. Major landmarks also include features which will be important to local road users, residents and other viewers which would see them from beyond the road reservation. An example would be the Emigrant Creek crossing where the upgraded highway would pass over the existing highway alignment which would be retained as the main local road link and tourist route.

As memorable key points along the route, the design of structures and elements associated with the upgraded highway around those landmarks will be important in influencing the experience and perception of the visual character of the proposed upgrade. They therefore warrant a high level of attention and design resolution in the detail design stages of the proposed upgrade, to achieve an outcome of high visual and urban design quality consistent with the importance of the landmark. More detailed information on landmarks is provided in the relevant precinct concept plans.

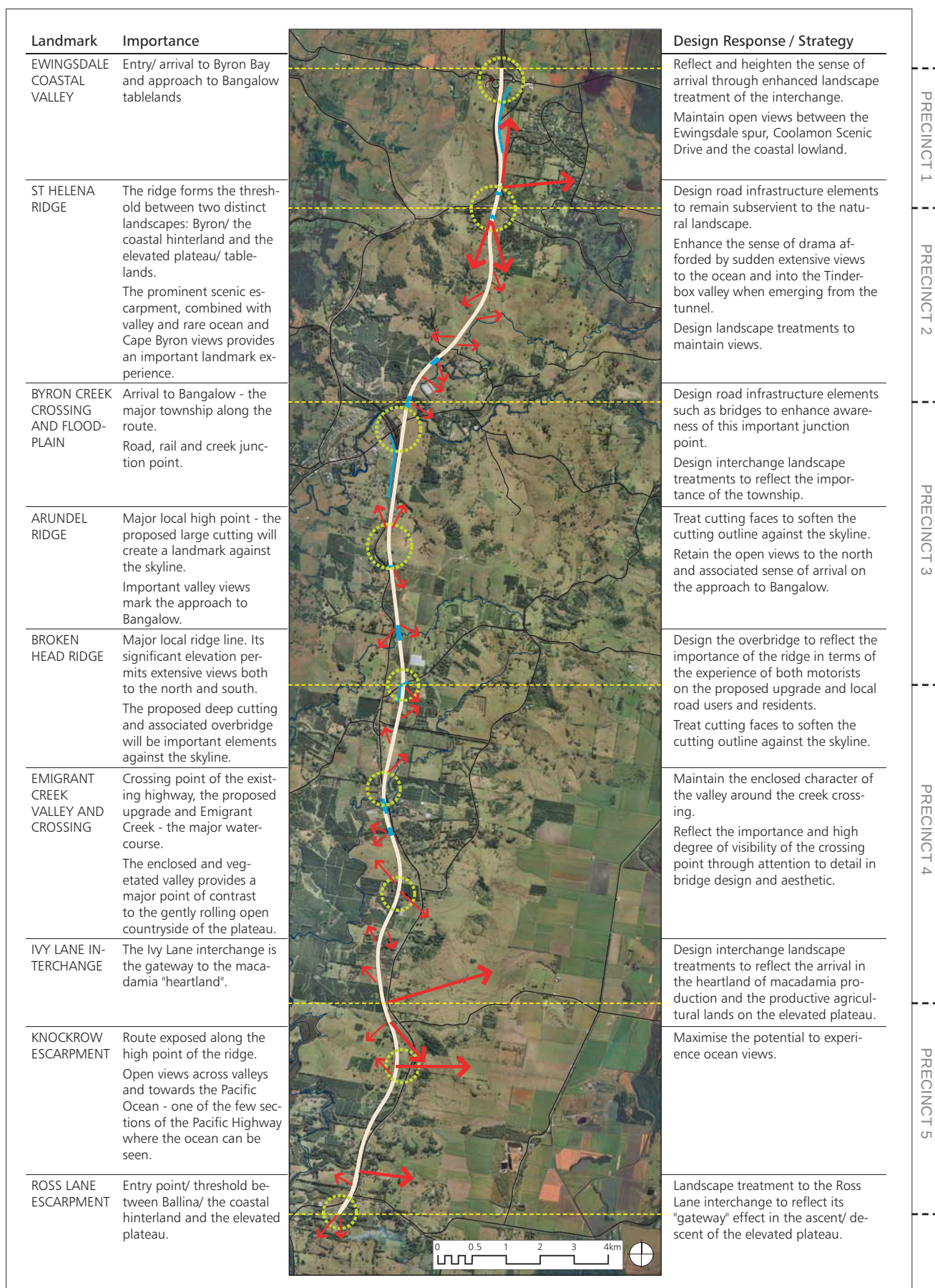
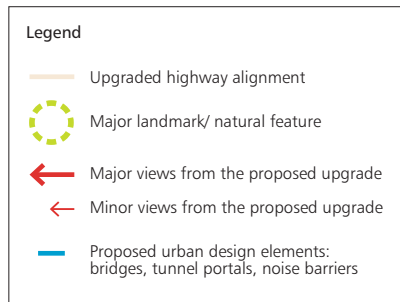


Illustration 64:

Urban and Landscape Design Strategic Concept: Major Landmarks and Natural Features along the proposed upgrade



Legend for Illustration 64: Major Landmarks and Natural Features along the proposed upgrade

ROAD INFRASTRUCTURE ELEMENTS

Road Infrastructure Elements are the major items of road infrastructure associated with the proposed upgrade, both along the upgraded highway and in connection with the local road system. They include elements such as interchanges, major cuttings, bridges, tunnel portals, noise barriers and local access roads (refer to Illustration 65).

Generally, it is these elements that will form the more highly visible components of the upgraded highway, being exposed to both motorists and to viewers in surrounding areas. Design resolution of the road infrastructure elements is important as they define the junction points between the upgraded highway and the landscape beyond the immediate road corridor. Further, a number of these elements coincide with major landmarks along the route and are therefore likely to be particularly memorable.

In contrast, detailed design components such as safety barriers would not be perceptible by viewers from surrounding areas, being generally small in scale. While their design resolution would be important from the point of view of the motorists experience of the upgrade, it would have less influence on the way the upgrade would be perceived by viewers in surrounding areas.

The Urban and Landscape Design Strategic Concept has identified a hierarchy of road infrastructure elements, based on their location and the relative importance of that location, based on the number of viewers likely to see the works, the visual and landscape setting, the identified visual effect and associated visual impact, and the potential for landscape planting or other mitigation measures to reduce the potential visual impact of the road infrastructure element. In addition, the proposed hierarchy emphasises the balance between the key considerations of design aesthetic and upfront costs.

1) Design 'Priority One' Element

The combination of a landmark location, the large size of the structure, the high degree of visual exposure and limited potential for screening or landscaping to reduce the visual effect, warrant an approach whereby the design aesthetic and integration of the structure with the surrounding landscape is the key consideration.

2) Design 'Priority Two' Element

The size of the structure, the moderate degree of visual exposure and the limited potential for screening, combine to warrant a moderate level of design detail, with an even balance between design aesthetic and cost effectiveness.

3) Design 'Priority Three' Element

The relatively low number of viewers and the potential to mitigate the visual effect of the structure with landscape planting permit a more purely functional design, giving priority to cost-effective design.

A more detailed discussion of the design principles for major road infrastructure elements including for bridges, tunnel portals and noise walls are provided in the section 'Urban Design Elements' and in the relevant precinct concept plans.

CORRIDOR LANDSCAPE STRATEGY

The Corridor Landscape Strategy provides an approach to the planting and other landscape treatments within the road corridor (refer to Illustration 66). The Strategy has been developed based on the existing pattern of planting/ vegetation and open landscapes in the area. Consistent with the 'Pacific Highway Urban Design Framework', the Corridor Landscape Strategy aims to augment existing vegetation patterns to provide an interesting and varied road user experience consisting of opening and enclosed views, as well as to minimise the visual contrast between the upgraded highway corridor and the surrounding rural landscape. An important aspect of the strategy is to augment and upgrade identified lowland rainforest, riparian zones and wildlife corridors with the protection of existing vegetation and planting additional areas with indigenous species.

However, it is important to note that the Corridor Landscape Strategy was developed at a large-scale, strategic level and therefore provides a general guide or principle to be followed in highway landscaping works. Future design development and associated detail site investigation may determine that exceptions to the Strategy are warranted in certain locations along the route, such as to emphasise (or conceal) particular features, views or conditions in areas along the proposed upgrade.

* Notes:

1. All chainages are approximate.
2. "Planting" refers to the final outcome and not to any particular technique during construction: it includes both individual plantings and large-scale revegetation works.

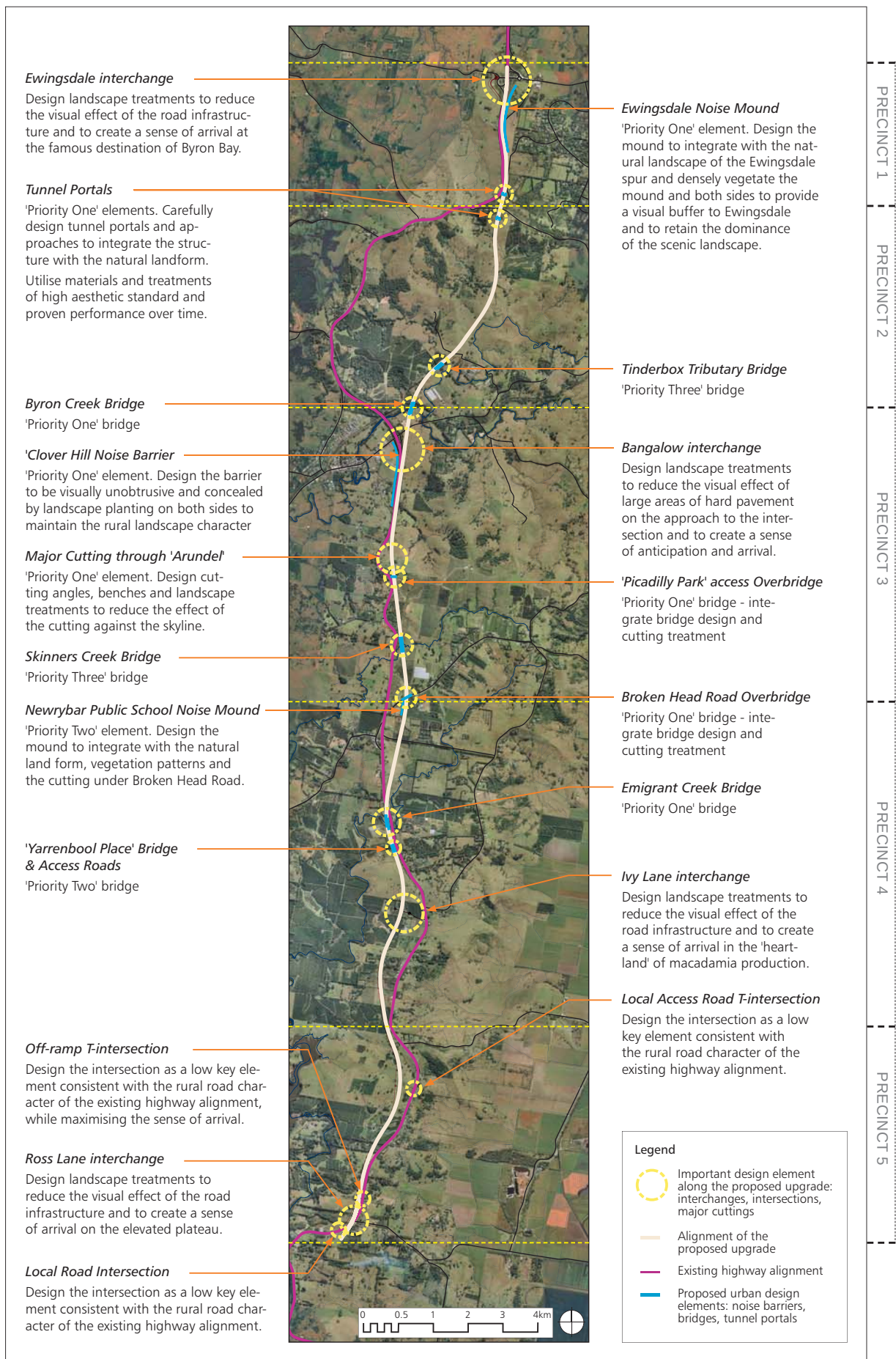


Illustration 65:
Urban and Landscape Design Strategic Concept: Road Infrastructure Elements

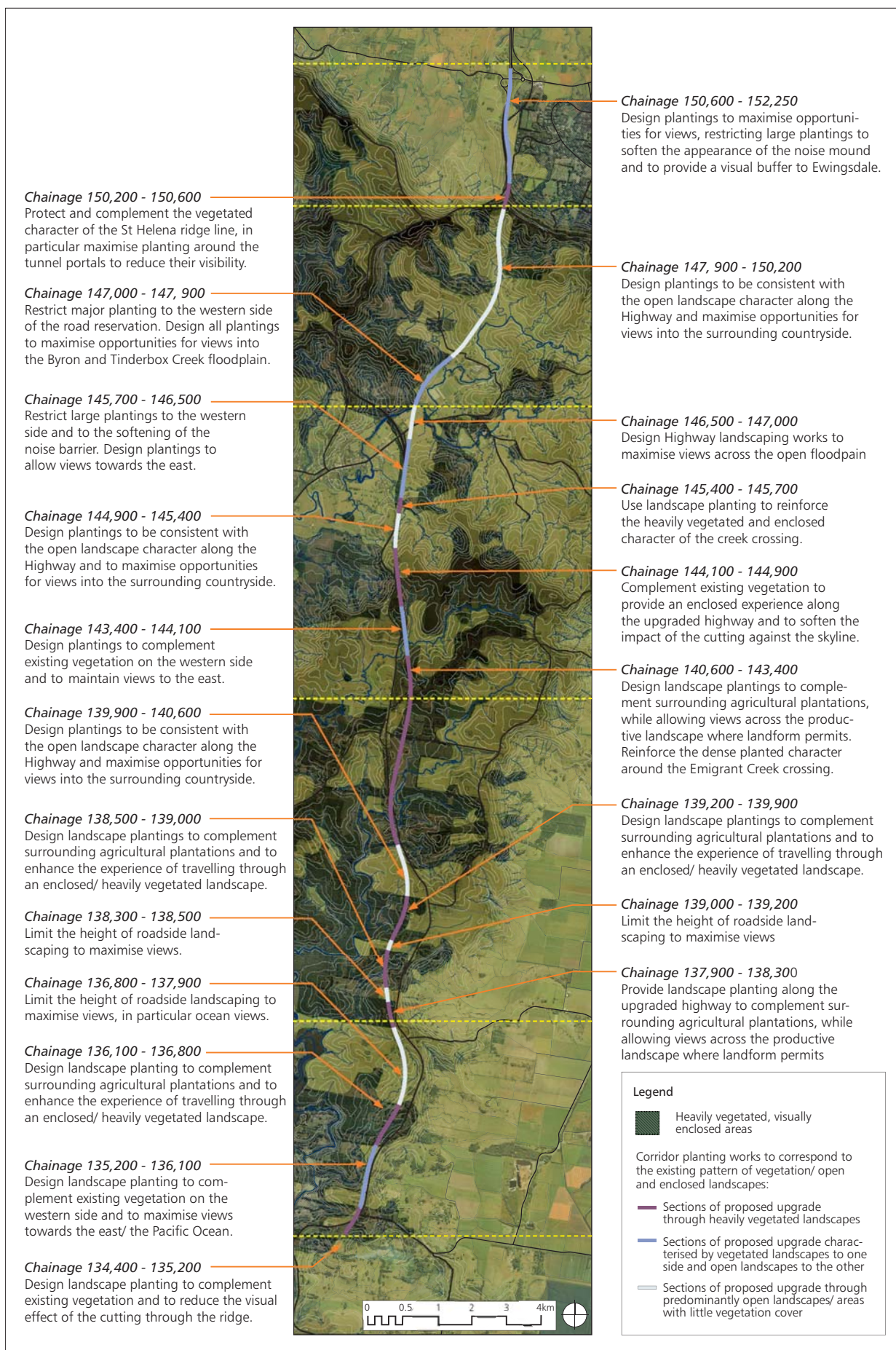


Illustration 66:
Urban and Landscape Design Strategic Concept: Corridor Landscape Strategy

URBAN AND LANDSCAPE DESIGN CONCEPT - PRECINCT 1: KNOCKROW

ROSS LANE TO MARTINS LANE, CHAINAGE 134,750 TO 138,000

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SUMMARY OF ISSUES

As discussed in the "Visual Assessment" section of this working paper, the main urban and landscape design and visual issues in the Knockrow precinct are the large scale of the infrastructure at the Ross Lane interchange, the increase in amount of hard pavement through the parallel location of the proposed upgrade, the existing highway and local access roads, and the severing and loss of roadside vegetation, including macadamia plantations along the existing highway.

