Preface

This Working Paper presents findings from the F3 to Sydney Orbital Link Study. The Study applied strategic analysis to the assessment of corridor types and feasible route options to determine an acceptable and preferred option which best satisfies National Highway objectives.

A number of specific routes and associated engineering details such as interchange and ventilation layouts were developed and analysed during the course of the Study, for the purpose of determining feasibility and assessing the options. The specific routes and details described in this document should be seen in this context.

This Study is documented in a Main Report which is supported by two records of Value Management Workshops, a draft Options Development Report and seven Working Papers as follows:

Value Management Workshop No.1 Record (June, 2002)
Value Management Workshop No.2 Record (September, 2003)
Draft Options Development Report (October, 2002)
Working Paper No 1: Community Consultation Report
Working Paper No 4 Traffic and Transportation Report
Working Paper No 6 Tunnel Investigations Report

It may be necessary to read sections from the Main Report, Value Management Workshop records, and Working Papers to gain a more complete understanding of the information being reported in this Working Paper.

Access to the Main Report is available via the study website at:


Details on how to gain access to the Working Papers can be found on the study website.

If Government decides to further develop the recommended option from this Study, a concept proposal and an Environmental Impact Statement (EIS), including a route alignment and other details, will be developed for further assessment. Community consultation will continue through each stage of project development.
## Contents

**Preface**

**Executive Summary**

2 Part A: Introduction and Background

1 Introduction

1.1 Background

1.2 Study Area

2 Urban Design, Landscape & Visual Constraints To Selection

2.1 Design Objectives

2.1.1 General

2.1.2 Environment

2.1.3 Social

2.1.4 Economic

2.1.5 Visual

2.2 Urban and Regional Design Principles

2.3 Methodology

2.3.1 Visual Character

2.3.2 Character Zones

2.3.3 Visual Effect

2.3.4 Visual Sensitivity

2.4 Visual Characteristics of each Character zone

2.4.1 Character Zone 1: River Valleys and Dissected Waters Edge. Undeveloped

2.4.2 Character Zone 2: Undulating Forests

2.4.3 Character Zone 3: Rural Areas – Undeveloped

2.4.4 Character Zone 4: Semi-Rural Areas – Semi-developed

2.4.5 Character Zone 5: Villages and Small Town Centres– Developed

2.4.6 Character Zone 6: Residential Areas– Developed

2.4.7 Character Zone 7: Major Retail and Commercial Centres– Developed

2.4.8 Character Zone 8: Industrial Areas – Developed

3 Part B: Options Development and Assessment of Broad Corridor Types

3.1 Corridor Option Generation

3.2 Grouping of Corridor Options

3.2.1 List of Options

3.3 Assessment of Corridor Options

3.3.1 Type A Corridor

3.3.2 Type B Corridor

3.3.3 Type C Corridor

3.4 Comparison and Assessment of Options

3.5 Urban Design, Landscape and Visual Criteria
Part C: Assessment of Type A Options

4 Urban design, landscape and visual impacts of Type A options

4.1 Introduction ..................................................................................................................................47

4.2 Impacts of the corridor options .....................................................................................................48

4.2.1 The Interchanges..........................................................................................................48

4.3 Comparison and Assessment of the Options ..................................................................................49

4.3.1 Purple Base Option ......................................................................................................50

4.3.2 Blue Option...................................................................................................................60

4.3.3 Yellow Option ...............................................................................................................61

4.3.4 Red Option....................................................................................................................66

4.4 Assessment of Four Base Options ............................................................................................. .70

4.5 Assessment and Comparison of Purple Option Alternatives.......................................................70

4.5.1 Purple Option: Alternative 1: Single Long Tunnel  No surface road in cut at Brickyard Park ..............................................................................................70

4.5.2 Purple Option: Alternative 2: Two Tunnels with Central Access ..................................72

4.5.3 Purple Option: Alternative 3: Two Tunnels with Intermediate Southern Access ..........72

4.5.4 Purple Option: Alternative 4: Sharing the rail corridor..................................................73

4.6 Development and Integrated Public Transport Opportunities......................................................74

4.7 Urban design outcomes along Pennant Hills Road .....................................................................75

4.8 Urban Design, Landscape and Visual Assessment Tables of Route Options.............................75

4.9 Other Alternatives ........................................................................................................................76

5 Assessment of the Ventilation Locations .....................................................................................77

5.1 Introduction ..................................................................................................................................77

5.1.1 Design Principles ......................................................................................................... .77

5.2 Purple Option ................................................................................................................................77

5.3 Blue Option ..................................................................................................................................79

5.4 Yellow Option...............................................................................................................................80

5.5 Red Option.................................................................................................................................81

5.6 Ventilation structure siting............................................................................................................82

6 Findings and Conclusions ............................................................................................................83

Part D Appendices .............................................................................................................................85

Appendix A Four Type A Base Options: Purple, Blue, Yellow and Red. Plans of Interchanges and Assessment Tables A-1

Appendix B Alternatives to Options: Descriptions, Plans of Interchanges and Assessment Tables B-1

6.1 Interchange Alternatives ........................................................................................................... B-2

6.1.1 Northern Interchanges ................................................................................................ B-2

6.1.2 Southern Interchanges ................................................................................................... B-6

Appendix C Landscape Sketches of Potential Interchanges C-1
List of Tables

Table 2.1 - Visual Sensitivity ............................................................................................................................17
Table 3.1 - Urban Design Criteria .....................................................................................................................44
Table 3.2 – Landscape and Visual Criteria ......................................................................................................45

Table 1A - Purple Route : Open alignment in cut along western edge of Brickyard park maximising the length in open trench and minimising the land take from the park................................................. A-2

List of Figures

Figure 1.1 - The Study Area ...............................................................................................................................7
Figure 2.1 - Traffic Routes - Schematic ..............................................................................................................9
Figure 2.2 – Methodology Diagram ..................................................................................................................12
Figure 2.3 - Character Zones ...........................................................................................................................14
Figure 2.4 - Character Zones mapping ............................................................................................................15
Figure 2.5 - Local Character Rating Table .......................................................................................................16
Figure 3.1 - Broad Corridor Options .................................................................................................................28
Figure 3.2 - Long list of Corridor Options .........................................................................................................29
Figure 4.1 - The four feasible Type A options. .................................................................................................47
Figure 4.2 - Brickyard Park Potential Open Road in Deep Cut ........................................................................50
Figure 4.3 - Potential Central Access Interchange ...........................................................................................71
Figure 4.4 – Section through shared rail corridor .............................................................................................73
Executive Summary

This Urban Design, Landscape and Visual Assessment Working Paper has been prepared for the F3 to Sydney Orbital Link Study and supports the Final Report, prepared by Sinclair Knight Merz. The purpose has been to assess the full range of link options for the future National Highway connecting the F3 to the Sydney Orbital. Urban design considerations, which help differentiate the broad corridor options, have been described with the intention of narrowing down the options to a preferred option.

The approach and methodology of assessment has been conducted as an integrated process with engineering, environment, social and community input (refer to separate Working Papers). The methodology adopted for this paper is summarised in the attached methodology diagram.

The key urban design principles established for the link were that:

- The link should ensure that existing landscape values are protected. This includes built, natural, scenic and heritage areas, within the study area.
- The link should support planned urban developments and enable future urban development opportunities to occur. It should also minimise impacts on existing land uses and development patterns in sensitive situations.
- The link should minimise severance of communities and improve access.
- Where practical, the link should be coordinated and integrated with other transport modes, including rail and bus routes.
- Where practical, the link should improve conditions for local traffic, pedestrians and cyclists.

A broad analysis of the region was carried out for the study area to describe the regional character and identify key features of the character zones established. Eight (8) character zones were identified, combining different characteristics associated with landform, land use, built form, vegetation cover, activity and the relationship of these factors.

The potential visibility and contrast of a road through these character zones was also assessed. This was done to determine the potential visual impact of the link options passing through these areas.

The study team developed a “long list” of options for the potential National Highway link. These were based on the criteria established by the discipline specialists. Factors in the development of options included traffic, feasible connection points within the existing road network, environment, urban design, visual impact and planning considerations. This long list of options was then grouped into three strategic corridor types, Type A, B and C.

**Broad Corridor Types**
STUDY OBJECTIVES

DESIGN OBJECTIVES
Environment  Economic
Social       Visual

URBAN & REGIONAL DESIGN PRINCIPLES

VISUAL CHARACTER ZONES

Visual Effect
Contrast

Visual Sensitivity
Visibility

POTENTIAL VISUAL IMPACT WITHIN CHARACTER ZONES

DEVELOPMENT OF BROAD CORRIDOR OPTIONS
Based on Traffic, Engineering, Planning, Urban Design, Landscape & Visual Criteria

ASSESSMENT OF CORRIDOR OPTIONS
Grouped as Type A, B or C
Opportunities  Constraints

SHORTLIST OPTIONS
Type A

ASSESSMENT OF TYPE A OPTIONS: PURPLE, BLUE, YELLOW & RED
Legibility  Connectivity & Future Landuse
Visual Impacts  Landscape

PURPLE OPTION ALTERNATIVES

ASSESSMENT OF POTENTIAL VENTILATION LOCATIONS

PREFERRED OPTION: PURPLE
The Type A, B and C options were then evaluated by the Sinclair Knight Merz study Team within their specialist areas. These were based on the range of criteria established by all discipline specialists, including urban design.

The options were scored against the principles established earlier and identified Type A options as scoring higher than the Type B and C options. The key areas where the Type A options scored the highest related to the following predominant factors:

- The potential to combine with other transport modes, including rail and bus;
- Minimum community disruption and severance;
- Improvements to local traffic;
- Minimum impacts on existing and future land use patterns and future development;
- Minimum visual impacts for residents.

Type A options would also mostly be in tunnel thereby reducing their impacts.

**Four Feasible Type A Options**

Four feasible Type A options were then assessed in further detail. Design principles were established for the major elements of the options that would impact on the community. As most of the Type A options were in tunnel the majority of impacts would occur at the tunnel connections, (or interchanges), areas of cut and cover, above ground sections of road and at ventilation structures. Evaluation criteria relating to these areas were established based on legibility of the road, potential visual impacts, connectivity and landscape opportunities. Refer to Section 4.2 for further explanation of these criteria.

The purple option best satisfies the National Highway objectives whilst also provides the greatest potential for the development of alternatives that could enhance the function of the highway and the associated benefits to the community. In addition, it provides the greatest potential for integration of transport modes.

The urban design characteristics that distinguish the purple option include:
• The most legible northern interchange contributed to a small “land take” to accommodate the interchange.

• Acceptable southern interchange with potential for alternative layouts that would be more suitable. The purple and blue options’ alternative southern interchange was more acceptable from an urban design perspective and could be replaced as the purple option’s southern interchange if the other assessments concurred with this recommendation.

• Improved southern connection at the M2 for traffic travelling further south along Pennant Hills Road, providing a better solution in terms of the metropolitan road network structure.

• The provision of an open road section in deep cut, north of Pennant Hills Road, at Hornsby Council’s future Brickyard Park. This breaks the option into two tunnels allowing natural light to be provided within this section and reducing the length of road in tunnel.

• Improvement to Pennant Hills Road with possible revitalisation, incorporating better pedestrian and bicycle amenity, improved local bus routes and potential improved streetscape.

• Potential benefits in the creation of an integrated transport network, particularly when the alternatives are considered. (Refer to Appendix B and Section 4.5-4.7).

• The purple route has a number of alternatives that could realise additional benefits:
  • The link could be located within a shared rail corridor between Pennant Hills Station and Dartford Road, Normanhurst. This alternative had many strategic advantages including: natural light provided with the length of tunnels decreased; footprint of impacts reduced; reduced visual impacts; and reduced requirements for noise amelioration.
  • Potential connections from the tunnel to Thornleigh and Pennant Hills Stations could be included to integrate with a potential transport interchange at Pennant Hills Stations. This could provide modal split from bus to rail from destinations such as the Central Coast, Dural and Cherrybrook.
  • Integrated commuter parking at these stations could improve the potential modal split.
  • A Central access alternative between Pennant Hills and Thornleigh Stations could be provided with the road in open cut for a length of approximately 800 metres.
  • The provision of ramps to provide on and off connections could provide more extensive use of the tunnels for residents in Thornleigh, Cherrybrook, Westleigh and Pennant Hills due to a direct connection with the tunnel at this point.
  • A potential southern access alternative where the tunnel would daylight in an open trench in deep cut between Boundary Road and Beecroft Road could be provided. Similar connections for local traffic as described in the previous point.

Not all of these benefits would flow from a particular alternative, however the purple option provides the potential to incorporate various alternatives and the advantages associated with them.

Finally the ventilation structures provide the most difficult urban design issues to resolve within this National Highway link. Design principles were identified for the best siting of these structures, however in such a heavily built up area, with an almost even distribution of residences, schools, hospitals and other sensitive locations for ventilation structures, the potential impacts associated with these will be high. Reducing the number of structures may help, whilst more detailed environmental planning and urban design assessment at concept design and Environmental Impact Statement (EIS) stage, should be undertaken.
Part A: Introduction and Background
Introduction

1.1 Background

This feasibility study was funded by the Federal Department of Transport and Regional Services (DOTARS) and managed by the New South Wales Roads and Traffic Authority (RTA). Sinclair Knight Merz was commissioned to undertake the study.

The purpose of the study was to identify a new high standard transport link between the F3 and the Sydney Orbital and replace Pennant Hills Road as the interim National Highway. The study timeframe is 20 years.

This Working Paper outlines the assessment of Urban Design, Landscaping and Visual aspects of the feasible options undertaken in Stage 3 of the study. The Final Report outlines the initial stages of the project, where the methodology, development of broad corridors and evaluation of Type A, B and C Broad Corridors has been assessed.

The initial project definition and objectives are contained in the Final Report.

1.2 Study Area

The study area extends from the Sydney to Newcastle Freeway (F3) at Kariong in the Central Coast area, to the northern section of the Sydney Orbital from Dean Park in the west, to the M2 Motorway at Macquarie Park in the east.

The four feasible Type A options lie within an area extending from the M2 Motorway in the south to the existing F3 Freeway at Wahroonga in the north and from Pennant Hills Road in the west to Pacific Highway and Ryde/Lane Cove Road in the east.

Refer to Figure 1.1 outlining the study area.
Figure 1.1 - The Study Area

Investigation between Kariong and Sydney Orbital, from Dean Park to the M2 Motorway at Macquarie Park
Consideration of urban design within route selection has been a major component of the route selection process. “Beyond the Pavement” issues have been increasingly emphasised in other RTA & DOTARS studies and go beyond “mitigation” once routes have been selected.

This section outlines the urban design and associated landscape and visual constraints identified during route selection. The urban design constraints and opportunities have been identified to address criteria for the evaluation of the Link options. These constraints, in many cases, overlap with other issues, such as the social, planning and environmental aspects identified in the Main Report and other Working Papers.

2.1 Design Objectives

Refer to the Main Report for the planning objectives and project objectives for the Study. The following are broad urban design and landscape objectives that were developed to assist in route selection. Refer to Figure 2.1 outlining the need for the route and the potential connections to the Sydney Road network.

Figure 2.1 provides a diagrammatic layout of the problem to be solved by the link. The study is to investigate feasible options to link the F3 freeway to the Sydney Orbital. Figure 2.1 illustrates the missing connection between these two road corridors. Once this connection is complete a functioning road network will provide connections between the Sydney Ports, the CBD, the airport and the western areas of Sydney, with the existing road network leading into the city from the south north and west.

2.1.1 General:

The following objectives outline the overall design objectives for the link.

- Provide an effective National Highway Link for through traffic including freight and general traffic.
- Provide an effective solution to traffic problems that exist:
  - Movement of dangerous goods into, through and from Sydney.
  - Movement of bulky goods into, through and from Sydney.
  - Integration with the public transport network.
- Connect all traffic types – and eliminate dangerous conditions. The route should:
  - be direct, efficient and quick;
  - connect to maximum effective route alternatives;
  - provide strong legibility at points of connection;
  - be safe;
  - be a desirable motorist experience.
2.1.2 Environment

- Minimise negative impacts on natural systems including:
  - topography;
  - hydrology;
  - air quality;
  - vegetation;
  - fauna
  - national parks, nature reserves, open space systems;
  - noise environment

2.1.3 Social

- Minimise severance and disruption to existing social patterns. ie neighbourhoods should not be severed and if possible should be connected by improving access for pedestrians, cars and cyclists;

- Journeys between and/or to the following destinations should not be disrupted:
  - workplaces and residences;
  - schools and recreation areas;
  - schools and residences;
  - places of worship and residences;
  - hospitals;
  - shopping centres and places of social gathering.
• public transport between all land uses should be improved.

2.1.4 Economic

• Enhance existing and proposed economic areas and avoid adverse impacts;
• Provide connections with the major centres of Hornsby, Castle Hill, Beecroft, Rouse Hill, and Pennant Hills. Maximise connectivity for the majority of people. (short and long term);
• Evaluate effectiveness versus benefit;
• Demonstrate viability of cost and constructability;
• Add value to new release areas by better connectivity;
• Minimise negative economic impacts, e.g. home values;
• Maximise and identify positive economic impacts.

2.1.5 Visual

• Minimise visual impacts on local communities, whether in suburban development areas, villages, or rural properties;
• Minimise visual contrast with the landscape and local character;
• Minimise the number of persons visually affected by the route or gaining views to the route;
• Minimise contrast of the built elements of the road located within a natural environment such as: a National park, Scenic reserve or recreation destination area;
• Minimise visual character changes to existing villages and towns and views from these localities;
• Maximise the visual experience for motorists, legibility of the journey and clarity of orientation and direction finding;
• Ensure a high architectural and aesthetic quality of the road including bridges, portals and roadside elements.

2.2 Urban and Regional Design Principles

The urban and regional design principles established for the link are that;

• The link ensure that existing landscape values within the study area are protected. This includes:
  - Built environment.
  - Natural landscapes.
  - Scenic areas.
  - Heritage and cultural values.
• The link should support planned urban developments and enable future urban development opportunities to occur within the study area. It should also minimise impacts on existing land uses and development patterns in sensitive situations.
• The link should minimise severance of communities and improve access.
• Where practical, the link should improve conditions for local traffic, pedestrians and cyclists.
2.3 Methodology

A broad regional character analysis has been undertaken to provide a foundation for the urban design study. This has included a visual impact assessment. In order to determine the visual constraints to route selection a number of factors have been assessed. The visual impact of a proposed road is determined by evaluating the visual effect of the proposal against the visual sensitivity of the viewer.

The following methodology diagram provides an outline of the method of evaluation adopted for the urban design, landscape and visual impact assessment for the study.
Figure 2.2 – Methodology Diagram

STUDY OBJECTIVES

DESIGN OBJECTIVES
Environment Economic
Social Visual

URBAN & REGIONAL DESIGN PRINCIPLES

VISUAL CHARACTER ZONES

Visual Effect Contrast
Visual Sensitivity Visibility

POTENTIAL VISUAL IMPACT WITHIN CHARACTER ZONES

DEVELOPMENT OF BROAD CORRIDOR OPTIONS
Based on Traffic, Engineering, Planning, Urban Design, Landscape & Visual Criteria

ASSESSMENT OF CORRIDOR OPTIONS
Grouped as Type A, B or C
Opportunities Constraints

SHORTLIST OPTIONS

ASSESSMENT OF SHORTLIST OPTIONS: PURPLE, BLUE, YELLOW & RED
Legibility Connectivity & Future Landuse
Visual Impacts Landscape

CONSIDERATION OF OPTION ALTERNATIVES

ASSESSMENT OF POTENTIAL VENTILATION LOCATIONS

PREFERRED OPTION
2.3.1 Visual Character

Visual character is determined by a combination of landscape and topographic factors. This broad scale analysis phase has assessed the visual character of the study area by identifying the major visual character zones. This enables areas of similar landscape characteristics to be assessed. It also enables the area to be divided into visual management types where similar guidelines and design principles can be adopted.

The major factors that determine visual character are a combination of landform, vegetation cover, land use and built form. The means of assessing vegetation in visual terms is not the floristic characteristics of the vegetation species, but the density and pattern of the vegetation within the landform.

A number of character zones have been identified within the broad scale assessment of the study area. These are described in the following section. Each of these Character zones will exhibit different visual sensitivities, visual effects and visual impacts to a proposed road corridor.

These are summarised in the next section.

