Northern Beaches Hospital Connectivity and Network Enhancement Project Urban and Landscape Design Report
NBHRDC-0000-UD-170A

Prepared for:
Roads and Maritime Services

Prepared by:
AECOM Australia Pty Ltd and Ferrovial York Joint Venture

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1. Introduction

1.1 Background

Roads and Maritime Services (RMS) are undertaking road corridor works to enhance the road network connectivity in the proposed Northern Beaches Hospital (NBH) precinct in Frenchs Forest. Due to the scale of the works the New South Wales (NSW) State Government has identified the project as being State Significant Infrastructure (SSI). The connectivity and network enhancement works are to be implemented over two stages:

• Stage One – connectivity and enhancement including surface works and intersection upgrades on Forest Way, Frenchs Forest Road (east and west), Wakehurst Parkway and the eastern end of Warringah Road (Planning Approval - dated 29 June 2015)
• Stage Two – connectivity and enhancement works associated with improving traffic movements chiefly along Warringah Road and improving pedestrian / cyclist connection along and across Warringah Road. (Planning Approval dated 25 February 2015)

This geographic split for the project is illustrated in Figure 1.

1.1.1 Approval Process

Consistent with State Government requirements for SSI planning for the project required preparation of an Environmental Assessment (split over two stages). As part of this process an Urban Design Report and Landscape Character and Visual Impact Assessments were undertaken to inform the development of a reference concept design for stages 1 and 2.

An environmental impact statement (EIS) was placed on public exhibition in October 2014 which described and assessed the Concept Proposal at a strategic concept level and provided a more detailed environmental assessment of the Stage 1 Project. The Concept Proposal and Stage 1 Project were approved on 29th June 2015. Construction work to build the Stage 1 Project is anticipated to commence by the end of 2015.

The Environmental Impact Assessment (EIS) was for Stage 2 was placed on public display for community and stakeholder feedback from 22 July to 21 August 2015. The Stage 2 Submissions Report was completed in November 2015. Stage 2 of the Project was approved on the 25 February 2016.

In parallel to this process Roads and Maritime sought tenders for the detailed design and construction delivery of the Project for both Stages 1 and 2. The Ferrovial York Joint Venture (FYJV) was successful and awarded the project design and construction in June 2015. AECOMs Design + Planning team are providing the integrated urban and landscape design for FYJV.
1.2 Purpose of this Report

This report is the guiding document that demonstrates the adherence to and implementation of:

- The requirements of Exhibit A – Scope of Works and Technical Criteria Appendix B11 – Urban Design and Landscaping
- The Secretary’s Conditions of Approval for the Northern Beaches Hospital Connectivity and Network Enhancements – Concept Proposal and Stage 1 dated 29th of June 2015
- The Secretary’s Conditions of Approval for the Northern Beaches Hospital Connectivity and Network Enhancements – Stage 2 dated 25th of February 2016
- Infrastructure Sustainability Council of Australia (ISCA) credit points compliance for urban design and landscape elements (Refer Appendices)
- Consistency with Northern Beaches Hospital Connectivity and Network Enhancements - Urban Design Report and Landscape Character and Visual Impact Assessment Stage 1 (Spackman Mossop Michaels 17.10.2014)
- Consistency with Northern Beaches Hospital Connectivity and Network Enhancements - Urban Design Report and Landscape Character and Visual Impact Assessment Stage 2 (Spackman Mossop Michaels 06.07.2015)
- Submissions and Preferred Infrastructure Report (including revised safeguards and management measures)
- The FYJV tender Urban and Landscape Design

The report is structured so as to demonstrate the integrated design response and clear adherence to the key documents listed above.

The detailed design drawings will represent the strategies and approaches outlined in the report.

1.3 Urban Design Guidance

The following guidelines, policy documents and design reports have been reviewed and considered in the preparation of the Urban Design and Landscape Plan.

1.3.1 General Design and Policy Guidance

- Beyond the Pavement (Roads and Maritime Services, 2014)
- Bridge Aesthetics (Roads and Maritime Services, 2012)
- Noise Wall guidelines (RTA, 2006)
- Shotcrete Design Guidelines (RTA, 2005)
- Landscape Guidelines (RTA, 2008)
- Designing to Minimise Vandalism (Final Draft) - (RTA, 2008)
- Guidelines for Batter Surface Stabilisation using vegetation (Roads and Maritime Services, 2015)
- Biodiversity Guidelines – Protecting and managing Biodiversity on RTA projects (Roads and Maritime Services, 2011)

1.3.2 Project Specific Design Guidance

- Northern Beaches Hospital Concept Proposal and Stage One EIS – Urban Design Report and Landscape Character and Visual Impact Assessment (Spackman Mossop Michaels for Roads and Maritime, 2014)
- Northern Beaches Hospital Connectivity and Network Enhancement Works – Urban Design and Landscape Reference Concept Report (Spackman Mossop Michaels for Roads and Maritime Services, October 2014)
- Northern Beaches Hospital Precinct Supporting Road Network Urban Design Framework (KI Studio for Roads and Maritime Services, September 2013)
- Shaping our future, transport and health investment (SHOROC, 2010)

1.3.3 Warringah Council (now Northern Beaches Council) Design Guidance

- Public Spaces Design Guidelines (Warringah Council, 2014)
- Warringah Council Local Environmental Plan (Warringah Council, 2011)
- Warringah Bike Plan (Warringah Council, 2010)
- Frenchs Forest Structure Plan (Warringah Council, 2014)
- Draft Street Tree Planting Policy (Warringah Council, 2013) - adopted August 2013
1.4 Conditions of Approval

The Conditions of Approval have been issued in two stages for the project. Within those conditions there are particular conditions which relate to Urban Design and Landscape. These conditions and the associated section of the report where compliance is demonstrated are outlined in Table 1 (For Stage 1) and Table 2 (for Stage 2).

As an integrated project, urban and landscape design contribute to meeting the conditions of approval in other discipline areas of Soil, Water and Hydrology, Heritage, Transport and Access, Biodiversity and Utilities and Services.

Table 1 Stage 1 Conditions of Approval relating to Urban Design and Landscape

<table>
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<th>Condition</th>
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<td>B28</td>
<td>Section 2.2 + Appendix C</td>
<td>Detailed summary is provided in Appendix C</td>
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<td>B29</td>
<td>Section 1.3</td>
<td>No exposed shotcrete is proposed as part of the project design</td>
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<td>B30</td>
<td>Section 1.3, Section 6.2 and Appendix E</td>
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### Table 1 Stage 1 Conditions of Approval relating to Urban Design and Landscape

- **The Proponent, in consultation with the Council, shall where feasible and reasonable, implement the urban design objectives and principles, giving consideration to the design strategies and mitigation measures identified in Northern Beaches Hospital Connectivity and Network Enhancements: Concept Proposal and Stage 1 Urban Design and Landscape Character and Visual Impact Assessment Spackman Mossop and Michaels, October 2014. Where an urban design principle or objective is not considered feasible or reasonable, this will be clearly demonstrated to the Secretary in conjunction with the submission of the Urban Design and Landscape Plan required by condition B30.**

- **The use of visible shotcrete for retaining walls and other structures is not permitted, unless approved by the Secretary through the Urban Design and Landscape Plan required by condition B30.**

- **Prior to the commencement of permanent built works and/ or landscaping, or as otherwise agreed by the Secretary, an Urban Design and Landscape Plan shall be prepared and implemented (following approval) for the SSI. The Plan shall be prepared by suitably qualified and experienced person(s), in consultation with the Council, Health Infrastructure, educational facilities and the community, for the approval of the Secretary. The Plan shall present an integrated urban and landscape design for the SSI, and shall include, but not necessarily be limited to:**
  - identification of design objectives, principles and standards based on:
    - local environmental values; Section 2.1
    - urban design context; Section 2.1
    - sustainable design and maintenance; Section 2.2 + Section 6.4
    - community safety, amenity and privacy, including ‘safer by design’ and crime prevention through environment design principles where relevant; Section 2.2 + Section 6.4
    - relevant design standards and guidelines (including consideration of Council standards and guidelines where feasible and reasonable); and Section 1.3
    - the requirements of condition B28, Section 1.3
  - the location of existing vegetation, a description of disturbed areas (including compounds) and details of the strategies to progressively revegetate these areas; Section 2.3
  - proposed landscaping (including use of endemic and advanced tree species where practicable). Details of species to be replanted/ revegetated shall be provided, including their appropriateness to the area and habitat for threatened species (including rehabilitation of riparian and Duffy’s Forest ecological community vegetation); Section 6.1, 6.2 + 6.3 + Appendix E
  - the provision of a Seed Collection and Revegetation Strategy, to ensure seed from flora within Duffy’s Forest ecological community, where feasible and reasonable, are collected and species identified and used to progressively rehabilitate, regenerate and/ or revegetate these areas with the assistance and involvement of key community and land or bush care groups in the area, where practicable; Section 1.3, Section 6.2 and Appendix E
### Condition

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<td>Form, materials and finishes are described for each of the elements</td>
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<td>Section 8 - Noise Walls</td>
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<td>(f) an assessment of the visual screening effects of existing vegetation and the proposed landscaping and built elements. Where receivers have been identified as likely to experience high visual impact as a result of the SSI, the Proponent shall in consultation with affected receivers, identify opportunities for providing at-receiver landscaping to further screen views of the SSI. Where agreed to with the landowner, these measures shall be implemented during the construction of the SSI;</td>
<td>Section 2.3</td>
<td>Areas likely to experience high visual impact is based on the EIS assessment outlined in the Northern Beaches Hospital Connectivity and Network Enhancements: Concept Proposal and Stage 1 Urban Design and Landscape Character and Visual Impact Assessment Spackman Mossop and Michaels, October 2014</td>
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<td>(g) graphics such as sections, perspective views and sketches for key elements of the SSI, including, but not limited to built elements of the SSI;</td>
<td>Section 3.4 - Artists Impressions Sections 3, 4, 5, 7 and 8 as covered under item (e)</td>
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<td>(h) monitoring and maintenance procedures for the built elements, rehabilitated vegetation and landscaping (including weed control) including performance indicators, responsibilities, timing and duration and contingencies where rehabilitation of vegetation and landscaping measures fail; and</td>
<td>Section 6.5 + Appendix E - Vegetation Management Plan</td>
<td>The safe management maintenance of built elements will be considered in the Detailed Design process and is part of the Safety In Design Quality Assurance Procedures. All built elements will meet the durability requirements specified in the Project Documents.</td>
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<td>(i) evidence of consultation with stakeholders on the proposed urban design and landscape measures prior to its finalisation.</td>
<td>Section 1.4 Table 3</td>
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<td>D8 The ongoing maintenance of urban design and landscaping items and works implemented as part of this SSI approval shall remain in the Proponent’s responsibility unless satisfactory arrangements have been put in place for the transfer of ownership to another authority. The proponent will maintain items and works to the standards established in the Urban Design and Landscape Plan required under condition B30, unless and until landscaping items have been transferred.</td>
<td>Appendix E - Vegetation Management Plan</td>
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Table 2 Stage 2 Conditions of Approval relating to Urban Design and Landscape

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<td>Section 6.5 + Appendix F - Vegetation Management Plan</td>
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1.5 Stakeholder Consultation Register

Consistent with the Conditions of Approval the urban design and landscape report has been prepared with inputs from key stakeholders. A register of this consultation is listed in Table 3.

Table 3  Stakeholder Consultation involving FYJV urban design team involvement

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic area</th>
<th>Stakeholders Represented</th>
<th>Urban Design Landscape objectives</th>
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<tr>
<td>21/07/2015</td>
<td>Community Information Evening specifically for residents in and around Karingal Crescent to explain the pending EIS and issues related to the proposed noise wall.</td>
<td>Community, RMS and FYJV</td>
<td>To better understand community concerns related to the proposed noise wall</td>
</tr>
<tr>
<td>03/08/2015</td>
<td>Forest High School works coordination and confirm extent of property works adjustments</td>
<td>Department of Education, RMS, FYJV</td>
<td>Clarify expectations for urban and landscape elements within the scope of property adjustments</td>
</tr>
<tr>
<td>28/09/2015</td>
<td>Meeting with Warringah Council confirming Council interface for review of design packages for utilities, drainage, road alignment and urban design related to Stage 1 works area</td>
<td>Warringah Council (now Northern Beaches Council), RMS, FYJV</td>
<td>Confirm Council review requirements and process for Urban and Landscape Design Packages</td>
</tr>
<tr>
<td>16/12/2015</td>
<td>Meeting and site walk through of Frenchs Forest High School to photographic and better understand the detailed scope of works</td>
<td>Forest High School (School Principal), FYJV</td>
<td>Confirm scope, school functions and objectives, make adjustments to current civil concept and refine design</td>
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NOTE: CONSULTATION WILL CONTINUE FOLLOWING ISSUE OF THIS REPORT AND BE REGISTERED IN ROADS AND MARITIME CONSULTATION MANAGER SYSTEM
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2. Urban Design and Landscape

2.1 Local and regional context

The Project area is situated in the suburb of Frenchs Forest in the Northern Beaches area of Sydney. This broader area encompassing the suburbs of Forestville, Frenchs Forest, Belrose, Davidson, Killarney Heights, Terry Hills and Duffs Forest is colloquially known as ‘the Forest’. This context is illustrated in Figure 2. The area is located within the Warringah Council local government area. The main surrounding road network includes:

- Warringah Road (between Courtley Road and Maxwell Avenue)
- Wakehurst Parkway, which has intersections with both Frenchs Forest Road and Warringah Road
- Forest Way, which has intersections with both Naree Road (Frenchs Forest Road West) and Warringah Road
- Frenchs Forest Road which runs parallel with Warringah Road connecting with Forest Way to the west and Allambie Road to the east.

2.1.1 Local environmental values

Within the Project area the natural features of the existing environment are summarised below.

Vegetation

The broader area includes extensive remnant bushland and reserves including:

1. Brick Pit Reserve, Frenchs Forest
2. Nandi Reserve, Frenchs Forest
3. Jindabyne Reserve, Frenchs Forest
4. Beacon Hill Reserve, Beacon Hill
5. Forestville Reserve, Forestville
6. Aquatic Reserve, Frenchs Forest

These areas are visually connected into the broader areas of Garrigal and Ku-ring-gai Chase National Parks. These areas are illustrated in Figure 2.
Biodiversity impacts, especially associated with the Duffys Forest Ecological Community (DFEC) are a very important consideration. The study area is located in a Priority 1 Wildlife Corridor identified by Warringah Council and contains habitat for a number of threatened fauna and flora species. There are two native vegetation associations identified in the area, the Sydney Ironstone Bloodwood-Silver Ash Forest and the Coastal enriched sandstone dry forest. (Source Biodiversity Assessment Report – SMEC, 2014)

Geology and soils
Hawkesbury Sandstone is the underlying geology. Across the site there is evidence of exposed sandstone outcrops while in others there are deeper areas of shale derived clays. Shale areas can be observed as supporting generally larger tree specimens.

Landform and topography
Warringah Road generally follows the east-west ridge line. These are intersected by two ridge lines running north-south; one at Hilmer Street and the other near the intersection of Warringah Road and Rodborough Road. The drainages between these ridge lines quickly form steep gullies to the north and south of the project area.

Climate
The proximity to the coast and the higher elevations (150m AHD at the intersection of Hilmer Street at Warringah Road) provide for a slightly wetter and milder climate when compared to other parts of Sydney.

Hydrology & Drainage
The catchments formed by the ridge lines drain to the Narrabeen Lakes catchment to the north or the Bantry Bay / Manly Dam catchment to the south.

The natural landform and topography features are illustrated in Figure 3.

Warringah – interpretations “signs of rain”, “across the waves” and “sea”.
2.1.2 Urban design context

Within the Project area the built (functional) and community features of the existing environment are summarised below.

Transport network
Warringah Road is the main arterial road in the region. It links Chastwood and the Pacific Highway to the south west, and Dee Why to the east. Wakehurst Parkway connects the Narrabeen region through to Manly and the Spit, while Forest Way connects Terry Hills, St Ives and Mona Vale from the north. A number of bus services utilise this route, connecting the various local and regional centres and future transport planning includes provision for bus rapid transit (BRT) corridor along Warringah Road.

Pedestrian / cycle network
The existing pedestrian network generally consists of 1.2m – 1.5m wide pathways along Frenchs Forest Road (east + west) and Warringah Road. There are no formal bicycle facilities other than the use of roads, footpaths and bus lanes. A partially complete off-road connection exists from Warringah Aquatic Centre to Bantry Bay Road.

Land use
The land uses in the area are a mix of residential, commercial retail, industrial and community (school and health). The new Northern Beaches Hospital precinct will have a strong influence on the future land development. The study area falls within the NSW Department of Planning and Environment structure plan for a future specialised centre based around the hospital.

These key functional and community features are illustrated in Figure 4.
2.1.3  Natural environment potentials and constraints

An appreciation of the existing and unique characteristics of the landscape is important in developing a thorough understanding of the opportunities and constraints for an integrated design solution.

Landscape character

As a natural environment / landscape response there are three distinct landscape typologies.

• The bushland corridor
• The forest parkway
• The evolving suburban street

These three broad landscape typologies are illustrated in Figure 8.

The Bushland Corridor

This landscape typology is characterised by:

• Full structure landscape of tree canopy, mid storey, understorey and ground covers
• Naturalistic landscape (minimal modifications)
• High species diversity
• Dense visual screen
• High habitat value
• Natural rocky outcrops are visible

The Forest Parkway

This landscape typology is characterised by:

• Modified natural landscape
• Open forest landscape, large canopy trees with grass and / or ground cover understorey
• Trunks provide a strong visual presence and reinforce seasonal change (e.g. Angophora costata specimens with pinks, salmon and red trunk transitions)

The Suburban Street

This landscape typology is characterised by:

• Highly modified landscape
• Canopy and understorey of grass
• Mix of remnant native trees and introduced cultural plantings
• Forest trees as the overall dominant element

The existing character of these three landscape typologies are illustrated in Figures 5 through 7.
Landscape as a structuring element

The dominant nature of ‘the forest context’ provides a structuring element to inform the development of the concept design. The three distinct landscape typologies are considered in terms of a hierarchy. The dominant movement is considered to be the Wakehurst Parkway / Duffys Forest Ecological Community (DFEC). Figure 8 illustrates the broader landscape typologies and the hierarchy. Opportunities to reinforce these three landscape typologies are outlined below.

**Bushland Corridor**
- In impacted areas re-establish full structure planting
- Use a species mix consistent with the DFEC
- Minimise impacts of infrastructure on the DFEC
- For retaining structures facing the corridor use natural materials informed by local geology

**Forest Parkway**
- Minimise impacts on the existing trees (where possible)
- Maximise the space for tree planting
- Use a mix of low growing understorey and or turf grass to reinforce open ‘forest’ nature of parkway landscape

**Suburban Street**
- Wrap bushland corridor into interface with Wakehurst Parkway
- Seek opportunities for planting of street trees (coordinated with utilities and circulation requirements) and private residences.

The constraints on new landscape works include:
- General increase in overall project footprint width
- Existing topography and steep slopes
- Clear zone requirements
- Shared path widths
- Utilities, both above ground and below ground
- Availability of land for upgrade works

Figure 8 The three landscape typologies within the project area
2.1.4 Built (functional) and community environment potentials and constraints

Within the study area the built (functional) and community opportunities are highlighted under two key categories of circulation, access and amenity.

Circulation and access

As a fundamental focus for the provision of new infrastructure is an improvement in the circulation and access for local community. Opportunities to improve circulation and access include:

• Implementation of a pedestrian and shared path system consistent with the Warringah Council (now Northern Beaches Council) Strategies (Public Spaces Design Guidelines - Warringah Council, 2013)
• Providing safe access across the corridor and connecting people with where they need to go
• Applying the principles of Crime Prevention Through Environmental Design (CPTED) to the layout of elements
• Integrating bus stop locations with the circulation system to maximise ease of access
• Integrating with the new shared path access between the Northern Beaches Hospital Precinct and Forest High School

Amenity

The design elements (shared path bridges, noise walls, retaining walls, lighting) in combination with the landscape works should provide high quality amenity. Opportunities include:

• Providing distinctive shared path bridges that celebrate access and connectivity
• Shade (micro-climate enhancement) for users
• Well detailed interfaces and transitions
• Integrated lighting
• Deep and healthy soil zones for tree, shrub and ground cover planting to provide a well vegetated corridor where vegetation can thrive.

The constraints on new landscape will include:

• General increase in overall project footprint width
• Clear zone requirements
• General grades and slopes in the project area
• Availability of land for upgrade works
• Utilities, both above ground and below ground.

The integration of the current circulation network, the proposed upgrade works and the broader Warringah Council (now Northern Beaches Council) planned networks are illustrated in Figure 9.
2.2 Urban design objectives

The FYJV’s Design provides a project that is physically and visually integrated within its surrounding environment, enhances community connectivity and engages the road user with the unique and defining characteristics of the local context. This is consistent with the vision outlined in the ‘Northern Beaches Hospital Connectivity and Network Enhancements: Concept Proposal and Stage 1 Urban Design and Landscape Character and Visual Impact Assessment’, Spackman Mossop Michaels, October 2014. Appendices C (Stage 1) and D (Stage 2) include a full listing of the EIS framework and objectives and recommended concept design strategies and outline the extent to how these have been implemented in the FYJV design.

The integrated urban design outcome delivers:

- A landscape ‘forest’ legacy
- Improved connectivity for local community that is adaptable to future growth
- A distinctive, expressive and integrated driving experience

The core concept design objectives are to maximise the opportunities for sustainable and resilient landscape planting that:

- Minimises the initial visual impacts of the project
- Establishes a long term legacy that integrates the corridors back into the broader regional ‘Forest’ landscape character
- Improves access and connectivity across and along the project corridors for the local community by providing safe, legible and engaging public domain
- Provides road users with a safe, engaging and enjoyable driving experience
- Provides a circulation network that will cater to future growth and change for the evolving Frenchs Forest Specialised Centre

The Design adopts a range of design principles which are derived from these five core objectives. These principles relate to:

- Safety and operational efficiency
- Landscape maintenance
- Minimising ecological impacts

FYJV’s high level strategy is illustrated in Figure 10 which demonstrates the integration of the landscape context and the new infrastructure elements.

“Optimise the design to provide an urban design and landscape outcome that complements the surrounding natural, built and community environment.”

Exhibit A – SWTC 1.2 Project Objectives -specific project objectives (page 11 of 64)
2.3 The design concept

The key infrastructure elements associated with the ‘slot’ structure are an integrated component part and are informed by reference to the landscape typology.

The objectives for the infrastructure elements associated with the slot include:

• Reinforcing the landscape typologies
• Celebrating access and circulation
• Providing a gateway element to the Northern Beaches
• Providing safe, legible access across the corridor
• Providing road users with a safe, engaging and enjoyable driving experience

A concept sketch of the core family of road infrastructure items is illustrated in Figure 11. Further details on the design of the shared path bridges, overpasses and slot structure walls are illustrated in Section 3.0.
2.4 Visual Impact Stage 1 Works

As part of the Stage 1 Approvals Process an Urban Design Report and Landscape Character and Visual Impact Assessment was prepared by Spackman Mossop Michaels, October 2014 which formed part of the EIS Submission.

Condition of Approval B30 (e) requires an assessment of the visual screening effects of the existing vegetation and the proposed landscaping and built elements. The visual impact assessment summary for Primary Visual Catchment Zone (PVCZ) is illustrated in Figure 12. Receivers in this context include both road users and adjacent residents.

Naree Road is identified as a high impact and Frenchs Forest Road West and Wakehurst Parkway are rated as a high to moderate impact.

Due to corridor width, above ground utilities, setbacks and mandated pedestrian pathway widths, very little opportunity exists for at receiver landscaping to screen the SSI. Refer Figure 13.

**Receivers in the HIGH impact zone of Naree Road will be consulted as part of the Communications and Property adjustments works to identify and agree on any landscaping measures to further screen the SSI.**

---

**Table: Visual Impact Assessment**

<table>
<thead>
<tr>
<th>VAP</th>
<th>Sensitivity</th>
<th>Magnitude</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 Skyline Shops</td>
<td>Moderate</td>
<td>Moderate</td>
<td>MODERATE</td>
</tr>
<tr>
<td>02 Frenchs Forest Road East</td>
<td>Moderate</td>
<td>Low</td>
<td>MODERATE TO LOW</td>
</tr>
<tr>
<td>03 Parkway North</td>
<td>Moderate</td>
<td>High</td>
<td>HIGH TO MODERATE</td>
</tr>
<tr>
<td>04 Frenchs Forest Road West</td>
<td>Moderate</td>
<td>High</td>
<td>HIGH TO MODERATE</td>
</tr>
<tr>
<td>05 Naree Road</td>
<td>High</td>
<td>High</td>
<td>HIGH</td>
</tr>
<tr>
<td>06 Forest Way North</td>
<td>Low</td>
<td>Moderate</td>
<td>MODERATE TO LOW</td>
</tr>
</tbody>
</table>

---

**Figure 12: Primary Visual Catchment Zone Impact Rating for Stage 1 (Source: Northern Beaches Hospital Connectivity and Network Enhancements: Concept Proposal and Stage 1- Urban Design Report and Landscape Character and Visual Impact Assessment was prepared by Spackman Mossop Michaels, October 2014)**

**Figure 13: Typical cross section of Naree Road illustrating the existing and proposed corridor design and the constraints to providing landscape screening and revegetation to the road corridor**
2.5 Visual Impact Stage 2 Works

As part of the Stage 2 Approvals Process an Urban Design Report and Landscape Character and Visual Impact Assessment was prepared by Spackman Mossop Michaels, July 2015 which formed part of the EIS Submission.

The visual impact assessment summary for Primary Visual Catchment Zone (PVCZ) is summarised in Figure 14. Receivers in this context include both road users and adjacent residents.

Four areas were identified as having high impact while three other areas have high to moderate impact.

Figure 15 below, illustrates the typical change in the Warringah Road cross section and the in the vicinity of Karingal Crescent. At receiver landscaping is chiefly confined to the space between the shared user path and proposed noise wall.

Receivers in the HIGH impact zone of Fitzpatrick Avenue East, Karingal Crescent, Bantry Bay Shops area will be consulted as part of the Communications and Property adjustments works to identify and agree on any landscaping measures to further screen the SSI.
2.5.1 Strategy plan
Within the study area the built (functional) and community opportunities are highlighted under three key categories of legacy, circulation and access and amenity. The project aims to provide:

- A landscape 'forest' legacy
- Improved connectivity for local community that is adaptable to future growth
- A distinctive, expressive and integrated driving experience

The FYJV high level strategy plan is shown in Figure 16.

Figure 16 The family of elements associated with the slot structure.
2.6 Urban design concept plan

A coordinated set of urban and landscape design drawings have been prepared. These drawings illustrate the combined potentials and constraints that have been worked through with the following discipline inputs and coordination:

- Road design and alignment
- Structural design (retaining structures)
- Structural design (bridges)
- Utilities design
- Traffic design and bus planning
- Drainage design
- Property works adjustments
- Environmental design and considerations
- Noise mitigation design
- Sustainability review and assessment (ISCA rating review and inputs)
- Construction and staging design inputs

The design illustrates the integration with the following documentation and interface considerations:

- SWTC requirements for Urban Design and Landscape (Appendix B.11)
- Northern Beaches Hospital Precinct Master Plan (EIS 2)
- Warringah Council Bike Plan

- Design principles and strategies identified in the Northern Beaches Hospital Connectivity and Network Enhancements - Urban Design Report and Landscape Character and Visual Impact Assessment Stage 1 (Spackman Mossop Michaels 17.10.2014)

- Design principles and strategies identified in the Northern Beaches Hospital Connectivity and Network Enhancements - Urban Design Report and Landscape Character and Visual Impact Assessment Stage 2 (Spackman Mossop Michaels 06.07.2015)

The concept design plans and associated cross sections are split into Stage 1 and Stage 2 designs. The key plan layout for the drawings for each stage is illustrated in Figures 17 and 18.
NOTES:

1. ANY STREET TREE PLANTING NEAR INTERSECTIONS WILL BE ASSESSED FOR IMPACTS ON SIGHT LINES
2. TREE PLANTING EXTENT AND NUMBERS IS INDICATIVE ONLY AND SUBJECT TO DETAILED DESIGN AND COORDINATION

STAGE 1

1. STREET LIGHTS AND QTH POWER TO RESIDENTS ON NORTHERN SIDE OF NAREE RD
2. LOW GROWING TREES SPECIES TO NORTHERN SIDE OF NAREE ROAD
3. NEW SIGNALISED INTERSECTION

NOTES:

1. ANY STREET TREE PLANTING NEAR INTERSECTIONS WILL BE ASSESSED FOR IMPACTS ON SIGHT LINES
2. TREE PLANTING EXTENT AND NUMBERS IS INDICATIVE ONLY AND SUBJECT TO DETAILED DESIGN AND COORDINATION

03 02 01

NOT FOR CONSTRUCTION
ANY STREET TREE PLANTING NEAR INTERSECTIONS HAS BEEN ASSESSED FOR IMPACTS ON SIGHT LINES.

STREET LIGHTS AND ON-PH POWER TO RESIDENTS ON NORTHERN AND SOUTHERN SIDE OF FRENCHS FOREST ROAD WEST.

LOW GROWING TREES SPECIES TO NORTHERN SIDE OF FRENCHS FOREST ROAD WEST.

1.5M WIDE PEDESTRIAN PATH TO WESTERN CARPARK.

UPGRADE DRIVEWAY ENTRY TO WESTERN CARPARK.

UPGR<br><br>DE WIDE PEDESTRIAN PATH TO WESTERN CARPARK.

OPPORTUNITY FOR TREE PLANTING WITHIN PRIVATE PROPERTY AS PART OF PROPERTY ADJUSTMENT WORKS (SUBJECT TO CONSULTATION WITH OWNER).

3.5M PATH TO WESTERN CARPARK.

EMERGENCY AND MAINTENANCE ACCESS TO SCHOOL OVAL.

UPGRADED WESTERN CARPARK.

RETAIL EXISTING ANGOPHORA COSTATA SPECIMEN.

EXTENT OF PROPERTY WORKS AT FOREST HIGH SCHOOL TO BE CONFIRMED BY RMS.

NOT FOR CONSTRUCTION

LEGEND

- Approximate Extent of Works Line
- Proposed Roadworks Extents
- Proposed 1.5m Wide Footpath
- Proposed 2.5m Wide Shared Path
- Proposed 3.0 / 3.5m Wide Shared Path
- Proposed Roadside Retaining Wall in Cut
- Proposed Roadside Retaining Wall in Fill
- Proposed Safety Fence on Central Slot Retaining Wall
- Proposed Noise Wall
- Proposed Fauna Fence

- Relocated or Proposed Bus Stop
- Existing Driveways Retained (Residential / Non-residential)
- Existing Tree to be Removed
- Existing Tree to be Retained
- Proposed Street Tree or Buffer Planting Tree
- Proposed Tree Planting in Private Property
- Proposed Turf
- Proposed Verge & Median Planting
- Proposed Vegetation

PROJECT COMPANY NUMBER: NBHR-SHT-11000-UD-1002
NORTHERN BEACHES HOSPITAL CONNECTIVITY AND URBAN DESIGN ENHANCEMENT
LANDSCAPE & URBAN DESIGN
ZONE 1000 - STAGE 1 LANDSCAPE & URBAN DESIGN PLAN

PRELIMINARY DESIGN PROJECT 05/21

AECOM

CONTRACTOR

Transport Roads & Maritime Services

 embracing framing
ANY STREET TREE PLANTING NEAR INTERSECTIONS HAS BEEN ASSESSED FOR IMPACTS ON SIGHT LINES.
ANY STREET TREE PLANTING NEAR INTERSECTIONS HAS BEEN ASSESSED FOR IMPACTS ON SIGHT LINES.

TRANSITION FROM DUFFYS FOREST PLANTING TYPOLOGY TO SUBURBAN STREET TYPOLOGY

1.5M PEDESTRIAN PATH

1.5M PEDESTRIAN PATH

2.0M WIDE SHARED PATH

2.0M WIDE SHARED PATH

NOT FOR CONSTRUCTION

LEGEND

- Approximate Extent of Works Line
- Proposed Roadworks Extents
- Proposed 1.5m Wide Footpath
- Proposed 2.5m Wide Shared Path
- Proposed 3.0 / 3.5m Wide Shared Path
- Proposed Roadside Retaining Wall in Cut
- Proposed Roadside Retaining Wall in Fill
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- Proposed Noise Wall
- Proposed Fauna Fence
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- Existing Driveways Retained
  (Residential / Non-residential)
- Existing Tree to be Removed
- Existing Tree to be Retained
- Proposed Street Tree or Buffer Planting
- Proposed Tree Planting in Private Property
- Proposed Turf
- Proposed Verge & Median Planting
- Proposed Revegetation

NOT FOR CONSTRUCTION
ANY STREET TREE PLANTING NEAR INTERSECTIONS HAS BEEN ASSESSED FOR IMPACTS ON SIGHT LINES.
ANY STREET TREE PLANTING NEAR INTERSECTIONS HAS BEEN ASSESSED FOR IMPACTS ON SIGHT LINES.