From the point of view of the motorist and the driving experience along the proposed upgrade, maximising opportunities for views into the surrounding countryside and in particular towards the Pacific Ocean will be a key consideration for this precinct. As highlighted earlier in this working paper, the Tintenbar to Ewingsdale section of the Pacific Highway is one of the areas from where the Pacific Ocean can be seen and the Knockrow precinct is one of the most important precincts in this regard. Important views have been identified in Illustration 67 and include views towards the Pacific Ocean, as well as views into more open pasture landscapes north-west of Knockrow, and views into the Sandy Flat floodplain south of Ross Lane.

In terms of how the proposed upgrade will be perceived by local residents and visitors to the area, views from the local road system and the visual relationship between the existing highway and the proposed upgrade are important factors and have been addressed by the urban and landscape design concept plan.

KEY AREAS FOR DETAIL DESIGN

In precinct 1, the key areas for further design investigation, resolution and development include:

> Vertically independent carriageways

Investigating the potential for independent vertical grading of the two carriageways, in order to reduce the motorway character of the proposed upgrade while also potentially reducing the amount of earthworks required. The section of the proposed upgrade south of Ivy Lane seems particularly suited for this (chainage 137,200 in precinct 1 to chainage 139,700).

> Protect the character of the existing highway

The retention and protection of existing roadside vegetation along the existing highway will be an important factor in minimising the degree of visual change in the precinct, and in protecting the attractive driving experi-

ence along this route, for both locals and visitors to the area. Detail design and construction works should therefore aim to maximise the retention of this vegetation and where this is not possible, reinstate vegetation following completion of the works. Reinstated vegetation should be of sufficiently established size to compensate for the loss of roadside vegetation in the short term.

> Reduce the visual impact of parallel areas of hard pavement

Reducing the amount of hard pavement visible from any one area or viewpoint will assist in reducing the dominance of the hard engineering structure of the proposed upgrade. Maximising landscaping opportunities between separate carriageways (including the upgraded highway, on- and off-ramps, local access roads and the existing highway) will ensure the landscape remains the most important visual element. Further, road design development should seek to minimise hard paved areas as much as possible, in particular in instances such as where hard pavement would only be required in the case of future road widening or the provision of additional traffic movements at intersections. In verges, consideration should also be given to the use of alternative materials and/ or textures that reduce the width of the uniform driving surface.

> Severed plantations

As previously discussed, macadamia plantations are a defining feature of the area's visual and landscape character. The retention of stands of macadamia trees should therefore be maximised as much as possible. The issue arises where existing plantations are being severed by the proposed upgrade, leaving isolated stands of established trees that are nevertheless not directly affected by the construction of the proposed upgrade. Retaining such stands of trees is especially important within a context of aiming to reduce the degree of visual change in parts of the landscape not directly affected by the construction of the proposed upgrade. An example would be the severed plantations in "Deenford Plantations" (property 30), in Knockrow.

While the issue of residual lands and their future uses is addressed in a separate working paper, continuing discussions with affected and neighbouring land business owners would be important from a visual point of view, in order to maximise the degree to which the existing visual landscape character can be retained.

URBAN AND LANDSCAPE DESIGN CONCEPT PLAN AND SPECIFIC RECOMMENDATIONS

Building on the identified key areas for detail design and the strategic principles outlined in the urban and landscape design strategic concept, Illustration 84 provides a more detailed concept plan for precinct 1. It identifies a series of specific urban and landscape design measures for the precinct, which have been developed in response to the urban design objectives and principles for the proposed upgrade, and to mitigate the identified visual impacts. The plan further identifies important views to be retained and protected, in order to enhance the experience of the motorist on both the existing and the upgraded highway.

The cross sections on the following page (Illustrations 68 to 70) further illustrate the three-dimensional urban and landscape design treatments at a number of important locations within the precinct.

Specific recommendations to mitigate the potential visual impact of the proposed upgrade and to be investigated at a detailed level in the next design stages are:

1. Design the new intersections between the existing highway and both local access roads (chainage 134,900 and 137,120 approximately) and the southbound off-ramp (Chainage 136,120) to be of a small scale consistent with other local road intersections along the existing highway alignment.
2. Use tree planting along local access roads to create the character of a country lane or avenue while allowing filtered views of the surrounding countryside (chainage 134,900 - 138,130, chainage 136,720 - 138,000).
3. Provide landscape planting of trees and shrubs between the existing and proposed highway, to reduce the visual prominence of the upgrade, in particular where it is situated on fill (Chainage 134,900 - 135,350, Chainage 135,950 - 136,150 and Chainage 137,700 - 138,000).
4. Plant between the many parallel roadways around the Ross Lane interchange to reduce the scale of the infrastructure visible from any one view point (chainage 134,900 - 135,500).
5. As much as possible, provide separate cuttings for individual roadways at the Ross Lane interchange, to reduce the amount of pavement that can be seen from any one of these roads (chainage 135,100 - 135,500).
6. In areas where the upgraded highway is located in cuttings, maintain open views from properties across the upgraded highway and towards the Pacific Ocean (Chainage 135,150 - 135,400 and 137,300 - 137,600).

7. Maintain the low character of road-side planting along the eastern side of the existing highway to maintain/ enhance Ocean Views, in particular around Martins Lane (chainage 135,200 - 136,400, chainage 136,800 - 138,000).
8. Use planting to minimise the prominence of the upgraded highway at the end of local access roads and driveways (Chainage 135,400 - 135,600).
9. Use planting between the upgraded highway and local access roads to reduce the extent to which the upgraded highway would be able to be viewed, and to break up the expanse of paving visible from the existing highway alignment (chainage 135,500 - 138,130, chainage 136,720 - 138,000).
10. Provide open views from the upgraded highway towards the Pacific Ocean (Chainage 135,550 - 135,900 and Chainage 136,800 - 137,300).
11. Protect the hedge and avenue of trees along the existing highway alignment at 'Clovelly Grove' (Chainage 135,600 - 135,800 approximately).
12. Plant trees and shrubs on the western side of the existing highway to reduce the visual prominence of the proposed upgrade and to direct views towards the east and the Pacific Ocean (Chainage 137,500 - 137,700).
13. Retain and protect avenue/ tree planting along the existing highway, north of Martins Lane West (Chainage 137,700 - 137,950).
14. Retain and protect macadamia plantations between the existing highway and the proposed Upgraded, to maintain the visual diversity along the existing highway (Chainage 137,700 - 137,950).
15. Revegetate cuttings and embankments throughout the precinct, to soften and reduce their visual effect. A list of locally appropriate species is provided in Appendix 1.

* Notes:

1. All chainages are approximate.
2. "Planting" refers to the final outcome and not to any particular technique during construction: it includes both individual plantings and large-scale revegetation works.

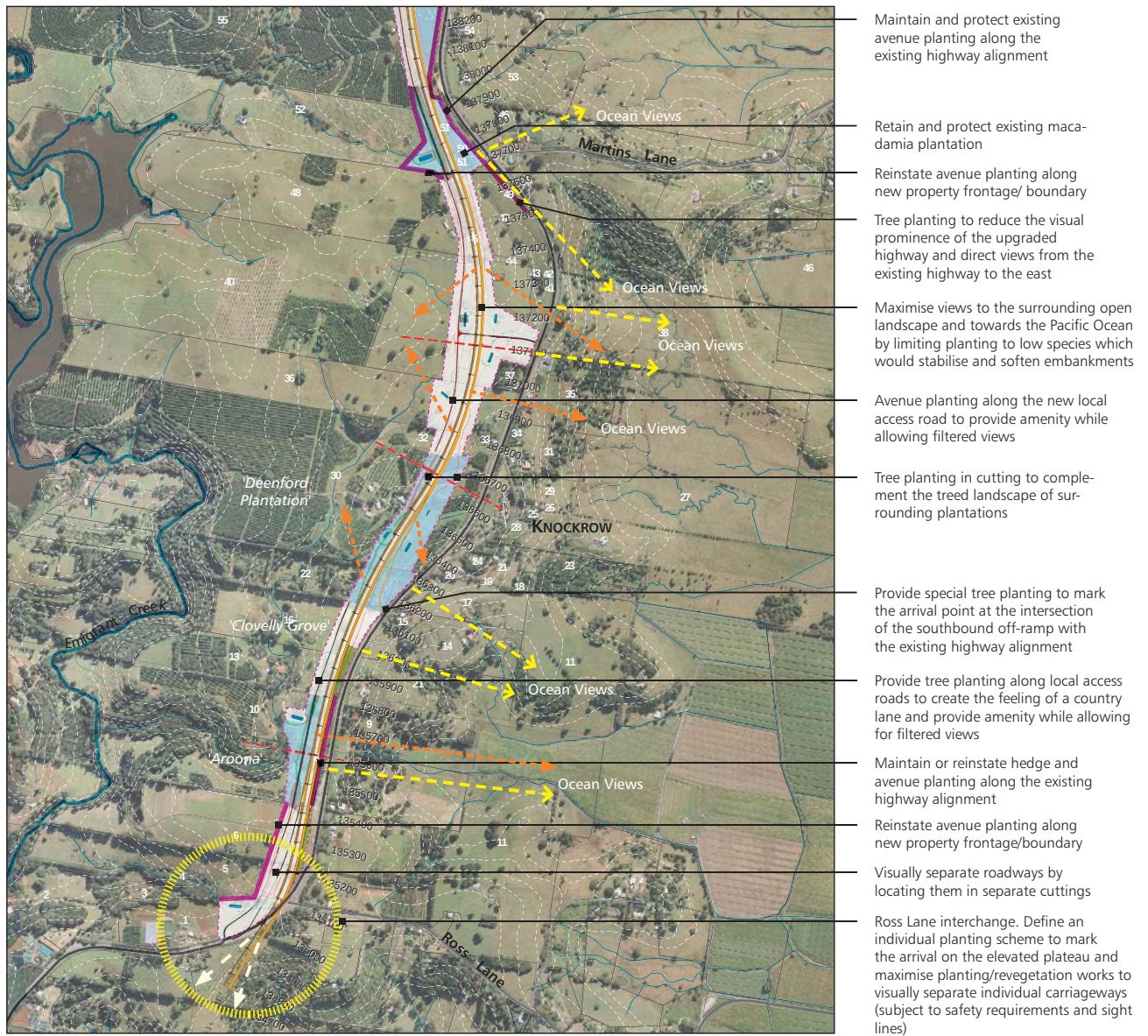
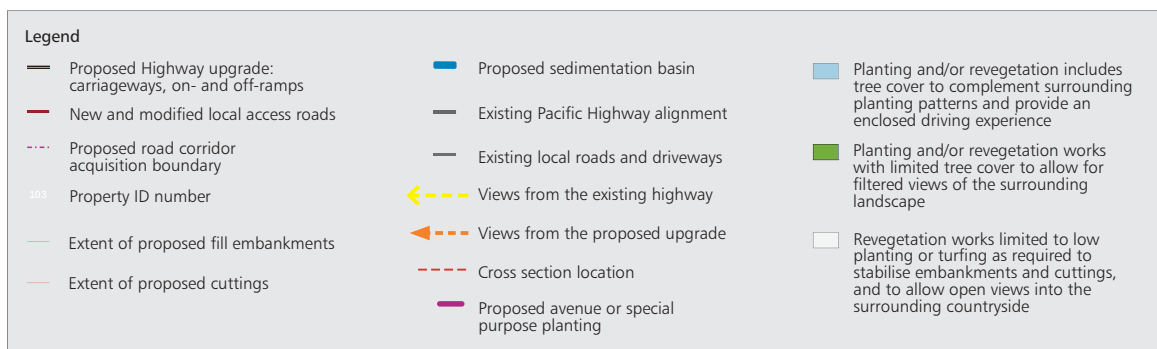


