Northern Beaches Hospital
Connectivity and Network Enhancements
Traffic and Transport Assessment

Client // SMEC Australia
Office // NSW
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Date // 18/03/15
Northern Beaches Hospital
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Traffic and Transport Assessment

Issue: D  18/03/15

Client: SMEC Australia
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GTA Consultants Office: NSW

Quality Record

<table>
<thead>
<tr>
<th>Issue</th>
<th>Date</th>
<th>Description</th>
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<tbody>
<tr>
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<td>09/09/14</td>
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<td>D</td>
<td>18/03/15</td>
<td>Final Revised Modelling Outputs</td>
<td>A Farran</td>
<td>K Kirk</td>
<td>J Morris</td>
<td></td>
</tr>
</tbody>
</table>
Table of Contents

1. Introduction 1
   1.1 Background 1
   1.2 Staged Project Application 1
   1.3 Concept Proposal Description 1
   1.4 Purpose of this Report 4
   1.5 Revision of Report 6

2. Existing Transport Environment 8
   2.1 Road Network 8
   2.2 Traffic Flows 11
   2.3 Heavy Vehicles and Freight 15
   2.4 Travel Speeds 17
   2.5 Travel Demand Characteristics 19
   2.6 Network and Intersection Performance 22
   2.7 Rat Running’ 25
   2.8 Car Parking 26
   2.9 Public Transport 28
   2.10 Pedestrian Infrastructure 31
   2.11 Bicycle Infrastructure 32
   2.12 Crashes 34
   2.13 Summary of Existing Travel Conditions 36

3. Strategic Justification 38
   3.1 Strategic and Policy Framework 38
   3.2 Committed Transport Improvements 40

4. Assessment Methodology 42
   4.1 Overview 42
   4.2 Traffic Model Extent 43
   4.3 Development of Transport Demand Forecasts 44
   4.4 Hospital Traffic Generation 45
   4.5 Hospital Traffic Distribution and Assignment 47
   4.6 Public Transport Improvements 50
   4.7 Traffic and Transport Modelling 52

5. Forecast Future Base Traffic and Transport Conditions 55
   5.1 Overview 55
   5.2 Network Performance 55
   5.3 Intersection Performance 58
5.4 Travel Speed Comparison 62
5.5 Other Operational Impacts 63
5.6 Summary of Forecast Travel Conditions 64

6. Transport Impacts of Concept Proposal 68
   6.1 Overview 68
   6.2 Network Performance 68
   6.3 Regional Impacts 70
   6.4 Intersection Performance and Travel Time Comparison 72
   6.5 Other Operational Impacts 72
   6.6 Summary of Impacts and Benefits 77

7. Transport Impacts of Stage 1 Connectivity Works 78
   7.1 Overview 78
   7.2 Network Performance 78
   7.3 Intersection Level of Service and Average Delays 82
   7.4 Travel Time Comparison 86
   7.5 Other Operational Impacts 88
   7.6 Summary of Stage 1 Project Impacts 96
   7.7 Need for Stage 2 Network Enhancement Works 98

8. Construction Traffic Impacts 99
   8.1 Construction Works 99
   8.2 Construction Activities 100
   8.3 Concept Proposal Construction Impacts 105
   8.4 Stage 1 Project Construction Impacts 111
   8.5 Potential Traffic Mitigating Measures during Construction 126

9. Summary 129
   9.1 Overview 129
   9.2 Existing Conditions 129
   9.3 Future Year Traffic Demands 130
   9.4 Forecast Future Base Traffic and Transport Conditions 130
   9.5 Transport Impacts of Stage 1 Connectivity Works 131
   9.6 Impacts of Concept Proposal Works 134
   9.7 Construction Traffic Impacts 135

Appendices
   A: References
Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Project Locational Context</td>
<td>2</td>
</tr>
<tr>
<td>1.2</td>
<td>Schematic of the Concept Proposal</td>
<td>5</td>
</tr>
<tr>
<td>2.1</td>
<td>Northern Beaches Hospital Site and Surrounding Roads</td>
<td>8</td>
</tr>
<tr>
<td>2.2</td>
<td>Road Network Map</td>
<td>9</td>
</tr>
<tr>
<td>2.3</td>
<td>Daily Traffic Volumes, 2012</td>
<td>12</td>
</tr>
<tr>
<td>2.4</td>
<td>Warringah Road (near Daines Parade, Beacon Hill) – Two-Way Hourly Traffic Volumes, 8 to 14 August 2011</td>
<td>13</td>
</tr>
<tr>
<td>2.5</td>
<td>Warringah Road (near Daines Parade, Beacon Hill) – Two-Way Daily Traffic Volumes, 2011</td>
<td>13</td>
</tr>
<tr>
<td>2.6</td>
<td>Warringah Road (west of Melwood Avenue, Forestville) – Two-Way Hourly Traffic Volumes (21 to 27 February 2011)</td>
<td>14</td>
</tr>
<tr>
<td>2.7</td>
<td>Wakehurst Parkway (south of Oxford Falls Road, Frenchs Forest) – Two-Way Hourly Traffic Volumes (21 to 27 February 2011)</td>
<td>14</td>
</tr>
<tr>
<td>2.8</td>
<td>Restricted Access Vehicle Routes</td>
<td>16</td>
</tr>
<tr>
<td>2.9</td>
<td>Sydney Road Freight Hierarchy</td>
<td>17</td>
</tr>
<tr>
<td>2.10</td>
<td>Origins and Modes of Workers in Selected Travel Zones, 2011</td>
<td>20</td>
</tr>
<tr>
<td>2.11</td>
<td>Destinations and Modes of Employed Residents in Selected Travel Zones, 2011</td>
<td>21</td>
</tr>
<tr>
<td>2.12</td>
<td>2012 Base Condition Intersection Delays and LOS – AM Peak Period</td>
<td>24</td>
</tr>
<tr>
<td>2.13</td>
<td>2012 Base Condition Intersection Delays and LOS – PM Peak Period</td>
<td>24</td>
</tr>
<tr>
<td>2.14</td>
<td>Common ‘Rat Run’ Routes in the Study Area during the AM Peak</td>
<td>25</td>
</tr>
<tr>
<td>2.15</td>
<td>Common ‘Rat Run’ Routes in the Study Area during the PM Peak</td>
<td>26</td>
</tr>
<tr>
<td>2.16</td>
<td>Bus Network</td>
<td>29</td>
</tr>
<tr>
<td>2.17</td>
<td>Forest Way/Rabbett Street Bus Passenger Activity, AM Peak</td>
<td>30</td>
</tr>
<tr>
<td>2.18</td>
<td>Observed School Bus Manoeuvre on Frenchs Forest Road</td>
<td>31</td>
</tr>
<tr>
<td>2.19</td>
<td>Footbridge across Warringah Road</td>
<td>32</td>
</tr>
<tr>
<td>2.20</td>
<td>Warringah Bike Plan for NBH Precinct – Existing and Proposed Cycle Routes</td>
<td>33</td>
</tr>
<tr>
<td>2.21</td>
<td>Crash Data Map</td>
<td>34</td>
</tr>
<tr>
<td>2.22</td>
<td>Crash Map Highlighting Pedestrian Crashes</td>
<td>36</td>
</tr>
<tr>
<td>4.1</td>
<td>Extent of Road Network Included in the Micro-simulation Traffic Model</td>
<td>43</td>
</tr>
<tr>
<td>4.2</td>
<td>Proposed changes to bus routes</td>
<td>51</td>
</tr>
<tr>
<td>5.1</td>
<td>Do Minimal Project Intersection Delays – AM Peak Period 2018</td>
<td>59</td>
</tr>
<tr>
<td>5.2</td>
<td>Do Minimal Project Intersection Delays – PM Peak Period 2018</td>
<td>60</td>
</tr>
<tr>
<td>5.3</td>
<td>Do Minimal Project Intersection Delays – AM Peak Period 2028</td>
<td>61</td>
</tr>
<tr>
<td>5.4</td>
<td>Do Minimal Project Intersection Delays – PM Peak Period 2028</td>
<td>61</td>
</tr>
<tr>
<td>5.5</td>
<td>Travel Time Routes used for Comparative Assessment of Do Minimal Scenarios</td>
<td>62</td>
</tr>
<tr>
<td>5.6</td>
<td>Comparison of Average Speeds, km/h</td>
<td>65</td>
</tr>
<tr>
<td>5.7</td>
<td>Comparison of Total Travel Time, hours</td>
<td>66</td>
</tr>
</tbody>
</table>
Figure 6.1: Proposed Footpaths 75
Figure 7.1: Stage 1 Project Intersection Delays – AM Peak Period 2018 84
Figure 7.2: Stage 1 Project Intersection Delays – PM Peak Period 2018 84
Figure 7.3: Stage 1 Project Intersection Delays – AM Peak Period 2028 85
Figure 7.4: Stage 1 Project Intersection Delays – PM Peak Period 2028 85
Figure 7.5: Extension of Forestway Shopping Centre bus stop (northbound on Forest Way) 88
Figure 7.6: Changes to School Bus Routes 90
Figure 7.7: Comparison of Average Speeds, km/h 97
Figure 7.8: Comparison of Total Travel Time, hours 97
Figure 8.1: Proposed Construction Compound Location 104
Figure 8.2: Proposed Construction Compound Layout 105
Figure 8.3: Mona Vale Road Upgrade Components 110
Figure 8.4: Stage 1 Project Limits 113
Figure 8.5: Wakehurst Parkway/Frenchs Forest Road Intersection – Indicative Phase 1 Traffic Plan 121
Figure 8.6: Wakehurst Parkway/Frenchs Forest Road Intersection – Indicative Phase 2 Traffic Plan 122
Figure 8.7: Wakehurst Parkway/Frenchs Forest Road Intersection – Indicative Phase 3 Traffic Plan 123
Figure 8.8: Wakehurst Parkway/Frenchs Forest Road Intersection – Indicative Phase 4 Traffic Plan 124

Tables

Table 1.1: Key Transport Issues in Director General’s Requirements and Where Addressed 6
Table 2.1: Indicative Weekday Peak Hours (6-10AM & 3-7PM) Freight Traffic Volumes for Key Roads 15
Table 2.2: Average Peak Period Speeds on Selected Major Northern Beaches Routes 17
Table 2.3: Average Peak Period Speeds (km/h) on Sections of Warringah Road (21–22 May 2013) 18
Table 2.4: Level of Service Criteria for Intersections 22
Table 2.5: Network Performance Results – 2012 Base Scenario, AM and PM Peak Periods 23
Table 2.6: Kerbside Parking Surveys – 12-hour Average Occupancy 27
Table 2.7: Bus Services and AM and PM Peak Services 29
Table 4.1: Anticipated Peak Hour Traffic Generation 47
Table 4.2: Adopted Vehicle Arrival and Departure Patterns for NBH (vehicle trips) 47
Table 4.3: Adopted Vehicle Arrival and Departure Patterns for NBH (vehicle trips) 47
Table 4.4: Trip Distribution of NBH Staff, 2018 (based on Existing Residential Address) 48
Table 4.5: Average commuter trip length by vehicle for public hospitals in Northern Sydney

Table 4.6: Trip Distribution of NBH Staff based on a Trip Length Distribution from Hornsby Hospital

Table 4.7: Estimated Trip Distribution of NBH Patients, Visitors and Deliveries

Table 4.8: Proposed 2018 and 2028 Bus Frequencies (AM peak period)

Table 4.9: Scenario Assessment

Table 5.1: Network Performance Results – 2012 Base Scenario vs 2018 Do Minimal Scenario, AM Peak Period

Table 5.2: Network Performance Results – 2012 Base Scenario vs 2018 Do Minimal Scenario, PM Peak Period

Table 5.3: Network Performance Results – 2018 vs 2028 Do Minimal Scenarios, AM Peak Period

Table 5.4: Network Performance Results – 2018 vs 2028 Do Minimal Scenarios, PM Peak Period

Table 5.5: Summary of AM and PM Peak Period Intersection Level of Service

Table 5.6: Average Vehicle Speeds (km/h) – 2018 vs 2028 Do Minimal Scenario

Table 5.7: Average Bus Speed (km/h) – 2018 vs 2028 Do Minimal Scenario

Table 5.8: Network Performance Results – Concept Proposal vs Do Minimal Scenario (2021)

Table 5.9: Network Performance Results – Concept Proposal vs Stage 1 Project Scenario (2036)

Table 5.10: Network Performance Results – Stage 1 Project vs Do Minimal Scenario (AM Peak Period)

Table 5.11: Network Performance Results – Stage 1 Project vs Do Minimal Scenario (PM Peak Period)

Table 6.1: Network Performance Results – 2018 Stage 1 Project vs Do Minimal Scenario (AM Peak Period)

Table 6.2: Network Performance Results – 2018 Stage 1 Project vs Do Minimal Scenario (PM Peak Period)

Table 6.3: Summary of AM and PM Peak Period Intersection Level of Service

Table 6.4: Summary of Average Delays and Intersection Operation

Table 6.5: Average Travel Speeds (km/h) – 2018 Do Minimal vs 2018 Stage 1 Project Scenario

Table 6.6: Average Travel Speed (km/h) – 2018 Do Minimal vs 2018 Stage 1 Project Scenario

Table 6.7: Average Bus Speed (km/h) – 2018 Do Minimal vs 2018 Stage 1 Project Scenario

Table 6.8: Average Bus Speed (km/h) – 2018 Do Minimal vs 2018 Stage 1 Project Scenario

Table 6.9: Average Bus Speed (km/h) – 2028 Do Minimal vs 2028 Stage 1 Project Scenario

Table 6.10: Average Bus Speed (km/h) – 2028 Do Minimal vs 2028 Stage 1 Project Scenario

Table 7.1: Network Performance Results – 2018 Stage 1 Project vs Do Minimal Scenario (AM Peak Period)

Table 7.2: Network Performance Results – 2018 Stage 1 Project vs Do Minimal Scenario (PM Peak Period)

Table 7.3: Network Performance Results – 2028 Stage 1 Project vs Do Minimal Scenario (AM Peak Period)

Table 7.4: Network Performance Results – 2028 Stage 1 Project vs Do Minimal Scenario (PM Peak Period)

Table 7.5: Summary of AM and PM Peak Period Intersection Level of Service

Table 7.6: Summary of Average Delays and Intersection Operation

Table 7.7: Average Travel Speeds (km/h) – 2018 Do Minimal vs 2018 Stage 1 Project Scenario

Table 7.8: Average Travel Speed (km/h) – 2018 Do Minimal vs 2018 Stage 1 Project Scenario

Table 7.9: Average Travel Speed (km/h) – 2018 Do Minimal vs 2018 Stage 1 Project Scenario

Table 7.10: Average Travel Speed (km/h) – 2018 Do Minimal vs 2018 Stage 1 Project Scenario

Table 7.11: Average Travel Speed (km/h) – 2028 Do Minimal vs 2028 Stage 1 Project Scenario

Table 7.12: Average Travel Speed (km/h) – 2028 Do Minimal vs 2028 Stage 1 Project Scenario

Table 7.13: Average Bus Speed (km/h) – 2018 Do Minimal vs 2018 Stage 1 Project Scenario

Table 7.14: Average Bus Speed (km/h) – 2028 Do Minimal vs 2028 Stage 1 Project Scenario

Table 7.15: Car parking demand on Naree Road/ Frenchs Forest Road

Table 7.16: Car parking demand on Naree Road/ Frenchs Forest Road

Table 7.17: Car parking demand on Naree Road/ Frenchs Forest Road

Table 7.18: Car parking demand on Naree Road/ Frenchs Forest Road

Table 7.19: Car parking demand on Naree Road/ Frenchs Forest Road

Table 7.20: Car parking demand on Naree Road/ Frenchs Forest Road

Table 7.21: Car parking demand on Naree Road/ Frenchs Forest Road

Table 7.22: Car parking demand on Naree Road/ Frenchs Forest Road

Table 7.23: Car parking demand on Naree Road/ Frenchs Forest Road

Table 7.24: Car parking demand on Naree Road/ Frenchs Forest Road
Table 8.1: Stage 1 and Stage 2 Project Construction Activities

Table 8.2: Potential Pre-Construction and Construction Activities
1. Introduction

1.1 Background

Roads and Maritime Services (Roads and Maritime) is seeking approval for the Northern Beaches Hospital – Connectivity and Network Enhancement Project. The approval is sought under Part 5.1 of the Environmental Planning and Assessment Act 1979 (EP&A Act). The project comprises road upgrades to enhance arterial and sub-arterial road network connectivity in the Northern Beaches Hospital (NBH) precinct at Frenchs Forest, within the Warringah local government area (LGA) on Sydney’s Northern Beaches.

1.2 Staged Project Application

The Northern Beaches Hospital Connectivity and Network Enhancement Project is proposed to be assessed in stages under Section 115ZD of the EP&A Act. The EIS provides an assessment of the concept proposal for the whole of the project and a more detailed assessment of the Stage 1 works.

The Concept Proposal for the whole Northern Beaches Hospital Connectivity and Network Enhancement Project includes two stages:

- Stage 1 Hospital Connectivity Works (the Project) which aim to enhance the existing road network to facilitate the opening of the proposed Northern Beaches Hospital by 2018.
- Stage 2 Network Enhancement Works is directed towards broader network capacity enhancement particularly along Warringah Road.

The EIS assesses both stages at a concept proposal level and provides more detailed environmental assessment of the Stage 1 works. This would enable Stage 1 to proceed to construction (subject to approval).

The need for the remainder of the infrastructure, which is directed towards broader network capacity enhancement (Stage 2 Network Enhancement Works), particularly along Warringah Road, has been identified at a strategic level and developed as a concept proposal only (so far).

The staged approach would enable construction of the Stage 1 Connectivity Works to commence (subject to planning approval) in a timely fashion providing adequate connectivity to the hospital by 2018, while the design of the Network Enhancement Works is being refined and assessed.

1.3 Concept Proposal Description

The strategic aims of the Concept Proposal relate to provision of a road network solution that optimises connectivity of the arterial and sub-arterial road network to the Northern Beaches Hospital and its environs. At a wider level, the Concept Proposal also aims to reinforce Warringah Road and Wakehurst Parkway as key arterial connections between the beachside suburbs of Sydney’s north and Chatswood and Sydney’s CBD.
Specific project objectives are:

- To improve peak period travel speeds and reliability on Warringah Road following the development of the Northern Beaches Hospital and the surrounding precinct.
- To improve the network performance surrounding the Northern Beaches Hospital to support the development of the precinct.
- To support the activation of the Northern Beaches Hospital precinct by facilitating access connections to the proposed hospital.
- To allow for road based public transport along and across the corridor.
- To maintain or improve road safety in accordance with current standards.
- To minimise impacts on the environment.
- To optimise the design to provide an urban design and landscape outcome that complements the surrounding environs.

The location of the Concept Proposal is shown in Figure 1.1.

---

**Figure 1.1: Project Locational Context**

Source: Roads and Maritime Services

The overall project (Concept Proposal) comprises the Stage 1 Connectivity Works (Stage 1 Project), being the provision of essential road works to enhance connectivity to the hospital, and the Stage 2 Network Enhancement works to improve the broader network capacity (Stage 2 Project). Collectively these comprise the Concept Proposal which would broadly include the following:

- Widening of Warringah Road from west of Fitzpatrick Avenue to the east of Allambie Road to include:
  - Subsurface eastbound and westbound travel lanes in slot (underpass), through the middle of the Warringah Road corridor, generally from west of Forest Way through to east of Wakehurst Parkway.
Surface eastbound and westbound lanes running parallel to the slot as part of the Warringah Road corridor to provide access to side roads and the Northern Beaches Hospital.

Upgrades to intersections with Forest Way, Hilmer Street and Wakehurst Parkway at surface level.

Widening, intersection upgrades, new signalised intersections and potential changes to access along sections of Forest Way, Naree Road, Frenchs Forest Road and Allambie Road.

Widening of Wakehurst Parkway from north of the intersection with Frenchs Forest Road to south of Aquatic Drive.

Provision of a new connection at Aquatic Drive and Wakehurst Parkway.

Traffic management measures along a number of local roads.

Substantial utility relocations including water, sewer mains, telecommunication, electricity and gas services.

Ancillary works for construction including, but not limited to, construction compounds, batch plants and stockpile sites.

More specific detail is provided on the Stage 1 Project works which are proposed generally along the Naree Road and Frenchs Forest Road corridor and intersections with Forest Way, the proposed hospital, Wakehurst Parkway, Allambie Road and Warringah Road.

The Stage 1 Project would include:

- Widening and intersection upgrades along sections of Forest Way between Warringah Road and south of Adams Street.
- Upgrade of the existing bus stop fronting the Forest Way shopping centre on Forest Way, to accommodate two buses within the bay.
- Widening of Naree Road, Frenchs Forest Road West and a section of Frenchs Forest Road East from the Wakehurst Parkway intersection to about 50 metres west of Skyline Place.
- Provision of new traffic signals with pedestrian crossings at Naree Road and Forest Way; at Naree Road, Frenchs Forest Road West and Rabbett Street; on Frenchs Forest Road West at a new access to the hospital opposite Gladys Avenue; at Frenchs Forest Road East and Romford Road; and at Frenchs Forest Road East, Patanga Road and Allambie Road.
- Widening and upgrades to the intersection of Frenchs Forest Road and Wakehurst Parkway.
- Provision of dedicated kerb side bus lanes along approaches and departures to the Frenchs Forest Road intersection with Wakehurst Parkway.
- Widening of Wakehurst Parkway from about 330 metres north of the intersection with Frenchs Forest Road to the intersection with Warringah Road.
- Provision of a sea-gull type traffic management arrangement at the intersection of Frenchs Forest Road East and Nandi Avenue to allow all points access.
- Widening of Allambie Road to the north of the intersection with Warringah Road.
- Widening and upgrade to the Warringah Road and Allambie Road (north) intersection.
- Widening of Warringah Road from west of Allambie Road for about 700 metres to east of Courtley Road.

The Stage 1 Project and Stage 2 Project would also include drainage works, landscaping, property acquisition and adjustments, utility relocations (which may be required to extend into surrounding streets), as well as ancillary works during construction. The ancillary works would
include but not be limited to, construction compounds, and stockpile sites. For the purposes of this EIS, the scope of the Concept Proposal would not include ongoing maintenance works.

The first stage of the Concept Proposal, the Stage 1 Project, comprises the provision of essential road works to enhance connectivity to the hospital. Further design development would inform a more detailed description and assessment of the Concept Proposal for the Stage 2 Project which comprises road network enhancement works to improve the existing road network capacity. A detailed assessment of the Stage 2 Project would be the subject of a separate environmental impact statement which will follow in mid-2015.

A schematic of the Concept Proposal is shown in Figure 1.2. A more detailed description of the Concept Proposal and the Stage 1 Hospital Connectivity Works are provided in Chapter 6 and Chapter 7 respectively.

1.4 Purpose of this Report

This Report sets out an assessment of the anticipated traffic and transport implications of the project as a staged infrastructure, comprising of the concept proposal for the overall project, and for the Stage 1 Hospital Connectivity Works, in response to the Director General’s Requirements (DGRs) to address key traffic and transport issues.

Table 1.1 lists these key traffic and transport issues, and indicates where each has been addressed in this report.
Figure 1.2: Schematic of the Concept Proposal

Figure 1.2: Schematic of the Concept Proposal

Key:
- Stage one road upgrades
- Stage two road upgrades
- Hospital connectivity works
- Natural enhancement works
- Underpass for through traffic
- Pedestrian overbridge

Source: Roads and Maritime Services
Table 1.1: Key Transport Issues in Director General’s Requirements and Where Addressed

<table>
<thead>
<tr>
<th>Key Issue</th>
<th>Director General’s Requirement</th>
<th>Where addressed in this assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept Plan</td>
<td>Details of how the works meet the traffic and transport objectives of the project, taking into account the adjacent sensitive land uses, future growth areas, approved and proposed infrastructure projects, and traffic (vehicular, cyclist and pedestrian) needs.</td>
<td>Chapter 3</td>
</tr>
<tr>
<td>Transport objectives</td>
<td>An assessment and modelling of operational traffic and transport impacts of all stages of the project on the local and regional road network.</td>
<td>Chapter 5, 6 and 7</td>
</tr>
<tr>
<td>Operational traffic and transport impacts</td>
<td>An assessment of additional impacts/benefits on the local and regional road network beyond those accommodating/compensating for the traffic and transport impacts of the proposed Northern Beaches Hospital.</td>
<td>Chapter 6</td>
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<tr>
<td>Additional impacts/benefits</td>
<td>Induced traffic and operational implications for public transport (particularly with respect to strategic bus corridors and bus routes) and consider opportunities to improve public transport patronage.</td>
<td>Chapter 6</td>
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<tr>
<td>Induced traffic and operational implications for public transport</td>
<td>Induced traffic and operational implications for public transport (particularly with respect to strategic bus corridors and bus routes) and consider opportunities to improve public transport patronage.</td>
<td>Chapter 6</td>
</tr>
<tr>
<td>Stage 1 Connectivity enhancement works</td>
<td>Detailed assessment and modelling of operational traffic and transport impacts of Stage 1. This must consider key intersections within the Stage 1 area, and the performance of upstream and downstream intersections should Stage 1 be completed prior to subsequent stages.</td>
<td>Chapter 7</td>
</tr>
<tr>
<td>Stage 1 impacts</td>
<td>Impacts on property access and existing on-street parking provision, including permanent and temporary (construction) changes to access.</td>
<td>Chapter 7</td>
</tr>
<tr>
<td>Impacts on property access and on-street parking</td>
<td>Impacts on cyclists and pedestrian access and safety, and consideration of opportunities to integrate cycleway and pedestrian elements with surrounding networks.</td>
<td>Chapter 7</td>
</tr>
<tr>
<td>Impacts on cyclists and pedestrians</td>
<td>Construction traffic and transport impacts of the project (including ancillary facilities) and associated management measures, in particular:</td>
<td>Chapter 8</td>
</tr>
<tr>
<td>Construction traffic and transport impacts</td>
<td>• impacts to the road network (including safety and level of service, pedestrian and cyclist access, and disruption to public transport services and access to properties)</td>
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</tr>
<tr>
<td></td>
<td>• impacts of potential shifts of traffic movements to alternative routes outside the project area</td>
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</tr>
<tr>
<td></td>
<td>• impacts to school related traffic (bus and private vehicle) and pedestrian movements</td>
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<td>• route identification and scheduling of transport movements</td>
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<td>• the number, frequency and size of construction related vehicles (both passenger, commercial and heavy vehicles)</td>
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<td></td>
<td>• the nature of existing traffic on construction access routes (including consideration of peak traffic times)</td>
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<td>• the need to close, divert or otherwise reconfigure elements of the road network associated with construction of the project having reference to the cumulative construction impacts of other infrastructure preparing for or commencing construction, including any concurrent construction associated with subsequent stages of this proposal and/or the Northern Beaches Hospital project.</td>
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1.5 Revision of Report

Since public exhibition of the EIS, Roads and Maritime has continued to refine the traffic model for the project and has undertaken further operational traffic and transport assessment work. The results and findings of the updated modelling and additional assessment have been included in this revised Traffic and Transport working paper for the Concept Proposal and Stage 1 Project.
(Issue D). This document supersedes ‘Issue C’ of the Traffic and Transport working paper which formed Appendix D of the EIS.

The revised assessment includes a quantitative assessment of impacts to the regional road network (a qualitative assessment was provided in the exhibited report) and updates traffic model predictions for the Stage 1 Project.
2. Existing Transport Environment

The project area covers the road network surrounding the site of the proposed Northern Beaches Hospital (NBH) to the north west of the Warringah Road/Wakehurst Parkway intersection in Frenchs Forest. Located to the west of the proposed NBH is The Forest High School. The NBH site currently has a land use classification as medium density residential and is occupied by residential houses and bush area.

The Forestway Shopping Centre is located on Forest Way to the west. The Frenchs Forest Public School is located on Forest Way next to the Warringah Road intersection. The surrounding properties include businesses to the east and residential uses to the north of Frenchs Forest Road East.

The location of the NBH site and the key roads in the immediate precinct is shown in Figure 2.1.

Figure 2.1: Northern Beaches Hospital Site and Surrounding Roads

![Map of Northern Beaches Hospital Site and Surrounding Roads](source: Health NSW website)

2.1 Road Network

Key roads covered by the project include:
- Warringah Road (Route A38)
- Wakehurst Parkway
- Forest Way
- Frenchs Forest Road (east and west)/ Naree Road
- Allambie Road.

Figure 2.2 shows a map of the road network surrounding the proposed NBH site.
Map Source: Sydways

Warringah Road

Warringah Road is a major State Road that runs from Dee Why in the east to Roseville Chase in the west. West of Forest Way, it largely serves residential land uses in a confined corridor, whereas east of Forest Way, it operates in a much wider landscaped reserve and fronts schools, shopping centres and industrial/business parks.

Warringah Road has a six lane carriageway configuration with wide central median. Between Woodlands Road/Arthur Street and Allambie Road, it has eight sets of signalised intersections (at an average spacing of 500 metres) to accommodate pedestrian crossing opportunities and traffic accessing Warringah Road. A number of these and some unsignalised intersections have auxiliary right turn bays allowing access to side streets. The major intersections of Starkey Street, Forest Way and Wakehurst Parkway also have auxiliary left turn bays.

The posted speed limit on Warringah Road is generally 70 km/h. There are three 40 km/h school zones: at Our Lady of Good Counsel Primary School at Cook Street, at Frenchs Forest Public School at Forest Way and at The Forest High School near Hilmer Street.

Lane widths are relatively narrow, typically being 3.1 metres. Turning lanes are approximately 3.0 metres wide. The horizontal alignment is generally straight. Where it does bend, the curve radius is greater than the minimum radius of 150 metres for the 70 km/h posted speed. The terrain is slightly hilly throughout but the road gradient is within the desirable maximum of between 4 percent and 6 percent for the speed environment. Within the study area, parking is prohibited on both sides of Warringah Road.

In the vicinity of the NBH site, Warringah Road carries 70-80,000 total vehicles west of Wakehurst Parkway and 40-50,000 total vehicles east of Wakehurst Parkway per weekday.
Wakehurst Parkway

Wakehurst Parkway is a State Road that runs between Narrabeen in the north–east and Seaforth in the south providing further connections onto Sydney CBD via the Spit Bridge and Cremorne.

Wakehurst Parkway is mostly surrounded by bushland on both sides of the road. The majority of Wakehurst Parkway is two lanes undivided but widens out to four lanes on the southbound approach to Frenchs Forest Road, including one dedicated left turn lane to Frenchs Forest Road East. It also widens to six lanes on the north side of the Warringah Road intersection to cater for right turn lanes and a dedicated bus lane, and to five lanes on the south side of the Warringah Road intersection.

The only vehicle access onto Wakehurst Parkway in this section is through the two signalised intersections with Frenchs Forest Road and Warringah Road. Aquatic Drive and Fitzpatrick Avenue East do not open onto Wakehurst Parkway.

The posted speed limit along the section of Wakehurst Parkway between Frenchs Forest Road and Aquatic Drive is 70 km/h. Parking is prohibited on both sides of the road. The lane widths are typically 3.4 metres. Both sides have road shoulders of 1–1.5 metre widths. The topography of Wakehurst Parkway north is hilly with a gradient of between 2 percent and 6 percent. The road is generally straight throughout.

In the vicinity of the proposed NBH site, Wakehurst Parkway carries 20–30,000 vehicles daily. It is a significant component of the road network as it functions as one of two key north–south routes through the precinct. The other key north-south route is Forest Way.

Forest Way

Forest Way is a State Road that consists of six lanes and links Frenchs Forest and Belrose to the north, continuing onto Mona Vale Road. Within the project area shown in Figure 1.2, the section of Forest Way between Naree Road and Warringah Road is about 400 metres in length, but has intensive land uses including shopping centre and associated car park, school, residential areas and small businesses (eg medical shops). It is a six lane divided carriageway and it has a mid-block signalised pedestrian crossing fronting the Forestway Shopping Centre.

Rabbett Street to the north of the Forest Way/Warringah Road intersection is used by buses and its intersection is limited to left out only onto Forest Way, further restricted to bus only egress during weekdays from 6-10am. The area is heavily used by bus customers during peak periods. These include school bus users and busy passenger interchange activity between buses and kiss-and-ride, park-and-ride transfers from other bus routes, including those across Forest Way.

The posted speed along most of this section of Forest Way is generally 70 km/h. Parking is prohibited along Forest Way between Warringah Road and Naree Road. Forest Way is mostly flat and straight with lane widths of approximately 3.1 metres. While six lanes exist, there are no auxiliary turn lanes, and as such, limits the capacity of Forest Way.

It carries about 45,000 vehicles daily north of Warringah Road.

Naree Road/Frenchs Forest Road

Naree Road and Frenchs Forest Road are local roads that run parallel to Warringah Road in an east–west direction between Forest Way to the west and Allambie Road and onto Warringah Road to the east. It carries 15–20,000 vehicles daily, much higher than typical volumes for the

Warringah Road is the principal component of the road network as it is the main east–west route through the study area, providing access to Brookvale/ Dee Why, Chatswood and Sydney CBD via multiple routes onto the Warringah Expressway.
collector functions they were meant to perform. It acts as a ‘rat run’ for traffic avoiding congestion on Warringah Road. (Refer to Section 0 for discussion).

The land use along this road is predominantly residential on the north side and towards the west end, business/industrial in the south east, with The Forest High School and the proposed NBH site occupying the south west area.

The intersection of Frenchs Forest Road and Wakehurst Parkway is controlled by traffic signals. The remaining intersections along its length are unsignalised as they are generally with minor roads. Frenchs Forest Road is generally a two lane undivided road, with parking allowed on both sides. On its western half, buses travel in the eastbound direction only.

The posted speed limit on Frenchs Forest Road West is 50 km/h. The road is not accessible for vehicles with more than a three tonnes load, buses excepted. There are several traffic calming devices including speed humps, marked footway crossings and zig-zag lines to enforce low traffic speeds. A 40 km/h school zone operates outside The Forest High School adjacent to the proposed NBH site.

Allambie Road

Allambie Road south of Warringah Road is a Regional Road while the section of the road north of its intersection with Warringah Road is a Local Road. Allambie Road consists of two lanes and runs between Manly Vale in the south and Frenchs Forest. It is sign-posted with a speed limit of 60 km/h and carries between 4,000 and 20,000 vehicles daily.

2.2 Traffic Flows

Approximately 8-9 percent of the daily traffic volumes on the key roads in the study area occur within peak hours and the existing at-grade intersections currently operate near or at capacity during these times. The morning peak period, when traffic is predominantly moving westwards towards the Sydney CBD, is particularly prone to congestion and frequently enters grid-locked conditions.

The intersection at Warringah Road and Wakehurst Parkway directly adjacent to the NBH site has very high levels of delay and queuing for motorists as vehicles converge from three major arterial road streams into one (Warringah Road East and West, Wakehurst Parkway North and South, and Allambie Road) and are added to again at Forest Way.

Variability of demand and incidents regularly cause major breakdowns in continuous movement, and long queues can form throughout the day. Travel times can vary significantly day to day.

Key intersections that currently experience high levels of peak period traffic congestion are:

- Wakehurst Parkway/Warringah Road intersection
- Wakehurst Parkway/Frenchs Forest Road intersection
- Warringah Road/ Allambie Road intersection
- Warringah Road/Forest Way intersection
- Warringah Road/Starkey Street/Ferguson Street intersection
- Forest Way/Adams Street intersection.

