Northern Beaches Hospital

Stage 2 EIS - Network Enhancement Works
Traffic and Transport Impact

Client: SMEC Australia
Office: NSW
Reference: 14S9025500
Date: 14/07/15
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Quality Record

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1. Introduction

1.1 Background

Roads and Maritime Services (Roads and Maritime) is now seeking approval for the Stage 2 Project Network Enhancement Works (Stage 2 Project) which forms part of the Northern Beaches Hospital - Road Connectivity and Network Enhancements Project Concept Proposal. The approval is sought under Part 5.1 (State Significant Infrastructure) of the Environmental Planning and Assessment Act 1979 (NSW) (EP&A Act). The proposed Northern Beaches Hospital (NBH) at Frenchs Forest is located within the Warringah local government area (LGA) on Sydney's Northern Beaches. The site is bounded by Frenchs Forest Road to the north, Wakehurst Parkway to the east, Warringah Road to the south and The Forest High School to the west.

The NBH Road Connectivity and Network Enhancement Project includes two stages, as follows:
- **Stage 1** aims to enhance the existing road network to facilitate the opening of the proposed NBH by 2018 (separate Environmental Impact Statement).
- **Stage 2** comprises road upgrades directed towards broader network capacity enhancement, particularly along Warringah Road.

The Traffic and Transport Impact Assessment of the Stage 1 Project and Concept Proposal was included in Volume 2 Appendix D Traffic and Transport Impact Assessment prepared for the NBH Road Connectivity and Network Enhancement Project Environmental Impact Statement (EIS) (Roads and Maritime, October 2014).

This report documents the assessment of traffic and transport impacts of the Stage 2 Project, and updates the assessment of Stage 1 using more recent traffic modelling.

1.2 Project Description

1.2.1 Background

Roads and Maritime placed the EIS for the Concept Proposal and Stage 1 Project Hospital Connectivity Works on public exhibition between 22 October 2014 and 21 November 2014. A Submissions Report which responds to issues raised during exhibition has been prepared and is currently being considered by the Department of Planning and Environment as part of its assessment. Based on this assessment the Department will decide whether to recommend concept approval of the NBH – Road Connectivity and Network Enhancements Project, and Project approval for the Stage 1 Project.

The NBH is proposed by NSW Health Infrastructure (HI) and would be located at the intersection of Warringah Road and Wakehurst Parkway. The hospital concept proposal and the first stage (clearing and utility works) of the hospital project were approved on 22 June 2014, and the second stage of the NBH project (hospital construction and operation) is currently being considered by the Department of Planning and Environment.

The NSW Long Term Transport Master Plan (Transport for NSW, 2012) identifies Warringah Road as a key strategic transport corridor linking Dee Why and Chatswood. Heavy traffic flows and congestion along Warringah Road during commuter peak periods and, to a lesser degree, during business hours result in low average peak travel speeds, unreliable travel times and disruptions to traffic movements. This impacts both road users and the adjoining community. Warringah Road is...
already operating at or beyond capacity during peak periods and is expected to experience continued traffic growth in the future.

Based on the anticipated future land use changes, both within and surrounding the NBH Precinct, under Warringah Council’s structure plan (currently being prepared by Warringah Council), and the current level of congestion on Warringah Road (a key strategic transport corridor linking Dee Why and Chatswood), the Stage 2 Project is needed at a strategic level to:

- assist in the management of journeys in connection with anticipated future intensification of medical, commercial and residential land uses surrounding the new hospital
- mitigate the worsening of traffic congestion on the Warringah Road and Wakehurst Parkway arterial road corridors and their principal feeder roads
- enhance access arrangements by car, bus and active transport for the NBH employees, patients, outpatients and visitors
- facilitate improved access to the NBH and the surrounding employment precincts
- have key infrastructure components in place for the proposed hospital opening in 2018.

The Stage 2 Project comprises road upgrades directed towards broader network capacity enhancement of the existing road network surrounding the NBH at Frenchs Forest, within the Warringah local government area (LGA) on Sydney’s Northern Beaches (refer to Figure 1.1). These upgrades focus on Warringah Road which caters for the dominant traffic movement.

**Figure 1.1: Project Location**

![Figure 1.1: Project Location](image)
1.2.2 Project Location

The Stage 2 Project is proposed generally to be carried out in the following locations:

- Warringah Road between west of Fitzpatrick Avenue East to west of Allambie Road
- Forest Way between Warringah Road and the Stage 1 Project tie in (about 100 metres north of the Warringah Road intersection)
- Wakehurst Parkway from the intersection with Warringah Road to about 120 metres south of Aquatic Drive
- Aquatic Drive for about 100 metres east from the intersection with Wakehurst Parkway
- Allambie Road between Warringah Road and Rodborough Road.

On Warringah Road, the Stage 2 Project is incorporated largely within the existing road-reserve to the north, and extends beyond the existing road-reserve to the south by up to 30 metres.

1.2.3 Project Description

The Stage 2 Project would include broadly the following key project elements (subject to detailed design):

- Provision of four through lanes on Warringah Road (two lanes in each direction for east-west through traffic) within a grade separated open slot for about 1.3 kilometres
- Ingress and egress points from and to the slot include:
  - Western extent - Warringah Road near Fitzpatrick Avenue East
  - Eastern extent - Warringah Road from about 350 metres east of the Wakehurst Parkway grade separated intersection
  - Provision of a two-lane on-ramp (merging into one lane) from Wakehurst Parkway (southbound) into the slot (westbound)
- Widening of Warringah Road from west of Fitzpatrick Avenue East to west of Allambie Road to include:
  - Westbound travel lanes, at surface level on the southern side of the Warringah Road corridor for the length of the project
  - Eastbound travel lanes, at surface level on the northern side of the Warringah Road corridor (using existing road pavement), for the length of the project
- The intersections of Warringah Road with Forest Way, Hilmer Street and Wakehurst Parkway to form a surface level bridge over the slot to provide all traffic movements at surface level and allow east-west through traffic in the slot to pass beneath uninterrupted.
- Upgrades or adjustments to existing intersections of Warringah Road with the following local roads and approaches:
  - Fitzpatrick Avenue East (including the closing of the left turn into Fitzpatrick Avenue East from Warringah Road westbound)
  - Rodborough Road
  - Allambie Road
- Widening of Wakehurst Parkway from the intersection of Warringah Road to south of Aquatic Drive.
- Provision of a new connection at Aquatic Drive including right in from Wakehurst Parkway (northbound), left in from Wakehurst Parkway and left out movements from Aquatic Drive and Wakehurst Parkway.
- Provision of shared (pedestrian and cyclist) bridges at the following locations:
- Across Warringah Road west of the intersection of Forest Way (removal and replacement of the existing pedestrian bridge)
- Across Warringah Road on the western side of the intersection with Hilmer Street (new pedestrian bridge)
- Removal of the existing pedestrian crossing across Warringah Road at Hilmer Street.
- Shared paths and footpaths on sections of Warringah Road, Wakehurst Parkway, Forest Way, Aquatic Drive and Allambie Road.

The Stage 2 Project would also include drainage works, landscaping, property acquisition and adjustments. 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 Stage 2 Project would not include ongoing maintenance works.

The Stage 2 Project is subject to detailed design during which, further investigation may result in refinements to the Project.

A schematic of the Stage 2 Project is shown in Figure 1.2, with further details relating to traffic and transport provided in Chapter 6.

1.3 Purpose of this Report

This Report sets out an assessment of the anticipated traffic and transport implications of the Stage 2 Network Enhancement Works, in response to the Secretary’s Environmental Assessment Requirements (SEARs) 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 Stage 2 Project

Source: Roads and Maritime Services
### Table 1.1: Key Transport Issues in Secretary's Environmental Assessment Requirements