Illustration 67:
Urban and landscape design concept plan for precinct 1



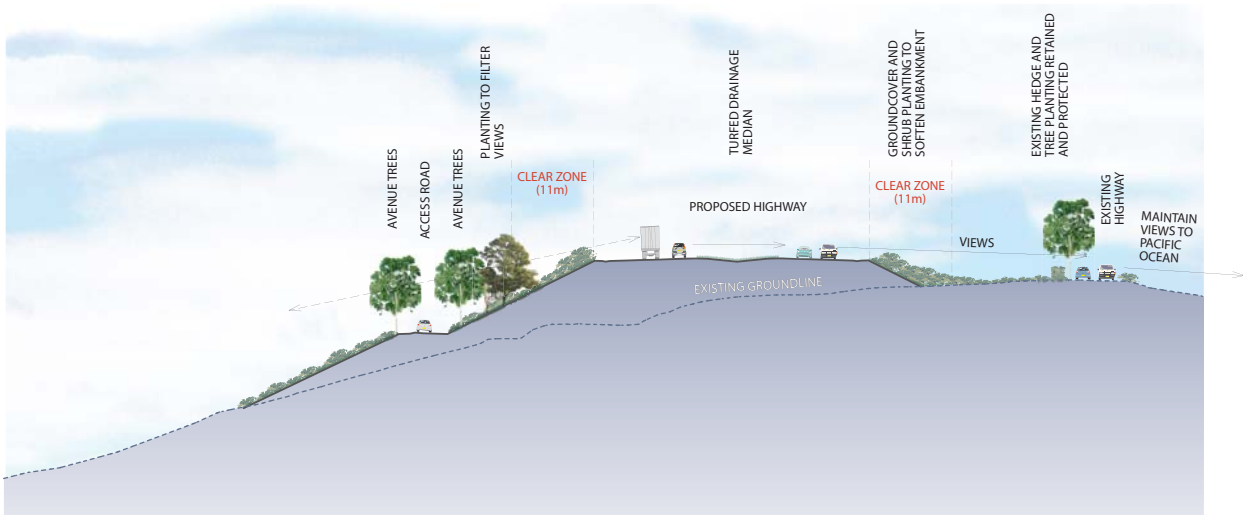


Illustration 68: Cross section at chainage 135,600

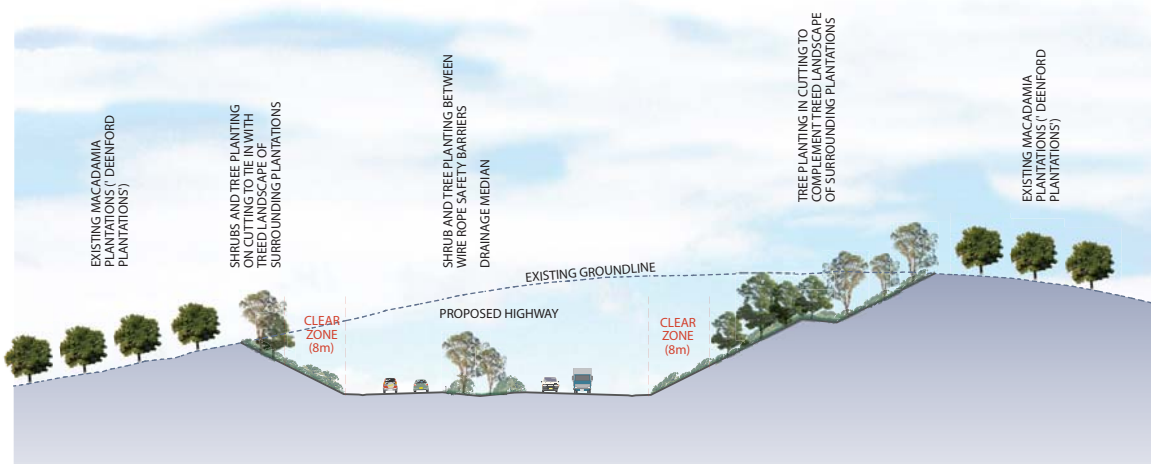


Illustration 69: Cross section at chainage 136,650

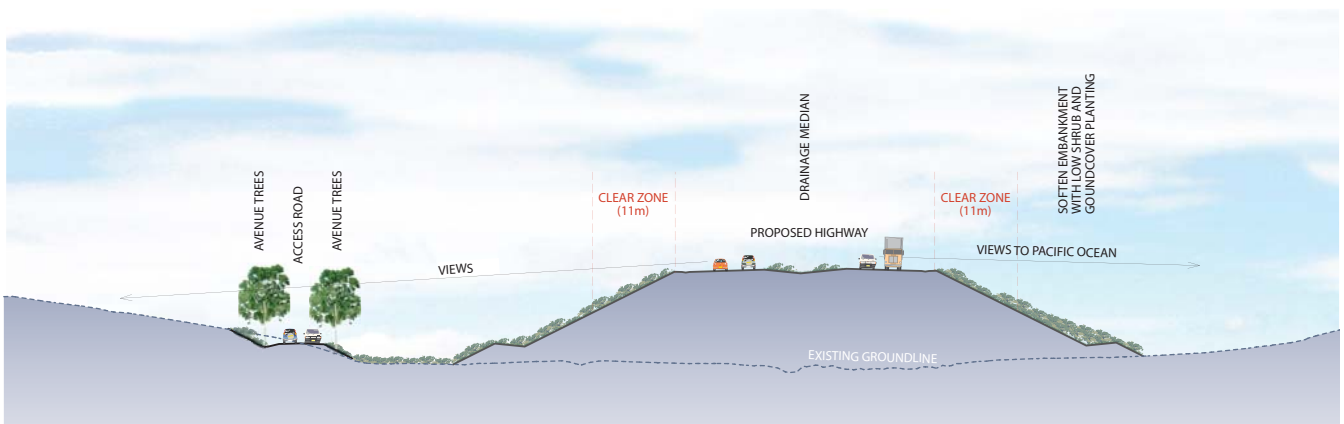


Illustration 70: Cross section at chainage 137,100

URBAN AND LANDSCAPE DESIGN CONCEPT - PRECINCT 2: EMIGRANT CREEK

MARTINS LANE TO BROKEN HEAD ROAD, CHAINAGE 138,000 TO 142,800

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SUMMARY OF ISSUES

As discussed in the "Visual Assessment" section of this working paper, the main urban and landscape design and visual impacts in the Emigrant Creek precinct are associated with the Ivy Lane interchange, the Emigrant Creek and local road crossings, the severing of agricultural plantations and removal of vegetation along the existing highway and the large cuttings and fill embankments required along much of the route.

From the point of view of the motorist and the driving experience along the proposed upgrade, the Emigrant Creek precinct is a visually diverse precinct that has the potential to provide a range of different visual experiences, ranging from expansive Pacific Ocean views in the southern part of the precinct to the enclosed valley surrounding the Emigrant Creek crossing, to the highly structured macadamia plantations typical of the elevated plateau. Developing the concept to build on these will provide a visually interesting and memorable journey which might also assist in keeping drivers alert. Important views have been identified in Illustration 71 and include views towards the Pacific Ocean, as well as views into the agricultural hinterland west of the proposed upgrade near the Macadamia Castle and the Ivy Lane interchange, views from the 'Yarrenbool Place' bridge, and views south from the Broken Head Road cutting.

In terms of how the proposed upgrade will be perceived by local residents and visitors to the area, views from the local road system and the visual relationship between the existing highway and the proposed upgrade are important factors and have been addressed by the urban and landscape design concept plan.

KEY AREAS FOR DETAIL DESIGN

In precinct 2, the key areas for further design investigation, resolution and development include:

> Vertically independent carriageways

Investigating the potential for independent vertical grading of the two carriageways, in order to reduce the motorway character of the proposed upgrade while also potentially reducing the amount of earthworks required. The section of the proposed upgrade south of Ivy Lane seems particularly suited for this (chainage 137,200 in precinct 1 to chainage 139,700).

> Cutting and embankment stabilisation

As about 80% of the route within this precinct features noticeable (2-5 metres tall) to very large (10-20 metres tall) cuttings and embankments, the successful stabilisation and revegetation of these will be a critical factor influencing the character of the proposed upgrade, both from the point of view of motorists and when seen from surrounding areas.

Consideration should be given to the angle of cutting and embankment slopes with regard to short and long term soil stability, the potential for plants to successfully establish and long term maintenance (issues include mulch or small rocks being washed onto the road pavement). Close liaison with geotechnical specialists is recommended in order to identify the need for and best means of soil stabilisation to ensure good long-term vegetation cover.

> Shaping of cuttings and embankments

In order to reduce the impact of sharply defined cuttings against the gently rolling character of the natural landscape, consideration should be given to the shaping of cuttings in a way that reduces this contrast and allows cuttings to blend into the natural landscape.

Similarly, embankments should be 'graded out' at the bottom, to reduce the visual impact of an obvious junction between fill embankments and the natural landform.

Combined with the establishment of vegetation over time, this will assist in reducing the 'artificial' character of cuttings and embankments.

> Bridge design

As discussed in the strategic urban and landscape concept, the Emigrant Creek crossing is considered a major landmark, both along the proposed upgrade and along the diverted existing highway. Similarly, the bridges at 'Yarrenbool Place' are potentially prominent visual elements associated with the proposed upgrade. The development of bridge designs that result in an elegant, transparent and light weight appearance that is subservient to the surrounding landscape would be highly desirable from an urban design and visual point of view.

The chapter on "Urban Design Elements" in the "Urban and Landscape Concept Design" section of this working paper provides more detailed recommendations on bridge design. The application of these guidelines has the potential to greatly enhance the visual experience of the creek crossings.

> Severed plantations

As previously discussed, macadamia plantations are a defining feature of the area's visual and landscape character. The retention of stands of macadamia trees should therefore be maximised as much as possible. The issue arises where existing plantations are being severed by the

proposed upgrade, leaving isolated stands of established trees that are nevertheless not directly affected by the construction of the proposed upgrade. Retaining such stands of trees is especially important within the context of aiming to reduce the degree of visual change in parts of the landscape not directly affected by the construction of the proposed upgrade, and in order to protect the experience of the landscape for motorists along the existing highway. A prime example would be the residual plantation north of Ivy Lane, between the existing and proposed highway.

While the issue of residual lands and their future uses is addressed in a separate working paper, continuing discussions with affected and neighbouring land business owners would be important from a visual point of view, in order to maximise the degree to which the existing visual landscape character can be retained.

URBAN AND LANDSCAPE DESIGN CONCEPT PLAN AND SPECIFIC RECOMMENDATIONS

Building on the identified key areas for detail design and the strategic principles outlined in the urban and landscape design strategic concept, Illustration 71 provides a more detailed concept plan for precinct 2. It identifies a series of precinct-specific urban and landscape design measures, which have been developed in response to the urban design objectives and principles for the proposed upgrade, and to mitigate the identified visual impacts. The plan further identifies important views to be retained and protected, in order to enhance the experience of the motorist on both the existing and the upgraded highway.

The cross sections in Illustrations 72 to 74 further demonstrate the three-dimensional urban and landscape design treatments at a number of important locations within the precinct.

Specific recommendations to mitigate the potential visual impact of the proposed upgrade and to be investigated at a detailed level in the next design stages are:

1. Use tree planting along the western side of the existing highway alignment north of Martins Lane, to redirect views of motorists travelling north on the existing highway and reduce the prominence of the proposed upgrade in the view (Chainage 137,900 - 138,100, chainage 138,600 - 138,900). Ensure to maintain good visibility of the 'Macadamia Castle' from the existing highway.
2. Use planting between the upgraded highway and local access roads to reduce the extent to which the upgraded highway would be able to be viewed, and to break up the expanse of paving visible from the existing highway alignment (chainage 138,000 - 139,100, chainage 139,750 - 140,100).
3. Use tree planting along local access roads to create the character of a country lane or avenue while allowing filtered views of the surrounding countryside (chainage 138,000 - 139,100, chainage 139,750 - 140,100).
4. Retain and protect macadamia plantations between the existing highway and the proposed Upgraded, to maintain the visual diversity along the existing highway (Chainage 137,700 - 137,950, Chainage 139,650 - 140,100 and Chainage 141,100 - 142,200).
5. Maintain the small scale of the intersection of Ivy Lane with the existing highway (Chainage 139,680).
6. Use tree and shrub planting around the Ivy Lane interchange, including between on- and off-ramps and the proposed highway alignment, to break up large areas of hard pavement and reduce its potential visual prominence from the existing highway and from Old Byron Road (chainage 139,700 - 140,200).
7. Install trees and shrubs between the existing highway and the proposed upgrade to reduce the visual prominence of the proposed upgrade around the Emigrant Creek crossing (Chainage 140,450 - 141,000, and Chainage 141,100 - 141,700).
8. Following bridge construction, reinstate riparian vegetation along Emigrant Creek and complement it with additional planting to reinstate the enclosed landscape character around the creek crossing and re-establish the dense visual buffer between the proposed upgrade and adjoining properties (chainage 140,900 - 141,100).
9. Use planting to soften the appearance of the bridge piers (chainage 140,900 - 141,100).
10. Provide planting between the realigned existing highway and the access road into 'Delserene' (properties 97, 100 and 101), to reinstate dense boundary planting and visually screen the property from the proposed upgrade and associated works (Chainage 141,100 - 141,500).
11. Densely plant the noise mound at Newrybar Public School to tie in with adjoining agricultural plantations and to provide visual as well as acoustic screening (chainage 142,300 - 142,700).
12. Integrate the design and shape of the noise mound near Newrybar Public School with the cutting under the Broken Head Road overbridge (chainage 142,600 - 142,850).
13. Revegetate cuttings and embankments throughout the precinct, to soften and reduce their visual effect. A list of locally appropriate species is provided in Appendix 1.

* Notes:

1. All chainages are approximate.
2. "Planting" refers to the final outcome and not to any particular technique during construction: it includes both individual plantings and large-scale revegetation works.