2.2.1 Daily Traffic Volumes

Figure 2.3 illustrates the total daily traffic volume throughout the study area road network. The highest traffic volumes in the precinct are generally on Warringah Road west of Wakehurst Parkway.
The daily pattern of activity on Warringah Road (Figure 2.4) is fairly constant in terms of traffic volume. The AM peak periods are much the same throughout the working week (generally 7–9 am), while the PM peak steadily increases from Monday to Thursday and splits on Fridays (peaking between 4:30–6:30pm). The Saturday peak is of a similar magnitude to the week day peaks, although the peak hour is 12–1pm. Sunday traffic is lower, but with the same peak period as the Saturday.

The annual pattern of daily traffic on Warringah Road in 2011 (Figure 2.5) suggests there is no atypical seasonal pattern to traffic activity.

Figure 2.3: Daily Traffic Volumes, 2012

Source: Roads and Maritime Services
Figure 2.4: Warringah Road (near Daines Parade, Beacon Hill) – Two-Way Hourly Traffic Volumes, 8 to 14 August 2011

Source: Roads and Maritime Services

Figure 2.5: Warringah Road (near Daines Parade, Beacon Hill) – Two-Way Daily Traffic Volumes, 2011

Source: Roads and Maritime Services

2.2.2 Hourly Traffic Volumes and Patterns

The typical hourly pattern of traffic in the precinct is shown in Figure 2.6 for Warringah Road (west of Melwood Avenue, Forestville) and in Figure 2.7 for Wakehurst Parkway (south of Oxford Falls Road, Frenchs Forest) for the period 21 to 27 February 2011. These show conventional commuter peaks. The 2-hour morning peak period from 7am to 9am has 16 percent of the daily traffic. The 2-hour evening peak period from 4–6pm has 15 percent of the daily traffic.
Each individual peak hour has its own travel pattern. In the mornings, the earlier hour/s contain more commuters passing through the area whereas the second hour is more about the diverse movement associated with local activities such as schools, shops and businesses. In the evening, the reverse applies.

Figure 2.6: Warringah Road (west of Melwood Avenue, Forestville) – Two-Way Hourly Traffic Volumes (21 to 27 February 2011)

Figure 2.7: Wakehurst Parkway (south of Oxford Falls Road, Frenchs Forest) – Two-Way Hourly Traffic Volumes (21 to 27 February 2011)
2.3 Heavy Vehicles and Freight

The road system, particularly the state road network, is required to be made available for general use by all vehicle types and State Roads are more readily used by vehicles carrying freight.

Freight is carried in vehicles ranging from large articulated vehicles down to light commercial vehicles such as vans and station wagons. Vehicles are classified into a range of groups, broadly based on size and type:

- Light vehicles – including privately owned cars and a variety of small commercial vehicles carrying freight, such as station wagons and vans (Austroads Classes 1–2).
- Heavy freight rigid vehicles – including small and medium rigid trucks (Austroads Classes 3–5).
- Heavy freight articulated vehicles – including large semi-trailers and B-double articulated trucks (Austroads Classes 6–12).

The make-up of vehicle types on Warringah Road is presented below. Heavy freight vehicles (vehicle classes 3–12), particularly those at the upper end of the scale, place great stress on the road network in terms of travel speed, lateral and headroom clearances, manoeuvrability, and pavement impact.

<table>
<thead>
<tr>
<th>Vehicle Class</th>
<th>Warringah Road (at Hilmer Street)</th>
<th>Wakehurst Parkway (at Warringah Road)</th>
<th>Forest Way (at Naree Road)</th>
<th>Frenchs Forest Road (at Romford Road)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All types of vehicles</td>
<td>45,800</td>
<td>29,000</td>
<td>24,000</td>
<td>9,200</td>
</tr>
<tr>
<td>Light (Austroads Classes 1-2)</td>
<td>44,100 (96.3%)</td>
<td>27,800 (95.9%)</td>
<td>22,700 (94.6%)</td>
<td>9,000 (97.8%)</td>
</tr>
<tr>
<td>Heavy rigid (Austroads classes 3-5)</td>
<td>1,600 (3.5%)</td>
<td>1,100 (3.8%)</td>
<td>1,200 (5.0%)</td>
<td>200 (2.2%)</td>
</tr>
<tr>
<td>Heavy articulated (Austroads classes 6-12)</td>
<td>100 (0.2%)</td>
<td>100 (0.3%)</td>
<td>100 (0.4%)</td>
<td>0 (0%)</td>
</tr>
</tbody>
</table>

Source: Roads and Maritime Services traffic counts, March 2012.

Forest Way, Wakehurst Parkway north of Warringah Road and Warringah Road west of Allambie Road are all designated as Higher Mass Limit (HML) roads that can take up to 68 tonne semi-trailers and B-Doubles. Rodborough Road also allows B-doubles up to 25 metres long, but only for vehicles exiting to the Warringah Road designated route. These are shown in Figure 2.8.
Freight Routes

The hierarchy concept discussed in the Metropolitan Road Freight Hierarchy on the State Road Network – Practice Note (TfNSW, 2011) identifies three tiers of freight links on the State Road network (primary, secondary and tertiary freight routes) mainly on the basis of existing heavy vehicle volumes, accessibility offered for freight vehicles, as well as the strategic freight function which in turn is determined by the spatial clustering of freight hubs, intermodal terminals and freight corridors. The freight route hierarchy for the greater Sydney area is shown in Figure 2.9.

In the area surrounding the NBH precinct, Warringah Road, Wakehurst Parkway and Forest Way are designated as tertiary freight routes, with the proportions of heavy freight vehicles represent between 3 to 5 percent of all vehicles.

The freight routes serve end destinations in the industrial and commercial areas of Frenchs Forest, Brookvale, Manly Vale, Dee Why and Warriewood.
2.4 Travel Speeds

The Key Roads Performance Report\(^1\) (Roads and Maritime, June 2013) outlines how well the road network in Greater Sydney is performing during morning and afternoon peak periods, in terms of travel time during the AM and PM peak periods, as gathered from global positioning system (GPS) surveys of the routes.

The report provides trip times calculated using weekday traffic information from 1 March 2013 to 31 May 2013 (excluding public holidays), and the average speeds on key routes in the Northern Beaches are summarised in Table 2.2.

Table 2.2: Average Peak Period Speeds on Selected Major Northern Beaches Routes

<table>
<thead>
<tr>
<th>Route</th>
<th>Distance, km</th>
<th>AM Peak Inbound Average Speed, km/h</th>
<th>PM Peak Outbound Average Speed, km/h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warringah Road (Frenchs Forest–Roseville)</td>
<td>7.1</td>
<td>39</td>
<td>32</td>
</tr>
<tr>
<td>Warringah Road (Frenchs Forest–Brookvale)</td>
<td>5.3</td>
<td>33</td>
<td>27</td>
</tr>
<tr>
<td>Forest Way</td>
<td>6.0</td>
<td>34</td>
<td>45</td>
</tr>
<tr>
<td>Mona Vale Road</td>
<td>20.1</td>
<td>42</td>
<td>41</td>
</tr>
<tr>
<td>Pittwater Road (Mona Vale–Brookvale)</td>
<td>10.4</td>
<td>24</td>
<td>30</td>
</tr>
<tr>
<td>Pittwater Road (Balgowlah–Brookvale)</td>
<td>5.8</td>
<td>22</td>
<td>25</td>
</tr>
<tr>
<td>Military Road - Spit Road - Manly Road</td>
<td>6.6</td>
<td>20</td>
<td>27</td>
</tr>
</tbody>
</table>

Source: Key Roads Performance Report, Roads and Maritime, June 2013.

2.4.1 Warringah Road Speed Surveys

Roads and Maritime undertook speed surveys along Warringah Road between Woodlands Road and Government Road on Tuesday 21 May 2013 and Wednesday 22 May 2013. The surveys recorded the travel time and speed, and encompassed a total of 58 survey runs during the 2 hour morning and 2 hour evening peak periods.

While Figure 2.6 indicates differences in directional traffic volumes during peak periods, the traffic signal timing settings at the major intersections allocate capacity according to directional demand, resulting in the observed travel speeds to being approximately the same for each direction of travel. In some circumstances, the counter-peak travel time is slower despite lesser traffic volumes.

Also, the results of the speed surveys indicate the variability of peak period average travel speeds along the stretch of Warringah Road.

Table 2.3: Average Peak Period Speeds (km/h) on Sections of Warringah Road (21–22 May 2013)

<table>
<thead>
<tr>
<th>Time period</th>
<th>Woodlands Road–Starkey Street</th>
<th>Starkey Street–Allona Avenue</th>
<th>Allona Avenue–Forest Way</th>
<th>Forest Way–Hillmer Street</th>
<th>Hillmer Street–Wakehurst Pkwy</th>
<th>Wakehurst Pkwy–Allambie Road</th>
<th>Allambie Road–Government Road</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>730m 680m 760m 500m 260m 850m 920m 4,700m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7–8am</td>
<td>44</td>
<td>33</td>
<td>13</td>
<td>34</td>
<td>38</td>
<td>43</td>
<td>46</td>
<td>20</td>
</tr>
<tr>
<td>8–9am</td>
<td>49</td>
<td>45</td>
<td>26</td>
<td>35</td>
<td>44</td>
<td>32</td>
<td>38</td>
<td>32</td>
</tr>
<tr>
<td>Average</td>
<td>47</td>
<td>39</td>
<td>20</td>
<td>36</td>
<td>41</td>
<td>38</td>
<td>42</td>
<td>26</td>
</tr>
<tr>
<td>Eastbound AM peak</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4–5pm</td>
<td>43</td>
<td>55</td>
<td>25</td>
<td>44</td>
<td>54</td>
<td>37</td>
<td>38</td>
<td>34</td>
</tr>
<tr>
<td>5–6pm</td>
<td>31</td>
<td>33</td>
<td>16</td>
<td>34</td>
<td>44</td>
<td>30</td>
<td>31</td>
<td>25</td>
</tr>
<tr>
<td>Average</td>
<td>37</td>
<td>44</td>
<td>21</td>
<td>39</td>
<td>49</td>
<td>34</td>
<td>35</td>
<td>30</td>
</tr>
<tr>
<td>Westbound AM Peak</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7–8am</td>
<td>53</td>
<td>29</td>
<td>32</td>
<td>35</td>
<td>21</td>
<td>6</td>
<td>31</td>
<td>15</td>
</tr>
<tr>
<td>8–9am</td>
<td>49</td>
<td>45</td>
<td>41</td>
<td>33</td>
<td>36</td>
<td>19</td>
<td>38</td>
<td>24</td>
</tr>
<tr>
<td>Average</td>
<td>51</td>
<td>37</td>
<td>37</td>
<td>34</td>
<td>29</td>
<td>13</td>
<td>35</td>
<td>20</td>
</tr>
<tr>
<td>Westbound PM Peak</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4–5pm</td>
<td>48</td>
<td>23</td>
<td>64</td>
<td>52</td>
<td>44</td>
<td>33</td>
<td>43</td>
<td>37</td>
</tr>
<tr>
<td>5–6pm</td>
<td>50</td>
<td>30</td>
<td>56</td>
<td>44</td>
<td>43</td>
<td>15</td>
<td>40</td>
<td>28</td>
</tr>
<tr>
<td>Average</td>
<td>49</td>
<td>23</td>
<td>60</td>
<td>49</td>
<td>44</td>
<td>24</td>
<td>42</td>
<td>33</td>
</tr>
</tbody>
</table>


The results of these travel speed surveys indicate that speeds during the morning peak period are generally slower in both directions compared with the PM peak period.

Key slow points are the eastbound approach to Forest Way and the westbound approach to Wakehurst Parkway. The first hour travel speed from the survey on this section was 6 km/h, which is comparable to average walking speed.
2.5 Travel Demand Characteristics

Journey to work information was gathered from the Bureau of Transport Statistics (BTS) through its visualiser website, for a number of travel zones in the Warringah LGA covering the key trip generators in the Frenchs Forest precinct. Figure 2.10 shows where the 28,079 people who work in the selected travel zones come from, while Figure 2.11 shows where the 26,033 employed residents of these travel zones go to work.

Figure 2.10 shows that about 58 percent of the people working in the selected travel zones come from Warringah LGA, indicating a high share of local travel to work. It is followed by Pittwater LGA with about 9 percent.

In terms of travel modes, about 66 percent of workers in the selected travel zones drove private vehicles to work, while about 7 percent took a bus. About 3 percent walked to work.

Figure 2.11 shows that about 44 percent of employed residents in the selected travel zones worked in Warringah LGA, followed by about 17 percent working in the Sydney CBD. About 60 percent of the employed residents in the selected travel zones drove to work, while about 11 percent took a bus. About 3 percent walked to work.

The information on travel modes for trips to work in the selected travel zones indicate the current state of transport options available for workers residing or working in the Frenchs Forest precinct. There are currently no rail transport options in the Northern Beaches, and the heavy reliance on private vehicle trips creates significant road traffic management issues during peak periods.
Figure 2.10: Origins and Modes of Workers in Selected Travel Zones, 2011

Source: Bureau of Transport Statistics
Figure 2.11: Destinations and Modes of Employed Residents in Selected Travel Zones, 2011

Source: Bureau of Transport Statistics
2.6 Network and Intersection Performance

2.6.1 Model Outputs Utilised in the Assessment

The analysis has considered the following modelling outputs for the 2012 Base Model:
- Network performance statistics
- Intersection performance statistics.

Network Performance Statistics

The following general network statistics have been determined for each of the scenarios modelled:
- Number of vehicles that have left the network
- Number of vehicles that remain in the network
- The total distance travelled in the network
- The total time travelled in the network
- Average vehicle speed
- Average delay time per vehicle
- Average number of stops per vehicle
- Total delay time, including unreleased time (the delay to vehicles trying to enter a congested network)
- Unreleased demand (the number of vehicles trying to enter the road network, but prevented because of congestion).

The above parameters provide a good indication of how the network performs and provides key statistics that can be used to compare scenarios.

Intersection Performance Statistics

The commonly used measure of intersection performance, as defined by Roads and Maritime is vehicle delay. The intersection modelling used determines the average delay that vehicles encounter and provides a measure of the level of service.

Table 2.4 shows the ranges of average vehicle delay adopted in determining the level of service of intersections.

Table 2.4: Level of Service Criteria for Intersections

<table>
<thead>
<tr>
<th>Level of Service (LOS)</th>
<th>Average Delay per vehicle (seconds/vehicle)</th>
<th>Traffic Signals, Roundabout</th>
<th>Give Way &amp; Stop Sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Less than 14</td>
<td>Good operation</td>
<td>Good operation</td>
</tr>
<tr>
<td>B</td>
<td>15 to 28</td>
<td>Good with acceptable delays and spare capacity</td>
<td>Acceptable delays and spare capacity</td>
</tr>
<tr>
<td>C</td>
<td>29 to 42</td>
<td>Satisfactory</td>
<td>Satisfactory, but accident study required</td>
</tr>
<tr>
<td>D</td>
<td>43 to 56</td>
<td>Near capacity</td>
<td>Near capacity, accident study required</td>
</tr>
<tr>
<td>E</td>
<td>57 to 70</td>
<td>At capacity, at signals incidents will cause excessive delays</td>
<td>At capacity, requires other control mode</td>
</tr>
<tr>
<td>F</td>
<td>Greater than 70</td>
<td>Extra capacity required</td>
<td>Extreme delay, major treatment required</td>
</tr>
</tbody>
</table>

Source: Guide to Traffic Generating Developments, Roads and Maritime Services, 2002
The average vehicle delay statistics at key intersections have been extracted from the transport models to provide an indication of the level of performance.

The Level of Service (LOS) for the key intersections throughout the study area has been determined based on the following criteria (based on Table 2.4):

- LOS A to D: less than 56 seconds
- LOS E: between 57 seconds and 70 seconds
- LOS F: greater than 70 seconds.

Therefore, where the average vehicle delay at an intersection exceeds 70 seconds, the intersection is considered to be operating over capacity with long delays and queues.

### 2.6.2 Network Performance

Table 2.5 summarises the network performance modelling results of the 2012 Base Year scenario for the three-hour AM and PM peak periods.

Table 2.5: Network Performance Results – 2012 Base Scenario, AM and PM Peak Periods

<table>
<thead>
<tr>
<th>Network Measure (3 hours)</th>
<th>2012 Base AM Peak</th>
<th>2012 Base PM Peak</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total traffic demand (vehicles)</td>
<td>38,734</td>
<td>45,094</td>
</tr>
<tr>
<td>Number of vehicles that have left the network (vehicles)</td>
<td>35,276</td>
<td>42,034</td>
</tr>
<tr>
<td>Number of vehicles that remain in the network (vehicles)</td>
<td>2,786</td>
<td>2,087</td>
</tr>
<tr>
<td>Unreleased demand (vehicles)</td>
<td>672</td>
<td>973</td>
</tr>
<tr>
<td>Proportion of vehicles unreleased</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>Total distance travelled in network (km)</td>
<td>113,676</td>
<td>132,742</td>
</tr>
<tr>
<td>Total time travelled in network (hr)</td>
<td>5,188</td>
<td>4,681</td>
</tr>
<tr>
<td>Average speed (km/h)</td>
<td>21.9</td>
<td>28.4</td>
</tr>
<tr>
<td>Average delay time per vehicle (sec)</td>
<td>320</td>
<td>210</td>
</tr>
<tr>
<td>Average number of stops per vehicle</td>
<td>5.4</td>
<td>3.6</td>
</tr>
<tr>
<td>Total delay time including unreleased time (hr)</td>
<td>4,032</td>
<td>3,592</td>
</tr>
</tbody>
</table>

Source: NBH Roadworks VISSIM model (GTA, 2014).

The demands for the 2012 peak period (3 hour) are higher than the 2012 AM peak period (3 hour) which reflects the traffic count data presented in Section 2.2. Notwithstanding, it is noted that the AM and PM peak hour (1 hour) traffic volumes on Warringah Road are similar.

### 2.6.3 Intersection Performance

Figure 2.12 shows the existing (2012 Base Scenario) intersection levels of service for key intersections in the study area during the AM and the PM peak periods. The levels of service have been estimated based information extracted from the micro-simulation model.

The modelled intersection average delays and LOS for the 2012 Base Year scenario for the AM and PM peak period are illustrated graphically in Figure 2.12 and Figure 2.13.
The 2012 Base scenario indicates that the following intersections currently operate at LOS F during either the AM or PM peak periods (or both):

- Forest Way/ Adams Street
- Forest Way/ Warringah Road
- Wakehurst Parkway/ Frenchs Forest Road
Wakehurst Parkway/ Warringah Road.

2.7 Rat Running’

The existing traffic conditions along the major roads in the precinct exhibit high levels of traffic congestion, with the key intersections experiencing long delays during the peak periods.

‘Rat running’ is a common outcome of an over-congested arterial road system. Excess traffic seeks alternate routes to minimise delays, and in doing so, often use residential streets or roads passing through sensitive land uses. The result is loss of residential amenity and other road safety concerns.

Site observations and anecdotal information indicate that existing traffic conditions have induced ‘rat running’ in the study area to some extent, with through traffic using local roads in order to bypass congested road sections and intersections. This practice has prompted Council to implement traffic management measures to minimise impacts on local amenity. The most evident example of this is the restriction to southbound/westbound traffic movements on Grace Avenue in Forestville between 7–8:45am Mondays to Fridays, together with installation of traffic calming devices on a number of identified common rat runs, as shown in Figure 2.14 and Figure 2.15 (for the AM and PM peaks, respectively).

Figure 2.14: Common ‘Rat Run’ Routes in the Study Area during the AM Peak

![Map showing common 'Rat Run' routes](image)
2.8 Car Parking

To determine current kerbside car parking demand levels that would potentially be impacted by the project, kerbside car parking occupancy surveys were undertaken by Roads and Maritime on a number of days in May 2014. These covered a weekend (Sunday 11 May 2014 for some streets and Saturday 17 May 2014 for others) and two weekdays (Tuesday 13 May and Thursday 15 May 2014). The surveys were undertaken for the stretch of Naree Road and Frenchs Forest Road between Forest Way and Allambie Road/Patanga Road, Rabbett Street between Adams Street and Forest Way, as well as the local roads to the north of Frenchs Forest Road (west and east), including:

- Cobb Street
- Gidya Street
- Sylvia Place
- Bluegum Crescent
- Gladys Avenue
- Bantry Bay Road (north of Frenchs Forest Road)
- Nandi Avenue
- Newell Place
- Bimbadeen Crescent
- Romford Road
- Hurdis Avenue
- Harmston Avenue
- Inverness Avenue
- Patanga Road.
Table 2.6: Kerbside Parking Surveys – 12-hour Average Occupancy

<table>
<thead>
<tr>
<th>Road Name</th>
<th>Section</th>
<th>Side</th>
<th>Weekday</th>
<th>Weekend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naree Rd</td>
<td>Forest Way-Rabbett St</td>
<td>North</td>
<td>42%</td>
<td>13%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>South</td>
<td>60%</td>
<td>23%</td>
</tr>
<tr>
<td>Frenchs Forest Rd West</td>
<td>Rabbett St-Wakehurst Parkway</td>
<td>North</td>
<td>6%</td>
<td>11%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>South</td>
<td>18%</td>
<td>9%</td>
</tr>
<tr>
<td>Frenchs Forest Rd East</td>
<td>Wakehurst Parkway – Patanga Rd</td>
<td>North</td>
<td>43%</td>
<td>42%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>South</td>
<td>25%</td>
<td>23%</td>
</tr>
<tr>
<td>Rabbett St</td>
<td>Adams St-Naree Rd</td>
<td>West</td>
<td>19%</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>East</td>
<td>4%</td>
<td>3%</td>
</tr>
<tr>
<td></td>
<td>Naree Rd-Forest Way</td>
<td>West</td>
<td>83%</td>
<td>25%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>East</td>
<td>86%</td>
<td>18%</td>
</tr>
<tr>
<td>Cobb St</td>
<td>Gidya St-Frenchs Forest Rd W</td>
<td>West</td>
<td>28%</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>East</td>
<td>1%</td>
<td>3%</td>
</tr>
<tr>
<td>Gidya St</td>
<td>Sylvia Pl-Cobb St</td>
<td>North</td>
<td>34%</td>
<td>36%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>South</td>
<td>20%</td>
<td>48%</td>
</tr>
<tr>
<td>Sylvia Pl</td>
<td>Gidya St-Frenchs Forest Rd W</td>
<td>West</td>
<td>38%</td>
<td>43%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>East</td>
<td>26%</td>
<td>21%</td>
</tr>
<tr>
<td>Bluegum Cr</td>
<td>Frenchs Forest Rd W (loop)</td>
<td>West</td>
<td>26%</td>
<td>25%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>East</td>
<td>34%</td>
<td>42%</td>
</tr>
<tr>
<td>Gladys Ave</td>
<td></td>
<td>West</td>
<td>21%</td>
<td>19%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>East</td>
<td>25%</td>
<td>22%</td>
</tr>
<tr>
<td>Nandi Ave</td>
<td>Frenchs Forest Rd E-Bimbadeen Cr</td>
<td>West</td>
<td>9%</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>East</td>
<td>0%</td>
<td>14%</td>
</tr>
<tr>
<td>Newell Pl</td>
<td>Nandi Avenue to end</td>
<td>West</td>
<td>42%</td>
<td>64%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>East</td>
<td>27%</td>
<td>29%</td>
</tr>
<tr>
<td>Bimbadeen Cr</td>
<td>Romford Rd-Ilford Rd</td>
<td>North</td>
<td>0%</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>South</td>
<td>26%</td>
<td>34%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>East</td>
<td>22%</td>
<td>22%</td>
</tr>
<tr>
<td>Romford Rd</td>
<td>Frenchs Forest Rd E-Iris St</td>
<td>West</td>
<td>45%</td>
<td>36%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>East</td>
<td>22%</td>
<td>21%</td>
</tr>
<tr>
<td>Hurdis St</td>
<td>Frenchs Forest Rd E-Iris St</td>
<td>West</td>
<td>20%</td>
<td>28%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>East</td>
<td>29%</td>
<td>32%</td>
</tr>
<tr>
<td>Harmston Ave</td>
<td>Frenchs Forest Rd E-Iris St</td>
<td>West</td>
<td>8%</td>
<td>23%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>East</td>
<td>8%</td>
<td>14%</td>
</tr>
<tr>
<td>Inverness Ave</td>
<td>Frenchs Forest Rd E-Iris St</td>
<td>West</td>
<td>19%</td>
<td>5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>East</td>
<td>35%</td>
<td>20%</td>
</tr>
<tr>
<td>Patanga Road</td>
<td>Frenchs Forest Rd E-Iris St</td>
<td>West</td>
<td>38%</td>
<td>14%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>East</td>
<td>57%</td>
<td>19%</td>
</tr>
<tr>
<td></td>
<td>Frenchs Forest Rd E-Dareen St (1P)</td>
<td>East</td>
<td>88%</td>
<td>27%</td>
</tr>
</tbody>
</table>

Source: GTA analysis of SkyHigh parking survey results undertaken for Roads and Maritime, May 2014.

Key findings from these car parking surveys include:

- Significant levels of weekday daytime parking are observed on the southern side of Naree Road between Forest Way and Rabbett Street, as well as on Rabbett Street.
between Naree Road and Forest Way. From spot observations, this parking demand generally relates to park and (bus) ride commuters heading towards Chatswood and the city.

- There is generally a low level of kerbside parking demand on Frenchs Forest Road West.
- Generally, there is about 50 percent average occupancy on the kerbside parking spaces along Frenchs Forest Road East (likely due to off-street parking provision in the business parks), except closer to the Skyline Shops during the weekend morning survey, during which the spaces are almost fully occupied.

The project will likely impact on kerbside parking activity on a number of roads, both during construction and the operation stage. From the results of the parking occupancy surveys, there are only a handful of sections in which parking demand would need to be managed. These include Naree Road, Rabbett Street and Patanga Road.

Alternative parking areas would need to be identified to accommodate parking demand on Naree Road, which would be removed temporarily during construction, and during peak periods when the project is in its operational stage. Parking demand on Rabbett Street could potentially increase as a result of removal of parking supply on Naree Road.

2.9 Public Transport

Buses are the predominant form of public transport on the Northern Beaches as the nearest railway station located at Chatswood is about 9 kilometres to the west.

A number of key bus routes servicing the Northern Beaches provide public transport interchange opportunities to rail services at Chatswood. In addition, a number of bus routes provide services linking with Manly Wharf, about 10 kilometres away and from where ferry services to the Sydney CBD are operated.

2.9.1 Bus Routes

A review of the bus routes serving the Frenchs Forest precinct and the frequencies for the AM and PM peak period is summarised in Table 2.7. The bus frequencies have been calculated for the two hour AM peak period (7–9am) and for the two hour PM peak period (4–6pm). Figure 2.16 shows the bus route coverage in the study area.

Previous observations indicate that although bus services are frequent in the study area, they commonly experience considerable delays in traffic through the network. Existing indented bus stops are only designed to cater for one bus at a time. At some bus stop locations (in particular at Forestway Shopping Centre), multiple buses may arrive within a short period and subsequent buses are required to queue in the kerbside lane until the indented bus bay is clear. This results in delays to both the buses and cars queuing behind in the kerbside lane. As such, longer bus bays and improved bus priority measures would potentially contribute towards increasing their efficiency.
<table>
<thead>
<tr>
<th>Route Number</th>
<th>Operator</th>
<th>Description</th>
<th>Morning Peak (7–9am)</th>
<th>Afternoon Peak (4–6pm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Inbound</td>
<td>Outbound</td>
</tr>
<tr>
<td>136</td>
<td>Sydney Buses</td>
<td>Chatswood to Manly</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>137</td>
<td>Sydney Buses</td>
<td>Chatswood to Bantry Bay (House With No Steps)</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>142</td>
<td>Sydney Buses</td>
<td>Allambie Heights to Manly</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>E66</td>
<td>Sydney Buses</td>
<td>Allambie Heights to City express</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>L60</td>
<td>Sydney Buses</td>
<td>Mona Vale to Chatswood (Limited Stops)</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>169</td>
<td>Sydney Buses</td>
<td>Manly to City via Narrabeena</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>E69</td>
<td>Sydney Buses</td>
<td>Manly to City Narrabeena</td>
<td>15</td>
<td>-</td>
</tr>
<tr>
<td>173</td>
<td>Sydney Buses</td>
<td>Narrabeena to Milsons Point</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>260</td>
<td>Forest Coaches</td>
<td>Terrey Hills to North Sydney</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>270</td>
<td>Forest Coaches</td>
<td>Terrey Hills to City (Town Hall)</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>L70</td>
<td>Forest Coaches</td>
<td>Terrey Hills to City (Town Hall)</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>271</td>
<td>Forest Coaches</td>
<td>Terrey Hills to City (Town Hall)</td>
<td>9</td>
<td>-</td>
</tr>
<tr>
<td>274</td>
<td>Forest Coaches</td>
<td>Belrose/Davidson to City (Town Hall)</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>278</td>
<td>Forest Coaches</td>
<td>Forestville to Chatswood</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>279</td>
<td>Forest Coaches</td>
<td>Frenchs Forest to North Sydney</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>280</td>
<td>Forest Coaches</td>
<td>Warringah Mall to Chatswood</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>281</td>
<td>Forest Coaches</td>
<td>Belrose to Chatswood</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>282</td>
<td>Forest Coaches</td>
<td>Belrose to Chatswood</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>283</td>
<td>Forest Coaches</td>
<td>Belrose to Chatswood</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>284</td>
<td>Forest Coaches</td>
<td>Chatswood to Duffys Forest</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

Note: Inbound direction is towards the Sydney CBD, North Sydney and Chatswood

Figure 2.16: Bus Network

2.9.2 Bus Priority

A number of bus priority measures are provided in the study area, with both Warringah Road and Frenchs Forest Road being part of Strategic Bus Corridor 15 (Dee Why–Chatswood). In particular, bus lanes and queue jumps are provided at the following locations:

**Bus lanes**
- Section of southbound Wakehurst Parkway between Frenchs Forest Road and Warringah Road.

**Bus queue jumps**
- Southbound Forest Way turning right to Warringah Road
- Westbound Warringah Road on the approach to the Wakehurst Parkway intersection
- Westbound Frenchs Forest Road East on the approach to the Wakehurst Parkway intersection
- Westbound Frenchs Forest Road East turning left on to Wakehurst Parkway
- Westbound Warringah Road turning right to a bus only link to Frenchs Forest Road East (westbound).

**Bus only sections**
- Rabbett Street southbound between Holland Crescent and Forest Way
- Access into Frenchs Forest East westbound from Warringah Road.

2.9.3 School Buses

Sydney Buses and Forest Coaches operate school bus routes through the study area in addition to the standard scheduled services. A total of 44 school bus services operate in the morning period and 78 school bus services operate in the afternoon period. These school bus services serve the various schools within study area (including The Forest High School) and the students who live in the catchment. In addition, a number of school buses stop at the Forestway Shopping Centre (either on Forest Way or at the southbound bus stop on Rabbett Street) with this location...
serving as an interchange point between school bus services and the standard bus services operated by Sydney Buses and Forest Coaches.

A number of school buses serve the Forest High School on Frenchs Forest Road, with buses picking up students outside the school, on the southern side of Frenchs Forest Road. Some of these buses execute a U-turn manoeuvre at the existing bus turnaround facility, west of the high school, to travel eastbound on Frenchs Forest Road towards Wakehurst Parkway. Figure 2.18 shows an image of an articulated school bus operated by Sydney Buses executing such a U-turn manoeuvre after picking-up school students in the afternoon peak.

Figure 2.18: Observed School Bus Manoeuvre on Frenchs Forest Road

2.10 Pedestrian Infrastructure

The key pedestrian desire lines in the study area are focused on the Skyline Shops towards the eastern end of Frenchs Forest Road, as well as in the vicinity of Forestway Shopping Centre and the Rabbett Street bus stops. Site observations indicate a significant volume of bus interchange activity at the Rabbett Street bus stop and on the bus stops on either side of Forest Way. These activities include walk access, kiss-and-ride and pedestrians crossing Forest Way at the signalised pedestrian crossing. A high number of pedestrians have been observed during AM and PM peak periods using the Forest Way pedestrian crossing to transfer between bus stops on opposite sides of the road.

Overall, pedestrian infrastructure provision is adequate to serve current levels of demand. Footpaths are provided on Warringah Road, with the path on the south side generally following an alignment further away from the road west of Hilmer Street, connecting with the existing footbridge across Warringah Road west of the Forest Way intersection, as well as on Forest Way, Frenchs Forest Road and Wakehurst Parkway south of Frenchs Forest Road up to about 100 metres south of Warringah Road.

However, the existing provision of pedestrian facilities can be generally considered poor in terms of encouraging higher levels of walking. There are constraints in pedestrian crossing provision at a number of key signalised intersections, including at the following locations, which do not have full pedestrian connectivity:
o the north and west legs of the Frenchs Forest Road/Wakehurst Parkway intersection
o the west leg of the Warringah Road/Wakehurst Parkway intersection
o Warringah Road/Allambie Road intersection (only east leg with crossing).

There are no formal pedestrian crossing facilities provided either at a number of key priority-controlled intersections, including:

o Frenchs Forest Road East/Allambie Road intersection (Skyline Shops).

o Forest Way/Naree Road intersection.

o Intersections with local streets on the north side of Frenchs Forest Road East between Patanga Road and Wakehurst Parkway.

There are no formal pedestrian crossings on Forest Way between the signalised crossing outside the Forestway Shopping Centre and Adams Street, a distance of about 600 metres. The footpath on Forest Way is also narrow.

Figure 2.19: Footbridge across Warringah Road

The area occupied by the business parks on Frenchs Forest Road East highlight the constraints to walking. The Frenchs Forest Specialised Centre Local Transport Assessment (AECOM, 2011) notes:

‘The existing commercial developments have encouraged car usage, with large at-grade car parks and limited pedestrian and cyclist permeability. This has resulted in a poor level of pedestrian/cyclists connectivity between the north and south areas of Frenchs Forest. This severance is exacerbated by the scale of the roadway and lack of pedestrian/cyclist crossing facilities on Warringah Road and Wakehurst Parkway.’

The AECOM report adds:

‘The scale of Wakehurst Parkway and the volumes of traffic in the peak periods also create an uninviting pedestrian environment, creating a north-south severance as well as the east-west barrier along Warringah Road. This results in the central core of Frenchs Forest being hard to reach for cyclists and pedestrians.’

2.11 Bicycle Infrastructure

There are limited bicycle facilities in the study area.

A number of on-road and off-road bicycle routes are proposed by Warringah Council, as well as bicycle route investigation areas around Bike Plan (Warringah Council, 2010). These are shown in Figure 2.20.
Figure 2.20: Warringah Bike Plan for NBH Precinct – Existing and Proposed Cycle Routes

It is noted that a number of the proposed on-road bicycle routes in the bike plan are along roads with high volumes of fast-moving traffic (eg Wakehurst Parkway, Allambie Road, Warringah Road east of Allambie Road), and pose a hostile cycling environment. There also needs to be better connectivity between the east and west sides of Frenchs Forest Road (the plan shows no precinct-wide east-west link except for Warringah Road and via Aquatic Drive). It is also noted that no facility is proposed for Frenchs Forest Road West.

The Warringah Bike Plan (Warringah Council, 2010) proposes a number of non-route bicycle infrastructure and programs to promote higher use of cycling in the local government area, including:

- Bicycle parking
- Provision of a bicycle fleet for Council staff
- Replacement of drainage grates on bicycle routes to be cycle-safe
- Promotion of school cycling programs
- Public information drive
- Support to local cycling events
- Plans of Management for a number of parks.

2.12 Crashes

Roads and Maritime provided GTA Consultants with crash data for the Frenchs Forest area for the period January 2010 to June 2013. The data has been analysed by GTA and prepared into a map depicting the location and type of crashes in the area, shown in Figure 2.21.