LOW GROWING TREES SPECIES TO NORTHERN SIDE OF FRENCHS FOREST ROAD WEST

STREET LIGHTS AND DH POWER TO RESIDENTS ON NORTHERN AND SOUTHERN SIDE OF FRENCHS FOREST ROAD WEST

3.0M WIDE SHARED PATH

3.0M PEDESTRIAN PATH

02 - UD-1195

EXISTING DRIVEWAY LEFT IN

FOREST CENTRAL BUSINESS PARK

ALLAMBIE GROVE BUSINESS PARK

LEGEND

- Approximate Extent of Works Line
- Proposed Roadworks Extents
- Proposed 1.5m Wide Footpath
- Proposed 2.5m Wide Shared Path
- Proposed 3.0 / 3.5m Wide Shared Path
- Proposed Roadside Retaining Wall in Cut
- Proposed Roadside Retaining Wall in Fill
- Proposed Safety Fence on Central Slot Retaining Wall
- Proposed Noise Wall
- Proposed Fauna Fence

Existing Driveways Retained (Residential / Non-residential)
Existing Tree to be Removed
Existing Tree to be Retained
Proposed Street Tree or Buffer Planting Tree
Proposed Tree Planting in Private Property
Proposed Turf
Proposed Verge & Median Planting
Proposed Vegetation

NOT FOR CONSTRUCTION
Any street tree planting near intersections will be assessed for impacts on sight lines.

Skyline Shops Enlargement Plan - 1050

Opportunity for tree planting within private property as part of property adjustment works (subject to consultation with owner).

3.0m wide shared path

New footpath to match into existing

Paved plaza space to front of Skyline Shops, pharmacy and Australia Post

Street lights and on off power to residents on northern and southern side of Frenchs Forest Road west

Perpendicular parking

New path connection

Opportunity for tree planting outside project boundary as part of property adjustment works (subject to consultation with owner).

Legend:
- Approximate extent of works line
- Proposed roadworks extents
- Proposed 1.5m wide footpath
- Proposed 2.5m wide shared path
- Proposed 3.0 / 3.5m wide shared path
- Proposed roadside retaining wall in cut
- Proposed roadside retaining wall in fill
- Proposed safety fence on central slot retaining wall
- Proposed noise wall
- Proposed fauna fence
- Relocated or proposed bus stop
- Existing driveways retained (residential / non-residential)
- Existing tree to be removed
- Existing tree to be retained
- Proposed street tree or buffer planting tree
- Proposed tree planting in private property
- Proposed turf
- Proposed verge & median planting
- Proposed revegetation

Not for construction

OPEN: NBHR-SHT-1000-UD-1007
LANDSCAPE & URBAN DESIGN
ZONE 1007 - STAGE 1
LANDSCAPE & URBAN DESIGN PLAN

AECOM
Transport Roads & Maritime Services

FERROVIAL YORK Joint Venture

Release 7.00 26 May 2023

FINAL DESIGN

Sheet no. FD
ANY STREET TREE PLANTING NEAR INTERSECTIONS WILL BE ASSESSED FOR IMPACTS ON SIGHT LINES.
ANY STREET TREE PLANTING NEAR INTERSECTIONS WILL BE ASSESSED FOR IMPACTS ON SIGHT LINES
ANY STREET TREE PLANTING NEAR INTERSECTIONS WILL BE ASSESSED FOR IMPACTS ON SIGHT LINES.
Skyline Shops Precinct

Sketch plan has been used to illustrate and coordinate with drainage, utilities and alignment.

Materials Palette to be consistent with the guidelines specified in the ‘Warringah Public Spaces Design Guidelines’ - August 2013

Skyline Shops
Skyline Supermarket
Skyline Centre
Newsagent
Skyline Seafood
KFC Restaurant

Possible Outdoor Dining Space (to be confirmed)
Existing Trees to be maintained
Retaining Walls
Vacant Lot with Overflow Carparking
Reinstated Bus Stop
Existing Residential
Access
Access

* Feature Paving - Colour: Austral Braham Granite Bowral Dry Pressed
Size: 230 x 115 x 65mm
Pattern: Stretchbond
Header Course: Austral Silver Sand Bowral Dry Pressed
Installation: 30mm sand bed, 2mm sand joint spacing, 20mpa concrete slab base

Possible Outdoors Dining Space (to be confirmed)
TYPICAL SECTION
FRENCHS FOREST ROAD WEST ADJACENT TO HOSPITAL
SCALE 1:250

TYPICAL SECTION
FRENCHS FOREST ROAD WEST ADJACENT TO SCHOOL
SCALE 1:250

NOTES:
1. PAVEMENT EXTENTS AND EDGE DETAILS SHOWN ARE INDICATIVE ONLY. REFER TO PAVEMENT DRAWINGS ("P" SERIES).
2. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.
3. LOCATION OF ROAD SAFETY BARRIERS VARY. REFER TO ROAD ALIGNMENTS AND EDRS.

PROJECT ORGANIZATION
NORTHERN BEACHES HOSPITAL CONNECTIVITY AND NETWORK UPGRADE
LANDSCAPE & URBAN DESIGN
ZONE 1000 - STAGE 1
LANDSCAPE & URBAN DESIGN SECTIONS

ABCOM

ABCOM

ABCOM
01

FRENCHS FOREST ROAD EAST NEAR WAKEHURST PKWY

TYPICAL SECTION

SCALE 1:250

02

FRENCHS FOREST ROAD WEST NEAR WAKEHURST PKWY

TYPICAL SECTION

SCALE 1:250
TYPICAL SECTION
FRENCHS FOREST ROAD EAST
SCALE 1:250

TYPICAL SECTION
FRENCHS FOREST ROAD EAST
SCALE 1:250
NOTES:
1. ANY STREET TREE PLANTING NEAR INTERSECTIONS WILL BE ASSESSED FOR IMPACTS ON SIGHT LINES
2. TREE PLANTING EXTENT AND NUMBERS IS INDICATIVE ONLY AND SUBJECT TO DETAILED DESIGN AND COORDINATION

NOTES:
1. ANY STREET TREE PLANTING NEAR INTERSECTIONS WILL BE ASSESSED FOR IMPACTS ON SIGHT LINES
2. TREE PLANTING EXTENT AND NUMBERS IS INDICATIVE ONLY AND SUBJECT TO DETAILED DESIGN AND COORDINATION

LEGEND
- Approximate Extent of Works Line
  - Proposed Roadworks Extents
  - Proposed 1.5m Wide Footpath
  - Proposed 2.0m Wide Shared Path
  - Proposed 3.0m Wide Shared Path
  - Proposed Roadside Retaining Wall in Cut
  - Proposed Roadside Retaining Wall in Fill
  - Proposed Central Slot Retaining Wall
  - Proposed Safety Fence on Central Slot Retaining Wall
  - Proposed Noise Wall
  - Proposed Fauna Fence
  - Relocated or Proposed Bus Stop
  - Existing Driveways Retained (Residential / Non-residential)
  - Existing Tree to be Removed
  - Existing Tree to be Retained
  - Proposed Street Tree or Buffer Planting Tree
  - Proposed Tree Planting in Private Property
  - Proposed Turf
  - Proposed Verge & Median Planting
  - Proposed Revegetation

VMS STRUCTURE No. 3

ON SITE BELOW GROUND DETENTION TANK

START STAGE 2

NOT FOR CONSTRUCTION

PROJECT DISCLAIMER
NORTHERN BEACHES HOSPITAL, CONNECTIVITY AND URBAN ENVIRONMENT LANDSCAPE & URBAN DESIGN PLAN 2020 - STAGE 2 LANDSCAPE & URBAN DESIGN PLAN

NOT FOR CONSTRUCTION

FINAL DESIGN

FF5
3. NOTES:
1. VEGETATION SHOWN INDICATIVE ONLY

NOTES:
1. PAVEMENT EXTENTS AND EDGE DETAILS SHOWN ARE INDICATIVE ONLY
2. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE
3. LOCATION OF ROAD SAFETY BARRIERS VARY FASTER TO ROAD FURNITURE PLANS FOR EXTENT
4. "D" DENOTES WHERE CURVE WIDENING HAS BEEN APPLIED TO LANE WIDTH
5. MINIMUM WORKING WIDTH 7.2m
Northern Beaches Hospital Connectivity and Network Enhancement

NBHR-0000-UD-170A

Urban and Landscape Design

TYPICAL SECTION
WARRINGAH ROAD WEST OF WAKEHURST PKWY UNDERPASS
SCALE 1:250

TYPICAL SECTION
WARRINGAH ROAD WEST OF HILMER STREET BRIDGE
SCALE 1:250
WARRINGAH ROAD WEST OF RODBOROUGH ROAD

TYPICAL SECTION

SCALE 1:250

INDUSTRIAL

WARRINGAH ROAD
EASTBOUND

3.5
3.3
3.3
3.3
VARIES
3.3
3.3
3.5

"S" KERB

"S" KERB

"S" KERB

"S" KERB

FOOTWAY VARIES

PAVEMENT

2 Path

2 Path

"S" KERB

INDUSTRIAL

WARRINGAH ROAD
WESTBOUND

3.5
3.3
3.3
3.3
VARIES
3.3
3.3
3.5

"S" KERB

"S" KERB

"S" KERB

"S" KERB

FOOTWAY VARIES

PAVEMENT

2 Path

2 Path

"S" KERB

WARRINGAH ROAD EAST OF WAKEHURST PKWY UNDERPASS

TYPICAL SECTION

SCALE 1:250

INDUSTRIAL

WARRINGAH ROAD
EASTBOUND

3.5
3.3
3.3
3.3
VARIES
3.3
3.3
3.5

"S" KERB

"S" KERB

"S" KERB

"S" KERB

FOOTWAY VARIES

PAVEMENT

2 Path

2 Path

"S" KERB

INDUSTRIAL

WARRINGAH ROAD
WESTBOUND

3.5
3.3
3.3
3.3
VARIES
3.3
3.3
3.5

"S" KERB

"S" KERB

"S" KERB

"S" KERB

FOOTWAY VARIES

PAVEMENT

2 Path

2 Path

"S" KERB

NOTES:

1. PAVEMENT EXTENTS AND EDGE DETAILS SHOWN ARE INDICATIVE ONLY.
2. ALL DIMENSIONS ARE METRES UNLESS NOTED OTHERWISE.
3. LOCATION OF ROAD SAFETY BARRIERS VARY, REFER TO ROAD ALIGNMENT PLANS FOR EXTENT.

DUFFY'S FOREST

WARRINGAH ROAD
EASTBOUND

3.5
3.3
3.3
3.3
VARIES
3.3
3.3
3.5

"S" KERB

"S" KERB

"S" KERB

"S" KERB

FOOTWAY VARIES

PAVEMENT

2 Path

2 Path

"S" KERB
TYPICAL SECTION
WAKEHURST PKWY NORTH OF AQUATIC DRIVE
SCALE 1:250

WAKEHURST PKWY SOUTH OF WARRINGAH ROAD
SCALE 1:250

NOTES:
1. PAVEMENT EXTENTS AND EDGE DETAILS SHOWN ARE INDICATIVE ONLY.
2. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
3. LOCATION OF ROAD SAFETY BARRIERS VARY; REFER TO ROAD ALIGNMENT PLANS FOR EXTENT.
4. * DENOTES RIGHT TURN LANE DEVELOPING IN THIS LOCATION.
Northern Beaches Hospital Connectivity and Network Enhancement

01

TYPICAL SECTION
WAKEHURST PKWY NORTH OF EXISTING BRIDGE
SCALE 1:250

02

TYPICAL SECTION
WAKEHURST PKWY SOUTH OF AQUATIC DRIVE
SCALE 1:250
Northern Beaches Hospital Connectivity and Network Enhancement

**Typical Section**

**01. Allambie Road South of Warringah Road**
- Scale: 1:250

**02. Fitzpatrick Avenue East**
- Scale: 1:250

**03. Hospital Access Road South**
- Scale: 1:250

**04. Hilmer Street**
- Scale: 1:250

**NOT FOR CONSTRUCTION**

Project: Northern Beaches Hospital Connectivity and Network Enhancement

Zone: 2000 - Stage 2

Landscape & Urban Design Sections

Design: ASCON

Contractor: ferrovial YORK Joint Venture

Transport Roads & Maritime Services

Final Design

[Scale and Dimensions]
TYPICAL SECTION
RODBOROUGH ROAD
SCALE 1:250

01

FOREST WAY NEAR BUS BAY
TYPICAL SECTION
SCALE 1:250

02

NOT FOR CONSTRUCTION

NBHR-8HT-2005-UD-2106

LANDSCAPE & URBAN DESIGN
ZONE 2000 - STAGE 2
LANDSCAPE & URBAN DESIGN SECTIONS

FINAL DESIGN
3. Bridges, including shared user path bridges

3.1 Concept

In Stage 1 of the project - there are no bridges or shared user path bridges proposed. In Stage 2 the following bridges are proposed:

- a shared path bridge over Warringah Road opposite Forest Way
- a shared path bridge over Warringah Road near Hilmer Street
- a short underpass on Warringah Road at the intersection with Forest Way
- a short underpass on Warringah Road at the intersection with Hilmer Street
- a short underpass on Warringah Road at the intersection with Wakehurst Parkway

These locations are illustrated in Figure 20.

3.1.1 Overall concept

The short underpasses (bridges), shared path bridges and main slot wall structures are considered as part of an overall design language. Collectively they provide a unified visual experience viewed both from the road user in the slot and adjacent roads and the shared path users. The underpinning theme is derived from reference to the local landscape concept of ‘the northern beaches’, of Warringah – ‘from the sea’. The sweep, curves and forms of the shared path bridges, the portal at Wakehurst Parkway interchange and the pattern on the slot walls reflect the biorhythms of the ocean. Swell period along the slot structure crescendo with cresting waves in the form of the shared path bridges and portals.

The science and mechanics of swell period is illustrated in Figure 19.

The concept design proposes no additional embellishments to the short underpass bridges at Forest Way and Hilmer Street. These portals will be neatly detailed and consistent with RMS best practice and guidelines for these structures. They will integrate the parapet elements, throw screens, slot wall copings and 1.8m high slot fence into a simple and elegant form.

Figure 19 The mechanics of swell period
3.2 Shared Path Bridges

The shared path bridges aim to celebrate the enhanced connectivity within the local area. The bridges are considered as completely interconnected elements with the shared path system, safely connecting key community destinations across the corridor and embedding them into the forest parkway landscape setting. Both shared path bridges have been located and designed to maximise connectivity with the broader circulation networks, minimise visual instruction on local residents, optimise safety for users, ensure ease of maintainability and contribute positively to the local built form character. They are designed as simple, elegant and distinctive elements. The location and form of the two shared path bridges is illustrated in Figure 20. The cresting wave form concept for the curved pedestrian bridge is illustrated in Figure 21.

Key characteristics of the design of the shared path bridge alignments and localities are:

- Reinforcing the forest parkway canopy experience, setting the ramps in amongst either existing and/or reinstated plantings of clear stemmed gum trees
- Engaging the road users with a strong, elegant form that is a dynamic visual element in the landscape
- Provision of generous and smooth radii to ramps and bridge structures providing safe line of sight and easy transitions for cyclists and pedestrians
- Using the arced form to gain the benefits of local topography to minimise ramp lengths
- Enabling through integrated lighting a beacon/gateway element in the landscape

For each of the three key bridge elements, the two shared path bridges and the portal at Wakehurst Parkway FYJV has provided:

- An architectural concept to explain the form, materials and shape
- An enlargement site plan of the key interfaces illustrating the ramp and interface integration with the shared path network and other infrastructure elements including noise walls
- An elevation of each structure
- Cross sectional details of each structure
3.2.1 Shared User Path Bridge near Forest Way

The Forest Way/Warringah Road shared user path bridge (replacing the existing bridge), will thrust out from the ridge line engaging both the road users below (as a gateway to the Northern Beaches) and as a district forest top view for the users. The form of the bridge engages users with expansive views south west over the urban forest of ‘Forestville’ down to Middle Harbour and Roseville Chase while beyond the skyline, Chatswood sits in a sea of greenery marking the southern edge of ‘the forest’. The eastern landing presented FYJV with a number of design challenges including:

- Having sufficient clearance for the bridge to the westbound lanes on Warringah Road
- Providing a safe and level landing area at the interface with the 3m wide shared path
- Providing the connection through Karingal Crescent
- Providing overlap of the noise wall to facilitate the connection to Karingal Crescent
- Providing a 5% grade connection down to Fitzpatrick Avenue East
- Minimising impacts to existing vegetation especially two very large Sydney Blue Gum specimens

A number of configurations were explored in order to develop the optimum outcome. The FYJV design solution achieves all of these functional requirements and permits the retention of the two existing blue gum trees and is illustrated in Figure 23. The supporting cross sections illustrate the relationship at the three key locations in this vicinity.

Resolving the bridge landing on the eastern side of Warringah Road and matching in with the existing grade at the Karingal Crescent mid block connection has allowed the FYJV to design a 5% at grade direct connection down to Fitzpatrick Avenue East. This arrangement is illustrated in Figure 24. This configuration is subject to detailed design and survey information.

On the western side, the ramp is configured to provide a consistent radius down to connect directly with the pathway and pedestrian desire lines to connect to the School and Forest Way Shopping Centre. Working with the design alignment team the existing kerb line has been maintained maximising the ramp radius, space for landscaping and maintaining access for pedestrians to the crossing of Forest Way. This is illustrated in Figure 25.

3.2.2 Shared User Path Bridge near Hilmer Street

The Hilmer Street shared user path bridge is consistent with the form and shape of the proposed structure at Forest Way. The landing areas take advantage of the higher point near the intersection of Hilmer Street and Warringah Road, while the ramps and arc traverse the lower section of road to the west. The landing on the north side of Warringah Road connects directly with the shared path running along the western boundary of the hospital and the eastern edge of the high school. On the southern side of Warringah Road, the shared path bridge configuration integrates with the proposed noise wall, maintains direct connection through to Karingal Crescent and connects with the westbound bus stop west of Hilmer Street.

FYJV’s concept design solution and its benefits are illustrated in Figure 26. Both of the shared path bridges are designed to be safe, provide good sight lines and be open to the sky and landscape beyond. This openness is illustrated in the artist’s impression in Figure 22.
Figure 23 Enlargement plan illustrating the concept for the shared path bridge, ramp, landing and shared path integration on the east side, Warringah Road, near Forest Way.

*1 - Retention of existing specimen gum trees subject to detailed design and Arborist inputs.

For details on retaining walls please refer to Section 4.0 and for details on noise walls refer to Section 8.0.
Figure 24: Enlargement plan illustrating the concept design for the shared path connection down to Fitzpatrick Avenue East.

For details on retaining walls, please refer to Section 4.0, and for details on noise walls, refer to Section 8.0.
Figure 25 Enlargement Plan illustrating the concept for the shared path bridge and landing at the intersection of Forest Way and Warringah Road

FOR DETAILS ON RETAINING WALLS PLEASE REFER TO SECTION 4.0 AND FOR DETAILS ON NOISE WALLS REFER TO SECTION 8.0

NOTE:
REFER FIGURE 32 FOR STRUCTURAL PLAN + LONG ELEVATION

FOREST PRIMARY SCHOOL

SCHOOL BUS AND LAYOVER AREA

ROADSIDE BARRIER TO PROTECT BRIDGE PIERS

WARRINGAH ROAD (EASTBOUND)

FOREST WAY

NEW TREE PLANTINGS

SHARED PATH BRIDGE

TREE PLANTING TO TOP OF SLOT

MAIN SLOT RETAINING WALL

TREE PLANTING TO TOP OF SLOT

FOREST WAY SHORT UNDERPASS

TO FOREST WAY SHOPPING CENTRE

PLAZA / THRESHOLD

RETAIN EXISTING TREES WHERE POSSIBLE / SUPPLEMENT WITH NEW TREE PLANTING

EXISTING PEDESTRIAN PATHWAY

NOTE:
REFER FIGURE 32 FOR STRUCTURAL PLAN + LONG ELEVATION

FOR DETAILS ON RETAINING WALLS PLEASE REFER TO SECTION 4.0 AND FOR DETAILS ON NOISE WALLS REFER TO SECTION 8.0
The image is a schematic plan for the Northern Beaches Hospital Connectivity and Network Enhancement. It illustrates the concept for the shared path bridge near Hilmer Street, including details such as:

- **Shared Path between Hospital and High School**: Connects to Frenchs Forest Road West.
- **Project Property Boundary**
- **Existing Tall Forest with Grass Under Storey**
- **Retain Existing Trees and Supplement with New Plantings**
- **Main Slot Retaining Wall**
- **Tree Planting to Top of Slot Structure**
- **SLOT (WESTBOUND)**
- **SLOT (EASTBOUND)**
- **Road Barrier to Protect Bridge Piers**
- **Throw Screen to Underpass**
- **OPEN PLAZA AREA TO ALLOW FOR EASY TRANSITION FROM RAMP TO PATHWAY SYSTEM**
- **Integrate Hospital Shared Path into Plaza Threshold to Make for Seamless Connection onto Bridge**
- **Service Vehicle Entrance to Hospital**
- **Theory Screen to Underpass**
- **Specific Screening to Adjacent Properties**
- **Bus Shelters**
- **3m Wide Shared Path**
- **3.5m High Noise Wall**
- **Connection Through to Karingal Crescent**
- **FOR DETAILS ON RETAINING WALLS PLEASE REFER TO SECTION 4.0 AND FOR DETAILS ON NOISE WALLS REFER TO SECTION 8.0**

Figure 26: Enlargement Plan Illustrating the concept for the shared path bridge near Hilmer Street.
3.2.3 Shared Path Bridge Architectural Design

Elevation of each bridge at 1:250 scale

Figure 27 Typical elevations of shared path bridge screening elements
Figure 28. Typical elevations of shared path bridge screening elements.
Figure 29 Typical cross sections of shared user path bridges
Figure 30 Typical cross sections of shared user path bridges

- **01** TYPICAL CROSS SECTION AT HIGHEST POINT
  - SCALE 1:50

- **02** INTERNAL ELEVATION
  - SCALE 1:50
Figure 31 Typical elevation of shared user path bridges feature aluminium cladding

EXAMPLE OF PERFORATED ALUMINIUM PANEL
Figure 32: Forest Way shared path bridge, structural plan and elevation
Figure 33 Hilmer Street shared path bridge, structural plan and elevation
### 3.3 Short underpasses and portals

There are three underpasses on the project, occurring at the intersections of Warringah Road with Forest Way, Hilmer Street and Wakehurst Parkway. Consistent with FYJV’s overall scheme, the portal structures at Forest Way and Hilmer Street are simple, uncluttered designs consistent with RMS design guidelines. The portal structure at Wakehurst Parkway includes a feature structure that is consistent with the overall project theme described in Section 2.3.

**Forest Way and Hilmer Street underpasses and portals**

In achieving simple, uncluttered and unified outcomes, the design of the Forest Way and Hilmer Street portals and underpasses is based on a set of core design principles. These principles together with the functional and SWTC requirements need to be satisfied in regards to safety including:

- Integration with roadside barriers
- Integration with the capping beam
- Integration of 1.8m high fence/screen along the top of the slot
- Integration of the 3m throw screen required at overpasses
- Barriers interfaces that meet safety requirements
- Retaining wall copings are integrated with the overpass parapets to form a continuous flowing line
- Integration and transition of the safety screen and fences

The design principles and their application are illustrated in Figure 34, 35 and 36. These design principles are also applicable to the Wakehurst Parkway interchange but, in this case, the architectural embellishment piece performs the requirements of the throw screen and is described further in Section 3.3.1.

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**Figure 34** Principles for integration of slot walls, roadside barriers and bridge parapet

**Figure 35** Simple and clean integrated detailing for throw screens

**Figure 36** Transition of coping into barrier and 1.8m high palisade fence into throw screen

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Due to different sight lines and approach angles the in-situ linking piece is different in each case.
3.4.1 Forest Way and Hilmer Street underpasses

As illustrated in FYJV’s Concept Design, the underpasses at Forest Way and Hilmer Street are intended to be designed as simple, clean and integrated elements. There are a number of elements that interface in these locations including:

- the underpass bridge parapet, rail and throw screen
- the slot wall coping panel
- the kerbside barrier
- the security fence to the top of the slot

The design consistent with the principles in Figure 34 and ensure integration by:

- minimising the number of interfaces and transitions
- providing clean lines with the parapet edge matching in line and elevation with the coping of the slot wall
- integrating the overpass parapet with the roadside barrier at the surface level
- a simple and neat transition of the throw screen into the security fence

These design initiatives are illustrated in Figure 37.
3.3.1 Wakehurst Parkway underpass and portal

As illustrated in FYJV’s Concept Design, the portal at Wakehurst Parkway is a key way finding and orientation element in our design. It is a built element that represents the important overlay of the Duffys Forest bushland corridor. The architectural component provides orientation to both surface road users and slot road users. At the surface level, the laid back sweep draws the road user’s eye toward the forest canopy of Duffys Forest and away from the slot below. The angle and set back of the portal has been designed to ensure that there are no impacts on sight lines for drivers. The form of the portal structure is illustrated in Figure 38. In this regard, it assists in reducing the perceived scale of the slice through the ‘bushland corridor’ of Duffys Forest.

At the slot level the portal structure is integrated with the rhythmic sweep of the swell pattern which peaks in this location. This is illustrated in Figure 40. This provides slot road users with orientation and connection with the surface level, especially reinforced on the eastern side of the portal with the extensive planting areas to the edge of the slot and portal. This is illustrated in Figure 39.

The form, structural members and materiality of the structure is consistent with the shared path bridges and integrates with integrated lighting. The arrangement of the structural design also meets and satisfies all of the requirements for sight lines, throw screens, safety barriers and pedestrian connectivity.

Additional design studies and details are provided in Figures 41 through 43.
SECTION B
WAKEHURST PARKWAY PORTAL FEATURE

Figure 41 Wakehurst Parkway portal architectural cross section
Figure 42: Wakehurst Parkway portal architectural cross section
Figure 43 Wakehurst Parkway portal structure design studies illustrating form and structural concept.
3.4 Artists’ impressions

To assist with the illustration of the design principles a series of artistic representations have been prepared. These artists’ impressions are accompanied by an existing view where practicable to allow for comparison between the proposed design and the existing condition. Artists impressions are provided at the following locations.

- Viewpoint #01 - View along Warringah Road corridor as a whole, showing the Central Slot including at least one overpass, other built elements, the character and scale of proposed landscape works, and their integration with the local setting. Refer Figures 45 and 46
- Viewpoint #02 - Warringah Road/Forest Way interchange including the proposed cutting/retaining wall on the southern side of Warringah Road, noise wall, other structures, fences, landscape works, and their integration with the local setting. Refer Figures 47 and 48
- Viewpoint #03 - Forest Way shared path bridge, showing the entire bridge including ramps, proposed cutting/retaining wall on the southern side of Warringah Road and proposed landscape works, and their integration with the local setting. Refer Figures 49 and 50
- Viewpoint #04 - Hilmer Street shared path bridge, showing the entire bridge including ramps, its relationship to the Warringah Road Central Slot and proposed landscape works, and their integration with the local setting. Refer Figures 51 and 52
- Viewpoint #05 - Warringah Road/Wakehurst Parkway interchange including proposed structures, roadside furniture and landscape works, and their integration with the local setting. Refer Figures 53 and 54
- Viewpoint #06 - View from within Warringah Road Central Slot approaching one overpass, showing proposed finish to walls and integration of walls with overpass. Refer Figure 55

The location of each of these viewpoints is illustrated in Figure 44.
Figure 45: Existing view along Warringah Road corridor, showing landscape character and scale of the road corridor.
Figure 46 View along Warringah Road corridor as a whole, showing the Central Slot including at least one overpass, other built elements, the character and scale of proposed landscape works, and their integration with the local setting.
Figure 47 Existing pedestrian bridge at intersection of Forest Way and Warringah Road showing landscape character and scale of the road corridor
Figure 48 Proposed Forest Way shared path bridge, showing the entire bridge including ramps, proposed cutting/retaining wall on the southern side of Warringah Road and proposed landscape works, and their integration with the local setting.
Figure 49 Existing Warringah Road/Forest Way intersection showing landscape character and scale of the road corridor
Figure 50 Proposed Warringah Road/Forest Way interchange including the proposed cutting/retaining wall on the southern side of Warringah Road, noise wall, other structures, fences, landscape works, and their integration with the local setting.
Figure 51 Existing intersection of Hilmer Street and Warringah Road showing existing landscape character and scale
Figure 52 Hilmer Street shared path bridge, showing the entire bridge including ramps, its relationship to the Warringah Road Central Slot and proposed landscape works, and their integration with the local setting.
Figure 53 Existing pedestrian bridge at intersection of Wakehurst Parkway and Warringah Road showing existing landscape character and scale
Figure 54: Short underpass, slot and pedestrian bridge on Warringah Road and Wakehurst Parkway (travelling westbound)
Figure 55 Proposed view from within Warringah Road Central Slot approaching one overpass, showing proposed finish to walls and integration of walls with overpass.
4. Retaining Wall Structures

4.1 Urban design aspects

Retaining walls will be constructed in a number of locations within the Project Works in both Stages 1 and 2. The design and detailing of the proposed retaining walls are informed by a number of requirements including:

- Satisfying the technical requirements to ensure safe and efficient operation of the roadway
- Minimising the construction footprint of the project
- Application and adherence to the relevant Austroads and RMS design guidelines and practice notes
- Providing amenity and quality to the public domain and carriageway corridor
- Maintaining operational flow to the existing traffic network during construction

The design and finishes of the retaining wall structures also need to be integrated as part of the contemporary road infrastructure as part of the overall kit of parts (including shared path bridges, barriers, railings, parapets, screens, fences, embankments and drainage elements).

4.1.1 Stage 1 - Retaining Walls

The concept design proposes the use of the following types of retaining structures in Stage 1:

- A combination piled and L-Shaped wall with concrete class 2 finish
- Soil nail wall with capping beam, finished with a precast concrete panel with sandstone facing and coping
- Pile wall with capping beam, finished in precast concrete panel with sandstone facing and coping
- Reinforced block work wall

Figure 56 illustrates the overall extent of these five types of retaining walls within the project, while Table 4 summaries the retaining wall types, stage in, locations, extent and proposed finishes.

Table 4 Stage 1 Retaining Wall Schedule

<table>
<thead>
<tr>
<th>Wall ID</th>
<th>Location</th>
<th>Length (approx)</th>
<th>Height (max)</th>
<th>Type and finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>3RW-01-EB</td>
<td>Frenchs Forest Road West</td>
<td>64m</td>
<td>3.5m</td>
<td>Piled wall adjacent to gas main with concrete fascia panel with sandstone facing and coping</td>
</tr>
<tr>
<td>3RW-02-NB</td>
<td>Wakehurst Parkway</td>
<td>178m</td>
<td>3.5m</td>
<td>Soil nail wall with concrete fascia panel with sandstone facing and coping panel</td>
</tr>
<tr>
<td>3RW-03-WB</td>
<td>Frenchs Forest Road East</td>
<td>80m</td>
<td>2.2m</td>
<td>Combination piled and L-Shaped wall with concrete class 2 finish</td>
</tr>
<tr>
<td>4RW-01-WB</td>
<td>Allambie Road</td>
<td>96m</td>
<td>1.6m</td>
<td>Reinforced split face block work wall, colour charcoal</td>
</tr>
</tbody>
</table>

*Retaining wall ID - is consistent with the structural design drawings*
4.1.2 Stage 2 - Retaining Walls

The concept design proposes the use of the following types of retaining structures in Stage 2:

- Soil nail wall with capping beam, finished with a precast concrete panel and coping
- Pile wall with capping beam, finished in precast concrete panel
- Reinforced soil wall with precast concrete panel
- Reinforced block work wall
- An L-type in situ concrete retaining wall

Figure 57 illustrates the overall extent of the fall types of retaining walls within stage 2 of the project, while Table 5 summaries the retaining wall types, locations, extent and proposed finishes.