<table>
<thead>
<tr>
<th>Key Issue</th>
<th>Secretary's Environmental Assessment Requirement</th>
<th>Where addressed in this assessment</th>
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<tr>
<td>Detailed assessment and modelling of operational traffic and transport impacts.</td>
<td>An assessment of impacts and/or benefits on the local and regional road network including in relation to and beyond those associated with the NBH, considering potential future land use patterns and intensification in the area detailed in regional planning documents;</td>
<td>Chapter 5 and 6</td>
</tr>
<tr>
<td>Stage 2 impacts</td>
<td>An assessment of impacts and/or benefits on the local and regional road network including in relation to and beyond those associated with the NBH, considering potential future land use patterns and intensification in the area detailed in regional planning documents;</td>
<td>Chapter 5 and 6</td>
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<tr>
<td>Intersection analysis</td>
<td>Key intersections, and the level of service/performance of intersections upstream and downstream of the project area;</td>
<td>Chapter 5 and 6</td>
</tr>
<tr>
<td>Impacts on property access and on-street parking</td>
<td>Impacts on property and business access and on street parking provision, including permanent and temporary (construction) changes to access and parking;</td>
<td>Chapter 6</td>
</tr>
<tr>
<td>Impacts on public transport</td>
<td>Operational implications for public transport (particularly with respect to strategic bus corridors and bus routes) and opportunities to improve public transport services and patronage, including the need to move or upgrade public transport infrastructure; and</td>
<td>Chapter 6</td>
</tr>
<tr>
<td>Impacts on cyclists and pedestrians</td>
<td>Safety and access impacts on road users (including cyclists and pedestrians) and consideration of opportunities to integrate cycleway and pedestrian elements with surrounding networks and attractors (existing and proposed). This should include impacts associated with The Forest High School and Frenchs Forest Public School, informed by surveys of traffic movements and mode distribution associated with the schools.</td>
<td>Chapter 6</td>
</tr>
<tr>
<td>Supplementary Traffic and Transport Environmental Assessment Requirements</td>
<td>Describe how the SSI will assist in improving bus services and what actions would be undertaken to assist in meeting the outcomes of Sydney's Bus Future (Transport for NSW, December 2013) and the Northern Beaches Transport Action Plan.</td>
<td>Chapter 6</td>
</tr>
<tr>
<td>Bus service improvements</td>
<td>Describe how the SSI will assist in improving bus services and what actions would be undertaken to assist in meeting the outcomes of Sydney's Bus Future (Transport for NSW, December 2013) and the Northern Beaches Transport Action Plan.</td>
<td>Chapter 6</td>
</tr>
<tr>
<td>Enhanced bus services to meet increased demand from land use changes</td>
<td>Describe what actions could be taken to enhance bus services to meet increased bus demand resulting from potential land use change within the vicinity of the SSI, such as the Northern Beaches Hospital Precinct Structure Plan, being prepared by Warringah Council.</td>
<td>Chapter 6</td>
</tr>
<tr>
<td>Connected cycleways</td>
<td>Actions to be undertaken to assist in the delivery of a connected cycleway network within and adjoining the Concept Proposal area.</td>
<td>Chapter 6</td>
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**Detailed assessment of construction traffic and transport impacts of the proposal (including ancillary facilities) and associated management measures, in particular: having reference to the cumulative construction impacts of other developments preparing for or under construction, including concurrent construction associated with subsequent stages of this proposal and/or the NBH proposal:**

| Traffic capacity                  | Impacts to the road network (including safety and level of service, pedestrian and cyclist access, maintenance of construction access to the NBH site, and disruption to public transport services and access to properties); | Chapter 7                          |
| Broader network impacts           | Impacts of potential shifts of traffic movements to alternative routes outside the proposal area; | Chapter 7                          |
| Impacts on parking                | Availability of on-street parking within and surrounding the project area; | Chapter 7                          |
| Impacts on school                 | Impacts to school related traffic (bus, service, emergency and private vehicles) both on-site and on-street, and pedestrian and cyclist movements; | Chapter 7                          |
| Heavy vehicle access routes       | Route identification and scheduling of transport movements, including movements to transport spoil; | Chapter 7                          |
| Traffic generation                | The number, frequency and size of construction related vehicles (both passenger, commercial and heavy vehicles); | Chapter 7                          |
| Traffic routes                    | The nature of existing traffic on construction access routes (including consideration of peak traffic times); and | Chapter 7                          |
| Temporary road network changes    | The need to close, divert or otherwise reconfigure elements of the road network associated with construction of the proposal. | Chapter 7                          |
2. Strategic Justification

2.1 Strategic and Policy Framework

The project is considered to have a good strategic fit with current transport development policy and State Government and Council strategies. In addition, the Project is recommended to ensure the proper functioning of the NBH.

2.1.1 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 NBH, which is also a commitment in NSW 2021.

2.1.2 NSW State Infrastructure Strategy

The State Infrastructure Strategy (Infrastructure NSW, December 2012 and updated in November 2014) 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 NBH 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.” The November 2014 update indicated that “pre-feasibility work undertaken suggests that Beaches Link would cost between $2.4 billion and $3.1 billion ($2014). Projected toll revenues are unlikely to fully offset the cost”.

- 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 (TNSW) “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. The November 2014 update stated that “Transport for NSW should prepare a final business case by the end of 2015 for Northern Beaches BRT.”

2.1.3 Metropolitan Plan for Sydney to 2031

A Plan for Growing Sydney (NSW Department of Planning and Environment, December 2014), outlines how Metropolitan Sydney would be structured spatially 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 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 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.

In support of the planned development of the specialised precinct in Frenchs Forest, the plan also identifies the need to improve walking and cycling connections between the different parts of NBH Precinct and to its surrounding area.

2.1.4 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).

2.1.5 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.

2.1.6 Sydney’s Cycling Future

Sydney’s Cycling Future was prepared by Transport for NSW and was released in December 2013 following the release of the LTMP to provide a mode specific cycling strategy. It presents a new direction for bicycle infrastructure planning in metropolitan Sydney by focusing on people who would like to ride more often if cycling was made a safer and more convenient option. It aims to make cycling a feasible transport option for these people by:

- investing in separated cycleways and providing connected bicycle networks to major centres and transport interchanges
- promoting better use of existing infrastructure
- engaging with partners across government, councils, developers and bicycle users.

The strategy aims to prioritise investment on projects that have the greatest potential to get the most people to shift their short transport trips to bicycle. In order to achieve this, it aims to invest in connected routes within 5 kilometres of major centres and public transport interchanges. It proposes a three-tier hierarchy of safe cycleways to major centres:

- Regional bicycle corridors - highly used routes that connect to major destinations, on cycleways that are separate from motor vehicles and pedestrians.
- Local bicycle network - lower use corridors that connect to priority corridors and neighbourhood destinations within catchments.
- Quiet local streets - connecting residential destinations and local services in low traffic environments, design treatments make provision for people on bikes.

Frenchs Forest is designated as a major centre and as such, a bicycle network should be developed connecting the site to the surrounding precincts within 5km.

2.2 Corridor Transport Planning

2.2.1 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.”

2.2.2 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.

2.2.3 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 5.2 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 Northern Beaches Transport Action Plan. These include a Northern Beaches Hospital Public Transport Interchange, as well as a feasibility study on a Northern Beaches motorway tunnel between the Spit Bridge and Warringah Freeway.

2.2.4 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.

The Northern Beaches BRT Feasibility Study is still being undertaken, and a Draft Final Report was completed in December 2014. This study focuses on the potential of BRT along Pittwater Road and does not include any assessment of BRT along Warringah Road. Although no details are yet available, the report does however mention the provision of the NBH public transport interchange within the next three to four years.

2.3 Other Considerations

2.3.1 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.

2.3.2 Warringah Bike Plan

A number of on-road and off-road bicycle routes are proposed by Warringah Council, as well as areas proposed in the Bike Plan (Warringah Council, 2010) for further network investigation. These are shown in Figure 2.1.

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 (e.g. Wakehurst Parkway, Allambie Road, Warringah Road east of Allambie Road), that pose a hostile cycling environment. There also needs to be better connectivity between the east and west sides of Frenchs Forest Road (the current 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, however Warringah Council has been working closely with Roads and Maritime to review their bike plan with consideration of the development of the NBH and the proposed road upgrades.

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.

The Warringah Bike Plan indicates that there is an existing bicycle route between Inverness Avenue and Oxford Falls Road. This route traverses the park between Inverness and Patanga Road, along a short section of Patanga Road, Daren Street and short section of Ellis Road. However, there is no bicycle infrastructure (such as line marking or shared paths provided along this route). In addition, the existing off-road footpaths are not to the standard of a shared path facility.
Figure 2.1: Warringah Bike Plan for NBH Precinct - Existing and Proposed Cycle Routes

3. Assessment Method

3.1 Overview

This report presents the assessment of traffic and transport impacts of both Stages 1 and 2 combined of the NBH Road Connectivity and Network Enhancement project. An earlier assessment was completed in support of the Stage 1 and Concept Proposal EIS. The assessment method is generally the same, although some details of the project specification and the traffic modelling have been refined for this assessment.

The transport modelling for both assessments has been undertaken using the VISSIM micro-simulation software package, with the micro-simulation model for the study area specifically developed for the transport assessment of this road upgrade. The micro-simulation model was initially developed by Transport Modellers Alliance (TMA) and High Range Analytics (HRA) for Roads and Maritime, and was used to evaluate four potential options for the Concept Proposal as part of the option development and selection process for the project.

3.2 Traffic Assessment for Stages 1 and 2

This section describes briefly the process of refining the modelling for Stage 1 and the subsequent modelling conducted for the TTIA of the Stage 2 Project.

3.2.1 Stage 1 Traffic Assessment

For the Stage 1 Connectivity Works assessment, the micro-simulation model was refined and updated to reflect more recent transport assessment information, including the NBH Stage 1 EIS (NSW Health Infrastructure, October 2013). The initial traffic modelling undertaken for the Concept Proposal (by TMA/HRA) covered two hour AM peak and PM peak periods (7–9am and 4–6pm). In general, these periods cover the network peak periods and are sufficient for the purposes of assessing the impacts of changes to the road network, for the purpose of the option development process.

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). These extended periods were 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 provided a more robust assessment of the potential impacts of the proposed NBH, allowing for an extended time within the Stage 1 assessment.

The initial Stage 1 modelling outputs were reported in the Stage 1 EIS. Some minor amendments have since been made to the Stage 1 model since the Stage 1 EIS was exhibited, with the updated inputs and results reflected in Sections 5 and 6 of this report.