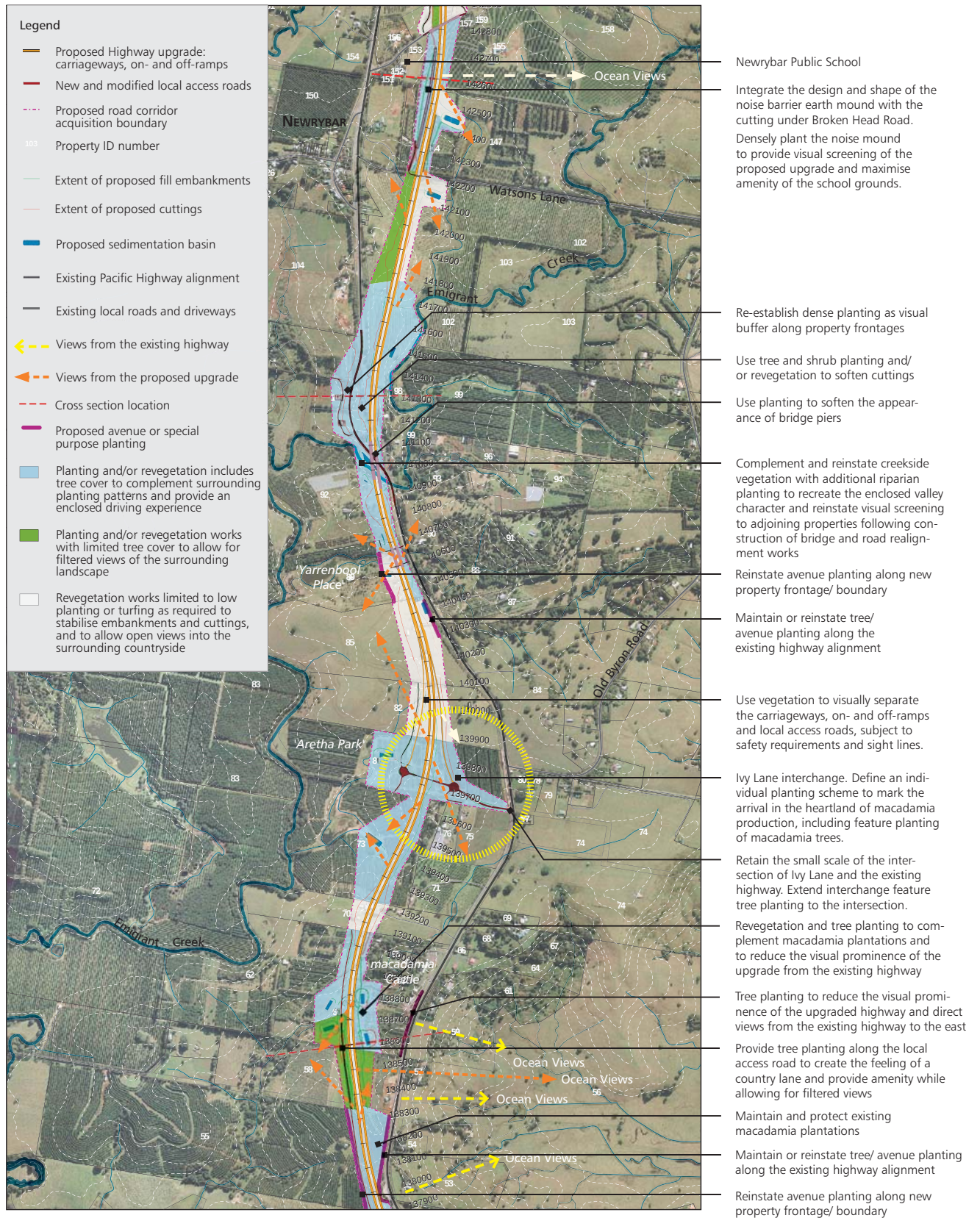


Illustration 71:
Urban and landscape design concept plan for precinct 2

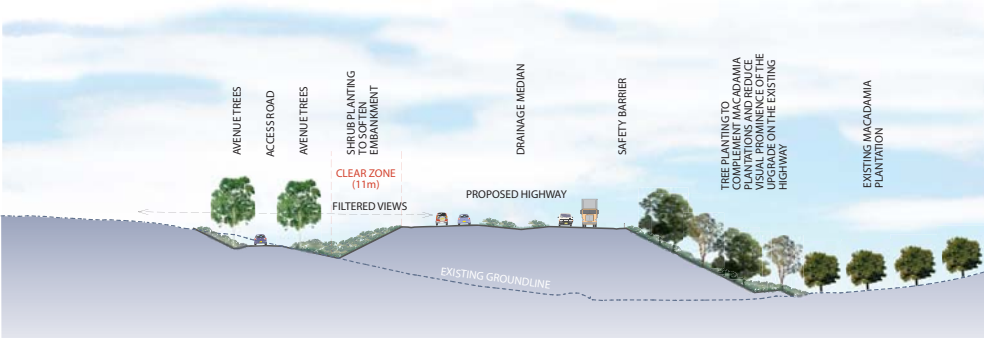


Illustration 72:
Cross section at chainage 138,600

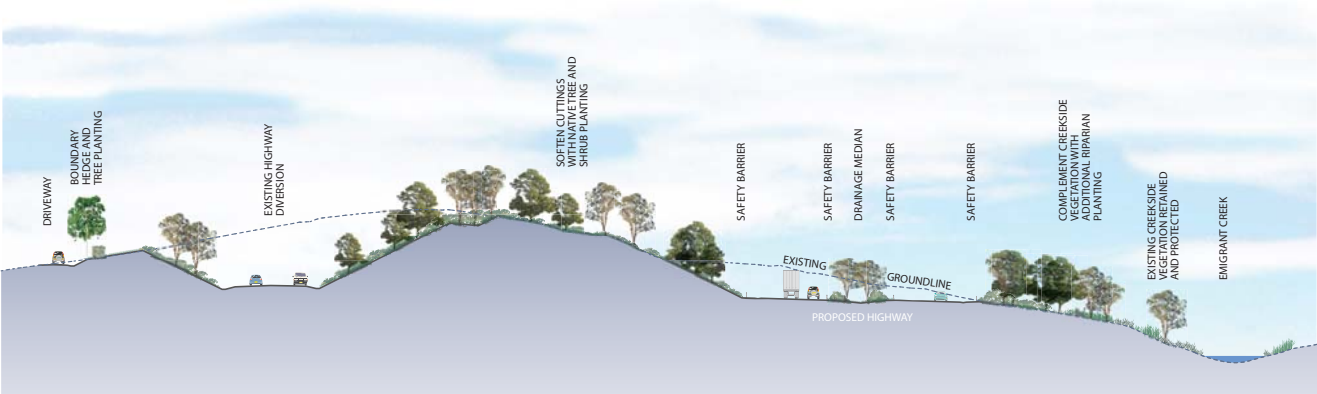


Illustration 73:
Cross section at chainage 141,300

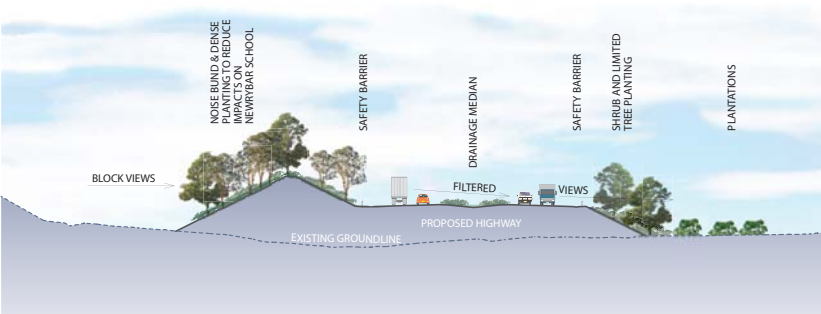


Illustration 74:
Cross section at chainage 142,600

URBAN AND LANDSCAPE DESIGN CONCEPT - PRECINCT 3: BANGALOW

BROKEN HEAD ROAD TO BYRON CREEK, CHAINAGE 142,800 TO 147,000

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SUMMARY OF ISSUES

As discussed in the "Visual Assessment" section of this working paper, the main urban and landscape design and visual impacts in the Bangalow precinct are associated with the large cutting through 'Arundel', the works around the existing Bangalow bypass including the wide areas of pavement associated with several parallel roadways, the crossing of Broken Head Road and the severing of agricultural plantations.

From the point of view of the motorist and the driving experience along the proposed upgrade, the Bangalow precinct is characterised by three major landmarks, located at the beginning and the end of the precinct (the Broken Head Road overbridge and Byron Creek crossing respectively), as well as approximately in the centre of the precinct (at Arundel). These punctuate the motorist's journey and compensate for the comparatively limited views from the proposed upgrade into the study area. The limited views are the result of much of the proposed highway being located in cuttings and of the interplay between the landform and the existing vegetation cover. Maximising the opportunities for views in areas such as at creek crossings will therefore be important (refer to Illustration 75 for other important views). The resulting contrast to visually contained sections of the route will provide an interesting driving experience and one that will make the limited areas with views all the more memorable.

In terms of how the proposed upgrade will be perceived by local residents and visitors to the area, views from the local road system and the visual relationship between the existing highway and the proposed upgrade are important factors and have been addressed by the urban and landscape design concept plan.

KEY AREAS FOR DETAIL DESIGN

In precinct 3, the key areas for further design investigation, resolution and development include:

> **Reduce the visual impact of parallel areas of hard pavement**

Reducing the amount of hard pavement visible from any one area or viewpoint will assist in reducing the potential visual impact resulting from the large concentration of parallel roadways around the existing Bangalow bypass and interchange. Landscape opportunities between the separate road- and carriageways (including the proposed upgrade, the existing highway, on- and off-ramps and local access roads) should be maximised, in order to visually break up the wide area of hard pavement.

Further, road design development should seek to minimise hard paved areas as much as possible, in particular where hard pavement would only be required in the case of future road widening or the potential provision of additional traffic movements at intersections in the future. In verges, consideration should also be given to the use of alternative materials and/ or textures that reduce the width of the uniform driving surface.

> **Greater horizontal separation between carriageways**

In the location of the existing Bangalow bypass, investigate the potential to increase the median width of the proposed upgrade, in order to retain and protect significant existing vegetation east of the Bangalow bypass (chainage 145,200 - 146,200). A wider median would also assist in creating better visual separation between the various roadways by providing sufficient space for planting works. Also refer to the discussion under "Reduce the visual impact of parallel areas of hard pavement"

> **Vertically independent carriageways**

Investigate the potential for independent vertical grading of the two carriageways, in order to reduce the motorway character of the proposed upgrade while also potentially reducing the amount of earthworks required. The section of the proposed upgrade between the Skinners Creek bridge and the Bangalow Road bridge seems particularly suited for this, especially in combination with greater horizontal separation of the carriageways at the Bangalow bypass (chainage 143,600 to chainage 146,600 approximately). Also refer to "Greater horizontal separation between carriageways".

> **Cutting design and stabilisation**

The cutting through 'Arundel' (property 197 and 198) is probably the most significant cutting along the proposed upgrade. This applies to both the physical magnitude of the cutting and its exposure to viewers. As discussed earlier, the cutting is potentially widely visible from surrounding areas, including from parts of Bangalow. It therefore takes on a landmark role along the proposed upgrade and the design outcomes for the cutting are likely to influence the perception of the visual quality of the proposed upgrade as a whole.

From a visual point of view and in order to reduce the potential visual impacts of the cutting, the main aim of cutting design is the reduction of the contrast between the cutting and the rolling character of the natural landscape. Consideration should therefore be given to the way the cutting is transitioned into the shape of the natural landscape, the steepness of cutting slopes, the design of benches and the potential of the cutting faces to successfully support revegetation measures in the long term.

The potential for successful and ongoing vegetation establishment should be treated as integral to the design of cuttings, because of the potential of vegetation to significantly reduce the engineered nature of the cutting, as well as of the portion of the cutting face exposed to viewers from any one angle. Close liaison with geotechnical specialists is recommended in order to identify the need for and best means of soil amelioration and stabilisation to ensure good long-term vegetation cover. In combination with the gentle curve of the cutting, dense vegetation at the more exposed northern end in particular would assist in reducing the visual impact of the cutting.

> Bridge design

As discussed in the strategic urban and landscape concept, the Byron Creek crossing is an important junction point considered a major landmark along the proposed upgrade. Both the Byron Creek bridge and the Bangalow Road bridge are elevated high above the natural floodplain, making them prominent elements in the naturally flat landscape.

The development of bridge designs that result in an elegant, transparent and light weight appearance that is subservient to the surrounding landscape would be highly desirable from an urban design and visual point of view.

The chapter on "Urban Design Elements" in the "Urban and Landscape Concept Design" section of this working paper provides more detailed recommendations on bridge design. The application of these guidelines has the potential to greatly enhance the visual experience of this important junction, in particular when seen from Bangalow Road, the Bangalow bypass and the railway line.

> Overbridge design Broken Head Road overbridge

Both overbridges in the precinct will be visually important elements, bridging a deep cutting at Broken Head Road and being located at the southern end of the major 'landmark' cutting at 'Arundel'. Both bridges would be highly visible from the proposed upgrade, giving great importance to the design of the overall structures and of specific details when seen from the side and below. Broken Head Road is also an important local road and the experience of the bridge by motorists on the road will be need to be carefully considered. In particular, the elevation of the ridge supporting Broken Head Road gives rise to scenic views into the surrounding countryside. The design and detail design of the bridge structure should support and complement these views. For a more detailed discussion on overbridge design, refer to the section on "Urban Design Elements".

> Severed plantations

As previously discussed, macadamia plantations are a defining feature of the area's visual and landscape character. The retention of stands of macadamia trees should therefore be maximised as much as possible. The issue arises where existing plantations are being severed by the proposed upgrade, such as north of Broken Head Road. Retaining severed plantations is important in order to reduce the degree of visual change in parts of the landscape not directly affected by the construction of the proposed upgrade, and to protect the experience of the landscape for motorists along the existing highway.

> Noise wall design

At the time of writing this working paper, detailed information on the likely length, height and location of the noise barrier in relation to the proposed upgrade near 'Clover Hill' was not known. However, as a noise barrier in a predominantly rural environment and one as scenic as the elevated plateau is likely to be perceived as highly unusual, the design of the noise barrier should aim to reduce the visibility of the structure as much as possible. This could be achieved through a landscaped earth mound or a hard engineering structure such as a noise wall, provided it is accompanied by dense planting. A more detailed discussion is provided in the section on 'Urban Design Elements'.

> Shaping of embankments

The proposed upgrade involves large fill embankments in the Byron Creek floodplain which would contrast strongly with the naturally flat landscape of the floodplain. In order to reduce this contrast, embankments should be shaped to 'grade out' at the bottom, making the junction between fill embankments and the valley floor less sharply defined. This should be combined with the planting of vegetation at the bottom of embankments, the establishment of which over time, this will assist in reducing the 'artificial' effect of embankments.

URBAN AND LANDSCAPE DESIGN CONCEPT PLAN AND SPECIFIC RECOMMENDATIONS

Building on the identified key areas for detail design and the strategic principles outlined in the urban and landscape design strategic concept, Illustration 91 provides a more detailed concept plan for precinct 3. It identifies a series of precinct-specific urban and landscape design measures, which have been developed in response to the urban design objectives and principles for the proposed upgrade, and to mitigate the identified visual impacts. The plan further identifies important views to be retained and protected, in order to

enhance the experience of the motorist on both the existing and the upgraded highway.

The cross sections in Illustrations 76 to 78 further demonstrate the three-dimensional urban and landscape design treatments at a number of important locations within the precinct.

Specific recommendations to mitigate the potential visual impact of the proposed upgrade and to be investigated at a detailed level in the next design stages are:

1. Complement cutting revegetation with tree planting around the Broken Head crossing to visually reduce the vertical scale of the cutting and the potential visual effect associated with the new bridge and its abutments (Chainage 142,700 - 143,300).
2. Retain and protect macadamia plantations between the existing highway and the proposed upgrade, to maintain the visual diversity along the existing highway (Chainage 142,800 - 143,400).
3. Provide landscape planting on the eastern side of the existing highway to reduce visibility of the Skinners Creek bridge and associated large fill embankments and direct views of drivers on the existing highway towards open areas in the west (chainage 143,150 - 143,550).
4. Provide planting of riparian species in the Skinners Creek floodplain to mark the creek crossing and to reduce the visual prominence of cuttings, embankments and bridge piers (Chainage 143,300 - 143,650).
5. Use tree planting along the existing highway alignment to reduce the visual prominence of the upgrade (Chainage 144,200 - 144,600 and Chainage 145,000 - 145,300).
6. Where subsoil conditions require relatively flat angles of repose to cuttings (such as at 'Arundel'), round off the tops and sides of cuttings and tie them back into the natural landforms to reduce the effect of engineered slopes against the skyline, as well as to reduce the contrast with the gently rolling natural hills of the area (Chainage 144,500 - 145,000).
7. Replace the large mature fig tree on the hilltop at 'Arundel' with a new mature landmark tree above the eastern edge of the proposed cutting (chainage 144,800).
8. As much as possible, provide dense shrub planting in the existing median of the Bangalow bypass, to provide visual separation between the existing highway/ future local road and the proposed upgrade, and to reduce the amount of pavement visible from any one roadway (Chainage 145,300 - 146,450).
9. On the eastern side of the proposed upgrade, re-establish the dense vegetation buffer between the proposed upgrade road corridor reservation and adjoining property frontages (chainage 145,200 - 146,700).
10. Use tree and shrub planting between the upgraded highway and the local access road, to reduce the amount of pavement visible from both the local access road and the upgraded highway, and to create the character of a country lane or avenue along the local access road (chainage 145,500 - 146,700).
11. Provide dense planting to both sides of the proposed noise barrier to reduce the visual impact of the noise barrier on the rural countryside, to reinstate the densely vegetated highway road corridor and to provide increased visual amenity to both adjoining residents and motorists (chainage 145,500 - 146,600).
12. Use tree and shrub planting plant between the upgraded highway, including on- and off-ramps, and the Bangalow bypass/ local link road to reduce the amount of road infrastructure visible from any one road and from surrounding areas (Chainage 146,100 - 146,720).
13. Remove obsolete pavements around the Bangalow interchange and revegetate the areas (chainage 146,100 - 146,700).
14. Complement existing riparian and floodplain vegetation to soften the appearance of fill batters and bridge abutments in the Byron Creek floodplain by planting at the bottom of fill embankments (Chainage 146,500 - 146,950).
15. Reinstate and complement existing riparian/ creekside vegetation with additional planting to reduce the visual impact of bridge piers in the Byron Creek floodplain (chainage 146,650 - 147,100).
16. Revegetate cuttings and embankments throughout the precinct, to soften and reduce their visual effect. A list of locally appropriate species is provided in Appendix 1.

*** Notes:**

1. All chainages are approximate.
2. "Planting" refers to the final outcome and not to any particular technique during construction: it includes both individual plantings and large-scale revegetation works.



Plant floodplain vegetation at the bottom of fill embankments to reduce the visual impact on the floodplain

Bangalow interchange. Build on the existing Bangalow bypass planting scheme to define an individual planting character marking the arrival the Bangalow township, including Bangalow Palms.

Reinstate the dense buffer of vegetation along the frontage with adjoining properties to the east.

Provide dense planting to both sides of the proposed noise barrier, to visually screen the barrier, and improve the visual amenity of both residents and motorists.

Provide tree planting along the proposed local access road to create the feeling of a country lane and provide amenity.

Maximise planting between individual road and carriageways of the existing Bangalow bypass and the Bangalow interchange, to maximise their visual separation and reduce the visual prominence of large paving areas. In particular, maximise planting in the existing Bangalow bypass median strip.

Provide tree and shrub planting along the existing highway to provide visual separation from the proposed upgrade.

Reinstate the major landmark tree on the hilltop above the 'Arundel' cutting

Round of benches and tops of cuttings to integrate the cutting with the shape of the natural landscape.

Provide tree and shrub planting along the existing highway to provide visual separation from the proposed upgrade.