The analysis shows a majority of crashes occurred on Warringah Road (west of Wakehurst Parkway) and to a lesser degree on Forest Way.

Figure 2.21: Crash Data Map

Data source: Roads and Maritime Services
2.12.1 Crash Clusters

The data indicates a relatively higher concentration of crashes at the following intersections:

- Forest Way/Adams Street
- Forest Way/Naree Road
- Warringah Road/Forest Way
- Warringah Road/Hilmer Street
- Warringah Road/Wakehurst Parkway
- Warringah Road/Allambie Road
- Warringah Road/Government Road
- Frenchs Forest Road/Patanga Road.

2.12.2 Crash Types

Of the 270 crashes recorded in the study area during the period January 2010 to June 2013, half were rear-end collisions. No fatal crash was recorded.

There were 24 crashes recorded during the period on Frenchs Forest Road East and eight on Naree Road/Frenchs Forest Road West. Of the eight on Naree Road/Frenchs Forest Road West, four were rear-end type crashes.

The crash data indicates that while crashes occur throughout the study area, they are also relatively concentrated at the intersections. Approximately half of all crashes were rear-end collisions, which may be due to the existing traffic congestion during the peak periods within the study area.

Improvements to traffic flows in the network would potentially contribute positively in reducing crashes, including rear-end collisions, particularly on Frenchs Forest Road West.

2.12.3 Pedestrian and Cyclist Crashes

Figure 2.22 highlights the spatial distribution of crashes involving pedestrians in the study area from the same crash data shown in Figure 2.21. Crashes involving pedestrians were recorded at the following locations:

- Intersection of Forest Way and Russell Avenue
- Along Forest Way at the pedestrian crossing outside Forestway Shopping Centre
- Intersection of Frenchs Forest Road East and Patanga Road (2 crashes)
- Intersection of Warringah Road and Government Road/Ellis Road.
The crash data indicates that three out of four pedestrian crashes recorded occurred adjacent to retail areas – two on Forest Way outside the Forestway Shopping Centre and one on Frenchs Forest Road East near the Skyline Shops.

2.13 Summary of Existing Travel Conditions

Within the NBH precinct, travel is predominately car based and the road network is highly constrained by topography. The arterial roads serving the precinct converge near the NBH site and as a result, the precinct experiences high levels of traffic congestion and volatility, with several of the major intersections operating at or over capacity.

Among the existing deficiencies during the morning commute peaks, when travel is predominantly westward, the network has capacity limitations that make it particularly prone to congestion and ‘rat running’. It frequently enters grid-locked conditions, despite being tightly managed through access and turning restrictions, and intensive signal coordination. The controlling intersection in the precinct – the surface-level signalised Warringah Road/ Wakehurst Parkway intersection, operates with long delays during the peak hours associated with both buses and general traffic.

Traffic from closely set intersections along Wakehurst Parkway is a major contributor to this congestion and consequently the Wakehurst Parkway/ Frenchs Forest Road intersection is operating beyond acceptable levels, with long delays averaging up to 230 seconds per vehicle, as well as extensive queues.

Traffic from Forest Way adds further to loading of the Warringah Road corridor, with the Forest Way/Warringah Road intersection and the Forest Way/Adams Street intersection both operating poorly, with long delays and extensive queues.

In the evening peak period, the Wakehurst Parkway/ Warringah Road intersection and the Wakehurst Parkway/ Frenchs Forest Road intersection operate at or approaching capacity.
The Warringah Road/ Forest Way intersection experiences long delays, particularly with the right turn from Warringah Road to Forest Way, which operates at LOS F during peaks. The average delays reach up to 130 seconds per vehicle, with queues extending beyond the Adams Avenue intersection.

As a result of the significant westbound traffic volumes on Warringah Road during the AM peak, it often operates with long rolling queues and periodic grid-lock. In the PM peak period, significant eastbound traffic volumes result in rolling queues which may extend to Roseville Bridge and beyond. Travel time surveys undertaken in 2013 along Warringah Road indicate that the average speed in the westbound direction during the AM peak period (7–9am) is 20 km/h and in the eastbound direction during the PM peak period (4–6pm) is 30 km/h.
3. Strategic Justification

3.1 Strategic and Policy Framework

The project could be considered to have a good strategic fit with the approval and proper functioning of the Northern Beaches Hospital, plus correspondence to current overarching transport development policy and strategy as outlined in a number of State Government, regional and Council documents, as discussed below.

3.1.1 NSW 2021

In 2011, the NSW Government published NSW 2021 – A Plan to Make NSW Number One, comprising the overarching policy document that guides planning in NSW, in particular Metropolitan Sydney. The project objectives are in support of the overall goals, objectives and strategies outlined NSW 2021.

The objectives and predicted performance of the project directly support NSW 2021’s key transport goals that include:

- Reduce travel times.
- Grow patronage on public transport by making it a more attractive choice.
- Improve customer experience with transport services.
- Improve road safety.

The project provides opportunities to contribute towards these goals in support of the Northern Beaches Hospital, which is also a commitment in NSW 2021.

3.1.2 NSW State Infrastructure Strategy

The State Infrastructure Strategy (Infrastructure NSW, December 2012) is a 20-year strategy to identify and prioritise the delivery of critical public infrastructure in NSW. The Strategy outlines strategic options for delivering infrastructure and market reform.

The Strategy indicates that the NBH is a priority project of NSW Government. It states: ‘the Northern Beaches Hospital should be delivered as a “healthcare precinct” combining both public and private service provision in an integrated fashion.’

It also outlines a number of transport infrastructure options and proposals in the study area. These include:

- Northern Beaches Link Road – linking the Gore Hill Freeway with the Burnt Bridge Creek Deviation via a tunnel under Mosman and a new bridge over the Spit. It could be combined with a transitway for buses from the Northern Beaches to the CBD. The State Infrastructure Strategy states: “the Northern Beaches Link could be accelerated if it can be built without public subsidy. In the short term, priority should be placed on incremental reforms to improve public transport from the Northern Beaches.”
- Incremental investment in bus corridors across Sydney to improve travel times on key corridors, including the Northern Beaches. Infrastructure NSW recommends that Transport for NSW (TfNSW) “further investigate a range of potential enhancements to bus priority on the Northern Beaches corridor to develop a value-for-money improvement plan for the coming decade.” This project, called the ‘Northern Beaches Rapid Transit’, would facilitate travel between Frenchs Forest and the CBD via Wakehurst Parkway.
3.1.3 Draft Metropolitan Plan for Sydney to 2031

The Draft Metropolitan Plan for Sydney to 2031 (NSW Department of Planning and Infrastructure, 2013), outlines how Metropolitan Sydney would be spatially structured in order to accommodate the anticipated increase in residential population to 2031. It also outlines how employment would be structured in a sustainable manner to accommodate the growth. The plan also aligns with the NSW Long Term Transport Master Plan and the State Infrastructure Strategy.

The Metropolitan Plan also encompasses sub-regional plans, intended to replace the 2007 North East and North Subregional Plans in the previous metropolitan strategy. The new North Subregional Plan will refine housing and employment targets for the subregion following investigative and consultative processes. The current draft of the North Subregion Plan identifies the Frenchs Forest Health Potential Specialised Precinct, which would ‘capitalise on the growing cluster of hospital and health-related uses with associated research/business park opportunities to stimulate local jobs’. The precinct will be served by a ‘potential transit extension’ between Dee Why and Chatswood, via the Warringah Road corridor.

3.1.4 Northern Beaches Regional Action Plan

The Northern Beaches Regional Action Plan (NSW Government, 2012) outlines the initiatives and strategies to be pursued by the NSW Government to meet its election commitments. It requires agencies to plan for and facilitate the NBH and its surrounding health precinct including addressing management of transport and community access during planning approval and ongoing functional operation.

The Action Plan required the investigations that underpin this proposal to identify likely impacts on the district, and identify and plan required improvements.

The Plan further states: “With the development of the new hospital and associated services, there will be additional transport pressure placed on an already congested road system in the Northern Beaches. To prepare for the building of this new infrastructure, a review of the current roads and intersections will be conducted and planning undertaken to address future needs of the area. Bus timetables and routes will also be reviewed to ensure maximum access and usage for commuters.”

3.1.5 NSW Long Term Transport Master Plan

The NSW Long Term Transport Master Plan (LTTMP) was released by Transport for NSW in December 2012, and aims to provide a framework for addressing the state’s transport challenges for the next 20 years.

The LTTMP serves as the “guiding transport planning and policy document to support the goals in NSW 2021”. The Master Plan integrates transport with wider economic, infrastructure, social, housing and land use planning. The Master Plan will also inform future detailed plans, such as modal plans and specific Regional Transport Plans.

The LTTMP, in acknowledgement of potential growth in population and employment on the Northern Beaches, and the pressure that this may place on transport infrastructure and services, identified the potential to introduce bus rapid transit (BRT) on key corridors, including a connection between the Northern Beaches and the Sydney CBD. Two potential routes for the Northern Beaches BRT were outlined, along the Spit Road-Military Road corridor (north-south) and the Warringah Road corridor (east-west).
3.1.6 Sydney’s Bus Future

Sydney’s Bus Future [Transport for NSW, 2013] sets out the Government’s overall plan to deliver fast and reliable bus services for customers in Sydney. Based on the integrated approach outlined in the LTTMP, the plan outlines how the bus network would be redeveloped to bring simpler, faster and more efficient services. It identifies three tiers of bus routes in the network:

- Rapid service routes, forming the backbone of the bus network with fast and reliable bus travel between key centres.
- Suburban service routes, consisting of a mix of timetabled and frequent, “turn-up-and-go” type services which do not require timetables.
- Local service routes, comprised of timetabled services with stops every 400 metres or so.

A total of 13 rapid transit routes have been identified. These would have stops every 800 metres to one kilometre.

Sydney’s Bus Future also outlines investment in bus priority infrastructure to support fast and reliable bus journeys. As discussed above, this includes adopting a staged approach to introducing BRT on key corridors, beginning with investigations along key high-growth corridors. These include the Northern Beaches.

Frenchs Forest is identified in the document as a ‘specialised centre’ and lined by improved suburban routes via Warringah Road and Forest Way with the ‘major centres’ of Brookvale, Dee Why and Chatswood.

3.1.7 Northern Beaches Bus Rapid Transit (BRT) Study

The Northern Beaches Bus Rapid Transit (BRT) Study – Draft Feasibility Summary Report [Transport for NSW, June 2012] identifies a number of corridor options for providing BRT service in the Northern Beaches. Two corridors were investigated:

- A north–south corridor linking Mona Vale with the CBD via the Pittwater Road–Spit Road–Military Road corridor.
- An east–west corridor linking Dee Why and Chatswood via Warringah Road.

TfNSW has sought comment on these BRT options and the initial findings to inform the direction of more detailed studies and analysis.

3.1.8 Shaping Our Future

Shaping Our Future [Shore Regional Organisation of Councils (SHOROC), 2010] informs debate on regional planning. SHOROC supports BRT initiatives in the NBH precinct in response to existing road congestion and growth targets, and supports upgrades of the key Warringah Road intersections as part of the NBH project. The project directly responds to these aspirations.

3.2 Committed Transport Improvements

3.2.1 Sydney Clearways Strategy

The Sydney Clearways Strategy [Transport for NSW, December 2013] is aimed at improving travel times and speeds on key road corridors in Sydney by restricting kerbside parking during peak travel periods. The strategy incorporates expanding the current set of clearways being implemented in Sydney for weekday AM and PM peak periods, by investigating additional roads
that would be subject to weekday peak clearways, as well as potentially extending clearway periods to weekends.

There are already existing clearway restrictions on Warringah Road west of Wakehurst Parkway. The strategy outlines further investigations on extending the clearway restrictions to cover Warringah Road east of Wakehurst Parkway, as well as Forest Way between Mona Vale Road and Warringah Road, during both weekday and weekend peak periods.

3.2.2 Northern Beaches Transport Action Plan

The NSW Government is investing in a number of transport improvements as part of the Northern Beaches Transport Action Plan (Transport for NSW, 2014) a key component of which is this project.

Other transport improvements that are part of the plan include:

- More frequent bus services for the area, with buses starting earlier and finishing later during the week and on weekends
- Kerbside Bus Rapid Transit (BRT) providing more reliable “turn up and go” bus services between the Northern Beaches and the Sydney CBD, incorporating new bus bays, upgraded intersections, road lanes and bridges to improve traffic flow and bus travel.
- New transport interchanges at Mona Vale, Dee Why, Brookvale and Mosman.
- Extra car parking for commuters using buses at Mona Vale, Narrabeen/North Narrabeen, Warriewood and Brookvale.

Section 50 describes the specific changes proposed in the Northern Beaches Transport Action Plan relevant to this assessment.

Investigations on a number of significant transport improvement proposals are also part of the action plan. This includes a feasibility study on a Northern Beaches motorway tunnel between the Spit Bridge and Warringah Freeway.
4. Assessment Methodology

4.1 Overview

The assessment of traffic and transport impacts for the Concept Proposal Works and the Stage 1 Connectivity Works has been separately addressed.

The transport modelling for both assessments has been undertaken using VISSIM micro-simulation software package. The micro-simulation model was initially developed by Transport Modellers Alliance (TMA) and High Range Analytics (HRA) for Roads and Maritime to evaluate various potential options for the Concept Proposal as part of the option development process for the project. A summary of the results of that analysis is included in Chapter 6.

For the Stage 1 Connectivity Works, the micro-simulation model has been refined and updated to reflect more recent transport assessment information, including the Northern Beaches Hospital Stage 1 EIS (NSW Health Infrastructure, October 2013). The initial modelling undertaken for the Concept Proposal covered two hour AM peak and PM peak periods (7–9am and 4–6pm). In general, these time periods cover the network peak periods and are sufficient for the purposes of assessing the impacts of changes to the road network. However, due to the anticipated traffic generation patterns of the proposed hospital and the adjacent Forest High School outside the typical peak periods, the traffic model was expanded to cover three hour AM and PM peak periods (6–9am and 3–6pm). This expanded time period was adopted to cover the start and end of the daytime shift at the hospital (7am–3:30pm) and also the end of the school day at 3pm. This provides a more robust assessment of the potential impacts of the proposed NBH, allowing for an extended time period within the Stage 1 assessment.

This updated and separate traffic model will be used to also assess the traffic and transport impacts for the Stage 2 Network Enhancement Works as part of a separate EIS for Stage 2 of the project.

Therefore, it is important to note two separate transport models are referred to in this report: a newly developed transport model for assessing the impacts of the Stage 1 Connectivity Works and an existing Roads and Maritime transport model for the Concept Proposal.

With regard to future years for the modelling scenarios, the following have been used for the assessment of the Concept Proposal and the Stage 1 Connectivity Works:

- **Stage 1 Connectivity Works**
  - Year of opening: 2018 (as per year of opening of the Northern Beaches Hospital)
  - Assessment period: 2028 (10 years after opening).

- **Concept Proposal (Stage 1 and Stage 2 project works)**
  - Year of opening: 2021 (year of opening assessed for Stage 2 Project works)
  - Assessment period: 2036 (15 years after opening of Stage 2 Project works).

The separate Stage 2 Network Enhancement EIS (and the traffic and transport assessment informing this) will review the anticipated year of opening for the proposed NBH, and adjust the modelling assumptions, where required, if this changes from the assumptions in this EIS.

This chapter outlines the key assumptions used in the assessment of the traffic and transport impacts of the Concept Proposal and the Stage 1 Connectivity Works.
4.2 Traffic Model Extent

The extent of the road network covered in the micro-simulation traffic model developed for this assessment is shown in Figure 4.1.

**Figure 4.1: Extent of Road Network Included in the Micro-simulation Traffic Model**

The following road sections are covered in the micro-simulation traffic model:

- Warringah Road between Forestville Avenue and Ellis Road/Government Road
- Forest Way between south of Prince Charles Road intersection and Warringah Road
- Wakehurst Parkway between south of Dreadnought Road and the bus stops in the vicinity of the pedestrian path linking with Yarraman Avenue
- Naree Road between Forest Way and Rabbett Street
- Frenchs Forest Road East and Frenchs Forest Road West
- Adams Street between Prince Charles Road and Rabbett Street
- Rabbett Street between Adams Street and Forest Way
- Nandi Avenue between Frenchs Forest Road East and Bimbadeen Crescent
- Bimbadeen Crescent between Nandi Avenue and Romford Road
- Iris Street between Romford Road and Ellis Road
- Romford Road between Iris Street and Frenchs Forest Road East
- Patanga Avenue between Iris Street and Frenchs Forest Road East
- Rodborough Road between Warringah Road and its eastern end outside Equinox Centre
- Allambie Road between Arnhem Road and Frenchs Forest Road East
- Aquatic Drive between Allambie Road and its western end outside Warringah Aquatic Centre.
Representative transport links for a number of local roads are also included in the micro-simulation traffic model. These indicate nodes used to ingress or egress from the modelled road network, and include the following:

- Linking with Warringah Road west of the Forest Way intersection: Arthur Street, Woodlands Road, Forestville Avenue, Melwood Avenue, Darley Street, Starkey Street, Ferguson Street, Cook Street, Currie Road, Brown Street, Altona Avenue, Maxwell Parade, Fitzpatrick Avenue West and Fitzpatrick Avenue East.
- Linking with Forest Way: Russell Avenue and Adams Street West.
- Linking with Rabbett Street: Holland Crescent North, Holland Crescent South and Epping Drive.
- Linking with Frenchs Forest Road West: Cobb Street, Sylvia Place, Bluegum Crescent West, Bluegum Crescent East, Gladys Avenue and the new NBH entry.
- Linking with Frenchs Forest Road East: the driveway to 81 Frenchs Forest Road, Skyline Place, the driveway to Forest Central Business Park (49 Frenchs Forest Road), Hurdis Avenue, Harmsdon Avenue, Inverness Avenue, the Allambie Grove Business Park (25 Frenchs Forest Road) and the Parkway Hotel driveways.
- Linking with Iris Street: Romford Road North, Sunset Place, Coster Street, Paxton Street, Jimada Avenue, Myra Street, Winslea Avenue, Karabah Place and Oxford Falls Road.
- Linking with Warringah Road east of the Forest Way intersection: Hilmer Street North, the NBH access north of the Hilmer Street intersection, Jones Street and Courley Road.

For purposes of reporting the traffic modelling results, the roads and links covered in Figure 4.1 and detailed above are taken to comprise the ‘network’.

4.3 Development of Transport Demand Forecasts

The development of the traffic demands are divided into the following two components:

- Background traffic (traffic passing through the study area and generated by all non-NBH land uses)
- Traffic generated by the NBH project.

The following sections outline the development of these two components of the traffic demand matrices.

4.3.1 Background Traffic Growth

The growth in travel demand across the precinct has generally been in line with the growth in population and employment levels. The North East Subregional Strategy anticipates that by 2036, the subregion would see a population growth of 40,000 persons on top of the current 238,000 population (15 percent increase), and a 26 percent increase of 23,000 additional jobs on top of the current 89,000 jobs. Employment is generally anticipated to grow within the key centres of North Sydney, Chatswood and Dee-Why/ Brookvale.

This assessment has utilised the strategic transport model developed by Roads and Maritime, which is based on updated small-area population and employment land use scenarios developed by the Bureau of Transport Statistics in August 2012 (released in October 2012).

While the population and employment land use forecasts developed by the BTS do not specifically include the proposed NBH, there is a predicted increase of about 3,400 people and 4,900 jobs within the surrounding precinct, between 2011 and 2036. This indicates a potential increase of 18 percent in population and 43 percent in employment over the next 25 years. It is
expected that the number of jobs generated by the hospital could be incorporated within the projected increase of 4,900 jobs in the precinct by 2036 in the BTS scenarios.

To determine the growth in traffic volumes, travel demand and distribution figures for the study area were gathered from the 2021 and 2036 future year scenarios. The growth in traffic volumes was determined by comparing these traffic volumes to the 2011 base year scenario. To develop the future year demand for the various scenarios assessed for the Concept Proposal and Stage 1 Connectivity Works, the base 2012 micro-simulation demand patterns were adjusted to account for the changes in the background traffic volumes (i.e., adding or subtracting trips based on changes in the strategic transport model).

Background traffic growth from the strategic model would essentially be comprised of growth in traffic moving through the precinct, as well as internally produced and attracted traffic (trips with at least one trip end within the precinct). This latter source would include trips generated by the proposed NBH. However, for purposes of this assessment, traffic generated by the NBH is considered and assessed separately from other sources of background traffic growth.

As indicated in Section 4.1, background traffic volumes were developed for 2018 and 2028 for the Stage 1 Connectivity Works and for 2021 and 2036 for the Concept Proposal works.

4.3.2 Northern Beaches Hospital

For the Concept Proposal, the assumptions used in the development of the NBH traffic generation and distribution were based on the preliminary assessment undertaken by Roads and Maritime and documented in the Northern Beaches Hospital Precinct, Frenchs Forest – Enabling Roadworks Package, Project Evaluation and Justification Working Paper (Roads and Maritime, 2014).

NSW Health Infrastructure has also released the Northern Beaches Hospital State Significant Infrastructure (SSI) Application - Environmental Impact Statement for Stage 1 including Concept Design, Site Clearance & Preparatory Works (NSW Health Infrastructure, October 2013), part of which Hyder Consulting conducted a transport assessment.

As part of the update to the micro-simulation modelling for the Stage 1 Connectivity Works, these assumptions for the NBH have been reviewed and where appropriate, the model has been updated based on the NBH Stage 1 EIS Transport Assessment (Hyder Consulting, August 2013).

The following section details the assumptions for the traffic generation and distribution for the Stage 1 Connectivity Works assessment.

4.4 Hospital Traffic Generation

The following two key assumptions have been adopted for the purposes of determining the likely traffic generation of the proposed NBH:

- The proposed NBH will deliver Level 5 hospital services to the Northern Beaches local community, with increased beds and theatres and provide surgical, medical, maternity, paediatric, inpatient mental health services, and ambulatory care, as well as a large, modern emergency department.
- One of the key objectives for the proposed NBH is that the Northern Beaches community will not have to travel outside the Northern Beaches to receive complex healthcare treatment, with a number of services and facilities transferred from Manly and Mona Vale Hospitals.
The calculation of the traffic generation of the NBH has been undertaken using a first principles basis. This process requires an estimate of the following:

- Number of staff employed at the hospital
- Number of bed at the hospital
- Number of daily outpatients
- Number of other vehicle movements (deliveries, visiting medical offices).

A press release by the NSW Premier (29 October 2014), indicated that the NBH would have 488 beds and 1,300 staff employed at the hospital.\(^2\)

1,000 outpatients per day were estimated for the modelling undertaken for the option development process for the Concept Proposal.

80 additional peak hour trips have been assumed for other vehicles, such as deliveries, visiting medical officers.

In order to identify an appropriate car mode share, reference has been made to the Journey to Work data\(^3\) (BTS, 2014) for employees of the surrounding areas (TZ 2135, 2136, 2138, 2139, 2140). The data indicates car mode share was 83% (sample size = 7,955 employees). For this assessment, a car mode share of 85% has been adopted for staff, visitors and outpatients to the site. It is noted that hospital developments typically exhibit slightly higher mode share to car than typical workforces, as a result of the hours work (shift work) and the nature of the work, hence the adoption of a mode share (85%) to car slightly greater than the BTS data (83%).

**Staff**

Assuming that 85% of staff are present during the peak periods and that 50% arrive or depart in the peak hour, a total of 470 peak hour staff trips is anticipated (=1,300 x 0.85 x 0.85 x 0.50).

**Outpatients**

Assuming that 10% of patients access (enter and exit) the hospital during each peak hour, a total of 170 peak hour outpatient trips is anticipated (=1,000 x 0.85 x 0.1 x 2).

**Visitors**

Assuming that each patient (hospital bed) has two visitors per day and that 10% of visitors access (enter and exit) the hospital during each peak hour, a total of 166 peak hour visitor trips is anticipated (=488 x 2 x 0.85 x 0.1 x 2).

**Other**

For assessment purposes 80 additional peak hour trips have been assumed for other vehicles, such as deliveries, visiting professionals, etc.

**Summary**

Based on the above a summary of the anticipated peak hour traffic generation is provided in Table 4.1.

---


\(^3\) Source of Journey to Work data (http://www.bts.nsw.gov.au/)
Table 4.1: Anticipated Peak Hour Traffic Generation

<table>
<thead>
<tr>
<th>Type</th>
<th>Number</th>
<th>Peak Hour Traffic Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staff</td>
<td>1,300</td>
<td>470</td>
</tr>
<tr>
<td>Outpatients</td>
<td>1000 per day</td>
<td>170</td>
</tr>
<tr>
<td>Beds</td>
<td>488</td>
<td>166</td>
</tr>
<tr>
<td>Other</td>
<td>-</td>
<td>80</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>886</strong></td>
</tr>
</tbody>
</table>

Table 4.1 indicates that the site is anticipated to generate approximately 890 movements during a typical peak hour.

To determine the traffic volumes for the three hour AM and PM peak periods, Roads and Maritime have provided a distribution from a similar hospital in metropolitan Sydney (refer to Table 4.2).

Table 4.2: Adopted Vehicle Arrival and Departure Patterns for NBH (vehicle trips)

<table>
<thead>
<tr>
<th>Time</th>
<th>6-7AM</th>
<th>7-8AM</th>
<th>8-9AM</th>
<th>3-4PM</th>
<th>4-5PM</th>
<th>5-6PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>In</td>
<td>44%</td>
<td>66%</td>
<td>79%</td>
<td>26%</td>
<td>25%</td>
<td>26%</td>
</tr>
<tr>
<td>Out</td>
<td>10%</td>
<td>20%</td>
<td>21%</td>
<td>66%</td>
<td>75%</td>
<td>64%</td>
</tr>
<tr>
<td>Total</td>
<td>54%</td>
<td>86%</td>
<td>100</td>
<td>92%</td>
<td>100</td>
<td>90%</td>
</tr>
</tbody>
</table>

Source: RMS (Month, 2014)

The data in Table 4.2 also provides the directional split in traffic for each hour (i.e. the ratio between the inbound and outbound traffic movements).

It is noted that a lower counter peak distribution has been adopted for the morning peak hour as there is anticipated to be more of a bias in visitors and deliveries entering the site only rather than exiting compared to the afternoon peak hour operation where it is anticipated that there would be more visitors and deliveries both entering and exiting the site.

Based on estimated peak hour traffic generation of 886 vehicles per hour, the arrival and departure volumes adopted for the three hour AM and PM peak periods are provided in Table 4.3.

Table 4.3: Adopted Vehicle Arrival and Departure Patterns for NBH (vehicle trips)

<table>
<thead>
<tr>
<th>Time</th>
<th>6-7AM</th>
<th>7-8AM</th>
<th>8-9AM</th>
<th>3-4PM</th>
<th>4-5PM</th>
<th>5-6PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>In</td>
<td>390</td>
<td>582</td>
<td>703</td>
<td>228</td>
<td>221</td>
<td>227</td>
</tr>
<tr>
<td>Out</td>
<td>90</td>
<td>178</td>
<td>184</td>
<td>587</td>
<td>666</td>
<td>588</td>
</tr>
<tr>
<td>Total</td>
<td>480</td>
<td>760</td>
<td>887</td>
<td>815</td>
<td>887</td>
<td>795</td>
</tr>
</tbody>
</table>

The above traffic generation estimates have been used in the modelling undertaken for the Base Case and Stage 1 2 assessments, as detailed in Chapter 5 and Chapter 7.

It is also noted that the traffic generation of the hospital varies throughout the day, associated with the arrival and departure of staff, patients, visitors and deliveries.

4.5 Hospital Traffic Distribution and Assignment

The directional distribution and assignment of traffic generated by the proposed NBH will be influenced by a number of factors. As a Level 5 hospital, the proposed NBH will be the predominant facility for the Northern Beaches area, with Mona Vale Hospital proposed to be reconfigured to provide services to support the new NBH. With the NBH, patients in the Northern Beaches should not have to travel outside the area to receive complex healthcare treatment.
Due to the different distribution pattern of hospital staff trips from the distribution pattern of hospital patients and visitors, this assessment has considered these two contributors separately, as discussed below.

4.5.1 Hospital Staff

Many of the clinical services from the Manly and Mona Vale Hospitals are expected to be transferred to the Northern Beaches Hospital. In this regard, the spatial distribution of the staff trips to these two hospitals was considered for the assessment.

This assessment acknowledges that some workers at Manly and Mona Vale hospitals may change residence as a result of being transferred to the NBH, and this may affect the traffic distribution pattern over time. As such, two different traffic distribution profiles have been adopted for this assessment:

- For the 2018 scenario, it has been assumed that staff transferring to the NBH would continue to reside at their current residential address.
- For the 2028 scenario, it has been assumed that the spatial distribution of staff work trips may change as hospital workers change residence locations. Some staff may no longer work at the NBH and new staff may commence at the NBH over the first 10 years of operation.

2018 Scenario

The Journey to Work data from the 2011 census was used to determine the spatial distribution of staff trips from Manly and Mona Vale Hospitals. As this distribution reflects the existing staff spatial distribution, this has been used for the 2018 scenario. A summary of the spatial distribution used for the 2018 scenario is provided in Table 4.4.

![Table 4.4: Trip Distribution of NBH Staff, 2018 (based on Existing Residential Address)]

<table>
<thead>
<tr>
<th>Direction</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>To/from Warringah Road (East of Allambie Road)</td>
<td>21%</td>
</tr>
<tr>
<td>To/from Allambie Road (South of Aquatic Drive)</td>
<td>17%</td>
</tr>
<tr>
<td>To/from Wakehurst Parkway (North of Frenchs Forest Road)</td>
<td>32%</td>
</tr>
<tr>
<td>To/from Forest Way (North of Naree Road)</td>
<td>7%</td>
</tr>
<tr>
<td>To/from Warringah Road (West of Forest Way)</td>
<td>3%</td>
</tr>
<tr>
<td>To/from Wakehurst Parkway (South of Warringah Road)</td>
<td>17%</td>
</tr>
<tr>
<td>Local catchment</td>
<td>2%</td>
</tr>
</tbody>
</table>

Note: Totals may not add up to 100 percent due to rounding off.
Source: TMA & HRA for Roads and Maritime Services, August 2014.

Table 4.4 indicates that the majority of the staff currently live east of the NBH, and would access the NBH via Wakehurst Parkway (north of Frenchs Forest Road), Warringah Road (east of Allambie Road) and Allambie Road (south of Aquatic Drive).

2028 Scenario

Journey to Work data for staff who work at Royal North Shore Hospital, Hornsby Hospital, Mona Vale Hospital and Manly Hospitals was previously assessed by TMA and HRA for Roads and Maritime to determine the average commuter trip length by vehicle for these four hospitals. The result of this analysis is provided in Table 4.5.
Table 4.5: Average commuter trip length by vehicle for public hospitals in Northern Sydney

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Average Commuter Car Trip Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mona Vale Hospital</td>
<td>6.6 km</td>
</tr>
<tr>
<td>Manly Hospital</td>
<td>7.3 km</td>
</tr>
<tr>
<td>Hornsby Hospital</td>
<td>8.3 km</td>
</tr>
<tr>
<td>Royal North Shore Hospital</td>
<td>8.7 km</td>
</tr>
</tbody>
</table>


The analysis indicated that staff trips lengths are longer for the Royal North Shore Hospital and shorter for the Mona Vale Hospital and Manly Hospital. As the Mona Vale Hospital and Manly Hospital are lower-order hospitals in comparison to the North Shore Hospital, this indicated that hospital staff generally live closer to the lower-order hospitals and are willing to travel further to get to work when working at a major hospital.

As the NBH is planned to be a Level 5 hospital, staff trip lengths (home to work and work to home) are anticipated to be longer than those calculated for the lower-order Mona Vale Hospital and Manly Hospital. However, the Royal North Shore Hospital is located close to St Leonards Railway Station on the North Shore Railway Line, and as such the staff distribution patterns would likely be affected by the availability of taking public transport to/from work. The distribution pattern of Hornsby Hospital, being located away from a major railway line, was considered to provide a closer similarity with the likely staff distribution pattern for the NBH work trips.

In this regard, the spatial distribution for the NBH for the 2028 scenario was developed based on the existing trip length distribution of the Hornsby Hospital, with an average commuter car trip length of 8.3 km.

A summary of the spatial distribution used for the 2028 scenario for the NBH is shown in Table 4.6.

Table 4.6: Trip Distribution of NBH Staff based on a Trip Length Distribution from Hornsby Hospital

<table>
<thead>
<tr>
<th>Direction</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>To/from Warringah Road (East of Allambie Road)</td>
<td>14%</td>
</tr>
<tr>
<td>To/from Allambie Road (South of Aquatic Drive)</td>
<td>5%</td>
</tr>
<tr>
<td>To/from Wakehurst Parkway (North of Frenchs Forest Road)</td>
<td>3%</td>
</tr>
<tr>
<td>To/from Forest Way (North of Naree Road)</td>
<td>21%</td>
</tr>
<tr>
<td>To/from Warringah Road (West of Forest Way)</td>
<td>29%</td>
</tr>
<tr>
<td>To/from Wakehurst Parkway (South of Warringah Road)</td>
<td>20%</td>
</tr>
<tr>
<td>Local catchment</td>
<td>6%</td>
</tr>
</tbody>
</table>

Note: Totals may not add up to 100 percent due to rounding off.
Source: TMA & HRA for Roads and Maritime Services, August 2014.

Table 4.6 indicates that with the revised commuter distribution, a larger proportion of staff are predicted to live to the east of the NBH and access the NBH via Warringah Road (west of Forest Way) or Forest Way (north of Naree Road). There is also expected to be a larger proportion of staff living within the local area.

Summary

Many of the clinical services from the Manly and Mona Vale Hospitals are expected to be transferred to the Northern Beaches Hospital. In this regard, the spatial distribution of the staff trips to these two hospitals has been considered for the assessment.

The assessment acknowledges that some existing workers at Manly and Mona Vale hospitals may change residence as a result of being transferred to the NBH, and this may affect the traffic
distribution pattern over time. As such, two different traffic distribution profiles have been adopted for this assessment:

1) For the 2018 scenario, it has been assumed that staff transferring to the NBH would continue to reside at their current residential address.

2) For the 2028 scenario, it has been assumed that the spatial distribution of staff work trips may change as hospital workers change residence locations. Some staff may no longer work at the NBH and new staff may commence at the NBH over the first 10 years of operation.

4.5.2 Hospital Patients, Visitors and Deliveries

The traffic distribution analysis for NBH patients, visitors and deliveries undertaken as part of modelling undertaken for the assessment of the Concept Proposal was adopted for this traffic assessment. The traffic distribution was derived by the following process:

i. The proposed hospital’s catchment was identified by Health Infrastructure as the Northern Beaches, covering Manly, Warringah and Pittwater LGAs. In addition, a small area of Roseville Chase was included in the catchment, due to the relative proximity to the proposed NBH compared with the Royal North Shore Hospital. Small area population statistics (from BTS, at travel zone level) were collated for these LGAs.

ii. It was assumed that patients and visitors to the proposed NBH would be drawn from each of the travel zones in proportion to the population of the zone.

iii. Travel zones in the catchment were aggregated into large areas based on their accessibility to the major external zones of the micro-simulation traffic model.

iv. Hospital patients and visitors drawn from within the area covered by the micro-simulation traffic model were aggregated to micro-simulation traffic model zones based on accessibility to them.

The resulting adopted trip distribution of NBH patients, visitors and deliveries is shown in Table 4.7.