3.2.2 Stage 2 Traffic Assessment

The micro-simulation model has been subsequently updated to reflect the proposed Stage 2 Network Enhancement Works, with the results presented in Section 6. For this assessment, scenarios have been modelled to describe the existing network conditions in 2012, the situation anticipated with the Do Minimal works completed by 2018 (the forecast year of opening of the
NBH) and as a reference for 2028 (10 years after opening), and a project case involving both Stage 1 and Stage 2 works combined, for assessment of network conditions in 2018 and 2028.

The assessment is based on comparison of the project case with the Do Minimal case, with short term impacts determined for 2018 and longer term impacts at 2028.

This chapter outlines the key assumptions used in the assessment of the traffic and transport impacts of the project.

3.3 Traffic Model Extent

The extent of the road network covered in the micro-simulation traffic model developed for this assessment is shown in Figure 3.1.

**Figure 3.1: 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 Waringah 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 Waringah 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, Hamston 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, Windele Avenue, Karabah Place and Oxford Falls Road.
- Linking with Waringah 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 3.1 and detailed above are taken to comprise the ‘network’.

3.4 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.

3.4.1 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 BTS 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. Roads and Maritime are continuing to consult with Warringah Council to ensure that the precinct structure plan for the surrounding lands can be developed sufficiently to allow for inclusion in any traffic modelling analysis.

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 Stage 1 and Concept Proposal TTIA, the base 2012 micro-simulation demand patterns were adjusted to account for the changes in the background traffic volumes (ie adding or subtracting trips based on changes in the strategic transport model).

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

As indicated in Section 3.1, background traffic volumes were developed for the design years of 2018 (NBH opening) and 2028 (10 year design period after opening).

### 3.4.2 Northern Beaches Hospital

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 (note: the NSW model for role delineation of health services identifies 6 levels for each major clinical activity, ranging from 0 for least complex to 6 for most complex. Royal North Shore Hospital is a Level 6 facility, while Manly and Mona Vale Hospitals are currently Level 4.).
- 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 beds at the hospital (which is also the basis for calculation of visitation rates)
• Number of daily outpatients
• Number of other vehicle movements (deliveries, visiting medical offices).

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

1,000 outpatients per day were estimated for the modelling undertaken for the option development process for the Concept Proposal, and this estimate has been maintained for the modelling for the EIS traffic and transport impact assessments in relation to both Stage 1 and Stage 2 of the project.

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\(^2\) (BTS, 2014) for people working in the areas in and around Frenchs Forest (Travel Zones 2135, 2136, 2138, 2139, 2140). The data indicates car mode share was 83 percent (sample size = 7,955 employees). For this assessment, a car mode share of 85 percent 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 worked (shift work) and the nature of the work, supporting the adoption of a mode share (85%) to car slightly greater than the BTS data (83%).

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

Outpatients
Assuming that 10 percent of patients access (enter and exit) the hospital during each peak hour, a total of 170 peak hour outpatient trips is anticipated (=1,000 outpatients per day x 85% mode share x 10% during peak hour x 2 directions).

Visitors
Assuming that each patient (hospital bed) has two visitors per day and that 10 percent of visitors access (enter and exit) the hospital during each peak hour, a total of 166 peak hour visitor trips is anticipated (=488 beds x 2 visitors per bed per day x 10% during peak hour x 85% mode share x 2 directions).

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 3.1.

---


\(^2\) Source of Journey to Work data (website address?)
Table 3.1: 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>Total</td>
<td></td>
<td>886</td>
</tr>
</tbody>
</table>

Table 3.1 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 3.2).

Table 3.2: 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 (July, 2014)

The data in Table 3.2 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 AM 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 PM 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 890 vehicles per hour, and the arrival and departure patterns shown in Table 3.2, the traffic volumes calculated for the three hour AM and PM peak periods are provided in Table 3.3.

Table 3.3: 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>580</td>
<td>700</td>
<td>230</td>
<td>220</td>
<td>230</td>
</tr>
<tr>
<td>Out</td>
<td>90</td>
<td>180</td>
<td>180</td>
<td>590</td>
<td>670</td>
<td>570</td>
</tr>
<tr>
<td>Total</td>
<td>480</td>
<td>760</td>
<td>890</td>
<td>820</td>
<td>890</td>
<td>800</td>
</tr>
</tbody>
</table>

The above traffic generation estimates have been used in the modelling undertaken for the Stage 1 and Stage 2 assessments, as detailed in Chapter 5 and Chapter 6.

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.

3.4.3 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.

**Hospital Staff**

Many of the clinical services from the Manly and Mona Vale Hospitals are expected to be transferred to the NBH. 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 3.4.

<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% due to rounding. Source: TMA & HRA for Roads and Maritime Services, August 2014.

Table 3.4 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 3.5.
The analysis indicated that staff trip 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 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, as the Royal North Shore Hospital is located close to St Leonards Railway Station on the North Shore Railway Line, it is expected that the staff distribution patterns would likely be affected by the availability of taking rail to/from work (compared to taking bus to the NBH). 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 3.6.

<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>

Table 3.6 indicates that with the revised commuter distribution, a larger proportion of staff is predicted to live to the west 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.

### Hospital Patients, Visitors and Deliveries

The traffic distribution for NBH patients, visitors and deliveries calculated as part of modelling for the Stage 1 Project was maintained for the Stage 2 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

<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>

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 3.7.

Table 3.7: Estimated Trip Distribution of NBH Patients, Visitors and Deliveries

<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>

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

3.5 Traffic and Transport Modelling

The transport modelling for each of the assessments 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 for traffic generated by the proposed NBH.

VISSIM micro-simulation modelling was considered an appropriate technique 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 and selection process.

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 include information provided by Roads and Maritime for this study. The updated model was initially used to assess the Stage 1 works and has been again updated to assess the Stage 2 works.

3.5.1 Scenarios Evaluated

Table 3.8 outlines the scenarios developed and evaluated as part of the traffic modelling tasks for this assessment, to determine the traffic and transport impacts of the proposed road works on the overall road network.

The traffic modelling for each scenario was carried out using the updated micro-simulation model (based on the initial micro-simulation model developed by TMA and HRA for Roads and Maritime), 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>
<thead>
<tr>
<th>Scenario</th>
<th>Base Year</th>
<th>Future Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Conditions (ie Existing Conditions)</td>
<td>2012</td>
<td></td>
</tr>
<tr>
<td>Do Minimal Scenario (ie no Stage 1 or Stage 2 works)</td>
<td>2018 and 2028</td>
<td></td>
</tr>
<tr>
<td>Stage 1 and Stage 2 Works</td>
<td>2018 and 2028</td>
<td></td>
</tr>
</tbody>
</table>

Modelling has been undertaken for the forecast years (as shown in Table 3.8), 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. For the purpose of this assessment, it is assumed that both the Stage 1 and Stage 2 works would be completed by 2018 for the opening of the new hospital.

A discussion of the changes to the road network included in the Do Minimal and project (Stage 1 and Stage 2 works) cases is included in each of the following chapters. As indicated in Section 4.1.2, some minor amendments have been made to the Do Minimal and Stage 1 models since the Stage 1 EIS was exhibited, with the updated inputs and results presented in Section 5 of this report.

3.5.2 Model Outputs Used in the Assessment

The analysis has considered the following modelling outputs:

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

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

Network Performance Statistics

The following network performance 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 metrics provide a good indication of how the network performs and provide the basis for comparing 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, for:
  - comparison of the 2012 Base Condition vs the future year Do Minimal results
  - comparison of the future years project scenario (Stages 1 and 2) vs the future year Do Minimal scenario

The above comparisons seek to provide an indication of traffic impacts of the road network associated with the increase in traffic volumes in the 2012 Base Conditions, and the potential improvements in the traffic conditions associated with the proposed road network enhancements in the project (Stages 1 and 2) scenarios.

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:

- 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 for the Do Minimal, Stage 1 and 2 scenarios. It is noted that the travel time statistics reported in the model outputs correspond to the peak period travel speeds resulting from a combination of factors, including forecast traffic volumes, delays at approaches to intersections, the ‘stop-and-go’ nature and the resulting acceleration-deceleration pattern along routes with newly introduced signals. The model reflects the allocation of capacity at intersections between conflicting movements in order to minimise delays and optimise performance of the area road network. Where priority for bus public transport is provided at and between intersections, network operation may be tuned to support this.
4. Existing Transport Environment

The project area covers the road network surrounding the site of the proposed 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 land.

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.

4.1 Road Network

4.1.1 Key Roads

Key roads covered by the Project (Stages 1 and 2) include:

- Warringah Road (Route A38)
- Wakehurst Parkway
- Forest Way
- Frenchs Forest Road (east and west)/ Naree Road
- Allambie Road.

Figure 4.1 shows a map of the road network surrounding the proposed NBH site.

Figure 4.1: Road Network Map

Map Source: Sydways
Warringah Road

Warringah Road is a state managed 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.

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.

Wakehurst Parkway

Wakehurst Parkway is a state managed 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 through the project area.
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 managed 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 a mid-block signalised pedestrian crossing fronting the Forestway Shopping Centre.

Rabbit 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 and 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 limit 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 council managed 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 collector functions they were meant to perform. It acts as a ‘rat run’ for traffic avoiding congestion on Warringah Road. (Refer to Section 4.7 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 tonne 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 and Frenchs Forest Public School.