Retain and protect existing trees and complement them with additional planting to provide a dense stand of bushland screening the proposed upgrade

Reinstate and complement existing riparian vegetation to mark the creek crossing and soften the visual effect of the bridge piers

Maximise floodplain views from the Skippers Creek bridge

Plant to the east of the existing highway to reduce the potential visual prominence of the Skippers Creek bridge and associated fill embankments

Use tree and shrub planting to reduce the perceived vertical scale of the Broken Head Road cutting and to mitigate the potential visual impacts of the bridge and bridge abutments

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Illustration 75:
Urban and landscape design concept plan for precinct 3

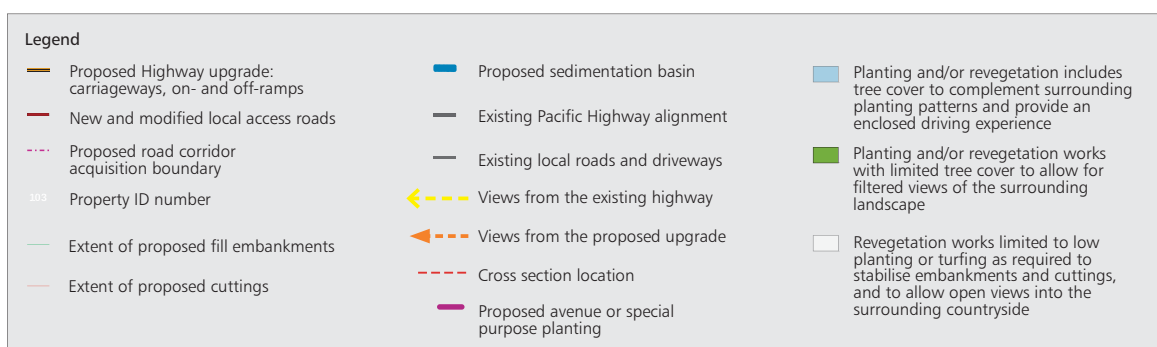




Illustration 76:
Cross section at chainage 143,700

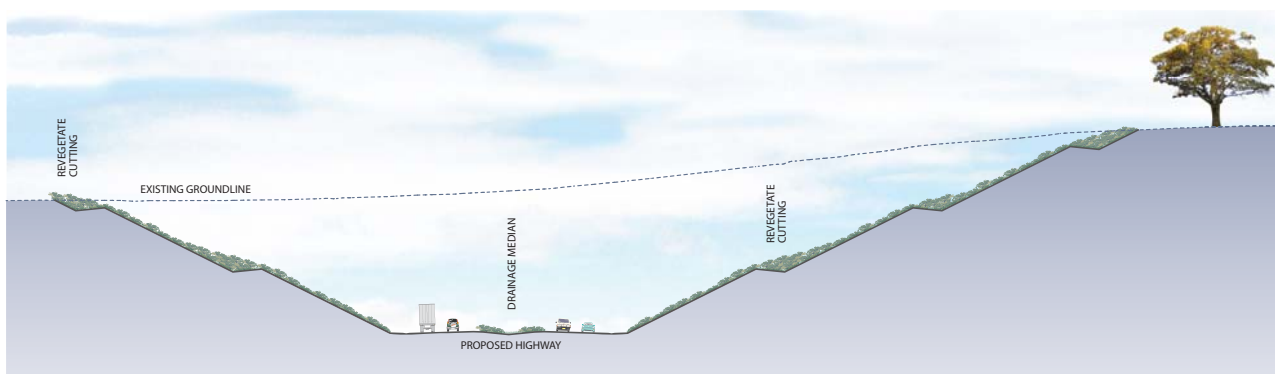


Illustration 77:
Cross section at chainage 144,800

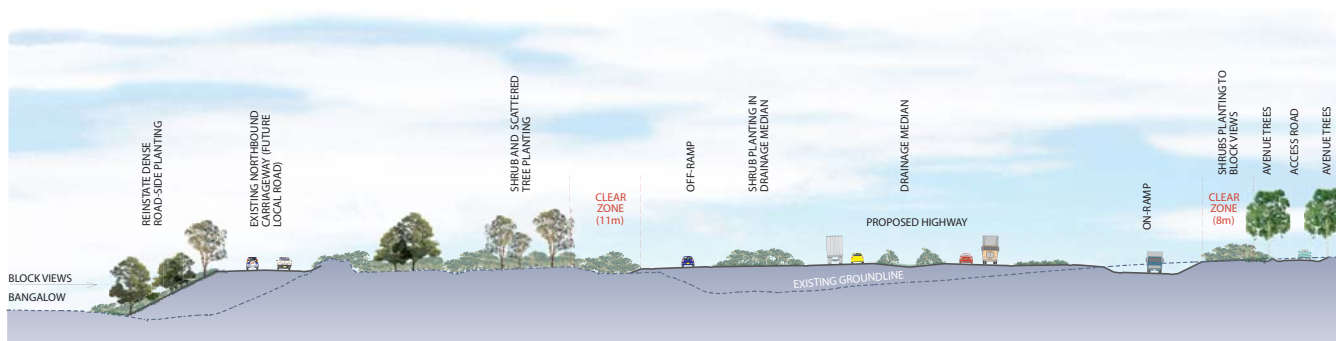


Illustration 78:
Cross section at chainage 146,400

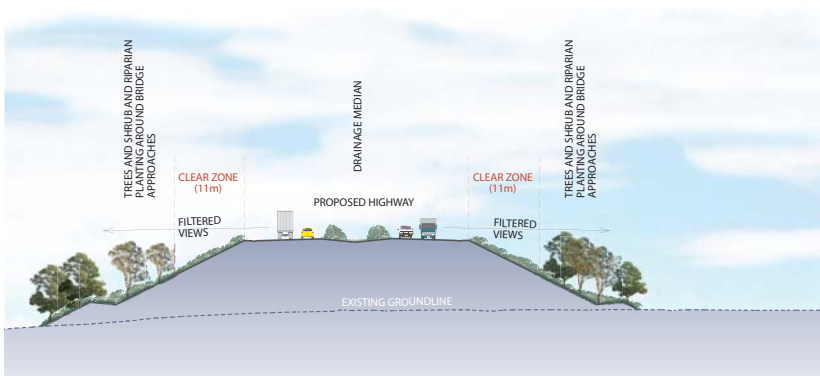


Illustration 79:
Cross section at chainage 146,870

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URBAN AND LANDSCAPE DESIGN CONCEPT - PRECINCT 4: TINDERBOX CREEK VALLEY

BYRON CREEK TO ST HELENA RIDGE, CHAINAGE 147,000 TO 150,300

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SUMMARY OF ISSUES

As discussed in the "Visual Assessment" section of this working paper, the main urban and landscape design and visual impacts in the Tinderbox Creek Valley precinct are associated with the large size of cuttings in the southern half of the precinct in particular and with the tunnel portals and associated cuttings around the tunnel opening.

From the point of view of the motorist and the driving experience along the proposed upgrade, the Tinderbox Creek Valley precinct is characterised by its low levels of development and its consistently open pastoral character which is in contrast to the much more heavily vegetated and varied landscape along the remainder of the proposed upgrade. This provides a pleasant contrast for the motorists as it allows for more distant views and gives the motorist more time to study and enjoy views before being enclosed by vegetation. Particular important views include views into the Tinderbox and Byron Creek floodplains north of the Byron Creek bridge, the views south when emerging from the tunnel in the St Helena ridge, and views into side valleys and along minor creeks and drainage lines (refer to Illustration 80).

In terms of how the proposed upgrade will be perceived by local residents and visitors to the area, views from the local road system are limited largely to middle-distance views from surrounding ridge line roads. The most important of these in terms of proximity to the upgrade would be St Helena Road and has been addressed in the urban and landscape design concept plan. In addition and as for all other precincts, the proposed upgrade would be visible from a number of residential dwellings. As most of the proposed upgrade would be located lower in the landscape than the majority of dwellings and farm houses in the precinct, attempting to screen the proposed upgrade with landscape planting would not be effective in concealing the upgrade from those higher elevated properties. Screen plantings at specific locations within individual properties might therefore be a more effective means of providing visual screening to residents in the precinct, while maintaining views and visual diversity for motorists on the proposed upgrade.

KEY AREAS FOR DETAIL DESIGN

In precinct 4, the key areas for further design investigation, resolution and development include:

> Shaping of cuttings and embankments

The precinct features a number of significant cuttings, in particular north of Tinderbox Road and around the tunnel portal (also refer to "Tunnel and tunnel portal design"). In order to reduce the impact of sharply defined cuttings against the gently rolling character of the natural landscape, consideration should be given to the shaping cuttings in a way that reduces this contrast and allows cuttings to blend into the natural landscape.

Similarly, embankments should be 'graded out' at the bottom, to reduce the visual impact of an obvious junction between fill embankments and the natural landform.

Combined with the establishment of vegetation over time, this will assist in reducing the 'artificial' character of cuttings and embankments (also refer to "Cutting and embankment stabilisation").

> Cutting and embankment stabilisation

The successful stabilisation and revegetation of the numerous cuttings and embankments will be an important factor influencing the character of the proposed upgrade, both from the point of view of motorists and when seen from surrounding areas.

Consideration should be given to the angle of cutting and embankment slopes with regard to short and long term soil stability, the potential for plants to successfully establish and long term maintenance (issues include mulch or small rocks being washed onto the road pavement).

Close liaison with geotechnical specialists is recommended in order to identify the need for and best means of soil amelioration and stabilisation to ensure good long-term vegetation cover.

> Tunnel and tunnel portal design

The tunnel under the St Helena ridge is prominently located in the side of the scenic escarpment and represents a major landmark along the proposed upgrade, as well as along the Pacific Highway as a whole. The current proposal involving major excavation of the natural hillside does not reflect the importance of the tunnel from an urban design and visual point of view.

Consideration should therefore be given to reviewing the tunnel design with the aim of increasing the length of the tunnel. This would significantly reduce the amount of excavation works which in turn would reduce the degree of engineering measures likely to be required to stabilise cutting faces (both potentially also representing a cost saving). Refer to the "Urban Design Elements" section of

this working paper for a further discussion of tunnel and tunnel portal design.

> Vertically independent carriageways

Investigate the potential for independent vertical grading of the two carriageways, in order to reduce the motorway character of the proposed upgrade while also potentially reducing the amount of earthworks required. The section of the proposed upgrade between the Tinderbox Creek bridge and the tunnel portal seems particularly suited for this (chainage 147,800 - 150,050), although the section between the Byron and Tinderbox Creek bridges may also offer some potential (chainage 147,000 - 147,700).

URBAN AND LANDSCAPE DESIGN CONCEPT PLAN AND SPECIFIC RECOMMENDATIONS

Building on the identified key areas for detail design and the strategic principles outlined in the urban and landscape design strategic concept, Illustration 80 provides a more detailed concept plan for precinct 4. It identifies a series of precinct-specific urban and landscape design measures, which have been developed in response to the urban design objectives and principles for the proposed upgrade, and to mitigate the identified visual impacts. The plan further identifies important views to be retained and protected, in order to enhance the experience of the motorist on both the existing and the upgraded highway.

The cross sections in Illustrations 81 to 83 further demonstrate the three-dimensional urban and landscape design treatments at a number of important locations within the precinct.

Specific recommendations to mitigate the potential visual impact of the proposed upgrade and to be investigated at a detailed level in the next design stages are:

1. Reinstate and complement existing riparian/ creekside vegetation with additional planting to reduce the visual impact of bridge piers in the Byron Creek floodplain (chainage 147,000 - 147,100).
2. Use planting to soften the appearance of bridge abutments in the Byron Creek floodplain by planting at the bottom of fill embankments (chainage 147,000 - 147,100).
3. Reinstate and complement existing riparian/ creekside vegetation along Tinderbox Creek and its tributary to reduce the visual impact of bridge piers (chainage 147,700 - 147,900).

4. Reinstate dense bushland on the western side of the proposed upgrade (chainage 147,700 - 147,900).
5. Provide dense boundary planting between the proposed upgrade road reservation and the piggery to provide a visual buffer to adjoining properties while maintaining views from the proposed upgrade (chainage 147,850 - 148,000).
6. Plant at the top of cuttings on the eastern side of the proposed upgrade to reduce the visual impact of the large western cutting face on the residents of the Tinderbox Valley (Chainage 148,000 - 148,300).
7. Provide low planting on the eastern side of the proposed upgrade to reduce the impact of headlight glare on surrounding properties while maintaining views from the proposed upgrade into the surrounding countryside (chainage 149,680 - 149,850).
8. Provide dense revegetation to the cutting faces and tops of cuttings surrounding the tunnel portals, to visually conceal the large excavation and cutting faces from St Helena Road (chainage 149,950 - 150,150).
9. Revegetate cuttings and embankments throughout the precinct, to soften and reduce their visual effect. A list of locally appropriate species is provided in Appendix 1.

*** Notes:**

1. All chainages are approximate.
2. "Planting" refers to the final outcome and not to any particular technique during construction: it includes both individual plantings and large-scale revegetation works.

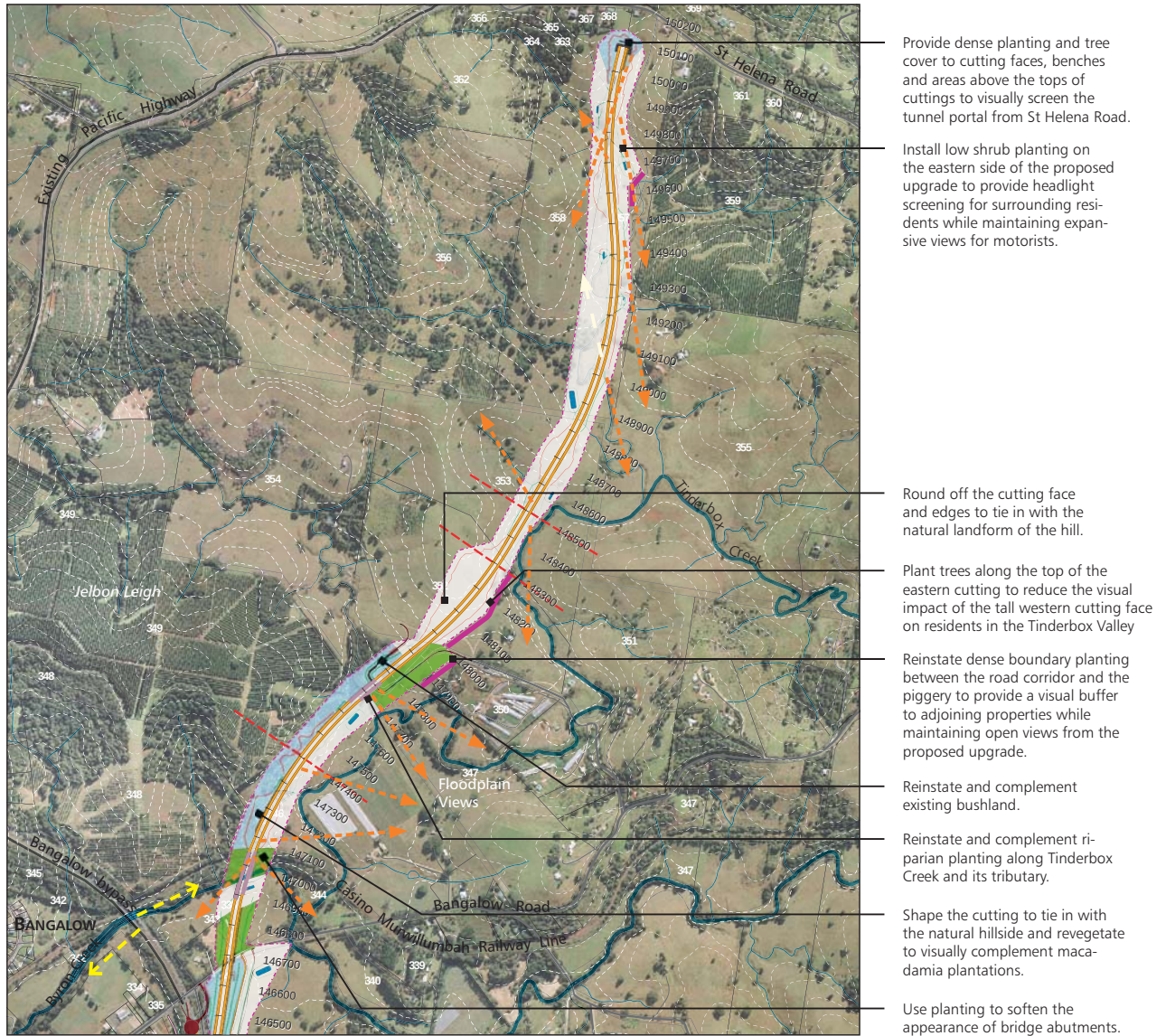
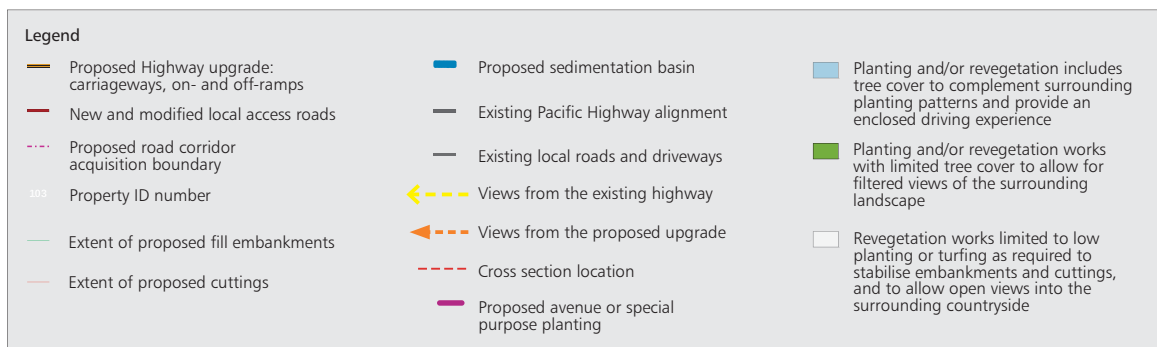