Figure 57 Retaining wall structures stage 2

Table 5 Stage 2 Retaining Wall Schedule

<table>
<thead>
<tr>
<th>Wall ID</th>
<th>Retaining wall ID</th>
<th>Location</th>
<th>Length (approx)</th>
<th>Height (max)</th>
<th>Type and finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2RW-08-EB - 2RW-11-EB</td>
<td>Warringah Road slot east bound</td>
<td>1205m</td>
<td>6.9m</td>
<td>Soil nail wall with architectural precast concrete fascia panel and coping panel</td>
</tr>
<tr>
<td>2</td>
<td>2RW-12-WB - 2RW-16-WB</td>
<td>Warringah Road slot east bound</td>
<td>1159m</td>
<td>6.9m</td>
<td>Soil nail wall with architectural precast concrete fascia panel and coping panel</td>
</tr>
<tr>
<td>3</td>
<td>2RW-07-WB</td>
<td>Warringah Road west bound south of Fitzpatrick Avenue east</td>
<td>54m</td>
<td>1.6m</td>
<td>L-Shaped concrete retaining wall</td>
</tr>
<tr>
<td>4</td>
<td>2RW-06-WB</td>
<td>Warringah Road opposite Forest Way</td>
<td>366m</td>
<td>4.8m</td>
<td>Reinforced soil wall with architectural precast concrete fascia panel</td>
</tr>
<tr>
<td>5</td>
<td>2RW-09-WB</td>
<td>Warringah Road, east of Wakehurst Parkway</td>
<td>15m</td>
<td>1.2m</td>
<td>L-Shaped concrete retaining wall</td>
</tr>
<tr>
<td>6</td>
<td>2RW-04-NB</td>
<td>Wakehurst Parkway south of Warringah Road</td>
<td>97m</td>
<td>3.8m</td>
<td>Reinforced soil wall with architectural precast concrete fascia panel</td>
</tr>
<tr>
<td>7</td>
<td>2RW-01-SB</td>
<td>Wakehurst Parkway south of Warringah Road</td>
<td>130m</td>
<td>3.9m</td>
<td>Reinforced soil wall with architectural precast concrete fascia panel</td>
</tr>
</tbody>
</table>

*Retaining wall ID - is consistent with the structural design drawings
4.2 Soil nail walls

Soil nail walls are proposed for use in both stage 1 and stage 2. In stage 1 the main soil nail wall runs along the west side of Wakehurst Parkway in a northerly direction from the intersection with Frenchs Forest Road West. In stage 2 soil nail walls are proposed for the central slot and the retaining wall on the southern verge of Warringah Road generally opposite the intersection with Forest Way.

4.2.1 The Central Slot

The Warringah Road central slot is considered a unifying visual element along the entire length of the slot. As a Project element, it supports the featured shared path bridges at Forest Way and Hilmer Street and the interchange at Wakehurst Parkway. The main slot wall will provide visual interest to the journey and relates to a defining aspect of the local area. The broad concept and family of elements is illustrated in Figure 58.

The structure is composed of a continuous soil nail wall, with capping beam and coping panel and will be finished with a precast concrete panel. The concrete panel includes a surface relief pattern designed to be experienced and interpreted at the design speed of between 60km/h and 70km/h. As a gateway to the Northern Beaches and the new Northern Beaches Hospital precinct, the design pattern on the wall draws from the natural ocean rhythms of swell period. This complements the form of the shared path bridges as cresting wave forms. In concept form the pattern is illustrated in Figure 59. The pattern is equivalent to a 10 second swell period, the time taken to travel between the crest or trough of each wave. When extrapolated out to work with the detailed road, the relationship can be seen in Figure 59.

The slot wall design provides for a continuous material and finish to the face of the walls both in the open slot and through the short underpasses. The precast architectural wall panel will be full height from the roadside barrier up to the coping panel. The elements that compromise the slot are considered as set of integrated elements.

The design also considers the undulating nature of the slot carriageway and the adjacent surface carriageways of Warringah Road. A coping panel will define the top edge of the slot wall and transition at portals into the leading edge of the short underpasses at Forest Way and Hilmer Street.

The eastbound long elevation is illustrated in Figure 60 and the westbound long elevation is illustrated in Figure 61.
Figure 60 Slot wall elevation eastbound on Warringah Road
Figure 61 Slot wall elevation westbound on Warringah Road
Typical Cross Section
The typical cross section for the soil nail wall involves a number of elements, these can be broken into two categories;

• the unseen including:
  – the concrete capping beam
  – the soil nail and rock bolt fixings
  – the shotcrete and drainage system and mass concrete footing for the precast fascia panel

• the seen / visible elements including:
  – the precast concrete coping panel (4m wide modules)
  – the precast concrete fascia panel (2m wide modules)
  – the roadside barrier
  – the safety fence (fixed to the top of the wall)

The typical cross section is illustrated in Figure 62.

The concrete coping panel, fascia and roadside barrier form a continuous face to the entire length of the soil nail walls.

The relief pattern for the wall fascia panels will be achieved through the use of either an embossed pattern on the precast panel or textured surface finish that defines the curved wave form. This concept is explained further in Section 4.3.

At the top of the slot wall there is provision for landscape in the space between the surface carriageway road side barrier and the capping beam. This gap varies along the corridor and where the space between is greater than 2 meters in width. The spaces between the top of the slot and road surface road vary as does the depth of the slot this is illustrated in Figures 64, 65 and 66 which show a range of cross sectional relationships along the slot.
Figure 63: Soil nail wall with capping beam

Figure 64: Typical slot cross sections

Figure 65: Typical slot cross sections
Figure 66 Typical slot cross sections
4.2.2 Warringah Road retaining wall

The retaining structure for this wall will be constructed in a similar manner to the main slot. Due to the proximity of this cutting to the main slot the same wave pattern is proposed to the panel. The relationship between the slot and adjacent retaining wall is illustrated in Figure 67.

The relationship between the shared path bridge, wall and noise wall is illustrated in Figure 67 and 68. Typical cross sections and details are shown in Section 8.0 Noise Barriers.
Figure 68: Elevation of retaining wall, noise wall and shared path bridge

NOTE: FINAL HEIGHT OF THE NOISE WALL ARE SUBJECT TO NOISE MODELLING

FOR DETAILS ON BRIDGES PLEASE REFER TO SECTION 3.0
AND FOR DETAILS ON NOISE BARRIERS REFER TO SECTION 8.0
4.3 Fascia panel details

Soil nail walls are the proposed construction technique for a number of walls on the project. The visible components include the fascia panels, coping panel and roadside barrier (where required). Based on the location and context there are two types of finishes proposed for the fascia panels. Theses two types are:

- precast concrete fascia panel with sandstone veneer applicable to soil nail walls in stage 1 at the intersection of Wakehurst Parkway and Frenchs Forest Road West and on Frenchs Forest Road East, in close proximity to Duffy’s Forest
- precast concrete fascia panel with super graphic pattern cast into the panel applicable to the Warringah Road slot and retaining wall opposite the intersection of Warringah Road and Forest Way

Sandstone clad fascia panel
This finish is used in the areas in close proximity to Duffy’s Forest and Frenchs Forest Road East and West where retaining walls face the corridor. The design features:

- a repeatable ashlar pattern that is consistent with the precast panel module
- allowances for the changes in direction and steps in wall height
- a fixing detail that meets all safety requirements
- integration of the fauna fence on top of the wall where deemed appropriate by the project ecologist
- a termination detail that integrates the roadside barrier detail and coping panel

Elevation studies are shown in Figure 69 and the elevation detail is and cladding detailing is shown in Figure 70.
Precast concrete Fascia panel - Option 1  super graphic with relief pattern

Two options have been developed for detailed design consideration to assess ability to achieve the design objectives and constructability. Both options include the top section, above the wave line to have a class 2, smooth concrete face with coping panel similar to what is shown in Figure 71. The section of panel below the line is where the two options differ.

The design features of option 1:
- a modular pattern which can read as both a super graphic and at a smaller scale
- a pattern that will be minimally impacted by concrete staining and marking over time
- integration with the portal element at Wakehurst Parkway
- reinforcement of the wave form on the shared user path bridges at Forest Way and Hilmer Street
- consideration of maintenance and natural weathering of the precast concrete surface
- a termination detail that integrates the barrier detail and coping panel

Design studies showed that a regular dot matrix pattern formed strong horizontal bands which was undesirable in developing the waved pattern. A range of possible patterns was assessed, these included a range of profiles, extrusions and intrusions. A variation in sizes was used with 25mm, 50mm, 75mm and 100mm diameters with either an extrusion on intrusion of 25mm. These variations are shown in Figure 72.

The extruded sphere form best satisfied the criteria and was selected for further detail design. These are shown in Figure 73.

Figure 71 Example of class 2 top section of fascia panel and coping element

Figure 72 Precast concrete fascia panel finish studies

Figure 73 Precast concrete fascia panel finish studies
Figure 73 Concrete fascia panel - typical elevation details

- ELEVATION
- TYPICAL 2M WIDE MODULE
- COPING PANEL 500HIGH WITH 120 OVERHANG OF FASCIA PANEL
- UPPER PANEL CLASS 2 SMOOTH FINISH
- 35MM LIP BETWEEN SMOOTH UPPER SECTION OF PANEL AND TEXTURED LOWER SECTION
- TEXTURED 'BUBBLE PATTERN' - FOUR SIZES 100, 75, 50 AND 25MM DIA WITH MAX PROFILE OF 25MM
- ROADSIDE BARRIER

- PANEL CROSS SECTION DETAIL
- STUDY MODULE
- ROADSIDE BARRIER
- COPING PANEL
- UN-TEXTURED PART OF THE PANEL CLASS 2 FINISH
- TRANSITION REINFORCED BY 35MM SET DOWN IN TEXTURED PART OF THE PANEL
- COPING PANEL
- FASCIA PANEL
- TERMINATION PANEL
- ROADSIDE BARRIER

Figure 74 Example termination detail

- ROADSIDE BARRIER
- COPING PANEL
- TERMINATION PANEL
- ROADSIDE BARRIER
Precast concrete Fascia panel - Option 2 textured / coloured concrete pattern.  
Two options have been developed for detailed design consideration to assess ability to achieve the design objectives and constructability.  
The design features of option 2 include:
• a textured and coloured lower panel that contrasts with the upper natural coloured concrete panel
• a pattern that will be minimally impacted by concrete staining and marking over time
• integration with the portal element at Wakehurst Parkway
• reinforcement of the wave form on the shared user path bridges at Forest Way and Hilmer Street
• consideration of maintenance and natural weathering of the precast concrete surface
• a termination detail that integrates the barrier detail and coping panel

Using a combination of exposed aggregate and / or concrete colour pigment a strong distinction can be made between the upper and lower panels that form the wave line along the slot. This would provide the contrast to the smooth finished top part of the panel finished in a smooth class 2 finish as illustrated in Figure 74.  
The range of aggregates, cement colour additives and exposure levels are shown in Figure 75. These will be developed further in detailed design.
Figure 76 Concrete fascia panel - typical elevation details

- Panel cross section detail
- Typical 2M wide module
- Roadside barrier
- Coping panel
- Upper panel class 2 smooth finish
- 35mm lip between smooth upper section of panel and textured lower section
- Textured ‘bubble pattern’ - four sizes 100, 75, 50 and 25mm dia with max profile of 25mm
- Un-textured part of the panel class 2 smooth concrete finish
- Transition reinforced by 35mm set down in textured part of the panel

Roadside barrier study module

Coping panel 500 high with 120 overhang of fascia panel
4.4 Other Retaining Wall Types

While the soil nail wall types compromised the greater majority of retaining walls on the project that are a small number of other wall types that are proposed, these include:

- L-Shaped concrete retaining walls
- Reinforced soil walls (RSW)
- Bored piled walls
- Reinforced concrete block work walls

The selection of wall construction type is based on the consideration of road safety requirements, constructability, structural requirements, and aesthetic and visual amenity.

4.4.1 L-Shaped Concrete Walls

L-shaped walls are used in locations where they can be integrated with adjacent pavements and roadside barriers to both retain and assist in meeting roadside barrier crash performance requirements.

L-Shaped concrete retaining walls are reinforced in situ concrete walls with a class 2 finish to all exposed faces. Edges would include a 25mm chamfer.

These walls are included in stage 1 on the southern side of Frenchs Forest Road East adjacent to Sky Racing. In stage 2 they are located at the western end of the project on the southern side of Warringah south of the intersection with Fitapatrick Avenue East and on the southern side of Warringah Road east of the intersection with Wakehurst Parkway.

![Figure 77 Typical L-Shaped Retaining Wall section](image-url)
4.4.2 Reinforced Soil Walls

Reinforced soil walls (RSW) are used in the areas of fill, where the walls are facing away from the corridor. Typical examples are shown in figure 79.

The widening of Wakehurst Parkway south of the intersection of Warringah Road includes RSWs on both the eastern and western side of the corridor. In this location the wall is also integrated with a fauna underpass.

In all cases RSW are in fill and face outwards from the road corridor and into Duffys Forest vegetation. The wall on the eastern side of Wakehurst Parkway is integrated with a balustrade and roadside barrier. This provides cyclists and pedestrians with an improved amenity and connection with the adjacent bushland. A typical cross section is shown in figure 78.

The proposed finish would be a simple relief pattern with a sample shown in figures 80 and 81.
4.4.3 Bored Piled Walls

Bored piled walls are proposed to be used in two locations on the project. It should be noted that in both instances these walls are contiguous with other wall types.

A bored pile wall is required on the northwestern corner of the intersection of Wakehurst Parkway and Frenchs Forest Road West. Construction proximity to a major gas pipeline in this location dictates that a soil nail wall is not feasible and that a bored pile wall is required. In terms of the wall, facing and coping there will be no visible difference in the look of the wall when compared with the soil nail wall described in section 4.2.

The second location where a bored piled wall is required is on the southern side of Frenchs Forest Road East near the Sky Racing building. The retaining wall in this location is a combination of L-Shaped Concrete Wall and bored piled. The bored pile is required because of the proximity of the building to the road corridor and prohibits construction of a L-Shaped wall for a length of approximately 16m. In this location the concrete fascia panel will be finished to the same quality as the adjacent L-Shaped Concrete Wall.

A typical cross section for a bored pile retaining wall is illustrated in Figure 82.

4.4.4 Reinforced Block Work Wall

Reinforced block work walls are proposed in a limited number of locations in Stage 1 only. The proposed block would be consistent with what has been used with the project area on previous upgrades and intersection works, refer to figure 83. Reinforced block worked walls would also be used for property works adjustments to private properties impacted as part of the works. The extent is subject to discussions with affected residents.

The proposed colour would be charcoal with a split faced finish. A typical cross section for a reinforced block work wall is illustrated in Figure 84.
5. Earthworks, Landform and Slope Stabilisation

5.1 Cross sections

As part of the overall design approach of reducing the project footprint, earthworks have been reduced to minimum by:

- Using retaining walls
- Maximising the use of existing and widened road corridor to allow for safe operational function.

Where embankments are required, the design blends with the existing context by:

- Using suitable rock and exposing cuttings where possible; this would be applicable on the cuttings in the vicinity of the Wakehurst Parkway overbridge
- For fill embankments into Duffys Forest on the south side of Warringah Road, use site-won sandstone boulders to terrace and providing habitat at the edge of Duffys Forest Ecological Area
- Matching in with adjacent slopes and utilising 4:1 batters where feasible, especially in the areas of turf grass along Warringah Road

These principles are illustrated in Figure 86.

The most significant cuttings are located:

- In the vicinity of the existing pedestrian bridge over Wakehurst Parkway, illustrated in Figure 88
- On the northern and southern side of Frenchs Forest Road West, on the approach to the intersection with Wakehurst Parkway

Figure 86: Large area of 2:1 cut embankments at station 320 on Wakehurst Parkway illustrating impacts on existing Duffys Forest vegetation
5.2 Slope stabilisation

Based on the current level of geotechnical investigation, shotcrete is not proposed for rock seam stabilisation for exposed areas of embankment cutting. It is FYJV’s intention during detailed design to investigate the opportunities for closer to vertical cuts into suitable rock to minimise impacts to Duffys Forest Ecological Community. This approach would be complimented with a batter revegetation strategy to slopes with a maximum slope of 2(H):1(V). These slopes would use an organic erosion control blanket fixed over site ameliorated topsoil and planted out densely with a Duffys Forest mix of shrubs, ground covers and grasses.

Figure 87 illustrates the regrowth that has occurred on the existing cutting along Wakehurst Parkway.
Enlargement section to illustrate strategy for minimising and reducing impacts of cutting on Duffys Forest vegetation.

**NEAR VERTICAL BATTER IN SUITABLE SANDSTONE ROCK**

**EXTENT OF CLEARING REQUIRED 10m +/- (REDUCTION OF APPROXIMATELY 6m)**

**VEGETATED SWALE OR CATCH DRAIN TO TOP OF EMBANKMENT**

**ANCHOR TRENCH FOR ECB TO TOP OF SLOPE**

**EROSION CONTROL BLANKET (ECB) FIXED TO 2:1 BATTER SLOPE WITH A MIXTURE OF TRANSLOCATED TOPSOILS AND GAP GRADED MULCH. PLANTED OUT WITH ENDEMIC DUFFYS FOREST PLANT COMMUNITY TUBESTOCK MIX**

**GAP GRADED MULCH PLANTED OUT WITH ENDEMIC DUFFYS FOREST PLANT COMMUNITY TUBESTOCK MIX**

**ILLUSTRATION OF DAY 1 WORKS**

**EG - EXISTING GRADE**
Figure 89: Enlargement section to illustrate strategy for minimising and reducing impacts of cutting on Duffy's Forest vegetation.

ILLUSTRATION OF REGENERATED LANDSCAPE WORKS: 3-5 YEARS
6. Landscape Design

6.1 Strategy and principles

There are four core strategies to meeting one of the projects core elements of a ‘forest legacy’. These include:

- Maximising the retention of existing trees
- Ensuring a diverse and robust revegetation strategy for;
  - Duffys Forest landscape community and
  - The Warringah Road and Frenchs Forest road corridors
- Integrating with a viable and sustainable top soil strategy
- Developing a landscape establishment and ongoing management plan

Existing Tree Retention

The retention of existing vegetation is a key starting point in realising this project aspiration. This strategy to maximise the retention of existing vegetation is underpinned by the following process:

- Working with the road alignment team have looked to minimise road footprint while meeting safety and functional requirements
- Working with the structural design team to coordinate and introduce retaining structures and retaining structure typologies to minimise impacts on existing vegetation
- Working with the utilities design team to coordinate and allow for utility trenching, under grounding and access that minimises impact on existing vegetation

The benefits of these approaches are summarised in Table 6.

Complementary to the initiatives to retain existing vegetation is a landscape design that will mitigate as much as possible the increased corridor footprint and loss of existing vegetation as part of the Works. FYJV’s planting and revegetation design supports and reinforces the key landscape typologies:

- The bush land corridor (Duffys Forest Ecological Community),
- The forest parkway
- The suburban street.

The forest canopy of Warringah Road will be reinforced by tree plantings between the shared path and noise walls. The design of the space between the surface carriageway and the slot along Warringah Road has been coordinated between disciplines to maximise the opportunity for tree planting and understorey to reduce the perceived scale of the large paved areas.

Plantings of Eucalyptus, Corymbia and Angophora species will be use to deliver the long term legacy of the Forest landscape. This approach can be seen in the example image from the Lane Cove Tunnel project where extensive new tree planting has been used to complement existing trees and ensure a long term forest legacy. Refer to Figure 90.

Table 6  Summary of actions to maximise the retention of existing vegetation

<table>
<thead>
<tr>
<th>Coordinated design action</th>
<th>Location</th>
<th>Benefits to existing vegetation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retention of existing kerb line</td>
<td>At southern side of Forest Way / Warringah Road intersection</td>
<td>Retention of number of existing trees located just behind existing pathway. Refer figure 91.</td>
</tr>
<tr>
<td>Reduction in proposed widening of Wakehurst Parkway</td>
<td>North of Frenchs Forest Road West</td>
<td>Significantly less clearing of Duffys Forest vegetation required and reduced height of retaining wall.</td>
</tr>
<tr>
<td>Adjustment of existing kerb line on Warringah Road</td>
<td>North side of Warringah Road east of intersection with Forest Way</td>
<td>Minimises impact on very large existing Eucalyptus trees, puts existing trees outside the clear zone and provides adequate space for underground utilities while minimising impact on existing trees. Refer figure 92.</td>
</tr>
<tr>
<td>Retaining walls reducing impacts on Duffys Forest vegetation</td>
<td>Eastern and western sides of Wakehurst Parkway near Frenchs Forest Road East and West</td>
<td>Reduced clearing extent</td>
</tr>
<tr>
<td>Low retaining walls adjacent to pathways</td>
<td>Around Allambie Road at Warringah Road intersection</td>
<td>Minimises impacts on large / healthy existing specimens</td>
</tr>
<tr>
<td>Using an on grade shared pathway connection in lieu of an elevated structure</td>
<td>Between Fitzpatrick Avenue East and the shared path bridge landing across Forest Way</td>
<td>Potential to retain some existing specimens close to the back fences of properties on Karingal Crescent</td>
</tr>
</tbody>
</table>
**Figure 91** Design improvements to retain existing vegetation at the intersection of Forest Way and Warringah Road

**Figure 92** Design improvements to retain existing vegetation on the northern side of Warringah Road

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CONCEPT DESIGN RETAINS THE EXISTING KERB ALIGNMENT, RETAINING WALL AND PATHWAY TO PEDESTRIAN CROSSING

ADJUSTED KERB RESULTS IN MINIMAL IMPACTS ON LARGE EXISTING TREES

AREA OF EXISTING LANDSCAPE ZONE REQUIRED FOR PATH AND RETAINING WALL (IN REFERENCE DESIGN)

EXISTING RETAINING WALL PROPOSED KERB ALIGNMENT OF REFERENCE DESIGN

TURF VERGE

3m WIDE SHARED PATH WITH PROVISION FOR SERVICES UNDERNEATH

ADJUSTED KERB LINE AS ILLUSTRATED ON ALIGNMENT DRAWINGS
6.2 Water Sensitive Urban Design

Opportunities for Water Sensitive Urban Design (WSUD) have been considered as integral part of both the project landscape design and interaction with the water management cycle. While only a Consultation Draft the TfNSW Guideline to Water Sensitive Urban Design has been reviewed and the guidelines applied where feasible.

Particular constraints include;

- The actual width of the corridor, where landscape area is significantly restricted
- The adjacent interfaces with private property (where no additional storm water runoff is permissible)
- Management of overland flow and required flood immunity levels

Working within these constraints a range of strategies and approaches have been developed to maximise the opportunities for WSUD on the project. These include;

- Modifying pavement cross falls where the corridor is not interfacing with private property facilitating;
  - passive irrigation
  - initial treatment
  - reducing required earthworks
- Providing vegetation to swales at the top of retaining walls and reducing the number of concrete dish drains
- Reducing the amount of hardstand on the project - an example being the elevated (and permeable) deck to the eastern side of Wakehurst Parkway and northern side of Aquatic Drive
- Improving water infiltration by;
  - Reducing the extent of embankment by using retaining walls
  - Where embankments are required designing with slopes of 4:1 with a 3:1 as a maximum where project footprint allows.

6.3 Seed Collection and Revegetation Strategy

Consistent with the project objectives, conditions of approval and SWTC the FYJV has put into place a Revegetation Strategy for the Duffys Forest ecological landscape community. Revegetation of Duffys Forest Ecological Community will be required as part of Stage 1 and Stage 2 works. The exact extent of disturbed areas requiring revegetation is to be confirmed and is based on the principle of minimum disturbance. All works will be carried out consistent with the requirements of ‘Biodiversity Guidelines – Protecting and managing biodiversity on RTA projects’ – RMS 2011.

The Seed Collection and Revegetation Strategy are requirements of the Conditions of Approval and Appendix B11 of the Scope of Work and Technical Criteria (SWTC). A Vegetation Management Plan has been prepared which includes a Seed Collection and Revegetation Strategy, this report is include in APPENDIX E of this report.
6.4 Planting schedule

The plant schedule is specifically tailored to meet the following objectives and requirements:

- A long term ‘forest’ canopy legacy for the project area
- Establishment of a well vegetated, sustainable and resilient landscape
- Reinforcement of the three distinct landscape typologies in the project area
- The requirements of the environmental documents
- Adherence to the Roads and Maritime specifications, specifically R179 (Planting), R176 (Seed Procurement) and R178 (Revegetation).

- Council approved species as listed in the Draft Street Tree Planting Policy (Warringah Council, 2014)

Table 7 outlines the proposed plant schedule for the works. The schedule identifies species based on the landscape typology.

A detailed plant schedule for each stage of the project is provided in Appendix A.

The species listed are consistent with those listed in the Vegetation Management Plan, refer APPENDIX E, table 1.

<table>
<thead>
<tr>
<th>Landscape Typology</th>
<th>Plant type</th>
<th>Species</th>
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</thead>
<tbody>
<tr>
<td><strong>Canopy Trees</strong></td>
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<td>Angophora costata</td>
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<td>Corymbia guillaufi</td>
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<td>Allocasia anna littoralis</td>
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<th>Landscape Typology</th>
<th>Plant type</th>
<th>Species</th>
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<td>Soft Leaved Buffalo - Sir Walter or similar</td>
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<table>
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<th>Landscape Typology</th>
<th>Plant type</th>
<th>Species</th>
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<tr>
<td><strong>Turf Grass</strong></td>
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<td>Soft Leaved Buffalo - Sir Walter or similar</td>
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</table>
6.5 Landscape management requirements

Landscape management will be required to ensure the intent of the landscape design is realised. The design intention of the Works fall into three key categories that support the three landscape character typologies. These are:

- Duffys Forest landscape association including areas adjacent to Wakehurst Parkway, Aquatic Drive and approximately 100m east and west on Frenchs Forest Road and Warringah Road. This area will require a combination of revegetation and replanting (Figure 93).
- Warringah Road corridor planting including areas adjacent to the slot. Planting in these areas will include a combination of tree planting, mass planted areas and turf grass. These areas will require replanting (Figure 94).
- Frenchs Forest Road East and West / Naree Road. Planting in these areas will be chiefly restricted to street trees (generally smaller species to allow for overhead services) and turf grass. There will be some mass planted areas but these will be isolated.

Landscape management requirements will need to be tailored to each of these landscape typologies. The following management requirements will be required to ensure the successful landscape legacy of the project:

- Plant establishment: A thorough and well implemented plant establishment period to ensure that all of the new plantings are in the optimum state at completion of this stage.
- Vegetation Management Plan: A detailed recording of implementation of the Vegetation Management Plan (VMP) for the Duffys Forest Ecological Area.
- Maintenance of vegetation between the shared path and noise wall to ensure that understory shrubs do not shade out and block the north facing transparent panels to the private residences along Karingal Crescent.

A landscape management plan detailing all landscape maintenance actions will be prepared for the Project’s landscape works.
7. Road Furniture

7.1 Feature lighting and lighting fixtures

The lighting layout will meet all relevant standards and requirements of RMS and Council. Lighting design has been undertaken to ensure that the relevant vehicle (V) and pedestrian (P) category levels are met.

FYJV has reviewed the Project from an urban design viewpoint, and have committed to install underground streetlight power where it is not practical or necessary to have overhead power mains. This allows the use of steel street light columns using underground power supply for the full length of the Warringah Road slot, and for all of the upgraded Wakehurst Parkway, as well as along the south verge of Frenchs Forest Road West in front of the new Northern Beaches Hospital and The Forest High School.

Key characteristics of the lighting scheme include:

- The use of double outreach LED lights located between the slot and surface carriageways. An example of this is illustrated in Figure 84. This single post fixture can provide sufficient illumination to the slot, surface lanes and adjacent pathways in all locations except where the shared path is on top of the retaining wall opposite Forest Way intersection. Supplemental lighting to the shared path will be provided in this location.
- Feature lighting to the shared path bridges through the use of an embedded LED strip light in the handrail of the inside arc of the structure. An example of this is illustrated in Figure 96.
- Frenchs Forest Road West / Naree Road will have fixtures on the northern side only that are set back from the kerb to meet clear zone requirements. Where Frenchs Forest Road West widens at the intersection of Wakehurst Parkway, lighting will also be provided on the north side of the intersection.
- Additional fixtures will be provided at the main intersections, consistent with RMS requirements to meet the required levels.
- Short under passes will have strip fluorescent lighting.

The overall project lighting strategy is illustrated in Figure 95.
The Design will follow the preliminary power pole layouts produced by the Project’s nominated Ausgrid approved Level 3 designer UGL.

The following information was used in developing the Lighting Design:

- UGL Concept Design
- SWTC Section 4.19 Lighting
- AS 1158 – 2007 Code of Practice for Public Lighting
- RMS Specification 3851
- FYJV Tender lighting design

Lighting layout will be coordinated with the street tree planting layout in order to provide the most rhythmic layout while meeting the required lighting levels.

For the slot and shared user path bridges the lighting elements will become an RMS asset. For the slot the lighting fixture will be a marine grade die cast aluminium alloy with an LED bulb and utilise a double outreach to light both the slot and surface roads. An example of a double outreach fixture is illustrated in Figure 97.

The design demonstrates that lighting levels are suitable for all pedestrian areas except along the southern side of Warringah Road west of Hilmer Street around to Fitzpatrick Avenue East. Pole top lights will be used along the shared path in this location. The proposed fixture for the slot lighting is shown in Figure 98.

For the shared user path bridges an integrated LED in the handrails will be used to provide lighting. The length of the shared path bridge requires that there are four runs of LED lighting, two on each side of the bridge running towards the centre. The lighting controls are hidden within the handrail itself while the power source will be discretely fixed to one of the post supports for the bridge railing. Indicative details and style of this type of lighting is illustrated in Figure 96.
7.2 Furnishings and fixings

The furnishings and fixings components of the public domain will be consistent with the requirements of Warringah Council and RMS.

Fencing and Balustrades

Three types of fencing are required on the project these include:

- Fauna fencing along Wakehurst Parkway
- Security / safety fencing to the top of the slot
- Safety fencing to the top of retaining walls with a fall height of greater than 900mm

The fauna fence and safety fencing to the top of retaining walls are consistent with and meet all the technical requirements of the relevant RMS standards. The security fence to the top of the slot is proposed to be a palisade style fence. The selected style has been chosen in order to maximise transparency across the corridor while also being complimentary in style to the existing black palisade fence installed to the perimeter of the Forest High School.

The proposed security specification would be:

- Curve pale - round steel tube 25mm dia.
- hot dipped galvanised and powder coated - colour: black
- anti climb profile
- stepped horizontal profile
- straight pale top

Balustrades to shared pathways will be consistent with the relevant requirements outlined in AustRoads for shared user pathways. This detail would be used along the southern side of Warringah Road between the Noise Wall at Hilmer Street and Fitzpatrick Avenue East and to the sections of 2.5m and 1.5m shared path and path along the eastern and northern sides of Wakehurst Parkway and Aquatic Drive respectively.

Indicative materials are illustrated in Figures 99, 100 and 101.
Bus stops

Across the project area there are 45 identified bus stop locations. Shelters are required at 29 of these stops.

A site map of agreed and RMS / Warringah Council endorsed bus stop locations and the scope of elements for inclusion at each of those stops is provided in Figure 104 (over the page).

All bus stop locations will include the provision for:

- 1540mm x 2070mm wheelchair circulation and level boarding point with a maximum cross fall of 1:40
- A minimum 150mm high barrier kerb at bus stop boarding locations
- All signage will be offset a minimum 600mm from face of kerbs
- Tactile paving to meet the requirements of AS1428.4.1

A number of stops will also provide shelters, these are noted in Figure 104 and will include:

- Lighting to bus shelters to have a minimum LUX level of 150
- Seating to be installed as per AS1428.2

A typical bus stop layout with shelter is illustrated in Figure 103.