Allambie Road

Allambie Road south of Warringah Road is a State-managed road while the section of the road north of its intersection with Warringah Road is a local council managed 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 to the south of Warringah Road and 50 km/h to the north. Within the study area, Allambie Road carries between 4,000 and 20,000 vehicles daily.
4.1.2 Other Streets within the Project Area

There are a number of other streets within the project area shown in Figure 4.1, that intersect with the roads described above to provide access to residential and commercial activities within the precinct. None of these streets are intended to carry through traffic.

Aquatic Drive

Aquatic Drive is a local road providing access to the Warringah Aquatic Centre, the Arranounbai School for students with special needs, commercial developments on the north side (including along Tilley Lane), about 40 residential dwellings (on Madison Way), and the Eurobodalla Homes retirement housing. It runs about 700 metres in an east-west orientation between Allambie Road and close to Wakehurst Parkway. However, it does not have an intersection with Wakehurst Parkway. As a result, there is no through traffic using Aquatic Drive, and it generally experiences low traffic volumes.

Rodborough Road

Rodborough Road runs about 580 metres in an east-west orientation, intersecting in a left-in/left-out arrangement at Warringah Road to the west and the commercial developments to the east. It also intersects with Allambie Road at a roundabout about 125 metres south of the Allambie Road/Warringah Road intersection.

The 170-metre western section of Rodborough Road between Allambie Road and Warringah Road provides an egress link from Allambie Heights to Warringah Road, and thus experiences high volumes of through traffic heading out to Warringah Road westbound, particularly during the AM peak. The eastern section predominantly serves industrial and commercial (business park) uses.

Bantry Bay Road

Bantry Bay Road is a local road running in a north-south orientation.

The northern section of Bantry Bay Road between Warringah Road and Frenchs Forest Road east served mainly private residential dwellings, which have been acquired to make way for the Northern Beaches Hospital development. As such, Bantry Bay Road north will become part of the hospital complex.

The southern section provides access to residential dwellings at the south east section of Frenchs Forest, as well as access to Brick Pit Reserve, including 90-degree angle parking for the reserve’s customers. A short section of about 50 metres immediately south of Warringah Road is occupied by retail establishments.

Hilmer Street

Hilmer Street is a local road providing access to about 20-30 residential dwellings between Warringah Road and Fitzpatrick Avenue East. Currently, its intersection with Warringah Road is signalised and allows all movements. As a result of this configuration, Hilmer Street also serves local through traffic from within Frenchs Forest (south) aiming to gain access to/from Warringah Road East and Wakehurst Parkway.

Fitzpatrick Avenue

Fitzpatrick Avenue is a local road running in an east-west orientation between Bantry Bay Road in the east and Grace Avenue in the west. It intersects with Warringah Road in left-in/left-out arrangements for both the east and west sections. Both Fitzpatrick Avenue West and Fitzpatrick Avenue East service access requirements for residential areas.
Fitzpatrick Avenue East functions mainly as a collector road providing an egress link to Warringah Road, while Fitzpatrick Avenue West is used as a short-cut during both AM and PM peaks.

Russell Avenue
Russell Avenue is a local road that functions as a minor access link to/from Belrose, western Frenchs Forest and to some extent north eastern Forestville. It runs in an east-west orientation for about 100 metres between Grace Avenue and Forest Way.

It provides access to retail establishments, including Forestway Shopping Centre and commercial facilities (including a medical centre) on the north side.

Rabbett Street
Rabbett Street is a local road running in a north-south orientation between Adams Street and Forest Way. It mainly serves about 60 residential dwellings, including those on Holland Crescent. It is also used by through traffic as a short-cut from Forest Way north of Adams Street and Frenchs Forest Road to Wakehurst Parkway.

The south end of Rabbett Street is configured as an egress only to Forest Way, which is further restricted to be for buses only during the AM peak period between 6-10am on weekdays. As such, the section of Rabbett Street south of Naree Road/Frenchs Forest Road West experiences a lower volume of traffic compared with the northern section between Naree Road/Frenchs Forest Road West and Adams Street. However, it has been observed that the southern section, together with Holland Crescent, experiences a heavy park-and-ride and kiss-and-ride use during weekday AM peak periods, with commuters either parking all day or getting dropped off to transfer to buses along Forest Way.

4.2 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 AM 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.
4.2.1 Daily Traffic Volumes

Figure 4.2 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 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 weekday peaks, although it occurs in the hour 12–1pm. The peak hour on Sundays also occurs at this time, although the daily volume of traffic is lower.

The annual pattern of daily traffic on Warringah Road in 2011 (Figure 4.2) suggests there is no atypical seasonal pattern to traffic activity.

![Figure 4.2: Daily Traffic Volumes, 2012](source: Roads and Maritime Services)
4.2.2 Hourly Traffic Volumes and Patterns

The typical hourly pattern of traffic in the precinct is shown in Figure 4.5 for Warringah Road (west of Melwood Avenue, Forestville) and in Figure 4.6 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 AM peak period from 7-9am has 16 percent of the daily traffic. The 2-hour PM 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 4.5: Warringah Road (west of Melwood Avenue, Forestville) - Two-Way Hourly Traffic Volumes (21 to 27 February 2011)

Source: Roads and Maritime Services

Figure 4.6: Wakehurst Parkway (south of Oxford Falls Road, Frenchs Forest) - Two-Way Hourly Traffic Volumes (21 to 27 February 2011)

Source: Roads and Maritime Services
4.3 Heavy Vehicles and Freight

The road system, particularly the state managed road network, is required to be made available for general use by all vehicle types and these 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 composition of traffic during peak periods on Warringah Road is presented in Table 4.1. 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 4.1: Traffic Composition on Key Roads During Peak Periods (6-10AM & 3-7PM)**

<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 classes</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 Figure 4.7.
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 4.8.

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 vehicles observed on these roads being between 3 and 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.
4.4 Travel Speeds

The Key Roads Performance Report\(^3\) (Roads and Maritime, June 2013) outlines how well the road network in Greater Sydney is performing during AM and PM peak periods, based on travel times 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 4.2.

<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.

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 AM and 2 hour PM peak periods.

While Table 4.3 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 4.3: Average Peak Period Speeds (km/h) on Sections of Warringah Road (21–22 May 2013)

<table>
<thead>
<tr>
<th>Period</th>
<th>Woodlands Road–Starkey Street</th>
<th>Starkey Street–Altona Avenue</th>
<th>Altona Avenue–Forest Way</th>
<th>Forest Way–Hilmer Street</th>
<th>Hilmer Street–Wakehurst Pkwy</th>
<th>Wakehurst Pkwy–Allambie Road</th>
<th>Allambie Road–Government Road</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section Distance</td>
<td>730m</td>
<td>680m</td>
<td>760m</td>
<td>500m</td>
<td>260m</td>
<td>850m</td>
<td>920m</td>
<td>4700m</td>
</tr>
<tr>
<td><strong>Eastbound AM peak</strong></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>36</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><strong>Average</strong></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><strong>Eastbound PM peak</strong></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><strong>Average</strong></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><strong>Westbound AM Peak</strong></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><strong>Average</strong></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><strong>Westbound PM Peak</strong></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><strong>Average</strong></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>

Notes: 1 Average speed of 6 km/h over 2 runs indicates potential incident

The results of these travel speed surveys indicate that speeds during the AM 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.

4.5 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 4.9 shows where the 28,079 people who work in the selected travel zones come from, while Figure 4.10 shows where the 26,033 employed residents of these travel zones go to work.
Figure 4.9 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 4.10 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 4.9: Origins and Modes of Workers in Selected Travel Zones, 2011

Source: Bureau of Transport Statistics
Figure 4.10: Destinations and Modes of Employed Residents in Selected Travel Zones, 2011

Source: Bureau of Transport Statistics
4.6 Network and Intersection Performance

4.6.1 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 4.4 shows the ranges of average vehicle delay adopted in determining the level of service of 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
4.6.2 Network Performance

Table 4.5 summarises the network performance modelling results of the 2012 Base Year scenario for the three-hour 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).

4.6.3 Intersection Performance

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 4.11 and Figure 4.12.

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

### 4.7 Use of Local Roads by Through Traffic

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

Use of local roads by through traffic (referred to commonly as ‘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 4.13 and Figure 4.14 (for the AM and PM peaks, respectively).
Figure 4.13: Common 'Rat Run' Routes in the Study Area during the AM Peak

Figure 4.14: Common 'Rat Run' Routes in the Study Area during the PM Peak
4.8 Car Parking

On-street car parking is generally not permitted in the Stage 2 Project study area, including the following locations:

- Warringah Road between Fitzpatrick Avenue East and Allambie Road
- Wakehurst Parkway between Warringah Road and Aquatic Drive
- Allambie Road between Warringah Road and Rodborough Road
- Forest Way between Warringah Road and the Stage 1 Project

On-street parking is however permitted on a number of the intersecting roads to the south of Warringah Road, including Hilmer Street, Bantry Bay Road and Fitzpatrick Avenue (east), and on Aquatic Drive.

Detailed car parking surveys of these locations have not been undertaken as part of this study. Notwithstanding the following was observed based on a number of site visits to the study area:

Bantry Bay Road
- a combination of 2P and unrestricted spaces are provided (the time restricted spaces are provided at the northern end)
- car parking demands are high during peak periods
- demands generated by Bantry Bay Road shops and Brick Pit Reserve.