<table>
<thead>
<tr>
<th>Character Zone</th>
<th>Description</th>
<th>Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Character Zone 1</td>
<td>River valleys</td>
<td>Undeveloped</td>
</tr>
<tr>
<td>Character Zone 2 (includes National Parks, nature reserves, scenic destination areas)</td>
<td>Undulating forests</td>
<td>Undeveloped</td>
</tr>
<tr>
<td>Character Zone 3</td>
<td>Rural areas</td>
<td>Undeveloped</td>
</tr>
<tr>
<td>Character Zone 4</td>
<td>Semi rural areas</td>
<td>Semi developed</td>
</tr>
<tr>
<td>Character Zone 5</td>
<td>Villages and small town centres</td>
<td>Developed</td>
</tr>
<tr>
<td>Character Zone 6</td>
<td>Residential areas</td>
<td>Developed</td>
</tr>
<tr>
<td>Character Zone 7</td>
<td>Major retail / commercial centres</td>
<td>Developed</td>
</tr>
<tr>
<td>Character Zone 8</td>
<td>Industrial areas</td>
<td>Developed</td>
</tr>
</tbody>
</table>

2.3.2 Character Zones

In order to describe the landscape character a rating table has been developed to assist in the definition of each local character zone and to provide a means of describing the characteristics of each character zone. Later stages will review the character of detailed areas within the route corridors.

The following aerial photographs assist in the recognition of the varied character zones throughout the study area.
Figure 2.3 - Character Zones

Character Zone 1: River Valleys
Character Zone 2: Undulating Forests
Character Zone 3: Rural Areas
Character Zone 4: Semi-Rural Areas

Character Zone 5: Villages & Small Town Centres
Character Zone 6: Residential Areas
Character Zone 7: Major Retail & Commercial Centres
Character Zone 8: Industrial Areas
Figure 2.4 - Character Zones mapping

Figure 2.5 provides a table to assist in the description and understanding of the visual Character Zones. This table provides in graphic form an example of the values generally attached to different characteristics within the local and regional landscape. It also provides an understanding of the impact built form can have on these values. Refer to Figure 2.4 for the mapping and extent of each Character Zone.
### Landscape Character Unit:

<table>
<thead>
<tr>
<th>Score</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>+1</th>
<th>+2</th>
<th>+3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Landform</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flat</td>
<td>Rolling to low ridges</td>
<td>Steeply sloping to pronounced ridges</td>
<td>Cliffs and escarpments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Structures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industry</td>
<td>Commercial buildings and light industry</td>
<td>Units, medium density</td>
<td>Single houses &amp; townhouses</td>
<td>Scattered Farmhouses</td>
<td>No structures</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Tree Cover</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Light</td>
<td>Scattered</td>
<td>Dense</td>
<td>Distinctive &amp; contrasting vegetation types</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Water Character</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No water</td>
<td>Flat, still water in narrow creeks, dams &amp; lakes</td>
<td>Wide expanses, moving water, channels</td>
<td>Waterfalls, meandering stream</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Activity/ Landuse/ Naturalness</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Industrial, Major roads &amp; traffic</td>
<td>Normal Urban activity, Residential &amp; Commercial use</td>
<td>Recreational Activities, Golf, sports, playing fields</td>
<td>Predominantly natural areas, bushland, walking trails, rural, farming</td>
<td>Wilderness: including National parks, nature reserves</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Visibility</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Within midground views of industrial areas</td>
<td>Within midground views of industrial &amp; commercial areas</td>
<td>Within foreground views from towns &amp; villages and residential areas</td>
<td>Within foreground views of residential areas</td>
<td>Within foreground views of villages and towns</td>
<td>Within visibility of walking trails, lookouts and natural areas (Foreground views from semi rural areas)</td>
<td></td>
</tr>
</tbody>
</table>

This "rating table" enables analysis of the values generally attached to different types of local and regional landscape units. A high score for scenic value will generally related to a low visual absorption capability within the landscape. This will assist in the evaluation of route options and determining the areas with the least visual impact.

Max Score: 18  Min Score: -5
2.3.3 Visual Effect

The visual effect is determined by the degree of contrast the proposed development, (ie road) would have within its landscape environment or setting. A high visual contrast would occur where the existing environment would have to be modified significantly by the road. (For example through the removal of vegetation, significant cut and fill, and landform modifications.) Very little natural screening would be available. A low visual effect would occur where the contrast with the landscape is minimal and it integrates to some degree with the surrounding landscape. Some visual screening would be present to prevent high contrasts of form, colour and texture within the landscape. In some cases contrast through a new landmark form can contribute to the landscape and journey. This needs to be considered when evaluating visual effect.

2.3.4 Visual Sensitivity

Visual sensitivity describes the visibility of the proposal and is determined by the potential observer to this proposal. The nature of the observer, the duration and frequency of view and the observer’s distance all contribute to visual sensitivity. The visual sensitivity experienced by the observers will vary dependent on the nature of the observers activities, their expectations while undertaking such activities and the degree of contrast the road has with these activities. The following are potential activities undertaken by observers within the study area and an assessment of the degree of visual sensitivity applied to that activity. The visual sensitivity describes potential views to the road by observers. Potential views from the road by motorists is an aspect of ‘journey’ and experience for the motorist. This is not addressed in visual sensitivity.

Table 2.1 - Visual Sensitivity

<table>
<thead>
<tr>
<th>Activity</th>
<th>Visual Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive recreation eg picnic areas, walking trails, national parks, lookouts</td>
<td>High</td>
</tr>
<tr>
<td>Residential areas</td>
<td>High</td>
</tr>
<tr>
<td>Rural and semi-rural areas</td>
<td>High to Medium</td>
</tr>
<tr>
<td>Commercial activities</td>
<td>Medium</td>
</tr>
<tr>
<td>Industrial activities</td>
<td>Low</td>
</tr>
</tbody>
</table>
2.4 Visual Characteristics of each Character zone

2.4.1 Character Zone 1: River Valleys and Dissected Waters Edge. Undeveloped

The northern section of the study area is characterised by steeply undulating hill slopes leading to wide river flats and highly dissected valleys. The Hawkesbury River meanders through the upper north-eastern section and is one kilometre wide in the northern section around Mooney Mooney and Fishermans Point. This broad river valley is enclosed on most sides by steep hill slopes, heavily vegetated and characterised by dramatic rock outcrops. Cliffs and escarpments are common.

Islands are located within the river including two large islands, Spectacle Island (nature reserve) and Milson Island. North-west the edges of the river are characterised by mangroves located in the major meanders of the river and smaller inlets. Oyster leases are also prominent. The edges of the river have very few river flats. Where flat areas do exists adjacent to the river there are clusters of residences and in some areas small villages, eg Bar Point, Marlow, Spencer.

Berowra Creek runs into the river from the south, starting much further south at Cherrybrook and meandering north gradually widening from less than 100 metres wide to 750 metres wide around Coba Point. This river valley is more highly dissected than the Hawkesbury River valley with similar steeply vegetated valley sides leading to steeply undulating ridges.

High Points act as landmarks from the river, forming orientation markers for boats travelling along the river.

Most of the northern area is not only densely vegetated but is National Park including Dharug National Park, Popran National Park, Marramarra National Park, and Muogamarra National Park.

Very few existing roads are present in the character zone and where present they are generally located on ridges or adjacent to the edge of the water. The Wisemans Ferry Road flanks the waters edge leading towards Spencer and provides the only road through this area.

A number of registered heritage items are present within this zone and are identified in the Heritage report (see Working Paper No.5 Appendix F). These are important visual landmarks and need to be protected and considered. They include:

- Galston Gorge Road Bridge, Australian Heritage Commission (AHC)
- Pearces Creek Bridge, Galston Road, State Heritage Register (SH)
Visual Sensitivity: (Visibility)  HIGH

This area is highly scenic in nature due to a combination of values that have been identified as representing places generally valued by persons for their scenic nature. As the environment is natural the expected activities of an observer in this area would be undertaking natural pursuits such as boating and bushwalking. Small residential areas exist as isolated areas or clusters adjacent to the water. Any man made element through this landscape would be highly visible.

Visual Effect: (Visual contrast)  HIGH

Visual contrast would be high within this environment.

Visual Impact:  HIGH

The combination of a high visual sensitivity and high visual effect would result in a potentially high visual impact of any link through this area.

2.4.2  Character Zone 2: Undulating Forests

This zone extends from the Character Zone 1 areas in the north to the Berowra Heights, Fiddletown and Glenorie areas in the middle of the study area. It also extends through the valley of the Berowra Valley Regional Park south to Cherrybrook and Pennant Hills.

It is characterised by steeply undulating and dense forested areas of the Berowra Valley Regional Park. Berowra Creek runs through the centre of the area with Galston Gorge as a dramatic landform characterised by sandstone rock outcrops and cliff areas. The Great North Walk passes through this valley and parallels the Creek in many areas with rapids and waterfalls present.

Lookouts and high points are located within the forested areas, providing landmarks and areas of orientation for the bush walker. These areas also enable panoramic views to be obtained of the Character Zone itself and areas well beyond, with middleground and background views available.

A number of registered heritage sites are present within this zone. These are potential visual constraints and reinforce the visual sensitivity of the area. They include:

- Cattai Estate, Cattai National Park  SH
- Mooney Mooney Creek, Site Pacific Hwy  AHC
- Muogamarra Nature Reserve, Glendale Rd  AHC
- Big Bay Marramarra Creek  AHC
Visual Sensitivity: (Visibility) HIGH

The area is highly scenic in nature due to a combination of factors. As the environment is natural, including regional parks, the nature of the observer in this area is undertaking natural pursuits and would obtain views, and potentially intrusive views, to a man made structure. A new route traversing these zones would be undesirable.

Visual Effect: (Visual Contrast) HIGH

A road corridor through this environment would create a high visual contrast to this natural environment.

Visual Impact: HIGH

The combination of high visual sensitivity and high visual effect would result in a high visual impact within this character zone.

2.4.3 Character Zone 3: Rural Areas – Undeveloped

Visual Character

Canoelands Road, Canoelands

Very few rural areas exist within the study area. Generally these are restricted to areas such as Mount White, consisting of cleared pasture with scattered dams; Canoelands, consisting of cleared pasture and orchards set within a background of forest; and areas along Old Northern Road north of Glenhaven, including Forest Glen and Yoothamurra.

These areas include light vegetation cover, some with distinctive patterns of orchard, are generally located on plateaus and are gently undulating to flat in topography.

There are few structures, limited generally to scattered farmhouses. No water, other than occasional farm dams, is present. Activity is rural and passive in nature.

Roads through these areas are generally located on the ridgelines and afford views of the surrounding areas. Most of the northern rural areas are located adjacent to Old Northern Road and flank the tree-lined road for most of its length between Yoothamurra and Glenorie.

Visual Sensitivity: (Visibility) MEDIUM

The area exhibits medium visual sensitivity due to the nature of the observer (located in a man altered landscape yet rural in character) and high duration of view but low frequency.
Visual Effect: (Visual Contrast) HIGH

A road corridor through this environment would create a high visual contrast to this rural environment.

Visual Impact: HIGH

The combination of medium visual sensitivity and high visual effect would result in a high visual impact within this character zone.

2.4.4 Character Zone 4: Semi-Rural Areas – Semi-developed

Many semi-rural areas exist within the study area. These are located in the central to southern sections of the study area and include the areas west of Berowra Valley Regional Park including; Berrilee, Dural, Glenorie, Arcadia, Round Corner, Kenthurst, Annangrove, Nelson, Box Hill, some areas of Kellyville, the northern parts of Rouse Hill, and some parts of Riverstone.

These areas are characterised by small lot paddocks, creating a distinctive pattern in the landscape when combined with the scattered and sometimes dense patches of vegetation and clustering of farmhouse and associated structures.

Some dams provide the only water forms visible with activity mixed between rural and limited semi-urban activities.

Roads through these areas are also generally located on the ridges with the semi-rural farmhouse clusters located adjacent to the roads. Many of these semi-rural areas are dissected by densely vegetated valleys, (Character zone 2). This creates a distinctive pattern within the local character with semi-rural areas on the ridge tops adjacent to the connecting roads and the valleys undeveloped, vegetated and steep. In many cases the roads themselves form a distinctive landscape characteristic. They represent the history of settlement and in many cases are historic routes. Their character consists of remnant vegetation, orchards and exotic tree planting mixed with built form and clustered settlement patterns.

A number of heritage items listed within the Australian Heritage Commission and State heritage registers are located in this character area. They include:

- Hornsby Diatreme Area Quarry Rd AHC
- The Pines House and pine trees, Dural AHC
Visual Sensitivity: (Visibility) MEDIUM

The area exhibits medium visual sensitivity due to the nature of the observer (located in a man altered landscape yet semi-rural in character), a high duration of view, and medium frequency of view due to the number of observers and density of settlement.

Visual Effect: (Visual Contrast) MEDIUM

A road corridor through this environment would create a medium visual contrast to this semi-rural environment.

Visual Impact: MEDIUM

The combination of medium visual sensitivity and medium visual effect would result in a medium visual impact rating for this character zone. Refer to Table 3.1 and Table 3.2, providing a summary of visual impact rating.

2.4.5 Character Zone 5: Villages and Small Town Centres– Developed

The villages and small towns are generally centred within the semi-rural areas described previously. They include a higher density of housing clusters and a few local shops. These areas include Dural, Glenorie, Galston, Arcadia, Round Corner and Kenthurst.

They are characterised by a concentration of housing in a similar density to the residential character zones identified in the next category. The extent of the housing clusters, in Character Zone 3, are smaller. These areas are generally surrounded by rural residential areas, giving each village a sense of a smaller landscape scale with visual breaks between landuses.

The landform characteristics of these areas are generally flat to undulating, located on plateaus with scattered vegetation. Heritage landscapes and sites within these areas are not identified at this level of study.

Visual Sensitivity: (Visibility) HIGH

The area exhibits high visual sensitivity due to the high duration of view and high frequency of view obtained by residents within these areas.
Visual Effect: (Visual Contrast) MEDIUM

A road corridor through this environment would create a medium visual contrast to this residential environment.

Visual Impact: HIGH

The combination of high visual sensitivity and medium visual effect would result in a high visual impact rating for this character zone. Any new road would need to be sited very sensitively through these zones.

2.4.6 Character Zone 6: Residential Areas– Developed

The built up residential areas form the major component of the southern part of the study area. Starting at Berowra Heights along the Pacific Highway in the north and extending south through Hornsby Heights, Mt Colah, Hornsby, Waitara, Thornleigh, Normanhurst, Pennant Hills, Cherrybrook, West Pennant Hills, Castle Hill, and Glenhaven. Extending West areas include Baulkham Hills, Kellyville’s southern areas, Stanhope Gardens, Glenwood, Acacia Gardens, Parklea, Quakers Hill, Schofields and the new and developing residential release areas of Rouse Hill, and Marsden Park.

All of these areas exhibit similar characteristics where they are located in undulating to flat topography with few major ridges. Vegetation is generally scattered with some dense patches in open space areas within the residential areas. In this broad scale assessment they are included within the residential category.

These areas are very established with many leafy neighbourhoods that characterise the Upper North Shore particularly. Settlement forms in these areas include a mixture of housing of many styles with individual arterial and local road access. The north west sector includes significant areas of new housing, generally of large scale new urban developments. Vegetation in this area is sparse with some remnant forest clusters and young, yet to establish landscape associated with the new development areas.

Visual Sensitivity: (Visibility) HIGH

The area exhibits high visual sensitivity due to the high duration of view and high frequency of view obtained by residents within these areas.

Visual Effect: (Visual Contrast) MEDIUM

A road corridor through this environment would create a medium visual contrast to this residential environment. Any associated noise reduction requirements would result in a high impact in these areas.
Visual Impact: HIGH

The combination of high visual sensitivity and medium visual effect would result in a high visual impact rating for this character zone. Refer to Table 3.1 and Table 3.2, providing a summary of visual impact rating.

2.4.7 Character Zone 7: Major Retail and Commercial Centres– Developed

There are a number of major commercial centres located within the study area. These include Hornsby, Castle Hill, and the proposed area at Rouse Hill.

Visual Character

Visual Sensitivity: (Visibility) MEDIUM

The area exhibits medium visual sensitivity due to the medium duration of view and medium frequency of view obtained by commercial and retail users within these areas

Visual Effect: (Visual Contrast) LOW

A road corridor through this environment would create a medium visual contrast to this commercial environment. However, many of these commercial centres include a close knit commercial fabric, that could result in a high visual impact if disrupted by a road corridor through its centre.

Visual Impact: LOW

The combination of medium visual sensitivity and low visual effect would result in a low visual impact rating for this character zone, however, dependent on the location of the link, a large piece of infrastructure through this area would still impact significantly.
2.4.8 Character Zone 8: Industrial Areas – Developed

Visual Character

Salisbury Road, Asquith

There are a number of industrial areas located within the study area. These include Hornsby, Castle Hill and Rouse Hill.

**Visual Sensitivity: (Visibility)** MEDIUM

The area exhibits medium visual sensitivity due to the medium duration of view and medium frequency of view obtained by users within these areas.

**Visual Effect: (Visual Contrast)** LOW

A road corridor through this environment would create a low visual contrast to this industrial environment.

**Visual Impact:** LOW

The combination of medium visual sensitivity and low visual effect would result in a low visual impact rating for this character zone. However, a new road could be visually detrimental to the existing quality of the built fabric, open space ecology, and community ambience and would need to be sited and designed very sensitively to reduce impacts.
Part B: Options Development and Assessment of Broad Corridor Types
3

Broad Corridor Options and their Assessment

3.1 Corridor Option Generation

A number of options were developed by the Sinclair Knight study team and are described in the Final Report. The following section describes the urban design assessment of these options.

This has been undertaken by describing the opportunities and constraints associated with each Option. It includes the Urban Design and Landscape/Visual design principles used in the Assessment Framework. The assessment was incorporated into the overall Assessment Framework, for the full study.

3.2 Grouping of Corridor Options

3.2.1 List of Options

It was convenient to group the corridor options into strategic types of corridors, to understand their relative merits with respect to satisfying the National Highway Link objectives, as well as the urban design principles.

The broad corridor options were found to fall into three strategic groups, or types of corridor options.

The three types, were referred to as A, B and C, and have been illustrated in Figure 3.1.
The Type A corridor options are an extension of the F3 corridor south to the M2 and they rely on the F3 corridor as the only major transport corridor into Sydney from the north.

The Type B corridor options bypass the M2 and the developed areas of Hornsby. As with Type A, the Type B corridor options would rely on the F3 corridor as the major transport link into Sydney from the north.

The Type C corridor options would provide a direct transport link for long distance traffic to and from western Sydney bypassing the M2 and F3 south of the Hawkesbury River. Type C would also provide relief of M2 and the F3 and act as a second major corridor into Sydney, providing additional capacity to the F3.
Figure 3.2 - Long list of Corridor Options
3.3 Assessment of Corridor Options

The following evaluation includes a description of the major opportunities and constraints associated with each Corridor Option, and an evaluation against the urban and regional design principles. Refer to Figure 3.2 for the location of each of these options. The other specialist's evaluation of the options is included in their corresponding Working Papers. Figures in brackets after dot point "Opportunities" or "Constraints" refer to other options for which dot point applies.