Bus shelters types will be consistent with the Warringah Council guidelines. Four types of shelter have been nominated within the project extents;

- Optishel (existing style and nominated for reuse)
- EVO Stoddart
- Metro Stoddart

These three types are illustrated in Figure 102. For further details refer to the Road Furniture design packages for Stage 1 and 2.
Northern Beaches Hospital Connectivity and Network Enhancement

**Variation 18**

**Date:**

- Enhancements
  - Existing - Final = 5 Evo Type Shelters
  - Brick type shelter Scope: Replace
  - Scope - Existing: Existing bus stop with shelter Scope: Retain existing stop
  - 3 Warringah Rd near Forest Way (EB)
  - 2 Warringah Rd near Fitzpatrick Av (WB)
  - 7 Warringah Rd near Forest High School (WB)
  - 16 Warringah Rd near Wakehurst Pkwy
  - 20 Frenchs Forest Rd near Patanga Rd (EB)
  - 21 Frenchs Forest Rd near Inverness Av (EB)
  - 25 Frenchs Forest Rd near Patanga Rd (WB)
  - 27 Frenchs Forest near Patanga Rd (WB)
  - 28 Frenchs Forest near Skyline Pl (EB)
  - 30 Frenchs Forest near Hurdis Av (WB)
  - 31 Frenchs Forest Rd near Denison Av (EB)
  - 32 Frenchs Forest Rd near Wakehurst Pkwy
  - 33 Frenchs Forest Rd near Skyline Pl (EB)
  - 35 Frenchs Forest near Banyan Bay Rd (WB)
  - 39 Wakehurst Parkway near Frenchs Forest Rd
  - 40 Northern Beaches Hospital Connectivity and Network Enhancement
  - 41 Naree Rd near Rabbet St (WB)

**Key**

- Retain Existing Bus Stop
- Replace
- Relocate Laterally
- Remove/To be removed
- Not in scope
- Variation 18 (description in RED)

**Bus Stop Locations**

- (Source: RMS, 2016)
- Use existing surplus shelter if available
- Not required if services use Rabbet Street. Flag poll

**Figure 104**

Bus stop locations and relevant actions within the project works (Source: HMS, 2016)
7.3 Shared Path and Pedestrian Pavements

Consistent with the project vision of providing improved circulation and access for local community and extensive upgrades to the network are being provided as part of the project works. This network is illustrated in Figure 105.

To assist with defining space and increasing safety a hierarchy of pavement types are proposed to shared paths and pedestrian paths. These are summarised in table 8. The path types described in the table cover almost all of the pavement types on the project, however there are few sections where specialised paving is used. These locations included:

- The skyline shops precinct where the design applies the Warringah Council Public Space design guidelines. In this location brick unit paving is to be used.
- The bus stop outside of Forest Way Shops on Forest Way. In this location brick paving is proposed consistent with the guidelines.
- At the landing thresholds for the two shared user path bridges near Forest Way and Hilmer Street. In these locations concrete pavement will still be used but a different surface finish and scoring pattern will be used. The objective being to assist with safety and identify the space as an intersection / transition location.
- At the approaches to bus stops located on shared paths. In these locations concrete pavement will still be used but a different surface finish and scoring pattern will be used. The objective being to assist with safety and identify the space as an intersection / transition location.

Examples of the proposed path finishes are illustrated in Figure 106 and for the specialised paved areas typical details are shown in Figure 107.

In all cases hazard tactiles and directional tactiles will be laid out in the pavement ground to meet the relevant standards and luminance contrasts.

### Table 8 Noise Wall Schedule

<table>
<thead>
<tr>
<th>Path Type</th>
<th>Description</th>
<th>Width</th>
<th>Finish</th>
<th>Colour*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pedestrian Path</td>
<td>1.5m</td>
<td>Broom finish</td>
<td>Integral Colour - equivalent to CCS ‘Onyx’</td>
</tr>
<tr>
<td>2</td>
<td>Pedestrian Path</td>
<td>3.5m</td>
<td>Broom finish</td>
<td>Integral Colour - equivalent to CCS ‘Onyx’</td>
</tr>
<tr>
<td>3</td>
<td>Shared Path</td>
<td>2.5m</td>
<td>Broom finish</td>
<td>Integral Colour - equivalent to CCS ‘Onyx’</td>
</tr>
<tr>
<td>4</td>
<td>Shared Path</td>
<td>3.0m</td>
<td>Broom finish</td>
<td>Integral Colour - equivalent to CCS ‘Onyx’</td>
</tr>
<tr>
<td>5</td>
<td>Shared Path Bridge Ramps</td>
<td>3.0m</td>
<td>Broom finish</td>
<td>None</td>
</tr>
<tr>
<td>6</td>
<td>Shared Path Bridge Deck</td>
<td>3.0m</td>
<td>Broom finish</td>
<td>None</td>
</tr>
</tbody>
</table>

*Note: Scope of Work and Technical Criteria - Appendix B11 Clause 10 (b) - Footpaths, shared use paths must be constructed from a brush finished concrete with an integral oxide pigmentation, grey in colour equal to Colour Concrete Systems ‘Onyx’ to reduce glare.
EXAMPLE OF SHARED USER PATH WITH LIGHT BROOM FINISH TO NATURAL COLOURED CONCRETE

DETAIL OF JOINT ON NATURAL COLOURED CONCRETE WITH LIGHT BROOM FINISH

INTEGRAL OXIDE PIGMENT WITH CONCRETE WITH MEDIUM BROOM FINISH - COLOUR EQUIVALENT TO CCS - ONYX

EXAMPLE OF CONCRETE WITH LIGHT ABRASIVE BLAST FINISH AND SAW CUT PATTERN

TYPICAL BRICK PAVING LAYOUT DETAILS TO BE APPLIED TO SKYLINE SHOPS PRECINCT

Figure 106 Proposed path finishes

Figure 107 Proposed indicative paved area typical details
8. Noise Barriers

8.1 Location and extent

The extent of noise barriers is illustrated in Figure 108. The noise walls vary in height to a maximum of 4m. The proposed walls are generally north and north west facing. The noise walls will interface with the rear gardens of residential properties which have frontage along Karingal Crescent and Panorama Crescent. Between Hilmer Street and Bantry Bay Road the noise wall will interface with the northern (side) boundaries of three dwellings. One on the west side of Hilmer Street and one on the west side of Bantry Bay Road.

The approach and design of the noise walls is consistent with the requirements of Noise wall design guidelines - Design guidelines to improve the appearance of noise walls in NSW (RMS, November 2007). The FYJV design achieves the following outcomes:

- Reinforces the linear nature of the forest parkway
- Minimises overshadowing to residences along Karingal Crescent and Panorama Crescent
- Maximises landscape planting between the shared path and wall
- Maintains the two through block connections from Karingal Crescent

There are two sections of noise wall overlap required to maintain the through block connections from Karingal Crescent. The overlap at the western connection, opposite Forest Way intersection, involves integrating the wall with the retaining wall and shared path bridge landing. Enlargement plans illustrating these arrangements are in Section 3.0, Figures 23 and 26.

Constraints include:
- underground services including sewer lines
- topography (some areas have slopes of up to 18%)
- the integration of overland flow and surface drainage requirements
- shared user path lighting
- existing trees adjacent to property boundaries

A proposed noise walls and relevant details are summarised in Table 9.

<table>
<thead>
<tr>
<th>Wall ID</th>
<th>Location</th>
<th>Length</th>
<th>Height (min)</th>
<th>Heights and finishes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2NW-01-WB</td>
<td>72m</td>
<td>4.0m</td>
<td>2.5m opaque precast, 1.5m transparent</td>
</tr>
<tr>
<td>2</td>
<td>2NW-02-WB</td>
<td>188m</td>
<td>3.5m</td>
<td>2.5m opaque precast, 1.0m transparent</td>
</tr>
<tr>
<td>3</td>
<td>2NW-03-WB</td>
<td>Within road corridor; 36m / 72m</td>
<td>2.5m</td>
<td>Half of length on top of wall, half integrated into bridge throw screen</td>
</tr>
<tr>
<td>4</td>
<td>2NW-04-WB</td>
<td>328m</td>
<td>3.5m</td>
<td>2.5m opaque precast, 1.0m transparent</td>
</tr>
<tr>
<td>5</td>
<td>2NW-05-WB</td>
<td>Within road corridor; 56m</td>
<td>1.5m</td>
<td>800mm high road barrier, 700 high transparent panel</td>
</tr>
<tr>
<td>6</td>
<td>2NW-06-WB</td>
<td>96m</td>
<td>3.5m</td>
<td>2.5m opaque precast, 1.0m transparent</td>
</tr>
<tr>
<td>7</td>
<td>2NW-07-WB</td>
<td>96m</td>
<td>3.0m</td>
<td>2.5m opaque precast, 0.5m transparent</td>
</tr>
</tbody>
</table>
8.2 Materials and finishes

The proposed materials for the noise wall panels are a combination of precast concrete panel and a transparent panel. The panel module will be 4m long and vary in height between 4m and 3.0m for all walls adjacent to private property as illustrated in Figure 112.

To support the linear nature of the corridor, reduce the apparent height of the wall and integrate an anti-graffiti strategy a simple horizontal relief pattern will be provided on the public facing face. This fluting has a depth of 25mm. An example of this is illustrate in Figure 109. On the private residents face a horizontal relief is also provided but with a shallower depth of 5mm. This still provides a subtle horizontal relief to reduce the scale of the wall and reduces the need to increase the thickness and structural reinforcement of the panels.

The proposed colour will be a recessive grey charcoal, providing a backdrop to the tree, shrub and ground cover planting located between the shared path and noise wall. An indicative colour palette is illustrated in Figure 110.

The top 1.5m of the 4m high wall, top 1.0m of the 3.5m and top 0.5m of the 3m high wall will be transparent plexiglass with a frameless top* and include provision for an embedded horizontal frit to minimise possible bird strike. A typical detail of this is illustrated in Figure 111. This has been selected for the following reasons;

• To reduce the visual bulk of the noise wall
• Minimise overshadowing into private backyard spaces and
• Reduce the structural weight of the noise wall

The vast majority of the noise wall will be located adjacent to the boundary with private property. The approach will be to locate the supporting pile foundations immediately adjacent to the property line. This relationship is illustrated in Figure 109.

Typical elevation details and cross sectional information is illustrated in Figures 113 to 116.

The noise wall over lap near Hilmer Street (at the through connection to Karingal Crescent) is integrated with the road side barrier. The details for this wall are illustrated in Figure 115.

The noise wall over lap near Forest Way (at the through connection to Karingal Crescent) is integrated with the bridge throw screen and retaining wall. The details for this wall are illustrated in Figure 116.

* To meet structural design requirements a top frame is required for the plexiglass when the height of the panel is great than 1.5m and is located on the end section of the wall.
Figures 113 Typical elevation of 3.5m high noise walls

PUBLIC FACING ELEVATION

PRIVATE FACING ELEVATION

- POST TO SIT 50mm BELOW THE PLEXIGLASS
- PLEXIGLASS PANEL FRAMELESS TOP EDGE
- PRECAST CONCRETE PANEL WITH HORIZONTAL FLUTED PROFILE - 25MM DEPTH TO FLUTING
- H.D. GALVANISED UB PANEL SUPPORT POST POWDERCOATED

- POST TO SIT 50mm BELOW THE PLEXIGLASS
- PLEXIGLASS PANEL FRAMELESS TOP EDGE
- PRECAST CONCRETE PANEL WITH HORIZONTAL FLUTED PROFILE - 5MM DEPTH TO FLUTING
- H.D. GALVANISED UB PANEL SUPPORT POST POWDERCOATED
Figure 114 Panel cross section and elevation details

**Typical PreCast Module 1250mm**

**Precast Concrete Panel with Horizontal Fluted Profile - 25mm Depth to Fluting**

**PreCast Concrete Panel with Horizontal Fluted Profile - 5mm Depth to Fluting**

** Plexiglass Panel Frameless Top Edge**

**H.D. Galvanised UB Panel Support Post Powdercoated**

1. For NoiseWall Adjacent to Property Boundary
2. For NoiseWall Overlap Sections

TYPICAL CROSS SECTION DETAIL
Figure 115 Noise wall overlap near Hilmer Street illustrating integrated noise wall and roadside barrier detail.
Figure 116 Noise wall overlap near Forest Way illustrating integrated noise wall and throw screen.
8.3 Cross sections

A typical cross sections for the noise wall is illustrated in Figure 90. For the majority of the length of the noise wall there is a width (2m - 3m) of landscape between the edge of the shared path and the noise wall. The condition changes where:

- The mid block connections from Karingal Crescent puncture the noise wall
- The space between the carriageway and property boundary is less than 6m

The typical cross sectional detail provides space for a landscape buffer between the noise wall and shared path, as illustrated in Figure 114.

For the area around the Forest Way shared path bridge, the design integrates to allow the retention of two large blue gums, safe open transition from the shared path to the bridge structure and a connecting path down to Fitzpatrick Avenue East. This design is illustrated in the enlargement plan in Section 3.0 Figure 23. The detailed cross sections are illustrated in Figures 117, 118 and 119.

Figure 117 Typical cross section through shared path and noise wall (east of Forest Way)
Figure 118 Section through roadside retaining wall, shared path, retaining wall and noise wall

- Private Residents (receivers)
- Landscape Buffer
- 3m Wide Pedestrian/Shared Path
- Warringah Road Westbound (emitters)

- Tree Buffer Planting
- Shared User Path Lighting
- Top 1.0m of Noise Wall to be Transparent
- Lower Section of Noise Wall / Transitions to be Retaining Wall
- Shared User Path Lighting
- Shared Path Coming Uphill at 5% Grade from Fitzpatrick Avenue East
- Balustrade to Edge of Shared Path
- Coping Panel for Balustrade
- Precast Concrete Wall Panel

KEY PLAN
Figure 119: Section through roadside retaining wall, shared path bridge ramp, shared path and noise wall (with overlap)

*1 - Retention of existing specimen gum trees subject to detailed design and Arborist inputs

*2 - Retention of existing specimen gum trees subject to detailed design and Arborist inputs
Figure 120  Section through roadside retaining wall, noise wall and shared path

*1 - Retention of existing specimen gum trees subject to detailed design and Arborist inputs
Figure 121  View of two large Blue Gum specimens from Forest Way

SPECIMEN NUMBER 1 - LOCATED IN PRIVATE PROPERTY - REFER TO SECTION 3.0 FIGURE 23 *1

SPECIMEN NUMBER 2 - LOCATED IN ROAD RESERVE - REFER TO SECTION 3.0 FIGURE 23 *1

Note: RETENTION OF THESE TWO LARGE BLUE GUM SPECIMENS WILL ASSIST IN GREATLY REDUCING THE SCALE AND IMPACT OF CHANGE AT THE INTERSECTION OF FOREST WAY. VIRTUALLY ALL OF THE OTHER VEGETATION IN THIS PHOTOGRAPH WILL REQUIRE REMOVAL AS PART OF THE WORKS.

*1 - RETENTION OF EXISTING TREES SUBJECT TO DETAILED DESIGN OF LEVELS, NOISE WALLS AND ARBORIST INPUTS.
8.4 Elevations

A typical elevation (from the roadside) for the noise wall is illustrated in Figure 122 and 123. This shows the approximate relationship with the wall and the existing properties. An indicative elevation is also provided from the private property side of the noise wall in Figure 120.
Figure 123  Enlargement typical elevation of noise wall, road users view

- 3.5m high noise wall
- 2.5m opaque
- 1.0m transparent
- 4.0m noise wall module
- Shared user path lighting
- Top 1.0m of panel to be transparent to maximise solar gain
- Steel post support @4000mm centres painted to match concrete panel
- Precast concrete panel 150mm thick with horizontal relief pattern
- Tree plantings to reinforce parkway character and provide long term forest canopy legacy to Warringah Road
Figure 124  Typical elevation of noise wall from rear garden of residences along Karingal Crescent

- **3.5 m HIGH NOISE WALL**
- **2.5 m OPAQUE**
- **1.0 m TRANSPARENT**
- **PROPERTY BOUNDARY**
- **EXISTING BOUNDARY FENCE TO BE RETAINED AND EXTENDED AS REQUIRED**
- **APPROXIMATE HEIGHT OF 1.8m HIGH EXISTING FENCE**
- **STEEL POST SUPPORTS WITH PAINTED FINISH**
- **LEVEL CHANGES TO BE MADE AT PROPERTY BOUNDARIES WHERE POSSIBLE**
- **TREE PLANTINGS TO REINFORCE PARKWAY CHARACTER AND PROVIDE LONG TERM FOREST CANOPY LEGACY TO WARRINGAH ROAD**
- **LANDSCAPE BUFFER BEHIND WALL WITH CLEAR STEMMED TREE PLANTINGS AND NATIVE SHRUBS AND GRASSES**
8.5 Elevation studies

The Scope of Works and Technical Criteria - Appendix B11 (Section 9.2 section (I) (vi) states:

“the tops of noise walls and headlight screens in general must not be stepped and must form a continuous flowing line. Where stepping of noise wall panels is unavoidable, for example due to topography, then stepping should be neat and architecturally thought out”.

Following detailed review of the noise wall elevations there are a couple of locations where topography will require stepping of the tops of noise walls. These are located at:

- Noise Wall 2NW-01-WB between chainages 20 and 40 (south of Fitzpatrick Avenue East). Located on the boundary between the underground detention area and the rear of private residences on Panorama Crescent. Maximum cross-falls here are in the order of 1:5.5 (18%)
- Noise Wall 2NW-02-WB between chainages 110 and 150 (north of Fitzpatrick Avenue East). Located on the boundary between the shared user path and the rear of private residences on Karingal Crescent. Maximum cross-falls here are in the order of 1:5.5 (18%).

Generally for the rest of the project area the falls are less than 5% in areas proposed to have noise walls.

In meeting the requirements the urban design team in collaboration with the structural design has been undertaking studies to consider the best layout for the noise walls in locations of steeper topography. These are illustrated in Figures 125 through 127.

Table 9 summarises the benefits and constraints for each of the options and the recommendations for further design development. A key component will be to align the horizontal patterning of the concrete panel (refer Figure 128) with the transition to the transparent panel.

### Table 10: Sloped Noise wall

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Benefits</th>
<th>Constraints</th>
<th>Meets requirements</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Single stepped panel module (Refer Figure 121)</td>
<td>Consistent with other panels (in flatter sections of wall) Minimises the extent of wall projecting above 4m in height Most efficient use of materials</td>
<td>Jagged top to wall Doesn’t meet criteria in the SWTC</td>
<td>low</td>
<td>Transition between transparency and opaque module to be in alignment Use a module 125mm Only consider for very step sections of slope</td>
</tr>
<tr>
<td>2. Double stepped panel module (Refer Figure 122)</td>
<td>Softer more balanced transitions than the single panel option Longer (8m) length horizontals are consistent with adjacent house roof lines Simpler rhythm More efficient use of materials</td>
<td>Some walls project well over 4m in height Custom panels and footings required for sections of wall greater than 4m Greater wall height to rear yards of Karingal Crescent residents</td>
<td>medium</td>
<td>Transition between transparency and opaque module to be in alignment Use a module 100mm Develop further in detailed design Preferred option</td>
</tr>
<tr>
<td>3. Sloped top - transparency panel (Refer Figure 123)</td>
<td>Can maintain a consistent 4m offset from ground level Minimise height of wall to rear yards of Karingal Crescent residents</td>
<td>Class 2 concrete integrated with 2 post rail traffic barrier Custom transparency sections for each module required Less efficient use of materials - plexiglass</td>
<td>medium</td>
<td>Develop further in detailed design Unsustainable in terms of material use and costly - do not pursue in detailed design</td>
</tr>
</tbody>
</table>

The design parameters for detailed design include:

- Assuming that precast panels are to be 1250mm high, all steps are to be a multiple of 125mm
- Single panel steps may be used where the step between adjacent panels is greater than or equal to 250mm
- Single step panels may not be used alone they must be in groups with a minimum of four panels.

- Steps between panels must be consistent, for example five steps of 250mm
- Double panels should be used in all other instances.
Figure 127: Elevation study example #02

Figure 128: Panel stepping studies
9. Appendices
9.1 Appendix A - Planting Schedule

Considerations -

Plant Material Availability

Informing the plant schedule are the following procurement strategies -
• Procurement of advanced tree stock for street tree and screen planting;
• Seed collection and germination of material for preparation as tube stock for revegetation of Duffys Forest Areas
• Topsoil striping, testing an amelioration recommendations
• Selection of street trees includes species that are commercially grown in the sizes specified and can be easily procured in the current project lead times.

Topsoil and Weed Management Strategy (Appendix G)

Topsoil testing and amelioration recommendations have considered the specific requirements of the Duffys Forest species mix.

Project Staging

The project is expected to be delivered in three main phases.
• Stage 1a
• Stage 1b
• Stage 2

The plant schedules are structured to meet this staging and also to distinguish between the areas of Duffys Forest regeneration and general corridor landscape.

<table>
<thead>
<tr>
<th>STAGE 1A STREET TREES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genus and species</td>
</tr>
<tr>
<td>-----------------------</td>
</tr>
<tr>
<td>Angophora costata</td>
</tr>
<tr>
<td>Callistemon 'Kings Park Special'</td>
</tr>
<tr>
<td>Callistemon salignus</td>
</tr>
<tr>
<td>Corymbia maculata</td>
</tr>
<tr>
<td>Cupaniopsis anacardioides</td>
</tr>
<tr>
<td>Elaeocarpus reticulatus</td>
</tr>
<tr>
<td>Gondonia axillaris</td>
</tr>
<tr>
<td>Harpulla pendula</td>
</tr>
<tr>
<td>Hibiscus lalaeus 'Rubra'</td>
</tr>
<tr>
<td>Leptospermum petersoni</td>
</tr>
<tr>
<td>Melaleuca bracteata 'Revolution Gold'</td>
</tr>
<tr>
<td>Tristaniopsis laurina</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STAGE 1A STREET AND VERGE GROUND COVERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genus and species</td>
</tr>
<tr>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Callistemon viminiatis 'Little John'</td>
</tr>
<tr>
<td>Carpobrotus glaucescens</td>
</tr>
<tr>
<td>Dieteris grandiflora</td>
</tr>
<tr>
<td>Doryanthes excelsa</td>
</tr>
<tr>
<td>Gazania lomentosa</td>
</tr>
<tr>
<td>Gazania 'Double Gold'</td>
</tr>
<tr>
<td>Lomandra conferifolia 'Winggarra'</td>
</tr>
<tr>
<td>Lomandra longifolia</td>
</tr>
<tr>
<td>Muellerbeckia axillaris</td>
</tr>
<tr>
<td>Trachilospermum jasmoides 'Flat Mat'</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STAGE 1A STREET AND VERGE TURF GRASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
</tr>
<tr>
<td>-------------------------------------</td>
</tr>
<tr>
<td>Zoysia 'Empire' ^</td>
</tr>
</tbody>
</table>

^Turf grass species is consistent with RMS Specification 179
## DUFFYS FOREST REVEGETATION PLANT SCHEDULE - STAGE 1A

**Species** | **Common Name** | **Description** | **Seed Collection** | **Size (At installation)** | **Quantity** **Note**
--- | --- | --- | --- | --- | ---
Afrocarpus rivotortus | Black She-oak | Tree; 5 - 15 m | Year round | 200mm | **to be confirmed in Design Development**
Argophora costata | Smooth-barked Apple | Tree; to 30 m | Late December – Early February | 200mm | **Refer note**
Banksia serrata | Old Man Banksia | Tree; to 15 m | Year round | 200mm | **Refer note**
Eucalyptus capellei | Brown Stringy-bark | Tree; to 20 m | Mid September – Late March | 200mm | **Refer note**
Eucalyptus gunnifera | Red Bloodwood | Tree; to 30 m | June - Late March | 200mm | **Refer note**
Eucalyptus haemastoma | Broad-leaved Scribbly Gum | Tree; to 15 m | Year round | 200mm | **Refer note**
Eucalyptus siderox | Silvertop Ash | Tree; to 30 m | Year round | 200mm | **Refer note**
*Refer note* | **to be confirmed in Design Development**

**Species** | **Common Name** | **Description** | **Seed Collection** | **Size (At installation)** | **Quantity** **Note**
--- | --- | --- | --- | --- | ---
Aliosia infausta | White Wattle | Erect or spreading shrub; 1.5 - 4 m | Early November – Late December | tubestock | **Refer note**
Alacosia myrtifolia | Red-stemmed Wattle | Prostrate to erect shrub; 0.3 - 3 m | Early September – Late December | tubestock | **Refer note**
Alacosa australis | Sweet Wattle | Prostrate to erect shrub; 0.3 - 2.5 m | Early September – Mid December | tubestock | **Refer note**
Alacosa ulicifolia | Priory Moss | Erect shrub; 0.5 - 2 m | winter | tubestock | **Refer note**
Bankia johnsonii | Hair-leafed Banksia | Bushy shrub or small tree; to 6 m | April - October | tubestock | **Refer note**
Bankia australis | Old Man Banksia | Shrub or to 16 m | Year round | tubestock | **Refer note**
Eucalyptus pilularis | Hairy-pink Banksia | Multi-stemmed shrub; to 3 m | Year round | tubestock | **Refer note**
Phyllanthus hirtellus | Hair-pin Banksia | Small shrub; to 0.5 m | January | tubestock | **Refer note**
Hovea lanceolata | Evening Primrose | Small shrub; < 1 m | spring - summer | tubestock | **Refer note**
Hovea linifolia | Hair-pin Banksia | Spiny Boosaava | Rigid shrub; to 2 m | December | tubestock | **Refer note**
Christmas Bush | Christmas Gum | Shrub or tree | Early January – Late February | tubestock | **Refer note**
Dampiera stricklandii | Dampiera | Multi-stemmed sub-shrub; 20 - 60 cm | January - March | tubestock | **Refer note**
**to be confirmed in Design Development**

**Species** | **Common Name** | **Description** | **Seed Collection** | **Size (At installation)** | **Quantity** **Note**
--- | --- | --- | --- | --- | ---
Acacia baileyana | Large-leaf Hops-bush | Erect shrub; to 3 m | Early November – Early January | tubestock | **Refer note**
Epacris puchella | Wallum Heath | Slender erect shrub; 40 - 150 cm | Usually grown from cuttings | tubestock | **Refer note**
Gononiaspis multirotata | German Gardenia | Multi-stemmed shrub; 20 - 40 cm | Usually grown from cuttings | tubestock | **Refer note**
Grey Spider-flax | Grey Spider-flax | Erect to spreading shrub; 0.5 - 2 m | spring - summer | tubestock | **Refer note**
Linear-flax | Linear-flax | Erect shrub; 1 - 2 m | Early October – Late February | tubestock | **Refer note**
Nakea torquata | Finger Hakea | Shrub; 1 - 3 m | Year round | tubestock | **Refer note**
Nakea ericoides | Needledash | Spreading shrub; 1 - 3 m | Year round | tubestock | **Refer note**
Nakea henrici | Needledash | Spreading shrub; 1 - 3 m | Year round | tubestock | **Refer note**
Hibbertia bracteata | Erect shrub; to 1 m | Late November – Early January | tubestock | **Refer note**
Hovea linearis | Hovea | Erect shrub; 1.2 m | Mid - Late December | tubestock | **Refer note**
Lambskin monticola | Mountain Devil | Shrub; to 2 m | Year round | tubestock | **Refer note**
Laeopteridum farringtonii | Rusty Hairpin-bush | Shrub; to 1 m | Early October – Late December | tubestock | **Refer note**
Lepidosperma laterale | Sander Tea-tree | Shrub or tree; 2 - 5 m | *Refer note | tubestock | **Refer note**
Lomatia alata | Crinkle Bush | Shrub; 1 - 2 m | *Refer note | tubestock | **Refer note**
Morionanthus ericoides | Morionanthus | Shrub; to 70 cm | September – December | tubestock | **Refer note**
Pittosporum glabella | Waxy Pittosporum | Leafy Pittosporum | Sub-shrub; 30 - 60 cm | *Refer note | tubestock | **Refer note**
Pittosporum sericeum | Silky Purple-flag | Sub-shrub; 60 cm | *Refer note | tubestock | **Refer note**
Persoonia tenuiflora | Broad-leaved Geostele | Shrub or tree | Difficult to propagate | tubestock | **Refer note**
Pittosporum chinense | Pine-leaved Geostele | Erect shrub | *Refer note | tubestock | **Refer note**
Phyllanthus krugii | Thyme Spurge | Spreading shrub; to 80 cm | *Refer note | tubestock | **Refer note**
Pimelea infausta | Slender Rice Flower | Shrub; to 1.5 m | October - November | tubestock | **Refer note**
Phyllodoce linearifolia | Waxy Neebe | Erect or spreading shrub; 40 - 150 cm | *Refer note | tubestock | **Refer note**
Phyllodoce daphnoides | Large-leaf Bush-pea | Erect shrub | Early December – Early January | tubestock | **Refer note**
Phyllodoce daphnoides | Large-leaf Bush-pea | Erect shrub | Early December – Early January | tubestock | **Refer note**

**Notes**

1. Plant schedule is consistent with the Schedules provide in the Northern Beaches Hospital Connectivity and Network Enhancement Project - Vegetation Management Plan (Stage 1) - (Biosis October 2015)
2. Extent of Duffys Forest Vegetation is based on the proposed clearing of all the works
3. Final quantities and numbers are subject to revision based on the availability of seed, viability of seed and germination rates
4. This schedule is to be used in conjunction with the Northern Beaches Hospital Connectivity and Network Enhancement Project - Vegetation Management Plan (Stage 1) - (Biosis October 2015)
5. Plant sizes and plant spacings are consistent with the requirements of the SWTC Appendix B.1 section 7.3 tables B11-1 and B11-2.
6. * Refer note is known or not appropriate species for seed collection and propagation for the Project
7. **Planting ratio are consistent with what is recommended in the Northern Beaches Hospital Connectivity and Network Enhancement Project - Vegetation Management Plan (Stage 1) - (Biosis October 2015) Proposed ratio is (1:1:3 shrubs: 2:9:1 groundcovers)
### STAGE 1B STREET TREES

<table>
<thead>
<tr>
<th>Genus and species</th>
<th>Common Name</th>
<th>Warringah Council approved</th>
<th>Native / exotic</th>
<th>Size at Installation</th>
<th>Quantity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angophora costata</td>
<td>Sydney Red Gum</td>
<td>not applicable</td>
<td>native</td>
<td>75 litre</td>
<td></td>
<td>For planting underneath powerlines</td>
</tr>
<tr>
<td>Banksia serrata</td>
<td>Old Man Banksia</td>
<td>Yes</td>
<td>native</td>
<td>75 litre</td>
<td></td>
<td>For planting underneath powerlines</td>
</tr>
<tr>
<td>Callistemon 'Kings Park Special'</td>
<td>Bottle Brush</td>
<td>Yes</td>
<td>Native</td>
<td>75 litre</td>
<td></td>
<td>For planting underneath powerlines</td>
</tr>
<tr>
<td>Callistemon salignus</td>
<td>Bottle Brush</td>
<td>Yes</td>
<td>Native</td>
<td>75 litre</td>
<td></td>
<td>For planting underneath powerlines</td>
</tr>
<tr>
<td>Corymbia maculata</td>
<td>Spotted Gum</td>
<td>not applicable</td>
<td>Native</td>
<td>75 litre</td>
<td></td>
<td>For planting underneath powerlines</td>
</tr>
<tr>
<td>Cupanionopsis anacardoides</td>
<td>Turkeroo</td>
<td>Yes</td>
<td>Native</td>
<td>75 litre</td>
<td></td>
<td>For planting underneath powerlines</td>
</tr>
<tr>
<td>Eucalyptus capiteflata</td>
<td>Brown Stringybark</td>
<td>not applicable</td>
<td>Native</td>
<td>75 litre</td>
<td></td>
<td>For planting underneath powerlines</td>
</tr>
<tr>
<td>Eucalyptus gunniferana</td>
<td>Red Bloodwood</td>
<td>not applicable</td>
<td>Native</td>
<td>75 litre</td>
<td></td>
<td>For planting underneath powerlines</td>
</tr>
<tr>
<td>Eucalyptus haemastoma</td>
<td>Scribbly Gum</td>
<td>not applicable</td>
<td>Native</td>
<td>75 litre</td>
<td></td>
<td>For planting underneath powerlines</td>
</tr>
<tr>
<td>Eucalyptus saligna</td>
<td>Sydney Blue Gum</td>
<td>not applicable</td>
<td>Native</td>
<td>75 litre</td>
<td></td>
<td>For planting underneath powerlines</td>
</tr>
<tr>
<td>Elaeocarpus reticulatus</td>
<td>Blueberry Ash</td>
<td>Yes</td>
<td>Native</td>
<td>75 litre</td>
<td></td>
<td>For planting underneath powerlines</td>
</tr>
<tr>
<td>Gordonia axillaris</td>
<td>Fried Egg Plant</td>
<td>Yes</td>
<td>Exotic</td>
<td>75 litre</td>
<td></td>
<td>For planting underneath powerlines</td>
</tr>
<tr>
<td>Harpaula pendula</td>
<td>Tulipwood</td>
<td>Yes</td>
<td>Native</td>
<td>200 litre</td>
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<td>For planting underneath powerlines</td>
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<tr>
<td>Hibiscus albus</td>
<td>'Rubra'</td>
<td>Yes</td>
<td>Native</td>
<td>75 litre</td>
<td></td>
<td>For planting underneath powerlines</td>
</tr>
<tr>
<td>Leptospermum petersonii</td>
<td>Lemon Scented Tea Tree</td>
<td>Yes</td>
<td>Native</td>
<td>75 litre</td>
<td></td>
<td>For planting underneath powerlines</td>
</tr>
<tr>
<td>Melaleuca bracteata 'Revolution Gold'</td>
<td>Revolution Gold Honey Myrtle</td>
<td>Yes</td>
<td>Native</td>
<td>75 litre</td>
<td></td>
<td>For planting underneath powerlines</td>
</tr>
<tr>
<td>Tristaniopsis laurina</td>
<td>Water Gum</td>
<td>Yes</td>
<td>Native</td>
<td>100 litre</td>
<td></td>
<td>For planting underneath powerlines</td>
</tr>
</tbody>
</table>