Hilmer Street
- unrestricted car parking spaces are provided on both sides of the carriageway
- demands are generally low and generated by the abutting residential uses.

Fitzpatrick Avenue East
- unrestricted car parking spaces are provided on both sides of the carriageway
- demands are generally low and generated by the abutting residential uses.

Aquatic Drive
- unrestricted car parking spaces are provided on both sides of the carriageway at the eastern and western end of the road, which supplement off-street parking for public and private uses along the road
- occupancy of the on-street spaces is moderate to high, with demands generated by the commercial activities along the road.

4.9 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.

4.9.1 Bus Routes

Regular public transport bus services within the study area, and connecting Frenchs Forest with other centres of the Northern Beaches, North Shore and the Sydney CBD are provided by Sydney Buses and Forest Coaches. The network maps illustrating connections within and between the Frenchs Forest area are shown in Figure 4.15 (Sydney Buses) and Figure 4.16 (Forest Coaches).
Forest Coaches operate services from Terrey Hills to North Sydney and Town Hall, and from Frenchs Forest and Belrose to Chatswood and Warringah Mall. All services travel via Forest Way and Warringah Road, with City-bound services continuing via Eastern Valley Way. The bus stop nearest to the NBH providing access to these services is 800m away on Forest Way. Only the route between Warringah Mall and Chatswood travelling via Warringah Road passes the NBH site.

Sydney Buses operate services between Manly and Chatswood via Dee Why and Frenchs Forest travelling across Roseville Bridge, between Manly and the City via Dee Why and Frenchs Forest travelling along Wakehurst Parkway and the Spit Bridge, as well as services linking Skyline Shops in...
the eastern part of Frenchs Forest with Manly and with the City travelling along Allambie Road and Spit Bridge. Some of these routes offer express (limited stop) services during peak periods.

For access to the NBH site, services to/from Chatswood travel via Warringah Road, while services to/from the City travel via Wakehurst Parkway. Services to/from Dee Why travel via Frenchs Forest Road East and Warringah Road. There are services to Manly via both Warringah Road and Allambie Road. All of these services pass the NBH site either on Frenchs Forest Road East or Warringah Road, where bus stops are located close to the site.

A number of services operate from the Skyline Shops at the corner of Frenchs Forest Road East and Allambie Road, 1km east of the NBH site. These link the eastern part of Frenchs Forest with Manly via Allambie Road and with Wynyard via Allambie Road and Spit Bridge.

There are no bus services on Wakehurst Parkway north of Frenchs Forest Road.

The average service frequencies calculated over the two hour AM peak period (7–9am) and the two hour PM peak period (4–6pm) are listed in Table 4.6.

Table 4.6: Bus Services and AM and PM Peak Services

<table>
<thead>
<tr>
<th>Route Number</th>
<th>Operator</th>
<th>Description</th>
<th>AM Peak (7-9am)</th>
<th>PM Peak (4-6pm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>136</td>
<td>Sydney Buses</td>
<td>Chatswood to Manly</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>137</td>
<td>Sydney Buses</td>
<td>Chatswood to Bantry Bay</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>166</td>
<td>Sydney Buses</td>
<td>Allambie Heights to City</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>160</td>
<td>Sydney Buses</td>
<td>Mona Vale to Chatswood</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>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>Tempe Hills to North Sydney</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>270</td>
<td>Forest Coaches</td>
<td>Tempe Hills to City (Town Hall)</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>271</td>
<td>Forest Coaches</td>
<td>Tempe Hills to City (Town Hall)</td>
<td>5</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 Duffy's Forest</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

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

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.

Figure 4.17 shows an image of bus passengers waiting at the bus stop on Forest Way at the intersection with Rabbett Street. A number of school students were also observed to be waiting for school buses on the Rabbett Street bus stop (not shown, to the left of the photo).

Figure 4.17: Forest Way/Rabbett Street Bus Passenger Activity AM Peak

4.9.2 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.

4.9.3 School Buses

Sydney Buses and Forest Coaches operate school bus routes through the study area in addition to the standard scheduled services. A review of timetabled school bus services operated by
Sydney Buses and Forest Coaches in the study area indicated a total of 44 services operating in the AM period and 78 in the PM period, as shown in Table 4.7.

Table 4.7: School Bus Services in the Study Area

<table>
<thead>
<tr>
<th>Operator</th>
<th>AM (7-9am)</th>
<th>PM (3-4:30pm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sydney Buses</td>
<td>22</td>
<td>37</td>
</tr>
<tr>
<td>Forest Coaches</td>
<td>22</td>
<td>41</td>
</tr>
<tr>
<td><strong>Total services</strong></td>
<td><strong>44</strong></td>
<td><strong>78</strong></td>
</tr>
</tbody>
</table>

These serve the various schools within study area (including The Forest High School, Forest Public School and Arranounbai 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.

The number of school bus services shown in Table 4.6 indicates that more services in the study area during the PM peak period compared with the AM peak period. This is primarily due to more PM-peak only school bus services compared with AM-peak only school bus services. One possible factor contributing to this (consistent with site observations) is that there is likely a significant number of parents dropping off children at school on their way to work in the morning, but with the children taking the bus home after school dismissal in the afternoon, as the parents are still at work.

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 4.18 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 PM peak.

Figure 4.18: Observed School Bus Manoeuvre on Frenchs Forest Road
4.10 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, Bantry Bay shops, The Forest High School and Forest Public School, 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 mid-block signalised pedestrian crossing. A high number of pedestrians have been observed during AM and PM peak periods using the Forest Way mid-block signalised pedestrian crossing to transfer between bus stops on opposite sides of the road.

Overall, the provision of pedestrian infrastructure is adequate to serve current levels of demand however the overall quality of the facilities is of a low standard. 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 through Karingai Reserve, 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 to be of a low standard 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:

- north and west legs of the Frenchs Forest Road/Wakehurst Parkway intersection
- west leg of the Warringah Road/Wakehurst Parkway intersection
- Warringah Road/Allambie Road intersection (only east leg with crossing).

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

- Frenchs Forest Road East/Allambie Road intersection (Skyline Shops)
- Forest Way/Naree Road intersection
- Warringah Road/Bantry Bay Road
- Intersections with local streets on the north side of Frenchs Forest Road East between Patanga Road and Wakehurst Parkway.

It is noted that there are currently no pedestrian facilities servicing the Bantry Bay Road shops at the Warringah Road / Bantry Bay Road intersection. These shops are frequented by residents on both sides of Warringah Road as well as students at The Forest High School. The lack of pedestrian facilities is further exacerbated by no pedestrian crossings being provided on the eastern leg of the Warringah Road / Hilmer Street intersection and western leg of the Warringah Road / Wakehurst Parkway intersection.

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

4.11 Bicycle Infrastructure

The extent of the bicycle path network in the study area is limited. There are a number of informal routes within the study area, but with little infrastructure provision to define a right-of-way, provide for legible routing, separation from other traffic, or to support a safe riding environment.

Planning for development of the cycle infrastructure network in the study area is discussed further in Section 2.3.2.

4.12 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 4.20.

The analysis shows a majority of crashes occurred on Warringah Road (west of Wakehurst Parkway) and to a lesser degree on Forest Way.
4.12.1 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.

4.12.2 Crash Types

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

The crash data indicates that while crashes occur throughout the study area, they are also relatively concentrated at the arterial road intersections. The majority of crash clusters occurred along the Warringah Road corridor.

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 and are typical of a congested urban road environment.

4.12.3 Pedestrian and Cyclist Crashes

Figure 4.21 highlights the spatial distribution of crashes involving pedestrians in the study area from the same crash data shown in Figure 4.20. 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.

Figure 4.21: Crash Map Highlighting Pedestrian Crashes

Data source: Roads and Maritime Services

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. The only pedestrian accident on Warringah Road was at the Warringah Road / Government Road intersection on the eastern boundary of the study area.

4.13 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 AM 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 traffic signal coordination. The controlling intersection in the precinct – the surface-level signalised Warringah Road/ Wakehurst Parkway intersection, operates with long delays during the peak periods 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 the 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 PM 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.
5. 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 Scenario

The future base scenario incorporated in this assessment incorporates basic access arrangements for the proposed NBH, as well as other anticipated road upgrades not specifically associated with the Stage 1 Connectivity Works or the Stage 2 Network Enhancement Works Projects. 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 AM 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 Public Transport Improvements

The existing network of bus routes servicing the study area was described in Section 4.9.1 and illustrated in Figure 4.15 and Figure 4.16.

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

- A new public transport interchange servicing the NBH.
- Additional bus services on the Terrey Hills/Beulah 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 (Chatswood to Bantry Bay/House with No Steps)
- Route 142: Extend service from Skyline Shops to Terrey 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 (Chatswood to Davidson/Beulah via Frenchs Forest).

The roads that these routes travel along are detailed in Figure 5.1. The existing bus services are listed in Table 4.6 and shown in Figure 4.15 and Figure 4.16.