Illustration 80:
Urban and landscape design concept plan for precinct 4



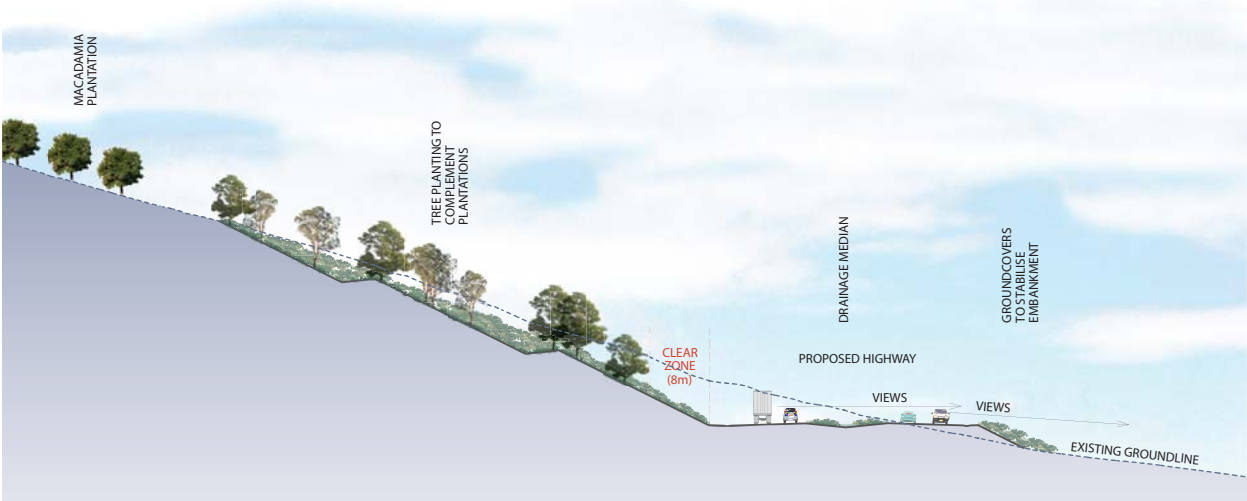


Illustration 81:
Cross section at chainage 147,400

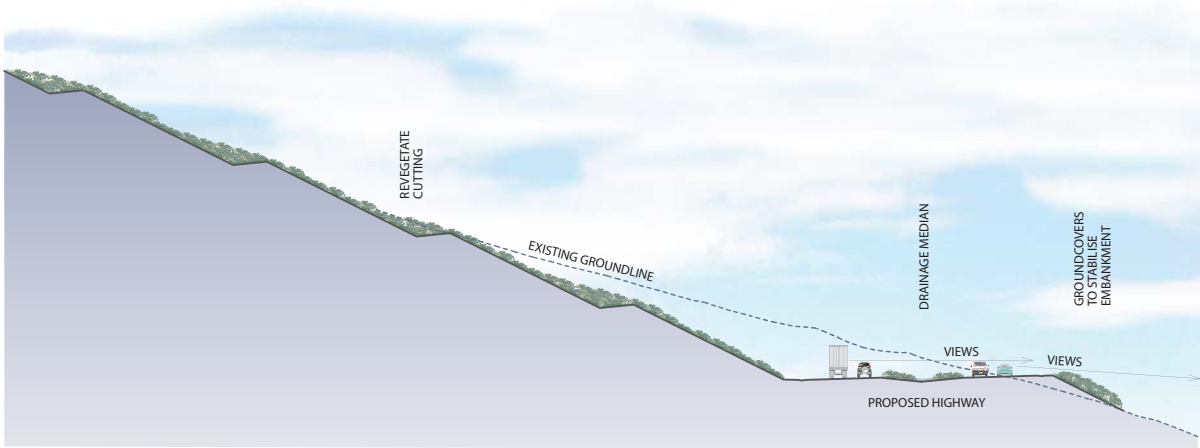


Illustration 82:
Cross section at chainage 148,300

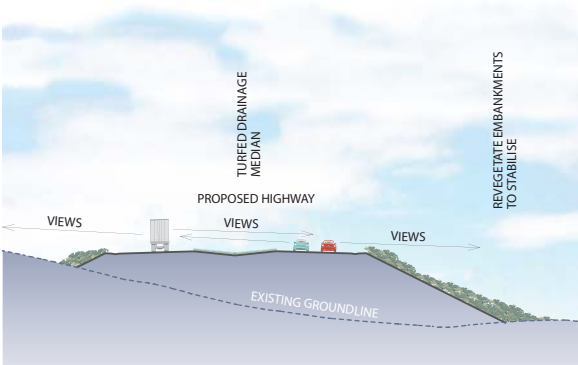


Illustration 83:
Cross section at chainage 148,500

URBAN AND LANDSCAPE DESIGN CONCEPT - PRECINCT 5: EWINGSDALE

ST HELENA RIDGE TO EWINGSDALE INTERCHANGE, CHAINAGE 150,300 TO 152,200

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SUMMARY OF ISSUES

As discussed in the "Visual Assessment" section of this working paper, the main urban and landscape design and visual impacts in the Ewingsdale precinct are associated with the large increase of road infrastructure on the Ewingsdale spur, the major fill embankment on the eastern side of the spur and the construction of the tunnel portals and associated cuttings around the tunnel openings.

From the point of view of the motorist and the driving experience along the proposed upgrade, the Ewingsdale precinct is characterised by dramatic change in topography associated with the climb up or descent down from the scenic escarpment. Associated with this are panoramic views along the face of the escarpment and towards Cape Byron, the Pacific Ocean and coastal plain (Illustration 84). They represent a landmark experience both along the proposed upgrade and along the Pacific Highway overall, contrasting with the coastal hinterland that dominates much of the Pacific Highway. Maintaining and maximising these views will therefore be important and ensure the experience of the highway in the study area remains a memorable one.

In terms of how the proposed upgrade will be perceived by local residents and visitors to the area, views from the existing highway and its visual relationship with the proposed upgrade are important factors and have been addressed by the urban and landscape design concept plan.

KEY AREAS FOR DETAIL DESIGN

In precinct 5, the key areas for further design investigation, resolution and development include:

> Tunnel and tunnel portal design

The tunnel under the St Helena ridge is prominently located in the side of the scenic escarpment and represents a major landmark. The current proposal involving major excavation of the natural hillside is not sympathetic to the significance of the scenic escarpment from an urban design and visual point of view.

Consideration should therefore be given to reviewing the tunnel design with the aim of increasing the length of the tunnel. This would significantly reduce the amount of excavation works which in turn would reduce the degree of engineering measures likely to be required to stabilise cutting faces. Refer to the "Urban Design Elements" section of this working paper for a further discussion of tunnel and tunnel portal design.

> Embankment stabilisation and revegetation

The successful stabilisation and revegetation of the large fill embankment will be important from the point of view of protecting the visual character of the prominent Ewingsdale spur, in particular its appearance when viewed from Ewingsdale and other areas to the east. The main aim of the design of the embankment would be to ensure a natural appearance of the embankment. This involves an overall shape that would blend in with the natural landform and a slope steepness that allows revegetation to the degree where it would match the established vegetation pattern of the spur over time.

Consideration should therefore be given to the angle of embankment slopes with regard to short and long term soil stability, the potential for plants to successfully establish and long term maintenance, reducing the 'artificial' character of the embankment.

> Reduce the visual impact of parallel areas of hard pavement

Reducing the amount of hard pavement visible from any one area or viewpoint will assist in reducing the potential visual impact resulting from the large concentration of parallel roadways around the Ewingsdale interchange. Planting, including planting of trees and shrubs, between the separate road and carriageways (including the proposed upgrade, the existing highway and its proposed diversion, on- and off-ramps and local access roads) should be maximised, in order to visually break up the wide area of hard pavement.

Further, road design development should seek to minimise hard paved areas as much as possible, in particular where pavement would only be required in the case of future road widening or the potential provision of additional traffic movements at intersections in the future. In shoulders, consideration should also be given to the use of alternative materials and/or textures that reduce the width of the uniform driving surface.

On the upper sections of the spur, the existing and proposed highway would be visually separated by nature of their vertical alignments. In these areas, planting between the existing and proposed highway should remain low, in order to protect significant views from the existing highway alignment while stabilising embankments.

URBAN AND LANDSCAPE DESIGN CONCEPT PLAN AND SPECIFIC RECOMMENDATIONS

Building on the identified key areas for detail design and the strategic principles outlined in the urban and landscape design strategic concept, Illustration 84 provides a more detailed concept plan for precinct 5. It identifies a series of precinct-specific urban and landscape design measures, which have been developed in response to the urban design objectives and principles for the proposed upgrade, and to mitigate the identified visual impacts. The plan further identifies important views to be retained and protected, in order to enhance the experience of the motorist on both the existing and the upgraded highway.

The cross sections in Illustrations 85 to 87 further demonstrate the three-dimensional urban and landscape design treatments at a number of important locations within the precinct.

Specific recommendations to mitigate the potential visual impact of the proposed upgrade and to be investigated at a detailed level in the next design stages are:

1. Maximise tree and shrub planting around the tunnel portals and above the tunnel portal cuttings to reduce the visual impact on Plantation Drive and on properties along St Helena Road (Chainage 150,300 - 150,450).
2. Complement and improve existing revegetation works on the western side of the fill embankment supporting the existing highway, to reduce the visually obvious transition between the embankment and the natural landform of the Ewingsdale spur and to soften the appearance of the embankment when seen from areas along the scenic escarpment. Design plantings to preserve views towards the escarpment from the existing highway (chainage 150,400 - 151,400).
3. Provide low planting between the existing and proposed highway to stabilise embankments and to reduce the visibility of the proposed upgrade from the existing highway, while maintaining significant views from the existing highway open towards the east and north (chainage 150,450 - 151,200).
4. Densely revegetate the major fill embankment to reduce the visual impact of the artificial benched landform when seen from the east, including from Ewingsdale Road and distant viewers from Cape Byron. Limit tree planting to areas east of the realigned Plantation Drive and set out trees to ensure that views to the east from the existing highway are maintained (Chainage 150,500 - 150,950).

5. Densely plant the noise mound, including both sides of the mound, with trees, shrubs and groundcovers to reduce the visual impact of the noise barrier, to visually conceal the barrier from both residents in adjoining areas and from motorists on the existing highway and the proposed upgrade and to maintain the natural appearance of the Ewingsdale spur as much as possible, especially when seen from a distance. As much as possible, integrate the design of the noise mound with the natural landform of the Ewingsdale spur (chainage 151,050 - 152,000).
6. Maximise tree and shrub planting and embankment revegetation between the existing and the proposed highway, to visually separate the existing and proposed highway and reduce visual impact of large areas of hard pavement (Chainage 151,200 - 151,750).
7. Develop an individual planting scheme for the Ewingsdale interchange, including selective tree species to mark the arrival at the special destination of Byron Bay (chainage 151,200 - 151,750).
8. Maximise planting at the Ewingsdale interchange, including planting of trees and shrubs between on- and off-ramps and both the existing highway and the proposed upgrade, to reduce the visual impact of large areas of hard pavement and of the prominence of the interchange infrastructure when seen from the scenic escarpment and Ewingsdale spur (chainage 151,700 - 152,200).
9. Revegetate cuttings and embankments throughout the precinct, to soften and reduce their visual effect. A list of locally appropriate species is provided in Appendix 1.

* Notes:

1. All chainages are approximate.
2. "Planting" refers to the final outcome and not to any particular technique during construction: it includes both individual plantings and large-scale revegetation works.