### STAGE 1B STREET AND VERGE GROUND COVERS

<table>
<thead>
<tr>
<th>Genus and species</th>
<th>Common Name</th>
<th>Warringah Council approved</th>
<th>Native / exotic</th>
<th>Size at Installation</th>
<th>Quantity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Callistemon viminalis 'Little John'</td>
<td>Dwarf Bottle Brush</td>
<td>bcc</td>
<td>native</td>
<td>5 Litre</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carpobrotus glaucens</td>
<td>Pig Face</td>
<td>bcc</td>
<td>native</td>
<td>150mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dietes grandiflora</td>
<td>Wild Iris</td>
<td>bcc</td>
<td>exotic</td>
<td>5 Litre</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doryanthes excelsa</td>
<td>Gymea Lily</td>
<td>bcc</td>
<td>native</td>
<td>300mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gazania tomentosa</td>
<td>Silver Gazania</td>
<td>bcc</td>
<td>exotic</td>
<td>150mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gazania 'Double Gold'</td>
<td>Double Gold Gazania</td>
<td>bcc</td>
<td>exotic</td>
<td>150mm</td>
<td></td>
<td></td>
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<tr>
<td>Lomandra confertifolia 'Wingarra'</td>
<td>Wingarra Mat Rush</td>
<td>bcc</td>
<td>native</td>
<td>5 Litre</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lomandra longifolia</td>
<td>Mat Rush</td>
<td>bcc</td>
<td>native</td>
<td>150mm</td>
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<td></td>
</tr>
<tr>
<td>Maclerbeckia axillaris</td>
<td>Creeping Wire Vine</td>
<td>bcc</td>
<td>native</td>
<td>150mm</td>
<td></td>
<td></td>
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<tr>
<td>Trachelospermum Jasminoides 'Flat Mat'</td>
<td>Star Jasmine</td>
<td>bcc</td>
<td>exotic</td>
<td>150mm</td>
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<td></td>
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</table>

### STAGE 1B STREET AND VERGE TURF GRASS

<table>
<thead>
<tr>
<th>Type</th>
<th>Location</th>
<th>Attributes</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zoysia 'Empire'</td>
<td>Turf areas to verge</td>
<td>Minimise requirement for mowing and drought tolerant</td>
<td>Turf grass to be approved by Warringah Council</td>
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</tbody>
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*Turf grass species is consistent with RMS Specification 179*
### STAGE 2 STREET TREES

<table>
<thead>
<tr>
<th>Genus and species</th>
<th>Common Name</th>
<th>Warringah Council approved</th>
<th>Native / Exotic</th>
<th>Size at Installation</th>
<th>Quantity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angophora costata</td>
<td>Sydney Red Gum</td>
<td>not applicable</td>
<td>native</td>
<td>75 litre</td>
<td></td>
<td>For planting underneath powerlines</td>
</tr>
<tr>
<td>Banksia serrata</td>
<td>Old Man Banksia</td>
<td>Yes</td>
<td>native</td>
<td>75 litre</td>
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<td>For planting underneath powerlines</td>
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<tr>
<td>Callistemon 'Kings Park Special'</td>
<td>Bottle Brush</td>
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<td>native</td>
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<td>Callistemon salignus</td>
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<td>native</td>
<td>75 litre</td>
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<td></td>
</tr>
<tr>
<td>Corymbia maculata</td>
<td>Spotted Gum</td>
<td>not applicable</td>
<td>Native</td>
<td>75 litre</td>
<td></td>
<td>For planting underneath powerlines</td>
</tr>
<tr>
<td>Cupanionapis anacardioides</td>
<td>Turpetero</td>
<td>Yes</td>
<td>Native</td>
<td>75 litre</td>
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<tr>
<td>Eucalyptus capitata</td>
<td>Brown Stringy Bark</td>
<td>not applicable</td>
<td>Native</td>
<td>75 litre</td>
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<td></td>
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<tr>
<td>Eucalyptus gummifera</td>
<td>Red Bloodwood</td>
<td>not applicable</td>
<td>Native</td>
<td>75 litre</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eucalyptus haemastoma</td>
<td>Scribbly Gum</td>
<td>not applicable</td>
<td>Native</td>
<td>75 litre</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eucalyptus saligna</td>
<td>Sydney Blue Gum</td>
<td>not applicable</td>
<td>Native</td>
<td>75 litre</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eucalyptus sieberi</td>
<td>Silvertop Ash</td>
<td>not applicable</td>
<td>Native</td>
<td>75 litre</td>
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<tr>
<td>Elaeocarpus reticulatus</td>
<td>Blueberry Ash</td>
<td>Yes</td>
<td>Native</td>
<td>75 litre</td>
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<td></td>
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<tr>
<td>Gordonia australis</td>
<td>Fried Egg Plant</td>
<td>Yes</td>
<td>Exotic</td>
<td>75 litre</td>
<td></td>
<td>For planting underneath powerlines</td>
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<tr>
<td>Harpia pendula</td>
<td>Tulipwood</td>
<td>Yes</td>
<td>Native</td>
<td>200 litre</td>
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<td>For planting underneath powerlines</td>
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<tr>
<td>Hibiscus italicus 'Rubra'</td>
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<td></td>
<td></td>
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<td>For planting underneath powerlines</td>
</tr>
<tr>
<td>Leptospermum petersonii</td>
<td>Lemon Scented Tea Tree</td>
<td></td>
<td>Yes</td>
<td>Native</td>
<td>75 litre</td>
<td></td>
</tr>
<tr>
<td>Melaleuca bracteata 'Revolution Gold'</td>
<td>Revolution Gold Honey Myrtle</td>
<td></td>
<td>Yes</td>
<td>Native</td>
<td>75 litre</td>
<td>For planting underneath powerlines</td>
</tr>
<tr>
<td>Triastcanthes laurina</td>
<td></td>
<td></td>
<td>Yes</td>
<td>Native</td>
<td>100 litre</td>
<td>For planting underneath powerlines</td>
</tr>
</tbody>
</table>

### STAGE 2 STREET AND VERGE GROUND COVERS

<table>
<thead>
<tr>
<th>Genus and species</th>
<th>Common Name</th>
<th>Warringah Council approved</th>
<th>Native / Exotic</th>
<th>Size at Installation</th>
<th>Quantity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Callistemon viminalis 'Little John'</td>
<td>Dwarf Bottle Brush</td>
<td></td>
<td>native</td>
<td>5 Litre</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carpobrotus glaucescens</td>
<td>Pig Face</td>
<td></td>
<td>native</td>
<td>150mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dianthus grandiflora</td>
<td>Wild Iris</td>
<td></td>
<td>native</td>
<td>5 Litre</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doryanthes excelsa</td>
<td>Gymea Lily</td>
<td></td>
<td>native</td>
<td>300mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gazania tomentosa</td>
<td>Silver Gazania</td>
<td></td>
<td>exotic</td>
<td>150mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gazania 'Double Gold'</td>
<td>Double Gold Gazania</td>
<td></td>
<td>exotic</td>
<td>150mm</td>
<td></td>
<td>Sterile variety</td>
</tr>
<tr>
<td>Lomandra confertifolia 'Wingara'</td>
<td>Wingara Mat Rush</td>
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<td>native</td>
<td>5 Litre</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lomandra longifolia</td>
<td>Mat Rush</td>
<td></td>
<td>native</td>
<td>150mm</td>
<td></td>
<td>Cultivar type to be confirmed with council</td>
</tr>
<tr>
<td>Muscleasebeckia axillaris</td>
<td>Creeping Wire Vine</td>
<td></td>
<td>native</td>
<td>150mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trachelospermum Jasminoides 'Flat Mat'</td>
<td>Star Jasmine</td>
<td></td>
<td>exotic</td>
<td>150mm</td>
<td></td>
<td>Prostrate form</td>
</tr>
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</table>

### STAGE 2 STREET AND VERGE TURF GRASS

<table>
<thead>
<tr>
<th>Type</th>
<th>Location</th>
<th>Attributes</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zoysia 'Empire'</td>
<td>Turf areas to verge</td>
<td>Minimum requirement for mowing and drought tolerant</td>
<td>Turf grass to be approved by Warringah Council</td>
</tr>
<tr>
<td></td>
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</tr>
</tbody>
</table>

*Note: RMS Specification 179*
**DUFFYS FOREST REVEGETATION PLANT SCHEDULE - STAGE 2**

**Genus Species** | **Common Name** | **Description** | **Seed Collection** | **Size (At Installation)** | **Quantity**
--- | --- | --- | --- | --- | ---
**Trees**
Allocaea triandra | Black She-oak | Tree; 5 - 15 m | Year round | 200mm | 
Angophora costata | Smooth-barked Apple | Tree; to 30 m | Late December – Early February | 200mm | 
Bankia serrata | Old Man Banksia | Tree; to 15 m | Year round | 200mm | 
Eucalyptus capitata | Brown Stringybark | Tree; to 20 m | Mid September – Late March | 200mm | 
Eucalyptus pumilliflora | Red Bloodwood | Tree; to 30 m | June – Late March | 200mm | 
Eucalyptus haemastoma | Broad-leaved Scribbly Gum | Tree; to 15 m | Year round | 200mm | 
Eucalyptus sieberi | Silver Ash | Tree; to 30 m | Year round | 200mm | 
**Shrubs**
Acacia fiji | White Wattle | Erect or spreading shrub; 1.5 - 4 m | Early November – Late December | tubestock | 
Acacia mitchellii | Red-stemmed Wattle | Prostrate to erect shrub; 0.3 - 3 m | Early September – Late December | tubestock | 
Acacia auriculiformis | Sweet Wattle | Prostrate to erect shrub; 0.3 - 2.5 m | Early September – Mid December | tubestock | 
Acacia urophylla | Prickly Moses | Erect shrub; 0.5 – 2 m | Winter | tubestock | 
Bankia ericifolia | Heath-leaved Banksia | Bushy shrub or small tree; to 6 m | April – October | tubestock | 
Bankia serrata | Old man Banksia | Shrub or tree; to 15 m | Year round | 
Bankia spinulosa | Hair-pin Banksia | Multi-stemmed shrub; to 3 m | Year round | 
Billardiera scandens | Hairy Apple Berry | Small shrub; to 0.5 m | January | 
Boronia isidifolia | Snowy Boronia | Shrub; 0.3 - 1.5 m | Mid November – Late March | 
Boronia juniperina | Shrub; 0.5 - 1.5 m | 
Bossiaea heterophylla | Variable Bossiaea | Shrub; < 1 m | Spring - Summer | tubestock | 
Bossiaea obtusata | Spiny Bossiaea | Rigid shrub to 2 m | December | tubestock | 
Cardotetum glaucescens | Christmas Bush | Shrub or tree | Early January – Late February | 
Dampiera stricta | Dampiera | Multi-stemmed sub-shrub; 20 - 60 cm | January - March | 
Dyehya rotata | | | Late December | tubestock | 
**Ground Covers**
Dorothea longifolia | | | 
Dorothy longifolia | | | 
Eucalyptus colensoi | | | 
Grevillea robusta | | | 
Grevillea robusta | | | 
Grevillea robusta | | | 
Grevillea robusta | | | 
Hakea dactyloides | Finger Hakea | Shrub; 1 - 3 m | Year round | 
Hakea sericea | Needlebush | Spreading shrub; 1 - 3 m | Year round | 
Hakea hirtifolia | Needlebush | Spreading shrub; 1 - 3 m | Year round | 
Hibbertia bracteata | | | 
Hovea leprosula | Hovea | Erect shrub; 0.5 - 1.2 m | Mid – Late December | 
Leptospermum trinervium | | | 
Allocasuarina littoralis | | | 
Angophora costata | | | 
Banksia serrata | | | 
**Notes:**
1. Plant schedule is consistent with the Schedules provided in the Northern Beaches Hospital Connectivity and Network Enhancement Project - Vegetation Management Plan (Stage 1) - (Biosis October 2015).
2. Extent of Duffys Forest Vegetation is based on the proposed extent of clearing drawings for the works.
3. Final quantities and numbers are subject to revision based on the availability of seed, viability of seed and germination rates.
4. This schedule is to be read in conjunction with the Northern Beaches Hospital Connectivity and Network Enhancement Project - Vegetation Management Plan (Stage 1) - (Biosis October 2015).
5. Plant sizes and plant spacings are consistent with the requirements of the SWT/14A厮1 section 1.3 table 111-1 and 111-2.
*Little information known or not appropriate species for seed collection and propagation for this Project.
**Planting ratios are consistent with what is recommended in the Northern Beaches Hospital Connectivity and Network Enhancement Project - Vegetation Management Plan (Stage 1) - (Biosis October 2015) Proposed site is (7 tree 1 shrub: 10 groundcovers)
9.2 Appendix B - ISCA compliance

Crime Prevention Through Environmental Design (CPTED)

The important principles of Crime Prevention Through Environmental Design (CPTED) are prioritised throughout the project works. These principles have been applied to the benefit of the local community. The principles are focused around three key areas:

- Natural surveillance
- Natural access control
- Natural territorial reinforcement.

Natural surveillance:
This is achieved by arranging physical elements, activities and users in such a way as to maximise visibility, promote day and night time use, and foster social interaction. This approach includes:

- Optimising transparency of materials including;
  - Noise wall overlaps
  - Throw screens to shared use bridges
  - Bus stops
- Placing noise walls against property boundaries and minimising any space that cannot be easily seen or accessed
- Minimising any spaces for hiding, challenging locations being where the two pedestrian links from Karingal Close connect to the shared user path.
- Ensuring that planting in areas used by the local community are a balance of canopy and low understory, maximising views through the landscape
- Providing large radii to shared paths (as far as practicable)
- Laying back screening elements to reduce the sense of enclosure on the shared user bridges

Natural access control:
Use of palisade fencing (that matches that used at the Forest High School) to secure the slot area of the corridor and integrate it with the throw screens at the short underpasses.

Natural Territorial reinforcement:
A primary objective for the project is to create a sense of ownership and pride and stewardship of the public domain to ensure that natural territorial reinforcement occurs. This approach includes:

- Providing a urban and landscape design response that has included thorough community and stakeholder engagement
- Designing an urban and landscape design that is consistent with RMS policy and principles and with principles from the Australian Urban Design Protocol.
- Considering relevant interfaces and land uses including;
  - Private Residences
  - Businesses
  - Retail and Commercial (eg: Skyline Shops)
  - Community (eg: hospital, place of worship)
  - Schools
  - National Park and Public Reserves
  - Other infrastructure
9.3 Appendix C - EIS Consistency Stage 1

Stage 1 - Urban and Landscape Design Objectives and Principles

For Stage 1 of the Project Approval, Condition of Approval B28 states:

The Proponent, in consultation with the Council, shall where feasible and reasonable, implement the urban design objectives and principles, giving consideration to the design strategies and mitigation measures identified in Northern Beaches Hospital Connectivity and Network Enhancements: Concept Proposal and Stage 1 Urban Design and Landscape Character and Visual Impact Assessment: Spackman Mossop Michaels, October 2014. Where an urban design principle or objective is not considered feasible or reasonable, this will be clearly demonstrated to the Secretary in conjunction with the submission of the Urban Design and Landscape Plan required by condition B30.

The following table includes:

- The urban design objectives and principles as listed in the Stage 1 Report
- The concept design strategies as listed in the Stage 1 Report
- A description of the FYJV Design
- An assessment to the demonstration of compliance of the FYJV design, considered as ‘yes’, ‘in part’ and ‘no’
- If ‘in part’ or ‘no’ the reasonable and feasible reasons as to why FYJV have not been able to implement the principles and objectives and concept design strategies and mitigation measures.
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<tr>
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<th>FYJV DESIGN</th>
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<tr>
<td>1. Retain and reinforce the parkway character of Warringah Road and Wakehurst Parkway and distinguish the ecological character of Wakehurst Parkway from the more formal and urbanised parkland character of Warringah Road</td>
<td>Due to widening of Frenchs Forest Road, some vegetation loss would be unavoidable at the intersection with Wakehurst Parkway. Due to widening of Warringah Road in the eastern section of Stage 1, street trees located in the existing verge would be removed. In combination with replacement street tree planting, existing trees located in the front of commercial and residential properties would assist in maintaining the vegetation corridor parkway character.</td>
<td>New and / or replacement street trees are being provided on the northern side of Naree Road, Frenchs Forest Road West and Frenchs Forest Road East. These trees have been selected from Warringah Councils approved street tree palette. At Wakehurst Parkway areas disturbed will be revegetated with a Duffy's Forest mix of trees, shrubs and ground covers using endemic and locally sourced seed.</td>
<td>X</td>
<td>THE FYJV design is consistent with the concept Design strategy.</td>
</tr>
<tr>
<td>1A. Ensure that parkway character of both Warringah Road and Wakehurst Parkway are retained through ensuring adequate retention and protection of the existing trees and vegetation. In particular, ensure vegetation is retained on both sides of the roadway, along Warringah Road, where higher impacts are planned</td>
<td>Due to widening of Frenchs Forest Road, both cutting and filling would be required. In order to minimise impacts on vegetation through encroachment, retaining walls would be utilised in these locations. Retaining wall design and finishes are to be designed in accordance with the mitigation strategy, which would see the use of terracing and stone finishes in order to reduce visual bulk and blend with the existing landscape.</td>
<td>Retaining walls are proposed at Wakehurst Parkway and on the southern side of Frenchs Forest Road West. An embankment is proposed on the south western corner of Frenchs Forest Road West and Wakehurst Parkway adjacent to the hospital site. The finishes for Stage 1 retaining walls includes sandstone facing, class 2 concrete and concrete block, all consistent with the urban design strategy. Terracing is not be utilised due to the wall construction type.</td>
<td>X</td>
<td>Retaining walls are designed in accordance with the concept design mitigation strategy.</td>
</tr>
<tr>
<td>1B. Minimise earthworks in order to maximise vegetation retention</td>
<td>Due to widening of Frenchs Forest Road, both cutting and filling would be required. In order to minimise impacts on vegetation through encroachment, retaining walls would be utilised in these locations.</td>
<td>Shared paths are located and designed to meet the requirements of the AustRoads standards for shared paths and to minimise impacts to existing vegetation and mature trees. Road alignment has been adjusted in some locations to permit the retention of large existing trees on Warringah Road. There are very few locations where corridor width and existing grades permit the formation of a curvilinear path.</td>
<td>X</td>
<td>Meeting the required standards for safety negates being able to fully achieve the strategy.</td>
</tr>
<tr>
<td>1C. Carefully locate shared paths so as to not to require removal of critical trees eg locate shared user path if practical along the southern verge of Warringah Road</td>
<td>In line with Warringah Council’s desire to provide access along both sides of Warringah Road, for both pedestrians and cyclists, shared paths would be required. Where road corridor width permits, the shared paths would be designed to avoid trees through minimising path widths and by a curvilinear route that avoids trees.</td>
<td>The design is consistent with the concept in that virtually all of the widening is on the southern verge of Warringah Road (Stage 2 areas). Some widening of Warringah Road occurs on the north side in the eastern section of the project (Stage 1) to facilitate new and safer movements around the intersection of Frenchs Forest Road East, Allanbeie Road and Warringah Road.</td>
<td>X</td>
<td>THE FYJV design is consistent with the concept Design strategy.</td>
</tr>
<tr>
<td>1D. Encroach any required new road work into the southern verge of Warringah Road</td>
<td>The concept design demonstrates that widening would primarily occur along the southern verge, in order to limit vegetation loss and impacts on private and commercial properties to one side. However, widening on the northern side of Warringah Road is also being considered in order to determine the most appropriate impacts.</td>
<td>Wakehurst Parkway widening occurs to the north and south of the intersection with Frenchs Forest Road West. Wakehurst Parkway widening also occurs on the south side of the intersection with Frenchs Forest Road East. This widening is to accommodate the required traffic and intersection turning movements. Duffy’s Forest bushland planting will be reinstated to disturbed areas, retaining walls are being used in locations to minimise the impacts on the existing bushland. Street Tree selected for Stage 1 works are native species and on Warringah Councils approved street tree palette.</td>
<td>X</td>
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<tr>
<td>1E. Apply an informal bush landscape character with large scale boulders and informal planting along Wakehurst Parkway, and a more urbanised parkway landscape concept along Warringah Road.</td>
<td>Widening of Wakehurst Parkway as part of the Stage 1 Project is limited to the eastern boundary of the hospital site and the opposite eastern verge With only limited road corridor width available, opportunities to reinstate bushland character may be limited in these circumstances, however indigenous vegetation communities would inform revegetation species selection Street Tree selection for all Stage 1 roads would comprise native species</td>
<td>Wakehurst Parkway widening occurs to the north and south of the intersection with Frenchs Forest Road West. Wakehurst Parkway widening also occurs on the south side of the intersection with Frenchs Forest Road East. This widening is to accommodate the required traffic and intersection turning movements. Duffy’s Forest bushland planting will be reinstated to disturbed areas, retaining walls are being used in locations to minimise the impacts on the existing bushland. Street Tree selected for Stage 1 works are native species and on Warringah Councils approved street tree palette.</td>
<td>X</td>
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<tr>
<td>1F. Improve facilities for all road users – including motorists, pedestrians and cyclists.</td>
<td>The road and intersection upgrades, footpath connectivity and widening and provision for cycling would see improvements to all road users.</td>
<td>The upgrades in the stage 1 design area are consistent with what is illustrated in the EIS for shared paths and pedestrian paths.</td>
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<tr>
<td>2 Reinforce the lush and green character of the area and express the bushland character</td>
<td>Indigenous vegetation communities, particularly those comprising the Duffys Forest EEC, would inform revegetation species selection. Ideally, planting and revegetation species would be propagated from endemic locally sourced seed.</td>
<td>A Vegetation Management Plan (VMP) has been prepared to inform the works. This includes a seed collection strategy and revegetation/planting strategy to disturbed and new landscape areas within the project.</td>
<td>X</td>
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<tr>
<td>2A Use native vegetation in the application of landscape design strategies to reinforce the character of the area</td>
<td>Widening of Forest Way would require property acquisitions along front boundaries making it unlikely that street tree planting would be possible along a majority of the road. Where opportunities exist, tree planting would be undertaken on both road reserve and private properties with landowner consent.</td>
<td>The design includes provision for new street planting along the northern verge of Naree Road, Frenchs Forest Road West and Frenchs Forest Road East. On the southern verge, the requirement for a 3.5m wide path to Naree Road and Frenchs Forest Road West, and a 2.5m wide path to Frenchs Forest Road East. The verge is only 3.5m in total.</td>
<td>X</td>
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<tr>
<td>2B Evaluate opportunities of introducing street trees along Forest Way</td>
<td>Due to widening of Frenchs Forest Road, some vegetation loss would be unavoidable at the intersection with Wakehurst Parkway. Clearing associated with construction activities would be revegetated in accordance with the associated vegetation management plan.</td>
<td>The VMP defines the disturbed areas at the intersection of Frenchs Forest Road West / East and Wakehurst Parkway as being revegetation zones using plant material sourced from locally collected seed. Street tree selection for Stage 1 roads would comprise native species.</td>
<td>X</td>
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<tr>
<td>2C Reinforce the definition of the intersection of Warringah Road and Wakehurst Parkway through strategic landscape measures such as revegetating impacted areas where applicable</td>
<td>In Stage 1, there would be some impact to existing vegetation due to reconfiguration of the Forest High School car park and internal access road.</td>
<td>The design team has consulted with the school in the development of the detailed design. The proposed design will satisfy the school's functional requirements for safe student access and egress and for visitor and teacher parking and access. The planting palette will be consistent with the existing site character and reinforce the 'bushland' feel of the Forest High.</td>
<td>X</td>
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<tr>
<td>2D Minimise impacts to existing vegetation and utilise it as green buffers/visual foils to new built form, and urban infrastructure</td>
<td>In the Stage 1 Project, pedestrian crossings of Warringah Road would be associated with signalled intersections. New pedestrian crossing facilities would be provided at the following signalled intersections: Forest Road East of Naree Road.</td>
<td>New pedestrian crossing facilities are provided at: * Frenchs Forest Road West at Naree Road and Rabbett Street * Frenchs Forest Road East at Gladys Avenue</td>
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<td>3 Deliver an integrated approach to traffic (including pedestrian and cycle), public transport and land use</td>
<td>In the Stage 1 Project, pedestrian crossings of Warringah Road would be associated with signalled intersections. New pedestrian crossing facilities would be provided at the following signalled intersections: Forest Road East of Naree Road.</td>
<td>New pedestrian crossing facilities are provided at: * Frenchs Forest Road West at Naree Road and Rabbett Street * Frenchs Forest Road East at Gladys Avenue</td>
<td>X</td>
</tr>
<tr>
<td>3A Provide user-friendly pedestrian crossings at Warringah Road and Forest Way</td>
<td>Existing pedestrian crossing facilities would be upgraded or reconfigured at the following signalled intersections: Forest Road East of Naree Road.</td>
<td>Existing pedestrian crossing facilities have been upgraded and / or reconfigured: * Frenchs Forest Road East at Patonga Road * Frenchs Forest Road East at Allambie Road * Frenchs Forest Road and Wakehurst Parkway (south side only)</td>
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*The concept design strategy for a crossing of Frenchs Forest Road East west of Romford Road has not been provided based on a Safety in Design Review.*
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<td>3B Ensure good connectivity to public transport modes, particularly along Warringah Road.</td>
<td>Widening of Frenchs Forest Road is associated with a major bus route upgrade under consultation with TNSW. A range of bus transport improvements have been included in the Stage 1 Project consistent with TNSW Sydney Bus Future. Bus connections into Frenchs Forest Road from Warringah Road would be maintained by the right turn provision east of from Warringah Road into Allambie Road and associated widening of Frenchs Forest Road and Naree Road. Widening associated with bus requirements is to minimise, through careful alignment design, impacts on bicycle and pedestrian connectivity, as well as physical impacts on the public domain and residential screening requirements.</td>
<td>The FYJV design includes bus lane configurations and bus stop facilities that meet the requirements of the agreement between Council and TNSW. Bus connections into Frenchs Forest Road from Warringah Road have been maintained.</td>
<td>✗</td>
</tr>
<tr>
<td>4 Retain the privacy and amenity residents in the local streets in the immediate area, and provide opportunities for urban restructuring and redevelopment</td>
<td>New developments along Frenchs Forest Road and Warringah Road may be possible in the future in line with the planned Warringah Council Structure Plan and following the construction of the NBH. New developments should retain existing vegetation to the greatest extent possible in order to assist with visual impact mitigation.</td>
<td>FYJV supports the Concept Design Strategy and meets the Framework Objective and Principle.</td>
<td>No</td>
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<tr>
<td>4A Utilise existing vegetation as visual screening within new developments to retain green character and minimise visual impacts</td>
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<td><strong>4B</strong> Apply landscape strategies that complement the future character and scale of built form elements of the precinct</td>
<td>Existing built form is primarily single storey residential and one and two storey commercial buildings. The NBH development will be substantially bigger in scale than the existing built form. Road verges are to be planted wherever possible, with street trees and shrubs. FYJV supports the Concept Design Strategy and meets the Framework Objective and Principle.</td>
<td>X</td>
</tr>
<tr>
<td><strong>4C</strong> Minimise pedestrian and vehicular conflicts and noise impacts for residents along Frenchs Forest Road West as much as practical</td>
<td>Pedestrian and vehicular conflicts would be managed through signalisation of pedestrian crossings and provision of pathways along both sides of Frenchs Forest Road. A widened pathway, connecting hospital and school users with Forestway Shopping Centre in the west, and Skyline Shops in the east. The pathways would connect with the broader region via new pathways and shared pathways along Frenchs Forest Road and Warringah Road in Stages 1 and 2. Noise impacts are not expected to substantially increase. New signalised intersections are designed for along Frenchs Forest Road West at - Rabbett Street, at the NBH entry and at Bluegum Crescent. Widened paths and shared paths have been provided to Frenchs Forest Road and Warringah Road in Stages 1 and 2 (refer to Stage 2 – Appendix D). Noise modelling has determined that there is no requirement for any physical noise mitigation along Frenchs Forest West.</td>
<td>X</td>
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<tr>
<td><strong>4D</strong> Enhance pedestrian facilities and crossing points along Frenchs Road West to enhance pedestrian safety for school children.</td>
<td>Pedestrian crossings points would be rationalised in accordance with the road widening and signalisation, however these new and existing crossings would be upgraded to improve safety. New signalised crossings would be provided at the NBH entry road and Rabbett Street. One crossing would be removed due to the need for road widening, safety and vehicle movements in peak times as well as increased bus movements. New signalised intersections are designed for along Frenchs Forest Road West at - Rabbett Street, at the NBH entry and at Bluegum Crescent to improve safety and access for both pedestrians and school children.</td>
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<td><strong>5</strong> Define the address of the hospital locality as well as expressing the area as a gateway to the Northern Beaches.</td>
<td>The hospital would be visible from Frenchs Forest Road, Wakehurst Parkway and Warringah Road, as well as from longer range viewpoints situated on higher ground. Gateway landscape treatments and robust urban design would assist with reinforcing the ‘sense of place’ and mitigating visual impacts. The Hospital has been consulted during the design development phase to ensure coordination of the road corridor and hospital circulation system and landscape design. An overall scheme is provided that in the broader context supports the hospital as a regional facility and focal point.</td>
<td>X</td>
</tr>
<tr>
<td><strong>5A</strong> The opportunity exists to make the hospital site a strong visual marker along the journey, reinforcing the sense of place.</td>
<td>The hospital would be visible from Frenchs Forest Road, Wakehurst Parkway and Warringah Road, as well as from longer range viewpoints situated on higher ground. Gateway landscape treatments and robust urban design would assist with reinforcing the ‘sense of place’ and mitigating visual impacts. The Hospital has been consulted during the design development phase to ensure coordination of the road corridor and hospital circulation system and landscape design. An overall scheme is provided that in the broader context supports the hospital as a regional facility and focal point.</td>
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<td><strong>6</strong> Create a clear structural framework for streetscapes that enhances the legibility, way-finding and functioning of the precinct</td>
<td>The hospital would be visible from Frenchs Forest Road, Wakehurst Parkway and Warringah Road, as well as from longer range viewpoints situated on higher ground. Gateway landscape treatments and robust urban design would assist with reinforcing the ‘sense of place’ and mitigating visual impacts. The Hospital has been consulted during the design development phase to ensure coordination of the road corridor and hospital circulation system and landscape design. An overall scheme is provided that in the broader context supports the hospital as a regional facility and focal point.</td>
<td>X</td>
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<tr>
<td>6A Consider separating regional from local traffic to enhance the legibility and way-finding around the precinct</td>
<td>Local traffic would continue to use Frenchs Forest Road, with regional traffic using Warringah Road, Wakehurst Parkway and Forest Way. Signalled intersections would be provided in order to facilitate local traffic access to Frenchs Forest Road during peak hours.</td>
<td>Supports the Concept Design Strategy and meets the Framework Objective and Principle.</td>
</tr>
<tr>
<td>6B If possible, avoid the introduction of noise barriers that visually bisect the community/precinct. If these elements would be required integrate these with fencing elements and soften their appearance</td>
<td>Environmental studies including noise monitoring and assessment have indicated that it is unlikely that noise walls would be proposed as part of the Stage 1 Project works. Noise is to be managed by the use of acoustic pavement if required.</td>
<td>FYJV design does not include any noise walls in stage 1. No acoustic pavement is proposed.</td>
</tr>
<tr>
<td>6C Minimise impacts to existing vegetation and utilise it as green buffers/visual foil to new built form, and urban infrastructure</td>
<td>Due to demands on the corridor it has been necessary to remove some existing vegetation to allow for road widening. Where front-line vegetation such as street trees would be removed, this would be mitigated by revealing second-line vegetation and replacement with new planting. Land owners would be encouraged to plant trees in the front of their properties where applicable.</td>
<td>FYJV design will require the removal of all trees within the road reserve along Naree Road, Frenchs Forest Road West and Frenchs Forest Road East. Some clearing will be required to Warringah Road / Allambie Road (stage 1) with the widening and improvements to the intersections in this area. Tree planting will be carried out on the north side of Naree Road, Frenchs Forest Road West. In front of the school on Frenchs Forest Road West, in the old area of Bus Turn around (no longer required).</td>
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<tr>
<td>6D Reinforce/formalise the existing pedestrian link between hospital site and school</td>
<td>A widened pathway is proposed along the southern verge of Frenchs Forest Road connecting the hospital with The Forest High School and Forest Way Shopping Centre. A signalled crossing would be provided in order to ensure safe pedestrian movements Other pedestrian connections would form part of potential private property adjustments</td>
<td>A 3.5m wide path is being provided along the southern side of Naree Road (starting at Forest Way) and along Frenchs Forest Road West up to Wakehurst Parkway. A midblock connection between the school and hospital (being constructed by the hospital) will link Frenchs Forest Road West with Warringah Road.</td>
</tr>
<tr>
<td>6E Ensure existing pedestrian links are retained and proper connectivity is achieved to road crossings, particularly for Warringah Road</td>
<td>A widened pathway is proposed along the southern verge of Frenchs Forest Road West connecting the hospital and The Forest High School with Forestway Shopping Centre. Pedestrian access would be maintained along both sides of Warringah Road between Allambie Road and Courteley Road as part of Stage 1. Pedestrian pathways are to be maintained along both sides of Frenchs Forest Road, Naree Road, Forest Way and Warringah Road.</td>
<td>FYJV design supports the Concept Design Strategy and meets the Framework Objective and Principle.</td>
</tr>
<tr>
<td>6F Create a buffer zone between road and path to increase pedestrian safety and articulate the paved surfaces</td>
<td>In order to provide wider paths and provide vegetative screening along boundary lines, a vegetated buffer would not be possible along the southern verge kerb line of Frenchs Forest Road. Along the northern verge of Frenchs Forest Road, a vegetative strip would be protected between the path and property boundaries to assist with visual mitigation. Landowners would be encouraged to plant trees in the front of their properties. On Warringah Road, a turf strip would be provided adjacent to the kerb in order to provide greater separation of vehicles and pedestrians. Where screening is not required or not feasible along property boundaries, pedestrian footpaths are to be set back from the kerb and separated by landscape.</td>
<td>No vegetation screening has been provided to the southern verge of Frenchs Forest Road due to path requirements within the verge. The northern side of Frenchs Forest Road includes a vegetation strip and street tree planting along the entire length. A turf strip is maintained along the northern side Warringah Road to maintain separation between pedestrians and vehicles. Footpaths are setback from the edge of kerb where room exists, the exception being the northern side Frenchs Forest Road West adjacent to the existing gas main line. A major gas pipeline exists on the northern side of Frenchs Forest Road West neat the corner of Wakehurst Parkway. The pedestrian path in this location is immediately adjacent to the vehicle lane.</td>
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NBHR-0000-UD-170A
Urban and Landscape Design
## Concept Design Strategy