The proposed headways for scheduled services are provided in Table 5.1 for 2021 (adopted for 2018 scenarios) and 2031 (adopted for 2028 scenarios).
Table 5.1: Proposed 2018 and 2028 Bus Headways (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>Terrey Hills to Manly</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>666</td>
<td>Sydney Buses</td>
<td>Allambie Heights to City express</td>
<td>20</td>
<td>20</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 Narrabeena</td>
<td>8</td>
<td>60</td>
</tr>
<tr>
<td>E69</td>
<td>Sydney Buses</td>
<td>Manly to City Narrabeena</td>
<td>7.5</td>
<td>7.5</td>
</tr>
<tr>
<td>173</td>
<td>Sydney Buses</td>
<td>Narrabeena 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 (2014)

Note: Inbound direction is towards the Sydney CBD, North Sydney and Chatswood
AM bus headways have been transposed for the PM peak period.

5.3 Network Performance

5.3.1 Short Term (2018) Conditions under Do Minimal Scenario

Table 5.1, Table 5.2 and Table 5.3 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 5.2: 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 (vehicles)</td>
<td>35,276</td>
<td>33,837</td>
<td>-4%</td>
</tr>
<tr>
<td>Number of vehicles that remain in the network (vehicles)</td>
<td>2,786</td>
<td>3,444</td>
<td>+24%</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 5.3: 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 (vehicles)</td>
<td>42,034</td>
<td>41,518</td>
<td>-1%</td>
</tr>
<tr>
<td>Number of vehicles that remain in the network (vehicles)</td>
<td>2,087</td>
<td>2,435</td>
<td>+17%</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. The increased levels of unreleased demand reflect a congested network.

Without substantial improvements to the capacity of 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.

5.3.2 Long Term (2028) Conditions under Do Minimal scenario

Table 5.4 and Table 5.5 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 5.4: 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 5.5: 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).

The demand forecasts indicate moderate growth in traffic between 2018 and 2028, increasing by 5 percent and 4 percent in the AM and PM peak periods respectively. With minimal improvement to the transport network, traffic congestion is predicted to increase, resulting in a reduction in average travel speeds, increases in the average delay per vehicle and in the average number of stops per vehicle, particularly for the PM peak period.
Average travel speeds are predicted to be 10 percent slower in the AM peak period (refer to Table 5.4) and 16 percent slower in the PM peak period (refer to Table 5.5).

Between 2018 and 2028, the level of unreleased demand is predicted to reduce from 14 percent to 10 percent during the AM peak period, but to increase from 12 percent to 17 percent of total demand during the PM peak period.

This different outcome between the AM and PM peak periods is due largely to the redistribution of staff traffic movements to align with network capacity and away from congested areas of the network (refer to discussion provided at Section 4.5), with staff commuting more likely to coincide with regional commuting movements during the AM peak period. 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 to access the precinct from the west.

5.4 Intersection Performance

5.4.1 Overview of Intersection Operation

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 5.6. The worst case LOS for the AM and PM peak periods are presented in Table 5.6.

**Table 5.6: 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>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/ Naree Road/ 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 1: Warringah Road/ Forest Way intersection predicted to operate at LOS F under system-wide network performance.

Note 2: The number of intersections assessed in the 2012 and future year (2018, 2028) cases is different due to the new intersections that are created to provide access to the hospital.

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 2 of the 5 intersections along Warringah 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 all of the intersections along Warringah 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.

5.4.2 Short Term (2018) Intersection Performance with Do Minimal Case

The average intersection delays and LOS forecast for the AM and PM peak periods for the 2018 Do Minimal scenario are illustrated graphically in Figure 5.2 and Figure 5.3.

Figure 5.2: 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 Figure 5.2 and Figure 5.3 indicates 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 Table 5.6, the following intersections operate currently (reflected by the 2012 base year model) 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.

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 Forest 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.

5.4.3 Long-Term (2028) Intersection Performance with Do Minimal case

The average intersection delays and LOS forecast for the AM and PM peak periods in the 2028 Do Minimal scenario are illustrated in Figure 5.4 and Figure 5.5.
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.

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

5.5 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 5.6.

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 5.7.
Table 5.7: 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 predicted generally to reduce or remain relatively stable.

The average speed and total travel time for the 2012 base year and the 2018 and 2028 Do Minimal scenarios are illustrated in Figure 5.7 and Figure 5.8.

Figure 5.7: Comparison of Average Speeds, km/h

Source: NBH Roadworks VISSIM Model (GTA, 2014).
5.6 Summary of Future Base Case Conditions

5.6.1 Future traffic growth under Do Minimal case

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 (when compared with the 2018 Do Minimal case).

5.6.2 Future network performance under Do Minimal case

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 (refer to Table 5.4) and the average delay per vehicle is predicted to increase by about 41 percent (refer to Table 5.2). While during the PM peak period, the average travel speed is predicted to reduce by 30 percent (refer to Table 5.5) and the average delay per vehicle is predicted to increase by 71 percent (refer to Table 5.3). In the Do Minimal Case, the level of unreleased demand (vehicles queued up on the periphery due to insufficient road capacity to enter the network) would be 14 percent in the AM peak period and 12 percent in the PM peak period (refer to Table 5.2 and Table 5.3). The high levels of unreleased demand reflect a road network with significantly overloaded conditions.
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, including all intersections along Warringah Road in the study area. The two exceptions are the Frenchs Forest Road East/ Patanga Road/ Allambie Road intersection and the Frenchs Forest Road West/ NBH/ Gladys Road intersection.

The traffic 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.

5.7 Need for Network Enhancement Works

The analysis of the 2012 Base 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.

Modelling of the Do Minimum scenario indicates that without further improvement of connections to the proposed NBH and enhancement of the network in the study area, the demands associated with the hospital and moderate level of growth in background traffic will lead to unacceptable levels of congestion and delay across the precinct road network by 2018.

Under this scenario, there is insufficient capacity in the network to support the forecast demands. Further moderate traffic growth will result generally in increasing congestion across the study area, with most intersections failing at Level of Service F in 2028, 10 years after the opening of the NBH.
6. Transport Impacts of Stage 2 Network Enhancement Works

6.1 Overview of the Project Case Scenario

The combined works associated with Stages 1 and 2 of the project (assessed as the Project Case Scenario), which is the basis of the assessment presented in this chapter are detailed in the following sections.

6.1.1 Scope of Stage 1 works

The Stage 1 Connectivity Works are provided to facilitate the opening of the NBH and are summarised below:

- Widening of Naree Road, Frenchs Forest Road West and Frenchs Forest Road East between Forest Way and Allambie Road to two lanes in both directions
- Widening of Warringah Road between Allambie Road and Government Road
- Upgrade of the following intersections:
  - Forest Way/Naree Road (future signals)
  - Naree Road/Frenchs Forest Road West/Rabbett Street (future signals)
  - Wakehurst Parkway/Frenchs Forest Road East/Frenchs Forest Road West (upgrade existing signalised intersection)
  - Frenchs Forest Road East/Romford Road (future signals)
  - Frenchs Forest Road East/Patanga Road/Allambie Road (future signals)
  - Warringah Road/Allambie Road (upgrade existing signalised intersection)
  - Frenchs Forest Road / Nandi Avenue (future seagull layout).
- Shared paths and footpaths at various locations along the proposed roadworks.

6.1.2 Scope of Stage 2 works

The Stage 2 Enhancement Works have been proposed in order to return the operation of the network to better than or comparable to the existing operation whilst catering for potential future development in the precinct and growth in background traffic volumes.

The proposed road upgrades associated with the Stage 2 Network Enhancement Works are illustrated in Figure 1.2.

The major changes to the road network are summarised below:

- Warringah Road underpass (four lanes with two lanes in each direction for east-west through traffic) from west of Forest Way to east of Wakehurst Parkway
- Eastbound and westbound surface lanes on Warringah Road either side of the underpass
- An on-ramp for vehicles turning right from Wakehurst Parkway (north approach) onto Warringah Road underpass (westbound)
- Signalised intersections of Forest Way, Hilmer Street and Wakehurst Parkway with the Warringah Road surface lanes
- New connection at Wakehurst Parkway / Aquatic Drive intersection (left in, right in and left out movements only)
- upgrade of the Warringah Road/Allambie Road intersection
- grade-separated shared pedestrian / cyclists crossings of Warringah Road west of Forest Way and west of Hilmer Street
- Shared paths and footpaths on sections of Warringah Road, Wakehurst Parkway, Forest Way, Aquatic Drive and Allambie Road.

Approval for the Concept Proposal and Stage 1 Project has been sought separately to this EIS. The assessment presented below assumes that the road network upgrade works associated with both the Stage 1 Project and the Stage 2 Project are constructed by the opening of the NBH in 2018. The assessment is made against a base case of the Do Minimal scenario presented in the previous chapter.

6.2 Network Performance

An assessment of the traffic impacts resulting from the Project Case Scenario (Stages 1 and 2 combined) compared to the impacts of the Do Minimal scenario are presented in the following sections. Where appropriate, results have been provided for comparison with Stage 1 outcomes. In both cases performance is assessed against the Do Minimal case.

6.2.1 Short Term (2018) Network Performance with Project Case Scenario

**AM Peak Period**

Table 6.1 provides a comparison of the modelling results between the Stage 1 Project and the Project Case Scenario against the 2018 Do Minimal scenarios for the 2018 three hour AM peak period.