3.3.1 Type A Corridor

**Type A: Option 1** M2 at Marsfield to F3 at Wahroonga

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>❑ Provides a direct route from the F3 at Wahroonga to the M2 at Marsfield linking directly with the toll-booths. This provides a direct route for the majority of traffic with City and Eastern destinations.</td>
<td>❑ Does not provide an alternative crossing of the Hawkesbury River or reduce traffic on the existing F3 freeway. Widening of the F3 would alleviate some congestion. This is currently occurring within part of the F3 from Kariong.</td>
</tr>
<tr>
<td>❑ This option is in tunnel, thereby reducing the impacts on existing values, including built, natural and scenic values. Visual impacts at the F3 and Marsfield portals need to be reviewed.</td>
<td>❑ Potential impacts of the portals at Marsfield would be low to medium, with surrounding land uses consisting of playing fields &amp; open space. Residential areas are predominantly located on the southern side of the connection and would not be impacted. Further review is required at the next stage to incorporate visual impacts.</td>
</tr>
<tr>
<td>❑ This option minimises impacts on existing land uses and development patterns.</td>
<td>❑ The footprint of the impacts at the southern interchange extends over a large area.</td>
</tr>
<tr>
<td>❑ Severance of existing communities is minimised and access is improved.</td>
<td></td>
</tr>
</tbody>
</table>

**Type A: Option 2** M2 at North Epping to F3 at Wahroonga

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>❑ This option is in tunnel, minimising impacts on existing values including built, natural and scenic values. It also provides direct connection to the existing M2.</td>
<td>❑ The tunnel would need to pass under Lane Cove National Park, requiring an Act of Parliament to allow use of the land.</td>
</tr>
<tr>
<td>❑ This option minimises impacts on existing land uses and development patterns.</td>
<td>❑ The requirement for two connections at the M2 will provide more impacts as a result of two portals and two areas impacted by the additional road. The footprint of impacts is increased.</td>
</tr>
<tr>
<td>❑ Severance of communities is minimised.</td>
<td>❑ Potential impacts of the tunnel portals will need to be reviewed.</td>
</tr>
<tr>
<td>❑ The option minimises impacts on built form and scenic areas.</td>
<td></td>
</tr>
</tbody>
</table>
### Type A: Option 3 M2 at Pennant Hills Road to F3 at Wahroonga

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>❑ This option is located nominally under Pennant Hills Road and would provide a direct alternative to this route for through traffic, bringing Pennant Hills Road back to the local traffic and reversing some of the severance issues that occur on Pennant Hills Road.</td>
<td>❑ The visual impacts of the interchanges at F3, Boundary Road and M2 will require management of visual impacts, particularly at Boundary Road. Changes, land resumption and visual impacts to the residences and commercial uses in the immediate vicinity will need to be reviewed at the next stage.</td>
</tr>
<tr>
<td>❑ A potential interchange at Boundary Road/Pennant Hills Road, in Pennant Hills would collect the Hills District traffic and reduce the use of the Cumberland Highway for this traffic.</td>
<td>❑ The use of this route by the F3 traffic travelling east, along the Pacific Highway, would probably be reduced due to the perceived indirect nature of this route. If this is the case, (traffic modelling reinforces this), the alleviation of the congestion and severance along the existing Pacific Highway would be small.</td>
</tr>
<tr>
<td>❑ The interchange at the F3 Wahroonga could provide potential connections for traffic from the south travelling to Hornsby Town Centre, and increase accessibility to the centre from the wider Hills area.</td>
<td></td>
</tr>
<tr>
<td>❑ Connections to the M2 for F3 traffic travelling west are favoured by this option, as it is the furthest west of the tunnel options from the F3.</td>
<td></td>
</tr>
<tr>
<td>❑ The corridor provides good southern connections to the Cumberland Highway south beyond the M2. This would improve the connections of the link both east-west and south. Other options only improve connections east-west.</td>
<td></td>
</tr>
<tr>
<td>❑ Severance of communities is minimised and access is improved.</td>
<td></td>
</tr>
<tr>
<td>❑ The link minimises impacts on existing land use patterns.</td>
<td></td>
</tr>
</tbody>
</table>
### Type A: Option 4 M2 at Pennant Hills Road to F3 at Asquith

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>This option provides connections with Hornsby Town Centre as well as taking traffic off the F3 north of Wahroonga interchange. This would reduce traffic congestion at the Wahroonga interchange and provide opportunities to maximise accessibility to the Hornsby Centre.</td>
<td>The detail of the location of the connection with F3 would need to be developed to reduce visual, landform and vegetation impacts. The industrial area at Asquith may provide opportunities for non-tunnel areas, thereby reducing the length of tunnel for this option. The surrounding areas are steep and densely vegetated.</td>
</tr>
<tr>
<td>Opportunities for a major bus/rail/road interchange also exist at Hornsby to provide flow-on urban design benefits from the route, through an integrated transport network.</td>
<td>Portal design could be visually intrusive to surrounding residential areas, as well as providing physical impacts on the built form, and vegetation within the interchange at the M2.</td>
</tr>
<tr>
<td>The corridor provides good southern connections to the Cumberland Highway south beyond the M2. This would improve the connections of the link both east-west and south. Other options only improve connections east-west.</td>
<td>The use of this route by the F3 traffic travelling east, along the Pacific Highway, would probably be reduced due to the perceived indirect nature of this route. If this is the case, (traffic modelling reinforces this), the alleviation of the congestion and severance along the existing Pacific Highway would be small.</td>
</tr>
</tbody>
</table>

For an assessment of the impacts from Thornleigh south to the Cumberland highway connection with the M2 refer to Option 3.
### Type B: Option 5 M2 at Windsor Road, Baulkham Hills to F3 at Mt Colah

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>q Connects with the centre of the M2 allowing equal distance travel east and west. This option therefore favours both directions of travel and is not biased toward westerly or easterly bound traffic. It does not however, provide an effective link for motorists travelling further east in the direction of the existing Pacific Highway. (refer to constraints).</td>
<td>q High visual and landform impacts, as well as high contrast to existing community values where the route passes along the Berowra Valley Regional Park. As it extends longitudinally along the park, parallel to Berowra Creek, (Landscape Character Unit 1: River valleys) the contrast to the scenic, natural values of the park are high. The Great North Walk follows generally the same route, &amp; would be potentially altered significantly, due to the visual intrusion of a road in this area.</td>
</tr>
<tr>
<td>q Potential conflict with existing settlement patterns and future urban developments opportunities.</td>
<td>q There would be high visual impacts with foreground views would be available from Hornsby, Thornleigh, Westleigh, Cherrybrook and Pennant Hills.</td>
</tr>
<tr>
<td></td>
<td>q The high urban, regional, local, landform, landscape and visual impacts of this corridor outweigh the benefits. It is a long route and has long tunnels, as well as the on grade impacts.</td>
</tr>
<tr>
<td></td>
<td>q Impacts on natural features outweigh the benefits.</td>
</tr>
<tr>
<td></td>
<td>q Option 6 links the same two areas without the amount of disadvantages and significant character altering impacts to the highly valued Berowra Valley Regional Park.</td>
</tr>
<tr>
<td></td>
<td>q Motorists travelling east, to destinations along the Pacific Highway from the F3, would not use the route.</td>
</tr>
</tbody>
</table>
### Type B: Option 6 M2 at Windsor Road, Baulkham Hills to F3 at Mt Colah via Round Corner

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>❑ Provides a direct connection to Castle Hill Commercial Centre, thereby potentially increasing connectivity to this commercial area from the link.</td>
<td>❑ High visual impacts on Berowra Valley Regional Park, including views from Great North Walk at the potential bridge crossing and its approaches.</td>
</tr>
<tr>
<td>❑ Visual Impacts at the interchange with M2 at Windsor Road (Options 6 and 9) are low (existing area already modified by the road). (Options 6 and 9)</td>
<td>❑ High visual impacts from Westleigh Quarter Sessions Road with high landform modifications at the potential bridge abutments over Berowra Creek.</td>
</tr>
<tr>
<td>❑ Connects with the centre of the M2 allowing equal distance travel east and west. This option therefore favours both directions of travel and is not biased toward westerly or easterly bound traffic. It does not however, provide an effective link for motorists travelling further east in the direction of the existing Pacific Highway. (refer to constraints).</td>
<td>❑ High visual impacts at Round Corner from foreground residential views unless located below ridgeline (6, 9).</td>
</tr>
<tr>
<td>❑ The corridor provides good southern connections to Parramatta beyond the M2, thereby increasing connectivity of the link east, west and south.</td>
<td>❑ Potential high impacts on existing landscape values including natural and scenic values,</td>
</tr>
<tr>
<td></td>
<td>❑ Potential impacts on existing land use patterns.</td>
</tr>
</tbody>
</table>

### Type B: Option 7 Sydney Orbital at Quakers Hill Parkway, Quakers Hill to F3 at Mt Colah

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refer to Option 6 for impacts from the F3 at Mt Colah to Round Corner</td>
<td></td>
</tr>
<tr>
<td>Refer to Option 8 for impacts from Round Corner to Dean Park, on the Westlink M7.</td>
<td></td>
</tr>
</tbody>
</table>
### Type B: Option 11 Sydney Orbital at Dean Park to F3 at Berowra via Riverstone

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>- High scenic route for travellers on road</td>
<td>- Impacts on Muogamarra Nature Reserve, including natural, scenic and heritage issues.</td>
</tr>
<tr>
<td>- Visual Impacts for northern sector from Glenorie to Cowan affects few towns, villages and residential areas.</td>
<td>- High visual and landform impacts to Community at Collingridge Point at Berowra Creek.</td>
</tr>
<tr>
<td></td>
<td>- High visual contrast to Berowra Creek River Valley including topographic impacts, vegetation impacts and water form impacts (Character Unit 1).</td>
</tr>
<tr>
<td></td>
<td>- High visual, physical and urban design impacts at steeply undulating forests (Character Unit 2).</td>
</tr>
<tr>
<td></td>
<td>- High visual contrast to “naturalness” of area from Cowan to Glenorie.</td>
</tr>
</tbody>
</table>

Refer to Option 10 for impacts from Glenorie to Dean Park

### Type B: Option 13 M2 at Pennant Hills Road to F3 at Mt Colah via Railway Line

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Corridor impacts would be grouped with existing visual and severance impacts created by the existing railway.</td>
<td>- The potential widening and straightening required for a road located above the railway line would appear to be too significant a disruption. This requires further engineering review.</td>
</tr>
<tr>
<td></td>
<td>- The character of the existing railway line, flanked by trees with residential development immediately adjacent to the railway, will be significantly altered by an elevated road.</td>
</tr>
<tr>
<td></td>
<td>- The impacts and legibility of interchanges will be high, at the M2 and the northern interchange with the F3.</td>
</tr>
</tbody>
</table>
### Type B: Option 14 Brooklyn to Somersby via Railway Line

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>- The corridor separates Central Coast traffic into Sydney from the National highway link. The extent of this separation needs consideration.</td>
<td>- The impact of the corridor through the Brisbane Water National Park will be high.</td>
</tr>
<tr>
<td>- The corridor through the corridor through the Brisbane Water National Park will be high.</td>
<td>- The route will only cater to central coast traffic and will not provide an alternative route for traffic travelling further north. (traffic volumes require consideration)</td>
</tr>
<tr>
<td>- The route ultimately connects with the F3 at Mt Kur-ring-gai thereby requiring other widening measures to satisfy the study objectives</td>
<td></td>
</tr>
</tbody>
</table>

### Type B: Option 15 Sydney Orbital at Dean Park to F3 north of Mt Ku-ring-gai via Middle Dural and Galston

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Provides a second orbital linking Mt Ku-ring-gai to Dean Park and bypassing most existing developed areas of Sydney</td>
<td>- High potential visual and landscape character impacts from residential areas as the route crosses Berowra Creek.</td>
</tr>
<tr>
<td>- Route avoids the Galston Gorge and lookout areas, however is located further north with its subsequent impacts. The width of the Regional Park at the area where it crosses is less than areas to the south thereby minimising the impacts.</td>
<td>- High impacts on landform modification steeply undulating forests (character unit 2) and Berowra Valley Regional Park including the Great north Walk at Berowra Creek and areas along Galston Ridge.</td>
</tr>
<tr>
<td>- Above Rouse Hill industrial area located south of Annangrove Road the route potentially uses severance in a positive way to separate the new industrial areas from the semi rural areas north.</td>
<td>- Visual impacts from Hornsby Heights would be potentially high as the route passes along Galston Ridge.</td>
</tr>
<tr>
<td>- The route between Rouse Hill and Schofields passes through low undulating open areas with scattered trees, some orchards and mixed development. Visual contrast could be minimised</td>
<td>- Potential high visual impacts from Galston township, and potential severance of community.</td>
</tr>
<tr>
<td></td>
<td>- Potential high visual impacts from Kenthurst as the route passes north of the township.</td>
</tr>
<tr>
<td></td>
<td>- Between Kenthurst and Annangrove the route passes through some 8 kilometres of undulating and dissected forest areas with semi rural areas set on the ridges. High impacts on the pattern of the landscape potential here.</td>
</tr>
</tbody>
</table>

Refer to Option 10 for impacts from Schofields to Dean Park.

Option 15 variation follows the same route as Option 9 from Mid Dural to Seven Hills and the connection with the M2 at Windsor Road.
**Type B: Option 17 Sydney Orbital at Kings Langley to F3 north of Mt Ku-ring-gai, via Round Corner and Galston**

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Refer to option 15 for impacts from Mount Ku-Ring-Gai to Dural. The option then follows Option 8 around Dural and then passes to Glenhaven Road.</td>
<td>- The route crosses Cattai Creek over undulating landform with potential high visual impacts at Kellyville and the residential areas around Kings Road and Wrights Road</td>
</tr>
<tr>
<td>- Connections with Norwest Boulevard and the crossings of Old Windsor road combine with existing road corridors, improving connections to the existing road network from the link.</td>
<td>- High potential visual impacts from William Clarke College and the corridor passes through Castle Hill Country Club</td>
</tr>
</tbody>
</table>
### 3.3.3 Type C Corridor

**Type C: Option 8 Sydney Orbital at Quakers Hill Parkway, Quakers Hill to F3 north of the Hawkesbury via Dural**

Refer to Option 10 for Impacts from Calga to Glenorie

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium visual impacts as corridor follows semi-rural areas from Glenorie to Round Corner following ridgeline of Old Northern Road route. Alternative location to be investigated in relation to the existing road and the ridgeline. (8, 9)</td>
<td>Potential severance of local communities along Old Northern Road, particularly at Dural (consider location west of Old Northern Rd and Galston Rd intersection) (8, 9).</td>
</tr>
<tr>
<td>Impacts on National Parks minimised between Glenorie and Round Corner (8, 9).</td>
<td>High potential visual impacts at Round Corner, location of route needs careful siting to minimise severance, foreground views from township and visual contrast to local character (8, 9).</td>
</tr>
<tr>
<td>Medium visual impacts from semi-rural areas between Round Corner and Kellyville (7, 8).</td>
<td>Potential high visual impacts on landform modification and steeply undulating forests (Character Unit 2) between Round Corner and Kellyville (7, 8).</td>
</tr>
<tr>
<td>Improvements to access from New Release areas of Rouse Hill, but potential severance effects may outweigh.</td>
<td>High severance impacts to Rouse Hill Release Area (7, 8).</td>
</tr>
<tr>
<td>The route avoids dense vegetation and Cumberland Plain Woodland at Dean Park by passing west from Schofields and connecting to Quakers Hill Parkway.</td>
<td>Potential high visual and physical impacts on Nirimba Hawkesbury Blacktown campus of UWS.</td>
</tr>
<tr>
<td>Potential use of former Schofields aerodrome (Check future and proposed planning uses)</td>
<td>Impacts along Schofields Road medium (relatively flat, scattered vegetation) (7, 8).</td>
</tr>
</tbody>
</table>

**Type C: Option 9 M2 at Windsor Road to F3 north of the Hawkesbury via Dural**

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refer to Option 10 for impacts from Mt White to Glenorie</td>
<td></td>
</tr>
<tr>
<td>Refer to Option 8 for impacts from Glenorie to Round Corner</td>
<td></td>
</tr>
<tr>
<td>Refer to Option 6 for impacts from Round Corner to M2 at Windsor Road</td>
<td></td>
</tr>
<tr>
<td>Opportunities</td>
<td>Constraints</td>
</tr>
<tr>
<td>------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Located within the corridor of Boundary Road Maralya thereby minimising visual contrast and changes to landscape character (Boundary Road is a relatively straight road through flat to undulating landform) (10, 11).</td>
<td>Follows Old Northern Road north which is located on the ridgeline and meanders through the landscape flanked by significant trees. This historic route connects a scale of development including orchards and rural properties of a small scale, ordered in their landscape pattern. If this road was widened and straightened, significant land use impacts would occur on the rural communities (8, 9, 12, 16).</td>
</tr>
<tr>
<td>Can be located outside foreground views from Glenorie (10, 11).</td>
<td>The impacts of widening Boundary road will be significant on the local community and provide significant severance effects. Existing trees flank the road and rural property entry gates, front fences and significant amenity occurs along this road. Alternative locations within the corridor need to be reviewed to reduce the impact on this circulation route.</td>
</tr>
<tr>
<td>Provides a second crossing of Hawkesbury River (8, 9, 12, 16)</td>
<td>Potential impacts on Marramarrna National Park north of Yoothamurra including significant landform and vegetation modifications. (8, 9, 12, 16).</td>
</tr>
<tr>
<td>Provides potential future connection to New England Highway via Calga and Wollombi (10, 11).</td>
<td>High visual impacts crossing Hawkesbury River, visual contrast to wilderness, inner valley character and small towns. (8, 9, 12, 16).</td>
</tr>
<tr>
<td>Scenic amenity to travellers on road would provide a highly scenic journey experience, equal to the existing F3 to Berowra (Gateway to Sydney) (8, 9, 12, 16).</td>
<td>High impacts on the landscape character at Canoelands and potential community severance (8, 9, 12, 16).</td>
</tr>
<tr>
<td></td>
<td>Views from townships of Spencer and Marlow changed with potential foreground and middle ground views available.</td>
</tr>
<tr>
<td></td>
<td>High visual sensitivity contrast and impact.</td>
</tr>
<tr>
<td></td>
<td>High visual impacts on Riverstone and Schofields residential areas (10, 11).</td>
</tr>
<tr>
<td></td>
<td>High visual impacts from Dean Park (7, 8, 11, 16).</td>
</tr>
<tr>
<td></td>
<td>Crosses Blacktown, Richmond Railway with potential high visual impacts from Quakers Hill and Schofields (7, 8, 11, 16).</td>
</tr>
</tbody>
</table>
Type C: Option 12 Sydney Orbital at Sunnyholt Road, Acacia Gardens, to F3 north of the Hawkesbury via Annangrove

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refer to Option 10 for Impacts from Mt White to Glenorie.</td>
<td>Refer to Option 12 for Impacts from Mt White to Glenorie.</td>
</tr>
<tr>
<td>❑ Location in proximity to Glenorie should bypass Old Northern Road north of Glenorie and be located west of Glenorie to avoid severance of the Glenorie community. As much of the Glenorie community is centred around the Old Northern Road with schools on one side, playing fields on the other and residences on both sides.</td>
<td>❑ South of Glenorie the route passes through undulating forest areas with semi rural areas flanking the roads that cross the area from east to west. Crossing the highly dissected and vegetated valleys will alter the landscape character and be highly visible. These Character areas 4 and 2 extend for some 12 kilometres.</td>
</tr>
<tr>
<td>❑ Visual impacts from semi rural areas is medium with medium visual effect and medium visual sensitivity</td>
<td>❑ As the route passes from Annangrove it is required to pass through or around Rouse Hill residential release area as well as Stanhope Gardens new residential releases. Any route through this area will negatively impact on these release areas.</td>
</tr>
<tr>
<td>❑ Will improve access to the new release areas of Rouse Hill, Stanhope Gardens, however this may be cancelled by negative visual impacts and land use implications.</td>
<td>❑ Views from Rouse Hill House would potentially be available to the route as it crosses Caddies Creek valley. This will significantly alter the curtilage of the house and its previous rural outlook, however current planning proposals to locate the Rouse Hill commercial area and surrounding residential development within this valley will also alter this view significantly.</td>
</tr>
<tr>
<td>✧ High visual impacts from these release areas and negative impacts on existing land uses. (There may be a route of less impact around Parklea Prison, however this needs further study).</td>
<td>❑ Negative impact at Sunnyholt Road connection with the WM7 due to the high capacity of the road and the probable requirement to further widen this road.</td>
</tr>
</tbody>
</table>

Type C: Option 16 Sydney Orbital at Dean Park to F3 north of the Hawkesbury via Annangrove

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refer to route 12 for impacts from Mount White to Kellyville</td>
<td>Refer to route 12 for impacts from Mount White to Kellyville</td>
</tr>
<tr>
<td>Refer to route 8 for impacts from Kellyville to Schofields.</td>
<td>Refer to route 8 for impacts from Kellyville to Schofields.</td>
</tr>
</tbody>
</table>
3.4 Comparison and Assessment of Options

The following assessment provides a summary of the major urban design, landscape and visual impacts of corridor alternatives. In reviewing the feasible options the potential for the tunnel to alleviate traffic congestion, severance, neighbourhood character and community social patterns along both the Pacific Highway and Pennant Hills Road needs to be considered. An option that does both will be the most suitable, however this may not be achieved by one option.

The following summarises briefly each option.