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<td>6G Avoid as much as practical the introduction of barriers</td>
<td>Barriers would not be required for the Stage 1 Project. Barriers would be required for the concept proposal where pedestrian access is provided next to the intersection of Warringah Road and Forest Way or next to distinct level change that would pose a safety risk.</td>
<td>The only barriers required in Stage 1 are on Forest Way where a Variable Message Sign (VMS) is located. Along Naree Road, Frenchs Forest Road West and East there are no roadside barriers. A roadside barrier is integrated into the base of the retaining wall on the north western corner of Wakehurst Parkway and Frenchs Forest Road West.</td>
<td>X</td>
<td>Barriers are required consistent with RMS Safety Policy.</td>
</tr>
<tr>
<td>6H Evaluate opportunities to introduce pedestrian crossings as overpasses, acting as legible markers to both drivers and pedestrians</td>
<td>An assessment of the Stage 1 Project indicated limited justification for footbridge crossings. In the Stage 2 Project, a footbridge crossing would be retained or replaced at Warringah Road and Forest Way intersection. Another location being considered is adjacent to The Forest High School in the vicinity of Hilmer Street.</td>
<td>FYJV design is consistent with the Concept Design Strategy. There are no overpasses proposed in Stage 1.</td>
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<tr>
<td>6I Ensure hospital access/entry point allows proper connectivity to major arterial roads</td>
<td>The primary access to the hospital would be via a new signalised intersection of Frenchs Forest Road. Another access will be provided off Warringah Road.</td>
<td>The design of Frenchs Forest Road West has been undertaken in close coordination with the Hospital to ensure safe access for pedestrians and hospital users. Another access is provided off Warringah Road and is part of the Stage 2 works.</td>
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<tr>
<td>6J Apply CPTED (Crime Prevention Through Environmental Design) principles in the design resolution of the Stage 1 Project</td>
<td>CPTED has informed the design of the hospital access and boundary treatments next to The Forest High School. Sightlines and safety would be maintained at all times during construction for motorists and pedestrians through careful staging and provision of temporary barriers. Security would be maintained at all times during construction through the provision of temporary fencing along school boundaries and following construction through reinstatement of permanent security fencing. Any new access points would require security gates to be installed.</td>
<td>Crime Prevention through Environmental Design (CPTED) principles have been applied to the design of the Stage 1 works. A Safety in Design (SiD) review has also been undertaken as part of the design development works. This involved a cross discipline review of the design. Security during construction is part of the project Construction and Environmental Management Plan.</td>
<td>X</td>
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## Framework Objective and Principle

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<tr>
<th>FRAMEWORK OBJECTIVE AND PRINCIPLE</th>
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</thead>
<tbody>
<tr>
<td>7 Design integrated urban infrastructure/landscape design elements that allow the landscape to dominate built forms to recede</td>
<td>In Stage 1, retaining walls including those facing Frenchs Forest Road or facing properties along Naree Road are to be finished in natural materials such as sandstone cladding or sandstone block sourced from regionally local quarries. On arterial roads, depending on their scale, walls facing the road may need to be faced with a high quality concrete panel. However, in all cases a stone finish is preferred. Wall finishes are to be designed to a high level of finish generally, as is required of an urban setting such as this.</td>
<td>The walls facing Frenchs Forest Road or Wakehurst Parkway are to be either a sandstone clad (soil nail walls) with a concrete coping panel to the top or a natural concrete wall with a class 2 finish. The narrow working space of the corridor dictates certain construction techniques and limitations of underground services. Structural assessment has determined that both bore piled walls and soil nail walls and L-shaped concrete retaining walls.</td>
<td>X</td>
</tr>
<tr>
<td>7A Consider the use of natural materials in built form elements to reinforce the setting’s character</td>
<td>Substantial underground utilities exist across the concept proposal area, particularly in Stage 1, making it difficult to accommodate additional underground services. The undergrounding of overhead services is to be considered during detailed design.</td>
<td>Utilities design coordination has been undertaken and undergrounding of overhead services is proposed for; The southern side of Frenchs Forest Road west in front of the School and Hospital All of Wakehurst Parkway West side Forest Way, from corner of Warringah Road up to Russell Avenue East Side of Forest Way from Warringah Road to north of Naree Road</td>
<td>X</td>
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<tr>
<td>7B Consider, if practical, under grounding power lines particularly on the high ridge area, and in constrained areas, to enhance opportunities for planting</td>
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Northern Beaches Hospital Connectivity and Network Enhancement

Urban and Landscape Design
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<tr>
<td>7C Use colour schemes that complement the area’s character or that help recede built form elements</td>
<td>Colour schemes are to be selected during detailed design in consideration of local textures and colours of the surrounding bushland in accordance with the urban design framework.</td>
<td>Colour palettes have been developed that complement the surrounding bushland and generally are receding colours and are consistent with the urban design framework. These will assist in featuring the revegetation and new landscape planting works.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>7D Apply landscape strategies that complement the future character and scale of built form elements of the precinct</td>
<td>Where possible, revegetation would consist of mature potted stock including canopy trees, with species informed by the Duffys Forest EEC.</td>
<td>Plant material used for revegetation and landscaping include mature potted stock consistent with the requirements of the project deed. All street trees for Stage 1 works will be a minimum of 75 litre stock.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>7E Apply darker colours in areas where structures should visually recede</td>
<td>Colour schemes are to be selected during detailed design in consideration of local textures and colours of the surrounding bushland in accordance with the urban design framework.</td>
<td>Colour palettes have been developed that complement the surrounding bushland and generally are receding colours and are consistent with the urban design framework. These will assist in featuring the revegetation and new landscape planting works.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>7F Introduce stepped retaining walls (where possible) with planted benches to reinforce the green character of the setting</td>
<td>In the Stage 1 Project, retaining walls would be required at the Wakehurst Parkway intersection. Terracing of the walls may be possible next to the hospital with treatments provided that are commensurate with a precinct gateway. Low walls will be required in other locations including along Naree Road, these would not be stepped however wall finishes and planting would be employed to address visual impact mitigation requirements. Incorporation of planting into wall design is to be undertaken wherever possible in order to reduce the bulk, scale and visible surface area of walls.</td>
<td>Detailed geotechnical investigations and assessment of structural wall types has informed the detailed design of the retaining walls for stage 1. Due to constraints of the future hospital expansion there is no longer a wall proposed next to the hospital. A batter is no proposed in this location.</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>7G Consider widening the road corridor in strategic areas to allow better greening opportunities</td>
<td>Widening for the purpose of greening is unlikely due to demands on the road corridor within a primarily residential precinct. Opportunity exists within the concept proposal area to utilise land acquired for road widening that is considered surplus to the immediate needs of the road corridor. In addition to an extensive street tree strategy, planting on private property may also be considered subject land owner consent.</td>
<td>There are limited opportunities for expansion of the corridor to allow for additional greening opportunities. The locations where the opportunity does exist is – At the old bus turnaround in front of Forest High School east of Bluegum Crescent, this will be revegetated with trees, shrubs and ground covers. At the eastern end of Frenchs Forest Road East at the intersection of Warringah Road, the adjusted road geometry here allows for trees planting to the widened verge.</td>
<td>X</td>
<td>Planting on private property is subject to consultation with owners.</td>
</tr>
<tr>
<td>7H Introduce vegetated batters where practical to conceal the apparent height of structures</td>
<td>Cut and fill would generally be reconciled through the construction of low retaining walls. Where retaining walls are not employed, batters and embankments would be revegetated.</td>
<td>Retaining walls are generally being used in stage 1 works areas, where batters are required they have been designed and detailed to ensure the establishment of a healthy, diverse and sustainable plant mix. Where interfacing with private properties this is subject to further consultation with owners. The design applies the RMS Guidelines for Batter Surface Stabilisation using vegetation (RMS 2015)</td>
<td>X</td>
<td>Cut and fill batters and / or retaining walls is subject to consultation with owners.</td>
</tr>
</tbody>
</table>

*Text is taken from Northern Beaches Hospital Connectivity and Network Enhancements - Urban Design Report and Landscape Character and Visual Impact Assessment Stage 1 (Spackman Mossop Michaels 17.10.2014) - Section 3.1 urban design and landscape strategy – table 3.1 Summary of urban design and landscape strategy*
9.4 Appendix D - EIS Consistency Stage 2

Stage 2 - Urban and Landscape Design Objectives and Principles

For Stage 2 of the Project Approval, Condition of Approval B22 states:

The Proponent, in consultation with the Council, shall where feasible and reasonable, implement the urban design objectives and principles, giving consideration to the design strategies and mitigation measures identified in *Northern Beaches Hospital Connectivity and Network Enhancements: Concept Proposal and Stage 1 Urban Design and Landscape Character and Visual Impact Assessment: Spackman Mossop Michaels, October 2014*. Where an urban design principle or objective is not considered feasible or reasonable, this will be clearly demonstrated to the Secretary in conjunction with the submission of the Urban Design and Landscape Plan required by condition B24.

The following table includes:

- The urban design objectives and principles as listed in the Stage 1 Report
- The concept design strategies as listed in the Stage 1 Report
- A description of the FYJV Design
- An assessment to the demonstration of compliance of the FYJV design, considered as ‘yes’, ‘in part’ and ‘no’
- If ‘in part’ or ‘no’ the reasonable and feasible reasons as to why FYJV have not been able to implement the principles and objectives and concept design strategies and mitigation measures.
<table>
<thead>
<tr>
<th>FRAMEWORK OBJECTIVE AND PRINCIPLE*</th>
<th>CONCEPT DESIGN STRATEGY*</th>
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<tr>
<td>1. Retain and reinforce the parkway character of Warringah Road and Wakehurst Parkway and distinguish the ecological character of Wakehurst Parkway from the more formal and urbanised parkland character of Warringah Road</td>
<td>Due to widening of Frenchs Forest Road, some vegetation loss would be unavoidable at the intersection with Wakehurst Parkway. Due to widening of Warringah Road in the eastern section of Stage 1, street trees located in the existing verge would be removed. In combination with replacement street tree planting, existing trees located in the front of commercial and residential properties would assist in maintaining the vegetation corridor parkway character.</td>
<td>Due to the widening of the road carriageway a number of trees are being removed as part of the works. Tree replacement is being undertaken consistent with the densities described in the EIS and the project Scope of Work and Technical Criteria. Development of the design has highlighted locations where some existing trees previously identified for removal will (with arborist’s inputs) be able to be retained. The FYJV design approach includes the provision for extensive tree planting that satisfy all safety and setback requirements to maintain the vegetated parkway character of the corridor.</td>
<td>X</td>
<td>THE FYJV design is consistent with the concept Design strategy.</td>
</tr>
<tr>
<td>1A Ensure that parkway character of both Warringah Road and Wakehurst Parkway are retained through ensuring adequate retention and protection of the existing trees and vegetation. In particular, ensure vegetation is retained on both sides of the roadway, along Warringah Road, where higher impacts are planned</td>
<td>Due to widening of Frenchs Forest Road, both cutting and filling would be required. In order to minimise impacts on vegetation through encroachment, retaining walls would be utilised in these locations. Retaining wall design and finishes are to be designed in accordance with the mitigation strategy, which would see the use of terracing and stone finishes in order to reduce visual bulk and blend with the existing landscape.</td>
<td>Retaining walls are being used to reduce impacts on existing vegetation along both Wakehurst Parkway and Warringah Road. Development of the design has highlighted locations where some existing trees previously identified for removal will (with arborist’s inputs) be able to be retained. Retaining wall designs consider the structural requirements, constructability and design aesthetic. Terracing of walls is not included due to the narrow footprint.</td>
<td>X</td>
<td>Retaining walls are designed in accordance with the concept design mitigation strategy but do not employ terracing in order to reduce footprint.</td>
</tr>
<tr>
<td>1B Minimise earthworks in order to maximise vegetation retention</td>
<td>In line with Warringah Council’s desire to provide access along both sides of Warringah Road, for both pedestrians and cyclists, shared paths would be required. Where road corridor width permits, the shared paths would be designed to avoid trees through minimising path widths and by a curvilinear route that avoids trees.</td>
<td>Shared path alignment on the northern side of Warringah Road between Forest Way and Wakehurst Parkway is located so as to not require the removal of any existing trees. Some trees on the northern side of Warringah Road (Adjacent to Forest High School) a small number of trees will require removal to allow for the Hilmer Street Share Path bridge structure.</td>
<td>X</td>
<td>The design will achieve where possible while working within the design requirements of the standards for shared pathways.</td>
</tr>
<tr>
<td>1C Carefully locate shared paths so not to require removal of critical trees eg locate shared user path if practical along the southern verge of Warringah Road</td>
<td>The concept design demonstrates that widening would primarily occur along the southern verge, in order to limit vegetation loss and impacts on private and commercial properties to one side and in order to reduce impacts on The Forest High School and the NBH (which would have occurred should the alignment have been on the northern side)</td>
<td>Consistent with the Concept Design road widening is chiefly on the southern side of Warringah Road. Minimising impacts to the existing landscape adjacent to Forest High School.</td>
<td>X</td>
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</tr>
<tr>
<td>1D Encroach any required new road work into the southern verge of Warringah Road</td>
<td>Widening of Wakehurst Parkway as part of the Stage 2 project would occur south of Warringah Road including the new intersection with Aquatic Drive. With only limited road corridor width available, opportunities to reinstate bushland character may be limited in these circumstances, however indigenous vegetation communities would inform revegetation species selection. Street tree selection for all Stage 2 roads would comprise indigenous species.</td>
<td>Retaining walls are design for the sections of widening on Wakehurst Parkway south of Warringah Road. Areas disturbed as part of the construction works will be revegetated with Duffy’s Forest ecological community species consistent with the requirements of the Vegetation Management Plan (VMP). The planting design strategy is for an informal bushland character to Wakehurst Parkway and a more urbanised parkway to Warringah Road Street trees selected for Stage 2 design areas include species that are indigenous to the local area.</td>
<td>X</td>
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<tr>
<td>1E Apply an informal bush landscape character with large scale boulders and informal planting along Wakehurst Parkway, and a more urbanised parkway landscape concept along Warringah Road.</td>
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<tr>
<td>1F Improve facilities for all road users – including motorists, pedestrians and cyclists.</td>
<td>The road and intersection upgrades, footpath connectivity and widening and provision for cycling would see improvements to all road users.</td>
<td>The upgrades in the stage 2 design area are consistent with what is illustrated in the EIS for shared paths and pedestrian paths.</td>
<td>X</td>
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<tr>
<td>2. Reinforce the lush and green character of the area and express the bushland character</td>
<td>Indigenous vegetation communities, particularly those comprising the Duffys Forest EEC, would inform revegetation species selection. Ideally, planting and revegetation species would be propagated from endemic locally sourced seed. Areas disturbed as part of the construction works will be revegetated with Duffys Forest ecological community species consistent with the requirements of the Vegetation Management Plan (VMP) The VMP includes provision for seed collection from local plant communities.</td>
<td>Yes</td>
<td>X</td>
<td>Any street trees would be within the required clear zone for a 70km/hr posted road corridor. Any trees proposed are subject to individual Road Safety Audit.</td>
</tr>
<tr>
<td>2A Use native vegetation in the application of landscape design strategies to reinforce the character of the area</td>
<td>Where opportunities exist, tree planting would be undertaken on both road reserve and private properties with landowner consent. Landowners would be encouraged to plant trees in the front of their properties. Where space permits and clear zone (safety) requirements can be achieved within the road corridor street trees will be installed.</td>
<td>In part</td>
<td>No</td>
<td></td>
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<tr>
<td>2B Evaluate opportunities of introducing street trees along Forest Way</td>
<td>Due to widening of Frenchs Forest Road, some vegetation loss would be unavoidable at the intersection with Wakehurst Parkway. Clearing associated with construction activities would be revegetated in accordance with the associated vegetation community. Street tree selection for all Stage 2 roads would comprise indigenous species. Street trees selected for Stage 2 design areas include species that are indigenous to the local area. Vegetation clearing at Wakehurst Parkway will be minimised as much as possible. Areas disturbed as part of the works will be revegetated with Duffys Forest ecological community species consistent with the requirements of the Vegetation Management Plan (VMP)</td>
<td>In part</td>
<td>No</td>
<td></td>
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<tr>
<td>2C Reinforce the definition of the intersection of Warringah Road and Wakehurst Parkway through strategic landscape measures such as revegetating impacted areas where applicable</td>
<td>In Stage 2, there would be impacts on existing vegetation due to road widening, shared path and footpath provisions. New planting would be undertaken to assist with mitigating visual impacts. Existing vegetation would be impacted due the road widening. The design strategy has been to minimise where possible the removal of existing trees. Some large existing specimens are likely to be able to be retained at the following locations: * At the end of the mid block pedestrian access point from Karingal Crescent – opposite the intersection with Forest Way * On the northern side of Warringah Road east of Forest Way Extensive new planting will be provided to the edges of the road corridor and to the landscape space between the lowered slot section of Warringah Road and the adjacent surface roads to mitigate visual impact and reduce the perceived width of the corridor.</td>
<td>In part</td>
<td>No</td>
<td></td>
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<tr>
<td>3. Deliver an integrated approach to traffic (including pedestrian and cycle), public transport and land use</td>
<td>In the Stage 2 project, new pedestrian crossings of Warringah Road would be associated with signalised intersections and shared path bridges. New pedestrian crossing facilities would be provided at the following locations: * Shared path bridge over Warringah Road near Hilmer Street, the NBH and The Forest High School. Existing pedestrian crossing facilities would be</td>
<td>Yes</td>
<td>In part</td>
<td>No</td>
</tr>
<tr>
<td>3A Provide user friendly pedestrian crossings at Warringah Road and Forest Way</td>
<td>The FYJV design includes provision for; *A New pedestrian crossing facilities are provided with a shared path bridge over Warringah Road near Hilmer Street. *A new shared path bridge over Warringah Road near Forest way to replace the existing bridge. * Retention of the existing bridge over Wakehurst Parkway near</td>
<td>In part</td>
<td>No</td>
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<td>upgraded or reconfigured at the following locations:</td>
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<tr>
<td>¬ Shared path bridge over Warringah Road at the intersection with Forest Way.</td>
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<td>aquatic Drive</td>
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<tr>
<td>¬ Existing footbridge retained over Wakehurst Parkway near Aquatic Drive/ Fitzpatrick Avenue.</td>
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<td>¬ Across Forest Way opposite Forestway Shopping Centre and at the intersection with Warringah Road.</td>
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<tr>
<td>¬ Across Warringah Parkway on both sides of the intersection with Warringah Road.</td>
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<tr>
<td>¬ Across Warringah Road at the intersection with Wakehurst Parkway (excluding western side) and the intersection with Allambie Road (excluding eastern side).</td>
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<tr>
<td>Pedestrian crossing locations, even where signalised, are to be located close to existing crossing locations. There is to be a net gain in pedestrian crossings throughout the project.</td>
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### 3B Ensure good connectivity to public transport modes, particularly along Warringah Road.

Widening associated with bus requirements is to be minimised (in line bus stops preferred), through careful alignment design. Impacts on bicycle and pedestrian connectivity, as well as physical impacts on the public domain and residential screening requirements are to be minimised.

Shared paths and footpaths are to be connect to bus stops in order to ensure access and connectivity for bus users and local residents. Bus stops should be kept as close as possible to existing locations.

The FYJV design includes bus lane configurations and bus stop facilities that meet the requirements of the agreement between Council and TfNSW.

The design of bus stops and lane configurations are based on the recommendations of the Road Safety Audit and consistent with the requirements of AustRoads.

Based on Road Safety audits some bus stop locations require isolate widening of the road pavement.

### 4. Retain the privacy and amenity residents in the local streets in the immediate area, and provide opportunities for urban restructuring and redevelopment

New developments along Frenchs Forest Road and Warringah Road may be possible in the future in line with the planned Warringah Council Structure Plan and following the construction of the NBH.

New developments should retain existing vegetation to the greatest extent possible in order to assist with visual impact mitigation.

The FYJV design supports the Concept Design Strategy and meets the Framework Objective and Principle.

### 4A Utilise existing vegetation as visual screening within new developments to retain green character and minimise visual impacts

Existing built form is primarily single storey residential and one and two storey commercial buildings. The NBH development will be substantially bigger in scale than the existing built form.

Road verges and remnant lands resulting from acquisition are to be planted, wherever possible, with native street trees and shrubs.

The FYJV design supports the Concept Design Strategy and meets the Framework Objective and Principle.

### 4B Apply landscape strategies that complement the future character and scale of built form elements of the precinct

Pedestrian and vehicular conflicts would be managed through signalisation of pedestrian crossings and provision of pathways and shared path bridges across Warringah Road.

The pathways would connect with the broader region via new pathways and

Conflicts are managed through the inclusion of signalisation of crossing points and two shared path bridges across Warringah Road.

The pathways are designed to integrate with broader regional
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<td>shared pathways along Frenchs Forest Road and Warringah Road in Stages 1 and 2. Noise impacts resulting from Warringah Road widening would be addressed by noise abatement walls, which would be designed to integrate visually with other elements.</td>
<td>pathways and cycleway infrastructure and the circulation network designed for Stage 1 of the project. Noise walls are designed to mitigate impacts to existing properties on the southern side of Warringah Road from Bantry Bay Road to south of Fitzpatrick Avenue East. The design of the walls has been undertaken in accordance with the RMS Design Guidelines for Noise Walls and is visually integrated with other road infrastructure elements.</td>
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<tr>
<td>4D Enhance pedestrian facilities and crossing points along Frenchs Road West to enhance pedestrian safety for school children.</td>
<td>Pedestrian crossings points would be rationalised in accordance with the road widening and signalisation, however these new and existing crossings would be upgraded to improve safety. A new shared path bridge would be provided across Warringah Road at Hilmer Street to ensure safe pedestrian access to The Forest High School.</td>
<td>All new crossing points design will meet the relevant design standards for safety. A new shared path bridge is provided across Hilmer Street and connects directly into the new mid-block shared path between the hospital and high school.</td>
<td>X</td>
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<tr>
<td>5. Define the address of the hospital locality as well as expressing the area as a gateway to the Northern Beaches.</td>
<td>The hospital would be visible from Frenchs Forest Road, Wakehurst Parkway and Warringah Road, as well as from longer range viewpoints situated on higher ground. Gateway landscape treatments and robust urban design would assist with reinforcing the ‘sense of place’ and mitigating visual impacts. Ensure integration of the hospital frontage landscape with the streetscape landscape along Warringah Road and Wakehurst Parkway</td>
<td>The Hospital has been consulted during the design development phase to ensure coordination of the road corridor and hospital circulation system and landscape design. An overall scheme is provided that in the broader context supports the hospital as a regional facility and focal point.</td>
<td>X</td>
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<tr>
<td>6. Create a clear structural framework for streetscapes that enhances the legibility, way-finding and functioning of the precinct</td>
<td>Local traffic would continue to use Frenchs Forest Road, and the Warringah Road (surface carriageway), with regional through-traffic using Warringah Road (central slot), Wakehurst Parkway and Forest Way. Signalised intersections would be provided in order to facilitate local traffic access to Warringah Road (via the surface carriageway) at all times, in particular during peak hours.</td>
<td>Supports the Concept Design Strategy and meets the Framework Objective and Principle.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>6A Consider separating regional from local traffic to enhance the legibility and way-finding around the precinct</td>
<td>Environmental studies, including noise monitoring and assessment, have indicated that it is likely that noise walls would be required as part of the Stage 2 project works along the section of road currently occupied by Karangal Reserve between Bantry Bay Road and Fitzpatrick Avenue East. Noise would also be managed by the use of architectural treatments to buildings if required.</td>
<td>Consistent with the environmental studies noise walls will be required as part of the Stage 2 works. A noise wall varying in height between 3.5m and 3m is proposed between Fitzpatrick Avenue East and Bantry Bay Road. South of Fitzpatrick Avenue east the noise wall will be 4m in height.</td>
<td>X</td>
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<tr>
<td>6C Minimise impacts to existing vegetation and utilise it as green buffers/ visual foils to new built form, and urban infrastructure</td>
<td>Due to demands on the corridor, it has been necessary to remove existing vegetation to allow for road widening. Where front-line vegetation such as street trees would be removed, this would be mitigated by revealing second-line vegetation and replacement with new planting. Land owners would be encouraged to plant trees in the front of their properties where applicable.</td>
<td>Extensive vegetation is being removed to the southern verge of Warringah Road. Tree planting will be provided to all areas outside of the clear zone setbacks. This will include the establishment of a tree buffer all the way from Fitzpatrick Avenue East through to Bantry Bay Road in front of the proposed noise wall. As part of the communications process land owners will be consulted in regards to encouraging planting of trees to the front of their properties where applicable.</td>
<td>X</td>
<td>Full implementation of the strategy is subject to consultation with land owners.</td>
</tr>
<tr>
<td>6D Reinforce/formalise the existing pedestrian link between hospital site and school</td>
<td>In Stage 2, signalised crossings and shared path bridges would be provided in order to ensure safe pedestrian movements into the hospital precinct and schools.</td>
<td>The FYJV design is consistent with the Concept Design in providing signalised crossings and shared path bridges to provide safe movements into the hospital, school and shopping precincts.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>6E Ensure existing pedestrian links are retained and proper connectivity is achieved to road crossings, particularly for Warringah Road</td>
<td>Pedestrian access would be maintained along both sides of Warringah Road and generally throughout Stage 2. Important suburban connections will be maintained across Warringah Road via shared path bridges and signalised intersections</td>
<td>Pedestrian access is maintained along both sides of Warringah Road. The shared path bridges landings are located to connect directly with key desire line and connecting routes within the area.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>6F Create a buffer zone between road and path to increase pedestrian safety and articulate the paved surfaces</td>
<td>On Warringah Road, a planted strip would be provided adjacent to the kerb in order to provide greater separation of vehicles and pedestrians. Where screening is not required or not feasible along property boundaries, pedestrian footpaths are to be set back from the kerb and separated by landscape.</td>
<td>The project design for access and circulation requires a 3.0m wide shared in the following locations along Warringah Road;  • On the northern side between Forest Way and Wakehurst Parkway  • On the southern side between Fitzpatrick Avenue East and Wakehurst Parkway  • On the southern side between Wakehurst Parkway and Allambie Road. In all of these locations there is no space provided for a planted strip to provide greater separation of vehicles and pedestrians.</td>
<td>X</td>
<td>Northern side of Warringah Road - The path is located off the back of kerb to reduce the impact on the existing trees in this location. Southern Side of Warringah Road (east of Wakehurst Parkway) - Pushing the path away from the kerb would require significant more and higher retaining walls and impact on existing trees due to additional earthworks. Southern side of Warringah Road (west of Wakehurst Parkway) - The carriageway is mostly in cut in this location and a shared path cycleway balustrade will provide a safe separation between vehicles and pedestrians.</td>
</tr>
<tr>
<td>6G Avoid as much as practical the introduction of barriers</td>
<td>Barriers would be required for the Stage 2 project where pedestrian access is provided next to the intersection of Warringah Road and Forest Way or next to distinct level change that would pose a safety risk.</td>
<td>Barriers are installed in Stage 2 consistent with the safety requirements and guidelines outlined in AustRoads. These are integrated into the design with the termination of walls designed to have a taper. The location of barriers does not impact safety and / or legibility for pedestrians or cyclists.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>6H Evaluate opportunities to introduce pedestrian crossings as overpasses, acting as legible markers to both drivers and pedestrians</td>
<td>In the Stage 2 project, shared path bridge crossings would be replace the existing footbridge at Warringah Road/ Forest Way intersection and an existing footbridge retained across Wakehurst Parkway near Fitzpatrick Avenue. A new shared path bridge would be provided in order to maintain access to the The Forest High School and to service the NBH near the intersection of Warringah Road/ Hilmer Street.</td>
<td>The FYJV design access points and circulation are consistent with the EIS Concept Design Strategy. The design includes replacement of the existing bridge at Forest Way and a new bridge linking the southern side of Warringah Road, near Hilmer Street with the new mid-block crossing on the western side of the Hospital on the northern side of Warringah Road.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>6I Ensure hospital access/entry point allows proper connectivity to major arterial roads</td>
<td>The primary access to the hospital would be via a new signalised intersection of Frenchs Forest Road. A secondary access would be</td>
<td>The design of Frenchs Forest Road West (Stage 1) has been undertaken in close coordination with the Hospital to ensure safe access for pedestrians and hospital users. The access off</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>FRAMEWORK OBJECTIVE AND PRINCIPLE*</td>
<td>CONCEPT DESIGN STRATEGY*</td>
<td>FYJV DESIGN</td>
<td>RFRAMEWORK + CONCEPT STRATEGY ACHIEVED</td>
<td>IF NO / IN PART – EXPLANATION</td>
</tr>
<tr>
<td>----------------------------------</td>
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<td>------------------------------</td>
</tr>
<tr>
<td>6. Apply CPTED (Crime Prevention Through Environmental Design) principles in the design resolution of the Stage 1 Project</td>
<td>CPTED has informed the design of pedestrian routes throughout the Stage 2 project. In particular, sightlines on footpaths, shared paths and shared path bridges has been considered. CPTED is to be considered in more detail during the detailed design stage. Sightlines and safety would be maintained at all times during construction for motorists and pedestrians through careful staging and provision of temporary barriers. Security would be maintained at all times during construction through the provision of temporary fencing along school boundaries and following construction through reinstatement of permanent security fencing. Any new access points would require security gates to be installed.</td>
<td>Warringah Road is part of Stage 2 and the design has been undertaken in consultation with the Hospital.</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FRAMEWORK OBJECTIVE AND PRINCIPLE</th>
<th>CONCEPT DESIGN STRATEGY</th>
<th>FYJV DESIGN</th>
<th>RFRAMEWORK + CONCEPT STRATEGY ACHIEVED</th>
<th>IF NO / IN PART – EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>7A Consider the use of natural materials in built form elements to reinforce the setting's character</td>
<td>On arterial roads, walls facing the road would be faced with a high quality concrete panel, with textures and colours appropriate to the setting. For walls facing private property a stone finish would be preferred. Wall finishes are to be designed to a high level of finish generally, as is required of an urban setting such as this.</td>
<td>Walls facing the road are designed and detailed to be constructed of a high quality concrete panel.</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