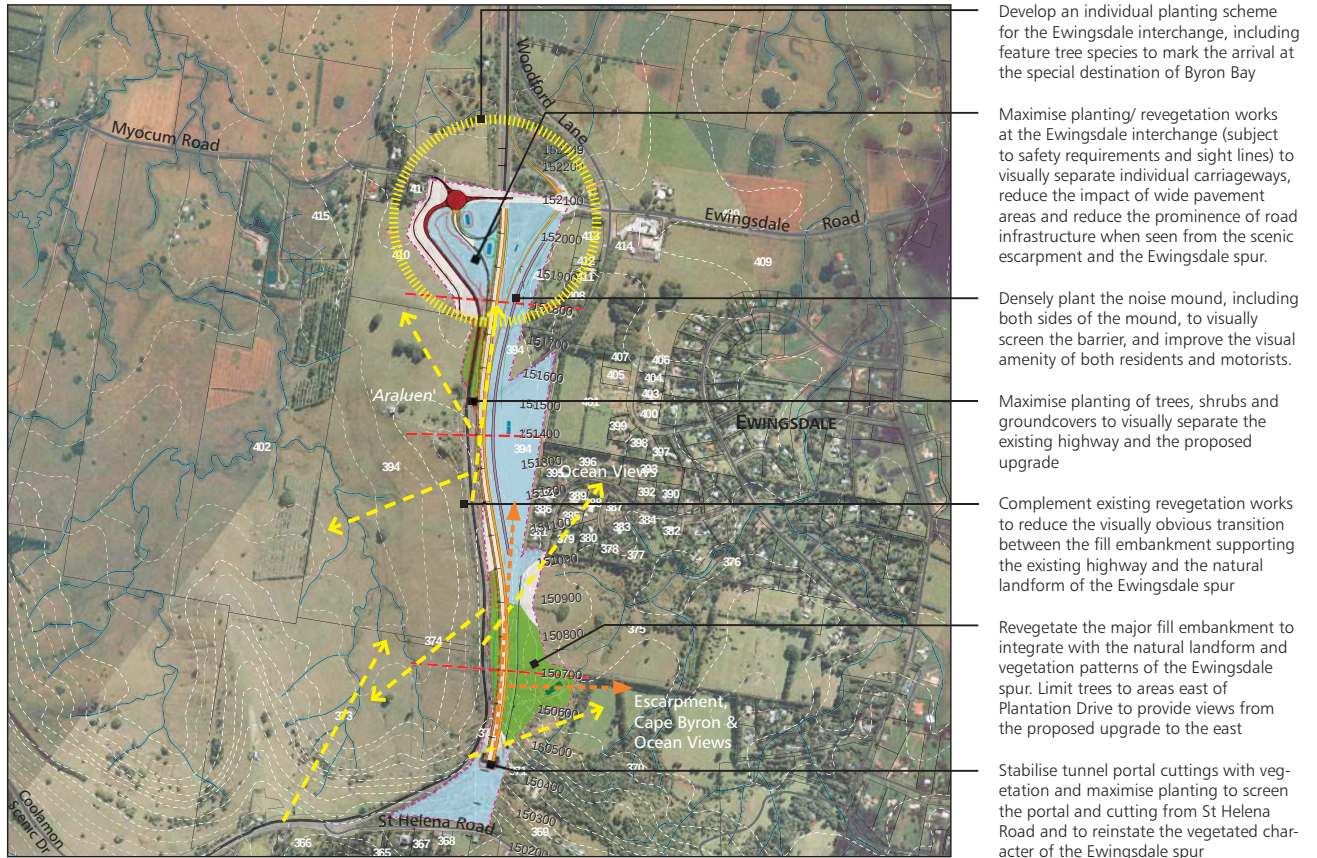
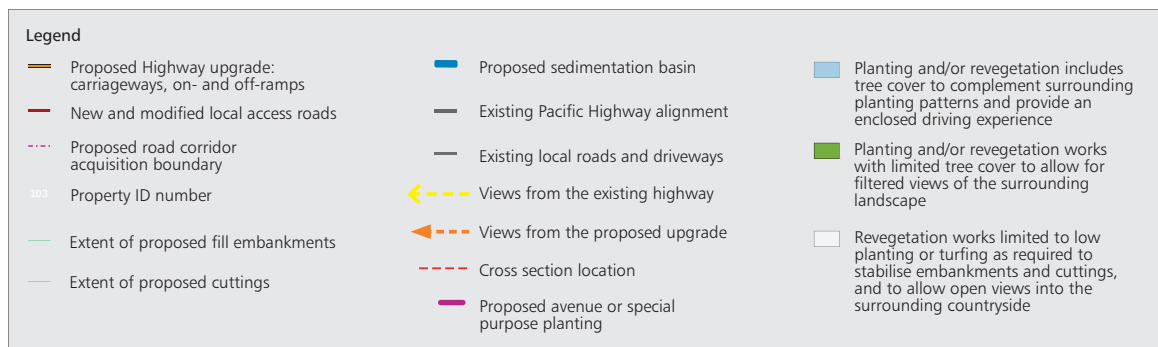


Illustration 84:
Urban and landscape design concept plan for precinct 5



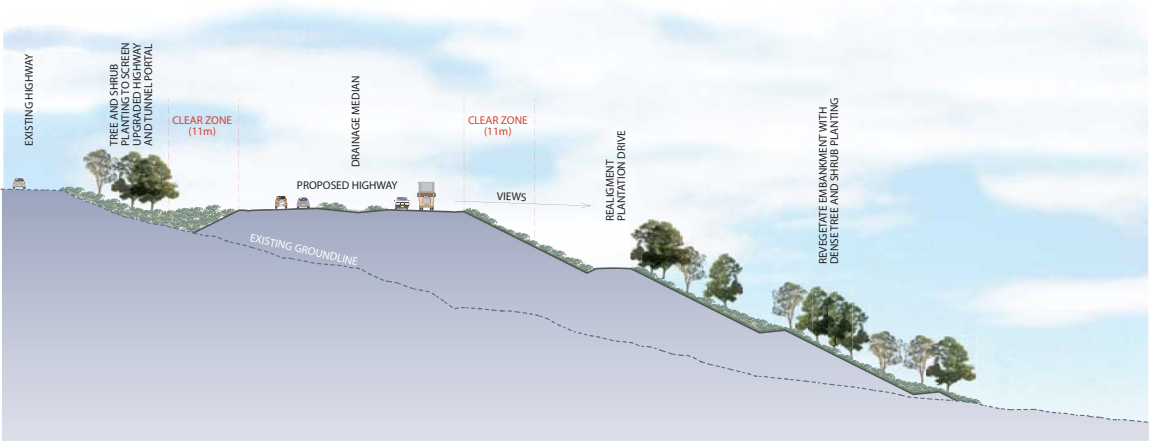


Illustration 85:
Cross section at chainage 150,700

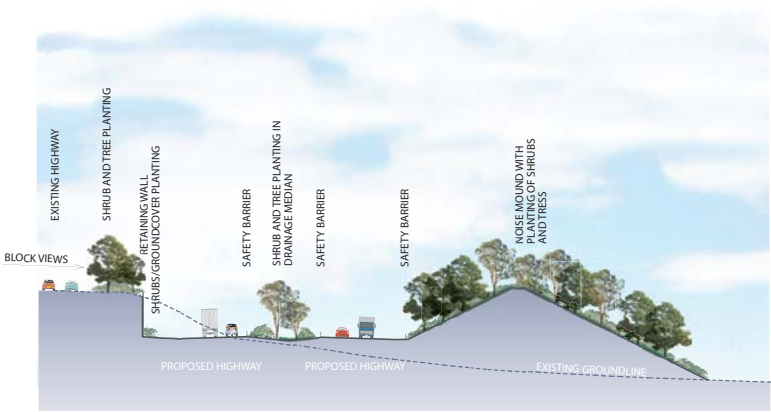


Illustration 86:
Cross section at chainage 151,400

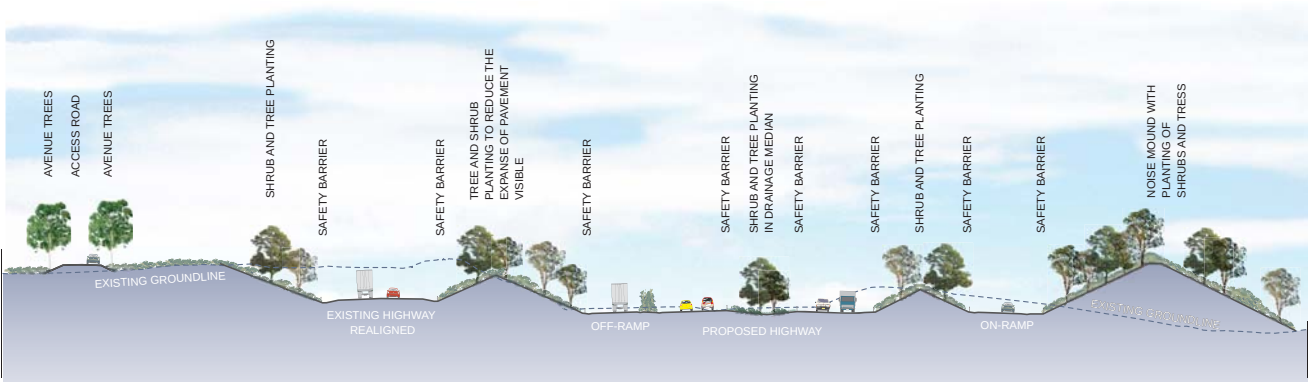


Illustration 87:
Cross section at chainage 151,800

URBAN DESIGN ELEMENTS

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While road infrastructure elements have been categorised according to their importance based on the visual contribution they make towards the proposed upgrade and the surrounding countryside, a key urban design objective for the Pacific Highway is the design of road infrastructure elements as a series of related elements. In the words of the *'Pacific Highway Urban Design Framework'*, they "should belong to the same design family and should be considered as part of a suite of unified elements" (p. 32).

In order to achieve this objective, a series of urban design principles were developed for major road infrastructure elements, including the tunnel (portals and cuttings), the bridges, overbridges and noise walls. The design principles were developed building on the overall urban and landscape design vision, objectives and principles outlined earlier in this working paper and have taken into consideration other relevant RTA publications and design guidelines.

The following pages provide an overview of the key urban design principles for major road infrastructure elements.

BRIDGES

The proposed highway upgrade features a number of bridges spanning local roads and waterways. Specifically, they are located at 'Yarrenbool Place' (properties 89 and 92 in precinct 2), Emigrant Creek (precinct 2), Skinners Creek (precinct 3), Bangalow Road (precinct 3), Byron Creek (precincts 3 and 4) and a tributary to Tinderbox Creek (precinct 4).

With the possible exception of Bangalow Road, these bridges are generally of significant length, and a number are highly exposed to a large number of viewers. Many are associated with significant earthworks, in particular fill embankments. While this is necessary in order to meet the horizontal alignment design criteria, it will increase the visual exposure of the upgraded highway. Further, in many instances the bridge abutments are staggered, with the start and finish of north- and southbound bridge decks offset relative to one another. This has the potential to increase the visual effect of the bridge, as the offset nature of piers supporting the north- and southbound carriageways may give the impression of a larger number of piers. As a result, the bridge structure will be less transparent, appear "heavier" and more visually dominant in the landscape.

As a response to these challenges and in building on the principles outlined in the RTA's *'Bridge Aesthetics'* design guidelines, the following design principles were developed for bridges to be constructed as part of the proposed upgrade.

They reflect the potential visual prominence of the bridges, as well as the need to respond to the highly scenic rural landscape along the proposed upgrade with simple, elegant and refined structures that remain subservient to the landscape setting.

- > Design bridges and overbridges as a 'family' of designed structures.
 - As much as possible, employ consistent proportions between design elements in the design of all bridges and overbridges associated with the proposed upgrade.
- > Design bridges as simple but elegant structures that subtly complement the surrounding rural landscape.
 - Minimise the complexity of bridges, in order for the rural landscape to remain the dominant visual feature.
 - Where possible, design the bridge with an uneven number of spans/ haunches (refer to Illustration 88). Integrate haunching with the pier design (refer to Illustrations 88, 89 and 91).
 - Use shadow lines in the short elevations to reduce the perceived thickness of piers (refer to Illustration 91).
 - Continue parapets beyond abutments in order to anchor the bridge to the surrounding landscape (refer to Illustration 92).
 - Conceal pile caps below the finished ground surface or low water line.



*Illustrations 88-90:
Examples of haunching and pier design well integrated
(88-89) and poorly integrated (90) (source: RTA 'Bridge Aesthetics', p 27)*

- > Minimise the thickness and perceived thickness of the bridge superstructure.
 - Design bridges to appear as long and thin elements in the landscape, with a high slenderness ratio (depth of superstructure to bridge span).
 - Minimise the thickness of bridge decks and use smoothly tapering haunched girders rather than single depth beams to provide an elegant bridge form that minimises the perceived thickness of the superstructure and allows the landscape setting to dominate the view (refer to Illustration 88).
 - Design girders and associated shadow lines to reduce the perceived thickness of the superstructure (refer to Illustration 88).



Illustration 91:
The thickness of the pier on this bridge has been broken up by the use of a shadow recess, reducing the perceived thickness of the pier (source: RTA 'Bridge Aesthetics', p 8)



Illustration 92:
The bridge is tied to the surrounding landscape by the parapet that continues past the abutments (source: RTA 'Bridge Aesthetics', p 26)

- > Maximise the transparency of bridges.
 - Minimise the number of bridge piers by maximising the span.
 - Design bridge piers as open bridge piers with a reverse taper to eliminate the need for headstocks and to reduce the number of piles (refer to Illustration 93).
 - Maximise the transparency of the bridge substructure by providing spill through abutments (refer to Illustration 88) and by orienting bridge piers so that long elevations are parallel to the main viewing direction (refer to Illustration 94).
 - Avoid walled abutments or abutments stabilised with 'hard' materials.
 - Where possible, design bridge spans for the first span to meet the bottom of spill abutments (refer to Illustration 88).
 - Set out piers of the north- and southbound carriageways to be aligned relative to the predominant direction of viewing, to reduce the amount of piers visible and maximise transparency (refer to Illustration 94).
 - Design parapets, traffic barriers and railings as integrated structures (refer to Illustration 95) that maximise transparency and views of the landscape, assisting motorists in the recognition of landmarks along the route.
 - Use rounded bridge rails and maximise the use of rails over solid barriers, to maximise motorist views to the surrounding landscape (refer to Illustration 96).

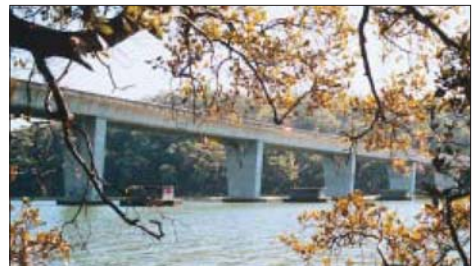


Illustration 93:
Reverse tapers on the long elevation of the Alford's Point Bridge (source: RTA 'Bridge Aesthetics', p 17)

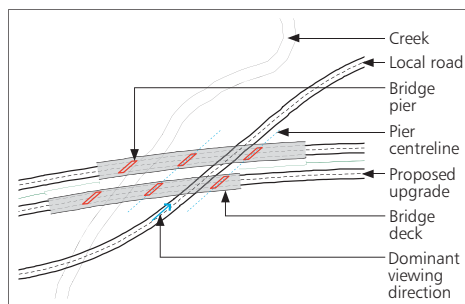


Illustration 94:
Diagram illustrating aligned bridge piers oriented with the long elevation parallel to the main viewing direction.



Illustration 95:
This design detail has successfully integrated a safety barrier and bridge parapet (source: RTA 'Bridge Aesthetics', p 43)



Illustration 96:
This transparent barrier along the F3 Freeway allows good views of the surrounding landscape. Using round instead of square sections would further reduce the perceived thickness of rails (image source: RTA)

The application of these design principles in the further design development of bridge structures should be consistent with the priority ranking assigned to the various bridges along the proposed upgrade in the urban and landscape strategic concept plan (refer to Illustration 65). Accordingly, the design of "Priority One" bridges should seek to realise a maximum number of these principles. The design of bridges of lower order priority may apply these principles less stringently, but should seek to mitigate any resulting visual impacts through other design measures, in particular in terms of the visual exposure of those bridges.

To date, design work for bridges has been limited to preliminary design investigations that would confirm that functional requirements for bridges can be achieved. This included the identification of potential span configurations for what were considered to be the two commercially most competitive options at the time:

- Option 1: pre-cast and prestressed (Super T) concrete superstructure with simply supported spans.
- Option 2: continuous variable span haunched steel trough superstructure.

Both design options featured spill through abutments and pilecaps concealed below the existing ground levels, to help reduce the visual impact.

The preliminary investigations revealed that haunched steel trough superstructures (Option 2) would allow for greater spans and would generally conform better to the urban design objectives and principles for the proposed upgrade, resulting in a more elegant structure. From an urban design and visual point of view, the adoption of this construction method (or of an alternative method that can be demonstrated to provide similar advantages and conformance to the identified design principles) would therefore be desirable for 'Priority One' bridges identified in the urban and landscape design strategic concept.

To achieve the objective of a 'family' of design structures, a consistent approach to bridge design and construction should ideally be adopted for the length of the proposed upgrade. This would offer the following advantages:

- Visual compatibility of structures along the upgrade, including compatibility and consistency of bridge span configurations.
- Less environmental disturbance during construction due to fewer piers, since the most significant environmental impact would be likely to occur during construction of the substructure.