**Option 1: Type A Option. M2 at Marsfield to F3 at Wahroonga**

As the option is in tunnel the impacts on existing landscape values are low. The potential impacts of the portals at Marsfield are considered in more detail later. ([Section 4](#)). The option minimises impacts on existing land use patterns, limits severance of communities, and improves conditions for local traffic.

**Option 2: Type A Option. M2 at North Epping to F3 at Wahroonga**

The impacts are similar to Option 1, however with two connections to the M2 the number of portals is doubled and the impacts will be spread to two areas, rather than one. The location of the tunnel under Lane Cove National Park is not desirable.

**Option 3: Type A Option. M2 at Pennant Hills Road to F3 at Wahroonga**

This option is in tunnel and provides traffic relief on Pennant Hills Road. It also has a number of sub-options that could have the added advantage of collecting additional traffic at Pennant Hills, and the Hills district traffic, thereby potentially decreasing the local traffic using Pennant Hills Road. This will reduce the severance effects to the local community currently present on Pennant Hills Road and improve conditions for pedestrians and cyclists along this route. The benefits in providing relief to traffic along the Pacific Highway may not be the same, nor the potential to improve conditions for pedestrians and cyclists. The option also combines with other transport modes including rail and bus.

**Option 4: Type A Option. M2 at Pennant Hills Road to F3 at Asquith**

This option is similar to Option 3 but provides an extra connection to Hornsby Town Centre, and diverts from the F3 further north at Asquith. The added benefits this may provide include reduction of traffic congestion at the existing Wahroonga F3 interchange, by allowing traffic travelling west and south to exit the F3 at a different location. This would increase legibility at both intersections. The added benefits of providing a connection to Hornsby include the potential to provide an integrated traffic interchange for bus/rail/road. This could potentially provide additional benefits through integration with other transport modes.

**Option 5: Type B Option. M2 at Windsor Road, Baulkham Hills to F3 at Mt Colah**

This option creates a significant visual and physical intervention to the Berowra Valley Regional Park, significantly changing the local character of this valley. As it passes longitudinally through the side slopes of the valley the potential visual impacts will be high and the modification to landform extreme. This option is not desirable due to these high impacts on the existing landscape, including built, natural, scenic and heritage values. The tunnel sections of the option at Mt Colah and Cherrybrook minimise the visual impacts in this area, however the option is longer than others without significant benefits outweighing the disadvantages. Few urban design benefits are achieved.

**Option 6: Type B Option. M2 at Windsor Road, Baulkham Hills to F3 at Mt Colah via Round Corner**

This option provides a central connection to the M2 allowing travel east or west. It consists of tunnel at each end and an on grade portion is located in the central section. A major bridge crossing of the Berowra Valley Regional Park would be required in the centre of the corridor. This would create significant impacts on existing landscape and urban design values at this location. The impacts at Round Corner would also be high. The potential for severance of the highly developed residential and decreasing semi-rural areas around Round Corner and Glenhaven would be high. The option has potential to provide a connection to...
Castle Hill Commercial/Retail centre thereby increasing its connectivity. The impacts on the Great Northern Road between Round Corner and Castle Hill, where it is not located in tunnel, would be high with potential severance and disruption to existing community patterns.

**Option 7: Type B Option. M2 Sydney Orbital at Quakers Hill Parkway, Quakers Hill to F3 at Mt Colah**

Similar impacts across the Berowra Valley Regional Park exist with this option. This is a long route connecting with the north west sector including Rouse Hill, Kellyville and Schofields. More detailed assessment of the potential siting is required through these areas as it has the potential to sever these new communities unless sited sensitively between land uses. There are potential high landscape and visual impacts due to landform modification and steeply undulating forest between Round Corner and Kellyville. The community benefits with such a long route connecting east-west requires further assessment, as these benefits will need to be balanced against the extent of disturbance to visual, landform, vegetation and potential social/land use issues. Potential severance of communities high as well as impacts on the existing land uses and development patterns in the western area.

**Option 8: Type C Option. Sydney Orbital at Quakers Hill Parkway, Quakers Hill to F3 north of the Hawkesbury via Dural**

Very high visual and physical impacts, landform modifications and alteration to existing landscape character in the northern section and at Glenorie, Middle Dural and Dural. Impacts on the existing land use patterns are high. From Dural on the route impacts are the same as Option 7.

**Option 9: Type C Option. M2 at Windsor Road to F3 north of the Hawkesbury via Dural.**

Similar impacts to Option 8 from Mount White to Dural. Similar impacts to Option 6 from Round Corner to M2.

**Option 10: Type C Option. Sydney Orbital at Dean Park to F3 north of the Hawkesbury via Riverstone**

Similar impacts to Option 8 from Mount White to Glenorie. As the route passes from Glenorie west along a similar alignment to Cattai Ridge Road there would be landform modifications to the steeply undulating forested valleys. The western portion of Cattai Ridge Road is a charming, narrow rural road, with creek crossings and scattered farmhouses located along the route. This rural character would be severely affected if the route followed the road. Lesser impacts may be experienced by locating a route off that road with careful consideration of views from the properties. The potential impact of this connection would be less than Option 12.

**Option 11: Type B Option. Sydney Orbital at Dean Park to F3 at Berowra via Riverstone**

The visual, landform and character changing impacts of this route in the Cowan to Glenorie section are very high. The remaining impacts are the same as Option10 from Glenorie to Dean Park.

**Option 12: Type C Option. Sydney Orbital at Sunnyholt Road, Acacia Gardens, to F3 north of the Hawkesbury via Annangrove**

Similar impact to Option 8 in the northern portion. From Glenorie the corridor passes through some 12 kilometres of highly dissected and vegetated valleys characterised by semi-rural land uses. This will significantly alter this landscape and local character creating an undesirable impact on the regional pattern of development.

**Option 13: Type B Option. M2 at Pennant Hills road to F3 at Mt Colah via Railway Line**

This route following the railway line has been suggested by some of the community groups. It will significantly alter the character of the surrounding areas as it will be elevated and will require special treatment at railway bridges. The railway line is very curvilinear also and in some places flanked by significant tree stands. This would all be altered significantly both visually and physically.
Option 14: Type B Option. Brooklyn to Somersby via Railway Line

This option will change the natural character of the Hawkesbury River valley, particularly as it crosses the river and runs around Brooklyn, with subsequent high visual and landform impacts. This route will cater for the Central Coast traffic and take them off the F3 at the Mooney Mooney bridge area. This will be beneficial for this section of the route, but its long-term benefits may be questionable as it joins the F3 south of Brooklyn and will not alleviate traffic along the F3 in this area.

Option 15: Type B Option. Sydney Orbital at Dean Park to F3 north of Mt Ku-ring-gai via Middle Dural and Galston.

The route provides an alternative crossing of Berowra Valley Regional Park and travels west to Annangrove. Most of the route is located in steeply undulating landform with many creek crossings. The landform modifications, alterations to existing landscape character and impacts on existing semi rural land uses and forested valleys will be high. Its impacts are potentially higher than Option 7.

Option 16: Type C Option. Sydney Orbital at Sunnyholt Road, Acacia Gardens, to F3 north of the Hawkesbury via Annangrove

This corridor follows the same alignment as Option 12 from Mt White to Kellyville and Option 8 from Kellyville to Dean Park. A short modification from Option 8 at Schofields extending to join Option 10,11,15 and 16 at Dean Park occurs across the Eastern Creek Valley. Significant impacts on flora and bio diversity would occur in this valley.

Option 17: Sydney Orbital at Kings Langley to F3 north of Mt Ku-ring-gai, via Round Corner and Galston

The impacts of this option are similar to Option 15, with high landform modifications and alterations to existing landscape character. The extent of the route from Glenhaven to the Westlink M7 Motorway creates high impacts on the development of Norwest Business Park, but could be located as a buffer between land uses in some areas.

The assessment included in this section was coordinated with other expert reports to ensure that the heritage, biophysical, social and traffic aspects are overlaid to determine where these impacts are reinforced.

The following tables have been prepared to address the broad scale urban design, landscape and visual principles that have been included in the Assessment framework for the preliminary routes. These tables are not stand-alone and are to be read in conjunction with the other Assessment criteria.

3.5 Urban Design, Landscape and Visual Criteria

Tables 3.1 and 3.2 describe the scoring of the Type A, B and C options against the urban design principles and the landscape/visual principles. From these tables the Type A options achieve the highest acceptability in relation to the principles. These options are developed and assessed in more detail in Part C.
Table 3.1 - Urban Design Criteria

<table>
<thead>
<tr>
<th>Options</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td><strong>Principles</strong></td>
<td><strong>Overall Score</strong></td>
<td><strong>Acceptability</strong></td>
</tr>
<tr>
<td>Minimises severance of communities and disruption to existing social patterns</td>
<td>H H H H L M M M L L</td>
<td>L L M M M M M M M</td>
<td>High: 17-20</td>
</tr>
<tr>
<td>Maintains existing urban and landscape qualities and minimises changes</td>
<td>H H H H L M L L L L</td>
<td>L L L L L L L</td>
<td>Medium: 14-16</td>
</tr>
<tr>
<td>Connects major centres with residential areas</td>
<td>H M M H L M H L L</td>
<td>L M L L L L</td>
<td>Low: 10-13</td>
</tr>
<tr>
<td>Minimises impacts on existing and future land use patterns and enhances potential development opportunities</td>
<td>H H H H L M L L H M M M M</td>
<td>M-H M L M M</td>
<td></td>
</tr>
<tr>
<td>Provides a legible environment for motorists</td>
<td>M M M M M-H M-H M H M M H H M H H H H</td>
<td>M M H H H H</td>
<td></td>
</tr>
<tr>
<td>Combines with other transport modes, including rail and bus.</td>
<td>M M H H M M M L H L L L</td>
<td>L L L L L L</td>
<td></td>
</tr>
<tr>
<td><strong>Overall Score (10-20)</strong></td>
<td>H M-H H H L M M L M L-M L L L-M M M M M</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Table 3.2 – Landscape and Visual Criteria**

<table>
<thead>
<tr>
<th>Principles</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimise landform modifications</td>
<td>H</td>
<td>M</td>
<td>L</td>
</tr>
<tr>
<td>Reduces landscape character impacts and modifications</td>
<td>H</td>
<td>M</td>
<td>L</td>
</tr>
<tr>
<td>Reduces visual impact based on a combination of Visual effect (contrast)</td>
<td>H</td>
<td>M</td>
<td>L</td>
</tr>
<tr>
<td>and visual sensitivity (visibility)</td>
<td>H</td>
<td>M</td>
<td>L</td>
</tr>
<tr>
<td>Reduces visual impacts on residents</td>
<td>H</td>
<td>M</td>
<td>L</td>
</tr>
<tr>
<td>Minimises changes to “Naturalness” ie National Parks, nature reserves.</td>
<td>H</td>
<td>M</td>
<td>L</td>
</tr>
<tr>
<td><strong>Overall Score (10-20)</strong></td>
<td>H</td>
<td>M</td>
<td>L</td>
</tr>
</tbody>
</table>
Part C: Assessment of Type A Options
4 Urban design, landscape and visual impacts of Type A options

4.1 Introduction

In order to assess the impacts of the “Type A” feasible options in more detail, shown in Figure 4.1, a rating table has been developed to assist in the comparison of potential impacts. The evaluation of the feasible options, at detail scale, has been undertaken by more detailed principles prepared to assist the development of the interchange options and rationalise alternatives. The terminology of the options was changed from Options 1, 2 and 3 to Red, Yellow and Blue respectively. A fourth option (Purple Option) was added as a variation to the Blue Option. This resulted in the relocation of the tunnel further west to be located directly under Pennant Hills Road. This was selected as a feasible option as it achieved a direct transfer of traffic from Pennant Hills Road below ground to the tunnel.

Figure 4.1 - The four feasible Type A options.
4.2 Impacts of the corridor options

In order to guide the development of feasible options it is important to determine what components of the link will result in impacts. Generally, as most of the Type A options proposed are in tunnel, the majority of the urban design, visual and landscape impacts occur as a result of the following:

- **The Interchanges**: This is where the tunnels interface with ground level and where the most complex of the built forms become visible to the surrounding community. Constructed elements that occur at these interchanges include:
  - On grade roads and connections
  - Road bridges and/or underpasses
  - Pedestrian bridges and/or underpasses
  - On and off ramps
  - Retaining walls
  - Portals
  - Acoustic walls
  - Medians and associated landscape treatments
  - Signage and Lighting
  - Fencing
  - Any associated buildings required including Motorway Control Building, air intake structures if necessary, maintenance areas, and truck breakdown bays.

- **Ventilation Structures**: These structures are required to provide ventilation for the tunnel and will be required for all of the tunnel options. The length of the tunnel will determine the number of ventilation structures required, however the current engineering identifies approximately one ventilation structure will be required for every two kilometres of tunnel. Air quality, visual and social implications of these structures needs to be considered.

- **Cut and Cover**: Where the tunnel is located less than approximately ten (10) metres below the ground surface it is generally constructed as cut and cover rather than driven tunnel. The implications of this method during construction can be high as existing built form and vegetation on the ground surface is removed and requires reinstatement. The visual impacts during construction can also be high.

- **Areas in cut with associated retaining walls**: These areas may not be highly visible to the community, however associated sound barriers and fences can increase the impacts.

4.2.1 The Interchanges

Urban design principles have been established for the most effective interchanges. These principles have been used to guide the broad conceptual layouts for the potential interchanges and should be included in the evaluation criteria for future interchange alternatives at later stages. They include:

- **Legibility and Integration**
  - Reduce the impact of built form by reducing the need for over bridges, extent of high retaining walls, and acoustic barriers. This can be undertaken in the horizontal and vertical configuration of the traffic movements. In some cases a balance between free traffic movement and efficiency will need to be made against the visual impact and intrusions.
  - Avoid complicated road interchanges, particularly at driver decision-making points. For example at portal approaches the carriage way and portal face should be uncomplicated, with clean and simple lines. Avoid visual complications at portals; such as over bridges and fly overs occurring immediately adjacent to the portal.
  - Reduce the number of decision-making points at the approaches to interchanges and at the interchanges themselves.
• Reduce the number of intersections associated with each interchange.

• Avoid crossing traffic movements and where possible locate grade-separated lanes adjacent to each other to avoid multiple retaining walls, and the visual impacts associated with these.

• Simplify interchanges and traffic movements

• Ensure views are available for the motorist beyond the road environment at strategic locations to provide legibility and assist in orientation

**Visual impacts**

• Reduce the extent of impacts on adjacent residents by avoiding interchanges that are elevated and above surrounding land uses.

• Reduce the extent of loss of existing landscape.

• Reduce the loss of open space, parks and reserves.

• Avoid impacts on natural pursuits, for example, walking trails such as the Great North walk, and local bush tracks.

**Connectivity and limiting future land uses**

• Avoid sterilising and isolating land resulting from land locked areas totally surrounded by traffic lanes

• Retain existing local movement patterns for local traffic and pedestrian connections;

• Interchanges should cater to through traffic and large traffic volumes, with local streets and access provided for resident’s local traffic movements.

• Retain safe driveway access for residents and surrounding land uses

**Landscape**

• Identify the route as a continuation of the gateway to Sydney from the north by ensuring appropriate urban and landscape outcomes.

• Provide a parkland character to the route to ensure it fits into the north shore character of tall Eucalyptus high forest

• Maximise the opportunity for landscape areas.

• Ensure medians widths allow a minimum of 1.5 metres landscape to provide a visual buffer between traffic lanes

• Provide a minimum of 1.5 metres between edge kerb line and noise barriers/ and or retaining walls to allow for landscape buffer treatment.

• For cut and cover ensure a minimum of 1 metre is provided on top of concrete structures to allow for sufficient landscape and drainage works.

• Retain and/or reinforce this character outside the road corridor as well as inside the corridor

• Retain high quality existing landscape and trees where possible.

### 4.3 Comparison and Assessment of the Options

The following section identifies the impacts associated with each Option and outlines potential treatments that would improve the impacts as well as items to be addressed at the next stage, including the Environmental Impact Statement. Drawings highlighting the urban design, visual and landscape issues associated with the interchanges are included in Appendix A. Generally the detail shown on the drawings for
at each interchange is not resolved until concept design. Instead the drawings outline constraints and opportunities at pre-concept design in sufficient detail to enable options and alternatives to be comparatively assessed. The options are described from west to east in this section.

4.3.1 **Purple Base Option**

The purple base option includes:

- A tunnel under Pennant Hills Road alignment between the M2 Motorway and Pennant Hills Station
- A tunnel under the Northern Rail Line between Pennant Hills Station and Brickyard Park
- A short section of open road in deep cut, located within future Brickyard Park (Hornsby Council’s proposed Dartford Road Sports Complex)
- A tunnel following Pennant Hills Road alignment between Brickyard Park and the F3 freeway.

**Figure 4.2 - Brickyard Park Potential Open Road in Deep Cut**

Note: This diagram outlines only a schematic layout for the road through this section of the route. Hornsby Council’s schematic design for the future Dartford Road Sports Complex has been shown with minor modifications to achieve the integration of the open road in cut adjacent to the railway. All locations of potential portals and the extent of the open cut area are schematic only, and would be the subject of future detailed design layouts (at later study stages).
The three areas of tunnel have no surface visual and landscape impacts. The short section of open road through Brickyard Park will provide some impacts on the park. Figure 4.2 outlines the potential treatment in the Brickyard Park. This would require detailed design investigation at the next stage to determine the best design approach. It does, however indicate that a good urban design outcome is possible with this option.

**Legibility and Integration**

The legibility of the route as it passes through the edge of the park will be improved, due to the increase in natural light and the orientation benefits associated with this for the drivers.

**Visual Impacts**

The visual impacts of this option route will be greater than the tunnel option as the route will need to include noise barriers and could impact visually on the park. This can be reduced by the introduction of mounding and landscaping as noise barriers, however it may reduce the available space within the park. Two tunnel portals will be required, along with a bridge over the area of cut at Dartford Road. These could increase visual impacts on the park, typically the Sports Field and open space areas.

**Connectivity and Limiting Future Land Uses**

No major limitations occur to future land uses, apart from the land take from the future park.

**Landscape**

The potential for landscape treatment at the park is high. The following design principles should be adopted in the siting of any open cut area within the park.

- The visual impacts on the future Brickyard Park should be reduced by locating the open cut as close to the existing rail corridor as possible
- The loss of existing landscape and open space should be minimised in the siting of the open cut area.
- Ensure land isolated between the rail and road corridor is minimised or avoided
- The potential to provide additional landscape and screening adjacent to the alignment should be maximised. This will assist in screening of any required noise barriers, potential use of mounding for noise barriers and the integration of the portals into the surrounding landscape.
- Retain maximum amount of existing landscape where possible
- Realign Dartford Road to minimise impacts
Northern Interchange Purple Option at F3 Freeway

Legibility and Integration

This interchange provides improved legibility over the existing interchange and creates a simplification of the traffic movements at the intersections within the overall interchange, by making them one way. This would cause decreased legibility in the short term due to the significant change to the Pacific Highway and Pennant Hills Road sections of the interchange, however over time these changes would reduce the potential for traffic conflicts. The Pennant Hills Road, F3 intersection is widened, and allows for more traffic movement, with 3 lanes for each movement. This will improve its function and provide both north and southbound access to the F3. The geometry of the intersection is improved and will create a clearer definition for motorists travelling along Pennant Hills Road.

The Pacific Highway/ F3 intersection is widened to accommodate a central portal for northbound and southbound access to the tunnel, as well as north and south bound access under the Pacific Highway to Pennant Hills Road. The existing off ramp south bound to the Pacific Highway is retained as well as the on ramp from the Pacific Highway to the F3. This results in a widened intersection to accommodate these movements. The required split of traffic north of the Pacific Highway into separate lanes to turn either right or left at Pennant Hills Road adds more decision points for motorists at this intersection.

In essence the interchange becomes a giant roundabout with the potential for movements one way to connect with each of the roads feeding from it. With good landscape treatment and clear portal design the legibility of this intersection will be retained. Access to the residential areas within the centre of the interchange is retained and traffic conflicts are reduced by the one way system.

Visual Impacts

The visual impacts are minimised due to the absence of over bridges and additional high level connections. Two portals and approach ramps are located on Pennant Hills Road. These will provide for clear movement to and from the portals.

A number of large trees along the highway would be affected by this acquisition and it would be important to plant additional species early to remediate these potential negative impacts.