The stage 2 walls proposed for Stage 2 facing private property are proposed as L-shape concrete walls with an integrated roadside barrier for safety. They will have a Class 2 concrete finish.

| 7B Consider, if practical, under grounding power lines particularly on the high ridge area, and in constrained areas, to enhance opportunities for planting | Substantial underground utilities exist across the concept project area, which, in combination with topographical issues, make it difficult to accommodate additional underground services. The undergrounding of overhead services is to be considered further during detailed design. | Underground utilities are being considered in the detailed design to ensure adequate coverage for extensive tree and landscape planting over. The existing 11kv line along the southern verge of Warringah Road (between Fitzpatrick Avenue East and Bantry Bay Road) is being relocated underground to reduce the visual impacts and maximise the opportunity for upper canopy vegetation to be established along the corridor. | | X |

| 7C Use colour schemes that complement the area’s character or that help recede built form elements | Colour schemes are to be selected during detailed design in consideration of local textures and colours of the surrounding bushland in accordance with the urban design framework. | Colour palettes have been developed that complement the surrounding bushland and generally are receding colours and are consistent with the urban design framework. These will assist in featuring the revegetation and new landscape planting works. | | X |

| 7D Apply landscape strategies that complement the future character and scale of built form elements of the precinct | Where possible, revegetation would consist of mature potted stock including canopy trees, with species informed by the Duffys Forest EEC. | Plant material used for revegetation and landscaping include mature potted stock consistent with the requirements of the project deed. All street trees for Stage 1 works will be a minimum of 75 litre stock. | | X |

<p>| 7E Apply darker colours in areas where structures should visually recede | Colour schemes are to be selected during detailed design in consideration of local textures and colours of the surrounding bushland in accordance with the urban design framework. | Colour palettes have been developed that complement the surrounding bushland and generally are receding colours and are consistent with the urban design framework. These will assist in featuring the revegetation and new landscape planting works. | | X |</p>
<table>
<thead>
<tr>
<th>FRAMEWORK OBJECTIVE AND PRINCIPLE*</th>
<th>CONCEPT DESIGN STRATEGY*</th>
<th>FYJV DESIGN</th>
<th>RFRAMEWORK + CONCEPT STRATEGY ACHIEVED</th>
<th>IF NO / IN PART – EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>7F Introduce stepped retaining walls (where possible) with planted benches to reinforce the green character of the setting</td>
<td>In Stage 2, several walls are required in both cut and fill scenarios, facing both the road upgrade, private residents and facing away from the upgrade towards bushland. Walls facing the road upgrade (in Cut) are to be clad in a high quality material, preferably locally sourced natural sandstone if possible. Walls facing private property or public land should be constructed of stone block facing. Incorporation of terracing and planting into wall design would be undertaken wherever possible in order to reduce the bulk, scale and visible surface area of walls, however increasing the footprint of the walls should not be undertaken at the expense of existing vegetation or extend beyond the project boundary.</td>
<td>The walls facing the corridor (in cut) in Stage 2 will be finished in a precast concrete fascia panel with a coping panel. These walls form part of the overall design language of the wave form and are complimentary to the shared path bridges and portal shape at Wakehurst Parkway. Walls facing private property or public land are a combination of precast concrete panel. The style of the wall is selected to best respond to the geotechnical constraints, minimising of project construction footprint, constructability and aesthetic. There is no terracing of walls proposed within the design as large walls facing away from the upgrade can reduce the impact by having a reduced overall footprint. Sandstone faced walls are used in Stage 1 (in retaining walls facing the corridor) where they occur in a Duffy’s Forest context. All of the walls in Stage 2 in Duffy’s Forest face away from the corridor and are finished in a concrete panel. None of the proposed walls extend beyond the approved project boundary.</td>
<td>X</td>
<td>Wall typologies have been selected based on geotechnical survey, construction technique, visual and aesthetic considerations and minimising of project footprint. Terracing has not been proposed.</td>
</tr>
<tr>
<td>7G Consider widening the road corridor in strategic areas to allow better greening opportunities</td>
<td>Widening for the purpose of greening is unlikely due to demands on the road corridor within a primarily residential precinct. Opportunity exists within the Stage 2 project area to utilise land acquired for road widening that is considered surplus to the immediate needs of the road corridor. In addition to an extensive street tree strategy, planting on private property may would also be considered subject land owner consent.</td>
<td>Consistent with the design vision all areas of landscape that are outside of the required clear zones spaces and within the project works will be revegetated with trees planting to reinforce the ‘forest’ character of the broader landscape. Planting on Private Property is encouraged and is subject to consultation with the relevant land owners and subject to their consent.</td>
<td>X</td>
<td>Planting on private property is subject to consultation with owners.</td>
</tr>
<tr>
<td>7H Introduce vegetated batters where practical to conceal the apparent height of structures</td>
<td>Cut and fill would generally be reconciled through the construction of low retaining walls. Where retaining walls are not employed, batters and embankments would be revegetated.</td>
<td>Retaining walls are generally being used in stage 2 works areas, especially around Wakehurst Parkway and Duffy’s Forest Vegetation. Where batters are required they have been designed and detailed to ensure the establishment of a healthy, diverse and sustainable plant mix. The design applies the RMS Guidelines for Batter Surface Stabilisation using vegetation (RMS 2015) The drainage design meets all the required project requirements for water quality management in native bushland areas.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>7I Introduce water sensitive design and minimise hard surface engineered drainage concepts.</td>
<td>Due to the upgrade being confined to a narrow road corridor, there are only limited opportunities to introduce water sensitive urban design landscape treatments. Run off is not to be allowed to enter native bushland or creeks in an uncontrolled fashion and should be improved and slowed at every opportunity.</td>
<td>Consistent with the Concept Design Strategy water sensitive urban design opportunities are limited. The main opportunities being employed include cross fall of shared paths (3.0m and 2.5m wide) into adjacent landscape areas where: • The natural grade is falling away from the corridor • The adjacent land (where the water is running) is in public ownership All stormwater runoff is captured and treated to meet the project water standards.</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

*Text is taken from Northern Beaches Hospital Connectivity and Network Enhancements - Urban Design Report and Landscape Character and Visual Impact Assessment Stage 2 (Spackman Mossop Michaels 06.07.2015) - Section 3.1 urban design and landscape strategy – table 3.1 Summary of urban design and landscape strategy
9.5 Appendix E- Vegetation Management Plan
Northern Beaches Hospital Connectivity and Network Enhancement Project
Vegetation Management Plan (Stage 1 and 2)

FINAL REPORT
Prepared for Ferrovial York Joint Venture
29 April 2016

Acknowledgements

Biosis acknowledges the contribution of the following people and organisations in undertaking this study:

- Ferrovial York Joint Venture: Mark Turner and Tim Faiz
- Rachel Clancy for report writing
- Tony Steelcable for quality assurance

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1 Introduction

1.1 Project background

Biosis Pty Ltd was engaged by Ferrovial York Joint Venture (FYJ) to develop a Vegetation Management Plan (VMP) for the Northern Beaches Hospital Connectivity and Network Enhancement Project, Frenchs Forest.

The Project has been assessed under Part 5.1 of the Environmental Planning and Assessment Act 1979 (EP&A Act) and is classified as State Significant Infrastructure (SSI). Roads and Maritime Services (Roads and Maritime) is undertaking the Northern Beaches Hospital Connectivity and Network Enhancement Project in two stages. Infrastructure Approval for Stage 1 (SSI-6434) and Stage 2 (SSI-6622) has been issued and are subject to Conditions of Approval (CoA). The preparation of this VMP addresses the condition requirements to reduce impacts to threatened species or Endangered Ecological Communities (EECs), and to rehabilitate impacted vegetation with endemic species (SSI-6434: CoA B18), as well as provision of a Seed Collection and Revegetation Strategy (SSI-6434: CoA B30 and SSI-6622: CoA B24). The seed collection and revegetation strategy is incorporated into the VMP.

1.2 Proposed works

1.2.1 Project Stages

The Project construction footprint for Stage 1 works is situated in the Warringah Shire Council Local Government Area (LGA) and involves the removal of 5.37 hectares of native vegetation. The surrounding land use is primarily business parks, residential, retail services, a school and parklands with patches of degraded and intact remnant bushland located to the immediate north and east of the Project footprint. The Project footprint includes the intersection of Warringah Road and Wakehurst Parkway and surrounding road infrastructure (Figure 1).

The Project construction footprint for Stage 2 works involves the removal of approximately 6.1 hectares of vegetation comprising Duffy’s Forest Ecological Community. Stage 2 will involve clearing of roadside vegetation along Warringah Road and Wakehurst Parkway (SMEC 2015). The footprint is shown in Figure 1.

1.2.2 Potential ecological impacts

Key aspects of the proposed works that could result in potential ecological impacts include:

- Clearing of native vegetation and habitat (including Duffy’s Forest EEC).
- Invasion of exotic species, weeds, pests and pathogens.
- Impacts on threatened species and their habitats.
- Habitat fragmentation and loss of connectivity.
- Stockpile/compound road construction.
- Works around and within watercourses.
- Noise, vibration, light and vehicular movement impacts.
- General earth vegetation resulting in disturbance of soils, erosion, and the mobilisation of sediment.
- Open excavation works.
2 VMP Scope and Objectives

2.1 Scope

The scope of this VMP is to develop a framework for the management of vegetation to be retained, vegetation to be removed and the management of weeds during the Project. The VMP will also incorporate a seed and revegetation strategy to outline the key species that contribute to the Duffy’s Forest Endangered Ecological Community (ECC) and outline timing of seed collection.

2.2 Objectives

The specific objectives for the implementation of this VMP are to:

- Outline strategies to avoid or minimise impacts on vegetation where possible.
- Outline the management of vegetation to be retained and vegetation to be removed, including details on tree management and requirements of construction workers regarding tree protection and retention.
- Outline rehabilitation details, including identification of flora species and sources, and measures for the management and maintenance of rehabilitated areas (including the duration of the implementation of such measures).
- Provide schedules for inspection, monitoring, management and corrective actions.
- Describe weed management activities.
- Incorporate a seed collection and revegetation strategy that is complementary to the planting details outlined in the Urban and Landscape Design Report (UALD Report) by AECOM (2015).
- Identify areas where revegetation would/could occur in the Project footprint (in conjunction with the UALD Report, AECOM 2015) and in the Northern Beaches Hospital Connectivity and Network Enhancements Environmental Impact Statement - Stage 1 works Volume 2: Appendix F Biodiversity (EIS survey) by SMEC (2014) and Northern Beaches Hospital Connectivity and Network Enhancements Environmental Impact Statement - Stage 2 works: Appendix E Biodiversity (EIS survey) by SMEC (2015).
- Review flora species lists of Duffy’s Forest ECC and identify a suite of flora species suitable for incorporation into the UALD Report.
- Identify the following for each species recommended to be included in the UALD Report:
  - Description of height and growth form (e.g. small shrub < 1 metre, spreading ground cover etc.).
  - Timing of the setting of seed to determine optimal timing of collection.
  - Seed collection methods.
- Describe planting density and composition of revegetated areas that is complementary to the details provided in the UALD Report.

3 Vegetation Management Zones

3.1 General approach

This VMP provides a framework for the management of vegetation to be retained, vegetation to be removed and the management of weeds during the Project, to meet CoA B18 (83–6434). The condition (B18) states the clearing of native vegetation shall be minimised with the objective of reducing impacts to any threatened species or Endangered Ecological Communities to the greatest extent practicable. Impacted vegetation shall be rehabilitated with endemic species to the greatest extent practicable.

The vegetation present within the Project footprint includes all areas of remnant and modified native vegetation, cleared and disturbed lands. As a result of the proposed works, the Project requires the removal of 5.37 hectares of vegetation within the Stage 1 Project footprint and approximately 6.1 hectares of vegetation within the Stage 2 Project footprint. Removal of vegetation includes both introduced and native vegetation, including Duffy’s Forest ECC. A pre-clearance survey undertaken prior to construction would confirm the extent of clearance and minimise the impacts to threatened species and endangered ecological communities, i.e., Duffy’s Forest ECC.

Where possible, retaining native vegetation is in preference to clearing and revegetation (RTA 2011). Priority has been given to avoiding and minimising the extent of vegetation removal in the planning and design phases of the Project. However, given the vegetation clearance required it will also be necessary to rehabilitate and revegetate areas where possible.

3.2 Revegetation zones – Bushland Corridor

To maintain a consistent approach to vegetation management for the Project, this VMP has been developed in parallel with the Northern Beaches Hospital Connectivity and Network Enhancement Project Urban and Landscape Design Report (AECOM 2015). The Urban and Landscape Design Report (UALD Report) describes three distinct landscape typologies (Bushland Corridor, Forest Parkway and Suburban Street) that reflect the existing character of the landscape (AECOM 2015). These typologies (or vegetation management zones) are mapped in the UALD Report in a series of urban and landscape design drawings that consider the natural values, landscape potential and design requirements of the Project (AECOM 2015). The UALD Report characterises the Bushland Corridor typology by a naturalistic landscape with high species diversity and high habitat value (AECOM 2015). In the Bushland Corridor zones, AECOM (2015) recommends that impacted areas are rehabilitated and/or revegetated to reflect the full structure and diversity of Duffy’s Forest ECC. The vegetation management details provided in this VMP are aimed at rehabilitating and revegetating the Bushland Corridor zones (as mapped by AECOM 2015) with Duffy’s Forest ECC. Vegetation management activities should reflect the revegetation and planting designs presented in the UALD Report.

The pre-clearance survey provides mapping that outlines the extent of vegetation communities located in the Project footprint that will be removed as a result of the proposed works. In the areas where Duffy’s ECC is removed, revegetation should follow the specifications provided in Section 5 of this VMP and the designs provided for the Bushland Corridor zones mapped in the UALD Report (AECOM 2015). Landscaping designs for maintained areas (planted natives and exotics) in the Project footprint are provided in the UALD Report (AECOM 2015) for the concept landscape design plan and areas to be revegetated.

The works prescribed may require modification in response to evolving site conditions and subsequently evolving management priorities. Further to this, planning of the implementation of this document must also

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recognise that departures from the recommended works may be required or considered in response to changing site conditions, due to natural processes or future uses of the site. More detail on this adaptive management approach is provided in Section 8. The operational period of this VMP is 36 months from the date of commencement.

4 Vegetation Clearing

The proposed works involves the removal of 5.37 hectares of vegetation in the Stage 1 Project footprint and approximately 6.1 hectares of vegetation in the Stage 2 Project footprint. The vegetation proposed for removal comprises an EEC as well as potential habitat for several threatened flora and fauna species listed under the Environment Protection and Biodiversity Conservation Act 1999 and/or Threatened Species Conservation Act 1995. The following sections outline the measures to be implemented to minimise the environmental risks associated with this clearance.

4.1 Seed collection for revegetation

The CoA B30 (c) (SSI-6434) and CoA B24 (c) (SSI-6622) for the Project requires “The provision of a Seed Collection and Revegetation Strategy, to ensure seed from flora within Duffy’s Forest ecological community, where feasible and reasonable, are collected and species identified and used to progressively rehabilitate, regenerate and/or re-vegetate these areas with the assistance and involvement of key community and land or bush care groups in the area, where practicable.”

When native vegetation is lost as a result of project works, revegetation may be necessary to reinstate native vegetation and habitat in the Project area. The purpose of revegetation for this Project includes:

- Replacing lost or damaged flora from within Duffy’s Forest EEC.
- Creating buffer zones around retained native vegetation to protect it from edge effects.
- Creating or maintaining habitat corridors to help facilitate the movement of flora and fauna species.
- Help to maintain native seed banks, local provenance of species endemic to the area and genetic diversity.

Seed collection from EECs requires a licence under the NSW National Parks and Wildlife Act 1974. Sufficient time should be allocated to seed collection for the Project to allow for seasonal variations in seed production. Depending on timing, this may include collecting seed up to 12 months in advance of revegetation works. Seed collection is to be undertaken for the Duffy’s Forest EEC that will be removed as a result of the proposed works. Collection of additional seed from the adjoining retained vegetation may be required (depending on seasonal variations in seed production) to ensure adequate genetic diversity is maintained. Seed collection for the Duffy’s Forest vegetation is to be carried out in accordance with RTA Seed Collection QA Specification R176 and the Florabank Guidelines and Model Code of Practice (RTA 2011). Seed collection is also to be carried out by experienced and licenced seed collectors.

4.1.1 Key species for collection

Flora surveys were undertaken for the EIS for this Project by SMEC (2014) and SMEC (2015). Of the flora recorded during the survey, 51 species were representative of the Duffy’s Forest EEC (Smith and Smith 2000). These were mapped by SMEC (2014). A list of the Duffy’s Forest EEC species that were recorded during the survey, suitable for seed collection, is provided in Table 1. This list is to form the basis of the seed to be collected for revegetation. Given the nature of flora surveys, it is possible that there are other species that make up the Duffy’s Forest EEC that are present in the Project footprint but were not recorded in that particular survey effort. These species are listed in Appendix 1 (Table 7) and seed should also be collected from any of these species if they are encountered in the Project footprint during seed collection.
Also provided in Table 1 is a brief description of the height and growth forms for the species listed. This information is used for species selection for revegetation as a guide, to be formalised by the seed collection contractor. Although species that would be appropriate for revegetation are highlighted, the viability of seeds collected and their propagation success may be variable. It is therefore recommended that seed is collected from as many of these species as possible, during appropriate seasons. Revegetation specifications are collected and their propagation success may be variable. It is therefore recommended that seed is collected from as many of these species as possible, during appropriate seasons. Revegetation specifications are described further in Section 5 below, and details including planting densities, spacing and number of plants is provided in the UALD Report (AECOM 2015).

### Table 1 Duffy’s Forest EEC species recorded in the Project footprint

<table>
<thead>
<tr>
<th>Species Name</th>
<th>Common Name</th>
<th>Growth Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acacia linifolia</td>
<td>White Wattle</td>
<td>Erect or spreading shrub; 1.5 - 4 m</td>
</tr>
<tr>
<td>Acacia myrtifolia</td>
<td>Red-stemmed Wattle</td>
<td>Prostrate to erect shrub; 0.3 - 3 m</td>
</tr>
<tr>
<td>Acacia suaveolens</td>
<td>Sweet Wattle</td>
<td>Prostrate to erect shrub; 0.3 - 2.5 m</td>
</tr>
<tr>
<td>Allocasuarina littoralis</td>
<td>Black She-oak</td>
<td>Tree; 5 - 15 m</td>
</tr>
<tr>
<td>Angophora costata</td>
<td>Smooth-barked Apple</td>
<td>Tree; to 30 m</td>
</tr>
<tr>
<td>Anisopogon avaceus</td>
<td>Oat Speargrass</td>
<td>Ground Cover; to 1.5 m</td>
</tr>
<tr>
<td>Austrostipa pubescens</td>
<td>Speargrass</td>
<td>Ground Cover; to 1.5 m</td>
</tr>
<tr>
<td>Banksia ericifolia</td>
<td>Heath-leaved Banksia</td>
<td>Bushy shrub or small tree; to 6 m</td>
</tr>
<tr>
<td>Banksia serrata</td>
<td>Old-man Banksia</td>
<td>Shrub or tree; to 16 m</td>
</tr>
<tr>
<td>Banksia spinulosa</td>
<td>Hair-pin Banksia</td>
<td>Multi-stemmed shrub; to 3 m</td>
</tr>
<tr>
<td>Billardiera scandens</td>
<td>Hairy Apple Berry</td>
<td>Small shrub; to 0.5 m</td>
</tr>
<tr>
<td>Boronia ledifolia</td>
<td>Showy Boronia</td>
<td>Shrub; 0.3 - 1.5 m</td>
</tr>
<tr>
<td>Bossiaeae obcordata</td>
<td>Spiny Bossiaeae</td>
<td>Rigid shrub; to 2 m</td>
</tr>
<tr>
<td>Brunoniella pumilio</td>
<td>Dwarf Brunoniella</td>
<td>Ground Cover</td>
</tr>
<tr>
<td>Ceratopetalum gummiferum</td>
<td>Christmas Bush</td>
<td>Shrub or tree</td>
</tr>
<tr>
<td>Cyathochaeta diandra</td>
<td>Ground Cover</td>
<td>Ground Cover</td>
</tr>
<tr>
<td>Dampiera stricta</td>
<td>Dampiera</td>
<td>Multi-stemmed sub-shrub; 20 - 60 cm</td>
</tr>
<tr>
<td>Dianella caerulea</td>
<td>Blue Flax-lily</td>
<td>Ground Cover</td>
</tr>
<tr>
<td>Dillywnia retorta</td>
<td></td>
<td>Erect shrub; to 3 m</td>
</tr>
<tr>
<td>Dodonaea triqueta</td>
<td>Large-leaf Hop-bush</td>
<td>Erect shrub; to 3 m</td>
</tr>
<tr>
<td>Entoliasia stricta</td>
<td>Wiry Panic</td>
<td>Ground Cover</td>
</tr>
<tr>
<td>Epacris pulchella</td>
<td>Wallum Heath</td>
<td>Slender erect shrub; 40 - 150 cm</td>
</tr>
<tr>
<td>Eucalyptus capitellata</td>
<td>Brown Stringy-bark</td>
<td>Tree; to 20 m</td>
</tr>
<tr>
<td>Eucalyptus haemastoma</td>
<td>Broad-leaved Scribbly Gum</td>
<td>Tree; to 15 m</td>
</tr>
<tr>
<td>Eucalyptus sieberi</td>
<td>Silvertop Ash</td>
<td>Tree; to 30 m</td>
</tr>
</tbody>
</table>

#### 4.1.2 Seed collection methods

To minimise negative impacts associated with seed collection, no more than 10% of the total seed available at the site (and from individual plants) should be collected in any one year (Ralph 1993). However, this is not applicable in the Project footprint where all native vegetation is to be cleared. If seed is collected from adjoining retained areas however, the 10% rule applies. General considerations for seed collection include:

- Collect seed from as many individual plants as possible to maximise genetic diversity.
- Collect from stands or groups of plants rather than isolated plants, even if they carry large amounts of seed.
Neighbouring plants are likely to be related so ensure that seed is collected from plants across the entire area.

Collect approximately equal amounts of seed from each plant.

Collect seed from various parts of the plant (not just those easily accessible).

Label each batch of seed collected with:
- Species
- Location
- Date collected and collector's name
- Number of plants collected from
- Details on position in the landscape, percentage of seed ripe, soil type, other relevant details.

Seed may be collected from tall trees by utilising fallen limbs and branches, or using a long-handled pruner. Seed on small trees and shrubs can be collected using seacateurs or pruners, hand-picked, or the branches hand-stripped. A drop-sheet or tarpaulin under the plant can be used to catch fallen seeds and fruit when branches are shaken. For species which release their seed very quickly upon ripening (such as wattles and bush-peas), it may be worthwhile to tie paper bags or nylon stockings around the branches before the seed pods ripen (OEH 2011).

4.1.3 Timing of seed collection

Timing of seed collection is a critical consideration. Timing is mostly dependant on when the seed matures and how long the seed remains on the plant after maturity. The peak seed collection period in NSW usually occurs from October to December. Although seed ripens generally the same time each year, seasonal variations and local climatic factors and conditions may lead to variations in timing from year to year (Ralph 1993). Seed collection times for the Duffys Forest EEC species are provided in Appendix 2 (Table 8).

Key indications of seed maturity include:
- Colour changes of fruits, seed heads or cones
- Seed or fruit hardness
- Dryness of fruits
- Ease of removal
- Opening of fruits

Another consideration of seed collection is that many plants flower over a long period of time and therefore contain seeds of varying maturity. It is important to only collect the mature seed and a second or third visit to the plant may be required to allow time for all seed to mature.

4.2 Exclusion fencing

The extent of ecologically sensitive areas located adjacent to the works areas will be shown on relevant Sensitive Site maps and physically delineated on site using protective fencing and signposting. Prior to the commencement of works outlined in Stage 1, exclusion fencing is to be installed along the boundaries of vegetated areas to be retained. The alignment of this fencing is to be in accordance with the Australian Standard Protection of Trees on Development Sites (AS4970-2009) and incorporate the relevant tree protection zones for trees and vegetation to be retained.

The fencing should be constructed of, as a minimum, capped star pickets and high visibility para webbing and have appropriate signage stating that it is an environmentally sensitive area to inform and educate construction personnel. Exclusion zones are to be clearly marked and labelled on design drawings issued for construction and should be displayed in prominent places and provided in site inductions. A register of sensitive area maps will be maintained. The ecologically sensitive areas include:

- Duffys Forest EEC
- Hollow-bearing trees
- Fauna habitat/food trees
- Riparian areas

The environmental coordinator should allow enough lead time to establish exclusion zones prior to clearing and should undertake regular inspections, checks and maintenance of exclusion fencing (RTA 2011).

4.3 Pre-clearance

Trees in the area should be marked with flagging tape; red for individual trees to be retained, if possible, close to and/or adjoining the construction zone and yellow for habitat trees to be cleared. Tree protection zones should be delineated prior to the commencement of construction activities for two Powerful Owl trees identified in the EIS (SMEC 2014) in close proximity to the proposed alignment at the Forest High School.

A suitably qualified ecologist will undertake searches in the Project footprint for native fauna immediately prior to clearing activities and be present during the clearing of the habitat trees identified in the pre-clearance survey undertaken prior to construction. Trees containing hollows should be felled using the “slow drop” technique. This technique involves nudging and shaking the tree followed by a controlled lowering of the tree to the ground.

4.4 Staged removal

The Project will require the removal of native vegetation that is potential habitat for native fauna species. To minimise disturbance to fauna, clearing will be undertaken following a staged habitat removal process (RTA 2011):

- Non-habitat trees and surrounding understorey vegetation will be felled/cleared first in order to give any fauna an opportunity to relocate.
- Habitat trees will be felled, under the supervision of the project ecologist after a minimum of 24 hours after clearing of non-habitat vegetation.

The environmental coordinator/project ecologist should ensure the following is undertaken for staged habitat removal and follow any other requirements listed in the Biodiversity Guidelines (RTA 2011):

- Staged habitat removal is conducted in at least two stages (non-habitat removed first, allow 24 hours for any fauna to relocate prior to felling habitat trees.
- Works are timed to minimise impacts on fauna (e.g. avoid known breeding/nesting seasons).
- Contact vets and wildlife carers prior to commencing works to ensure willingness to assist if required.
- Project ecologist to be on-site during habitat removal.
- Fell habitat trees using the “slow drop” technique.
4.5 Weed management

This Project has the potential to introduce and promote weeds and pathogens in the Project footprint as well as in the surrounding area. The Pre-construction Survey carried out by Biosis (2015a) identified 21 noxious weeds within the Project footprint as well as a range of ‘High Risk Weeds’ in accordance with the Sydney Weeds Committee (2013). A Pathogen and Weed Management Strategy (Biosis 2015b) has been developed to incorporate management measures for weeds and pathogens, with a particular focus on the early identification and effective management protocols. However, in addition to the general weed management protocols provided by Biosis (2015b) to be implemented during the construction phase, weed management measures will also need to be carried out in preparation for revegetation. Weed management measures should be undertaken with regards to the methods described in the Pathogen and Weed Management Strategy. These are provided in Table 2 below.

Table 2 Noxious and high risk weed management measures

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Manual control</th>
<th>Chemical control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anredera cordifolia</td>
<td>Madeira vine</td>
<td>Small seedlings and tubers can be manually removed, bagged and composted.</td>
<td>Handgun application of Triclopyr 300 g/L + Picloram 100 g/L Grazon® DS at a rate of 400 mL in 100 L of water.</td>
</tr>
<tr>
<td>Araujia sericifera</td>
<td>Moth vine</td>
<td>Physical removal of young plants; bag and remove any fruit.</td>
<td>Spot spray application of Glyphosate 360 g/L Roundup® at a rate of 2 L of glyphosate plus 15 g metsulfuron-methyl in 100 L of water.</td>
</tr>
<tr>
<td>Arundo donax</td>
<td>Giant reed</td>
<td>Mechanical removal, wherever possible.</td>
<td>Knapack application of Glyphosate 360 g/L Roundup® at a rate of 1 part glyphosate to 50 parts water.</td>
</tr>
<tr>
<td>Asparagus aethiopicus</td>
<td>Asparagus fern</td>
<td>Mechanically remove rhizomes where possible.</td>
<td>Spot spray application of Glyphosate 360 g/L Roundup® at a rate of 1 part glyphosate to 50 parts water. Best done between flowering and berries forming.</td>
</tr>
<tr>
<td>Bryophyllum species</td>
<td>Mother-of-millions</td>
<td>N/A</td>
<td>Apply a thorough even coverage of leaves of 2-4-D 300 g/L Affray 300® at a rate of 70 mL in 10 L of water.</td>
</tr>
<tr>
<td>Chrysanthemoides monilifera subsp. rotundata</td>
<td>Bitou bush</td>
<td>Hand removal of young plants, encourage native species regeneration.</td>
<td>Gas gun/Splatter gun application of Glyphosate 360 g/L Roundup® at a rate of 1 part per 29 parts water or 1 part per 19 parts water. Use the higher rate on bushes over 1.5 m.</td>
</tr>
<tr>
<td>Cinnamomum camphora</td>
<td>Camphor laurel</td>
<td>Seedlings can be manually removed. Trees can be physically removed if the cut stump is then treated with herbicide.</td>
<td>Stem injection for basal diameter up to 25 cm of Glyphosate 360 g/L Roundup® at a rate of 1 part glyphosate to 1 part water, 2 mL per cut or for basal diameter 25 cm to 60 cm undiluted, 2 mL per cut.</td>
</tr>
<tr>
<td>Cortaderia species</td>
<td>Pampas grass</td>
<td>Mechanical removal, wherever possible.</td>
<td>Apply Glyphosate 360 g/L Roundup® to actively growing plants, before flowering. Spring to autumn at a rate of 1.0 or 1.3 L per 100 L of water. Use higher rate on plants over 1 m high.</td>
</tr>
<tr>
<td>Cytilus scoparius</td>
<td>Scotch broom</td>
<td>N/A</td>
<td>Foliar spot spray application of Glyphosate 360 g/L Roundup® at a rate of 100–130 mL per 10 L of water.</td>
</tr>
<tr>
<td>Erythrina crista-galli</td>
<td>Cockspur coraltree</td>
<td>Physical removal is an option, always treat the remaining stump. Take care when removing the plant as all parts can potentially regrow.</td>
<td>Spot spray application of Triclopyr 300 g/L + Picloram 100 g/L Grazon® DS at a rate of 50 mL/10 L water.</td>
</tr>
<tr>
<td>Ipomoea indica</td>
<td>Morning glory</td>
<td>Small seedlings can be manually removed. Vines and runners can be collected and destroyed.</td>
<td>Spot spray application of Glyphosate 360 g/L Roundup® at a rate of 200 mL of glyphosate plus 1.5 g of metsulfuron-methyl in 10 L water.</td>
</tr>
<tr>
<td>Lantana camara</td>
<td>Lantana</td>
<td>Manual control can be effective by slashing or manual removal.</td>
<td>Spot spray application of Dichlorprop 600 L/L Lantana 600® at a rate of 1.0 L per 200 L of water. Completely wet all leaves and stems.</td>
</tr>
<tr>
<td>Ligustrum lucidum</td>
<td>Broad-leaf privet</td>
<td>Small plants and seedlings can be manually controlled.</td>
<td>Apply Metsulfuron-methyl 600 g/kg Brush-off® to bushes up to 3 m high at a rate of 10 g per 100 L of water. Complete coverage is essential.</td>
</tr>
</tbody>
</table>
4.5.1 Standard methods

Other general weed management measures that should be undertaken prior to and during revegetation works include:

- Use a range of weed management methods such as slashing or mowing (physical and mechanical control) as well as a range of herbicides (to avoid herbicide resistance).
- Mow/slashing areas infested with weeds before they seed (avoiding native vegetation).
- Employ appropriate vehicle hygiene such as:
  - Clean machinery, vehicles and footwear before moving to a new location.
  - Securely cover loads of weed-contaminated material.
  - Dispose of weed contaminated soil at an appropriate waste management facility.
- Remove weeds immediately and dispose of without stockpiling.
- Separate weeds from native vegetation to be mulched – do not use weeds for mulch.
- Minimise soil disturbance in weed infested areas.

Weed control methods adopted in the implementation of this VMP are based on a combination of the current site management, bush regeneration industry standards and botanical knowledge of the weeds. Techniques and methods recommended in following sections such as ‘hand weeding’ are described in detail in various publications such as Recovering Bushland on the Cumberland Plain: Best practice guidelines for the management and restoration of bushland. (DEC 2005). The publication Nuisious and Environmental Weed Control Handbook. A Guide to Weed Control in Non-crop, Aquatic and Bushland Situations, 5th Edition (DPI, 2011) provides descriptions on general and standard weed control methods.