<table>
<thead>
<tr>
<th>Direction</th>
<th>Percentage of Trips</th>
</tr>
</thead>
<tbody>
<tr>
<td>To/from Warringah Road (east of Allambie Road)</td>
<td>29%</td>
</tr>
<tr>
<td>To/from Allambie Road</td>
<td>12%</td>
</tr>
<tr>
<td>To/from Wakehurst Parkway (north of Frenchs Forest Road)</td>
<td>25%</td>
</tr>
<tr>
<td>To/from Forest Way (north of Naree Road)</td>
<td>9%</td>
</tr>
<tr>
<td>To/from Warringah Road (west of Forest Way)</td>
<td>6%</td>
</tr>
<tr>
<td>To/from Wakehurst Parkway (south of Warringah Road)</td>
<td>18%</td>
</tr>
<tr>
<td>Local catchment</td>
<td>1%</td>
</tr>
</tbody>
</table>

Note: Totals may not add up to 100 percent due to rounding off.

Source: TMA & HRA for Roads and Maritime Services, August 2014.

4.6 Public Transport Improvements

As part of the Northern Beaches Transport Action Plan, Transport for NSW is proposing to introduce additional services and increase the frequency of the services for the Northern Beaches. Within the vicinity of the proposed Northern Beaches Hospital, the following improvements are planned:

- A new public transport interchange servicing the NBH.
- Additional bus services on the Terry Hills/Belrose to CBD suburban route via Frenchs Forest and the NBH.
- Development of all-day, 7-days-a-week public transport network.
Enhanced local bus services starting earlier and finishing later during the week and on weekends.
Better bus connections between the northern beaches and the NBH via suburban and rapid bus routes.

Within the study area, the following route changes are proposed:

- Route 137: Discontinue service
- Route 142: Extend service from Skyline Shops to Terry Hills (via Frenchs Forest Road and Forest Way)
- Route 159: Extend service from Dee Why to Warringah Aquatic Centre via Frenchs Forest Road, Forestway Shopping Centre and Warringah Road
- Route 169: Modify service to stop at Forestway Shopping Centre, via Frenchs Forest Road and Warringah Road
- Route 280: Modify service to stop at NBH via Frenchs Forest Road
- Route 282: Discontinue service.

The roads that these routes travel along are detailed in Figure 4.2.

Figure 4.2: Proposed changes to bus routes

The proposed frequencies for scheduled services are provided in Table 4.8 for 2021 (adopted for 2018 scenarios) and 2031 (adopted for 2028 scenarios).
### Table 4.8: Proposed 2018 and 2028 Bus Frequencies (AM peak period)

<table>
<thead>
<tr>
<th>Route Number</th>
<th>Operator</th>
<th>Description</th>
<th>2018 AM Peak</th>
<th>2028 AM Peak</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Inbound</td>
<td>Outbound</td>
</tr>
<tr>
<td>136</td>
<td>Sydney Buses</td>
<td>Chatswood to Manly</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>142</td>
<td>Sydney Buses</td>
<td>Terry Hills to Manly</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>159</td>
<td>Sydney Buses</td>
<td>Warringah Aquatic Centre to Manly</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>L60</td>
<td>Sydney Buses</td>
<td>Mona Vale to Chatswood (Limited Stops)</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>169</td>
<td>Sydney Buses</td>
<td>Manly to City via Narraweena</td>
<td>8</td>
<td>60</td>
</tr>
<tr>
<td>E69</td>
<td>Sydney Buses</td>
<td>Manly to City Narraweena</td>
<td>7.5</td>
<td>7.5</td>
</tr>
<tr>
<td>173</td>
<td>Sydney Buses</td>
<td>Narraweena to Milsons Point</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>260</td>
<td>Forest Coaches</td>
<td>Terrey Hills to North Sydney</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>270</td>
<td>Forest Coaches</td>
<td>Terrey Hills to City (Town Hall)</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>L70</td>
<td>Forest Coaches</td>
<td>Terrey Hills to City (Town Hall)</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>271</td>
<td>Forest Coaches</td>
<td>Terrey Hills to City (Town Hall)</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>274</td>
<td>Forest Coaches</td>
<td>Belrose/Davidson to City (Town Hall)</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>278</td>
<td>Forest Coaches</td>
<td>Forestville to Chatswood</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>279</td>
<td>Forest Coaches</td>
<td>Frenchs Forest to North Sydney</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>280</td>
<td>Forest Coaches</td>
<td>Warringah Mall to Chatswood</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>281</td>
<td>Forest Coaches</td>
<td>Belrose to Chatswood</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>283</td>
<td>Forest Coaches</td>
<td>Belrose to Chatswood</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>284</td>
<td>Forest Coaches</td>
<td>Duffs Forest to Chatswood</td>
<td>30</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: Transport for NSW

Note: Inbound direction is towards the Sydney CBD, North Sydney and Chatswood.

AM bus frequencies have been transposed for the PM peak period.

### 4.7 Traffic and Transport Modelling

The traffic/transport modelling for both assessments (Concept Proposal and Stage 1 Connectivity Works) has been undertaken using the VISSIM micro-simulation software package, to evaluate the expected future operation of the proposed road network and its ability to cater for the increase in background traffic and traffic demand generated by the proposed NBH.

It is considered that VISSIM micro-simulation modelling would be an appropriate tool able to assess the proposed road network and its complex arrangement of the closely spaced intersections with regard to geometric layout and signal control within the study area.

The micro-simulation model was initially developed by Roads and Maritime to evaluate various potential options for the Concept Proposal as part of the option development process.

For the Stage 1 Connectivity Works, the micro-simulation model has been refined and updated to cover three-hour AM and PM peak periods (6–9am and 3–6pm) and to reflect information available from the Northern Beaches Hospital State Significant Infrastructure (SSI) Application - Environmental Impact Statement for Stage 1 including Concept Design, Site Clearance & Preparatory Works (NSW Health Infrastructure, October 2013), as well as transport model information provided by Roads and Maritime. This updated model could also be used to assess the Stage 2 Project component (Network Enhancement Works) as part of the Stage 2 Project EIS.
4.7.1 Scenarios Evaluated

Table 4.9 outlines the scenarios developed and evaluated as part of the transport modelling tasks for this assessment, to determine the traffic and transport impacts of the proposed road upgrade on the overall road network.

For the Concept Proposal assessment, the analysis was previously undertaken by Roads and Maritime and documented in the Northern Beaches Hospital Precinct, Frenchs Forest – Enabling Roadworks Package, Project Evaluation and Justification Working Paper (Roads and Maritime, 2014), based on the initial micro-simulation model undertaken by TMA and HRA for Roads and Maritime.

For the other scenarios, the traffic modelling for these options was undertaken using the updated micro-simulation model, which included the three-hour AM peak period (6–9am) and three-hour PM peak period (3–6pm). This enabled the transport model to incorporate the implications of the school peak period and also the anticipated daytime shift changes at the NBH into the assessment.

Table 4.9: Scenario Assessment

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Base Year</th>
<th>Future Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing conditions</td>
<td>2012</td>
<td>2018 and 2028</td>
</tr>
<tr>
<td>“Do Minimal” (1)</td>
<td></td>
<td>2018 and 2028</td>
</tr>
<tr>
<td>Stage 1 Project</td>
<td></td>
<td>2018 and 2028</td>
</tr>
<tr>
<td>Concept Proposal</td>
<td></td>
<td>2021 and 2036</td>
</tr>
</tbody>
</table>

(1) Refer to Section 5.1 for a more detailed description of the “Do Minimal” scenarios.

Modelling has been undertaken for forecast years (as shown in Table 4.9), on the basis that the anticipated year of opening of the proposed NBH is 2018, with the Stage 1 Project assessment covering opening year and ten years after opening. The assessment years for the Concept Proposal (Stage 1 and Stage 2 Project works) (2021 and 2036) were selected on the basis of established planning horizons.

A discussion of the changes to the road network included in the Do Minimal and the Stage 1 scenarios are detailed in the following relevant chapters.

4.7.2 Model Outputs Utilised in the Assessment

The analysis has considered the following modelling outputs:

- Network performance statistics
- Intersection performance statistics
- Average vehicle speed along selected routes.

Due to the nature of the modelling undertaken for the Concept Proposal, its assessment (discussed in Chapter 6) provides a summary of network performance statistics only. The intersection performance statistics and average vehicle speeds along selected routes are presented as part of the assessment for the Do Minimal scenarios (in Chapter 55 and the Stage 1 Connectivity works (in Chapter 7).

To assess the performance of individual intersections, a more detailed definition of the intersection layout needs to be developed (i.e., number of lanes, turn bay lengths). As such, the individual intersection performance statistics and vehicle speed information under the Stage 2 Network Enhancement Works will be assessed as part of the Stage 2 Project EIS.

Further details on each of the above modelling outputs are provided below.
Network Performance Statistics

The following general network statistics have been determined for each of the scenarios modelled:

- Number of vehicles that have left the network
- Number of vehicles that remain in the network
- The total distance travelled in the network
- The total time travelled in the network
- Average vehicle speed
- Average delay time per vehicle
- Average number of stops per vehicle
- Total delay time, including unreleased time (the delay to vehicles trying to enter a congested network)
- Unreleased demand (the number of vehicles trying to enter the road network, but prevented because of congestion).

The above parameters provide a good indication of how the network performs and provides key statistics that can be used to compare scenarios.

Intersection Performance Statistics

The maximum vehicle queue lengths and the average vehicle delay at key intersections have been extracted from the transport models to provide an indication of:

- the impacts of the additional background traffic volumes and traffic generated by the NBH (ie comparison of the base year vs future Do Minimal scenarios)
- the impact of the proposed road upgrade on the traffic conditions (ie comparison of the future year Do Minimal vs the future year Stage 1 Project scenarios).

The above comparisons seek to provide an indication of traffic impacts of the road network associated with the increase in traffic volumes in the Do Minimal scenario, and the potential improvements in the traffic conditions associated with the proposed road upgrades in the Stage 1 scenario.

With regards to the average vehicle delay, the Level of Service (LOS) for the key intersections throughout the study area has been determined based on the following criteria (based on Table 2.4):

- LOS A to D: less than 56 seconds
- LOS E: between 57 seconds and 70 seconds
- LOS F: greater than 70 seconds.

Therefore, where the average vehicle delay at an intersection exceeds 70 seconds, the intersection is considered to be operating over capacity with long delays and queues.

Average Travel Times along Selected Routes

The average travel times along selected routes have been extracted from the relevant model scenarios.
5. Forecast Future Base Traffic and Transport Conditions

5.1 Overview

The transport assessment for this project assumes the NBH would be operational by 2018. As such, the future year base case incorporates both the increase in background traffic volumes and the traffic generated by the NBH. Traffic modelling has been undertaken for the 2018 and 2028 forecast years, respectively corresponding to the anticipated opening year of the proposed NBH, and ten years after opening.

Future Base Scenarios

The future base scenarios included in this assessment incorporate basic access arrangements for the proposed NBH, as well as other anticipated road upgrades not associated with the Concept Proposal or the Stage 1 Project. For purposes of this assessment, these future base scenarios have been denoted as ‘Do Minimal’ scenarios, rather than ‘Do Nothing’ scenarios.

The ‘Do Minimal’ scenarios aim to provide basic access arrangements that would provide the minimum level of additional infrastructure to cater for access to the proposed NBH. These include:

- Provision of a signalised intersection on Frenchs Forest Road West to provide access to/from the hospital.
- Provision of left in/left out ambulance access at Frenchs Forest Road West
- Provision of left in/left out access at Warringah Road/Hilmer Street intersection to provide access to/from the hospital.

As part of the provision of the signalised intersection at the NBH on Frenchs Forest Road West, this intersection would include pedestrian crossings on the northern, southern and western approaches of the intersection.

In addition to the above, the following road upgrades within the study area are assumed to occur separately and have been included in the ‘Do Minimal’ scenarios:

- Grade-separation of the pedestrian crossing across Warringah Road at Starkey Street (currently one of the principal constraints in the corridor during the morning peak)
- Upgrade of the Wakehurst Parkway/Frenchs Forest Road intersection to extend the left turn lane on the northern approach.

As noted in the previous chapter, the term ‘network’ used in presenting the results of the traffic modelling is defined being comprised of the roads and links discussed in Section 4.1 and shown in Figure 4.1.

5.2 Network Performance

5.2.1 2018 Do Minimal Model Results

Table 5.1 and Table 5.2 provide a comparison of the modelling results between the 2012 Base Year scenario and the 2018 Do Minimal scenario for the three hour AM and PM peak periods, respectively.
Table 5.1: Network Performance Results – 2012 Base Scenario vs 2018 Do Minimal Scenario, AM Peak Period

<table>
<thead>
<tr>
<th>Network Measure (3 hours)</th>
<th>2012 Base Year</th>
<th>2018 Do Minimal</th>
<th>Percentage Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total traffic demand (vehicles)</td>
<td>38,734</td>
<td>43,252</td>
<td>+12%</td>
</tr>
<tr>
<td>Number of vehicles that have left the network</td>
<td>35,276</td>
<td>33,837</td>
<td>-4%</td>
</tr>
<tr>
<td>(vehicles)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of vehicles that remain in the network</td>
<td>2,786</td>
<td>3,444</td>
<td>+24%</td>
</tr>
<tr>
<td>(vehicles)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unreleased demand (vehicles)</td>
<td>672</td>
<td>5,971</td>
<td>+789%</td>
</tr>
<tr>
<td>Proportion of vehicles unreleased</td>
<td>2%</td>
<td>14%</td>
<td>-</td>
</tr>
<tr>
<td>Total distance travelled in network (km)</td>
<td>113,676</td>
<td>109,444</td>
<td>-4%</td>
</tr>
<tr>
<td>Total time travelled in network (hr)</td>
<td>5,188</td>
<td>6,393</td>
<td>+23%</td>
</tr>
<tr>
<td>Average speed (km/h)</td>
<td>21.9</td>
<td>17.1</td>
<td>-22%</td>
</tr>
<tr>
<td>Average delay time per vehicle (sec)</td>
<td>320</td>
<td>449</td>
<td>+41%</td>
</tr>
<tr>
<td>Average number of stops per vehicle</td>
<td>5.4</td>
<td>5.7</td>
<td>+6%</td>
</tr>
<tr>
<td>Total delay time including unreleased time (hr)</td>
<td>4,032</td>
<td>8,433</td>
<td>+109%</td>
</tr>
</tbody>
</table>

Source: NBH Roadworks VISSIM Model (GTA, 2014).

Table 5.2: Network Performance Results – 2012 Base Scenario vs 2018 Do Minimal Scenario, PM Peak Period

<table>
<thead>
<tr>
<th>Network Measure (3 hours)</th>
<th>2012 Base Year</th>
<th>2018 Do Minimal</th>
<th>Percentage Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total traffic demand (vehicles)</td>
<td>45,094</td>
<td>49,955</td>
<td>+11%</td>
</tr>
<tr>
<td>Number of vehicles that have left the network</td>
<td>42,034</td>
<td>41,518</td>
<td>-1%</td>
</tr>
<tr>
<td>(vehicles)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of vehicles that remain in the network</td>
<td>2,087</td>
<td>2,435</td>
<td>+17%</td>
</tr>
<tr>
<td>(vehicles)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unreleased demand (vehicles)</td>
<td>973</td>
<td>6,002</td>
<td>+517%</td>
</tr>
<tr>
<td>Proportion of vehicles unreleased</td>
<td>2%</td>
<td>12%</td>
<td>-</td>
</tr>
<tr>
<td>Total distance travelled in network (km)</td>
<td>132,742</td>
<td>129,252</td>
<td>-3%</td>
</tr>
<tr>
<td>Total time travelled in network (hr)</td>
<td>4,681</td>
<td>6,470</td>
<td>+38%</td>
</tr>
<tr>
<td>Average speed (km/h)</td>
<td>28.4</td>
<td>20.0</td>
<td>-30%</td>
</tr>
<tr>
<td>Average delay time per vehicle (sec)</td>
<td>210</td>
<td>360</td>
<td>+71%</td>
</tr>
<tr>
<td>Average number of stops per vehicle</td>
<td>3.6</td>
<td>5.5</td>
<td>+51%</td>
</tr>
<tr>
<td>Total delay time including unreleased time (hr)</td>
<td>3,592</td>
<td>11,226</td>
<td>+213%</td>
</tr>
</tbody>
</table>

Source: NBH Roadworks VISSIM Model (GTA, 2014).

The above results indicate that as traffic volumes increase, congestion levels would also increase resulting in lower average travel speeds, increases in the average delay per vehicle and the average number of stops per vehicle. Average traffic speeds are predicted to be slower by about 22 percent in the AM peak period and by about 30 percent in the PM peak period. The average delay per vehicle is predicted to increase by about 41 percent in the AM peak period and by about 71 percent in the PM peak period.

The modelling predicts that there would be a significant increase in unreleased demand which indicates that the proposed demand exceeds the capacity of the road network and enhancement to the capacity of the road network would be required to cater for the increase in background traffic volumes and traffic generated by the proposed hospital. In the AM peak period, the level of unreleased demand increases from 2 percent of the total demand in the 2012 Base Scenario to 14 percent in the 2018 Do Minimal Scenario, while for the PM peak period, the level of unreleased demand increases from 2 percent of the total demand in the 2012 Base Scenario to 12 percent in the 2018 Do Minimal Scenario.
Without substantial improvements to the road network, there would be extensive queuing along major roads leading into the study area network (Warringah Road, Forest Way, Wakehurst Parkway and Allambie Road) and substantial congestion across the study network.

5.2.2 2028 Do Minimal Model Results

Table 5.3 and Table 5.4 provide a comparison of the modelling results between the 2018 and 2028 Do Minimal scenarios for the three hour AM and PM peak periods, respectively.

Table 5.3: Network Performance Results – 2018 vs 2028 Do Minimal Scenarios, AM Peak Period

<table>
<thead>
<tr>
<th>Network Measure (3 hours)</th>
<th>2018 Do Minimal</th>
<th>2028 Do Minimal</th>
<th>Percentage Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Demand (vehicles)</td>
<td>43,252</td>
<td>45,346</td>
<td>+5%</td>
</tr>
<tr>
<td>Number of vehicles that have left the network (vehicles)</td>
<td>33,837</td>
<td>36,582</td>
<td>+8%</td>
</tr>
<tr>
<td>Number of vehicles that remain in the network (vehicles)</td>
<td>3,444</td>
<td>4,011</td>
<td>+16%</td>
</tr>
<tr>
<td>Unreleased demand (vehicles)</td>
<td>5,971</td>
<td>4,753</td>
<td>-20%</td>
</tr>
<tr>
<td>Proportion of vehicles unreleased</td>
<td>14%</td>
<td>10%</td>
<td>-</td>
</tr>
<tr>
<td>Total distance travelled in network (km)</td>
<td>109,444</td>
<td>116,143</td>
<td>+6%</td>
</tr>
<tr>
<td>Total time travelled in network (hr)</td>
<td>6,393</td>
<td>7,533</td>
<td>+18%</td>
</tr>
<tr>
<td>Average speed (km/h)</td>
<td>17.1</td>
<td>15.4</td>
<td>-10%</td>
</tr>
<tr>
<td>Average delay time per vehicle (sec)</td>
<td>449</td>
<td>503</td>
<td>+12%</td>
</tr>
<tr>
<td>Average number of stops per vehicle</td>
<td>5.7</td>
<td>7.4</td>
<td>+30%</td>
</tr>
<tr>
<td>Total delay time including unreleased time (hr)</td>
<td>8,433</td>
<td>9,132</td>
<td>+8%</td>
</tr>
</tbody>
</table>

Source: NBH Roadworks VISSIM Model (GTA, 2014).

Table 5.4: Network Performance Results – 2018 vs 2028 Do Minimal Scenarios, PM Peak Period

<table>
<thead>
<tr>
<th>Network Measure (3 hours)</th>
<th>2018 Do Minimal</th>
<th>2028 Do Minimal</th>
<th>Percentage Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Demand (vehicles)</td>
<td>49,955</td>
<td>52,025</td>
<td>+4%</td>
</tr>
<tr>
<td>Number of vehicles that have left the network (vehicles)</td>
<td>41,518</td>
<td>39,357</td>
<td>-5%</td>
</tr>
<tr>
<td>Number of vehicles that remain in the network (vehicles)</td>
<td>2,435</td>
<td>3,797</td>
<td>+56%</td>
</tr>
<tr>
<td>Unreleased demand (vehicles)</td>
<td>6,002</td>
<td>8,871</td>
<td>+48%</td>
</tr>
<tr>
<td>Proportion of vehicles unreleased</td>
<td>12%</td>
<td>17%</td>
<td>-</td>
</tr>
<tr>
<td>Total distance travelled in network (km)</td>
<td>129,252</td>
<td>129,531</td>
<td>+0%</td>
</tr>
<tr>
<td>Total time travelled in network (hr)</td>
<td>6,470</td>
<td>7,680</td>
<td>+19%</td>
</tr>
<tr>
<td>Average speed (km/h)</td>
<td>20.0</td>
<td>16.9</td>
<td>-16%</td>
</tr>
<tr>
<td>Average delay time per vehicle (sec)</td>
<td>360</td>
<td>468</td>
<td>+30%</td>
</tr>
<tr>
<td>Average number of stops per vehicle</td>
<td>5.5</td>
<td>6.5</td>
<td>+19%</td>
</tr>
<tr>
<td>Total delay time including unreleased time (hr)</td>
<td>11,226</td>
<td>14,852</td>
<td>+32%</td>
</tr>
</tbody>
</table>

Source: NBH Roadworks VISSIM Model (GTA, 2014).

Between 2018 and 2028, existing levels of traffic congestion is predicted to continue, with a reduction in average travel speeds, and increases in the average delay per vehicle and the average number of stops per vehicle, particularly for the PM peak period with minimal improvements to the transport network.

Average travel speeds are predicted to be 10% slower (from 17 km/h in 2018 to 15 km/h in 2028) in the AM peak period and 16 percent slower (from 20 km/h to 17 km/h) in the PM peak period.

The level of unreleased demand is predicted to reduce during the AM peak period between 2018 and 2028 this is largely due to the redistribution of staff traffic movements away from...
congested areas of the network (refer to discussion provided at Section 4.5). Specifically this is
likely due to the maturing of hospital staff demands being re-aligned slightly with the spare
capacity available in the road network of the precinct.

In the PM peak period, unreleased demand is expected to increase from 12 percent of total
demand in 2018 to about 17 percent of total demand in 2028.

5.3 Intersection Performance

5.3.1 Overview of Intersection Operation

The Level of Service (LOS) for the intersection can be estimated from the average vehicle delay
based on the following criteria (based on Table 2.4):

- LOS A to D: less than 56 seconds
- LOS E: between 57 seconds and 70 seconds
- LOS F: greater than 70 seconds.

Intersections that have an average vehicle delay of greater than 70 seconds (LOS F) are
considered to be operating over capacity with long delays and queues.

The changes in the LOS of the intersections within the immediate study area for the 2012 base
condition and the 2018 and 2028 Do Minimal scenarios are detailed in Table 5.5.

<table>
<thead>
<tr>
<th>Intersection</th>
<th>2012 Base Year</th>
<th>2018 Do Minimal</th>
<th>2028 Do Minimal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warringah Road/ Forest Way</td>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Warringah Road/ Hilmer Street</td>
<td>A-D</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Warringah Road/ Wakehurst Parkway</td>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Warringah Road/ Allambie Road</td>
<td>E</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Warringah Road/ Ellis Road/ Government Road</td>
<td>A-D</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Forest Way/ Adams Street</td>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Forest Way/ Naree Road</td>
<td>A-D</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Frenchs Forest Road West/ Rabbett Street</td>
<td>E</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Frenchs Forest Road West/ Hospital Entrance/ Gladys Avenue</td>
<td>-</td>
<td>A-D</td>
<td>E</td>
</tr>
<tr>
<td>Frenchs Forest Road/ Wakehurst Parkway</td>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Frenchs Forest Road East/ Romford Road</td>
<td>A-D</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Frenchs Forest Road East/ Patanga Road/ Allambie Road</td>
<td>A-D</td>
<td>A-D</td>
<td>A-D</td>
</tr>
</tbody>
</table>

Note: Warringah Road/ Forest Way intersection predicted to operate at LOS F under system-wide network performance
Source: NBH Roadworks VISSIM Model (GTA, 2014).

The LOS data indicates that 4 of the 11 existing intersections in the study area currently operate
with LOS F during either the existing AM or PM peak periods (or both), including 1 of the 4
intersections along Frenchs Forest Road. In 2018 and 2028, 10 of the 12 intersections are
predicted to operate with LOS F in either the future AM or PM peak periods (or both), including 3
of the 5 future intersections along Frenchs Forest Road.

The above information indicates that most of the intersections along Frenchs Forest Road and all
the intersections along the section of Warringah Road and Forest Way are predicted to operate
at LOS F in either the future AM or PM peak periods (or both). This indicates that vehicles
traversing these intersections would likely encounter congested conditions, with significant delays
and long queues. It is predicted that access to the NBH would become increasingly difficult as the performance of the adjacent intersections deteriorate.

5.3.2 Do Minimal Short-term (2018) LOS and Average Delay

The forecast intersection average delays and LOS for the AM and PM peak periods for the 2018 Do Minimal scenario are illustrated graphically in Figure 5.1 and Figure 5.2.

Figure 5.1: Do Minimal Project Intersection Delays – AM Peak Period 2018

Source: NBH Roadworks VISSIM Model (GTA, 2014).
The data indicates that the majority of intersections within the study area are predicted to operate with significant delays during the AM peak hour. Examination of the two illustrations indicate that the road network is predicted to operate better during the PM peak hour with better intersection LOS and reduced delays compared to the AM peak hour.

As detailed in Section 0, the following intersections currently operate at LOS F in the 2012 base year model, during either the AM or PM peak periods (or both):

- Forest Way/ Adams Street
- Forest Way/ Warringah Road
- Wakehurst Parkway/ Frenchs Forest Road
- Wakehurst Parkway/ Warringah Road.

By 2018, the following additional intersections are predicted to operate at LOS F in either the AM or PM peak period (or both), compared to the 2012 base year conditions:

- Forest Way/ Naree Road
- Frenchs Forest Road West/ Naree Road/ Rabbett Street
- Frenchs Forrest Road East/ Romford Road
- Warringah Road/ Hilmer Street
- Warringah Road/ Allambie Road
- Warringah Road/ Ellis Road/ Government Road.

The four intersections operating at LOS F in the 2012 base year model would continue to operate at LOS F in the 2018 Do Minimal scenario.

5.3.3 Long-term (2028) LOS and Average Delay with Do Minimal and Stage 1 Project

The forecast intersection average delays and LOS for the AM and PM peak periods for the 2028 Do Minimal scenario are illustrated graphically in Figure 5.3 and Figure 5.4.
The data indicates that minimal change in intersection operation and delays is predicted during the AM peak hour between 2018 and 2028, noting that the majority of intersections are already operating with LOS F in 2018.
Further deterioration of the intersection operation and increased delays are predicted during the PM peak hour between 2018 and 2028, with the number of intersections within the study area operating with a LOS F increasing from 4 to 7.

It is noted that the Frenchs Forest Road West/ Hospital Entrance/ Gladys Avenue intersection is predicted to operate with a LOS E during the PM peak hour in 2028.

Access to the NBH would become increasingly difficult as the performance of the adjacent intersections continue to deteriorate.

5.4 Travel Speed Comparison

The average vehicle travel times along selected routes have been extracted from the relevant model scenarios and converted to average vehicle speeds for ease of comparison.

The following three routes have been used in this analysis:
- Route 1: Warringah Road (between Government Road and Laurel Chase)
- Route 2: Forest Way (Bowman Avenue) to Warringah Road (Government Road) – via Frenchs Forest Road
- Route 3: Forest Way (Bowman Avenue) to Wakehurst Parkway (at overhead footbridge south of Warringah Road) – via Warringah Road.

The above three travel time routes are illustrated in Figure 5.5.

Figure 5.5: Travel Time Routes used for Comparative Assessment of Do Minimal Scenarios

The travel time results have been assessed for both directions (ie eastbound and westbound) for the AM and PM peak periods.

The average speed for the three routes for the 7–8am and 4–5pm peak hour for the 2018 and 2028 Do Minimal scenarios are provided in Table 5.6.
### Table 5.6: Average Vehicle Speeds (km/h) – 2018 vs 2028 Do Minimal Scenario

<table>
<thead>
<tr>
<th>Route</th>
<th>Direction</th>
<th>7–8am Peak Hour</th>
<th>4–5pm Peak Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2018</td>
<td>2028</td>
</tr>
<tr>
<td>Route 1: Warringah Road</td>
<td>Eastbound</td>
<td>31</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>Westbound</td>
<td>23</td>
<td>13</td>
</tr>
<tr>
<td>Route 2: Forest Way-Warringah Road</td>
<td>Eastbound</td>
<td>17</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Westbound</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Route 3: Forest Way-Wakehurst Parkway South</td>
<td>Northbound</td>
<td>14</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Southbound</td>
<td>13</td>
<td>12</td>
</tr>
</tbody>
</table>

Source: NBH Roadworks VISSIM Model (GTA, 2014).

Between 2018 and 2028, the average vehicle speeds along these routes are generally predicted to reduce or remain relatively stable. Although traffic volumes are predicted to increase over this 10 year period, high congestion levels on the road network surrounding the study area are likely to prevent significant reduction in the average travel speed on vehicles along these routes.

### 5.5 Other Operational Impacts

#### 5.5.1 Public Transport

As part of the proposed increases in public transport across the Northern Beaches, Transport for NSW is proposing to modify the bus routes within the study area and provide more frequent services for these routes in the AM and PM peak periods. The key changes relevant to this study include additional bus services along Frenchs Forest Road, with these changes documented in Section 4.6.

To assess the changes in bus travel times along Frenchs Forest Road (between Rabbett Street and Allambie Road), the bus travel times have been extracted from the model and converted to an average travel speed for comparison purposes.

The average speed for the bus route for the 7–8am and 4–5pm peak hour for the 2018 and 2028 Do Minimal scenarios are provided in Table 5.7.

### Table 5.7: Average Bus Speed (km/h) – 2018 vs 2028 Do Minimal Scenario

<table>
<thead>
<tr>
<th>Route</th>
<th>Direction</th>
<th>7–8am Peak Hour</th>
<th>4–5pm Peak Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2018</td>
<td>2028</td>
</tr>
<tr>
<td>Frenchs Forest Road</td>
<td>Eastbound</td>
<td>11.6</td>
<td>10.4</td>
</tr>
<tr>
<td></td>
<td>Westbound</td>
<td>8.8</td>
<td>9.5</td>
</tr>
</tbody>
</table>

Source: NBH Roadworks VISSIM Model (GTA, 2014).

The above results illustrate that the buses are predicted to operate at between 8 km/h and 15 km/h without any improvements to the road network. In addition there would be significant delays for buses turning right from Forest Road into Naree Road as this intersection is not signalised in the Do Minimal scenario.

Frenchs Forest Road has been designated as ‘Suburban’, medium-level regional bus corridor in Sydney’s Bus Future (TfNSW, 2013) strategy. The document proposes an incremental approach to bus priority aimed at developing an eventual Bus Rapid Transit (BRT) concept linking Chatswood and Dee Why via Warringah Road. For the short and medium term, Transport for NSW has designated a target average route operating speed of between 18 km/h and 25 km/h for buses. The future bus speeds fall well short of the target speeds of 18 km/h to 25 km/h set by TfNSW.
5.5.2 Road Safety

The analysis of the historic crash data (refer to Section 2.12) indicates that while crashes occur throughout the study area, they are also relatively concentrated at the intersections.

With traffic volumes and congestion expected to continue to increase, crash rates could also be expected to increase. Without improvements to the road network, the following crash types would be expected to continue:

- rear-end collisions
- turning movements at unsignalised intersections
- pedestrians crossing away from dedicated pedestrian infrastructure (i.e. signalised intersections).

Components of the Stage 1 Project such as the longer turn bays and additional signalised pedestrian crossings would contribute towards reducing the risk factors associated with the crash types observed in the study area.

5.5.3 Walking and Cycling

Statistics for the Forest District indicate the mode share for active transport modes of walking and cycling is relatively low at between two per cent and four per cent of Journey to Work trips (2006 Census by ABS).

There are more or less continuous footpaths on roads in the study area. Signalised pedestrian crossings are provided on Warringah Road and Wakehurst Parkway intersection and at the Wakehurst Parkway and Frenchs Forest Road intersection. There are no formal bicycle routes immediately adjacent to the hospital site.

Active transport modes are potentially important to the hospital precinct as forecasts indicate about 14 percent of workers will eventually reside in surrounding areas within the walking and cycling catchment of the NBH. Improvements to infrastructure for active transport modes could be an effective strategy to help manage traffic growth.

5.6 Summary of Forecast Travel Conditions

5.6.1 Traffic Conditions

Increased levels of population and employment across the Northern Beaches are expected to result in increased background traffic volumes within the precinct. The North East Subregional Strategy indicates a 15 percent increase in population (an additional 40,000 people by 2036 on top of the current 238,000 population level) and a 26 percent increase in employment (an additional 23,000 jobs by 2036 on top of the current 89,000 jobs). The majority of the employment growth is expected to occur at North Sydney, Chatswood and Dee Why/Brookvale.

In addition to the above background traffic growth, the proposed NBH is forecast to add about 900 vehicles in the AM peak hour (8–9am) as well as in the PM peak hour (5–6pm). The traffic generation of the hospital varies throughout the day, associated with the arrival and departure of patients, visitors and deliveries.

Vehicular access to the NBH is proposed via Frenchs Forest Road West and Warringah Road. To facilitate access to the NBH, existing turning restrictions at some key intersections, currently necessary for traffic management reasons, are required to be removed. The traffic generation of the NBH and anticipated intensification of the surrounding employment areas (including the
Frenchs Forest business park district) is forecast to significantly contribute to increased traffic congestion levels.

5.6.2 Network Performance

As a result of background traffic growth and the proposed NBH, traffic volumes in the 3 hour AM and PM peak periods are forecast to increase by 12 percent and 11 percent respectively between 2012 and 2018. By 2028, traffic volumes are forecast to increase by a further 5 percent in the AM peak period and 4 percent in the PM peak period.

As traffic volumes increase, congestion levels could also increase significantly, resulting in lower average travel speeds and an increase in the average delay per vehicle.

For example, during the AM peak period, the average travel speed is predicted to reduce by 22 percent (from 22 km/h in 2012 to 17 km/h in 2018) and the average delay per vehicle is predicted to increase by about 41 percent (from about 5 ½ minutes in 2012 to 7 ½ minutes in 2018). Whist during the PM peak period, the average travel speed is predicted to reduce by 30 percent (from 28 km/h in 2012 to 20 km/h in 2018) and the average delay per vehicle is predicted to increase by about 71 percent (from 3 ½ minutes in 2012 to 6 minutes in 2018). The level of unreleased demand (vehicles queued up on the periphery due to insufficient road capacity to enter the network) in the AM peak period is about 14 percent and in the PM peak period is about 17 percent of the total demand in the 2018. This reflects a road network with significantly overloaded conditions.

The average speed and total travel time for the 2012 base year and the 2018 and 2028 Do Minimal scenarios are illustrated in Figure 5.6 and Figure 5.7.

With regards to the performance of individual intersections, the majority of the signalised intersections within the study area are predicted to operate at LOS F in 2018 and 2028, in either the AM or PM peak periods. The two exceptions are the Frenchs Forest Road East/ Patanga Road/ Allambie Road intersection and the Frenchs Forest Road West/ NBH/ Gladys Road intersection.