Connectivity and Limiting Future Land Uses

Pedestrian access is maintained in all areas and potentially improved on the south side of the Pacific Highway between the F3 and Pennant Hills Rd. The width of this portion of the loop can be decreased thereby providing potential for a wider buffer between the medium density housing within the loop and the Pacific Highway.

Landscape

Potential new landscape can be accommodated within the wider portion of the Pacific Highway mentioned above. The existing landscape on the south of the medium density housing north of the F3 loop will be reduced by the wider requirements for the northbound lane from Pennant Hills Road.

Summary: This interchange provides significant improvements to existing traffic movements whilst reducing the extent of changes and maintaining the existing ‘footprints’ of the interchange.
Southern Interchange Purple Option- M2 at Pennant Hills Road; 4 Level interchange

This option includes four levels at the interchange.

- Tunnel taking traffic northbound from Pennant Hills Road to the Link (main tunnel), under the existing intersection
- Over-bridges for the link north-south between Pennant Hills Road and the tunnel ramps over the existing M2 and Pennant Hills Road intersection
- On and off ramps located on the north-west side of the interchange providing connections between the tunnel portal, the M2 and Pennant Hills Road.
- Existing on grade interchange with associated alterations

Legibility and Integration

The visual clarity of this interchange is complicated by the over bridges at the western approach to the interchange from the M2. This over bridge will pass in front of the portal and run obliquely over the M2, already in cut, creating visual complications to the approaches. The over bridge connecting Pennant Hills Road, as a grade separated link over the interchange, will also provide visual complications, increasing the decision making points required at the interchange. The north-western configuration of ramps, connecting to the tunnel requires lane cross overs that will be difficult to screen.

The north bound tunnel from Pennant Hills Road will also require additional portals and property acquisition on the south west and north west side of the M2 intersection.

The existing toll structures will be removed to accommodate the M2 to Pennant Hills Road west facing ramps.

Visual Impacts

The visual impacts will be medium, where the overbridges occur. The visual impacts of the ramps at the north west of the interchange will have minor impacts on the residents located around Hillside Place, Larchmont Place, parts of Eaton Road and Gum Grove Place. These properties slope away from the interchange to the west with their predominant views westbound. The two portals will create visual impacts for the residents to the west and will require screening.

Connectivity and limiting future land Use

The ramps and new lanes are generally located immediately adjacent to the interchange. This limits the potential for isolating land. However, there is a small portion of land that will be inaccessible between the on and off ramps from the M2 west heading north to the tunnel. This can be utilised for additional landscape and will assist in the integration of the additional roadworks with the surroundings. Maintenance feasibility of this area of landscape would require further detailed assessment.

Acquisition of properties west of Pennant Hills Road will be required to accommodate the new lanes, particularly at the north bound entry portal to the tunnel. (Most of these are currently owned by the RTA). Residents to the south east of the interchange will not obtain significant views of the proposed changes as they slope away from the interchange to the east and are separated by a landscape strip park. Even though they are higher than the interchange the views will mostly be screened. A residence to the south west of the interchange is located on a high knoll and will have foreground views of the overbridges.

Affects on Pennant Hills Golf Course are limited as the footprint of roadworks is located outside the golf course.

Landscape

Additional landscape can be accommodated adjacent to the interchange, as discussed previously. It will be important for these areas of additional landscape to provide visual screening of the new ramps particularly to the north west of the interchange, where the extent of road is approximately double the footprint, of the existing interchange.
Widening of Pennant Hills Rd South of the M2 to North Rocks Rd, including the intersection

This proposal has been included due to traffic impacts of the tunnel exiting at Pennant Hills Road. The extent of the widening is shown in the previous drawing. The proposal is to widen Pennant Hills Rd from south of the North Rocks Rd intersection, to the M2 intersection with varied lane configurations dependent on the proximity to the intersection.

**Impacts will be as follows:**

- Property Acquisition will be required as well as loss of landscape to the west and to a lesser extent the east of Pennant Hills Rd. Houses to the south west and south east of North Rocks Road intersection will be significantly impacted with substantial loss of front gardens. Where this is too significant the houses should be acquired. Loss of landscape and trees abutting the road will also occur.

- Properties to the north of North Rocks Rd opposite Roselea Park will be affected with possible acquisition required.

- The service station on the south-western corner of Murray Farm Rd and Pennant Hills Rd will also be very close to the widened road. Further investigation is required.

- Schools in the area are generally east of Pennant Hills Rd and shouldn't be affected.

- The properties identified in this section are only for the purpose of comparisons of options. Actual property requirements will not be determined until concept design stage.

**Visual Impacts on residents:**

High impacts will occur along the length of the widened Pennant Hills Rd and the western portion of North Rocks Road. The potential requirement for noise walls will mean that properties will be visually cut off from the road and this will create a severing of the community and lack of relationship of the residential areas to the road. The need for noise walls requires clarification as this is not desirable.

**Summary Assessment**

The purple option has been assessed against the criteria included within Appendix A Tables and a scoring of impacts combined for the option. This option performs the best against the criteria, except for the alternative southern interchange option described in the Appendix A. The combined scores result in a medium to low impact for the Purple Option.
4.3.2 Blue Option

The Blue Option is also located totally in tunnel with the on grade impacts occurring only at the interchanges. The impacts associated with the Blue Option northern and southern interchanges follow.

Northern interchange

Legibility and Integration

The legibility of this interchange is similar to the existing interchange with the following added complications.

Pacific Highway/F3 on and off ramps/tunnel northbound and southbound ramps

The right turn movement from the Pacific Highway to the F3 will be increased to 3 lanes. This will improve traffic flow but require additional land take and impacts on the adjacent residents.

F3 to Pennant Hills Road off ramps and tunnel portals

This intersection has four portals. Two north and southbound portals for the tunnel, connecting to the F3, and two north and south portals for the tunnel connecting to Pennant Hills Rd.

The design for the interchange currently has two over bridges. The first will be required for the southbound F3 exit over the north and south bound tunnel movement. This overbridge will be some 50-60 metres from the tunnel portal, but will appear as an oblique fly over that is visually intrusive and complicates the intersection, causing confusion and reduces legibility.

The second is required where the south-bound F3 exit to Pennant Hills Road is required to cross the northbound exit ramp leading to this intersection. Again this bridge will be visually intrusive.

Pacific Highway east and northbound intersection: This intersection remains unchanged.

Visual Impacts

The existing interchanges will result in increased visual impacts to residents and surrounding land uses due to the impacts of the over bridges and their elevated location in relation to the surrounding areas. The extent of the loss of existing landscape can be reduced if the extent of the cut and cover is reduced. This will need to be investigated in detail at later stages. Options to remove or reduce the over bridges would significantly improve the interchanges and reduce the visual impacts. This needs to be investigated further at a later detailed design stage.

Connectivity and limiting future land uses:

Construction issues related to the cut and cover required for the northbound tunnel ramps will impact on adjacent residents significantly and sever Eastbourne Ave to through traffic during construction. It is important that this connection is retained as it caters for local traffic movements and keeps local traffic off the main roads.

Landscape

Existing trees located in the gully south of the existing interchange will be removed during construction. This will change the character of this gully and impact on the adjacent residents. Measures to restrict the removal of vegetation and disturbance in this area during construction would be essential.
Southern Interchange Blue Option- M2 at Pennant Hills Road, Pennant Hills 4 Level Interchange

This option is the same as the Purple southern interchange assessed previously.

Summary Assessment

The blue option has been assessed against the criteria included within Appendix A Tables and a scoring of impacts combined for the option. This option performs less than the Purple Option against the criteria. The combined scores result in a medium impact for the Blue Option. Refer to the summary table of assessments in Appendix A for the scoring.

4.3.3 Yellow Option

The Yellow Option is also located totally in tunnel with the on grade impacts occurring at the interchanges. The impacts associated with the Yellow Option northern and southern interchanges follow.

Northern Interchange Yellow Option-

This interchange is the same as the Blue Option interchange. Refer to the previous section for an assessment of this northern interchange.
Southern Interchange Yellow Option- M2 at Tunnel (east of Beecroft Road) Epping

This option includes two areas of on and off ramps. The eastern ramps are located east of the existing M2 tunnel.

**Legibility and Integration**

These two areas will be discussed separately.

**Eastern Area**

The north bound on ramp is located in tunnel and has no surface impacts. The eastbound off ramp has a portal located near Harper Street. The extent of the surface road works involves locating the ramp over the tributary to Terrys Creek in the gully. It could severely impact on this creek line and would need to include tunnels and culverts to prevent disturbance to the existing drainage patterns. More detailed review of this extent needs to occur to minimise these impacts. Location of the ramp outside the creek line and gully would be preferable.

The legibility of this interchange for the motorist will be high.

**Western area**

The western area includes two portals. The first is located on the north side adjacent to Devlins creek and west of Beecroft Road. The approaches to the tunnel portal will require bridging over Devlins Creek and will impact on the gully associated with the creek. Noise barriers that will be required to reduce noise impacts to the residents in Lyne Rd and Boronia Ave, Cheltenham will increase the built form in the area and it will be located at a closer proximity to the residents. This section of the motorway is legible for the motorists.

**Visual Impacts**

**Eastern area**

The existing residential area located in Harper Street and Woodvale Avenue will obtain views to the new ramp with its associated noise barriers. This will create high impacts for residents as they will lose existing vegetation and gully character which will be replaced by a road, portal, retaining walls and noise barriers. Residents are also less than 20 metres from the off ramp and do not have intervening distance to mitigate the impacts. The potential to provide additional landscape is also minimised by the lack of space in this area.

**Western area**

The visual impacts associated with this portion of the site include impacts of the portal at Kent St and associated land acquisition of the school adjacent to the ramps. The school is lower than the existing M2 and will be looking up to the additional noise barriers. The tunnel will be in ramp and will include cut and cover impacts during construction. It will therefore create disruption during construction.

**Connectivity and Limiting future land uses**

The area adjacent to Devlins Creek and Beecroft Road to the north of the M2 will be partially isolated by the northbound exit. This land should retain its existing landscape character and protect Devlins Creek.

**Landscape**

The potential for landscape treatment is confined to the immediate areas adjacent to the ramps and portals. The impacts on the existing landscape are high adjacent to Devlins Creek, due to the tunnel on ramps being located over existing creek line and gully. This area would require more detailed investigation to reduce these impacts if this option is taken to the next stage.
Summary Assessment

The yellow option has been assessed against the criteria included within Appendix A Tables and a scoring of impacts combined for the option. When evaluated against the criteria this option performs less than the Purple and Blue Option. The combined scores result in a medium impact for the Yellow Option. Refer to the summary table of assessments in Appendix A for the scoring.

4.3.4 Red Option

The Red Option is also located totally in tunnel with the on grade impacts occurring at the interchanges. The impacts associated with the Red Option northern and southern interchanges follow.

Northern Interchange Red Option- Plan B

This interchange is the same as the Blue Option interchange. Refer to the previous section for an assessment of this northern interchange.
Southern Interchange Red Option – M2 at Toll plazas, Marsfield

The Red Option joins the existing M2 Motorway at Marsfield with ramps connecting to the motorway either side of the existing toll plazas. Two areas are therefore affected by the option. The first area occurs where the eastbound link connects with the M2. The second area occurs west of the toll plaza near the Macquarie University Sports Fields.

Legibility and Integration

Both of these interchanges are legible for the motorists with the number of decision making points minimised. The two areas are discussed separately.

Eastern ramps

No major bridges are required for these interchanges except for the areas immediately adjacent to the M2, including Khartoum Road where the existing bridge of the M2 will need to be widened. The second area includes the overbridge at the on ramp from the tunnel to the M2 where it will be required to go under the off ramp from the M2. These bridges immediately flank the motorway and minimise the extent of the impacts.

Western ramps

The second intersection west of the toll plazas would require an extended bridge adjacent to the motorway over Busaco Rd. Ramps on either side of the M2 lead to the two portals. Some land acquisition is required for the portals, however this is close to the M2 road reserve.

Visual Impacts

Visual impacts for both of these interchanges will occur at the commercial and light industrial areas along Talavera Road west of the Lane Cove Road, and the residential areas north of Fontenoy Road. These areas will have views of the option through the adjacent vegetation and are generally higher than the motorway. The noise barriers required for the extended ramps adjacent to the residential areas, would need to be designed sympathetically, with additional landscape to soften visual impact. The southern side may not require noise barriers, but additional landscape would be recommended.

The second area to the west will result in the tunnel approach ramps adjacent to the motorway being located closer to the student housing of Macquarie University to the south and Serviced Apartments to the north. The edge treatment and the portal treatment will need to consider reducing impacts at these locations.

The major impacts will occur in the two areas of cut and cover. The first area of cut and cover on the Eastbound exit ramps will result in loss of existing vegetation and disturbance to Mars Creek leading to the Lane Cove River. The existing M2 toll plaza is also located over the creek line. It will be important for the area of cut and cover to be minimised as much as possible to avoid disturbance to this natural system.

Connectivity and Limiting future land uses

No limitations to existing land uses will occur within this portion of the route. Some property acquisition will be required to the areas immediately adjacent to the M2 where the ramps are widened.

The majority of the impacts would occur during construction. The extent of cut and cover of the northbound on ramp to the tunnel is located immediately over the road, car park and part of the oval of the Macquarie University sports fields. The disturbance to these fields should be minimised and the extent of cut and cover reduced. If the construction does affect the use of the Sports Fields then compensatory sports facilities would be required.

Landscape

The potential for landscape treatment is minor. Strips of landscape could be provided adjacent to the ramps and should be located to screen additional road works. There is an opportunity to provide a key interchange at the existing M2/Lane Cove Road intersection with additional landscape treatment at the ramps and approaches.
Summary Assessment

The red option has been assessed against the criteria included within Appendix A Tables and a scoring of impacts combined for the option. This option performs less than the Purple Option but better than the Blue and Yellow options, assessed against the urban design principles. Generally the southern interchange performs higher than any of the other options in reduced visual impacts, land use effects and legibility. The northern interchange for this option, however performs poorly in comparison to the Purple Routes northern interchange, thereby reducing its overall acceptability. The Purple Option alternative for the northern interchange cannot be used for the Red Option due to the location of the tunnel exits. The combined scores result in a medium impact for the Red Option. Refer to the summary table of assessments in Appendix A for the scoring.

4.4 Assessment of Four Base Options

The Purple option provides the lowest impacts, based on the urban design, landscape and visual principles set out in the evaluation tables included in Appendix A. By reviewing some of the alternatives included in the following section, and the potential combination of the Blue Option’s Southern interchange, the acceptability of this option would be higher as assessed against the urban design principles.

4.5 Assessment and Comparison of Purple Option Alternatives

4.5.1 Purple Option: Alternative 1: Single Long Tunnel No surface road in cut at Brickyard Park

This option includes a long tunnel with no surface area within Brickyard Park or the future Dartford Road Sports Complex. The impacts will be the same as the Base Purple Option, with no added impacts at the park. The urban design and social implications of a longer tunnel require consideration at the next Environmental Impact Statement stage.
Figure 4.3 - Potential Central Access Interchange

Bellevue Street
Potential redevelopment opportunity
Station Street
Thornleigh Railway Station
New Bridge Over Road
Paling Street
Realignment of Pennant Hills Road may be necessary for a short section
Pomona Street
Central Access Interchange
Albion Street

Potential Redevelopment Opportunity

Pennant Hills Railway Station
Potential pedestrian and bicycle networks would be possible along Pennant Hills Road
4.5.2 **Purple Option: Alternative 2: Two Tunnels with Central Access**

This concept breaks the long tunnel into two tunnels each about 4km long, daylighting in an open trench in commercial land adjacent to the east of the railway line between Pennant Hills and Thornleigh stations. The open trench would be about 800 metres long.

**Central Access Interchange**

A Central Interchange of the Central Access Alternative would be located opposite Pomona Street and over the new Expressway trench. Pomona Street is located approximately 400m north of Pennant Hills railway station.

The 12 metres deep open trench would be covered for about 75 metres of its length to allow for a surface level roundabout of about 40 metres diameter (the roundabout may have to be oval in shape to provide traffic deflection). Two north facing and two south facing ramps to and from the Expressway would join with the Central Interchange. The roundabout would have two traffic lanes.

The new link exit and entry ramps could be on grades of up to 6% slope. At this grade the ramps would be at least 250m long. This would allow for smooth vertical transitions to align with the Expressway and the Central Interchange.

The Central Interchange would be connected to Pennant Hills Road via three exiting traffic lanes and with two entry traffic lanes from Pennant Hills Road. Both the Central Interchange and the intersection at Pennant Road and Pomona Street could be controlled by traffic lights, although it is preferable that the roundabout traffic is free flowing. If the Central Interchange is controlled by traffic lights, two traffic lanes would be required on the two ramps entering the interchange. It is also desirable that the left turning lane on to Pennant Hills Road from the Central Interchange is an uncontrolled merging lane.

The concept is shown schematically in Figure 4.3.

4.5.3 **Purple Option: Alternative 3: Two Tunnels with Intermediate Southern Access**

This concept would daylight the Purple tunnel in a trench of about 400 metres long between Boundary Road and Beecroft Road intersections. The proposed trench could be located to the north western side of the existing Pennant Hills Road.

A Southern Access Interchange would comprise a southern portal within Pennant Hills Road and north-bound exit to Pennant Hills Road and Boundary Road. A northern portal located on Pennant Hills Road would allow a south bound exit to Boundary Road and a north –bound entry from Bandy Road via Pennant Hills Road. Preliminary investigation would suggest that entry and exit ramps could be constructed between 4-6% grades from a 12 metre deep trench.

The southern access option would:

- Provide a shorter tunnel option with increased benefits associated with two shorter tunnels rather than one long tunnel
- Increase the use of the tunnel and the opportunities for connection at Pennant Hills by providing on and off ramps. This would increase the benefits of the tunnel to the community surrounding this connection such as Thornleigh, Cherrybrook, Westleigh and Pennant Hills.
- Provide more open road in cut, and day light along the option
- Result in loss of some housing adjacent to Pennant Hills in the area of open trench.

A connection to the tunnel from Boundary Road would provide the opportunity for traffic to join the route from this area. This would be particularly beneficial for traffic from the Hills District, providing a direct connection from Boundary Road. The benefits of this connection would potentially provide motorists in the Hills District and north-west sector more options for joining the orbital route. These greater alternatives provide for future flexibility of traffic movements, and better utilisation of the tunnel.
A number of residential properties would need to be acquired adjacent to Boundary Road to enable the ramps and access to occur at this location.

Figure 4.4 – Section through shared rail corridor

The approximate area where this section has been taken is shown in Figure 4.3

4.5.4 Purple Option: Alternative 4: Sharing the rail corridor

This alternative provides a deep cut, within the existing rail corridor between Pennant Hills Station and the Mallings Siding (near Dartford Road), Normanhurst. A strip acquisition of land adjacent to the rail corridor will be required. A section illustrating the alternative cross sectional proposal within the existing rail easement is shown in Figure 4.4. The lanes associated with the north and southbound carriageway would be located one above the other to the west of the rail lines.

The benefits of this option are:

- The visual impacts associated with the route are reduced as it is accommodated within the rail corridor
- Noise amelioration is restricted to the edge of the railway boundary and can be included as Railway fencing. Opportunity for a clear design approach to these noise barriers is possible.
- Impacts on existing landscape and open space are minimised.
- No land is isolated by the road, and existing pedestrian and vehicular circulation is accommodated within existing bridges
- A legible motorists environment is created, with decreased potential requirements for ventilation structures.
- Natural light is provided to this approximately 2 kilometre section, and the length of tunnels is decreased.
- The footprint of impacts is reduced
- Flow on benefits in the creation of an integrated transport network occurs. This is further discussed in the following section highlighting development opportunities.
4.6 Development and Integrated Public Transport Opportunities

The Purple Option, Alternative 3, proposal provides greater urban development opportunities around the rail stations along the Northern Rail line as the road is partially routed within the existing rail corridor. This option proposes that the road emerges from tunnel after Normanhurst Station near Darford Road and travels within the existing rail corridor adjacent to the existing rail lines in an open cut, returning to tunnel before Pennant Hills station. The proposal also allows possible future quadruplication of the rail line as a future up-grade to the Northern rail line.

The merging of the road route with the rail corridor creates greater urban development opportunities for Thornleigh and Pennant Hills stations. Pennant Hills could take on the role of a sub regional centre similar to the role Epping Station currently provides along the northern line. Thornleigh could develop as a district centre, similar to Gordon on the Northshore line. These alternatives would require planning and design integration, and cooperation with RailCorp.