<table>
<thead>
<tr>
<th>Network Measure (3 hours)</th>
<th>Do Minimal</th>
<th>Stage 1</th>
<th>Project Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total traffic demand (vehicles)</td>
<td>43,252</td>
<td>43,283 (+0%)</td>
<td>43,245 (+0%)</td>
</tr>
<tr>
<td>Number of vehicles that have left the network (vehicles)</td>
<td>33,837</td>
<td>36,265 (+7%)</td>
<td>39,427 (+17%)</td>
</tr>
<tr>
<td>Number of vehicles that remain in the network (vehicles)</td>
<td>3,444</td>
<td>2,950 (-14%)</td>
<td>2,888 (-16%)</td>
</tr>
<tr>
<td>Unreleased demand (vehicles)</td>
<td>5,971</td>
<td>4,068 (-32%)</td>
<td>930 (-84%)</td>
</tr>
<tr>
<td>Proportion of vehicles unreleased</td>
<td>14%</td>
<td>9%</td>
<td>2%</td>
</tr>
<tr>
<td>Total distance travelled in network (km)</td>
<td>109,444</td>
<td>111,728 (+7%)</td>
<td>125,784 (+15%)</td>
</tr>
<tr>
<td>Total time travelled in network (hr)</td>
<td>6,393</td>
<td>5,455 (-15%)</td>
<td>5,266 (-17%)</td>
</tr>
<tr>
<td>Average speed (km/h)</td>
<td>17.1</td>
<td>21.6 (+26%)</td>
<td>23.8 (+30%)</td>
</tr>
<tr>
<td>Average delay time per vehicle (sec)</td>
<td>449</td>
<td>327 (-27%)</td>
<td>280 (-38%)</td>
</tr>
<tr>
<td>Average number of stops per vehicle</td>
<td>5.7</td>
<td>4.8 (-15%)</td>
<td>4.5 (-21%)</td>
</tr>
<tr>
<td>Total delay time including unreleased time (hr)</td>
<td>8,433</td>
<td>7,714 (-9%)</td>
<td>4,313 (-49%)</td>
</tr>
</tbody>
</table>

Source: NBH Roadworks VISSIM Model (GTA, 2014).
As highlighted in the previous chapter, traffic demands during the AM peak period in 2018 are forecast to be 12 percent higher than those in 2012.

The above results indicate that the proposed road upgrades associated with Stage 1 of the project would reduce average delays during the AM peak period in 2018 by 27 percent while completion of the Project Case would reduce delays by 38 percent compared with the Do Minimal case. The predicted average delays during the 2018 AM peak period represent an improvement over the operation of the road network in 2012 (13 percent reduction).

As a result of the increased capacity in the network compared with the Do Minimal scenario, the works associated with Stage 1 of the project would reduce the number of vehicles not able to enter the network during the AM peak period by 32 percent, while completion of the Project Case would reduce this measure further to 84 percent, in both cases indicating a less congested network.

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 for the AM peak period include:

- Arthur Street and Forestville Avenue (at Warringah Road)
- Forest Way (north of Adams Street)
- Wakehurst Parkway (south of Aquatic Drive).

The level of unreleased demand at each of the above locations generally represents an improvement on the Do Minimal (Chapter 5) and Stage 1 outcomes. The majority of unreleased demand is on the minor roads approaching the study area. This is partly as a result of priority (traffic signal coordination and green time) being given generally to the arterial road links, namely Warringah Road and Wakehurst Parkway.

The results indicate that significant improvement is forecast in the operation of the network with the Stage 2 Project than with Stage 1 alone, particularly along the Warringah Road corridor where the slot allows through traffic to bypass a number of signalised surface road intersections.

It is noted that much of the congestion in the network is caused by the merge of the surface lanes with the slot traffic west of Fitzpatrick Avenue East (and the interaction with the downstream bus stops). The modelling indicates that the merge point will operate satisfactorily between 6 and 8am but deteriorate between 8 and 9am when extensive congestion is predicted should further works immediately downstream from the limit of works not take place (as outlined in Section 6.6). This congestion will increase the average delays at the Warringah Road surface lane intersections with Forest Way and Hilmer Street.

PM Peak Period

Table 6.2 provides a comparison of the modelling results between the Stage 1 Project and Project Case Scenario against the 2018 Do Minimal scenarios for the 2018 three hour PM peak period.
Table 6.2: Network Performance Results – 2018 Project Case (PM Peak Period)

<table>
<thead>
<tr>
<th>Network Measure (3 hours)</th>
<th>Do Minimal</th>
<th>Stage 1</th>
<th>Project Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total traffic demand (vehicles)</td>
<td>49,955</td>
<td>49,996</td>
<td>49,922</td>
</tr>
<tr>
<td></td>
<td>(+0%)</td>
<td>(+0%)</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>46,059</td>
</tr>
<tr>
<td></td>
<td>(+6%)</td>
<td>(+46%)</td>
<td>(+11%)</td>
</tr>
<tr>
<td>Number of vehicles that remain in the network (vehicles)</td>
<td>2,435</td>
<td>2,775</td>
<td>2,139</td>
</tr>
<tr>
<td></td>
<td>(+14%)</td>
<td>(+14%)</td>
<td>(-12%)</td>
</tr>
<tr>
<td>Unreleased demand (vehicles)</td>
<td>6,002</td>
<td>3,330</td>
<td>1,724</td>
</tr>
<tr>
<td></td>
<td>(-45%)</td>
<td>(-71%)</td>
<td></td>
</tr>
<tr>
<td>Proportion of vehicles unreleased</td>
<td>12%</td>
<td>7%</td>
<td>3%</td>
</tr>
<tr>
<td>Total distance travelled in network (km)</td>
<td>129,252</td>
<td>137,688</td>
<td>143,706</td>
</tr>
<tr>
<td></td>
<td>(+7%)</td>
<td>(+11%)</td>
<td>(+11%)</td>
</tr>
<tr>
<td>Total time travelled in network (hr)</td>
<td>6,470</td>
<td>5,947</td>
<td>5,541</td>
</tr>
<tr>
<td></td>
<td>(-8%)</td>
<td>(-14%)</td>
<td>(-14%)</td>
</tr>
<tr>
<td>Average speed (km/h)</td>
<td>20.0</td>
<td>23.2</td>
<td>25.9</td>
</tr>
<tr>
<td></td>
<td>(+16%)</td>
<td>(+30%)</td>
<td></td>
</tr>
<tr>
<td>Average delay time per vehicle (sec)</td>
<td>360</td>
<td>289</td>
<td>243</td>
</tr>
<tr>
<td></td>
<td>(-20%)</td>
<td>(-33%)</td>
<td></td>
</tr>
<tr>
<td>Average number of stops per vehicle</td>
<td>5.5</td>
<td>4.6</td>
<td>4.1</td>
</tr>
<tr>
<td></td>
<td>(-15%)</td>
<td>(-25%)</td>
<td></td>
</tr>
<tr>
<td>Total delay time including unreleased time (hr)</td>
<td>11,226</td>
<td>7,585</td>
<td>5,384</td>
</tr>
<tr>
<td></td>
<td>(-32%)</td>
<td>(-52%)</td>
<td></td>
</tr>
</tbody>
</table>

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

As highlighted in the previous chapter, the forecast 11 percent growth in PM peak traffic demands between 2012 and 2018 is similar to that during the AM peak.

The above results indicate that the proposed road upgrades associated with Stage 1 of the project would reduce average delays during the PM peak period in 2018 by 20 percent while completion of the Project Case would reduce delays by 33 percent compared with the Do Minimal case. Unlike the case in the AM peak period, this still represents a slight degradation over the operation of the road network in 2012.

As a result of the increased capacity in the network compared with the Do Minimal scenario, the works associated Stage 1 of the project would reduce the number of vehicles not able to enter the network during the PM peak period by 45 percent, while completion of the Project Case would reduce this measure further to 71 percent, in both cases indicating a less congested network.

In this regard, it is noted that almost 5,000 additional peak period vehicle movements are forecast between 2012 and 2018 (refer Table 5.3). 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.

With the modelling is 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 in the PM peak period include:

- Arthur Street (at Warringah Road)
- Forest Way (north of Adams Street)
- Government Road (at Warringah Road)
- Aquatic Drive (east of Wakehurst Parkway)
- Forestway Shopping Centre.
The majority of unreleased demand is on the minor roads approaching the study area. This is partly as a result of priority being given generally to the arterial road links, namely Warringah Road and Wakehurst Parkway.

### 6.2.2 Long-Term (2028) Network Performance with Project AM Peak Period

Table 6.3 provides a comparison of the modelling results between the Stage 1 Project and Project Case against the 2028 Do Minimal scenarios for the 2028 three hour AM peak period.