Figure 5.6: Comparison of Average Speeds, km/h

![Comparison of Average Speeds, km/h](image)

Source: NBH Roadworks VISSIM Model [GTA, 2014].
The transport modelling of the forecast base case conditions indicates that a considerable increase in network capacity will be required to maintain, let alone improve, existing service levels given critical intersections are currently operating at or over their effective capacity and that the proposed land use changes will exacerbate these conditions. In addition, the modelled unreleased demand would indicate more pressure placed on local streets subject to the current ‘rat running’.

5.6.3 Public Transport Operations

Buses presently operate in mixed traffic on Warringah Road and the resultant slow progress of buses is one of the contributors to low take-up of public transport, contributing to higher private car use, and further worsening travel conditions.

Warringah Road and Frenchs Forest Road have been designated as ‘Suburban’, medium-level regional bus corridor in Sydney’s Bus Future (TfNSW, 2013) strategy. The document proposes an incremental approach to bus priority aimed at developing an eventual Bus Rapid Transit (BRT) concept linking Chatswood and Dee Why via Warringah Road. For the short and medium term, Transport for NSW has designated a target average route operating speed of between 18 km/h and 25 km/h for buses.

The modelling indicates that the proposed bus routes along Frenchs Forest Road are predicted to operate with an average speed of between 9 km/h and 15 km/h during the peak periods. This is significantly lower than the target average operating speed of between 18 km/h and 25 km/h which Transport for NSW is seeking to achieve along the corridor.

To improve operating conditions for buses and support the intended service level increases, intersection-based bus priority treatments and mid-block interventions are likely to be required.
5.6.4 Walking and Cycling

Infrastructure for pedestrians, and particularly cyclists, is also deficient in places and take-up is very low. However, active transport modes are potentially important to the hospital precinct as forecasts indicate about 20 percent of workers will eventually reside in surrounding areas within the walking and cycling catchment of the NBH. Improvements to infrastructure for active transport modes could be an effective strategy to help manage traffic growth.
6. **Transport Impacts of Concept Proposal**

6.1 **Overview**

The strategic design of the Northern Beaches Hospital Connectivity and Network Enhancement Project in its entirety – referred to in this EIS as the Concept Proposal, broadly includes the following:

- Widening, intersection upgrades, new signalised intersections and potential changes to access along sections of Forest Way, Naree Road, Frenchs Forest Road West, Wakehurst Parkway, Frenchs Forest Road East, Allambie Road and Warringah Road (the Stage 1 Project).
- Widening and upgrades along Warringah Road to increase capacity and to enable through traffic to avoid signalised intersections at Forest Way, Hilmer Street and Wakehurst Parkway through grade separation of intersections (future Stage 2 Project).
- Potential traffic management measures along other roads (including kerbside parking management, bus lanes, turn restrictions, altered access arrangements and the like).

While the Stage 1 Connectivity Works are required to be constructed to provide adequate connectivity to the NBH by 2018, the remainder of the infrastructure is directed towards broader network capacity enhancement (Network Enhancement Works). These works have been identified at a strategic level and have only been developed as a concept proposal at this time.

**Need for Network Enhancement Works**

As a result of background traffic growth and the proposed NBH, traffic volumes in the 3 hour AM and PM peak periods are forecast to increase by 12 percent and 11 percent respectively between 2012 and 2018. By 2028, traffic volumes are forecast to increase by a further 5 percent in the AM peak period and 4 percent in the PM peak period.

The analysis of the existing conditions indicates that some intersections currently operate in oversaturated conditions (LOS F), and the predicted increase in traffic volumes would only increase the level of congestion within the study area.

The analysis of the Stage 1 Connectivity Works (refer to Chapter 7) indicates that the proposed road upgrades are expected to ameliorate the congestion to some extent. However, some of the intersections within the study area will still likely operate at LOS F. Therefore, this analysis details the need for further capacity improvements within the study area.

6.2 **Network Performance**

Whist the Network Enhancement Works are only at a concept level, traffic modelling analysis has previously been undertaken for Roads and Maritime as part of the Option Development phase.

A summary of the changes in the network performance predicted with the provision of the Concept Proposal (Stage 1 Connectivity Works and the Stage 2 Network Enhancement Works) are provided in the following section. This assessment has been undertaken for the years 2021 (year of opening of Concept Proposal) and 2036 (assessment period for Concept Proposal). As indicated previously, this modelling was only undertaken for a two hour AM and PM peak period (7–9am and 4–6pm).
6.2.1 Year 2021

Table 6.1 provides a comparison of the modelling results between the Concept Proposal and Do Minimal scenarios for the 2021 AM and PM peak two hour models.

<table>
<thead>
<tr>
<th>Network Measure</th>
<th>Change in AM Peak Period</th>
<th>Change in PM Peak Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average speed (km/h)</td>
<td>73%</td>
<td>67%</td>
</tr>
<tr>
<td>Average delay time per vehicle</td>
<td>-72%</td>
<td>-79%</td>
</tr>
<tr>
<td>Average number of stops per vehicle</td>
<td>-51%</td>
<td>-55%</td>
</tr>
<tr>
<td>Total delay time including unreleased time (hr)</td>
<td>-69%</td>
<td>-77%</td>
</tr>
<tr>
<td>Unreleased demand (vehicles)</td>
<td>-97%</td>
<td>-98%</td>
</tr>
</tbody>
</table>

Source: TMA/HRA.

The above results indicate that with the proposed road upgrades associated with the Concept Proposal, the network performance statistics illustrate significant improvements in the AM and PM peak periods. These improvements include:

- increase in average vehicle speed
- reduction in average delay time per vehicle
- reduction in the average number of stops per vehicle
- significant reduction in the proportion of unreleased traffic, which are waiting to enter the model due to congestion.

6.2.2 Year 2036

The modelling undertaken for the 2036 Do Minimal scenario indicates that the network would be virtually grid-locked characterised by congestion bottlenecks widespread throughout the study area. The analysis reveals that due to the widespread congestion, only 5 percent and 11 percent of traffic complete their journey in the AM and PM peak periods respectively. This would indicate that the remainder of the trips are either still in the modelled study area or waiting to enter the model network due to congestion.

The modelling results indicate that the network would require major capacity improvements into the year 2036, and the Stage 1 Project would be the minimum that needs to be implemented in the precinct to address future congestion issues.

For the purposes of determining the benefits of the Concept Proposal in 2036, a comparison against the Stage 1 Project analysis can be undertaken to provide an indication of the potential improvements in traffic performance.

Table 6.2 provides a comparison of the modelling results between the Concept Proposal and Stage 1 Project for the 2036 AM and PM peak two hour models.
### Table 6.2: Network Performance Results – Concept Proposal vs Stage 1 Project Scenario (2036)

<table>
<thead>
<tr>
<th>Network Measure</th>
<th>Change in AM peak period</th>
<th>Change in PM Peak Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average speed [km/h]</td>
<td>12%</td>
<td>22%</td>
</tr>
<tr>
<td>Average delay time per vehicle</td>
<td>-15%</td>
<td>-30%</td>
</tr>
<tr>
<td>Average number of stops per vehicle</td>
<td>-20%</td>
<td>-26%</td>
</tr>
<tr>
<td>Total delay time including unreleased time (hr)</td>
<td>-16%</td>
<td>-31%</td>
</tr>
<tr>
<td>Unreleased demand (vehicles)</td>
<td>-7%</td>
<td>-60%</td>
</tr>
</tbody>
</table>

Source: TMA/HRA.

The above results indicate that with the proposed road upgrades associated with the Concept Proposal, the network performance statistics illustrate improvements in the AM and PM peak periods, compared to the Stage 1 Project scenario. These improvements include:

- Increase in average vehicle speed
- Reduction in average delay time per vehicle
- Reduction in the average number of stops per vehicle
- Reduction in the proportion of unreleased traffic (in the PM peak period), which are waiting to enter the model due to congestion.

#### 6.3 Regional Impacts

##### 6.3.1 Induced Demand

The modelling results provided in Chapter 5 indicate that without any mitigation measures, approximately 17 percent of the traffic demand in the 2018 PM peak period would be unable to enter the modelled study area at the end of the three hour peak period. This indicates the existing road network is unable to accommodate the predicted increase in background traffic volumes and additional traffic generated by the NBH.

While the infrastructure upgrade proposed as part of Stage 1 Project will assist in alleviating the congestion, the additional infrastructure proposed as part of the Concept Proposal is expected to be required to mitigate the impacts of the NBH, once the NBH reaches its maximum capacity as detailed in the EIS prepared for NSW Health Infrastructure – Northern Beaches Hospital State Significant Infrastructure (SSI) Application – Environmental Impact Statement for Stage 1 including Concept Design, Site Clearance & Preparatory Works (NSW Health Infrastructure, October 2013).

As the design of the Concept Proposal has been developed to accommodate the predicted increase in background traffic volumes and likely additional traffic generated by the NBH, it is not expected that there will be excess road capacity during the AM and PM peak periods. However, as traffic volumes are lower during the off-peak periods, there could be some spare road capacity outside the peak periods.

As such, the provision of the Concept Proposal may result in improved travel times along the Warringah Road corridor in the off peak periods, compared to alternative routes such as Mona Vale Road (about 8 km to the north of Warringah Road) and Spit Road (about 6 km to the south of the Warringah Road).

While it is not expected that these travel time improvements would be sufficient to result in a significant change in the regional travel patterns, there may be situations where motorists travel between locations that are situated between these competing routes (i.e., between Killara and Narrabeen or between Northbridge and Manly). For these motorists, if the travel time between
the Warringah Road and the alternative route (Mona Vale Road or Spit Road) was similar, the Concept Proposal may result in some motorists selecting to use the Warringah Road corridor instead of the alternative route. If this was to occur, the Concept Proposal may result in a minor reduction in traffic volumes using the alternative competing route (Mona Vale Road or Spit Road) and an associated increase in traffic volumes on the Warringah Road corridor.

6.3.2 Impacts to Regional Road Network

RMS has provided analysis of traffic volumes out of their strategic model with and without the Concept Proposal for the AM peak period in 2021 and 2036. It is noted that whilst the traffic volume forecasts incorporate the road network upgrades associated with the Concept proposal they do not strictly include the additional traffic generation anticipated from the NBH itself.

The Northern Beaches are serviced by three main road connections, as follows:

i. Warringah Road (Project Study Area)
ii. Mona Vale Road (about 8 km to the north of Warringah Road)
iii. Spit Road (about 6 km to the south of the Warringah Road)

The forecast AM peak period traffic volumes for each of these links has been extracted from the RMS strategic model for the scenarios with and without the Concept Proposal. The percentage difference for each of the links between each scenario is provided in Table 6.3.

<table>
<thead>
<tr>
<th>Road Link</th>
<th>AM Peak Period Traffic Volume Percentage Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2021</td>
</tr>
<tr>
<td>Warringah Road</td>
<td>+3%</td>
</tr>
<tr>
<td>Mona Vale Road</td>
<td>-1%</td>
</tr>
<tr>
<td>Spit Road</td>
<td>-2%</td>
</tr>
</tbody>
</table>

Table 6.3 indicates that with the Concept Proposal the AM peak period traffic volumes on Warringah Road are predicted to increase only by 3 percent and 4 percent in 2021 and 2036, respectively. These very slight increases in traffic appear to result from similarly slight diversions from Mona Vale Road and Spit Road, across the Middle Harbour Screenline.

The above assessment however does not include the additional traffic generated by the NBH. In effect, the provision of the Concept Proposal is not expected to provide excess road capacity during the AM and PM peak period but rather accommodate the additional traffic demands generated by the NBH and background growth.

However, as traffic volumes are typically lower during the off-peak periods, there may be spare road capacity outside the peak periods.

During the off-peak periods, the predicted improved travel times along the Warringah Road corridor may result in a potential shift in traffic volumes from competing alternative routes such as Mona Vale Road (about 8 km to the north of Warringah Road) and Spit Road (about 6 km to the south of the Warringah Road).

For example, there may be situations where motorists travel between locations that are situated between these competing routes (ie between Killara and Narrabeen or between Northbridge and Manly). For these motorists, if the travel time between the Warringah Road and the alternative route (Mona Vale Road or Spit Road) was similar, the Concept Proposal may result in some motorists selecting to use the Warringah Road corridor instead of the alternative route. If this was to occur, the Concept Proposal may result in a minor reduction in traffic volumes using the
alternative competing route (Mona Vale Road or Spit Road) and an associated increase in traffic volumes on the Warringah Road corridor outside of peak periods.

6.4 Intersection Performance and Travel Time Comparison

To assess the performance of individual intersections and the predicted travel times along specific corridors, a more detailed definition of the intersection layout needs to be developed (ie number of lanes, turn bay lengths). As such, the individual intersection performance statistics and vehicle speed information under the Stage 2 Network Enhancement Works will be assessed as part of the Stage 2 Project EIS.

With the provision of the Concept Proposal, the average travel speed for vehicles travelling along Warringah Road (from west of Forest Way to east of Allambie Road) would be expected to improve due to the grade-separation of the two Forest Way and Wakehurst Parkway intersections along Warringah Road. In addition, with the grade-separation of these intersections, there would be a reduction in traffic volumes on the surface road network, with an associated improvement in performance of the surface intersections.

It should be noted that there is the assumption that the Warringah Road/Starkey Street intersection capacity improvement has been undertaken to remove a crucial bottleneck on the corridor.

Further detailed traffic modelling of the Concept Design will be separately undertaken as part of the EIS for the Stage 2 Network Enhancement Works.

6.5 Other Operational Impacts

6.5.1 Public Transport

Public Transport Operations

The Concept Proposal would contribute positively towards overall objectives of making public transport more attractive. Components of the Concept Proposal incorporate bus priority measures (eg changes to existing facilities at the Wakehurst Parkway/Frenchs Forest Road intersection) and consideration of bus operations in the overall concept design, including exemptions to buses for certain restrictions in turning manoeuvres (eg right turn from southbound Patanga Road to Frenchs Forest Road).

Transport for NSW has a designated target average route speed of 18-25 km/h for the Frenchs Forest Road corridor. The analysis of the Stage 1 Connectivity Works indicate that buses are predicted to operate along Frenchs Forest Road at a speed of up to 12 km/h in the AM and PM peak periods.

With the Stage 2 Network Enhancement Works, the following are predicted to improve bus travel times along Frenchs Forest Road:

- widening of Warringah Road is predicted to result in a potential diversion of traffic volumes from the Frenchs Forest Road corridor
- potential changes to the operation of the Wakehurst Parkway/ Frenchs Forest Road intersection may result in reduced intersection delays for east-west movements on Frenchs Forest Road.

Based on the above, it is expected that the Stage 2 Network Enhancement Works would result in improved bus travel times along the Frenchs Forest Road corridor.
Public Transport Mode Shift

With the Concept Proposal, the additional road capacity is expected to reduce vehicle travel times and increase travel speeds through the precinct when compared to the Do Minimal scenario (refer Table 6.1). In 2021, average speeds throughout the modelled network are anticipated to increase by 73 percent in the AM peak and 67 percent in the PM peak when the Concept Proposal is operating.

As part of the Project, bus lanes and other bus priority measures are also proposed to improve bus travel times, particularly for the Frenchs Forest Road corridor.

In this manner, the anticipated improvements to vehicle travel speeds with the Concept Proposal would also apply to public transport operations, and as such, it is not considered that the Concept Proposal would result in a mode shift from public transport to private transport modes.

On the other hand, public transport programs that are currently being investigated by others (e.g., the Northern Beaches Bus Rapid Transit) could further contribute towards corridor-wide public transport priority measures that would bring travel time benefits to public transport modes in the region as a whole.

6.5.2 Pedestrians and Cyclists

There are more or less continuous footpaths on roads in the study area. Signalised pedestrian crossings are provided on Warringah Road and Wakehurst Parkway intersection and at the Wakehurst Parkway and Frenchs Forest Road intersection. There are no formal bicycle routes immediately adjacent to the hospital site.

Although the ability to improve the active transport catchment potential of the Northern Beaches Hospital Precinct largely depends on the wider intensified redevelopment of the area, active transport modes are potentially important to the hospital precinct as forecasts indicate about 14 percent of workers will eventually reside in surrounding areas within the walking and cycling catchment of the NBH. As improvements to infrastructure for active transport modes could be an effective strategy to help manage traffic growth, some active transport access improvements have been integrated into the concept design of the proposed intersection upgrades, to support a shift to active transport modes.

Pedestrian Infrastructure

As part of the Stage 1 Connectivity Works, a 1.5 m-wide concrete footpath would be provided along the northern side of Naree Road and Frenchs Forest Road between Forest Way and Warringah Road, and along the southern side of Frenchs Forest Road between Wakehurst Parkway and Warringah Road. In addition, there would be a 3.5 m-wide concrete footpath along the southern side of Naree Road and Frenchs Forest Road between Forest Way and Wakehurst Parkway. The Stage 1 Connectivity Works also includes the provision of pedestrian crossings as part of the upgrading and signalisation of intersections within the study area. The locations of these proposed footpaths and intersection upgrades are illustrated in Figure 6.1.

The provision of a continuous footpath on the northern and southern side of Naree Road/Frenchs Forest Road, between Forest Way and Wakehurst Parkway, and the provision of pedestrian crossings as part of the upgrading and signalisation of intersections within the study area will provide a safe pedestrian facility for local residents, students and teachers at the Forest High School, and employees and visitors to the NBH and the various businesses along the corridor. The proposed signalisation of the Forest Way/Naree Road intersection will also provide a safe...
pedestrian crossing for local residents and students accessing the Forestway Shopping Centre and/or the bus stop on Forest Way outside the shopping centre.

These facilities will improve connectivity between the key activity nodes within the study area including the residential catchment on the northern side of Naree Road/ Frenchs Forest Road, Forestway Shopping Centre, the Forest High School, the NBH, the various businesses along Frenchs Forest Road East and the Skyline shops.

As part of the Concept Proposal, a concrete footpath would be provided on the southern side of Warringah Road between Rodborough Road in the east to Maxwell Parade in the west. In addition, the upgrade to Warringah Road would also include the provision of pedestrian crossings as part of the upgrading the Warringah Road/ Hilmer Street/ NBH access and Warringah Road/ Wakehurst Parkway intersection. In particular, the upgrade of the Warringah Road/ Wakehurst Parkway intersection would seek to provide pedestrian crossings on all approaches, addressing the existing deficiency on the western side of the intersection.

The provision of the continuous footpath along the southern side of Warringah Road and the improved pedestrian connectivity at the Warringah Road/ Hilmer Street/ NBH access and Warringah Road/ Wakehurst Parkway intersection will provide improved connectivity between the key activity nodes within the study area including the residential catchments at each end of the study area, Forestway Shopping Centre, the Forest High School, the NBH, and the various businesses along Frenchs Forest Road East and Warringah Road.
Figure 6.1: Proposed Footpaths

In addition, two pedestrian/cyclist overpasses are proposed as part of the Concept Proposal:

- Replacement of the existing overpass on the western side of the Warringah Road/Forest Way intersection
- Provision of a proposed overpass on the western side of the Warringah Road/Hilmer Street intersection.

These facilities will provide improved connectivity between the key activity nodes within the study area including the residential catchments at each end of the study area, Forestway Shopping Centre, the Forest High School, the NBH, the various businesses along Frenchs Forest Road East and Warringah Road.

**Cycle Infrastructure**

There are limited bicycle facilities on, or traversing, the existing road network of the Stage 1 Project. Proposed on-road bicycle routes as identified in the Warringah Bike Plan (Warringah Council, 2014) include Rabbett Street (traversing Frenchs Forest Road West), Wakehurst Parkway, Allambie Road (north of Warringah Road), Patanga Road and Warringah Road (east of Allambie Road).

The 3.5m concrete footpath along Naree Road and Frenchs Forest Road West cannot be considered as a shared path due to excessive vertical grades reaching 15 percent in some locations. It is proposed to provide an off-street shared path along Warringah Road between Forest Way and Allambie Road as part of Stage 2 of the project. This would tie in at either end with shared paths proposed by Warringah Council. As part of the provision of this off-street shared path, where the shared path crosses at signalised intersections, modifying the traffic signals to incorporate bicycle signals will be considered.

The proposed off-street shared path along Warringah Road will provide improved connectivity between the key activity nodes within the study area including the residential catchments at each end of the study area, Forestway Shopping Centre, the Forest High School, and the various businesses along Frenchs Forest Road East and Warringah Road.

As part of detailed design process for the Stage 1 Project, Roads and Maritime would investigate options to provide shared paths (being off-road cycleway and pedestrian footpath) aiming to connect with the existing or proposed cycleways indicated on the Warringah Bike Plan (refer to Figure 2.20). Investigation into the provision of shared paths (including off-road cycleways) would be undertaken at the following locations:

- Forest Way from Naree Road to about 170 metres north of Warringah Road
- Wakehurst Parkway between Frenches Forest Road East and Warringah Road
- Frenchs Forest Road East between the intersection of Wakehurst Parkway and Allambie Road
- Patanga Road between Frenchs Forest Road East and the existing Council cycleway
- Allambie Road between Warringah Road and Frenchs Forest Road East.

Where cycleways are provided as part of a shared path network, Roads and Maritime would consider modifying the traffic signals to incorporate bicycle signals at these pedestrian crossings. In addition, due to the proximity of the existing cycle path to the proposed Frenchs Forest Road/Patanga Road/Allambie Road intersection, Roads and Maritime would consider modifying the traffic signals to incorporate bicycle signals at this intersection.

The provision of the shared paths (including off-road cycleways) proposed to be investigated would provide a safe route and improved connectivity between the key activity nodes including various residential areas across the study area, Forestway Shopping Centre, the Forest High School, Forest High.
School, NBH and various businesses along these corridors. The provision of a bicycle signal at these intersections would provide a safe crossing for cyclists at these locations who use these proposed paths. At the Frenchs Forest Road/ Patanga Road/ Allambie Road intersection, the provision of a bicycle signal at this intersection would provide a safe crossing for cyclists who use the existing cycle path and would improve connectivity between the residential catchment north of Frenchs Forest Road East and the various businesses along the southern side of Frenchs Forest Road.

6.6 Summary of Impacts and Benefits

The Concept Proposal addresses the transport task and required access improvements arising from background growth in transport demand. It provides overall transport network benefits accruing to the wider community, beyond those addressing the access and movement requirements of the proposed Northern Beaches Hospital.

These include:

- **Positive impacts**
  - Increases in through traffic capacity as part of the Concept Proposal
  - Proposed bus priority measures that would benefit public transport customers in the wider precinct in general, not just those accessing the proposed Northern Beaches Hospital. These would include those using public transport to access jobs and activities within and outside the precinct, as well as present and future school children using school buses.
  - Improved pedestrian and connectivity across the study area, in particular between key activity nodes including the residential catchment at the edges of the study area, Forestway Shopping Centre, the Forest High School, the NBH, the various businesses along Frenchs Forest Road East and Warringah Road, and the Skyline shops.

- **Negative impacts**
  - Increases traffic volumes across the wider study area, which may result in additional congestion where these intersections are not proposed to be upgraded as part of the Concept Proposal
  - Increased traffic volumes in the vicinity of The Forest High School and NBH may result in potential road safety risks for students and hospital users.
7. Transport Impacts of Stage 1 Connectivity Works

7.1 Overview

The Stage 1 Connectivity Works have been proposed in order to address the anticipated transport and traffic problems identified in Chapter 5. The proposed road upgrades associated with the Stage 1 Connectivity Works are illustrated in Figure 1.2.

The major changes to the road network are summarised below:

- widening of Naree Road, Frenchs Forest Road West and Frenchs Forest Road East between Forest Way and Allambie Road
- widening of Warringah Road between Allambie Road and Government Road
- upgrade of the following intersections:
  - Forest Way/Naree Road
  - Naree Road/Frenchs Forest Road West/Rabbett Street
  - Wakehurst Parkway/Frenchs Forest Road East/Frenchs Forest Road West
  - Frenchs Forest Road East/Romford Road
  - Frenchs Forest Road East/Patanga Road/Allambie Road
  - Warringah Road/Allambie Road.

As indicated in Chapter 5, the provision of a signalised intersection on Frenchs Forest Road West to provide access to the NBH was included in the Do Minimal scenario.

As part of the upgrades to the above intersections, these signalised intersections would also provide improved pedestrian connectivity for the study area.

7.2 Network Performance

7.2.1 2018 Stage 1 Project Model Results

Table 7.1 and Table 7.2 provide a comparison of the modelling results between the Stage 1 Project and the Do Minimal scenarios for the 2018 AM and PM peak three hour models, respectively.
Table 7.1: Network Performance Results – 2018 Stage 1 Project vs Do Minimal Scenario (AM Peak Period)

<table>
<thead>
<tr>
<th>Network Measure (3 hours)</th>
<th>2018 AM Peak Period (Do Minimal)</th>
<th>2018 AM Peak Period (Stage 1 Project)</th>
<th>Percentage Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total traffic demand (vehicles)</td>
<td>43,252</td>
<td>43,283</td>
<td>+0%</td>
</tr>
<tr>
<td>Number of vehicles that have left the network (vehicles)</td>
<td>33,837</td>
<td>36,265</td>
<td>+7%</td>
</tr>
<tr>
<td>Number of vehicles that remain in the network (vehicles)</td>
<td>3,444</td>
<td>2,950</td>
<td>-14%</td>
</tr>
<tr>
<td>Unreleased demand (vehicles)</td>
<td>5,971</td>
<td>4,068</td>
<td>-32%</td>
</tr>
<tr>
<td>Proportion of vehicles unreleased</td>
<td>14%</td>
<td>9%</td>
<td>-</td>
</tr>
<tr>
<td>Total distance travelled in network (km)</td>
<td>109,444</td>
<td>117,829</td>
<td>+8%</td>
</tr>
<tr>
<td>Total time travelled in network (hr)</td>
<td>6,393</td>
<td>5,455</td>
<td>-15%</td>
</tr>
<tr>
<td>Average speed (km/h)</td>
<td>17.1</td>
<td>21.6</td>
<td>+26%</td>
</tr>
<tr>
<td>Average delay time per vehicle (sec)</td>
<td>449</td>
<td>327</td>
<td>-27%</td>
</tr>
<tr>
<td>Average number of stops per vehicle</td>
<td>5.7</td>
<td>4.8</td>
<td>-15%</td>
</tr>
<tr>
<td>Total delay time including unreleased time (hr)</td>
<td>8,433</td>
<td>7,714</td>
<td>-9%</td>
</tr>
</tbody>
</table>

Source: NBH Roadworks VISSIM Model (GTA, 2014).

Table 7.2: Network Performance Results – 2018 Stage 1 Project vs Do Minimal Scenario (PM Peak Period)

<table>
<thead>
<tr>
<th>Network Measure (3 hours)</th>
<th>2018 PM Peak Period (Do Minimal)</th>
<th>2018 PM Peak Period (Stage 1 Project)</th>
<th>Percentage Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total traffic demand (vehicles)</td>
<td>49,955</td>
<td>49,996</td>
<td>+0%</td>
</tr>
<tr>
<td>Number of vehicles that have left the network (vehicles)</td>
<td>41,518</td>
<td>43,891</td>
<td>+6%</td>
</tr>
<tr>
<td>Number of vehicles that remain in the network (vehicles)</td>
<td>2,435</td>
<td>2,775</td>
<td>+14%</td>
</tr>
<tr>
<td>Unreleased demand (vehicles)</td>
<td>6,002</td>
<td>3,330</td>
<td>-45%</td>
</tr>
<tr>
<td>Proportion of vehicles unreleased</td>
<td>12%</td>
<td>7%</td>
<td>-</td>
</tr>
<tr>
<td>Total distance travelled in network (km)</td>
<td>129,252</td>
<td>137,688</td>
<td>+7%</td>
</tr>
<tr>
<td>Total time travelled in network (hr)</td>
<td>6,470</td>
<td>5,947</td>
<td>-8%</td>
</tr>
<tr>
<td>Average speed (km/h)</td>
<td>20.0</td>
<td>23.2</td>
<td>+16%</td>
</tr>
<tr>
<td>Average delay time per vehicle (sec)</td>
<td>360</td>
<td>289</td>
<td>-20%</td>
</tr>
<tr>
<td>Average number of stops per vehicle</td>
<td>5.5</td>
<td>4.6</td>
<td>-15%</td>
</tr>
<tr>
<td>Total delay time including unreleased time (hr)</td>
<td>11,226</td>
<td>7,585</td>
<td>-48%</td>
</tr>
</tbody>
</table>

Source: NBH Roadworks VISSIM Model (GTA, 2014).

The above results indicate that with the proposed road upgrades associated with the Stage 1 Connectivity Works, the network performance statistics illustrate improvements in the AM and PM peak periods, with an increase in the average vehicle speed and a decrease in the average delay per vehicle.

The model predicts a reduction in the level of unreleased demand due to the additional capacity associated with the improvements to the road network. The level of unreleased demand is expected to reduce by over 30 percent in the AM peak period (from 14 percent to 9 percent of total demand) and by over 40 percent in the PM peak period (from 12 percent to 7 percent of total demand). This indicates that the proposed improvements to the road network result in significant benefits to the traffic congestion in both the AM and PM peak periods.

However, when compared with the 2012 Base Scenario, the network performance of the Stage 1 Connectivity Works in 2018 indicate that average vehicle speeds would be maintained in the AM...
peak period at about 22 km/h but would be expected to decrease by about 18 per cent in the
PM peak period (from 28 km/h to 23 km/h). Unreleased demand in 2018 is more than six times the
current (2012) levels in the AM peak, and nearly three and a half times the 2012 levels in the PM
peak.

With the modelling still predicting some level of unreleased demand, there will be locations within
the model where the predicted traffic volumes are still unable to enter the study area. These
areas include:

- AM peak period:
  - Arthur Street
  - Forest Way (north of Adams Street)
  - Wakehurst Parkway (north of Frenchs Forest Road)
  - Rodborough Road (east of Allambie Road)
  - Allambie Road (south of Aquatic Drive)
  - Wakehurst Parkway (south of Warringah Road)
  - Adams Street.

- PM peak period:
  - Warringah Road (west of Valley Road)
  - Allambie Road (south of Aquatic Drive)
  - Aquatic Drive
  - Wakehurst Parkway (south of Warringah Road)
  - Starkey Street.

The proposed Stage 1 Connectivity Works generally provides sufficient road capacity for the
traffic generated within the immediate study area to access the road network. However, traffic
may not be able to enter the study area at some intersections on the periphery of the study area
where these have not been upgraded as part of the Stage 1 Connectivity Works.

7.2.2 2028 Stage 1 Project Model Results

Table 7.3 and Table 7.4 provide a comparison of the modelling results between the Stage 1
Project and Do Minimal scenarios for the 2028 AM and PM peak three hour models, respectively.

<table>
<thead>
<tr>
<th>Network Measure (3 hours)</th>
<th>2028 AM Peak Period (Do Minimal)</th>
<th>2028 AM Peak Period (Stage 1 Project)</th>
<th>Percentage Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Demand (vehicles)</td>
<td>45,346</td>
<td>44,952</td>
<td>-1%</td>
</tr>
<tr>
<td>Number of vehicles that have left the network (vehicles)</td>
<td>36,582</td>
<td>38,465</td>
<td>+5%</td>
</tr>
<tr>
<td>Number of vehicles that remain in the network (vehicles)</td>
<td>4,011</td>
<td>3,606</td>
<td>-10%</td>
</tr>
<tr>
<td>Unreleased demand (vehicles)</td>
<td>4,753</td>
<td>2,881</td>
<td>-39%</td>
</tr>
<tr>
<td>Proportion of vehicles unreleased</td>
<td>10%</td>
<td>6%</td>
<td>-</td>
</tr>
<tr>
<td>Total distance travelled in network (km)</td>
<td>116,143</td>
<td>124,178</td>
<td>+7%</td>
</tr>
<tr>
<td>Total time travelled in network (hr)</td>
<td>7,533</td>
<td>6,074</td>
<td>-19%</td>
</tr>
<tr>
<td>Average speed (km/h)</td>
<td>15.4</td>
<td>20.4</td>
<td>+33%</td>
</tr>
<tr>
<td>Average delay time per vehicle (sec)</td>
<td>503</td>
<td>349</td>
<td>-31%</td>
</tr>
<tr>
<td>Average number of stops per vehicle</td>
<td>7.4</td>
<td>5.5</td>
<td>-26%</td>
</tr>
<tr>
<td>Total delay time including unreleased time (hr)</td>
<td>9,132</td>
<td>6,603</td>
<td>-28%</td>
</tr>
</tbody>
</table>

Source: NBH Roadworks VISSIM Model [GTA, 2014].
Table 7.4: Network Performance Results – 2028 Stage 1 Project vs Do Minimal Scenario (PM Peak Period)

<table>
<thead>
<tr>
<th>Network Measure (3 hours)</th>
<th>2028 PM Peak Period (Do Minimal)</th>
<th>2028 PM Peak Period (Stage 1 Project)</th>
<th>Percentage Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Demand (vehicles)</td>
<td>52,025</td>
<td>52,155</td>
<td>+0%</td>
</tr>
<tr>
<td>Number of vehicles that have left the network (vehicles)</td>
<td>39,357</td>
<td>41,949</td>
<td>+7%</td>
</tr>
<tr>
<td>Number of vehicles that remain in the network (vehicles)</td>
<td>3,797</td>
<td>3,047</td>
<td>-20%</td>
</tr>
<tr>
<td>Unreleased demand (vehicles)</td>
<td>8,871</td>
<td>7,159</td>
<td>-19%</td>
</tr>
<tr>
<td>Proportion of vehicles unreleased</td>
<td>17%</td>
<td>14%</td>
<td></td>
</tr>
<tr>
<td>Total distance travelled in network (km)</td>
<td>129,531</td>
<td>131,726</td>
<td>+2%</td>
</tr>
<tr>
<td>Total time travelled in network (hr)</td>
<td>7,680</td>
<td>6,934</td>
<td>-10%</td>
</tr>
<tr>
<td>Average speed (km/h)</td>
<td>16.9</td>
<td>19.0</td>
<td>+13%</td>
</tr>
<tr>
<td>Average delay time per vehicle (sec)</td>
<td>468</td>
<td>385</td>
<td>-18%</td>
</tr>
<tr>
<td>Average number of stops per vehicle</td>
<td>6.5</td>
<td>5.7</td>
<td>-12%</td>
</tr>
<tr>
<td>Total delay time including unreleased time (hr)</td>
<td>14.852</td>
<td>12.316</td>
<td>-17%</td>
</tr>
</tbody>
</table>

Source: NBH Roadworks VISSIM Model (GTA, 2014).

The above results indicate that with the proposed road upgrades associated with the Stage 1 Connectivity Works, the network performance statistics illustrate improvements in the AM and PM peak periods, with an increase in the average vehicle speed and a decrease in the average delay per vehicle.

The model predicts a reduction in the level of unreleased demand due to the additional capacity associated with the improvements to the road network. The level of unreleased demand is expected to reduce by 39 percent in the AM peak period and by 19 percent in the PM peak period. This indicates that the proposed improvements to the road network result in significant benefits to the traffic congestion in both the AM and PM peak periods.

However, when compared with the 2012 Base Scenario, the network performance of the Stage 1 Connectivity Works in 2028 indicate that average vehicle speeds would decrease by about 7 percent in the AM peak (from 22 km/h to 20 km/h) and about 33 percent in the PM peak (from 28 km/h to 19 km/h). Unreleased demand in 2028 is over four times the current (2012) levels in the AM peak period and over seven times in the PM peak period.

With the modelling still predicting some level of unreleased demand, there will be locations within the model where the predicted traffic volumes are still unable to enter the study area. These areas include:

- **AM peak period**
  - Warringah Road (west of Valley Road)
  - Arthur Street
  - Allambie Road (south of Aquatic Drive)
  - Wakehurst Parkway (south of Warringah Road)
  - Forestville Avenue
  - Adams Street (west of Forest Way).