Application of herbicide during weed control works will depend on species targeted and the growing situation. For example the selection of a herbicide and the application method for a particular species or class of plant will be determined by factors such as the degree of infestation of target species, limiting damage to off target native flora and preventing herbicides entering waterways. The DPI (2011) document cited above should be referred to as guide for specific herbicides, record keeping and herbicide application techniques.

Use of herbicides must be according to the NSW Pesticides Act 1999, Material Safety Data Sheets and labelling instructions for specific trade name herbicides and off label use permits registered with the APVMA. The use of herbicide as part of this VMP will be limited to direct application to cut stumps and spot spraying. Any contractors using herbicides on the site must be trained and appropriately qualified to do so (ChemCert Level 2 or equivalent for subordinates and ChemCert Level 3 or equivalent for supervisors).

Slashing can be used to prevent weeds from flowering and setting seed. This method can be undertaken with a tractor and slashing implement or by using a hand held brush cutter (DPI, 2011). In addition DEC (2005) have highlighted that slashing or mowing can also be used in bushland areas (with grassy native understorey) as an initial or holding treatment to reduce weed mass. This allows for more efficient follow up as fast growing reshooting weeds can be spot sprayed with herbicide among areas of native grasses and herbs. DEC (2005) also suggest that to effectively control exotic annual herbs and grasses, mowing or slashing must be done at least monthly in summer (possibly more frequently if conditions are warm and wet and weed growth is accelerated). For perennial weeds which mature in mid to late summer, mowing or slashing may be reduced to two to three times each season, with the final treatment being applied late in the season ideally before fruit ripens and seed becomes viable (DEC, 2005). Further simple techniques for reducing the potential for assisting the dispersal of weed species as a result of slashing are:

- Slash from areas of dominated by native species to more degraded areas dominated by introduced species.
- Shake or wash down slashing implements in disturbed and managed areas prior to use in more intact areas.

In summary it is recommended that a combination of reducing the height and number of occasions slashing occurs and appropriate weed hygiene protocols be implemented.
5 Revegetation Specifications

5.1 Natural regeneration

Encouraging the natural regeneration of pre-existing vegetation is an effective form of site restoration as:

- Seeds and propagules exist within the seed bank.
- Species of local provenance are better adapted to the environmental conditions in the area.
- Re-establishment of the community will follow natural patterns of re-colonisation and succession.
- Soil fauna, fungal and microbial populations that are essential to a healthy plant growing environment are already present.

Some practical and cost-effective management actions that can be used to encourage natural regrowth and regeneration include:

- Disturbing the soil surface
- Removing weed infestations
- Creating canopy gaps
- Watering

The applicability of any of the above management actions will be dependent on the pre-existing vegetation and local conditions. Natural regeneration will be most effective in the ancillary site facility location after construction works are complete and the facility is no longer required. Earthworks to remove contaminated soils as well as revegetation efforts to supplement natural regeneration may be required within the ancillary site facility. Natural regeneration may also be effective on the margins of the Project footprint in locations such as the Wakehurst Parkway, however these areas may also require some additional revegetation.

Appropriate monitoring and management of areas identified for encouragement of natural regrowth must be carried out as actions such as soil disturbance and canopy gaps may also result in the establishment of weed populations.

5.2 Infill planting and revegetation

Active revegetation is required in the Bushland Corridor zone outlined by AECOM (2015) in the UALD Report. The Bushland Corridor zone includes areas adjacent to Wakehurst Parkway, Aquatic Drive and approximately 100 metres along Frenchs Forest Road and Warringah Road (see AECOM 2015 for location). Infill planting and active revegetation are to be undertaken in general accordance with the details provided in the UALD Report (AECOM 2015) and the specifications outlined below. A topsoil strategy is being covered separately as part of landscaping design packages.

5.2.1 Species selection

A recommended species list for infill planting and active revegetation in the Bushland Corridor zone is provided in Table 1. The recommended planting list is based on species that are characteristic of the Duffy's Forest EEC and that have been recorded in the study area. Additionally they are species that are easily propagated and established from readily available local provenance seed. Table 1 also provides a brief description of the species’ growth form and height. Appendix 1 (Table 7) provides a further list of species comprising Duffy’s Forest EEC that may also be present in the Project footprint (but not recorded in previous survey efforts). The revegetation sites will be somewhat restricted in being able to support dense, diverse plantings (as many will be in linear areas along the roadsides) and so species selection will need to reflect this limited space.

5.2.2 Propagation

A nursery, local to Frenchs Forest (e.g. Harvest Seeds and Native Plants in Terrey Hills) should be sourced at least 6 months to 12 months prior to construction and provided with the proposed planting list in Table 1, so that seed can be sourced and propagated for revegetation works on site. Seed collection should follow the procedure outline in Section 4.1.

All plants shall be true to scheduled nomenclature, well formed, hardened off and disease free nursery stock. They shall be container grown in potting soil with a firmly established root system but with no large roots growing out of the container. No plant shall be pot bound.

The condition of plant stock should encourage future growth that is strong and typical of the species. Correct nursery/growing practices shall help ensure the long-term health and viability of the plant stock on site after planting.

The Bush Regeneration Contractor shall allow for an independent Horticultural certification of all stock prior to delivery to site that confirms the following:

- Stock is disease free and healthy.
- Rootball has adequately grown into the container appropriate to the specified size.
- Stock shows no evidence of spirally, being pot bound, or other undesired outcomes of growth at the nursery.

5.2.3 Recommended planting patterns and density

Although the majority of the revegetation required is along roadsides and linear in nature, active revegetation should, where possible, be carried out in a manner that avoids structured plantings in straight lines and achieves a more randomised pattern. Figure 2 below shows a typical set-out for the Bushland Corridor zone. The recommended spacing, composition, and percentage cover of infill planting is provided in the UALD Report (AECOM 2015).

Figure 2 Proposed planting layout for revegetation

<table>
<thead>
<tr>
<th>G</th>
<th>S</th>
<th>G</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>G</td>
<td>S</td>
<td>G</td>
<td>S</td>
</tr>
<tr>
<td>S</td>
<td>G</td>
<td>T</td>
<td>G</td>
</tr>
<tr>
<td>G</td>
<td>S</td>
<td>G</td>
<td>S</td>
</tr>
<tr>
<td>G</td>
<td>G</td>
<td>G</td>
<td>G</td>
</tr>
</tbody>
</table>

G = ground cover, S = shrub, T = tree
5.2.4 Fertilising
At the time of planting, fertiliser will be applied to each plant in the form of a 10 gram Agriform® tablet, or similar approved product. To avoid potential leaching of fertilisers, slow release nitrogenous (and low phosphate content) fertilisers will be used.

5.2.5 Watering
Watering of the supplementary planting works will be undertaken to ensure that an adequate survival and establishment rate is achieved. Watering is to abide by any local authority water restrictions or guidelines. To assist in this process, a soil wetting agent such as Hydrocel®, or similar approved product, will be mixed into each planting hole to maximise water retention around the root ball during the establishment period.

Watering of all supplementary planting will occur at the time of the planting itself during the construction phase, to minimise shock on the tubestock in their new conditions. Watering of stock during the construction will be on an as required basis.

During the three - six month establishment period, the frequency of watering to achieve plant establishment will depend on the prevailing climatic conditions at the time of planting and thereafter. Watering will generally be carried out in the cooler hours of the day (morning or afternoon), and will be frequent enough to prevent wilting of plants. Tubestock is to be watered prior to planting as well as immediately after planting installation.

During the establishment phase the following watering program is recommended (dependent on weather):

<table>
<thead>
<tr>
<th>Weeks 1 - 8</th>
<th>Months 2 - 4</th>
<th>Months 5 - 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Once a day</td>
<td>Once a week</td>
<td>Once a fortnight</td>
</tr>
</tbody>
</table>

The necessity for watering during the above program will be dependent upon rainfall. The frequency of watering will be gradually reduced as the plantings mature and it is anticipated that after period of 4 – 6 months the planting will be sufficiently established such that supplementary watering will no longer be required.

Planting areas are to be monitored during the extended maintenance period to ensure that climatic conditions are not affecting the newly planted tube stock. If climate or environmental conditions are affecting the tube stock a watering program may be reinstated pending the approval by the environmental manager.

5.2.6 Pest control
Predation by native macropods, introduced herbivores (rabbits and hares), insect pests and infection caused by plant diseases/pathogens can have an adverse affect on the establishment of plantings by defoliating, damaging, removing or killing young plants. To minimise the loss of plants through predation and/or disease, all new plantings will be protected by:

- Use of black plastic rigid mesh tree guards, which would be reused on new plantings once the initial planted specimens mature.
- Temporary exclusion fencing of larger areas or where initial trials indicate that the efficacy of using individual tree guards is low.

- Ensuring that equipment is clean prior to commencement of Earthworks as well as disease free certification of landscaping materials.
- Manual removal of insect pests or use of insecticides and fungal treatments where required.
- Preventing the spread of the pathogen Myrtle Rust by applying contact fungicide to infected plants, before moving or removing them, disposing of waste securely and decontaminating work clothes and vehicles (DPI 2011b).

A cost analysis should be undertaken to determine the most cost effective way to protect the planted areas from predation and disease.

5.3 Soil type
Topsoil must be of good texture and structure for selected use, generally required to be friable and free draining. Areas supporting a healthy vegetation community shall be deemed as exhibiting suitable soil composition, however in areas where poor soil quality is suspected samples should be sent to an agronomist or appropriate laboratory for testing. The results of this testing will be used to ensure that the composition is suitable for supporting the vegetation community and determine what amelioration is required to support the proposed vegetation type. Soil may be imported for use within the site providing it complies with Australian Standard 4419-2003 Soils for Landscaping and Garden Use. Soil characteristics that broadly comply with AS 4419-2003 Soils for Landscaping and Garden Use are detailed in Table 3 below.

<table>
<thead>
<tr>
<th>AS 4419-2003 Soil Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
</tr>
<tr>
<td>Silt</td>
</tr>
<tr>
<td>Clay</td>
</tr>
<tr>
<td>Organic matter</td>
</tr>
<tr>
<td>Salinity (EC)</td>
</tr>
<tr>
<td>pH</td>
</tr>
</tbody>
</table>

Topsoil that does not meet the composition requirements may require blending or conditioning to attain required specifications. Specified soil conditioners are to be applied evenly across the area to be treated at the required amounts. No application is to take place on days when windy conditions will blow treatment off, or during periods of prolonged rainfall.

5.4 Soils and erosion
No areas of significant soil erosion, soil loss or silation were observed in the study area in the current surveys. Other than establishing and maintaining soil and runoff control measures during construction of the approved development and until disturbed areas are stabilised post construction, no other soil management
measures are recommended. However, if site conditions change in response to climatic events or other land uses and soil erosion commence to operate and affect the resilience of the remnant vegetation of the study area then soil management measures need to be implemented. Management measures may include but not be limited to:

- Installation of sediment and erosion control structures and devices.
- Mulching of bare areas to prevent soil loss.
- Minor diversion of runoff until affected areas are stabilised.

Erosion will be treated with appropriate methods relating to the gradient and soil type. Where weeds are active in the stabilisation of erodible areas, an integrated approach with staged removal and supplementary revegetation will be undertaken to ensure there is no loss of the stabilising influence, except along creek banks and wetland banks. All grasses are to be retained on creek and wetland banks to minimise erosion, but all Noxious Weeds shall be removed from banks.

Where the bank/slope stability is compromised by weed control activities, stability techniques such as biodegradable jute matting will be used in conjunction with revegetation at two plants per square metre for slope stabilisation. Jute matting should be “Jutemaster – Fine Mat” or similar approved alternative installed to manufacturers’ specification paying particular attention to the pinning of the mat at the top and bottom of slopes, and the careful overlapping of the mat (upstream roll laid over downstream roll).

6 On-going Vegetation Management

6.1 Maintenance

Maintenance works will commence following the implementation of weed control and revegetation activities and will continue for a period of 32 months from commencement of the VMP. It is anticipated that the maintenance activities will occur quarterly during cooler months and bi-monthly in the warmer months. Required works and indicative effort are outlined in Table 4.

Table 4 Indicative maintenance works summary

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Effort</th>
<th>Frequency</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slashing along revegetation lines with mower or brush cutter</td>
<td>Four person days, 5 times per year</td>
<td>Quarterly in cooler months, bi-monthly in warmer months</td>
<td>Land manager/bush regeneration contractor</td>
</tr>
<tr>
<td>Spot spraying of annual and perennial weeds</td>
<td>Two person days, Monthly</td>
<td>Quarterly in cooler months, monthly in warmer months</td>
<td>Land manager/bush regeneration contractor</td>
</tr>
<tr>
<td>Checking and repairing tree guards</td>
<td>One person day, 5 times per year</td>
<td>Bi-annually</td>
<td>Land manager</td>
</tr>
<tr>
<td>Watering</td>
<td>As required</td>
<td>Only during excessively hot periods of summer</td>
<td>Land manager/bush regeneration contractor</td>
</tr>
<tr>
<td>Replacement of dead tubestock</td>
<td>As required</td>
<td>Annual checks and planting</td>
<td>Land manager/bush regeneration contractor</td>
</tr>
</tbody>
</table>

The implementation and maintenance of the revegetation works should achieve the following Performance Indicators, outlined below:

- Weed management
- Natural regeneration
- Infill planting and active revegetation

6.1.1 Weed management

The following general Performance Indicators should be achieved by all weed management works.

- No inappropriate plant species (i.e. non-endemic, exotic or weed species) to be used in the supplementary planting program.
- Initial weed management works and subsequent weed regrowth suppression to be carried out at regular intervals.
• A sustained reduction in the presence of Noxious and environmental weeds must be achieved to a level that will ensure weed species do not suppress or exclude rehabilitation plantings or the natural recruitment of native species.

• Nil fruiting of the priority weed species after the initial weed management works.

Monitoring of weed per cent cover is the key performance criteria to measure the progress of the works against the VMP objectives and general approach. Weed percentage cover assessment is to be carried out according to one of the methods recommended in A field manual for surveying and mapping nationally significant weeds (McNaught et al. 2006). Which ever method is used it is to be applied consistently over every management zone and each monitoring survey.

6.1.2 Natural regeneration

Natural regrowth and regeneration is the preferred mode of rehabilitation. However, natural processes may not always be successful and as such, management actions designed to encourage natural regeneration or active revegetation may be necessary in order to improve areas where natural regeneration and regrowth isn’t readily occurring.

During each monitoring period, the following indicators will trigger the need for encouragement of natural regeneration or an active revegetation program:

• Expanses of exposed ground which do not support mature or regenerating native species.

• Areas which become bare or sparse after removal of significant quantities of weed species.

• Areas of vegetation which lack one or more vegetation stratum (i.e. canopy, shrub layer groundcover layer).

• Gaps in vegetation which have been caused by past land use practices and are unlikely to contain a sufficient native seedbank in the soil to enable regeneration.

6.1.3 Revegetation

The following Performance Indicators must be achieved for all active revegetation works:

• Active revegetation programs have been implemented where native regeneration is insufficient.

• 90% survival rate of planted stock at the end of the six month establishment period and 80% survival rate after three years of the 36 month maintenance period.

• Active revegetation is to achieve a minimum (i.e. groundcover, understorey and canopy stratum) density of approximately one native plant/m².

• At the end of the establishment and maintenance (i.e. three years), native species are to comprise at least 95% of the:
  - Species composition within each plot.
  - Biomass and/or cover within each plot.

• Tree guards, stakes (or fencing) and coloured marker stakes are to be removed when plants reach approximately 1.5 times the height of the guards or approximately 0.75 metres.

6.2 Monitoring program

Monitoring of the weed control and rehabilitation works evaluated against performance targets is required to ensure the measures outlined in this VMP are implemented and that performance criteria are satisfied as far as possible. The monitoring program will commence prior to further weed control works and continue for the 32 month VMP operation period. The monitoring program can draw upon the information contained in this VMP and will involve reporting to assess and document:

• Weed management works including completion of key tasks.

• General condition of the study area including continued regeneration response and overall resilience.

• Identification of any areas where erosion and sedimentation need to be managed and corrective measures carried out.

• The survival rate of any revegetated areas and the requirements for additional revegetation and/or maintenance where observed survival is less than target.

• Recommendations for corrective measures and/or revised vegetation management techniques as a result of site response to the works specified herein or other factors such as climatic conditions.

Intensive monitoring events are to occur at the following intervals (Table 5).

Table 5 Monitoring event schedule

<table>
<thead>
<tr>
<th>Construction phase (0 – 6 months)</th>
<th>Establishment phase (6 – 12 months)</th>
<th>Maintenance phase (12 – 24 months)</th>
<th>Maintenance phase (&gt; 24 months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 visit/2 months</td>
<td>1 visit/2 months</td>
<td>1 visit/6 months</td>
<td>Annual</td>
</tr>
</tbody>
</table>

6.2.1 Monitoring quadrats

To determine whether the nominated Performance Indicators are being achieved at least four defined 20 x 20 m permanent quadrats will be established across the Project footprint and used for repeated monitoring events. The corners of the permanent plots will be marked in the field using brightly coloured stakes or star pickets. In addition to these permanent quadrats, Works undertaken during each monitoring event shall include, but not be limited to the following:

• Assessment of the degree of achievement with the Performance Indicators.

• Identification of mortality and/or damage to revegetation plots.

• Removal of litter and/or debris build up.

• Removal and management of weed species.

• Watering of plantings in accordance with specified schedule.

• Replacement of plantings that have died with plants of equivalent size and species.

Status reports will be submitted to Roads and Maritime at the end of each monitoring event. The status reports are to provide a summary of:

• The details of works carried out as part of the implementation of this VMP in the preceding period.

• The status of supplementary planting works and the degree of compliance with the specified Performance Indicators.

• The nature of any corrective or adaptive management actions that have been taken, or which are proposed, in respect of non-compliance with the specified performance criteria.
To avoid bias an additional two randomly placed 20 x 20 metre quadrats will be used for census during each monitoring event. These quadrats will be determined using GPS points only and will not be marked in the field or used for repeated monitoring events.

6.2.2 Monitoring photo points
A minimum of twelve photo point monitoring locations will be established and images captured in accordance with the monitoring schedule outlined above. The coordinates and bearings of the photo point monitoring locations are to be recorded in the annual report and previous photos used for reference.

7 Schedule of Works

The VMP will be undertaken in general accordance with the schedule of works provided below and the relevant specifications provided. The responsibility for completing the actions within the schedule of works will be attributed to the principal bush regeneration contractor that is engaged to complete the work.

Table 6 Three year action plan for vegetation management

<table>
<thead>
<tr>
<th>Actions</th>
<th>Timeframe</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engage licensed seed collectors to collect seed from Duffys Forest EEC</td>
<td>Pre-construction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organise nursery to propagate revegetation plants from collected seed (Table 2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Install sediment control fencing (top of bank and at vegetation clearance boundary)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Install exclusion fencing along vegetation clearance boundary</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Implement primary weed removal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Implement secondary weed removal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance weeding</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pile removed/treated woody weeds onsite</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spray annual weeds and exotic grasses</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stockpile logs for use in rehabilitation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scatter logs from cleared native vegetation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lay jute matting over areas prone to erosion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant out management zones</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water revegetation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance of stakes and bags within revegetated areas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remove litter and general rubbish</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Photo point monitoring and annual reporting</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
8 Adaptive Management

An adaptive management approach is to be employed in respect of the works forming part of this VMP. An adaptive management approach involves an integrated process of monitoring, reviewing and then responding to the health and condition of the plantings as well as the status of the weed species to identify any alterations to the design and maintenance of works that may be required to ensure the objectives of the VMP are achieved.

For example, the application rates for fertiliser and the watering schedule should be flexible in responding to the health and vigour of the plantings and changing climatic conditions. Monitoring the plantings will also allow for a review of the selected species to enable changes in the species composition of the supplementary planting if it is determined that a particular species or stock sourced from a certain location is not performing adequately. The supplementary planting species, planting densities and planting patterns nominated within this VMP may be subject to change and review if certain species are unavailable or are performing inadequately. The weed control works are also to be reviewed and appropriate changes implemented accordingly, if required. By example, if the nominated weed suppression schedule is not achieving the Performance Indicators specified, the frequency of weed suppression activities should be increased accordingly.

It is important to note that any changes should comply with the aims of this VMP and any licensing or approval conditions issued before implementation. An Adaptive Management Statement (or similar) will be prepared and signed by both parties prior to implementation of any adaptive management actions.

9 Roles and Responsibilities

FYJV will assume responsibility for ensuring that the following elements of this VMP are implemented:

- Implementation of the supplementary planting program in a manner that achieves the specified Performance Indicators for a period of 36 months.
- Maintenance of the supplementary planting program from the commencement of the supplementary planting works for a period of 36 months.
- Management and maintenance of natural regeneration from the date commencement of the supplementary planting works for a period of 36 months.
- Control of existing infestations of priority weed species and suppression of weed species regrowth from the date of commencement of the supplementary planting works for a period of 32 months.
- All monitoring activities as outlined in this VMP for a period of 36 months.

In discharge of its responsibilities FYJV will engage the services of an appropriately qualified, experienced and licensed contractor who can provide the services of trained, experienced bush regenerators with suitable qualifications and experience (e.g. TAFE Certificate in Bushland Regeneration or similar). It is standard practice for a VMP prepared for Roads and Maritime projects to cover a minimum 5 year period. At the end of the 36 month period FYJV will relinquish responsibilities identified within this VMP to the landholder/land manager.

If requested, FYJV is to provide NSW Department Planning and Environment a copy of the interim status reports documenting the status of implementation of this VMP following each monitoring event.

If requested, at the completion of the contracted maintenance period, FYJV is to provide a final status report to NSW Department Planning and Environment confirming that all the specified works have been carried out and relevant performance criteria have been achieved.

The interim status reports and final status report are to be prepared by a suitably qualified and experienced environmental scientist/ecologist.
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References


DPI 2011b. Factsheet – Myrtle Rust: everyday management. NSW Department of Primary Industries.


Sydney Weeds Committee 2013. High Risk Weeds in the Sydney and Blue Mountains Region.


Table 7 Species listed in Duffys Forest EEC that were not recorded in the EIS survey (SMEC 2014) but may be present in the Project footprint

<table>
<thead>
<tr>
<th>Species name</th>
<th>Common Name</th>
<th>Growth Form</th>
<th>Seed Collection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acacia ulicifolia</td>
<td>Prickly Moses</td>
<td>Erect shrub; 0.5 – 2 m</td>
<td>winter</td>
</tr>
<tr>
<td>Actinotus minor</td>
<td>Lesser Flannel Flower</td>
<td>Ground Cover</td>
<td>summer</td>
</tr>
<tr>
<td>Banksia serrata</td>
<td>Old Man banksia</td>
<td>Tree; to 15 m</td>
<td>Year round</td>
</tr>
<tr>
<td>Boronia pinnata</td>
<td>Shrub; 0.5 – 1.5 m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bossiaea heterophylla</td>
<td>Variable Bossiaea</td>
<td>Shrub; &lt; 1 m</td>
<td>spring - summer</td>
</tr>
<tr>
<td>Cassytha pubescens</td>
<td>Ground Cover</td>
<td>Shrub; to 2 m</td>
<td></td>
</tr>
<tr>
<td>Conospermum longifolium</td>
<td>Long Leaf Smoke Bush</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comesperma ericinum</td>
<td>Pyramid Flower</td>
<td>Shrub; 1 – 1.5 m</td>
<td>summer</td>
</tr>
<tr>
<td>Eucalyptus capitellata</td>
<td>Tree; to 25 m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eucalyptus sieberi</td>
<td>Silvertop Ash</td>
<td>Tree; to 30 m</td>
<td>spring - summer</td>
</tr>
<tr>
<td>Eucalyptus gummifera</td>
<td>Red Bloodwood</td>
<td>Tree; to 30 m</td>
<td>winter, spring and summer</td>
</tr>
<tr>
<td>Gompholobium grandiflorum</td>
<td>Large Wedge Pea</td>
<td>Erect shrub; to 1 m</td>
<td></td>
</tr>
<tr>
<td>Grevillea buxifolia</td>
<td>Grey Spider Flower</td>
<td>Erect to spreading shrub; 0.5 – 2 m</td>
<td>spring - summer</td>
</tr>
<tr>
<td>Lomandra glauca</td>
<td>Pale Mat-rush</td>
<td>Ground Cover</td>
<td></td>
</tr>
<tr>
<td>Lomandra multiflora</td>
<td>Many-flowered Mat-rush</td>
<td>Ground Cover</td>
<td>spring - summer</td>
</tr>
<tr>
<td>Petrophile pulchella</td>
<td>Conesticks</td>
<td>Shrub; to 3 m</td>
<td>Year round</td>
</tr>
<tr>
<td>Phyllocoeta phylloidea</td>
<td>Heath Phylloqua</td>
<td>Erect shrub; to 1 m</td>
<td>spring - summer</td>
</tr>
<tr>
<td>Pimelea linifolia</td>
<td>Slender Rice Flower</td>
<td>Shrub; to 1.5 m</td>
<td>spring</td>
</tr>
<tr>
<td>Pulicinia tuberculata</td>
<td>Wreath Bush-Pea</td>
<td>Erect to spreading shrub</td>
<td></td>
</tr>
<tr>
<td>Pulicinia linophylla</td>
<td>Erect to spreading shrub</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Telopea speciosissima</td>
<td>Waratag</td>
<td>Shrub; to 3 m</td>
<td>autumn - winter</td>
</tr>
<tr>
<td>Tetrahrhena juncea</td>
<td>Wiry Ricegrass</td>
<td>Ground Cover</td>
<td>summer</td>
</tr>
</tbody>
</table>

Appendix 2

Table 8 Timing of seed collection for Duffys Forest EEC species

<table>
<thead>
<tr>
<th>Species Name</th>
<th>Common Name</th>
<th>Months Seed Collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acacia linifolia</td>
<td>White Wattle</td>
<td>Early November – Late December</td>
</tr>
<tr>
<td>Acacia myrtifolia</td>
<td>Red-stemmed Wattle</td>
<td>Early September – Late December</td>
</tr>
<tr>
<td>Acacia suaveolens</td>
<td>Sweet Wattle</td>
<td>Early September – Mid December</td>
</tr>
<tr>
<td>Allocasuarina littoralis</td>
<td>Black She-oak</td>
<td>Year round</td>
</tr>
<tr>
<td>Angophora costata</td>
<td>Smooth-barked Apple</td>
<td>Late December – Early February</td>
</tr>
<tr>
<td>Anisopogon avenaceus</td>
<td>Oat Speargrass</td>
<td>December</td>
</tr>
<tr>
<td>Austrostipa pubescens</td>
<td>Speargrass</td>
<td>December</td>
</tr>
<tr>
<td>Banksia ericifolia</td>
<td>Heath-leaved Banksia</td>
<td>April - October</td>
</tr>
<tr>
<td>Banksia serrata</td>
<td>Old-man Banksia</td>
<td>Year round</td>
</tr>
<tr>
<td>Banksia spinulosa</td>
<td>Hair-pin Banksia</td>
<td>Year round</td>
</tr>
<tr>
<td>Billardiera scandens</td>
<td>Hairy Apple Berry</td>
<td>January</td>
</tr>
<tr>
<td>Boronia ledifolia</td>
<td>Showy Boronia</td>
<td>Mid November – Late March</td>
</tr>
<tr>
<td>Bossiaea obcordata</td>
<td>Spiny Bossiaea</td>
<td>December</td>
</tr>
<tr>
<td>Brunoniella pumilio</td>
<td>Dwarf Brunoniella</td>
<td>September – February</td>
</tr>
<tr>
<td>Ceratopetalum gummiferum</td>
<td>Christmas Bush</td>
<td>Early January – Late February</td>
</tr>
<tr>
<td>*Cytanthaca diandra</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dampiera stricta</td>
<td>Dampiera</td>
<td>January – March</td>
</tr>
<tr>
<td>Dianella caerulea</td>
<td>Blue Flax-lily</td>
<td>Early November – Late February</td>
</tr>
<tr>
<td>*Dillwynia retorta</td>
<td></td>
<td>Late December</td>
</tr>
<tr>
<td>Dodonaea triquetra</td>
<td>Large-leaf Hop-bush</td>
<td>Early November – Early January</td>
</tr>
<tr>
<td>*Entolasia stricta</td>
<td>Wiry Panic</td>
<td></td>
</tr>
<tr>
<td>Epciris pulchella</td>
<td>Wallim Heath</td>
<td>Usually grown from cuttings</td>
</tr>
<tr>
<td>Eucalyptus capitellata</td>
<td>Brown Stringy-bark</td>
<td>Mid September – Late March</td>
</tr>
<tr>
<td>Eucalyptus haemastoma</td>
<td>Broad-leaved Scribbly Gum</td>
<td></td>
</tr>
<tr>
<td>Eucalyptus sieberi</td>
<td>Silvertop Ash</td>
<td>Year round</td>
</tr>
<tr>
<td>Gonocarpus teuciroides</td>
<td>Germander Raspwort</td>
<td>Usually grown from cuttings</td>
</tr>
<tr>
<td>Grevillea linearifolia</td>
<td>Linear-leaf Grevillea</td>
<td>Early October – Late February</td>
</tr>
<tr>
<td>Species</td>
<td>Common Name</td>
<td>Bloom Period</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Hakea dactyloides</td>
<td>Finger Hakea</td>
<td>Year round</td>
</tr>
<tr>
<td>Hakea sericea</td>
<td>Needlebush</td>
<td>Year round</td>
</tr>
<tr>
<td>Hakea teretifolia</td>
<td>Needlebush</td>
<td>Year round</td>
</tr>
<tr>
<td>Hibbertia bracteata</td>
<td>Needlebush</td>
<td>Late November – Early January</td>
</tr>
<tr>
<td>Hovea linearis</td>
<td>Hovea</td>
<td>Mid – Late December</td>
</tr>
<tr>
<td>Lambertia formosa</td>
<td>Mountain Devil</td>
<td>Year round</td>
</tr>
<tr>
<td>Lasioptolium ferrugineum</td>
<td>Rusty Velvet-bush</td>
<td>Early October – Late December</td>
</tr>
<tr>
<td>Lepidosperma laterale</td>
<td>Variable Sword-sedge</td>
<td>August</td>
</tr>
<tr>
<td>Leptospermum trinervium</td>
<td>Slender Tea-tree</td>
<td>Year round</td>
</tr>
<tr>
<td>*Lindsaea linearis</td>
<td>Screw Fern</td>
<td></td>
</tr>
<tr>
<td>*Lindsaea microphylla</td>
<td>Lacy Wedge Fern</td>
<td></td>
</tr>
<tr>
<td>Lomandra longifolia</td>
<td>Spiny-headed Mat-rush</td>
<td>Late December – Late January</td>
</tr>
<tr>
<td>Lomandra obliqua</td>
<td>Mat-rush</td>
<td>Late December – Late January</td>
</tr>
<tr>
<td>Lomatia silifolia</td>
<td>Crinkle Bush</td>
<td>May</td>
</tr>
<tr>
<td>Micrantheum ericoides</td>
<td>Micrantheum</td>
<td>September – December</td>
</tr>
<tr>
<td>*Patersonia glabrata</td>
<td>Leafy Purple-flag</td>
<td></td>
</tr>
<tr>
<td>*Patersonia sericea</td>
<td>Silky Purple-flag</td>
<td></td>
</tr>
<tr>
<td>*Persoonia levis</td>
<td>Broad-leaved Geebung</td>
<td></td>
</tr>
<tr>
<td>*Persoonia pinifolia</td>
<td>Pine-leaved Geebung</td>
<td>Difficult to propogate</td>
</tr>
<tr>
<td>*Phyllanthus hirtellus</td>
<td>Thyme Spurge</td>
<td></td>
</tr>
<tr>
<td>*Platysace linearifolia</td>
<td>Platysace</td>
<td></td>
</tr>
<tr>
<td>*Pteridium esculentum</td>
<td>Bracken</td>
<td></td>
</tr>
<tr>
<td>Pultenaea daphnoides</td>
<td>Large-leaf Bush-pea</td>
<td>Early December – Early January</td>
</tr>
<tr>
<td>*Xanthorrhoea media</td>
<td>Grass Tree</td>
<td></td>
</tr>
<tr>
<td>*Xanthosia tridentata</td>
<td>Rock Xanthosia</td>
<td></td>
</tr>
</tbody>
</table>

* Little information known or not appropriate species for seed collection and propagation for this Project