- More elegant and structurally efficient bridges which may also prove to be economically justifiable as a result of continuity advantages, reduced material requirements and reduced substructure size.

OVERBRIDGES

- > Integrate the design of overbridges with the design of bridges. As much as possible, employ consistent proportions in the design of overbridges along the route, in order to achieve a 'family of overbridges'.
- > Design overbridges as simple but elegant structures that subtly complement the surrounding rural landscape.
 - Minimise the complexity of bridges, in order for the rural landscape to remain the dominant visual feature.
 - Where possible, design the bridges to feature a single haunched span over the upgraded highway.
 - If piers are required, design pier locations and bridge spans to achieve a symmetric overbridge design, relative to the upgraded highway/ median centreline and locate piers to meet the bottom of spill abutments (refer to Illustrations 97 and 98).
 - If piers are required, integrate haunching with the pier design to eliminate the need for headstocks (refer to Illustrations 89 and 91). Conceal pile caps below the finished ground surface.
 - Continue parapets/ bridge barriers and safety screens beyond the abutments in order to anchor the bridge to the surrounding landscape (refer to Illustration 92).
 - Design the underside of girders as simple smooth structures, consistent with the high degree of exposure to viewing by motorists on the upgraded highway.
- > Minimise the thickness and perceived thickness of the bridge superstructure.
 - Design bridges to appear as long and thin elements in the landscape, with a high slenderness (depth of superstructure to bridge span) ratio.
 - Minimise the thickness of bridge decks and use smoothly tapering haunched girders rather than single depth beams to provide an elegant bridge form that minimises the perceived thickness of the superstructure and allows the landscape setting to dominate the view (refer to Illustration 88).
 - Design girders and associated shadow lines to reduce the perceived thickness of the superstructure (refer to Illustration 88).

- Design bridge/ pedestrian barriers and safety/ throw screens as integrated structures (refer to Illustration 98) that minimise the perceived thickness of the superstructure and maximise transparency and views.

> Maximise the transparency of overbridges.

- Maximise the transparency of the bridge substructure by providing spill through abutments (refer to Illustrations 97 and 98).
- Avoid walled abutments or abutments stabilised with 'hard' materials.
- Use rounded bridge rails and maximise the number of rails over solid barriers, to maximise views of the scenic landscape (refer to Illustration 96).



*Illustrations 97 and 98:
Two examples of overbridges on the Pacific Highway with symmetrical pier layout and piers meeting the bottom of spill abutments, resulting in good transparency of the structure.*



*Illustration 99:
An example of an integrated barrier and safety/ throw
screen design near Shell Corner, on the Great Western
Highway.*

TUNNELS AND TUNNEL PORTALS

The proposed highway upgrade features a tunnel under the St Helena ridge. As a significant engineering structure located in the side of the scenic escarpment, the tunnel will be a prominent new element, contrasting strongly with the rural landscape of the study area.

From the motorists point of view, the tunnel will represent a major landmark along the route, with tunnels generally being a rare feature along the Pacific Highway.

The design of the tunnel, the tunnel approaches and tunnel portals, as well as any other associated engineering works such as cuttings or retaining walls, will therefore play an important role in how the upgraded highway is perceived, both by viewers in surrounding areas and by motorists using the upgraded highway.

The current tunnel and tunnel portal design includes a relatively short tunnel, based on fire and other safety considerations and associated costs. As a result of this, major cuttings are required at both tunnel entrances, effectively excavating the hillside in order to accommodate the desired tunnel length. The current concept design proposes steep cutting faces, stepping through a series of benches to facilitate maintenance access. As discussed in the "Visual Assessment" section of this working paper, the potential visual effect, and associated visual impact, of these cuttings would potentially be moderate to high.

The following design principles were identified in order to reduce the potential visual impact associated with cuttings and tunnel portals:

- > Use local materials (such as rock excavated from tunnels) to build retaining structures or to stabilise cutting faces and design cutting faces to avoid the use of shotcrete in both the short and long term, where possible (refer to Illustrations 100 and 101).
- > Where geotechnical conditions indicate poor slope stability or limited potential for successful revegetation, stabilise cutting faces through the use of retaining walls, gabions or other 'hard' structures which avoid the use of shotcrete.
- > Design the portal headwalls, portal openings, retaining walls and safety barriers leading up to the portal as an integrated series of elements (refer to Illustration 100).
- > Design cuttings and benching to maximise the potential for cutting revegetation and visual "softening" of the portals.

From a visual amenity and urban and landscape design point of view, the further development of the concept design should include a review of the tunnel and portal design, in order to achieve a final outcome which would be visually better integrated into the surrounding landscape, reflecting the importance of the tunnel's landmark status, its landmark location in the side of the escarpment with its recognised scenic values and its high level of visual exposure. In addition to the above principles, the review or refinement of the tunnel during future design stages should consider the following:

- > Minimise the amount of cut around tunnel portals by extending the tunnel length to correspond to the natural shape of the ridge line (refer to Illustration 102).
- > Design the north- and southbound tunnels to be independent in length to correspond to the natural shape of the hillside.
- > Design tunnel portals to follow the shape of the natural hillside (refer to Illustrations 102 and 103).



*Illustration 100:
The Laerdal tunnel in Norway is a good example of an integrated
design of the tunnel portal, safety barriers, cuttings and retaining
structures that is sympathetic to the surrounding landscape.
A similar approach may be suitable for the prominent southern
tunnel portal on the Ewingsdale spur.*



Illustration 101:
Detail of the simple but refined suite of materials used around the portal of the Laerda tunnel. The smooth concrete tunnel creates an attractive contrast with the head wall made from local rock material.

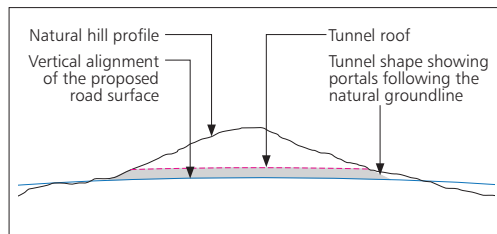


Illustration 102:
Tunnel length and portal shape designed to correspond to the natural land form.



Illustration 103:
Example of a tunnel portal shaped to correspond to the natural hill slope.

NOISE BARRIERS

Noise barriers are likely to be required in a number of locations along the upgraded highway. These are:

- at Newrybar, between Newrybar Public School and the proposed upgrade (precinct 2).
- between the proposed upgrade and residential development in Clover Hill, near Bangalow (precinct 3).
- at Ewingsdale, between the proposed upgrade and established residential areas, replacing the current noise wall along the existing highway (precinct 5).

As the design of noise barriers has the potential to influence the visual character of the upgraded highway, both when seen by motorists and by viewers from surrounding areas, the design of noise barriers is an important urban and landscape design consideration. In particular design resolution of noise barriers and the degree of integration with other landscape design measures, will have an influence on the perception of the visual effect and visual impact associated with the structures.

Guidance on the design of noise barriers is provided by the RTA's *Pacific Highway Urban Design Framework* and by its *'Noise Wall Design Guideline'*. Building on these, this working paper makes recommendations on the design of noise barriers, with regard to the aesthetics of the structures. Functional design (i.e. noise mitigation) considerations are dealt with in a separate specialist working paper.

In general, noise barriers are most commonly associated with major roads which run through highly developed urban or suburban areas. They are therefore likely to be perceived as unusual and visually uncharacteristic objects within the scenic rural landscape of the study area. The main aim of noise barrier design would be the reduction of the degree of visibility of noise barriers in general, and of structures made from 'hard' engineering elements such as walls, giving preference to landscape solutions such as vegetated acoustic earth mounds.

Based on the concept work completed to date, this would be able to be achieved for the noise barriers at Newrybar Public School and at Ewingsdale. On the visually widely exposed Ewingsdale spur in particular a landscape solution would be the preferred outcome, in order for the landscape to remain the dominant visual feature.

The same general principle would apply to the noise barrier at 'Clover Hill', and should be considered during the next design stages. However the likely height required in order for the

noise barrier to be effective, in particular near the Bangalow interchange, might make a landscape mound impractical. This is because of the large footprint that would result from the construction of a mound to achieve the necessary height, and the associated amount of clearing of established vegetation along the existing highway which currently provides a visual buffer. Depending on the ultimate height required, a vertical noise wall might therefore be the preferred solution, due to the smaller landtake associated with the structure. Dense vegetated screening should be provided to both sides of such a structure to reduce its impact on the rural countryside and to provide visual amenity to both residents and motorists.

The development of designs for noise barriers along the proposed upgrade should incorporate the following design principles which have been formulated building on the *Pacific Highway Urban Design Framework* and the RTA's 'Noise Wall Design Guideline':

- > Design noise walls to remain subservient to and integrate with the natural landscape.
 - Design noise walls as simple structures that remain subservient to the overall landscape experience.
 - Design noise walls as plain structures composed of a minimum number of materials and of dark colours that recede into the landscape.
 - Use landscape planting before and behind noise barriers to soften the visual appearance of the barrier and to allow the landscape to remain the dominant visual element.
 - Design the start of noise walls to integrate with any safety barriers that may be required or use earth mounding/ sculpting to tie noise barriers into the surrounding landscape.
 - Where noise barriers adjoining cuttings, integrate the design of the noise barriers with the design and treatment of cutting faces.
 - Consider the use of partially transparent wall panels to reduce overshadowing where walls are in close proximity to residential development (such as in Bangalow) and to maximise the motorists views of the surrounding landscape.
 - As much as possible, design the top of noise walls to provide a consistent form parallel to the road surface.
 - Where stepping of wall panels is required, design steps to create a regular rhythm and to align the horizontal joints of separate wall panels (where applicable).

- > Reduce the perceived height of noise barriers.

- Where possible (depending on land form and available road corridor width), use a combination of earth mounding and low barriers/ walling that reduces the height of wall structures.
- Where particularly tall structures may be required and there is little or no potential for screening/ planting, consider visually breaking up the height of walls by a mix of solid and transparent horizontal wall panel layers.

In addition to these considerations, maintenance and access issues also pose important considerations in the design of noise barriers. These include the need for maintenance and maintenance access, the potential for graffiti and vandalism, and the creation of areas with poor passive surveillance which might inadvertently 'encourage' these and other anti-social activities, including the potential to break into properties adjoining noise barriers.

UNDERPASSES

Underpasses would be required in a number of locations within the study area, to facilitate local traffic movements and access across the upgraded highway. Underpasses would feature in precinct one, connecting the new local access road to the existing highway alignment between Carney Place and Martins Lane, in precinct two as a key component of the Ivy Lane interchange and in Watsons Lane, and in precinct three, where a private underpass would link the two portions of the severed property 198 ('Arundel').

Extending for the full width of the upgraded Highway and associated fill embankments, the length of these underpasses would be significant, ranging from about 50 metres at Watsons Lane to about 70 metres at the Ivy Lane interchange and in precinct one. As such they would be major structures and would have the potential to influence the landscape experience and perception of travellers along these routes. In this regard, the underpass at the Ivy Lane interchange will be of particular importance, as the interchange represents a major arrival point on the elevated plateau, providing a first impression for the motorist. The underpass in precinct one would also be of importance, providing the gateway to a number of properties on the western side of the proposed upgrade.

In this context, it will be important to resolve the design of underpasses to contribute to a positive experience of the overall landscape. The main urban design considerations will be:

- > Maximise light access and visibility in underpasses.
 - Maximise natural light penetration.
 - Investigate the potential for the installation of light wells in the medians of the proposed upgrade above.
 - Provide artificial lighting to maximise visibility, ensure road safety and deter antisocial activities.
 - Use light wall colours and consider the use of Vitri panel cladding or similar to improve visibility.
- > Allow adequate space for pedestrian and cycle access.
- > Use materials which are either unsuitable for or resistant to graffiti and vandalism.
- > Integrate the design of headwalls/ underpass entrances to complement the landscape.
 - Design underpass entrances to complement the landform of fill embankments.
 - Integrate the design of headwalls with the design of tunnel portals and headwalls to achieve a consistent family of urban design elements associated with the proposed upgrade.

SAFETY BARRIERS

For safety reasons, white wire-rope safety barriers have been adopted as the standard barrier type along the Pacific Highway. In order to achieve consistency with other upgrade projects, they should also be adopted along the proposed upgrade. If further investigations consider white unsuitable (for reasons such as frequent fog for example), black wire-rope safety barriers would be the preferred type of barrier. This is due to the transparent nature of the structure and the way black colours tend to recede into the surrounding context, rendering the barriers less noticeable and allowing the landscape to be the dominant visual element in turn.

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appendix 1

APPENDIX 1 - SPECIES LIST

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The following species list was provided by Biosis Research, the consultant undertaking the ecological assessment of and recommendations for the proposed upgrade of the Pacific Highway between Tintenbar and Ewingsdale.

The species in the list reflect the specific local character of the study area and these species should be used as much as possible in order to visually tie the proposed upgrade to the surrounding landscape, especially in highly visual areas and where feature planting is required. The list may need to be complemented by species that have proven successful on similar, large scale highway revegetation projects.

PLANTS SUITABLE FOR ROAD VERGES

Trees

Acacia bakeri
Archontophoenix cunninghamiana
Araucaria cunninghamii
Alphitonia excelsa
Alphitonia petrei
Aphananthe philippinensis
Brachychiton acerifolius
Commersonia bartramia
Diploglottis cunninghamii
Ehretia acuminata
Elaeocarpus grandis
Euroschinus falcata
Ficus coronata
Flindersia bennettiana
Flindersia schottiana
Jagera pseudorhus
Macadamia tetraphylla
Mallotus discolor
Mallotus philippensis
Polyscias elegans
Polyscias murrayi
Schizomeria ovata
Sterculia quadrifida
Toona ciliata
Tristaniopsis laurina

Small Trees

Acacia irrorata
Acacia melanoxylon
Acmena smithii
Acrornychia oblongifolia
Alchornea ilicifolia
Cassine australis
Claoxylon australe
Clerodendrum floribundum
Clerodendrum tomentosum
Cupaniopsis anacardioides
Cyclophyllum longipetalum
Drypetes deplanchei
Duboisia myoporoides
Elaeocarpus reticulatus
Elaeodendron australe
Ficus fraseri
Glochidion ferdinandi
Glochidion sumatranum
Guioa semiglauca
Hymenosporum flavum
Lenwebbia prominens
Melia azederach
Melicope elleryana
Pararchidendron pruinosum
Pittosporum multiflorum
Rapanea spp.
Rhodamnia rubescens
Scolopia braunii
Streblus brunonianus
Synoum glandulosum
Syzygium spp
Trema tomentosa

Shrubs

Alpinia caerulea
 Breynia oblongifolia
 Choricarpia leptopetala
 Jasminum volubile
 Maclura cochinchinensis

Groundcovers

Adiantum formosum
 Dianella spp.
 Doodia aspera
 Doodia caudata
 Hibbertia scandens
 Pellaea falcata
 Peperomia tetraphylla
 Pollia crispata
 Pteris umbrosa

Shrubs

Breynia oblongifolia
 Jasminum volubile
 Maclura cochinchinensis
 Pittosporum multiflorum

Groundcovers

Dianella spp.
 Hibbertia scandens
 Lomandra longifolia

PLANTS SUITABLE FOR ROAD MEDIANS***Small Trees***

Acacia irrorata
 Acacia melanoxylon
 Cupaniopsis anacardioides
 Glochidion ferdinandi
 Guioa semiglaucula
 Lenwebbia prominens
 Melicope elleryana
 Pararchidendron pruinosum
 Pittosporum revolutum
 Rapanea spp.
 Scolopia braunii
 Streblus brunonianus
 Synoum glandulosum
 Syzygium spp