- **PM peak period**
  - Warringah Road (west of Valley Road)
  - Forest Way (north of Adams Street)
  - Rodborough Road (east of Allambie Road)
  - Allambie Road (south of Aquatic Drive).
The proposed Stage 1 Connectivity Works generally provides sufficient road capacity for the traffic generated within the immediate study area to access the road network. However, traffic may not be able to enter the study area at some intersections on the periphery of the study area where these have not been upgraded as part of the Stage 1 Connectivity Works. This may contribute to the continued ‘rat running’ through local roads.

7.3 Intersection Level of Service and Average Delays

7.3.1 Overview of Intersection Operation

The Level of Service (LOS) for the intersection can be estimated from the average vehicle delay based on the following criteria (based on Table 2.4):

- LOS A to D: less than 56 seconds
- LOS E: between 57 seconds and 70 seconds
- LOS F: greater than 70 seconds.

Intersections that have an average vehicle delay of greater than 70 seconds (LOS F) are considered to be operating over capacity with long delays and queues.

With the provision of the Stage 1 Connectivity Works, the signal timings of some of the intersections have been reviewed and modified to improve the overall performance of these intersections. As this was not undertaken in the Do Minimal scenarios, improvements may be evident at some intersections within the study area where capacity improvements have not been provided. For example, changes were made to the signal timings at Warringah Road/ Wakehurst Parkway which have resulted in improvements to the Warringah Road/ Hilmer Street (from LOS F in 2018 Do Minimal to LOS E in 2018 Stage 1).

It is noted that generally the signal timings were modified for the Stage 1 Project to reflect the updated capacity along Frenchs Forest Road, with the existing signal timings no longer been appropriate. The Do Minimal scenario did not increase the capacity along the corridor (just at the new signalised intersection to NBH) and as such, there is less need to alter the existing signal timings.

The changes in the LOS of the intersections within the immediate study area for the 2012 base condition and the 2018 and 2028 Do Minimal and Stage 1 Project scenarios are detailed in Table 5.5.
Table 7.5: Summary of AM and PM Peak Period Intersection Level of Service

<table>
<thead>
<tr>
<th>Intersection</th>
<th>2012 Base Year</th>
<th>2018 Do Minimal</th>
<th>2018 Stage 1 Scenario</th>
<th>2028 Do Minimal</th>
<th>2028 Stage 1 Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warringah Road/ Forest Way</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Warringah Road/ Hilmer Street</td>
<td>A-D</td>
<td>F</td>
<td>E</td>
<td>F</td>
<td>A-D</td>
</tr>
<tr>
<td>Warringah Road/ Wakehurst Parkway</td>
<td>F</td>
<td>F</td>
<td>E</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Warringah Road/ Allambie Road</td>
<td>E</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Warringah Road/ Ellis Road/ Government Road</td>
<td>A-D</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Forest Way/ Adams Street</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Forest Way/ Naree Road</td>
<td>A-D</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Frenchs Forest Road West/ Rabbett Street</td>
<td>E</td>
<td>F</td>
<td>A-D</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Frenchs Forest Road West/ Hospital Entrance/ Gladys Avenue</td>
<td>-</td>
<td>A-D</td>
<td>A-D</td>
<td>E</td>
<td>A-D</td>
</tr>
<tr>
<td>Frenchs Forest Road/ Wakehurst Parkway</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Frenchs Forest Road East/ Romford Road</td>
<td>A-D</td>
<td>F</td>
<td>E</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Frenchs Forest Road East/ Patanga Road/ Allambie Road</td>
<td>A-D</td>
<td>A-D</td>
<td>A-D</td>
<td>A-D</td>
<td>A-D</td>
</tr>
</tbody>
</table>

Note: Warringah Road/ Forest Way intersection predicted to operate at LOS F under system-wide network performance Source: NBH Roadworks VISSIM Model (GTA, 2014).

Table 5.5 indicates that the operation of the intersections within the study area are predicted to improve following the Stage 1 Project compared to the Do Minimal scenarios for 2018 and 2028. The LOS data indicates that 5 of the 12 intersections will operate with a LOS E or better during 2018 and 3 of the 12 intersections in 2028 with the Stage 1 Project. This compares to only 2 of 12 intersections during the 2018 and 2028 Do Minimal scenarios.

More specifically as a result of the Stage 1 Project 4 of the 5 intersections along Frenchs Forest Road will operate with a LOS E or better in 2018 with 2 of 5 intersections in 2028. The Frenchs Forest Road / Romford Road and Frenchs Forest Road / Rabbett Street intersections are predicted to operate with LOS F in 2028 compared to LOS’s of E or better in 2018.

Whilst not specifically illustrated by the LOS data the additional capacity on the Frenchs Forest Road corridor will result in some east-west traffic that currently uses Warringah Road using the Frenchs Forest Road corridor instead. This will in turn result in a slight improvement of the operation of the Warringah Road corridor compared to the Do Minimal scenario.

7.3.2 Stage 1 Project Short-term (2018) LOS and Average Delay

The forecast intersection average delays and LOS for the AM and PM peak periods for the 2018 Stage 1 Project scenario are illustrated graphically in Figure 7.1 and Figure 7.2.
Figure 7.1: Stage 1 Project Intersection Delays – AM Peak Period 2018

Source: NBH Roadworks VISSIM Model (GTA, 2014).

Figure 7.2: Stage 1 Project Intersection Delays – PM Peak Period 2018

Source: NBH Roadworks VISSIM Model (GTA, 2014).
7.3.3 Long-term (2028) LOS and Average Delay with Do Minimal and Stage 1 Project

The forecast intersection average delays and LOS for the AM and PM peak periods for the 2028 Stage 1 Project scenario are illustrated graphically in Figure 7.3 and Figure 7.4.

Figure 7.3: Stage 1 Project Intersection Delays – AM Peak Period 2028

Figure 7.4: Stage 1 Project Intersection Delays – PM Peak Period 2028

Source: NBH Roadworks VISSIM Model [GTA, 2014].
7.3.4 Summary

A summary of the intersection operation and average delay forecasts for each of the modelled scenarios is provided in Table 7.6. The analysis generally indicates that the average delays and intersection LOS are predicted to improve between the Do Minimal and Stage 1 Project scenarios and deteriorate for all scenarios between the 2018 and 2028 design years.

Table 7.6: Summary of Average Delays and Intersection Operation

<table>
<thead>
<tr>
<th>Assessment Period</th>
<th>Figure</th>
<th>Commentary</th>
</tr>
</thead>
</table>
| 2018 AM Peak Hour (Do Minimal vs. Stage 1) | Figure 5.1 & Figure 7.1 | - Significant improvement is predicted along the Frenchs Forest Road corridor following the Stage 1 Project, with improved intersection operation and reduced delays at each of the intersections.  
- With the exception of Frenchs Forest Road / Wakehurst Parkway and Frenchs Forest Road / Romford Road all intersections are predicted to have average delays of less than 60 seconds.  
- The Warringah Road corridor is anticipated to operate with improved intersection operation and reduced average delays compared to the Do Minimal scenario. |
| 2018 PM Peak Hour (Do Minimal vs. Stage 1) | Figure 5.2 & Figure 7.2 | - Each of the intersections along the Frenchs Forest Road corridor is predicted to operate with LOS A-D and with delays of less than 60 seconds.  
- The Warringah Road corridor is anticipated to operate with improved intersection operation and reduced average delays compared to the Do Minimal scenario. |
| 2028 AM Peak Hour (Do Minimal vs. Stage 1) | Figure 5.3 & Figure 7.3 | - Degradation of the Frenchs Forest Road corridor is predicted between 2018 and 2028, particularly at its intersection with Wakehurst Parkway where average delays in excess of 2 minutes are forecast.  
- The Warringah Road corridor is anticipated to operate with improved intersection operation and reduced average delays compared to the Do Minimal scenario however it is noted that the network operation is predicted to deteriorate against the 2018 outputs. |
| 2028 PM Peak Hour (Do Minimal vs. Stage 1) | Figure 5.4 & Figure 7.4 | - Degradation of the Frenchs Forest Road corridor is predicted between 2018 and 2028, with 2 intersections predicted to operate with LOS F.  
- The Warringah Road corridor is anticipated to operate with improved intersection operation and reduced average delays compared to the Do Minimal scenario. Some of the intersections are predicted to have improved operation however this is as a result of vehicles not being able to access the intersections from upstream delays. |

7.4 Travel Time Comparison

The average travel speeds following the Stage 1 Project for the routes identified in Figure 5.6 are presented below.

The average travel time for the six routes for the 7–8am and 4–5pm peak hours for the 2018 Do Minimal scenario and the 2018 Stage 1 Project scenario are shown in Table 7.7.
### 7.4.1 2028 Stage 1 Project Scenario

The average travel time for the six routes for the 7–8am and 4–5pm peak hour for the 2028 Do Minimal scenario and the 2028 Stage 1 Project scenario are provided in Table 7.8.

#### Table 7.7: Average Travel Speeds (km/h) – 2018 Do Minimal vs 2018 Stage 1 Project Scenario

<table>
<thead>
<tr>
<th>Travel Speed Route</th>
<th>Direction</th>
<th>7–8am Peak Hour</th>
<th>4–5pm Peak Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2018 Do Minimal</td>
<td>2018 Stage 1 Project</td>
<td>Difference</td>
</tr>
<tr>
<td>Route 1: Warringah Road</td>
<td>Eastbound</td>
<td>31</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>Westbound</td>
<td>23</td>
<td>39</td>
</tr>
<tr>
<td>Route 2: Forest Way-Warringah Road</td>
<td>Eastbound</td>
<td>17</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Westbound</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Route 3: Forest Way-Wakehurst Parkway South</td>
<td>Northbound</td>
<td>14</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Southbound</td>
<td>13</td>
<td>8</td>
</tr>
</tbody>
</table>

Source: NBH Roadworks VISSIM Model (GTA, 2014).

With the provision of the Stage 1 Connectivity Works, the signal timings of some of the intersections have been reviewed and modified to improve the overall performance of the intersections across the study area, however, this was not undertaken in the Do Minimal scenarios. Therefore, the improvements in the travel speeds in 2018, as indicated in Table 7.7, are associated with the increase in capacity associated with the Stage 1 Connectivity Works and also the changes undertaken to the signal timings of the intersections within the study area.

The average travel speeds in Table 7.7 indicate that the Stage 1 Connectivity Works generally provides an increase to travel speeds on the arterial road network, with the largest increase in travel speeds recorded in the both peak periods for Route 1 (Warringah Road). The travel speed increases for Routes 2 and 3 are of a lesser magnitude than Route 1.

### 7.4.1 2028 Stage 1 Project Scenario

The average travel time for the six routes for the 7–8am and 4–5pm peak hour for the 2028 Do Minimal scenario and the 2028 Stage 1 Project scenario are provided in Table 7.8.

#### Table 7.8: Average Travel Speed (km/h) – 2028 Do Minimal vs 2028 Stage 1 Project Scenario

<table>
<thead>
<tr>
<th>Travel Speed Route</th>
<th>Direction</th>
<th>7–8am Peak Hour</th>
<th>4–5pm Peak Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2028 Do Minimal</td>
<td>2028 Stage 1 Project</td>
<td>Difference</td>
</tr>
<tr>
<td>Route 1: Warringah Road</td>
<td>Eastbound</td>
<td>23</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>Westbound</td>
<td>13</td>
<td>28</td>
</tr>
<tr>
<td>Route 2: Forest Way-Warringah Road</td>
<td>Eastbound</td>
<td>14</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Westbound</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>Route 3: Forest Way-Wakehurst Parkway South</td>
<td>Northbound</td>
<td>8</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Southbound</td>
<td>12</td>
<td>11</td>
</tr>
</tbody>
</table>

Source: NBH Roadworks VISSIM Model (GTA, 2014).

With the provision of the Stage 1 Connectivity Works, the signal timings of some of the intersections have been reviewed and modified to improve the overall performance of the intersections across the study area, however, this was not undertaken in the Do Minimal scenarios. Therefore, the improvements in the travel times in 2028, as indicated in Table 7.8, are associated with the increase in capacity associated with the Stage 1 Connectivity Works and also the changes undertaken to the signal timings of the intersections within the study area.

The average travel times in Table 7.8 indicate that the Stage 1 Connectivity Works generally provide an increase in travel speeds to the NBH on the arterial road network.
7.5 Other Operational Impacts

7.5.1 Public Transport

Changes to the Public Transport System

As part of the proposed increases in public transport across the Northern Beaches, Transport for NSW is proposing to modify the bus routes within the study area and provide more frequent services for these routes in the AM and PM peak periods. These changes have been documented in Section 4.6.

Improvements to Existing Bus Stops

As part of the Stage 1 Connectivity Works, the northbound bus stop on Forest Way outside the Forestway Shopping Centre has been extended to cater for two buses. The extent of work is illustrated in Figure 7.5.

Figure 7.5: Extension of Forestway Shopping Centre bus stop (northbound on Forest Way)

Changes to Bus Stop Locations

There are two bus stops on Allambie Road (northbound and southbound), north of Warringah Road and south of Frenchs Forest Road (outside KFC). These bus stops are currently used by the Route 142 bus only, which commences and terminates at this location (and travels to and from the south). All other buses that travel along this section of Allambie Road use the bus stops that are located on Frenchs Forest Road west of Allambie Road (approximately 50m from the Allambie Road bus stops).

As part of the review of the bus network, the Route 142 bus is to be extended northwards to Terrey Hills and will subsequently continue on Frenchs Forest Road from Allambie Road. The Route 142 bus will now be able to use the bus stop located on Frenchs Forest Road approximately 50m from the previous stop. As such, it is proposed to remove the northbound bus stop on Allambie Road.

Travel Times for Buses along Frenchs Forest Road

The Transport for NSW target travel speeds on suburban bus routes is between 18 km/h and 25 km/h. To assess the changes in bus travel times along Frenchs Forest Road (between Rabbett
The average speed for the bus route for the 7–8am and 4–5pm peak hour for the Do Minimal and Stage 1 Project scenarios for 2018 and 2028 are provided in Table 7.9 and Table 7.10.

Table 7.9: Average Bus Speed (km/h) – 2018 Do Minimal vs 2018 Stage 1 Project Scenario

<table>
<thead>
<tr>
<th>Route</th>
<th>Direction</th>
<th>7–8am Peak Hour</th>
<th>4–5pm Peak Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2018 Do Minimal</td>
<td>2018 Stage 1 Project</td>
</tr>
<tr>
<td>Frenchs Forest Road</td>
<td>Eastbound</td>
<td>11.6</td>
<td>14.9</td>
</tr>
<tr>
<td></td>
<td>Westbound</td>
<td>8.8</td>
<td>7.3</td>
</tr>
</tbody>
</table>

Source: NBH Roadworks VISSIM Model (GTA, 2014).

Table 7.10: Average Bus Speed (km/h) – 2028 Do Minimal vs 2028 Stage 1 Project Scenario

<table>
<thead>
<tr>
<th>Route</th>
<th>Direction</th>
<th>7–8am Peak Hour</th>
<th>4–5pm Peak Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2028 Do Minimal</td>
<td>2028 Stage 1 Project</td>
</tr>
<tr>
<td>Frenchs Forest Road</td>
<td>Eastbound</td>
<td>10.4</td>
<td>14.9</td>
</tr>
<tr>
<td></td>
<td>Westbound</td>
<td>9.5</td>
<td>8.3</td>
</tr>
</tbody>
</table>

Source: NBH Roadworks VISSIM Model (GTA, 2014).

The 2018 data indicates that, with the exception of the westbound movement during the AM peak hour, modest increases to bus travel speeds are predicted along Frenchs Forest Road. Future bus speeds of between 7 and 17 km/h are predicted along Frenchs Forest Road.

The above results illustrate that the buses are predicted to generally operate at up to 15 km/h due to the proposed road upgrade associated with the Stage 1 Connectivity Works.

The Transport for NSW target travel speeds on suburban bus routes is between 18 km/h and 25 km/h. The above results indicate that the proposed Stage 1 Project road upgrades are not predicted to support these target bus travel speeds. However, modest improvements are predicted.

The two major contributors to the bus travel time along the Frenchs Forest Road corridor are:
- The dwell time at bus stops (20 seconds per bus stop)
- The delay incurred at the Wakehurst Parkway/Frenchs Forest Road intersection.

The Wakehurst Parkway/Frenchs Forest Road intersection operates with a 160 second cycle, and the delay to buses at this intersection is generally about 80 seconds (half the total cycle time). To improve the operation of this intersection, it may be possible to operate the intersection at a shorter cycle time (le 140 seconds), which would reduce the delays for buses travelling along Frenchs Forest Road.

In the longer term, the construction of the grade-separation of the Warringah Road/Wakehurst Parkway intersection (as part of the Concept Proposal), would reduce the at-grade traffic volumes on Warringah Road. This would potentially provide for additional green time for the southbound approach on Wakehurst Road, which may reduce the traffic queues and the associated blocking of the left turning vehicles from Frenchs Forest Road East.

Changes to School Bus Services

A number of school buses serve The Forest High School on Frenchs Forest Road, with buses picking up students outside the school, on the southern side of Frenchs Forest Road. Some of these buses
execute a U-turn manoeuvre at the existing bus turnaround facility, west of the high school, to travel eastbound on Frenchs Forest Road towards Wakehurst Parkway.

As part of the Stage 1 Connectivity Works, this U-turn facility will be closed, and buses will need to continue to travel westbound on Frenchs Forest Road and turn left on Rabbett Street, Forest Way and Warringah Road to travel back in an eastbound direction. This change in route is illustrated in Figure 7.6.

Figure 7.6: Changes to School Bus Routes

7.5.2 Pedestrians and Cyclists

Pedestrian Infrastructure

As part of the Stage 1 Connectivity Works, a 1.5 m-wide concrete footpath would be provided along the northern side of Naree Road and Frenchs Forest Road between Forest Way and Warringah Road, and along the southern side of Frenchs Forest Road between Wakehurst Parkway and Warringah Road. In addition, there would be a 3.5 m-wide concrete footpath along the southern side of Naree Road and Frenchs Forest Road between Forest Way and Wakehurst Parkway. The Stage 1 Connectivity Works also includes the provision of pedestrian crossings as part of the upgrading and signalisation of intersections within the study area. The locations of these proposed footpaths and intersection upgrades are illustrated in Figure 6.1.

The provision of a continuous footpath on the northern and southern side of Naree Road/ Frenchs Forest Road, between Forest Way and Wakehurst Parkway, and the provision of pedestrian crossings as part of the upgrading and signalisation of intersections within the study area will provide a safe pedestrian facility for local residents, students and teachers at the Forest High School, and employees and visitors to the NBH and the various businesses along the corridor. The proposed signalisation of the Forest Way/ Naree Road intersection will also provide a safe
pedestrian crossing for local residents and students accessing the Forestway Shopping Centre and/or the bus stop on Forest Way outside the shopping centre.

These facilities will improve connectivity between the key activity nodes within the study area including the residential catchment on the northern side of Naree Road/Frenchs Forest Road, Forestway Shopping Centre, the Forest High School, the NBH, the various businesses along Frenchs Forest Road East and the Skyline shops.

**Cycle Infrastructure**

There are limited bicycle facilities on, or traversing, the existing road network of the Stage 1 Project. Proposed on-road bicycle routes as identified in the Warringah Bike Plan (Warringah Council, 2014) include Rabbett Street (traversing Frenchs Forest Road West), Wakehurst Parkway, Allambie Road (north of Warringah Road), Patanga Road and Warringah Road (east of Allambie Road).

The 3.5m concrete footpath cannot be considered as a shared path due to excessive vertical grades along Naree Road and Frenchs Forest Road West reaching up to 15 percent in some locations. It is proposed to provide an off-street shared path along Warringah Road between Forest Way and Allambie Road as part of Stage 2 of the project. This would tie in at either end with shared paths proposed by Warringah Council. As part of the provision of this off-street shared path, where the shared path crosses at signalised intersections, modifying the traffic signals to incorporate bicycle signals will be considered.

As part of the detailed design process for the Stage 1 Project, Roads and Maritime would investigate options to provide shared paths (being off-road cycleway and pedestrian footpath) aiming to connect with the existing or proposed cycleways indicated on the Warringah Bike Plan (refer to Figure 2.20). Investigation into the provision of shared paths (including off-road cycleways) would be undertaken at the following locations:

- Forest Way from Naree Road to about 170 metres north of Warringah Road
- Wakehurst Parkway between Frenchs Forest Road East and Warringah Road
- Frenchs Forest Road East between the intersection of Wakehurst Parkway and Allambie Road
- Patanga Road between Frenchs Forest Road East and the existing Council cycleway
- Allambie Road between Warringah Road and Frenchs Forest Road East.

Where cycleways are provided as part of a shared path network, Roads and Maritime would consider modifying the traffic signals to incorporate bicycle signals at these pedestrian crossings. In addition, due to the proximity of the existing cycle path to the proposed Frenchs Forest Road/Patanga Road/Allambie Road intersection, Roads and Maritime would consider modifying the traffic signals to incorporate bicycle signals at this intersection.

The provision of the shared paths (including off-road cycleways) proposed to be investigated would provide a safe route and improved connectivity between the key activity nodes including various residential areas across the study area, Forestway Shopping Centre, the Forest High School, NBH and various businesses along these corridors. The provision of a bicycle signal at these intersections would provide a safe crossing for cyclists at these locations who use these proposed paths. At the Frenchs Forest Road/Patanga Road/Allambie Road intersection, the provision of a bicycle signal at this intersection would provide a safe crossing for cyclists who use the existing cycle path and would improve connectivity between the residential catchment north of Frenchs Forest Road East and the various businesses along the southern side of Frenchs Forest Road.
7.5.3 Road Safety

Vehicular Traffic
The Stage 1 Connectivity Works include widening of Frenchs Forest Road and the upgrading of several intersections (including signalisation of some intersections). These upgraded intersections are listed below:
- Forest Way/ Naree Road (upgrade and signalise)
- Forest Way/ Russell Avenue (provide southbound right turn pocket on Forest Way)
- Naree Road/ Frenchs Forest Road West/ Naree Road/ Rabbett Street (upgrade and signalise)
- Wakehurst Parkway/ Frenchs Forest Road (upgrade)
- Frenchs Forest Road East/ Romford Road (signalise)
- Frenchs Forest Road East/ Patanga Road/ Allambie Road (upgrade and signalise).

The analysis of the historic crash data (refer to Section 2.12) indicates that crashes occur throughout the study area, however, they are also relatively concentrated at the intersections. Approximately half of all crashes were rear-end collisions, which may be due to the existing traffic congestion during the peak periods within the study area.

The Stage 1 Connectivity Work is expected to provide additional road capacity and therefore may mitigate the increase in traffic volumes due to the forecast increase in population and employment within the study area, including the proposed NBH.

Two key areas where the Stage 1 Connectivity Works are predicted to improve road safety include:
- the widening of Frenchs Forest Road would provide two lanes in each direction, and therefore, this may reduce the frequency of rear end collisions, where traffic are waiting to turn into the residential streets along the corridor
- the upgrading and signalisation of the Forest Way/ Naree Road intersection should reduce the occurrences of turning collisions as the signalisation of the intersection will remove the conflict between the turning movements.

Pedestrians and Cyclists
As indicated in Section 7.5.2, the Stage 1 Connectivity Works includes the provision of pedestrian crossings as part of the upgrading and signalisation of intersections within the study area. The provision of these pedestrian facilities will improve the connectivity and provide safe crossing locations on Forest Way and along Frenchs Forest Road.

The existing crash statistics in Section 2.12 indicate that a crash involving a pedestrian occurred at the Forest Way/ Russell Street intersection and two crashes involving pedestrians at the Frenchs Forest Road East/ Patanga Road/ Allambie Road intersection. The provision of pedestrian crossings as part of the upgrade and signalisation of the Forest Way/ Naree Road intersection (north of Russell Street) and the Frenchs Forest Road East/ Patanga Road/ Allambie Road intersection is expected to result in improvements in pedestrian safety at these two locations.

7.5.4 Localised Intersection Changes
Changes are proposed at the following intersections which will alter the current traffic movements:
- Frenchs Forest Road/ Bluegum Crescent East
- Frenchs Forest Road/ Inverness Avenue
Frenchs Forest Road/ Patanga Road/ Allambie Road.

Frenchs Forest Road/ Bluegum Crescent East

Due to the proximity of the intersection of the new hospital access road with Frenchs Forest Road West, the Frenchs Forest Road/ Bluegum Crescent East is proposed to be restricted to left in/left out movements. Vehicles previously undertaking right turning movements at this location will have the alternative of turning right at Bluegum Crescent West.

Frenchs Forest Road/ Inverness Avenue

Due to the proximity of the Frenchs Forest Road East/ Inverness Avenue intersection to the new intersection at Patanga Road/ Allambie Road, it is proposed to restrict right turning into Inverness Avenue from Frenchs Forest Road East. Vehicles previously undertaking right turning movement into Inverness Avenue will need to utilise other side streets to the west of Inverness Avenue.

Frenchs Forest Road East/ Patanga Road/ Allambie Road

Due to the proximity of the Frenchs Forest Road East/ Patanga Road/ Allambie Road intersection to the Warringah Road/ Allambie Road intersection, it is proposed that only buses and garbage trucks be allowed on the southbound direction of Patanga Road approximately 20m north of the Frenchs Forest Road East intersection. Other vehicles would need to utilise Romford Road, Hurdis Avenue, Hamston Avenue or Inverness Avenue to access Frenchs Forest Road. The access into Patanga Road for general traffic would also be restricted to left-in and through movements from Allambie Road. Traffic analysis has indicated that this is necessary to avoid traffic queuing back into the Warringah Road/ Allambie Road intersection.

7.5.5 Changed Access Arrangements

At the Frenchs Forest Road/ Romford Road intersection, the driveway to Forest Central Business Park (49 Frenchs Forest Road, Frenchs Forest) would be affected by the proposed upgrade of the intersection to signals, as part of Stage 1 Project. The business park has a driveway that is located within the middle of the proposed signalised intersection. The eastern section of the driveway provides ingress to the business park, while the western part of the driveway provides egress from the development. As the western section part of the driveway is located within the proposed signalised intersection, it is proposed to be closed, with the eastern section of the driveway proposed to be converted to two-way operation.

7.5.6 Car Parking

Kerbside parking along Frenchs Forest Road is generally permitted with no restrictions during peak periods. Parking is prohibited on the southern side of Frenchs Forest Road East (outside the Skyline Business Park) between 7—9am on weekday. Some areas along Frenchs Forest Road are utilised for specific purposes, such as bus stops and mail zone (Skyline Shops).

As part of the Stage 1 Connectivity Works, it is expected that peak period kerbside parking restrictions would be put in place in order to optimise the additional traffic capacity provided by the project. Parking would not be permitted at any time along Frenchs Forest Road between Bluegum Crescent West and Wakehurst Parkway. However, parking would be permitted along Naree Road and Frenchs Forest Road off peak on weekdays and during weekends at the following locations:

- Naree Road between Forest Way and Rabbett Street
- Frenchs Forest Road between Rabbett Street and Bluegum Crescent West
- Frenchs Forest Road East between Skyline Place and Romford Road
The kerbside parking surveys undertaken in March 2014 indicate that there is a significant demand for on-street parking along Naree Road, Rabbett Street (between Naree Road and Forest Way), and Patanga Road during business hours on weekdays.

A summary of the demand and availability of car parking on Naree Road and Frenchs Forest Road is provided in Table 7.11.

Table 7.11: Car parking demand on Naree Road/ Frenchs Forest Road

<table>
<thead>
<tr>
<th>Location</th>
<th>Total car parking spaces available (both sides of road)</th>
<th>Maximum spaces used during the AM peak period (7-9AM)</th>
<th>Maximum spaces used during the PM peak period (4-6PM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naree Road</td>
<td>34</td>
<td>14</td>
<td>19</td>
</tr>
<tr>
<td>Frenchs Forest Road West</td>
<td>107</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>Frenchs Forest Road East</td>
<td>108</td>
<td>24</td>
<td>46</td>
</tr>
</tbody>
</table>

Source: GTA analysis of SkyHigh parking survey results undertaken for Roads and Maritime, May 2014.

The parking demand on Naree Road, Rabbett Street and Frenchs Forest Road could be attributed to commuter park-and-ride demand, based on site observations for customers transferring to city-bound buses in the AM peak or alighting from them in the PM peak at the Rabbett Street/Forest Way bus stops. Peak period restrictions on kerbside parking along Naree Road/ Frenchs Forest Road West would potentially shift a portion of the commuter park-and-ride demand to other non-restricted kerbside parking spaces on side streets. Based on the limited observed parking demand on these streets, it is expected that these additional vehicles could be accommodated within the surrounding non-restricted streets. Therefore, it is expected that compensatory parking may not be required along Frenchs Forest Road West.

The peak parking demand on Frenchs Forest Road East is concentrated between Skyline Place and Patanga Road. The maximum parking demand occurs between 9AM and 5PM, and could be attributed to parking demand generated by the business parks in the precinct. As an assessment of the parking utilisation within the on-site car parks within the business park precinct was not undertaken, it is not possible to determine the level of car parking associated with the business park.

The parking surveys indicate an average of about 50 percent occupancy of kerbside parking spaces on Frenchs Forest Road East during business hours. There is a likelihood that excess demand could spill-over to side streets, particularly during peak periods when kerbside parking restrictions may potentially be in place. However, with kerbside parking allowed on Frenchs Forest Road East during off-peak periods, the current levels of parking demand could be accommodated within existing spaces. There are currently 16 on-street car parking bays (including one disabled car parking bay) outside the Skyline Shops. Site observations confirm that the adjacent vacant parcel of land to the east of the shops is being used as an informal/overspill parking by patrons and clients to the businesses located at Skyline Shops. There is also a mail zone adjacent to the shops outside the vacant lot.

As part of the upgrade and signalisation of intersection of Frenchs Forest Road East/ Patanga Road/ Allambie Road, these existing on-street car parking spaces would have to be re-designed and re-configured to meet current road safety standards. A proposal to provide a new off-street car park on the adjacent vacant lot was identified in a recent community update for the project.

However, concerns with the proposal to relocate parking outside the shops to the adjacent vacant lot were raised by the property owner of the subject land and Roads and Maritime is now...
investigating alternative options to provide on-street parking along the widened section of Frenchs Forest Road East between Allambie Road and Warringah Road.

These options for alternate parking are currently being considered and further consultation would be undertaken with Council and local businesses. Measures such as the provision of time restrictions (up to 1 or 2 hours) for parking are also being considered.

Further environmental assessment of the preferred arrangement will be undertaken if required.

7.5.7 Impacts to The Forest High School

This section presents the proposed changes to existing conditions on Frenchs Forest Road outside The Forest High School as part of the Stage 1 Project, as well as the impacts these would have on the school operation, particularly during periods of high traffic use, such as starting and finishing times, excursion days and sport periods.

- Removal of the existing bus turning area on the south side of Frenchs Forest Road West outside the school. This would require school buses traveling westbound to continue towards Rabbett Street after dropping off or picking up students, and turning left at Rabbett Street, Forest Way and Warringah Road to travel back in an eastbound direction. This removes the road safety risks associated with the existing bus U-turn manoeuvres on Frenchs Forest Road West. The space occupied by the bus bay would be incorporated into the school grounds.

- Provision of a wider footpath on the south side of Frenchs Forest Road West, which is the primary pedestrian route. A footpath on the north side, the secondary route, is also proposed. These would improve amenity and accessibility of the school to pedestrians and school bus users.

- Removal of the existing unsignalised pedestrian crossing at the intersection with Bluegum Crescent East, and replacement by a signalised pedestrian crossing at the Gladys Avenue intersection with Frenchs Forest Road West and the proposed NBH access road, about 100 metres further to the east. This would potentially increase walk distance for a number of current users of the existing pedestrian crossing.

- Observations indicate that a number of the students using the current pedestrian crossing are kiss-and-ride users (drop-off in the morning, pick-up in the afternoon). The replacement of the unsignalised pedestrian crossing opposite Bluegum Crescent East and replacement with a signalised one near Gladys Avenue would also require the relocation of kiss-and-ride activities closer to the proposed signalised pedestrian crossing on Gladys Avenue, in order to benefit from the opportunity of lower safety risk levels provided by the relocated pedestrian crossing.

- Removal of the existing bus zone on the south side of Frenchs Forest Road West east of Gladys Avenue, as this area is part of the hospital zone. This is currently used as part of the school bus zone, with buses observed to layover using these spaces prior to school dismissal time. With the removal of bus spaces on the south side of Frenchs Forest Road Gladys Avenue east of the NBH entry opposite Gladys Avenue, additional spaces for school buses would be potentially be required to the west of Bluegum Crescent West.

- Redesign of the existing car parking areas within the high school grounds, including widening the main vehicle access, to consolidate vehicle movements (including service and emergency vehicle access), increase car park capacity and improve levels of safety as well as legibility. This would improve access to The Forest High School for staff and visitors.

- The existing school service access off Gladys Avenue is proposed to be consolidated with a school main entry to the west of Bluegum Crescent West, and would thus be
separate from the proposed hospital service and emergency vehicle access opposite Gladys Avenue. There are no major traffic impacts that are expected from this proposed arrangement.

7.6 Summary of Stage 1 Project Impacts

7.6.1 Network Performance

The traffic analysis undertaken for the Stage 1 Connectivity Works indicates that the road upgrades will provide a significant improvement in network statistics compared to the Do Minimal scenario. For example, in the 2018 AM peak period, the modelling indicates a 26 percent increase in the average vehicle speed and a 27 percent reduction in the average delay per vehicle. The modelling also predicts a reduction in the level of unreleased demand due to the additional capacity associated with the improvements to the road network. In the AM peak period, there is predicted to be over 30 percent reduction in the level of unreleased demand, with the level of unreleased demand reducing from 14 percent of the total demand to 9 percent of the total demand.

During the PM peak period, the modelling indicates a 16 percent increase in the average vehicle speed and a 20 percent reduction in the average delay per vehicle. The level of unreleased demand during the PM peak period is predicted to reduce by over 40 percent, reducing from 12 percent to 7 percent of the total demand.

However, when compared with the 2012 Base Scenario, the network performance of the Stage 1 Connectivity Works in 2018 indicate that average vehicle speeds would practically be maintained in the AM peak period (1 percent reduction) but would be expected to decrease by about 18 per cent in the PM peak period. It is also predicted that the future levels of unreleased demand in 2018 would be more than six times the current (2012) levels in the AM peak, and nearly three and a half times the 2012 levels in the PM peak.

With the modelling still predicting some level of unreleased demand, there will be locations within the model where the predicted traffic volumes are still unable to enter the study area. The proposed Stage 1 Connectivity Works generally provides sufficient road capacity for the traffic generated within the immediate study area to access the road network. However, traffic may not be able to enter the study area at some intersections on the periphery of the study area where these have not been upgraded as part of the Stage 1 Connectivity Works.

The average speed and total travel time for the 2012 base year and the 2018 and 2028 Do Minimal scenarios are illustrated in Figure 7.7 and Figure 7.8.
Figure 7.7: Comparison of Average Speeds, km/h

![Bar chart showing comparison of average speeds across different years and stages.](chart1)

Source: NBH Roadworks VISSIM Model (GTA, 2014).

Figure 7.8: Comparison of Total Travel Time, hours

![Bar chart showing comparison of total travel time across different years and stages.](chart2)

Source: NBH Roadworks VISSIM Model (GTA, 2014).
7.6.2 Intersection Performance

With the provision of the Stage 1 Connectivity Works, some of the intersections within the study area are predicted to operate with lower average vehicle delays, and therefore, some of these intersections may no longer be predicted to operate at LOS F in 2018 during the AM or PM peak periods (or both) without the proposed improvements. These intersections include:

- Warringah Road/ Hilmer Street
- Frenchs Forest Road West/ Rabbett Street
- Frenchs Forest Road/ Rumford Road.