Currently, Pennant Hills is a predominantly residential area with a district shopping centre and a component of commercial use. The merging of the road with the rail could see this centre transformed into a major transport interchange. Pennant Hills could become the transport hub for the Hornsby Regional centre, which is not located along the motorway route. This future scenario for Pennant Hills is reinforced by the Chatswood to Epping rail line, currently under construction, which allows trains to travel from Hornsby to Chatswood Via Epping.

A major transport interchange at Pennant Hills could see modal splits from bus to train from destinations such as the Central Coast, Dural, and Cherrybrook.

Pennant Hills could become Sydney’s Northern Transport Interchange. Bus rail links would provide connections between the Central coast, Cherrybrook, Dural and Glenorie to the Sydney CBD, Chatswood, Macquarie University, Macquarie Business Park, Hornsby, Parramatta and Sydney’s western Suburbs via this interchange. This interchange could also operate as a main northern coach interchange for coaches travelling interstate and to northern regional areas.

The alignment of the motorway with the rail corridor also provides greater commuter parking opportunities. Private cars could gain access to commuter parking below Pennant Hills Station directly off the Motorway itself. This would service car – rail commuters travelling from regional areas such as Cherrybrook, Dural, Glenorie and the central coast to the City CBD, and Chatswood.

With the up-grade of Pennant Hills as a major regional transport interchange, further development opportunities should be encouraged around and above the station area. This potential development area is bounded by Pennant Hills Road and the extent of the current shopping precinct on the eastern side of the rail line. It could include the possibility of building over the rail corridor in this location. Increased residential density, increased retail at street level and commercial usage could be accommodated.

Thornleigh currently is a mixture of a residential neighbourhood, a neighbourhood shopping centre, and a restaurant destination, with a bulky goods area. By merging the rail line with the motorway corridor, or the incorporation of the link adjacent to the rail line, Thornleigh could be developed as a district transport interchange. Buses from the local areas such as Normanhurst, Thornleigh, Westleigh, South Wahroonga and Turramurra would interchange here with the Northern rail line to connect to the Sydney CBD. The Chatswood to Epping Line would see local commuters using the northern line to travel to Epping, Macquarie University, Macquarie Business Park, Riverside Business Park and Chatswood. This new rail line would see commuters from Wahroonga, Warrawee and Turramurra commuting to Thornleigh to catch trains. Thornleigh could take on this more district interchange role. The interchange might connect to buses using the motorway below travelling to the Central Coast, Parramatta and Western Sydney.

Thornleigh could also provide more commuter parking connected to the surface road network for the local surrounding suburbs, providing district commuter parking.

An upgrade for Thornleigh as a district transport interchange could see increased development between the Northern rail line and Pennant Hills Road. This could be in the form of increased residential densities, increased retail, restaurant and café opportunities at street level.
Normanhurst Station should maintain its residential character and village atmosphere whilst the brick pit site is being developed by Hornsby Council for recreational usages to provide increased facilities for the increased populations of Thornleigh and Pennant Hills.

These integrated public transport opportunities could occur in various ways for the Purple Route Alternative 2, Two Tunnels with Central access, and Alternative 4, Shared Rail Corridor. They include the urban design opportunities that go beyond the road itself and could result in land use and public transport benefits. The short term impacts would, however be high as they require redevelopment, major land acquisition and re-planning of this corridor adjacent to Pennant Hills Road and bound by the railway line, Pennant Hills Station and Thornleigh Station.

In summary the Purple option provides the greatest potential to integrate with rail, as well as bicycle and bus routes, thus satisfying the key urban design principles of coordinating with other transport modes.

4.7 Urban design outcomes along Pennant Hills Road

As a result of the tunnel connection between the F3 and the M2 there will be resultant benefits to the existing on grade links, currently carrying significant peak hour traffic. Pennant Hills will benefit most from the tunnel, based on the traffic figures. This will result in the potential to revitalise Pennant Hills Road as a local and neighbourhood connecting road, with the added benefits of decreased traffic. This would be particularly applicable in the early years following the tunnel opening. The potential benefits to Pennant Hills Road include:

- Better pedestrian amenity by reduced traffic would be achieved.
- Potential to provide an improved streetscape character with the addition of street trees, improved pedestrian footpaths, dedicated bicycle lanes, and bus lanes could be realised.
- The improvements to the local bus routes along Pennant Hills Road with integrated bus shelters would be possible.
- The potential widths to footpaths and lanes would be investigated to determine opportunities for improvements.
- The opportunity to provide street furniture, that is complementary for the full length of the road would exist. This could include seating, tree guards, bollards, kerbs, fences and pedestrian control devices.

This will result in a positive outcome for Pennant Hills Road and the character of this road from the project and improve the surface road environment for the motorist, pedestrians, rail and bus commuter and cyclists using this road. Improvements to the cycle link and public transport along Pennant Hills Road could also be undertaken at the next assessment stage. This would be consistent with the current Roads and Traffic Authority bicycle network upgrade for Pennant Hills Road.

4.8 Urban Design, Landscape and Visual Assessment Tables of Route Options.

Assessment tables of the Four Type A options, in more detail, have been prepared and are located in Appendix A. This has been based on a method adopted for the project of grouping the major urban and visual criteria for each alternative and evaluating the impacts as high, medium or low. The other assessment criteria, including environmental, social and engineering issues have been independently assessed and are included in separate working papers.

Each assessment table is accompanied by a plan highlighting the key urban design, landscape and visual issues associated with each interchange. These should be read in conjunction with the text and engineering plans in this section.

A number of alternatives to the options have been evaluated. These descriptions, plans and assessment tables are included in Appendix B.

Potential illustrative landscape sketches including plans and sections have been prepared for a number of the interchanges. These are included in Appendix C.
4.9 Other Alternatives

A number of other alternatives have been considered. These include various interchange alternatives, particularly for the Northern interchanges. A description of these alternatives is included in the Appendix B along with drawings describing the main constraints and opportunities associated with the alternatives.
Assessment of the Ventilation Locations

5.1 Introduction

A number of Ventilation Stack locations have been investigated for the purpose of evaluation for each of the options. These will be addressed for each route option. Each location is indicative only and numerous options have been reviewed.

This assessment is preliminary by nature for a route evaluation study. Much more detail on the number of stacks, the alternative locations and detailed review of ventilation options is required for a full assessment of the impacts of ventilation structures on the community. No plans have been provided for the potential locations due to the early stage of this assessment. This preliminary assessment should be read in conjunction with Working Paper No.5 - Social and Environmental Studies Report.

5.1.1 Design Principles

Design principles for the most effective siting and location of the ventilation structure include:

- Locate the structure to provide the most efficient and effective dispersal of emissions away from ground level. Coordinate with air dispersion modelling.
- Locate the structure to avoid residential areas, schools and hospitals.
- If possible locate the structure in another structure (building)
- Utilise natural features to screen the structure from view, for example existing vegetation or existing landform
- Avoid disturbance to existing landform by avoiding creek lines, heavily vegetated areas that would require clearing
- Construct the structure in materials that are complementary to its surroundings, that will be non-reflective and quality materials.
- Where possible locate the structures on land already in the ownership of the Roads and Traffic Authority.
- Where possible locate the structures on suitably zoned land.

5.2 Purple Option

Four possible locations have been identified for the purple option. These are as follows:

**Location P1: Thompsons Corner**

**Visual Impacts:** The preferred possible location is within the shopping centre on the corner of Castle Hill Road and Pennant Hills road. This site is located on a ridge and is visible from the surrounding residential areas. The structure would be best located within the built elements of the shopping centre, and with appropriate design it could be a suitable location.

**Zoning:** Business General 3(a)
Proximity to schools, residential areas and hospitals: The site is within foreground views of the nearest residential area, but could be appropriately designed within the commercial area to reduce its visual impact. West Pennant Hills Primary School is located adjacent. This requires further assessment of impacts

**Location P2: Pennant Hills Road and The Crescent, Pennant Hills Station**

**Visual Impacts:** This site is within close proximity to Pennant Hills Railway station and adjacent commercial properties. The residences adjacent to the site would experience high visual impacts that could be reduced by locating the structure within the commercial area, within a building.

**Vegetation:** Limited existing vegetation exists to screen the structure

**Zoning:** Residential 2(b)

Proximity to schools, residential areas and hospitals: The site is within less than 10 metres of the nearest residence, and within five hundred metres of the nearest school.

**Location P3: Old Quarry site, Future Brickyard Park**

**Visual Impacts:** The site is located within sixty metres of the nearest residence and will provide negative visual impacts. By further locating the structure within the Park and adjacent to the railway line it could be accommodated within another structure, thereby limiting its visual impacts. It could also be accommodated within potential development of the Thornleigh station, as discussed previously.

**Vegetation:** Some existing vegetation exists that can provide screening, however the alternative described previously is preferred.

**Zoning:** Public Recreation 6(b)

Proximity to schools, residential areas and hospitals: The site is located close to residential properties as described previously, within approximately 750 metres of the nearest school.

**Location P4: Pacific Highway/Lucinda Ave intersection:**

This location is on an important interchange and would be highly visible to motorists and residents.

**Visual Impacts:** The site is located on a high ridgeline. The visual catchment would potentially extend some 500 metres to the north along the existing F3, where motorists would be able to view the structure above the Pacific Highway. The structure could also be visible some 500 metres to the south along Pennant Hills Road with the lower areas screened by the surrounding trees and intervening houses.

**Vegetation:** Existing mature trees exist on this site and could provide beneficial screening to the interchange and the ventilation structure. The tunnel shafts, required to connect to this site, should be located to protect the existing tree cover.

The site is not within a National Park or open space reserve.

**Zoning:** The site is zoned for freeway purposes.

Proximity to schools, residential areas and hospitals: 8 schools and one Hospital are located within approximately one kilometre of this site. The closest residences are located approximately 55 metres away.

**Alternative Location:** Within central areas in residential precinct

This site would only be feasible if the interchange Plan C is utilised. This option would then be designed within the alternative land uses proposed in this area and could be accommodated within a building and possible Motorway Control Centre for the tunnel. This site would be an ideal strategic location for this purpose.
5.3 Blue Option

Five possible locations have been identified for the blue option. These are as follows:

**Location B1: Residential land Adjacent Eaton Road**

**Visual Impacts:** The site is located in close proximity to dense residential areas adjacent to Pennant Hills Road. The site is considered too close to these residences and would create significant visual impacts for the residents and the golf course.

**Vegetation:** Very little vegetation exists at this site, except for general garden landscaping. There is no inherent screening.

**Zoning:** Residential 2(b), owned by RTA.

**Proximity to Schools, residential areas and hospitals:** Less than 25 metres to the nearest residence and approximately one kilometre to the nearest school.

**Alternate B1 locations:** Two alternatives are possible, one within Pennant Hills Golf Course and one on Maher Close, south of the M2. Both sites are within close proximity to residential properties and would impact highly on these residents. This location will require further detailed investigation to minimise impacts on residents.

**Location B2: Same location as Option P1 described in Section 5.2.**

**Location B3: Same location as Option P2 described in Section 5.2**

**Location B4: Same location as Option P3 described in Section 5.2**

**Location B5: RTA land west of Lucinda Ave and Fox Valley Way**

This site is located on the former freeway alignment, with the preferred possible location north of Fox Valley Way.

**Visual Impacts:** This site is located on a ridgeline that is followed by Fox Valley Road also. The site will be visible from the immediate adjacent residents. These residents are within 25 metres of the site and will experience high visual impacts. The site itself is zoned for freeway purposes, however it appears as a grassed and treed park, to the surrounding residents and is used as such. There will be perceived loss of open space to the surrounding residents.

**Vegetation:** The site has some tree cover that currently provides amenity to the neighbourhood. Any disturbance to this cover should be minimised.

**Zoning:** Zoned for Freeway purposes.

**Proximity to schools, residential areas and hospitals:** This site is within approximately one kilometre of the Sydney Adventist Hospital, as well as within approximately one kilometre of a number of Primary and High schools.

**Alternative Location:** South side of Fox Valley Way: This site is close to a Kindergarten and is not preferred to Location B5. Although it is also on RTA land, the first alternative is preferable.
5.4 Yellow Option

Four possible locations have been identified for the yellow option. An additional location exists for the long route nominated as Y1. This has not been assessed. These are as follows:

**Location Y2: Same location as Option B5 described in Section 5.3**

**Location Y3: George Christie Reserve**

Visual impacts: The site is within approximately four hundred (400) metres of the nearest residence. There are walking tracks and picnic areas in the vicinity that would obtain views to the structure.

Vegetation: The site is heavily vegetated, located just off the Playing Field.

Zoning: Zoned 6(a) Open Space Public Recreation

Proximity to schools, residential areas and hospitals: Close to the residential area Schools are within approximately one kilometre away and the Adventist Hospital is also approximately one kilometre away.

Alternative Site: Two alternatives are possible, one in Bushland within Baden Powell Land, which is accessible by walking tracks, but distanced from residential areas, some four hundred and fifty (450) metres. The other is located adjacent to Thornleigh Park. The first alternative is the most remote, would impact less on residents, but provide difficulties for access. All locations need further investigation

**Location Y4: Pennant Hills Park Near Archery and Hockey Fields**

Visual Impacts: The potential visual impacts within Pennant Hills Park are high from the residential areas. The site is distanced from residential areas and would not be within foreground views of any residential area.

Vegetation: Existing vegetation would provide screening for the structure and it is important to retain all existing vegetation.

Zoning: 6(b) Public Recreation.

Proximity to Schools, residential areas and hospitals: The site is located at least one and a half (1.5) kilometres from most schools and hospitals and approximately four hundred metres to the nearest residence.

**Location Y5: Unnamed Bushland off Sutherland Road**

Visual Impacts: Residential areas opposite the Railway line off the Crescent are located some one hundred and twenty metres away and could gain views to the structure as well as potential views from properties in Epping across Devlins Creek. Walking trails in this area could also view the structure.

Vegetation: the site is heavily vegetation and would provide some screening

Zoning: 2(a) residential

Proximity to schools, residential areas and hospitals: The site is close to residential areas with the closest school and hospital approximately seven hundred and fifty (750) metres away.
5.5 Red Option

Three possible locations have been identified for the red option. These are as follows:

*Location R1:* Same location as P4 described in Section 5.2.

**Location R2: Howson Oval: Site to the east and north of the Oval**

This site is located on the northern side of the oval in adjacent bush land.

**Visual impacts:** The extent of the visual catchment for this site is from 500 metres to one kilometre. It is surrounded by residential areas with the closest residential property approximately 170 metres away, located in Howson Ave. This site is located on a ridge vegetated to the north, east and west. The Comenarra Parkway is located to the west of the site and the structure would be visible from it. Locating the structure on the side of the ridge and utilising existing vegetation as screening would reduce the visual impacts.

**Vegetation:** Dense vegetation is located within the immediate surrounds with the grassed Howson Oval to the south.

**Zoning:** The site is zoned 6(a) open space and will need to be accessed through Howson Avenue, accessing through the residential area.

**Proximity to schools, residential areas and hospitals:** The closest residential areas are approximately 170 metres away and the Sydney Adventist Hospital is one kilometre away. This site is also less than 1 kilometre from Turramurra Primary School.

There are two alternatives for this location. The first is beside Gipps Close off the Comenarra Parkway at the edge of the Twin Creeks Reserve. This is considered to be located too close to adjacent houses with little area for screening.

The second alternative is off Mimosa Road at Mimosa Oval on the eastern side within bush land. This site is less than a kilometre from Turramurra Primary School and is just over a kilometre from Pymble Ladies’ College.

**Location R3: Macquarie University Playing Fields**

This site is within the Northern edge of the Macquarie University Playing Fields.

**Visual impacts:** The Potential Visual catchment of this site includes the Lane Cove River Valley, as well as the residential areas of West Pymble located on the ridgeline and side slopes to the north-east and east, and South Turramurra, located to the north-west. Both of these areas have housing on the edges of the ridgeline with views down into the valley. The stack would be highly visible within this valley and viewed from above.

The residences located along the eastern side of Busaco Rd would also view the ventilation structure.

As this site is located on the side slopes of the Lane Cove River Valley its visual impacts on this area, of natural pursuits, as well as the recreational activities of the oval would be high. The Great North Walk is along the valley with many connecting trails located in the base of the valley. The walk extends to the north along the side slopes, linking in with Koombalah Avenue and runs along the back of Turramurra High School.

The potential visual catchment of this site could extent for two kilometres along and up the valley including many areas of housing.

**Vegetation:** The site itself is located within the centre of a cluster of trees adjacent to the two most northern ovals. A 132 kV transmission line is located adjacent to the playing fields and is a barrier between the Lane Cove National Park and the site. These towers in themselves provide a visual disruption to the natural valley however, although these towers would be similar in height they are more open and transparent.

The existing vegetation should be retained and protected and the location of the ventilation structure accommodated to utilise the screening capabilities of the vegetation, without removing it.

**Zoning:** The site zoned 5c) Special Uses. The land is owned by Macquarie University.
Proximity to schools, residential areas and hospitals: The closest residents are located some 160 metres from the site. These residents are generally within medium density housing along Busaco Rd. The residents on the other side of the valley are some 400 to 500 metres away. The main campus of the University is some 600 metres away with the most populated areas of the campus approximately 900 metres away.

Turramurra High School is located just over 525 metres to the north west of this site with West Pymble Primary School located a similar distance to the north-east of the site.

One alternative location exists for this site. It is at the end of Koombalah Ave adjacent to the Great North Walk. This site is highly visible, located on an elevated area with steep side slopes leading down to the Lane Cove Valley. The site is considered too close to the residents in Koombalah Ave. Its visual catchment would be extensive, particularly to the south, south-west and east. It would also be located closer to Turramurra High School.

5.6 Ventilation structure siting

In conclusion the siting of ventilation structures provides one of the most difficult urban design issues to resolve within the National Highway Link. The locations described in this section are indicative only and were chosen as possible sites in the general areas that a ventilation stack would be required. The location for any ventilation structure requires more detailed environmental planning, urban design and visual assessment.
Findings and Conclusions

The impacts and assessment of all of the options have been described in the previous sections. This includes the broad scale constraints associated with the urban design, landscape and visual impacts to route selection. It has also included the development of broad corridor types, along with the assessment of feasible options.

The Type A options investigated in Part C have included the Purple, Blue, Yellow and Red options. Each of these has been assessed based on the urban design principles for evaluation of each option. Some options provide more indirect positive effects, including integrated public transport benefits, development opportunities, improvements to the natural, built and community environment, as well as visual improvements.

By assessing the options against the project objectives and the urban design, landscape and visual principles, the Purple option is preferred for a number of reasons. The urban design characteristics that distinguish the Purple option include:

- The most legible northern interchange contributed to a small “land take” to accommodate the interchange.
- Acceptable southern interchange with potential for alternative layouts that would be more suitable. The Purple and Blue options’ alternative southern interchange was more acceptable from an urban design perspective and could be replaced as the Purple option’s southern interchange if the other assessments concurred with this recommendation.
- Improved southern connection at the M2 for traffic travelling further south along Pennant Hills Road, providing a better solution in terms of the metropolitan road network structure.
- The provision of an open road section in deep cut, north of Pennant Hills Road, at Hornsby Council’s future Brickyard Park. This breaks the option into two tunnels allowing natural light to be provided within this section and reducing the length of road in tunnel.
- Improvement to Pennant Hills Road with possible revitalisation, incorporating better pedestrian and bicycle amenity, improved local bus routes and potential improved streetscape.
- Potential benefits in the creation of an integrated transport network, particularly when the alternatives are considered. (Refer to Appendix B and Section 4.5-4.7).
- The Purple route has a number of alternatives that could realise additional benefits:
  - The link could be located within a shared rail corridor between Pennant Hills Station and Dartford Road, Normanhurst. This alternative had many strategic advantages including: natural light provided with the length of tunnels decreased; footprint of impacts reduced; reduced visual impacts; and reduced requirements for noise amelioration.
  - Potential connections from the tunnel to Thornleigh and Pennant Hills Stations could be included to integrate with a potential transport interchange at Pennant Hills Stations. This could provide modal split from bus to rail from destinations such as the Central Coast, Dural and Cherrybrook.
  - Integrated commuter parking at these stations could improve the potential modal split.
  - A Central access alternative between Pennant Hills and Thornleigh Stations could be provided with the road in open cut for a length of approximately 800 metres.
The provision of ramps to provide on and off connections could provide more extensive use of the tunnels for residents in Thornleigh, Cherrybrook, Westleigh and Pennant Hills due to a direct connection with the tunnel at this point.