The following intersections are still predicted to operate at LOS F after the completion of the Stage 1 Connectivity Works in 2018 during the AM or PM peak periods (or both):

- Warringah Road/ Forest Way
- Warringah Road/ Wakehurst Parkway
- Warringah Road/ Allambie Road
- Warringah Road/ Ellis Road/ Government Road
- Forest Way/ Adams Street
- Forest Way/ Naree Road
- Frenchs Forest Road/ Wakehurst Parkway.

7.7 Need for Stage 2 Network Enhancement Works

Under the Stage 2 Network Enhancement Works, it is proposed to grade separate the Forest Way, Hilmer Street and Wakehurst Parkway intersections along Warringah Road, and upgrade the intersection of Warringah Road and Allambie Road. It is expected that these works would improve the operation of the four intersections listed above. However, further detailed modelling would be undertaken to confirm the performance of these intersections as part of the EIS for Stage 2 of the project.
8. Construction Traffic Impacts

It is noted that the sequence of construction activities relating to the Concept Proposal and the Stage 1 Project are not yet fully known in detail, and will be refined as detailed design progresses after planning approval. However, in order to manage and limit the likely transport, traffic and access impacts of the construction activities involved in the Concept Proposal and Stage 1 Project, a general framework of principles, guidelines and parameters that would assist is set out in this Chapter.

A key component of the impact mitigating framework is the objective of maintaining the current peak period capacity of the road network during the construction stage of the Concept Proposal and the Stage 1 Project.

8.1 Construction Works

The overall components of the two stages of the Project involve the activities shown in Table 8.1.

Table 8.1: Stage 1 and Stage 2 Project Construction Activities

<table>
<thead>
<tr>
<th>Stage 1 Project – Hospital Connectivity Works</th>
</tr>
</thead>
<tbody>
<tr>
<td>Widening and intersection upgrades along sections of Forest Way between north of Warringah Road and south of Adams Street to include an additional right turn bay from Forest Way into Naree Road</td>
</tr>
<tr>
<td>Upgrading the existing bus zone fronting the Forest Way shopping centre on Forest Way to allow two buses to stop within the bay</td>
</tr>
<tr>
<td>Widening of Naree Road/Frenchs Forest Road West from two to four lanes</td>
</tr>
<tr>
<td>Widening of Frenchs Forest Road East from Wakehurst Parkway to Allambie Road from two lanes to four lanes</td>
</tr>
<tr>
<td>New traffic signals with controlled pedestrian crossing facilities at the intersections of:</td>
</tr>
<tr>
<td>o Forest Way and Naree Road</td>
</tr>
<tr>
<td>o Naree Road, Rabbett Street and Frenchs Forest Road West</td>
</tr>
<tr>
<td>o Frenchs Forest Road West and the new main access to the hospital opposite Gladys Avenue</td>
</tr>
<tr>
<td>o Frenchs Forest Road East and Romford Road</td>
</tr>
<tr>
<td>o Frenchs Forest Road East, Patanga Road and Allambie Road.</td>
</tr>
<tr>
<td>Widening and upgrading the intersection of Frenchs Forest Road West and East with Wakehurst Parkway</td>
</tr>
<tr>
<td>Widening of Wakehurst Parkway from about 330 metres north of the intersection with Frenchs Forest Road West and East to the intersection with Warringah Road</td>
</tr>
<tr>
<td>New bus priority lanes along approaches and departures to the Frenchs Forest Road West and East intersection with Wakehurst Parkway</td>
</tr>
<tr>
<td>Widening of Allambie Road to the north of the intersection with Warringah Road to include additional turning lanes into Frenchs Forest Road East from Allambie Road</td>
</tr>
<tr>
<td>Widening and upgrading the intersection of Warringah Road and Allambie Road to include an additional right turn lane into Allambie Road from Warringah Road</td>
</tr>
<tr>
<td>Widening of Warringah Road from about 700 metres east of the intersection with Allambie Road up to Courtley Road</td>
</tr>
<tr>
<td>New traffic signals, to be activated by buses only, to enable buses to cross the eastbound lanes of Warringah Road to enter Frenchs Forest Road East from the median lane on Warringah Road in the westbound direction</td>
</tr>
<tr>
<td>A left-in and left-out access on Warringah Road opposite Hilmer Street to provide an additional access point to the hospital.</td>
</tr>
</tbody>
</table>

continued
Stage 2 Project – Network Enhancement Works

- Widening and upgrading of Warringah Road from west of Fitzpatrick Avenue to west of Allambie Road including:
  - An underpass for eastbound and westbound through traffic extending from west of Forest Way to east of Wakehurst Parkway and at the intersections with Forest Way, Hilmer Street and Wakehurst Parkway
  - Eastbound and westbound travel lanes at surface level on either side of the underpass.

- A new pedestrian overbridge near Hilmer Street

- Removal and replacement of the existing pedestrian overbridge west of Forest Way

- Connecting Aquatic Drive to Wakehurst Parkway

- Widening and upgrading along sections of Wakehurst Parkway between Warringah Road and south of Aquatic Drive

- Widening and upgrading Allambie Road from Warringah Road to Rodborough Road

- Modifying the existing traffic signals at Hilmer Street to include the hospital access as a four-way intersection.

8.2 Construction Activities

The general construction activities for the Concept Proposal comprise:

- Spoil haulage by heavy vehicles
- Delivery of construction materials
- Movements of construction equipment
- Light vehicle movements (vans, utility pick-ups) associated with construction staff and contractors.

In addition, the grade separation works under the Stage 2 Project may require deliveries of structural beam and other large structures and may involve oversize and/or slow moving vehicles.

The traffic and transport impacts of Stage 2 Project construction activities will be assessed separately in more detail as part of the Stage 2 Project EIS, in line with the staged application approach for the Project. However, the general construction activities associated with both Stage 1 Project and Stage 2 Project comprise similar tasks, which include:

- Pre-construction activities
- Site establishment
- Site preparation
- Relocation/protection of services
- Earthworks
- Drainage
- Road widening and pavements (including improvements to existing pavements as required)
- Ancillary works
- Finishing works.

Table 8.2 outlines the potential pre-construction and construction activities associated with Stage 1 of the project. Similar activities are associated with the Stage 2 Project, albeit with different intensities and durations.
### Table 8.2: Potential Pre-Construction and Construction Activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Proposed Works</th>
<th>Plant and equipment</th>
<th>Approximate duration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-construction activities</strong></td>
<td>o Undertake dilapidation surveys as required.</td>
<td></td>
<td>1–6 months (prior to construction)</td>
</tr>
<tr>
<td></td>
<td>o Notify residents of construction works.</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>o Leasing or acquisition of land.</td>
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<td></td>
</tr>
<tr>
<td><strong>Site establishment</strong></td>
<td>o Fencing of construction areas of the road corridor, including marking out of construction impact area.</td>
<td>Fences, portable sheds, portable toilets and fuel storage tanks</td>
<td>1–2 months</td>
</tr>
<tr>
<td></td>
<td>o Implementation of initial environmental safeguards.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Establishment of construction site facilities and access.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Additional surveys and geotechnical investigations, as required.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Installation of temporary traffic controls and line marking.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Installation of temporary (construction) signage and lighting.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Application of noise construction treatment works.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Site preparation</strong></td>
<td>o Prior to vegetation clearing the following activities would be undertaken: marking out no go zones; identifying fauna habitat trees through pre-clearing surveys; and avoiding habitat trees where possible.</td>
<td>Trucks, bulldozers, scrapers, excavators, front end loaders, backhoes, road sweepers and small equipment.</td>
<td>1–3 months</td>
</tr>
<tr>
<td></td>
<td>o Vegetation clearing and grubbing. Processing (including recycling) of various materials for use in landscaping activities.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Installation of site sediment and erosion controls and pollution management measures.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Construction of temporary diversion drains.</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>o Stripping and stockpiling of topsoil for reuse.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Adjustment of some property accesses.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Relocation/ protection of services</strong></td>
<td>o Consultation with relevant service providers on service relocation.</td>
<td>Trucks, cranes, excavators, elevated work platform vehicle, backhoes and trenchers, jack hammers, concrete saws, trenching equipment, and small equipment.</td>
<td>6–10 months</td>
</tr>
<tr>
<td></td>
<td>o Relocation or protection of services.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity</td>
<td>Proposed Works</td>
<td>Plant and equipment</td>
<td>Approximate duration</td>
</tr>
<tr>
<td>----------------------------------</td>
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</tr>
</tbody>
</table>
| **Earthworks**                   | o Removal and stockpiling of spoil and unsuitable material.  
   o Based on estimates drawn from the concept design, it is predicted that there would be about 35,850 cubic metres of cut produced, and 4,300 cubic metres of fill required for the project. Where possible cut would be re-used as fill for the project.  
   o Batter treatments would be undertaken adjacent to the proposed road surface of Frenchs Forest Road, on the south-western and south-eastern corners of the Wakehurst Parkway intersection.  
   o Retaining wall along new and existing property boundaries as required as part of property adjustment works and in some places to limit the extent of vegetation clearing. | Trucks, bulldozers, excavators, front end loaders, dump trucks, road trucks, road sweepers, scrapers, cherry pickers, jack hammers, concrete saws, two tonne road roller, vibratory rollers, graders, water carts, compactors, rollers, rock crushing equipment and elevated work platform vehicle. | 2–4 months           |
| **Drainage**                     | o Preparation of construction diversion drains and sedimentation ponds (if required).  
   o Construction of road drainage structures, including culvert extensions.                                                                                                                                   | Concrete pumps, cranes, excavators, trucks, trenching equipment, small equipment and elevated work platform vehicle.                                                                                   | 2–4 months           |
| **Road widening and pavements** | o Excavate and box out road widening sections.  
   o Stabilise and compact the existing sub-grade material.  
   o Construction of pavement layers including selected material, sub-surface drainage, sub-base, base layers and surfacing.                                                                           | Road trucks, front end loaders, bulldozers, dump trucks, excavators, graders, scrapers, road sweepers, concrete trucks, water carts, cherry pickers, jack hammers, concrete saws, two tonne road roller, vibratory rollers, asphalt/concrete pavers, compactors, generators, trenching equipment, bitumen sprayers, line marking machine | 2–4 months           |
| **Other works**                  | o Installation of lighting and roadside furniture.  
   o Installation of traffic lights.  
   o Line marking.  
   o Sign posting.  
   o Landscaping.  
   o Relocation of property accesses.                                                                                                                                                                   | Trucks, fencing and barrier materials, landscaping materials, cranes, line marking machine and small equipment.                                                                                      | 1–2 months           |
| **Finishing works**             | o Removal of temporary works.  
   o Rehabilitation of disturbed areas.  
   o Restoration and landscaping of construction compounds.  
   o Site clean-up and re-use of or disposal of any remaining surplus waste materials.                                                                                                                                 | Trucks and landscaping materials.                                                                                                                                                                              | 1–2 months           |
8.2.1 Construction Program

The Stage 1 Project would be delivered in a single construction program starting in 2015, and would take about 24 months to complete (weather permitting). Staging within the construction program would be determined by the construction contractor during detailed design and construction planning.

Stage 2 Project activities could overlap with other Stage 1 Project activities, ie the start of Stage 2 Project construction would not necessarily occur after completion of the Stage 1 Project.

8.2.2 Construction Methodology

Construction methods used for the project would be conventional techniques employed on road projects, adapted to account for project-specific traffic, transport, environmental and social constraints, to ensure the project is constructed in a safe, operationally functional, and efficient manner.

Equipment and plant requirements would be determined during detailed design and during the development of the construction methodology by the construction contractor. Details of the proposed Stage 1 Project pre-construction and construction activities, including the potential duration of each construction activity, are provided in Table 8.2.

Construction activities and works within each activity may occur simultaneously. As noted above, the Stage 2 Project works may also overlap with the latter activities in the Stage 1 Project.

The construction of the project stages would be undertaken by a contractor(s), to be selected following a tendering process. During detailed design of the project, a detailed work methodology would be refined and finalised. The detailed work methodology would take into consideration construction activities occurring, or programmed to occur, on the hospital site.

Construction activities would be guided by a construction environmental management plan (CEMP) to ensure work is carried out in accordance with the Director-General’s conditions of approval and to Roads and Maritime specifications. A component of the CEMP will be a construction traffic management plan(s).

8.2.3 Construction Staging Area

The project would need to be constructed while maintaining traffic flows. There are very limited opportunities to locate construction compounds within the road corridor, with no prolonged road closures anticipated. To accommodate the storage of materials, equipment and vehicles for the project and to provide a site office, a compound site of about three hectares has been identified at a location as close as possible to the construction area on Aquatic Drive, Frenchs Forest.

The construction compound would be utilised for the duration of the construction period for both Stage 1 and Stage 2 of the project. The existing buildings are planned to be retrofitted and used for administrative and project management support.

The construction compound would provide support to the construction sites and would comprise:

- Hardstand - The whole area would be covered in hardstand.
- Use of existing buildings on the site or temporary buildings (generally prefabricated) with:
  - Offices and meeting rooms.
  - Reception and general administration area.
  - Amenity, first aid and toilet facilities.
- Parking areas.
- Materials laydown and storage areas. These would include purpose-built temporary structures as required.
- Perimeter fencing, including visual screening of compounds where necessary.

No building demolition would be required to establish the construction compound. Minor works would be undertaken to the existing roundabout at the intersection of Aquatic Drive and Allambeie Road, to provide direct access to the site from the roundabout.

The site would be securely fenced with temporary fencing. All necessary signage advising the general public of access restrictions would be provided.

Figure 8.1 shows the location of the proposed construction compound off Aquatic Drive, while Figure 8.2 shows the layout for the site.

Figure 8.1: Proposed Construction Compound Location
8.3 Concept Proposal Construction Impacts

The Concept Proposal’s construction activities will generate transport and traffic impacts that generally involve the following:

- Temporary road closures
- Traffic diversions for general traffic and for buses
- Footpath and shared path diversions
- Temporary restrictions to property access.

Potential impacts caused by construction of the Concept Proposal generally include:

- Increased travel times due to road works restrictions and thus reduced speed limits around construction sites.
- Increased travel times due to increased truck and construction machinery movements, including in the vicinity of the construction compound.
- Increased travel times due to potential rerouting/diversion to alternative routes, including for walking and cycling.
- Temporary partial or complete closure of roads and altered property access during construction.
- Temporary changes to bus access arrangements, including stop relocation, resulting in increased walk distance for certain customers.
- Temporary or permanent decrease in kerbside parking.
- Temporary impacts of vehicle and pedestrian access arrangements to The Forest High School, including service and emergency vehicle access, and particularly during school peak activity periods such as start and finish times.
Potential safety issues relating to increased heavy vehicle movements, as well as to higher traffic flows temporarily traversing lower-capacity road sections.

It is noted that while these impacts are temporary in nature, they could be significant. Key intersections in the road network within the precinct are already operating at or beyond capacity (as discussed in Chapter 2 and Chapter 5 of this report). There are also limited opportunities for diverting through traffic to other routes, due to the lack of viable alternative routes in the precinct.

8.3.1 Concept Proposal Construction Traffic

In order to shorten the construction period, the construction works would be completed across multiple fronts. The works are typically sequential and each front may have multiple disciplines working simultaneously making new work available for the following crew.

During construction of the Concept Proposal, it is expected that there would be approximately up to 250 to 300 heavy vehicle movements (on average) per day. More than half of this estimate, about 160 daily truck movements, is generated by spoil removal activities from the proposed underground bypass (slot) and for the Warringah Road westbound lanes.

In addition to the truck movements, there will be light vehicle movements associated with staff, labourers, subcontractors and small deliveries. This light vehicle traffic will generally be to and from the administration and support site compound and the work sites. It is estimated that there would be about 30 to 50 light vehicle movements associated with construction personnel travelling to and from the project site during construction, as well as up to 150 onsite light vehicle movements daily.

Construction traffic as a result of the Concept Proposal is not considered to be substantial, given that the key road section in the area currently carry close to 45,000 vehicles per day. However, reduction of traffic capacity due to the construction works would potentially create significant impacts, and need to be managed in a manner that achieves existing capacity levels during peak periods.

Localised impacts may also occur in proximity to site access points for construction vehicles. Roads and Maritime would prepare a Construction Traffic Management Plan to manage construction traffic associated with the Concept Proposal. Designated access and haulage routes for construction vehicles would be along the arterial road network where practicable (ie Warringah Road west of Allambie Road, Wakehurst Parkway and Forest Way.)

Impacts of the Proposed Construction Compound on Allambie Road

Allambie Road in the vicinity of the Rodborough Road intersection (roundabout) carries about 2500 vehicles in the AM peak hour and about 1800 vehicles in the PM peak hour. The estimated construction traffic movements to and from the construction compound during the Concept Proposal would be expected to be up to 160 heavy vehicle movements per day and up to 200 light vehicle movements per day. It has been assumed that of the estimated 160 daily truck movements generated by spoil removal activities, the majority would travel via the designated haulage routes (Warringah Road, Wakehurst Parkway and Forest Way) to external locations to dispose of excess material. However, it is possible that up to 15 percent of these movements may travel to the construction compound to stockpile spoil to be reused as fill for the project.

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4 Data source: SkyHigh traffic counts undertaken at the Rodborough Road/Allambie Road intersection on 20 March 2012 for Roads and Maritime.
Based on the above, construction volumes along Allambie Road are expected to be up to 25 heavy vehicle movements per hour and 30 light vehicle movements per hour during the AM and PM peak hours, on the assumption that 15 percent of total daily movements occur during the peak hours. This would constitute about 2.2 percent and 3.0 percent of the total Allambie Road AM and PM peak hour traffic volumes, respectively. This would result in minor impacts on traffic relating to traffic volume contribution.

In order to further mitigate these impacts, traffic control measures in accordance with existing guidelines and policies would need to be prepared to manage traffic flows in and out of the proposed construction compound.

### 8.3.2 Potential Road Closures

Construction activities would be staged in order to allow traffic movements along alternative roads where possible. Where road closures will be required, construction activities should be undertaken in a manner that minimises reduction in traffic capacity, particularly during peak periods.

While details for these will be developed during the Project’s detailed design stage/s, including for the Stage 2 Project, partial road closures would potentially be required for the following roads:

- Warringah Road, between Government Road/Ellis Road and Fitzpatrick Avenue
- Wakehurst Parkway, between north of Frenchs Forest Road and south of Aquatic Drive
- Forest Way between south of Naree Road and Warringah Road
- Frenchs Forest Road West
- Naree Road
- Frenchs Forest Road East.

The road closures would be staged so as to allow priority for traffic movements in the peak direction, and alternate diversion routes provided. These diversions would potentially include roads in the wider region beyond the immediate precinct, including Mona Vale Road and the Spit Road-Military Road corridor.

As noted above, a construction compound as close as possible to the construction area, about three hectares in size, is proposed to be used. This is located off Aquatic Drive. The centralised construction compound and staging area would reduce the requirement for additional road closures at local construction sites, but increases construction traffic movements between the construction site and the construction compound. The section of Allambie Road between Aquatic Drive and Frenchs Forest Road is expected to carry practically all construction traffic generated by the construction compound during the Stage 1 Project, including heavy vehicle movements delivering materials and equipment storage/deployment, as well as light vehicle movements associated with construction staff.

The section between Aquatic Drive and Warringah Road will continue to carry construction compound generated traffic in the Stage 2 Project.

It is noted that in the 2012 Base Conditions traffic modelling (Section 5.3), the Allambie Road/Warringah Road intersection was already operating at Level of Service E during peak periods, and additional construction traffic generated during peaks would further worsen its operating condition.
8.3.3 Kerbside Parking

The construction of the Concept Proposal would require alterations to kerbside parking arrangements, particularly along Frenchs Forest Road. Significant sections of Wakehurst Parkway, Forest Way and Warringah Road are zoned as No Stopping areas, and as such, the construction of the Concept proposal would have limited impacts on kerbside parking demand on these roads.

However, the construction of the Concept Proposal would potentially shift current kerbside parking demand on the Frenchs Forest Road corridor to side streets. Analysis of parking survey information indicates that the following roads already are reaching kerbside parking capacity, particularly during weekdays:
- Naree Road
- Rabbett Street
- Patanga Road.

Along the north side of Frenchs Forest Road West, the section between Bluegum Crescent East and Gladys Avenue had an average weekday parking occupancy of 20 percent, while on the south side, the section west of The Forest High School to Rabbett Street had an average parking occupancy during the weekday of about 30 percent.

The demand for kerbside parking is currently at a level that could be temporarily accommodated along side streets, except for Naree Road, where a high demand for commuter car parking has been observed from the surveys and the site investigations. Given that Rabbett Street south of Naree Road is also operating at full capacity in terms of kerbside parking occupancy, the construction of the concept proposal would potentially shift commuter parking demand around the Naree Road/Rabbett Street area further to the north, potentially closer along Rabbett Street between Naree Road and Adams Street. Based on the parking surveys, there would be just enough remaining capacity on unrestricted parking spaces along Rabbett Street north of Naree Road to accommodate displaced kerbside parking on Naree Road.

8.3.4 Cumulative Construction Impacts

There are two key proposed developments in the surrounding area the construction traffic of which are expected to contribute towards cumulative construction traffic and access impacts to the Concept Proposal:
- Northern Beaches Hospital
- Mona Vale Road Upgrade.

Aside from these two, there are no other significant proposed developments whose traffic impacts are expected to contribute to cumulative construction traffic impacts.

Northern Beaches Hospital

The construction period of the Concept Proposal would overlap with the construction of the Northern Beaches Hospital, and additional traffic movements generated by construction activities would significantly impact on the transport and traffic operations in the precinct. Both projects would be using the arterial road network (ie Warringah Road, Wakehurst Parkway and Forest Way) for construction access routes, and these additional construction traffic movements would further use up limited capacity on the network, particularly if undertaken during peak commute periods.
The hospital construction activities would generally be limited to the NBH site on Frenchs Forest Road. However, it would also require Frenchs Forest Road West as an access route for construction traffic. As the NBH construction would likely overlap with the Stage 1 Project construction (focusing on Frenchs Forest Road), cumulative impacts of the construction phases of the two projects would significantly affect Frenchs Forest Road West, including residential areas along Frenchs Forest Road West and along local streets to the north (eg Cobb Street, Sylvia Place, Gidya Street, Bluegum Crescent, and Gladys Avenue), as well as The Forest High School. Access to these areas would be constrained, and additional travel delays are likely.

Delays from these cumulative impacts would also affect bus travel times along Frenchs Forest Road.

Access to Frenchs Forest Road East and the intersecting local streets could also be impacted by the cumulative effects of the project’s and the NBH’s construction activities, albeit to a less extent that the impacts on Frenchs Forest Road West. These cumulative impacts on Frenchs Forest Road East would consist generally of increased travel time due to delays along Frenchs Forest Road West and the Frenchs Forest Road/Wakehurst Parkway intersection.

Mona Vale Road Upgrade

Roads and Maritime is undertaking the Mona Vale Road upgrades aimed at improving safety and traffic efficiency. There are three components of the Mona Vale Road upgrade:

- Stage 1: Mona Vale Road East interim works – Minor upgrade of the Mona Vale Road/Ponderosa Parade & Samuel Street intersection at Mona Vale, involving widening of Mona Vale Road to two lanes westbound from Foley Street through the Ponderosa Parade roundabout and to two lanes eastbound through the roundabout.
- Stage 2: Mona Vale Road East Upgrade – Upgrade of 3.2 km of Mona Vale Road from two lanes to four lanes between Manor Road, Ingleside and Foley Street, Mona Vale.
- Stage 3: Mona Vale Road West upgrade – Upgrade of 3.2 km of Mona Vale Road from two lanes to four lanes between McCarrs Creeks Road, Terrey Hills and Powder Works Road, Ingleside.

The components of the upgrade are shown in Figure 8.3.

It is anticipated that during the construction of the Mona Vale Road upgrade, a portion of Mona Vale Road traffic could divert via Warringah Road, although an estimate of this diversion is not yet known at this stage. However, the cumulative impacts of the Mona Vale Road Upgrade and the Concept Proposal would potentially increase peak period traffic volumes on Warringah Road, Wakehurst Parkway and Forest Way, which reinforces the requirement for maintaining peak period traffic capacity throughout the study area network in order to manage and mitigate these impacts.
8.3.5 Recommended Mitigation Measures

The project being undertaken in stages (Stage 1 Project and Stage 2 Project) would likely contribute towards managing the traffic impacts of the concept proposal during construction. The increase in traffic capacity arising from the Stage 1 Connectivity Works positively contributes towards mitigating the traffic impacts of the construction phase of the Stage 2 Network Enhancement Works.

In order to further mitigate the impacts of the concept proposal during construction, a detailed construction traffic and transport impact assessment will need to be prepared during detailed design stage (for both Stage 1 Project and Stage 2 Project), when construction staging and activities would be determined. Further, during the respective tender stages, detailed Construction Traffic Management Plans will need to be prepared and assessed.

The Construction Traffic Management Plans would need to take into consideration how peak period traffic demand could be accommodated within the precinct with the reduction in traffic capacity of the affected roads and the increase in construction traffic movements. This may necessitate further traffic modelling to incorporate construction staging scenarios, prior to finalisation.

Potential mitigation measures that could be considered during construction of the concept proposal include:

- Reconfiguration of affected intersections throughout the precinct to maintain existing traffic capacities for peak turning movements and mid-section flows
- Temporary provision of additional/alternative traffic lanes where the road reserve is wide enough to allow additional flows/lanes
- Restrictions in certain turning movements at key intersections to improve traffic operation such as at Forest Way and Warringah Road.
- Temporary reconfiguration of bus routes or relocation of bus stops

Source: Roads and Maritime Services – Mona Vale Road Upgrade Project Documents website
Ensuring pedestrian pathways along major desire lines are maintained at all times
Scheduling of construction activities to limit traffic capacity reductions and construction movements during the peak periods.

8.4 Stage 1 Project Construction Impacts

The Stage 1 Project involves improving existing road and transport conditions connecting the NBH with the precinct road transport network. Stage 1 of the project involves construction of road network improvements focused on:

- Naree Road/ Frenchs Forest Road West/Naree Road, between Wakehurst Parkway and Forest Way and Wakehurst Parkway.
- Frenchs Forest Road East, between Wakehurst Parkway and Warringah Road.
- Forest Way, between north of the Naree Road intersection and north of the Rabbett Street intersection.
- Wakehurst Parkway, between about 330 metres north of the Frenchs Forest Road intersection and Warringah Road.
- Warringah Road, between east of the Rodborough Road intersection and about 100 metres east of the Courtly Road intersection.

The Stage 1 Project also incorporates improvements at intersections of Frenchs Forest Road with the following local streets:

- Rabbett Street
- Cobb Street
- Sylvia Place
- Bluegum Crescent West
- Bluegum Crescent East
- Gladys Avenue
- Proposed NBH Access 1
- Proposed NBH Access 2 (ambulance only)
- Skyline Place
- Romford Road
- Hurdis Avenue
- Harmston Avenue
- Inverness Avenue
- Patanga Road.

The extent of these works generally extends to no more than about 40 metres from Frenchs Forest Road.

The road improvements to be constructed involve road widening, intersection augmentation (ie additional or longer turning lanes), additional or altered pedestrian crossings and signalisation.

8.4.1 Stage 1 Project Construction Traffic

During construction of the Stage 1 Project, there would be approximately 30 to 40 heavy vehicle movements (on average) per day, increasing to between 60 and 100 during peak periods of construction activities such as during pavement and asphalt works. In addition, there would be about 20 to 30 light vehicle movements associated with construction personnel travelling to and from the project site during construction, as well as up to 100 onsite light vehicle movements daily.
Construction traffic as a result of the Stage 1 Project is not considered to be substantial, given that the eastern section of Warringah Road currently carries more than 44,000 vehicles per day. However, localised impacts may occur in proximity to site access points for construction vehicles, particularly on Frenchs Forest Road. Roads and Maritime would prepare a Construction Traffic Management Plan to manage construction traffic associated with the Stage 1 Project. Designated access and haulage routes for construction vehicles would be along the arterial road network where practicable (ie Warringah Road west of Allambie Road, Wakehurst Parkway and Forest Way.)

Figure 8.4 shows the proposed extent of work for Stage 1 Project.
8.4.2 Construction Access and Haulage Routes

The key construction access routes for the project would be limited to State Roads in the network, ie Warringah Road, Wakehurst Parkway and Forest Way, as well as the section of Allambie Road (a Regional Road) between Warringah Road and the proposed construction compound on Aquatic Drive.

Localised construction traffic movements would occur on Frenchs Forest Road as part of the Stage 1 Project construction activities.

8.4.3 Earthworks and Spoil Disposal

The Stage 1 Project would involve earthworks at various locations within the construction impact area. Based on estimates drawn from the concept design, it is predicted that about 35,850 cubic metres of material would be excavated, and 4300 cubic metres of fill would be required. Surplus material that cannot be used on site would be reused or disposed of.

The estimated quantities of materials for import, re-use and disposal would be refined during detailed design and the development of the construction methodology by the construction contractor.

8.4.4 Workforce and Construction Work Hours

Workforce

The construction workforce is expected to fluctuate in number throughout the Stage 1 Project construction period, depending on the stage of construction and associated activities. The workforce would be expected to peak at about 100 personnel per day. On either side of this peak period, daily workforce numbers would fluctuate between about 40 and 60 personnel at any given time during the construction period. The final number of construction workers would be determined by the construction contractor.

Construction Hours

The majority of construction works would be undertaken during the standard working hours of between:

- 7am and 6pm Monday to Friday.
- 8am and 1pm on Saturdays.

There would be no construction works on Sundays or public holidays.

To minimise disruption to daily traffic and disturbance to surrounding land owners and businesses, some construction activities would also be undertaken outside of the standard and extended construction hours in the following circumstances:

- If works do not cause construction noise to exceed the noise management levels.
- For the delivery of materials or oversized structural elements, required outside these hours by the police or other authorities for safety reasons.
- For the construction of tie-ins, intersections, utility cross-overs, and where there is potential for safety issues with pedestrians or vehicles.
- Where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm.
As agreed through negotiations between Roads and Maritime and potentially affected sensitive receivers. Any agreement would be recorded in writing and a copy kept on-site for the duration of the works.

Works outside of these hours would be avoided where possible; however should work be required during these times, the procedure contained in the Roads and Maritime Environmental Noise Management Manual 2001, “Practice Note vii – Roadworks Outside of Normal Working Hours” and the Interim Construction Noise Guidelines (ICNG) (DECCW 2010) would be followed. Local residents would be notified prior to any construction activities undertaken outside of standard construction hours.

8.4.5 Key Traffic and Transport Impacts during Construction of the Stage 1 Project

The Stage 1 Project construction activities will generate additional traffic and transport and traffic impacts that generally involve:

- Temporary road closures
- Traffic diversions, particularly along the local streets intersecting with Frenchs Forest Road
- Bus rerouting and bus stop relocation
- Footpath diversions.

Potential impacts caused by construction of the Stage 1 Project include:

- Increased travel times due to road works restrictions and thus reduced speed limits around construction sites on Forest Way, Naree Road, Frenchs Forest Road, Wakehurst Parkway and Warringah Road (east of Allambie Road).
- Increased travel times due to increased truck and construction machinery movements, particularly on the section of Allambie Road between the construction compound off Aquatic Drive and Frenchs Forest Road East, to access local construction areas on Frenchs Forest Road.
- Increased travel times due to potential rerouting/diversion to alternative routes, including for buses, walking and cycling.
- Temporary partial or complete closure of roads and altered property access during construction. These include all roads linking with Frenchs Forest Road West and Frenchs Forest Road East, covering local streets, residential driveways and access to business parks along Frenchs Forest Road East, the Forest High School and the police station on Frenchs Forest Road West.
- Temporary changes to regular scheduled bus operations and school bus access arrangements, including potential relocations of existing bus stops, which may result in increased walk distances, reduced passenger waiting or queuing areas and potential additional safety risks associated with pedestrian access and crossings for bus customers.
- Temporary or permanent decrease in kerbside parking availability along Frenchs Forest Road and Naree Road.
- Potential safety issues relating to increased heavy vehicle movements, as well as to higher traffic flows temporarily traversing lower-capacity road sections (ie Frenchs Forest Road and Naree Road).

It is noted that while these construction transport impacts are generally temporary in nature, they could be significant, depending on the detailed staging of construction activities and the specific local area. It is critical to consider these potential impacts during development of detailed design of the project in order to inform more detailed sequencing of construction.
activities during the Stage 1 Project. Construction Traffic Management Plans will subsequently need to be prepared to define the details of how transport and traffic impacts on network flows and connectivity would be managed and mitigated.

Construction traffic would be managed in accordance with the measures outlined in the Traffic Control at Worksites (Roads and Maritime, 2010) document. Traffic management measures to be implemented during construction include undertaking the proposed works in a staged manner to reduce traffic impacts, and the provision of temporary access arrangements with private landowners whose property is adjacent to construction activities. Local residents and business owners would be notified of traffic management procedures, and ongoing consultation would be undertaken to provide landowners with information on planned construction activities and changes to any access arrangements.

Impacts to the road network

There is potential for access to individual properties along the Stage 1 Project construction area and adjacent connecting roads to be affected by construction activities. However, property access would need to be maintained throughout construction of the Stage 1 Project, unless otherwise agreed with property owners and businesses.

Specific local impacts on the key roads affected by Stage 1 Project construction include:

- **Naree Road/Frenchs Forest Road**
  - Temporary disruption to property access (including private properties, business parks and The Forest High School), for example vehicular access to driveways during road widening and pedestrian access on footpaths
  - Removal of kerbside parking
  - Changes to bus stop access arrangements, including reduced waiting areas for customers and potentially increased walking distances.
  - Potential relocation of school bus operations servicing The Forest High School to Warringah Road
  - Temporary traffic diversion from intersecting local roads to other local roads, resulting in increased travel times
  - Access restriction to residential properties on Gladys Avenue and Bantry Bay Lane which do not have alternative access/egress opportunities, particularly during road widening works on Frenchs Forest Road.
  - Vehicular access restriction to The Forest High School and the police station on Frenchs Forest Road West. Vehicular access to off-street parking areas within these properties would be severely restricted during the road widening works on Frenchs Forest Road West as part of the Stage 1 Project construction activities. Vehicle access would be maintained to these sites throughout the construction period but will likely require that temporary vehicle access points are provided.

- **Forest Way**
  - Disruption to pedestrian access due to footpath closure, and potentially longer walk routes to pedestrian crossings.
  - Potential increases in traffic delays and longer travel times as a result of capacity reduction.

- **Warringah Road** (between Government Road and west of Allambie Road)
  - Increased traffic delays due to reduction in capacity as partial closures are implemented.
  - Temporary disruptions to property access during road widening activities.
Wakehurst Parkway
- Increased traffic delays due to reduction in capacity (number of lanes along Wakehurst Parkway, as well as capacity of the Wakehurst Parkway/Frenchs Forest Road intersection).

Allambie Road
- Increased traffic delays as a result of Stage 1 Project construction generated traffic movements between the construction compound off Aquatic Drive and Frenchs Forest Road East.

Safety Impacts
The construction of the Stage 1 Project will likely create conditions that would increase road safety risks associated with the following:

- Decreased sight distances due to hoardings, temporary structures and parked heavy vehicles.
- Increased likelihood of collisions due to altered lane arrangements (including narrower travel lanes for vehicles).
- General stop–start driving conditions, particularly during peak periods, that would increase the likelihood of rear-end collisions
- Footpath diversions and slow-moving traffic that would potentially encourage risk taking activities by pedestrians
- Relocated bus stops that would alter customer access arrangements which may increase the likelihood of pedestrian crashes due to reduced sight distances, footpath width reduction or bus waiting area reduction.

Impacts on public transport operations
The construction of the Stage 1 Project would require changes to public transport operations in the precinct, particularly along Frenchs Forest Road. All existing bus stops on Frenchs Forest Road would be relocated during road widening works, most within the same general local area. However, during specific road widening construction activities, bus stop access would progressively be transferred to a nearby temporary location which could result in increased walk distances for some bus customers.

The construction activities could also require existing bus waiting areas to be reduced, which could have impacts to safety, by way of increasing risk for waiting bus passengers to be more vulnerable to moving general and construction traffic.

Impacts of the Stage 1 Project construction to bus operations in the precinct are focused on Frenchs Forest Road (Routes 136 and L60), Warringah Road (east of Allambie Road for Routes 169, 173 and E69), buses running along Forest Way (Routes L70, 270, 279, 281, 282, 283 and 284), and buses along the section of Allambie Road north of Aquatic Avenue (Routes 142, E66 and 280).

Impacts by the Stage 1 Project construction to bus operations include:

- Potential bus timetable delays due to roadworks’ speed restrictions and increased traffic congestion through key affected intersections.
- Potential temporary removal of existing bus priority arrangements, particularly at the Wakehurst Parkway/Frenchs Forest Road intersection and on Wakehurst Parkway between Warringah Road and Frenchs Forest Road. This would mean that during limited periods of construction activity, buses would not have any priority at the intersection, and would have to mix with general traffic.
- Alterations to bus stop arrangements, locations and access, including potentially decreased bus passenger waiting areas
- Bus manoeuvres on the Forest Way/Naree Road intersection

**Impacts to kerbside parking**

The construction of the Stage 1 Project would require alterations to kerbside parking arrangements, particularly along Frenchs Forest Road, which would potentially shift current kerbside parking demand along the Stage 1 Project construction zones to side streets. Analysis of parking survey information indicates that the following roads already are reaching kerbside parking capacity, particularly during weekdays:

- Naree Road
- Rabbett Street
- Patanga Road.

Along the north side of Frenchs Forest Road West, the section between Bluegum Crescent East and Gladys Avenue had an average weekday parking occupancy of 20 percent, while on the south side, the section west of The Forest High School to Rabbett Street had an average parking occupancy during the weekday of about 30 percent.

The demand for kerbside parking is currently at a level that could be temporarily accommodated along side streets, except for Naree Road, where a high demand for commuter car parking has been observed from the surveys and the site investigations. Given that Rabbett Street south of Naree Road is also operating at full capacity in terms of kerbside parking occupancy, the construction of the concept proposal would potentially shift commuter parking demand around the Naree Road/Rabbett Street area further to the north, potentially closer along Rabbett Street between Naree Road and Adams Street. Based on the parking surveys, there would be just enough remaining capacity on unrestricted parking spaces along Rabbett Street north of Naree Road to accommodate displaced kerbside parking on Naree Road.

**Impacts to walking and cycling**

The most significant impact to active transport with the Stage 1 Project construction is on disruption to pedestrian activity on footpaths, particularly along Frenchs Forest Road, which could require pedestrians to walk longer distances to access facilities or crossing locations, as well as potential increases in risk levels associated with footpath and crossing diversions.

Impacts on the existing Warringah Council designated cycle route along Iris Street could include increased vehicular traffic volumes that would be diverted from Warringah Road during construction the Stage 1 Project component between Allambie Road and Government Road. While there are no other existing designated cycle routes in the precinct that would be impacted by the Stage 1 Project construction, local (short-distance) cycling demand in the precinct could be affected in terms of increased general (diverted) and construction traffic volumes, as well as lane and shared path restrictions.

**Impacts of the Proposed Construction Compound on Allambie Road**

Allambie Road in the vicinity of the Rodborough Road intersection (roundabout) carries about 2500 vehicles in the AM peak hour and about 1800 vehicles in the PM peak hour. The estimated construction traffic movements during the Stage 1 Project is expected to reach 100 heavy and 100 light vehicle movements per day, or up to 15 heavy and 15 light vehicle movements per hour

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Data source: SkyHigh traffic counts undertaken at the Rodborough Road/Allambie Road intersection on 20 March 2012 for Roads and Maritime.
during the AM and PM peak hours, on the assumption that 15 percent of total daily movements occur during the peak hours.

On further assumption that all these movements would need to use the proposed construction compound on Allambie Road, these Stage 1 Project construction movements would constitute about 1.2 percent and 1.7 percent of the total Allambie Road AM and PM peak hour traffic volumes, respectively. This would result in very minor impacts on traffic relating to traffic volume contribution.

In order to further mitigate these impacts, traffic control measures in accordance with existing guidelines and policies would need to be prepared to manage traffic flows in and out of the proposed construction compound.

Impacts to the wider regional transport network

During the construction of the Stage 1 Project, it is expected that travel times would be higher due to the impacts of the various construction activities on traffic movement, including the potential for reduced speed limits within the construction area. However, as the major competing east-west routes are Mona Vale Road (about 8km to the north of Warringah Road) and the Spit Road/Military Road corridor (about 6km to the south of the Warringah Road), a significant increase in travel time through the construction zone would be required for any substantial shift in traffic volumes to these two alternative routes.

However, if the travel time between the Warringah Road and the alternative competing routes (Mona Vale Road or Spit Road/Military Road) was similar, the increase in travel time during the construction phase may result in some motorists selecting to use either alternative route (Mona Vale Road or Spit Road/Military Road) instead of Warringah Road. If this was to occur, the concept proposal may result in minor increases in traffic volumes on the Mona Vale Road and/or Spit Road/Military Road corridors during the construction phase of the Stage 1 Project.

In addition to the above, if partial road closures were to occur during the evening periods or weekends, this may result in significant increases in travel times through the corridor, which may then result in a shift in traffic volumes to the Mona Vale Road and/or the Spit Road/Military Road corridors.

Impacts to traffic operations of The Forest High School

The Stage 1 Project construction outside The Forest High School compound on Frenchs Forest Road West would bring about the following transport impacts:

- Restricted vehicular access for school staff to access the off-street car parking areas.
- Temporary disruptions to staff, service and emergency vehicle access.
- Altered school bus stop arrangements, including kerbside use east of the Gladys Avenue intersection and school bus manoeuvres on Frenchs Forest Road West.
- Restrictions on on-street parking and kiss-and-ride activity on Frenchs Forest Road West, particularly on the northern side.
- Temporary diversions to pedestrian footpaths and crossings.
- Potential increased safety risks to school students and staff associated with increased construction traffic movements, including heavy vehicles and equipment.

8.4.6 Construction Staging

Figure 8.5 to Figure 8.8 show the preliminary indicative traffic flow arrangements and construction areas for various phases of the construction of the Wakehurst Parkway/Frenchs Forest Road intersection as part of the Stage 1 Project.
These preliminary plans will be further refined during the detailed design stage, in particular to manage the impacts of the construction staging area on the remaining space available to maintain traffic lanes along key routes, such as Forest Way. Based on the modelling undertaken for this assessment, as well as from site observations, it is likely that a minimum of six lanes will be required to be maintained for Forest Way during peak periods throughout the project construction stage.

It is noted that more detailed plans covering construction traffic management would be prepared during the detailed design stage. These detailed construction traffic management plans would also be prepared for other components of the Stage 1 Project.
Figure 8.5: Wakehurst Parkway/Frenchs Forest Road Intersection – Indicative Phase 1 Traffic Plan

Source: Roads and Maritime Services
Figure 8.6: Wakehurst Parkway/Frenchs Forest Road Intersection – Indicative Phase 2 Traffic Plan

Source: Roads and Maritime Services
Figure 8.7: Wakehurst Parkway/Frenchs Forest Road Intersection – Indicative Phase 3 Traffic Plan

Source: Roads and Maritime Services
Figure 8.8: Wakehurst Parkway/Frenchs Forest Road Intersection – Indicative Phase 4 Traffic Plan

Source: Roads and Maritime Services
More detailed local construction phasing plans would also need to be prepared to manage impacts to property access during these works.

8.4.7 Cumulative Construction Impacts

The construction of the Northern Beaches Hospital (NBH Stage 2) would potentially be undertaken over a period which overlaps with the construction of the Stage 1 Connectivity Works component of the project. While NBH construction activities would be limited to the NBH site, construction traffic movements generated by the NBH construction would also increase construction traffic demand on an already congested network.

As construction access routes for the two projects would both be principally limited to State Roads, the additional construction traffic on these access routes would need to be managed and scheduled to limit impacts.

The NBH construction activities would generally be limited to the proposed hospital site on Frenchs Forest Road. However, it would also require access for construction vehicles via Naree Road, Frenchs Forest Road West and via the Bantry Bay Road link on Warringah Road. As the NBH construction would likely overlap with the Stage 1 Project construction (focusing on Naree Road, Frenchs Forest Road and sections of Forest Way, Wakehurst Parkway and Warringah Road east of Rodborough Road), cumulative impacts of the construction phases of the two projects would significantly affect Naree Road and Frenchs Forest Road West, including residential areas along Naree Road and Frenchs Forest Road West and along local streets to the north (eg Cobb Street, Sylvia Place, Gidya Street, Bluegum Crescent, and Gladys Avenue), as well as The Forest High School. Access to these areas would be constrained, and additional travel delays are likely. The NBH construction would generate additional traffic along Naree Road and Frenchs Forest Road West, which potentially would also be undergoing road widening as part of Stage 1 Connectivity Works. These combined scenarios would limit the available capacity along Frenchs Forest Road, and would increase impacts of Stage 1 Connectivity Works on property access, travel times, kerbside parking availability, pedestrian and cyclist connectivity and bus travel times.

It is also likely that during the construction of Stage 1 Connectivity Works and the NBH, traffic conditions on Naree Road and Frenchs Forest Road would be a factor that would potentially divert through traffic on Frenchs Forest Road to Warringah Road, increasing traffic demand on Warringah Road between Forest Way and Allambie Road, and further impacting on operating conditions.

It is also likely that certain construction activities of the Stage 1 Project would overlap with the early stages of the Stage 2 Project construction (grade separation of Warringah Road/Forest Way and Warringah Road/Wakehurst Parkway intersections, among others). The cumulative transport impacts of construction of the Stage 1 Project, the Stage 2 Project as well as the NBH is expected to be significant, and need to be carefully considered to inform an integrated scheduling of construction activities for the two stages of the road improvement project.

The road network in the precinct is constrained in both east-west and north-south movements. The key east–west routes are limited to Warringah Road and Frenchs Forest Road, while the key north south routes are limited to Wakehurst Parkway and the Forest Way–Allambie Road route.

During the Stage 1 Project construction as well as NBH Stage 2 construction focusing on Frenchs Forest Road, through traffic currently using Frenchs Forest Road as a preferred through route would likely divert to Warringah Road. On the other hand, when Warringah Road capacity becomes restricted during the Stage 2 Project construction, a portion of through traffic would be expected to divert to Frenchs Forest Road, particularly when the Project’s construction is staged.
in a manner that the additional traffic capacity on Frenchs Forest Road as part of the Stage 1 Project could be utilised to accommodate diverted traffic from Warringah Road during the Stage 2 Project construction. If both Frenchs Forest Road and Warringah Road traffic capacities are restricted as a result of construction staging, the cumulative transport impacts of such a scenario would create significant traffic delays. The delays from these cumulative impacts would also significantly affect bus travel times in the precinct, for both regularly-scheduled buses as well as school buses. While it is difficult to quantify the magnitude of the cumulative traffic impacts, it could be compared on a quasi-quantitative level relative to the base 2012 conditions, in the sense that the intersection operation levels of service, for example (refer Table 2.4), would only be worse. Thus, it is likely that the operation of the four intersections already operating at LOS F during the peak periods:

- Forest Way/Adams Street intersection
- Forest Way/Warringah Road intersection
- Wakehurst Parkway/Frenchs Forest Road intersection
- Wakehurst Parkway/Warringah Road intersection.

The Allambie Road/Warringah Road intersection, as well as the Naree Road/Frenchs Forest Road West/Rabbett Street intersection were operating at LOS E, and could be expected to deteriorate to LOS F with cumulative construction impacts.

Other cumulative impacts of Stage 1 Project, Stage 2 Project and NBH project construction activities that need to be considered during detailed design include:

- Impacts on access to properties on Frenchs Forest Road West
- Access to The Forest High School.

8.5 Potential Traffic Mitigating Measures during Construction

A more refined evaluation of the impacts of construction traffic would be undertaken during the detailed design stage, when the phasing of construction activities is defined at a more detailed level. This may likely include additional traffic modelling to fine tune and inform the development of construction traffic management plans.

Notwithstanding this, this section presents potential mitigating measures that may be considered to manage the impacts of traffic during construction of the Stage 1 Project.

8.5.1 Construction Hours

Subject to other environmental impacts (e.g., noise), construction traffic movements would be limited to off-peak periods. The existing road network is heavily used during peak periods, and the additional construction traffic demand would need to be staggered to minimise additional traffic generation during peak periods.

8.5.2 Alternate Routes

The Stage 1 Project activities would be focused on Frenchs Forest Road. Detailed construction staging would inform the sections of Frenchs Forest Road that would be accessed by construction vehicles for each phase of Stage 1.

The preliminary indicative construction traffic management schemes for the Frenchs Forest Road/Wakehurst Parkway intersection for each key construction phase are shown in Figure 8.5 to Figure 8.8. These preliminary schemes provide a framework for managing traffic flows through
these intersections during various Stage 1 Project construction phases, although it is noted that these will still be reviewed and refined during the detailed design stage.

The refinements should take into consideration the increased traffic demands on alternate routes, in particular along Warringah Road between Forest Way and Allambie Road, as it provides the most direct alternative route for through traffic avoiding Frenchs Forest Road.

Other potential alternate routes could incorporate traffic diversions through local roads (eg Grace Avenue), at least during peak periods. However, the impacts of these potential diversions on local amenity could be significant, and would have to be included in the more detailed assessment once the phasing of construction activities are better defined.

8.5.3 Construction Vehicle Access Routes

The wider construction vehicle access routes for the Stage 1 Project would be limited to the arterial road network, ie Warringah Road, Wakehurst Parkway and Forest Way. Construction traffic movements along Allambie Road would also occur between the local construction sites and the construction compound off Aquatic Drive. Access to the proposed construction compound would need to be designed that links as direct as possible to the Aquatic Drive/Allambie Road intersection (albeit designed in a safe manner). This would minimise impacts to sections of Allambie Road south of Aquatic Drive (eg Arnhem Road, Sunlea Place).

While it is expected that there would be construction traffic along various sections of Frenchs Forest Road as part of construction activity, it should not be used as a through route for construction vehicles during the Stage 1 Project construction.

Key construction tasks requiring heavy vehicle movements would need to be undertaken as much as possible outside the peak commute periods between 7–9am and 4–6pm.

8.5.4 Property Access

Access to properties along affected roads, particularly along Frenchs Forest Road, would need to be maintained during construction. Where temporary vehicular access is required to be cut-off, alternative access arrangements would need to be agreed with affected property managers/owners. This will be undertaken during the detailed design stage and as part of construction traffic management planning.

Where possible, alternative access driveways to private developments would need to be further investigated. This could potentially include temporary driveway access off Warringah Road (eg for The Forest High School and a number of business parks along Frenchs Forest Road East).

A plan for maintaining vehicle access to The Forest High School, in particular service and emergency vehicle access, would need to be incorporated into any construction traffic management plan that would be prepared for construction activities along Frenchs Forest Road West. The designated access location to The Forest High School should be clearly signposted, with directional guide signs installed at appropriate locations. It is noted that throughout the construction stage, the designated access could potentially change. Guidance should correspondingly be adjusted.

8.5.5 Road Safety Audits

It is also recommended that construction stage road safety audits for key Stage 1 Project construction scenarios be undertaken to determine potential safety risks to vehicle users, bus customers, pedestrians and cyclists.
8.5.6 Mitigating Cumulative Impacts with NBH construction

In order to mitigate cumulative impacts arising from the construction of the Stage 1 Connectivity Works and the NBH construction, construction access to the hospital site should investigate opportunities of ingress/egress to the NBH site via the Warringah Road/Bantry Bay Road intersection.

The scheduling of construction activities between the two projects should be coordinated, with construction traffic movements generally limited to off-peak periods.

The minimum levels of lane availability should also be maintained for key road sections (e.g., Forest Way should be maintained with 6 lanes during peak periods).
9. Summary

9.1 Overview

Roads and Maritime Services (Roads and Maritime) is proposing a suite of road works to enhance arterial and sub-arterial road network connectivity in the proposed Northern Beaches Hospital precinct at Frenchs Forest, to be known as the Northern Beaches Hospital – Connectivity and Network Enhancement Project (the project). The project is proposed to be approved in stages, with this EIS seeking to obtain approval for the Stage 1 Project and concept approval for the project as a whole. GTA Consultants have been engaged by SMEC Australia to undertake a traffic and transport assessment in order to inform this EIS. The scope of the transport assessment includes an investigation of the Frenchs Forest precinct road network and the traffic, transport and access impacts of the proposed project.

9.2 Existing Conditions

9.2.1 Traffic Performance

The arterial road network within the precinct experiences high levels of traffic congestion and volatility, with several of the major intersections operating at or over capacity. During the weekday morning peak period, the network has capacity limitations that make it particularly prone to congestion and subsequent ‘rat running’ of excess demand along local streets. It frequently enters grid-locked conditions despite being tightly managed through access and turning restrictions, and intensive signal coordination.

The modelling of the 2012 Base scenario indicates that the following intersections currently operate at LOS F during either the AM or PM peak periods (or both):

- Forest Way/ Adams Street
- Forest Way/ Warringah Road
- Wakehurst Parkway/ Frenchs Forest Road
- Wakehurst Parkway/ Warringah Road.

Travel time surveys undertaken in 2013 along Warringah Road indicate that the average speed in the westbound direction during the AM peak period (7–9am) is 20 km/h and in the eastbound direction during the PM peak period (4–6pm) is 30 km/h.

9.2.2 Freight Routes

Forest Way, Wakehurst Parkway north of Warringah Road and Warringah Road west of Allambie Road are all designated as Higher Mass Limit (HML) roads that can take up to 68 tonne semi-trailers and B-Doubles, while the remaining sections of Wakehurst Parkway (south of Warringah Road) and Warringah Road (east of Allambie Road) could accommodate 4.6 metre high vehicles.

9.2.3 Public Transport

Buses are the predominant form of public transport on the Northern Beaches as the nearest railway station, located at Chatswood, is about 9 kilometres to the west. Within the study area, there are a number of bus priority measures, including bus lanes, bus queue jumps and dedicated bus only sections of the road network. Observations indicate that although bus
services are frequent in the study area, they commonly experience considerable delays in traffic through the network.

9.2.4 Crash History

A total of 270 crashes were recorded in the study area during the period from January 2010 to June 2013, with these crashes resulting in personal injury or property damage. Half of these crashes were rear-end collisions, and five crashes involved pedestrians. 24 crashes were recorded on Frenchs Forest Road East and eight crashes were recorded on Frenchs Forest Road West/Naree Road. This is likely due to the ‘stop-and-go’ traffic conditions arising from the heavy congestion during peaks.

9.3 Future Year Traffic Demands

Changes in background traffic volumes between 2012 and 2018 and 2028 have been drawn from the Roads and Maritime strategic demand model. The strategic model estimates traffic volumes on the key roads within the study area based on population and employment land-use forecasts development by the Bureau of Transport Statistics.

The traffic generation and distribution of the proposed NBH has been based on a number of assumptions. These include the number of beds, staff numbers and shift patterns, patient numbers and estimated visitor trips and deliveries. The traffic generation has been based on a minimum of 423 beds and an estimated 1000 full time employees. The proposed NBH is forecast to add approximately 900 vehicles in the peak hour (5–6pm), with this period corresponding with the end of the day-time shift. The traffic generation of the hospital varies throughout the day, associated with the arrival and departure of staff, patients, visitors and deliveries.

The distribution of these trips has been developed separately for staff (based on the current residential addresses Mona Vale and Manly Hospital staff member) and for patients and visitors (based on the population distribution surrounding the NBH).

As a result of background traffic growth and the proposed NBH, traffic volumes in the 3 hour AM and PM peak periods are forecast to increase by 12 percent and 11 percent respectively between 2012 and 2018. By 2028, traffic volumes are forecast to increase by a further 5 percent in the AM peak period and 4 percent in the PM peak period.

9.4 Forecast Future Base Traffic and Transport Conditions

The future year base case is denoted as the ‘Do Minimal’ scenario as this scenario includes basic access arrangements for the hospital and other proposed road upgrades not associated with the Stage 1 Connectivity Works. The minimum level of infrastructure to cater for access to the hospital includes:

- Provision of a signalised intersection on Frenchs Forest Road West to provide access to/from the hospital.
- Provision of left in/left out access for emergency vehicles at Frenchs Forest Road.
- Provision of left in/left out access at Warringah Road/Hilmer Street intersection to provide access to/from the hospital.
- Starkey Street/Warringah Road intersection improvements (grade separation of pedestrian movements).
9.4.1 Traffic Performance

Analysis indicates as traffic volumes increase, congestion levels would also increase, resulting in lower average travel speeds and an increase in the average delay and stops per vehicle. In comparison to the 2012 base scenario:

- The average traffic speeds are predicted to reduce by approximately 22 percent in the AM peak period and by approximately 30 percent in the PM peak period.
- The average delay per vehicle is predicted to increase by approximately 41 percent in the AM peak period and by approximately 71 percent in the PM peak period.

The model also predicts high percentages of unreleased demand, which indicates that the proposed demand exceeds the capacity of the road network. A consequence of this is ‘rat running’ in local streets. Enhancement to the capacity of the road network would be required to cater for the increase in background traffic volumes and traffic generated by the proposed hospital. Without substantial improvements to the road network, there would be extensive queuing at the major external locations (Warringah Road, Forest Way, Wakehurst Parkway and Allambie Road) and substantial congestion across the study network.

With regards to the performance of individual intersections, the majority of the signalised intersections within the study area are predicted to operate at LOS F in 2018, in either the AM or PM peak periods. The two exceptions are the Frenchs Forest Road East/ Patanga Road/ Allambie Road intersection and the Frenchs Forest Road West/ NBH/ Gladys Road intersection.

9.4.2 Public Transport Operations

As part of the proposed increases in public transport across the Northern Beaches, Transport for NSW is proposing to modify the bus routes within the study area and provide more frequent services for these routes in the AM and PM peak periods.

Warringah Road and Frenchs Forest Road have been designated as ‘Suburban’, medium-level regional bus corridor in Sydney’s Bus Future (TfNSW, 2013) strategy. The document proposes an incremental approach to bus priority aimed at developing an eventual Bus Rapid Transit (BRT) concept linking Chatswood and Dee Why via Warringah Road. For the short and medium term, Transport for NSW has designated a target average route operating speed of between 18 km/h and 25 km/h for buses.

The modelling indicates that in 2018 the proposed bus routes along Frenchs Forest Road are predicted to operate with an average speed of between 9 km/h and 15 km/h during the peak periods. This is lower than the target average operating speed of between 18 km/h and 25 km/h which Transport for NSW is seeking to achieve along the corridor.

To improve operating conditions for buses and support the intended service level increases, intersection-based bus priority treatments and mid-block interventions are likely to be required.

9.5 Transport Impacts of Stage 1 Connectivity Works

The Stage 1 Connectivity Works have been proposed in order to address the anticipated traffic and transport problems identified in the forecast future base scenario. The proposed road upgrades associated with the Stage 1 Connectivity Works are summarised below:

- Widening of Naree Road, Frenchs Forest Road Wast and Frenchs Forest Road East between Forest Way and Allambie Road.
- Widening of Warringah Road (westbound) between Allambie Road and Government Road
- Upgrade of the following intersections:
  - Forest Way/Naree Road
  - Naree Road/Frenchs Forest Road West/Rabbitts Street
  - Wakehurst Parkway/Frenchs Forest Road East/Frenchs Forest Road West
  - Frenchs Forest Road East/Romford Road
  - Frenchs Forest Road East/Patanga Road/Allambie Road
  - Warringah Road/Allambie Road.

### 9.5.1 Traffic Performance

The traffic analyses undertaken for the Stage 1 Connectivity Works indicate that these road upgrades would provide an improvement in network statistics compared to the Do Minimal scenario. For example, in the 2018 AM peak period, the modelling indicates a 26 percent increase in the average vehicle speed and a 27 percent reduction in the average delay per vehicle. The modelling also predicts a reduction in the level of unreleased demand due to the additional capacity associated with the improvements to the road network. In the AM peak period, there is predicted to be over 30 percent reduction in the level of unreleased demand, with the level of unreleased demand reducing from 14 percent of the total demand to 9 percent of the total demand.

During the PM peak period, the modelling indicates a 16 percent increase in the average vehicle speed and a 20 percent reduction in the average delay per vehicle. The level of unreleased demand during the PM peak period is predicted to reduce by over 40 percent, reducing from 12 percent to 7 percent of the total demand.

With the modelling still predicting some level of unreleased demand, there will be locations within the model where the predicted traffic volumes are still unable to enter the study area. The proposed Stage 1 Connectivity Works generally provides sufficient road capacity for the traffic generated within the immediate study area to access the road network. However, traffic may not be able to enter the study area at some intersections on the periphery of the study area where these have not been upgraded as part of the Stage 1 Connectivity Works.

With the provision of the Stage 1 Connectivity Works, some of the intersections within the study area are predicted to operate with lower average vehicle delays, and therefore, some of these intersections may no longer be predicted to operate at LOS F in 2018 during the AM or PM peak periods (or both) without the proposed improvements. These intersections include:

- Warringah Road/Hilmer Street
- Frenchs Forest Road West/Rabbitts Street
- Frenchs Forest Road/Romford Road.

The following intersections are still predicted to operate at LOS F after the completion of the Stage 1 Connectivity Works in 2018 during the AM or PM peak periods (or both):

- Warringah Road/Forest Way
- Warringah Road/Wakehurst Parkway
- Warringah Road/Allambie Road
- Warringah Road/Ellis Road/Government Road
- Forest Way/Adams Street
- Forest Way/Naree Road
- Frenchs Forest Road/Wakehurst Parkway.
9.5.2 Public Transport Operations

The modelling indicates that buses along Frenchs Forest Road are predicted to operate at up to 17 km/h due to the proposed road upgrade associated with the Stage 1 Connectivity Works. While this is faster than under the Do Minimal scenario, this is still slower than a target average bus operating speed of between 18 km/h and 25 km/h. To reach the 18 km/h target average bus speed, it may be necessary to construct the Stage 2 Network Enhancement Works and potentially change the operation of the Wakehurst Parkway/ Frenchs Forest Road intersection.

School buses serving The Forest High School would require altered egress arrangements. The current unsafe U-turn manoeuvres being made by school buses on Frenchs Forest Road after picking up school students in the afternoon would be avoided by requiring these buses to continue westward on Frenchs Forest Road and return towards the east via Rabbett Street, Forest Way and Warringah Road.

9.5.3 Walking and Cycling

As part of the Stage 1 Connectivity Works, a 1.5 m-wide concrete footpath would be provided along the northern side of Naree Road and Frenchs Forest Road between Forest Way and Warringah Road, and along the southern side of Frenchs Forest Road between Wakehurst Parkway and Warringah Road. In addition, there would be a 3.5 m-wide concrete footpath along the southern side of Naree Road and Frenchs Forest Road between Forest Way and Wakehurst Parkway. The Stage 1 Connectivity Works also includes the provision of pedestrian crossings as part of the upgrading and signalisation of intersections within the study area.

These facilities will improve connectivity between the key activity nodes within the study area including the residential catchment on the northern side of Naree Road/ Frenchs Forest Road, Forestway Shopping Centre, the Forest High School, the NBH, the various businesses along Frenchs Forest Road East and the Skyline shops.

While there are no specific cycling provisions as part of the Stage 1 Connectivity Works, Roads and Maritime would consider modifying the traffic signals at the proposed Frenchs Forest Road/ Patanga Road/ Allambie Road intersection to incorporate bicycle signals due to the proximity of the existing cycle path. This would provide a safe crossing for cyclists who use the existing cycle path and would improve connectivity to the various businesses along the southern side of Frenchs Forest Road.

As part of detailed design process for the Stage 1 Project, Roads and Maritime would investigate options to provide shared paths (being off-road cycleway and pedestrian footpath) aiming to connect with the existing or proposed cycleways indicated on the Warringah Bike Plan. The provision of the shared paths (including off-road cycleways) proposed to be investigated would provide a safe route and improved connectivity between the key nodes including various residential areas across the study area, Forestway Shopping Centre, the Forest High School, NBH and various businesses along these corridors.

9.5.4 Road Safety

The Stage 1 Connectivity Works are predicted to improve road safety. The widening of Frenchs Forest Road would provide two lanes in each direction, and therefore, this may reduce the frequency of rear end collisions, where vehicles are waiting to turn into the residential streets along the corridor. In addition, the upgrading and signalisation of the Forest Way/ Naree Road intersection should reduce the occurrences of turning collisions as the signalisation of the intersection would remove the conflict between the turning movements.
The provision of pedestrian crossings as part of the upgrade and signalisation of the intersections within the study area is expected to result in improvements in pedestrian safety.

9.5.5 Car Parking

As part of the Stage 1 Connectivity Works, Frenchs Forest Road is proposed to be widened to accommodate the increase in background traffic volumes and the traffic volumes associated with the hospital.

As part of the Stage 1 Connectivity Works, it is expected that peak period kerbside parking restrictions would be put in place in order to optimise the additional traffic capacity provided by the project. Along Frenchs Forest Road, parking would not be permitted at any time along Frenchs Forest Road between Bluegum Crescent West and Wakehurst Parkway. However, parking would be permitted along Naree Road and Frenchs Forest Road off peak on weekdays and during weekends at the following locations:

- Naree Road between Forest Way and Rabbett Street
- Frenchs Forest Road between Rabbett Street and Bluegum Crescent West
- Frenchs Forest Road East between Skyline Place and Romford Road
- Frenchs Forest Road East between Romford Road and Inverness Avenue.

A review of the observed parking demand on the surrounding streets indicated that it may be possible that any displaced car parking from Naree Road/ Frenchs Forest Road West may be able to be accommodated. Therefore, it is expected that compensatory parking may not be required along Frenchs Forest Road West.

The parking demand on Frenchs Forest Road East appears to be concentrated between Skyline Place and Patanga Road. As the existing on-street car parks outside the Skyline shops are proposed to be removed, the provision of time restrictions (up to 1 or 2 hours) may be warranted along Frenchs Forest Road, near the Skyline shops to provide parking for these shops.

9.6 Impacts of Concept Proposal Works

In addition to the Stage 1 Connectivity Works, the Concept Proposal also includes the widening and upgrades of Warringah Road to increase capacity and to enable through traffic to avoid the signalised intersections at Forest Way and Wakehurst Parkway through grade separation of these two intersections.

9.6.1 Traffic Performance

Whist the Network Enhancement Works are only assessed at a concept level, traffic analysis has previously been undertaken for Roads and Maritime as part of the Option Development phase. The traffic modelling indicates that with the Stage 2 Network Enhancement Works, the road upgrades would provide an improvement in network statistics compared to the Stage 1 Connectivity Works. For example, in the 2018 PM peak period, the modelling indicates a 30 percent increase in the average vehicle speed and a 40 percent reduction in the average delay per vehicle.

The average travel speed for vehicles travelling along Warringah Road (from west of Forest Way to east of Allambie Road) would be expected to improve due to the grade-separation of the Forest Way, Hilmer Street and Wakehurst Parkway intersections along Warringah Road. With the grade-separation of these intersections, there would be a reduction in traffic volumes on the
surface road network, with an associated improvement in performance of the surface intersections.

The analysis assumes that the Warringah Road/ Starkey Street intersection upgrade, separate to this project, is completed.

Further detailed traffic modelling of the Concept Design would be undertaken as part of the EIS for the Stage 2 Network Enhancement Works.

9.6.2 Public Transport Operations

The analysis of the Stage 1 Connectivity Works indicate that buses are predicted to operate along Frenchs Forest Road at a speed of up to 15 km/h in the AM and PM peak periods. This is less than the designated target average route speed of 18-25 km/h for the Frenchs Forest Road corridor.

The road upgrades associated with the Stage 2 Network Enhancement Works may assist in increasing the average bus speeds along Frenchs Forest Road closer to the 18 km/h target. The predicted average bus speeds would be confirmed when the detailed traffic modelling of the Concept Design is undertaken as part of the EIS for the Stage 2 Project.

9.6.3 Walking and Cycling

As part of the Concept Proposal, three pedestrian/ cyclist overpasses are also proposed as part of the Concept Proposal:

- Replacement of the existing overpass on the western side of the Warringah Road/ Forest Way intersection
- Provision of a proposed overpass on the western side of the Warringah Road/ Hilmer Street intersection.

In addition, a concrete footpath would be provided on the southern side of Warringah Road between Rodborough Road in the east to Maxwell Parade in the west, and the upgrade to the Warringah Road/ Wakehurst Parkway intersection would seek to provide pedestrian crossings on all approaches, addressing the existing deficiency on the western side of the intersection.

An off-street shared path along Warringah Road between Forest Way and Allambie Road is also proposed as part of the Concept Proposal. This would tie in at either end with shared paths proposed by Warringah Council. As part of the provision of this off-street shared path, where the shared path crosses at signalised intersections, modifying the traffic signals to incorporate bicycle signals will be considered.

The provision of these facilities will provide improved connectivity between the key activity nodes within the study area including the residential catchments at each end of the study area, Forestway Shopping Centre, the Forest High School, the NBH, and the various businesses along Frenchs Forest Road East and Warringah Road.

9.7 Construction Traffic Impacts

The construction activities associated with the project would generate traffic and transport impacts that generally involve:

- Temporary road or intersection closures
- Traffic diversions
- Bus rerouting and bus stop relocation
Footpath and shared path diversions.

Potential impacts caused by construction of the concept proposal include:

- Increased travel times due to road works restrictions and thus reduced speed limits around construction sites.
- Increased travel times due to increased truck and construction machinery movements.
- Increased travel times due to potential rerouting/diversion to alternative routes.
- Temporary partial or complete closure of roads and altered property access during construction.
- Temporary changes to bus access arrangements, including stop relocation, resulting in increased walk distance for certain customers.
- Temporary or permanent decrease in kerbside parking availability.
- Potential safety issues relating to increased heavy vehicle movements, as well as to higher traffic flows temporarily traversing lower-capacity road sections.

It is noted that while these impacts are temporary in nature, they could be significant, and could be highly dependent on the detailed staging of construction activities. It is critical to consider these potential impacts during development of detailed design of the project in order to inform construction staging, and for the subsequent construction traffic management plans to be prepared to define the details of how traffic and transport impacts on network flows and connectivity would be mitigated. A key consideration during construction is the need to maintain the minimum number of lanes required to manage traffic movements during peak periods (eg six lanes on Forest Way between Naree Road and Warringah Road).

Further evaluation of construction traffic impacts, including a more refined assessment of potential impacts of traffic diversion on local roads would be undertaken during the detailed design stage. This may require further traffic modelling once more details of construction phasing and activities are known.
Appendix A

References

In preparing this report, reference has been made to the following:

- an inspection of the site and its surrounds
- Warringah Council, Local Environmental Plan (LEP), 2011
- Warringah Council, Development Control Plan (DCP), 2011
- GTA Consultants, 2012, Strategic Bus Corridor 15 – Existing Conditions Report
- other documents and data as referenced in this report.