A potential southern access alternative where the tunnel would daylight in an open trench in deep cut between Boundary Road and Beecroft Road could be provided. Similar connections for local traffic as described in the previous point.

Not all of these benefits would flow from a particular alternative, however the purple option provides the potential to incorporate various alternatives and the advantages associated with them.

Finally the ventilation structures provide the most difficult urban design issues to resolve within this National Highway link. Design principles were identified for the best siting of these structures, however in such a heavily built up area, with an almost even distribution of residences, school, hospitals and other sensitive locations for ventilation structures, the potential impacts associated with these will be high. Reducing the number of structures may help, whilst more detailed environmental planning and urban design assessment at concept design and EIS stage, should be undertaken.

It is recommended that this option be further assessed, along with it's various alternatives at concept design and Environmental Assessment.
Appendix A

Four Type A Base Options: Purple, Blue, Yellow and Red. Plans of Interchanges and Assessment Tables
### Base Option Tables: Urban Design, Landscape And Visual Principles

**Table 1A - Purple Route: Open alignment in cut along western edge of Brickyard park maximising the length in open trench and minimising the land take from the park.**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Measure</th>
<th>High (10-13)</th>
<th>Medium (14-16)</th>
<th>Low (17-20)</th>
<th>Open cut in Brickyard park</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual impacts on residents</td>
<td></td>
<td></td>
<td>✔️</td>
<td></td>
<td>17</td>
<td>Two tunnel portals would be required. These will be visible but will allow for access.</td>
</tr>
<tr>
<td>Loss of existing landscape (trees)</td>
<td></td>
<td>✔️</td>
<td></td>
<td></td>
<td>15</td>
<td>Some landscape would be lost within the park, particularly in the north before the tunnel portal.</td>
</tr>
<tr>
<td>Noise amelioration required</td>
<td></td>
<td>✔️</td>
<td></td>
<td></td>
<td>14</td>
<td>Noise walls will be required through the Brickyard Park and will impact on the park.</td>
</tr>
<tr>
<td>Extensive bridges and walls required provides high impacts. Built form dominates</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
<td>14</td>
<td>Built form intervention within the future park will be visible from the park.</td>
</tr>
<tr>
<td>Loss of open space (parks, reserves)</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
<td>13</td>
<td>Open space will be lost where the tunnel portal and road in cut occurs in the reserve adjacent to Dartford Road.</td>
</tr>
<tr>
<td>Impacts on natural pursuits, walking trails, etc</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>No major walking trails are affected, however the local park will be altered significantly by the northern portal and approach road.</td>
</tr>
<tr>
<td>Creates/isolates sterile land</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
<td>11</td>
<td>A substantial portion of the future Brickyard Park to east of the railway will be isolated by the addition of the road. This will be inaccessible and could only be used as landscaping to soften the impact of the road on grade.</td>
</tr>
<tr>
<td>Criteria</td>
<td>Measure</td>
<td>Open cut in Brickyard park</td>
<td>Comments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------</td>
<td>---------</td>
<td>-----------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential property impacts</td>
<td>✔ High</td>
<td>16</td>
<td>The impacts are on the reserve and the future Brickyard Park. Residential and commercial property impacts are minimal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severs pedestrian access and existing movement patterns</td>
<td>✔ Medium</td>
<td>18</td>
<td>A bridge will be required for Dartford Road where it crosses the route and this will retain pedestrian access.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legible motorists environment</td>
<td>✔ Medium</td>
<td>18</td>
<td>Legibility for the motorist will be similar, however the extent of carriageway in cut will be increased.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential for new landscape</td>
<td>✔ High</td>
<td>15</td>
<td>The potential for new landscape exists, however this only replaces the existing landscape that will be lost by the construction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Footprint of impacts</td>
<td>✔ High</td>
<td>14</td>
<td>The footprint of impacts is greater than the rail corridor option as it extends the impact of the road beyond existing infrastructure impacts</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total Average**  ✔ Medium 15.08
Table 1B Purple Option Northern Interchange

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Measure</th>
<th>Purple Option Northern Interchange</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual impacts on residents</td>
<td>High (10-13)</td>
<td>✔</td>
<td>Low impacts at existing intersections at Pennant Hills Road and Pacific Highway due to limit of changes over existing</td>
</tr>
<tr>
<td>Loss of existing landscape (trees)</td>
<td>Medium (14-16)</td>
<td>✔</td>
<td>Low. Tree impacts isolated to Pacific Highway on ramp, Pacific hwy south and southern edge of central island residential area</td>
</tr>
<tr>
<td>Noise amelioration required</td>
<td>Low (17-20)</td>
<td>✔</td>
<td>Low, Minimal changes in extent of noise walls required from existing interchange.</td>
</tr>
<tr>
<td>Extensive bridges and walls required provides high impacts. Built form dominates</td>
<td>✔</td>
<td>19</td>
<td>No major new structures required, except a widened on ramp</td>
</tr>
<tr>
<td>Loss of open space (parks, reserves)</td>
<td></td>
<td>✔</td>
<td>No loss of parks or open space</td>
</tr>
<tr>
<td>Impacts on natural pursuits, walking trails, etc</td>
<td></td>
<td>✔</td>
<td>None affected</td>
</tr>
<tr>
<td>Creates/isolates sterile land</td>
<td></td>
<td>✔</td>
<td>No land isolated. Access to Central area improved</td>
</tr>
<tr>
<td>Potential property impacts</td>
<td></td>
<td>✔</td>
<td>Low number of properties impacted. Some along Pacific Hwy</td>
</tr>
<tr>
<td>Severs pedestrian access and existing movement patterns</td>
<td>✔</td>
<td>19</td>
<td>Pedestrian access improved.</td>
</tr>
<tr>
<td>Legible motorists environment</td>
<td></td>
<td>✔</td>
<td>Clear motorists environment. Major change is the one way system that would require changes in motorists access in the area, that has existed for a significant period of time. This change would be short term until the new layout is learnt and becomes familiar.</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Criteria</th>
<th>Measure</th>
<th>Purple Option Northern Interchange</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential for new landscape</td>
<td>✔️</td>
<td>16</td>
<td>Potential new landscape in south of Pacific Highway adjacent to medium density and aged housing</td>
</tr>
<tr>
<td>Footprint of impacts</td>
<td>✔️</td>
<td>18</td>
<td>Small footprint concentrated at the intersections.</td>
</tr>
<tr>
<td>Total Average</td>
<td>✔️</td>
<td>17.75</td>
<td>Low</td>
</tr>
</tbody>
</table>
### Table 1C Purple Option Southern Interchange: 4 level interchange

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Measure</th>
<th>Purple Option Southern Interchange</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual impacts on residents</td>
<td>✔️</td>
<td>14</td>
<td>Medium. The two new over ridges will be visible to residents, as well as the on grade on and off ramps associated with the portals to the north west of the existing intersection.</td>
</tr>
<tr>
<td>Loss of existing landscape (trees)</td>
<td>✔️</td>
<td>15</td>
<td>Trees will be lost to the west of Pennant Hills Road north of the intersection.</td>
</tr>
<tr>
<td>Noise amelioration required</td>
<td>✔️</td>
<td>14</td>
<td>The overbridges will require additional high level noise walls.</td>
</tr>
<tr>
<td>Extensive bridges and walls required provides high impacts. Built form dominates</td>
<td>✔️</td>
<td>13</td>
<td>The impacts of the overbridges and retaining walls associated with the on and off ramps will be high. The portals will also require noise walls and associated retaining walls.</td>
</tr>
<tr>
<td>Loss of open space (parks, reserves)</td>
<td>✔️</td>
<td>17</td>
<td>No parks or reserves are lost. Some existing landscape is lost. Impacts on Pennant Hills Golf Course are minimal.</td>
</tr>
<tr>
<td>Impacts on natural pursuits, walking trails, etc</td>
<td>✔️</td>
<td>18</td>
<td>Low.</td>
</tr>
<tr>
<td>Creates/isolates sterile land</td>
<td>✔️</td>
<td>17</td>
<td>Impacts are close to the existing roads and reduce the potential for isolating land.</td>
</tr>
<tr>
<td>Potential property impacts</td>
<td>✔️</td>
<td>16</td>
<td>Medium due to property impacts to the north west of Pennant Hills Road.</td>
</tr>
<tr>
<td>Severs pedestrian access and existing movement patterns</td>
<td>✔️</td>
<td>18</td>
<td>No significant changes to existing access.</td>
</tr>
<tr>
<td>Legible motorists environment</td>
<td>✔️</td>
<td>16</td>
<td>Some cross movements required where over bridges occur.</td>
</tr>
<tr>
<td>Criteria</td>
<td>Measure</td>
<td>Purple Option Southern Interchange</td>
<td>Comments</td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------</td>
<td>------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Potential for new landscape</td>
<td>✔ Medium (14-16)</td>
<td>16</td>
<td>Medium potential to the north west of the existing interchange</td>
</tr>
<tr>
<td>Footprint of impacts</td>
<td>✔ Medium (14-16)</td>
<td>16</td>
<td>Medium. Increased footprint occurs to the north-west of the existing interchange</td>
</tr>
<tr>
<td>Total Average</td>
<td>✔ Medium (14-16)</td>
<td>15.83</td>
<td>Medium</td>
</tr>
</tbody>
</table>

Summary: Option parallels the existing roads and includes widened impacts where portals and on and off ramps are located.

**Total Assessment Purple Option**

In combining the Northern interchange, Brickyard Park area and the southern interchange and averaging the score the combined score is as follows:

- Northern Interchange: Score 17.75
- Brickyard Park Area: Score 15.08
- Southern Interchange: Score 15.83

**Average total** Score 16.22
### Table 2A Blue Option Northern Interchange: Plan B

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Measure</th>
<th>Option B</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual impacts on residents</td>
<td>&gt; 25 properties affected</td>
<td>13</td>
<td>High impacts of on ramp</td>
</tr>
<tr>
<td>Loss of existing landscape (trees)</td>
<td>✔</td>
<td>13</td>
<td>Cut and cover impacts + loss of trees at central island</td>
</tr>
<tr>
<td>Noise amelioration required</td>
<td>✔</td>
<td>13</td>
<td>Extent of existing noise amelioration is increased at Pennant Hills Road and central residential area</td>
</tr>
<tr>
<td>Extensive bridges and walls required provides high impacts, Built form dominates</td>
<td>✔</td>
<td>13</td>
<td>Oblique fly over bridges create high impacts and extent of retaining walls is high</td>
</tr>
<tr>
<td>Loss of open space (parks, reserves)</td>
<td>✔</td>
<td>17</td>
<td>Cut and cover affects this, but not zoned open space.</td>
</tr>
<tr>
<td>Impacts on natural pursuits, walking trails, etc</td>
<td>✔</td>
<td>17</td>
<td>None affected.</td>
</tr>
<tr>
<td>Creates/isolates sterile land</td>
<td>✔</td>
<td>11</td>
<td>Central area is further isolated with difficult access.</td>
</tr>
<tr>
<td>Potential property impacts – resumption or land take</td>
<td>✔</td>
<td>13</td>
<td>High quantity of properties impacted</td>
</tr>
<tr>
<td>Severs pedestrian access and existing movement patterns</td>
<td>✔</td>
<td>13</td>
<td>Existing paths affected on south of Pacific Hwy</td>
</tr>
<tr>
<td>Legible motorists environment</td>
<td>✔</td>
<td>11</td>
<td>Interchange at Pennant Hills Road and off ramp + cross overs is confusing</td>
</tr>
<tr>
<td>Potential for new landscape</td>
<td>✔</td>
<td>16</td>
<td>Additional landscape in central area</td>
</tr>
<tr>
<td>Footprint of impacts</td>
<td>✔</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td><strong>Total Average</strong></td>
<td>✔</td>
<td>164:-12=13.6</td>
<td>Medium</td>
</tr>
</tbody>
</table>
Summary: Option B retains impacts near the existing interchange. Extent of elevated structures and retaining wall is high.

**Total Assessment Blue Option**
The Blue Option shares the same southern interchange as the Purple Option included in Table 1C previously.

Northern Interchange: Score 13.60 (Sketch In06111-SK033)
Southern Interchange: Score 15.83 (Sketch In06111-SK035)

Average Total Score: 14.71
### Table 3 Yellow Option  Southern Interchange: including both eastern & western connections to M2

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Measure</th>
<th></th>
<th></th>
<th></th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual impacts on residents</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
<td>Medium impacts. Bridge over Devlins Creek will be visible to residents north of M2. Reduce extent of area above ground south of Devon St.</td>
</tr>
<tr>
<td>Loss of existing landscape (trees)</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
<td>Loss of landscape where creek line and gully is traversed.</td>
</tr>
<tr>
<td>Noise amelioration required</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
<td>New acoustic walls required adjacent to portals.</td>
</tr>
<tr>
<td>Extensive bridges and walls required provides high impacts. Built form dominates</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
<td>Bridges and portals are required, earthworks over gullies will impact on natural landscape</td>
</tr>
<tr>
<td>Loss of open space (parks, reserves)</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
<td>Impacts where off and on ramps are above ground are medium as they effect existing vegetated areas</td>
</tr>
<tr>
<td>Impacts on natural pursuits, walking trails, etc</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
<td>Minimal impacts</td>
</tr>
<tr>
<td>Creates/isolates sterile land</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
<td>One section of Devlins Creek adjacent to Beecroft Rd and the M2 will be isolated by the northbound exit from the M2.</td>
</tr>
<tr>
<td>Potential property impacts</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
<td>Impacts on Open space</td>
</tr>
<tr>
<td>Severs pedestrian access and existing movement patterns</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
<td>Access not affected</td>
</tr>
<tr>
<td>Legible motorists environment</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
<td>Middle area decision required within tunnel by motorists going east or west on M2. Decreases legibility</td>
</tr>
<tr>
<td>Potential for new landscape</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
<td>Minor areas of landscape potential</td>
</tr>
<tr>
<td>Criteria</td>
<td>Measure</td>
<td>Yellow Option Southern Interchange</td>
<td>Comments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------</td>
<td>------------------------------------</td>
<td>------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Footprint of impacts</td>
<td>✔️</td>
<td>17</td>
<td>Minor footprint of impacts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Average</td>
<td>✔️</td>
<td>179:-12=14.91</td>
<td>Medium</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Summary: Option has two areas of impacts, the northbound on ramps and the south bound off ramps that are separated some ____ metres, thereby extending the area of impacts

**Total Assessment Yellow Option**

In combining the Northern interchange and the southern interchange and averaging the score the combined score is as follows:

Northern Interchange: Score 13.60 Plan B

Southern Interchange: Score 14.91

Average total score 14.25
### Table 4 Red Route Southern Interchange

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Measure</th>
<th>Red Option Southern Interchange</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual impacts on residents</td>
<td>✔️</td>
<td>17</td>
<td>Impacts minimised as on and off ramps parallel M2</td>
</tr>
<tr>
<td>Noise amelioration required</td>
<td>✔️</td>
<td>16</td>
<td>Extent of walls is in similar alignment to M2 but closer to adjacent properties</td>
</tr>
<tr>
<td>Extensive bridges and walls required provides high impacts. Built form dominates</td>
<td>✔️</td>
<td>17</td>
<td>These structures are minimised</td>
</tr>
<tr>
<td>Loss of open space (parks, reserves)</td>
<td>✔️</td>
<td>17</td>
<td>Final impacts are low. Reduce extent of off ramp from Link to Lane Cove Rd by extending tunnels. High impacts on Macquarie University Sports Fields during construction. Loss of grandstand. Reduce the extent of cut &amp; cover if possible. Compensatory alternative Fields would be required during construction</td>
</tr>
<tr>
<td>Impacts on natural pursuits, walking trails, etc</td>
<td>✔️</td>
<td>17</td>
<td>Minimum impacts</td>
</tr>
<tr>
<td>Creates/isolates sterile land</td>
<td>✔️</td>
<td>20</td>
<td>No</td>
</tr>
<tr>
<td>Potential property impacts</td>
<td>✔️</td>
<td>18</td>
<td>The rear of properties fronting Lane Cove Rd will be impacted with carparking affected plus loss of vegetation. (Mostly commercial properties)</td>
</tr>
<tr>
<td>Severs pedestrian access and existing movement patterns</td>
<td>✔️</td>
<td>19</td>
<td>Construction impacts generally. Final impacts minimal</td>
</tr>
<tr>
<td>Criteria</td>
<td>Measure</td>
<td>Red Option Southern Interchange</td>
<td>Comments</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>------------------</td>
<td>--------------------------------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>Legible motorists environment</td>
<td></td>
<td>18</td>
<td>Interchanges are legible and avoid complicated layouts</td>
</tr>
<tr>
<td>Potential for new landscape</td>
<td></td>
<td>16</td>
<td>Narrow landscape corridor adjacent to road is available</td>
</tr>
<tr>
<td>Footprint of impacts</td>
<td></td>
<td>17</td>
<td>Extent of Impacts minimised</td>
</tr>
<tr>
<td>Total Average</td>
<td></td>
<td>209:-12=17.41 Low</td>
<td></td>
</tr>
</tbody>
</table>

Summary: Impacts generally parallel the existing M2 and therefore only increase impacts where structures are located closer to adjacent land uses. Construction impacts will occur at Macquarie University Sports Fields and should be reduced where possible, as well as eastbound link connections to M2.

Total Assessment Red Option

In combining the Northern interchange and the southern interchange and averaging the score the combined score is as follows:

Northern Interchange: Score 13.60

Southern Interchange: Score 17.41

Average total score 15.50
### Alternatives for Base Options

#### Table 5 - Red Route Bridge at Lane Cove River rather than Tunnel

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Measure</th>
<th>Red Option Bridge</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual impacts on residents</td>
<td>High number of residents affected</td>
<td>12</td>
<td>Potential impacts to residents at the end of Busaco Road (closest residents) Other impacts to residents in Koombalah Ave, Eden Ave, Robin Ave (St Turramurra) &amp; Comenarra Parkway, Haite Cl, Edenholme St, Hillary St (West Pymble)</td>
</tr>
<tr>
<td>Loss of existing landscape (trees)</td>
<td>☑</td>
<td>14</td>
<td>Construction impacts</td>
</tr>
<tr>
<td>Noise amelioration required</td>
<td>☑</td>
<td>14</td>
<td>Noise would travel across the valley</td>
</tr>
<tr>
<td>Extensive bridges and walls required</td>
<td>☑</td>
<td>12</td>
<td>Bridges would be significant in height and extent over 200 metres long with 2 associated portals</td>
</tr>
<tr>
<td>Loss of open space (parks, reserves)</td>
<td>☑</td>
<td>11</td>
<td>Impacts on the National Park would be high due to high contrast of land use and impacts on “Naturalness”</td>
</tr>
<tr>
<td>Impacts on natural pursuits, walking trails, etc</td>
<td>☑</td>
<td>13</td>
<td>High visibility from the Great North Walk &amp; alteration to character of National Park</td>
</tr>
<tr>
<td>Creates/isolates sterile land</td>
<td>☑</td>
<td>18</td>
<td>No land is sterilised, except uses under the bridge are restricted</td>
</tr>
<tr>
<td>Potential property impacts</td>
<td>☑</td>
<td>15</td>
<td>Impacts on National Park,</td>
</tr>
<tr>
<td>Criteria</td>
<td>Measure</td>
<td>Red Option Bridge</td>
<td>Comments</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>------------------------------</td>
<td>-------------------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>High (10-13)</td>
<td>Medium (14-16)</td>
<td>Low (17-20)</td>
</tr>
<tr>
<td>Severs pedestrian access and existing</td>
<td></td>
<td>✔</td>
<td>18</td>
</tr>
<tr>
<td>movement patterns</td>
<td></td>
<td></td>
<td>Access not affected</td>
</tr>
<tr>
<td>Legible motorists environment</td>
<td></td>
<td>✔</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Bridge provides high visual character for drivers, however time out of tunnel is very short</td>
</tr>
<tr>
<td>Potential for new landscape</td>
<td>✔</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Minor</td>
</tr>
<tr>
<td>Footprint of impacts</td>
<td>✔</td>
<td></td>
<td>13</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Footprint higher than tunnel option</td>
</tr>
<tr>
<td>Total Average</td>
<td></td>
<td></td>
<td>167:-12=13.91</td>
</tr>
<tr>
<td>Summary:</td>
<td></td>
<td></td>
<td>High</td>
</tr>
</tbody>
</table>

Option is less preferable to tunnel due to visual and acoustic impacts of bridge for residents overlooking the Lane Cove Valley.

Impacts on Turramurra High School minimised due to bridge’s location low in valley.

Character of the Lane Cove Valley would be changed by the intrusion of a bridge with associated acoustic barriers.
<table>
<thead>
<tr>
<th>Criteria</th>
<th>Measure</th>
<th>Purple Option</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td>Medium 14-16</td>
<td>Low (17-20)</td>
</tr>
<tr>
<td>Visual impacts on residents</td>
<td></td>
<td>✔️</td>
<td>19 Low visual impacts due to the road and rail being accommodated within the existing rail boundary, and in cut.</td>
</tr>
<tr>
<td>Loss of existing landscape (trees)</td>
<td></td>
<td>✔️</td>
<td>20 Minimal loss of landscape, if any.</td>
</tr>
<tr>
<td>Noise amelioration required</td>
<td>✔️</td>
<td></td>
<td>17 Acoustic barriers would be required along the rail boundary.</td>
</tr>
<tr>
<td>Extensive bridges and walls required provides high impacts. Built form dominates</td>
<td>✔️</td>
<td>19 Impact of built form would be limited to the bridges.</td>
<td></td>
</tr>
<tr>
<td>Loss of open space (parks, reserves)</td>
<td>✔️</td>
<td></td>
<td>20 Loss of open space minimal</td>
</tr>
<tr>
<td>Impacts on natural pursuits, walking trails, etc</td>
<td>✔️</td>
<td></td>
<td>20 No impacts</td>
</tr>
<tr>
<td>Creates/isolates sterile land</td>
<td>✔️</td>
<td></td>
<td>20 No land outside the rail corridor boundary is affected.</td>
</tr>
<tr>
<td>Potential property impacts</td>
<td>✔️</td>
<td>19 Rail property affected only</td>
<td></td>
</tr>
<tr>
<td>Severs pedestrian access and existing movement patterns</td>
<td>✔️</td>
<td>20 No affects</td>
<td></td>
</tr>
<tr>
<td>Legible motorists environment</td>
<td>✔️</td>
<td>18 The legibility of the environment would be improved by the open area in cut for approximately 3 kilometres as it could reduce the impacts of long tunnels</td>
<td></td>
</tr>
<tr>
<td>Criteria</td>
<td>Measure</td>
<td>Purple Option Shared Rail Corridor</td>
<td>Comments</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>---------</td>
<td>-----------------------------------</td>
<td>----------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Potential for new landscape</td>
<td>✔️</td>
<td>14</td>
<td>There may be potential for new landscape adjacent to the SRA boundary, however the distance is limited and it would need to be reviewed with more detailed alignments.</td>
</tr>
<tr>
<td>Footprint of impacts</td>
<td>✔️</td>
<td>20</td>
<td>Footprint limited to rail corridor</td>
</tr>
<tr>
<td>Total Average</td>
<td>✔️</td>
<td>18.83</td>
<td>Low</td>
</tr>
</tbody>
</table>
F3 TO SYDNEY ORBITAL LINK STUDY

POTENTIAL RESUMED PROPERTIES PROVIDES ADDITIONAL LANDSCAPE OPPORTUNITIES

HIGH VISUAL IMPACT OF LARGER PORTAL REQUIRES CAREFUL DESIGN RESOLUTION

GOLF COURSE LANDSCAPE & WALLS REMAIN UNAFFECTED

JOIN ACOUSTIC BARRIER TO EXISTING

LAND LOCKED BY ON RAMP PROVIDES ADDITIONAL LANDSCAPE OPPORTUNITIES

BRIDGE CREATES CLUTTERED ENVIRONMENT FOR MOTORISTS APPROACHING FROM M2 WEST REVIEW DESIGN.

BRIDGES: HIGH VISUAL IMPACT COMPLICATES THE INTERCHANGE POTENTIAL ACOUSTIC BARRIERS REQUIRED ON BRIDGES INCREASES IMPACTS

COMPLEX JUNCTIONS OF BRIDGES & ON/OFF RAMPS

POTENTIAL VIEWS TO ELEVATED BRIDGE OVER INTERCHANGE

POTENTIAL UPGRADE OF EXISTING LANDSCAPE TO INTEGRATE & SCREEN THE INTERSECTION

LEGEND

PORTAL
BRIDGE
POTENTIAL RETAINING WALL
POTENTIAL ACOUSTIC BARRIER
POTENTIAL LANDSCAPE
POTENTIAL VIEWS
POTENTIAL RESUMED PROPERTIES
PEDESTRIAN ACCESS (RED PANEL)
PEDESTRIAN ACCESS (REVERSED)
LOSS OF LANDSCAPE
ROAD IN TUNNEL
SURFACE ROAD - RAMPS AND MAIN ROADS
SURFACE ROAD - MOTORWAY

F3 TO SYDNEY ORBITAL LINK STUDY

PURPLE OPTION

SOUTHERN INTERCHANGE WITH M2 MOTORWAY

URBAN DESIGN ISSUES
F3 TO SYDNEY ORBITAL
SOUTHERN INTERCHANGE
YELLOW OPTION: EASTERN AREA

URBAN DESIGN ISSUES
Appendix B

Alternatives to Options: Descriptions, Plans of Interchanges and Assessment Tables
6.1 Interchange Alternatives

6.1.1 Northern Interchanges

**Northern Interchange Alternative Purple Option**

The works associated with this interchange includes:

**Legibility and Integration:**

The legibility of the interchange is retained with additional decision making points required north of the Pacific Highway where access around the tunnel Portal is required north and southbound. No additional overbridge structures are required, thereby reducing the potential conflicts associated with these structures at interchanges.

**Visual Impacts**

Increased visual impacts will occur where the tunnel portals and lane widening is required along Pennant Hills Rd. Some tree removal along the Pacific Hwy will also be required in this option with impact on the properties to be assessed when more detailed interchange plans are prepared.

**Connectivity and limiting future land uses:**

No land uses are limited by this option. One property on the corner of Lucinda Ave will need to be acquired. All other access to properties is to be retained.

**Landscape**

Opportunities for landscape are available at limited areas on the north of the Pacific Highway where the portals and ramps occur and to the south between the north bound and south bound lanes.

**Summary:**

This interchange has little variation in urban design, visual and landscape impacts from the previous option described. Footprints are similar, the impacts on properties and landscapes are similar. The legibility of this option, due to its closer similarity to the existing interchange, is potentially better than the previous option, however this may be a short term advantage.
Northern Interchange Alternative Blue, Yellow and Red Option

Legibility and Integration

The legibility of the interchange is complicated due to the presence of four intersections.

Pacific Highway/ F3 on and off ramps/tunnel northbound and southbound ramps

This intersection is complicated visually by the introduction of the new bridge from the Pacific Highway northbound to the F3 closer to the traffic lights to create a true diamond intersection and reduce congestion at the lights. The benefits of this bridge needs to be considered against the visual intrusion and complicated approach it creates at the Pacific Highway for south-bound traffic on the F3. Visually it will be an ugly oblique crossing of the 6 lanes of the F3.

Tunnel Link to Pacific Highway and Pennant Hills Road off ramps and Tunnel portals

This intersection has four portals. Two north and southbound portals for the tunnel, connecting to the F3, and two north and south portals for the tunnel connecting to the Pacific Highway. The latter tunnel portals will be at a higher level than the first and will require retaining walls to separate them.

The design for the interchange currently has an over bridge some 60 metres north of the portal, is required to provide south bound link between the F3 and Pennant Hills Road. The traffic benefits of this link need to be assessed.

There is the potential to provide a variation for this intersection by deleting this link, and upgrading the Pennant Hills Road and Pacific Highway interchange to include this traffic. This would remove the second over bridge and simplify this intersection and increase motorists legibility. It would also benefit the residents in this area by reducing the visual impacts of these over bridges and the associated elevated acoustic barriers that would be required.

Pacific Highway/Pennant Hills Road intersection: This intersection has two additional lanes provided that will impact on the adjacent medium density and retirement housing, by some land acquisition and loss of existing landscape, mounding and barriers.

Pacific Highway East and Northbound intersection: This intersection remains unchanged. If the option outlined in Intersection 2 is adopted then this intersection will be deleted.

Visual Impacts

The proposed interchange will result in increased visual impacts to residents and surrounding land uses due to the impacts of the over bridges and their elevated location in relation to the surrounding areas. The extent of the loss of existing landscape can be reduced if the extent of the cut and cover is reduced. This should be investigated. The options discussed previously, including removal of the over bridges would significantly improve the intersections and reduce the visual impacts.

Connectivity and Limiting future land uses:

This option currently divides the Wahroonga and Normanhurst local traffic by cutting off Eastborne Ave, with the Pacific Highway northbound exit ramp from the tunnel. The detailed engineering and interchange design will need to be reviewed to avoid this problem. It is important that the Eastborne Ave connection is retained as it caters for local traffic movements and keeps local traffic off the main roads.

The existing area, containing Aaron Place and the residential properties, bounded by the four roads at this intersection, is not changed significantly, except for widening of lanes adjacent to it in the north. The existing movement patterns are therefore not significantly affected. The existing pedestrian access located along the northern side of the Pacific Highway is interrupted.

Landscape

Limited landscape opportunities exist adjacent to the carriage ways, ramps and in narrow medians. There are few significant areas where additional landscape can be accommodated higher impacts on properties than the Purple Route interchanges assessed previously.
6.1.2 Southern Interchanges

Alternate Southern Interchange – Pennant Hills Road Interchange

This option deletes the over bridges associated with the Purple Option and replaces them with tunnels.

Legibility and Integration

The structures associated with this interchange are adjacent to the existing roads, thereby reducing the potential footprint of construction. The existing interchange is not significantly altered and the approaches to and from the portals are not complicated. The number of decision points for the motorist are minimised. The built form will consist of six portals, two located at each side of the existing intersection, (north, south and west). These are offset some distance from the intersection and will therefore avoid complications of traffic movements at the intersection. There will be retaining walls and noise barriers associated with the new ramps, however this will involve relocating noise barriers closer to the adjacent land uses, (or new barriers dependent on the design criteria).

The existing built form in this area, associated with the existing roads and the interchange, already impacts on the surrounding land uses. The addition of the lanes and ramps required extends these impacts, but does not impact on natural open space, parks or significant landscape areas. Some impacts on the boundary of Pennant Hills Golf Course will occur with the construction of the portal in this location.

Visual Impacts

The visual impacts will result principally from the additional portals and ramps. Generally these will be located adjacent to the road closer to the existing land uses and will require some property acquisition. The existing noise barriers would be relocated, providing higher impacts on the adjacent properties.

Connectivity and limiting future land uses

No areas of land are isolated by this option, nor does the configuration of the interchange limit future land use or development opportunities.

Landscape

Some existing landscape will be affected by this option, with minor areas available for additional landscape. Pennant Hills Road is urban in character and has little landscape treatment at present. The areas of property acquisition may allow for a greater ‘greening’ of Pennant Hills Road.

This alternative option impacts less on the residents and motorists alike providing a more legible, less intrusive interchange. This is due to the absence of overbridges, that complicate the traffic movements and visually cause confusion. The tunnels remove the traffic from the intersection and locate them underground thereby reducing the impacts of traffic on the existing intersection.
### Alternatives for Northern and Southern Interchanges, including option alternatives

**Table 7 Alternative Purple Northern Interchange Plan L**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Measure</th>
<th>Purple Option Alternate Northern Interchange</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High (10-13)</td>
<td>Medium (14-16)</td>
<td>Low (17-20)</td>
</tr>
<tr>
<td>Visual Impacts on residents</td>
<td>✔️</td>
<td></td>
<td>✔️</td>
</tr>
<tr>
<td>Loss of existing landscape (trees)</td>
<td>✔️</td>
<td></td>
<td>✔️</td>
</tr>
<tr>
<td>Noise amelioration required</td>
<td>✔️</td>
<td></td>
<td>✔️</td>
</tr>
<tr>
<td>Extensive bridges and walls required provides high impacts. Built form dominates</td>
<td>✔️</td>
<td></td>
<td>✔️</td>
</tr>
<tr>
<td>Loss of Open Space (parks, reserves)</td>
<td>✔️</td>
<td></td>
<td>✔️</td>
</tr>
<tr>
<td>Impacts on natural pursuits, walking trails, etc</td>
<td>✔️</td>
<td></td>
<td>✔️</td>
</tr>
<tr>
<td>Creates/isolates sterile land</td>
<td>✔️</td>
<td></td>
<td>✔️</td>
</tr>
<tr>
<td>Potential property impacts</td>
<td>✔️</td>
<td></td>
<td>✔️</td>
</tr>
<tr>
<td>Severs pedestrian access and existing movement patterns</td>
<td>✔️</td>
<td></td>
<td>✔️</td>
</tr>
<tr>
<td>Legible motorists environment</td>
<td>✔️</td>
<td></td>
<td>✔️</td>
</tr>
<tr>
<td>Potential for new landscape</td>
<td>✔️</td>
<td></td>
<td>✔️</td>
</tr>
<tr>
<td>Criteria</td>
<td>Measure</td>
<td>Purple Option</td>
<td>Comments</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------</td>
<td>---------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>High (10-13)</td>
<td>Medium (14-16)</td>
<td>Low (17-20)</td>
</tr>
<tr>
<td>Footprint of Impacts</td>
<td>✔</td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Total Average</td>
<td>✔</td>
<td></td>
<td>✔</td>
</tr>
</tbody>
</table>
### Table 8 Alternative Blue, Yellow and Red Route Northern Interchange

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Measure</th>
<th>High (10-13)</th>
<th>Medium (14-16)</th>
<th>Low (17-20)</th>
<th>Alternate Blue/Yellow/Red Northern Interchange</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual Impacts on residents</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>Impacts of the new bridges(elevated views)</td>
</tr>
<tr>
<td>Loss of existing landscape (trees)</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td>14</td>
<td>Large loss of trees to cut and cover section</td>
</tr>
<tr>
<td>Noise amelioration required</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>Existing extent of noise amelioration retained. Walls closer to residents on south-east in particular</td>
</tr>
<tr>
<td>Extensive bridges and walls required provides high impacts. Built form dominates</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td>14</td>
<td>Bridges required provide high impacts</td>
</tr>
<tr>
<td>Loss of Open Space (parks, reserves)</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td>17</td>
<td>Cut and over area requires disturbance to landscape, but not zoned open space</td>
</tr>
<tr>
<td>Impacts on natural pursuits, walking trails, etc</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td>17</td>
<td>None affected</td>
</tr>
<tr>
<td>Creates/isolates sterile land</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td>17</td>
<td>Minimal change to existing</td>
</tr>
<tr>
<td>Potential property impacts</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td>17</td>
<td>Minor</td>
</tr>
<tr>
<td>Severs pedestrian access and existing movement patterns</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td>15</td>
<td>Northern side; pedestrian patters affected</td>
</tr>
<tr>
<td>Legible motorists environment</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Potential for new landscape</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td>14</td>
<td>Areas include; narrow areas adjacent ramps</td>
</tr>
<tr>
<td>Footprint of Impacts</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td>14</td>
<td>Existing footprint increased by 1/3 due to cut and cover</td>
</tr>
<tr>
<td><strong>Total Average</strong></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td>15.41 medium</td>
<td></td>
</tr>
</tbody>
</table>

Summary: this option retains the impacts near the existing interchange. Elevated bridges, particularly the northbound exit ramp and southbound exist ramp to Pennant Hills Rd will require crossing of several lanes, as flyovers, and will be ugly and visually intrusive.
<table>
<thead>
<tr>
<th>Criteria</th>
<th>Measure</th>
<th>Alternates Purple/Blue Southern Interchange</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High (10-13)</td>
<td>Low (14-16)</td>
<td></td>
</tr>
<tr>
<td>Visual Impacts on residents</td>
<td>✔</td>
<td>16</td>
<td>Medium impacts Properties south of the M2 will be impacted by the two new portals. Properties north on Pennant Hills Rd will be impacted, and properties west on the M2 will be impacted. However the existing impacts of this interchange are already high.</td>
</tr>
<tr>
<td>Loss of existing landscape (trees)</td>
<td>✔ ✔</td>
<td>17</td>
<td>Loss of landscape only occurs where routes parallel the existing roads, creating initial impacts prior to growth of new landscape.</td>
</tr>
<tr>
<td>Noise amelioration required</td>
<td>✔</td>
<td>16</td>
<td>New acoustic walls required adjacent to portals, similar to existing.</td>
</tr>
<tr>
<td>Extensive bridges and walls required provides high impacts. Built form dominates</td>
<td>✔</td>
<td>17</td>
<td>Portals and retaining walls create the most impacts, however these are isolated &amp; concentrated in one area.</td>
</tr>
<tr>
<td>Loss of Open Space (parks, reserves)</td>
<td>✔</td>
<td>19</td>
<td>Impacts to Pennant Hills Golf Course boundary on the north western side occur.</td>
</tr>
<tr>
<td>Impacts on natural pursuits, walking trails, etc</td>
<td>✔</td>
<td>19</td>
<td>Minimal impacts.</td>
</tr>
<tr>
<td>Creates/isolates sterile land</td>
<td>✔</td>
<td>20</td>
<td>No areas are isolated.</td>
</tr>
<tr>
<td>Potential property impacts</td>
<td>✔</td>
<td>17</td>
<td>Properties on Pennant Hills Rd affected southwest and north west of the M2. Properties immediately south of the interchange are also affected.</td>
</tr>
<tr>
<td>Severs pedestrian access and existing movement patterns</td>
<td>✔</td>
<td>19</td>
<td>Access not affected.</td>
</tr>
<tr>
<td>Legible motorists environment</td>
<td>✔</td>
<td>18</td>
<td>Existing interchange is not altered significantly. Decision making at Ports is required, however this is legible.</td>
</tr>
<tr>
<td>Potential for new landscape</td>
<td>✔</td>
<td>16</td>
<td>Minor areas of landscape potential.</td>
</tr>
</tbody>
</table>
### Criteria Evaluation Table

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Measure</th>
<th>Alternate Purple/Blue Southern Interchange</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Footprint of Impacts</td>
<td>✔️</td>
<td>17</td>
<td>Minor footprint of impacts</td>
</tr>
<tr>
<td>Total Average</td>
<td>✔️</td>
<td>211:-12=17.58</td>
<td>Low</td>
</tr>
</tbody>
</table>

#### Summary:
Option parallels the existing roads and includes widened impacts where ports and on and off ramps are located. The extent of impact is isolated to occur adjacent to existing and thereby increases the existing impacts on the same land uses.
Appendix C
Landscape Sketches of Potential Interchanges
Northern interchange: Plan of Pacific Highway/F3 Potential Intersection for Purple Option. Note refer to the section line marker above for the location where the sections on the following page are taken.
Character of existing interchange includes native landscape trees continuing the native character of the existing F3. This should be retained and reinforced. Built elements should be subservient to the landscape character.

**ELEVATION EXISTING SITUATION**

**Northern Interchange: F3/Pacific Highway existing section looking south**

*Retain existing trees at on ramps*
*Retain existing trees at off ramps*
*Sloped planting to meet portal*

Key design considerations at portal approach:
- Safety & comfort
- Legibility
- Clear views are retained
- Open driver perception at entrance to tunnel

**ELEVATION TUNNEL PORTAL LOOKING SOUTH**

Opportunity for large landscaped area over tunnel to the front face of the existing Pacific Highway bridge. Ensure the tunnel approaches are wide to reduce the perception of approaching a “Black Hole”.

All built elements should be simple, with clean lines and uncomplicated architectural elements. Portal should be rectangular, clean and uncluttered. Retaining wall finish should be complimentary to the portal with some detailing to match existing walls and reduce the visual impact of these walls.

**Northern Interchange: F3/Pacific Highway section of potential treatment looking south**
Southern Interchange: Pennant Hills Road existing section looking north

Southern Interchange: Pennant Hills Road section of potential treatment looking north
BIBLIOGRAPHY

DMR. 1987 Freeway F3 to Freeway F2 Connection - Concept Report
Kinhill Pty Ltd. 1998. Sydney- Newcastle Corridor Futures.
RTA. F3 Freeway-M2 Motorway Tunnel Link Pre-Feasibility Study