<table>
<thead>
<tr>
<th>Network Measure (3 hours)</th>
<th>Do Minimal</th>
<th>Stage 1</th>
<th>Project Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total traffic demand (vehicles)</td>
<td>45,346</td>
<td>44,952</td>
<td>45,341 (+0%)</td>
</tr>
<tr>
<td>Number of vehicles that have left the network (vehicles)</td>
<td>36,582</td>
<td>38,465</td>
<td>40,489 (+11%)</td>
</tr>
<tr>
<td>Number of vehicles that remain in the network (vehicles)</td>
<td>4,011</td>
<td>3,606</td>
<td>2,717 (-32%)</td>
</tr>
<tr>
<td>Unreleased demand (vehicles)</td>
<td>4,753</td>
<td>2,881</td>
<td>2,135 (-55%)</td>
</tr>
<tr>
<td>Proportion of vehicles unreleased</td>
<td>10%</td>
<td>6%</td>
<td>5%</td>
</tr>
<tr>
<td>Total distance travelled in network (km)</td>
<td>116,143</td>
<td>124,178</td>
<td>128,181 (+10%)</td>
</tr>
<tr>
<td>Total time travelled in network (hr)</td>
<td>7,533</td>
<td>6,074</td>
<td>5,406 (-28%)</td>
</tr>
<tr>
<td>Average speed (km/h)</td>
<td>15.4</td>
<td>20.4</td>
<td>23.7 (+54%)</td>
</tr>
<tr>
<td>Average delay time per vehicle (sec)</td>
<td>503</td>
<td>349</td>
<td>279 (-45%)</td>
</tr>
<tr>
<td>Average number of stops per vehicle</td>
<td>7.4</td>
<td>5.5</td>
<td>4.5 (-39%)</td>
</tr>
<tr>
<td>Total delay time including unreleased time (hr)</td>
<td>9,132</td>
<td>6,603</td>
<td>6,109 (-33%)</td>
</tr>
</tbody>
</table>

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

By 2028, the total traffic demand in the precinct during the AM peak period is forecast to be 45,346 vehicle trips – an increase of 4.8 percent from 2018 (refer Table 5.4), and the proportion of vehicles not able to enter the network during this period in 2028 is forecast to be 10 percent.

The Stage 2 Project results indicate a net improvement overall against the 2028 Do Minimal scenario, with average delays reduced by 45 percent (compared with 31 percent under Stage 1 alone) and average speeds increased by 54 percent (compared with 32 percent under Stage 1). Despite the growth in traffic across the network and addition of NBH demands, this represents a slight improvement over the current conditions in 2012 (average delay 13 percent lower and average speed 8 percent higher than in 2012).

The level of unreleased demand for the AM peak period in 2028 is forecast to fall from 10 percent of total vehicle trips in the Do Minimal scenario to 7 percent under Stage 1 and 5 percent under the full Project Case.

The locations where the predicted volumes of vehicles are unable to enter the study area during the AM peak period are:

- Arthur Street and Forestville Road (at Warringah Road)
The level of unreleased demand at each of the above locations generally represents an improvement on the Do Minimal (Chapter 5) and Stage 1 Project Scenario. The majority of unreleased demand is on the minor roads approaching the study area. This is partly as a result of priority generally being given to the arterial road links, namely Warringah Road and Wakehurst Parkway.

**PM Peak Period**

Table 6.4 provides a comparison of the modelling results between the Stage 2 Project and the 2028 Do Minimal scenarios for the 2028 three hour AM peak period.

**Table 6.4: Network Performance Results - 2028 Project Case (PM Peak Period)**

<table>
<thead>
<tr>
<th>Network Measure (3 hours)</th>
<th>Do Minimal</th>
<th>Stage 1</th>
<th>Project Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total traffic demand (vehicles)</td>
<td>52,025</td>
<td>52,155</td>
<td>52,046</td>
</tr>
<tr>
<td>Number of vehicles that have left the network (vehicles)</td>
<td>39,357</td>
<td>41,949</td>
<td>46,987</td>
</tr>
<tr>
<td>Number of vehicles that remain in the network (vehicles)</td>
<td>3,797</td>
<td>3,047</td>
<td>2,202</td>
</tr>
<tr>
<td>Unreleased demand (vehicles)</td>
<td>8,871</td>
<td>7,159</td>
<td>2,857</td>
</tr>
<tr>
<td>Proportion of vehicles unreleased</td>
<td>17%</td>
<td>14%</td>
<td>5%</td>
</tr>
<tr>
<td>Total distance travelled in network (km)</td>
<td>129,531</td>
<td>131,726</td>
<td>145,203</td>
</tr>
<tr>
<td>Total time travelled in network (hr)</td>
<td>7,680</td>
<td>6,934</td>
<td>5,782</td>
</tr>
<tr>
<td>Average speed (km/h)</td>
<td>16.9</td>
<td>19.0</td>
<td>25.1</td>
</tr>
<tr>
<td>Average delay time per vehicle (sec)</td>
<td>468</td>
<td>385</td>
<td>253</td>
</tr>
<tr>
<td>Average number of stops per vehicle</td>
<td>6.5</td>
<td>5.7</td>
<td>4.2</td>
</tr>
<tr>
<td>Total delay time including unreleased time (hr)</td>
<td>14,852</td>
<td>12,316</td>
<td>6,382</td>
</tr>
</tbody>
</table>

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

By 2028, the total traffic demand in the precinct during the PM peak period is forecast to be 52,025 vehicle trips – an increase of 4.1 percent from 2018 (refer Table 5.5), and the proportion of vehicles not able to enter the network during this period in 2028 is forecast to be 17 percent.

The Project Case results in a net improvement overall against the 2028 Do Minimal scenario, with average delays reduced by 46 percent (compared with 18 percent under Stage 1 alone) and average speeds increased by 49 percent (compared with 12 percent under Stage 1). This represents a moderate deterioration compared to the current conditions in 2012 (average delay 20 percent higher and average speed 12 percent lower than in 2012) (refer Table 5.3).

The level of unreleased demand for the PM peak period in 2028 is forecast to fall from 17 percent of total vehicle trips in the Do Minimal scenario to 14 percent under Stage 1 and 5 percent under the full Project Case.
The locations where the predicted volumes of vehicles are unable to enter the study area during the PM peak period are:

- Warringah Road (west of Arthur Street)
- Arthur Street (at Warringah Road)
- Forest Way (north of Adams Street)
- Warringah Road (east of Government Road)
- Government Road (at Warringah Road)
- Allambie Road (at Warringah Road)
- Aquatic Drive (east of Wakehurst Parkway)
- Starkey Street (at Warringah Road)

The majority of unreleased demand is on the minor roads approaching the study area. This is partly as a result of priority generally being given to the arterial road links, namely Warringah Road and Wakehurst Parkway.

### 6.3 Intersection Performance with Project

#### 6.3.1 Overview of Intersection Operation

The changes in the LOS of the intersections within the immediate study area for the 2012 base condition and the 2018 and 2028 scenarios for Stage 1 and 2 are detailed in Table 6.5.

<table>
<thead>
<tr>
<th>Intersection</th>
<th>2012 Base Year</th>
<th>2018 Do Minimal</th>
<th>2018 Project Case</th>
<th>2028 Do Minimal</th>
<th>2028 Project Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warringah Road/ Forest Way 1</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>A-D</td>
</tr>
<tr>
<td>Warringah Road/ Hilmer Street</td>
<td>A-D</td>
<td>F</td>
<td>A-D</td>
<td>F</td>
<td>A-D</td>
</tr>
<tr>
<td>Warringah Road/ Wakehurst Parkway</td>
<td>F</td>
<td>E</td>
<td>F</td>
<td></td>
<td>A-D</td>
</tr>
<tr>
<td>Warringah Road/ Allambie Road</td>
<td>E</td>
<td>F</td>
<td>E</td>
<td>F</td>
<td>E</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></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>E</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>A-D</td>
</tr>
<tr>
<td>Frenchs Forest Road West/ Hospital Entrance/ Gladys Avenue</td>
<td>NA 2</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></td>
</tr>
<tr>
<td>Frenchs Forest Road East/ Romford Road</td>
<td>A-D</td>
<td>F</td>
<td>A-D</td>
<td>F</td>
<td>E</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>
<tr>
<td>Allambie Road / Aquatic Drive</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td></td>
<td>F</td>
</tr>
</tbody>
</table>

Note 1: Warringah Road/ Forest Way intersection predicted to operate at LOS F under system-wide network performance for the Base Condition and Stage 1 Project Scenarios.

Note 2: The number of intersections assessed in the 2012 and future year (2018, 2028) cases is different due to the new intersections that are created to provide access to the hospital and also the new intersection on Wakehurst Parkway at Aquatic Drive.

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

The data indicates that 2 of the 5 intersections along Warringah Road will operate with a LOS of E or better in 2018 with the Project works compared to no intersection under the Do Minimal scenario. By comparison only 3 of the 5 intersections along Warringah Road operate with a LOS E or better in the 2012 base conditions scenario.
The 2028 data indicates that 4 of the 5 intersections along Warringah Road will operate with a LOS of E or better with the Project works compared to no intersections under the Do Minimal scenario.

Therefore the proposed Project will have a significant improvement to the operation of the Warringah Road corridor in 2018 and 2028.

In addition to the improved operation of the Warringah Road corridor, minor improvements along the Frenchs Forest Road corridor are anticipated as a result of the Stage 2 Project when compared with the Stage 1 Project in 2018 and 2028 (Stage 1 Project and Concept Proposal EIS, Appendix D, RMS October 2014). This includes improved operation of the Forest Way / Naree Road and Frenchs Forest Road / Romford Road intersections. In this regard it is noted that the Stage 2 Project will increase the east-west capacity of the broader network and in turn ease the capacity constraints on Frenchs Forest Road.

### 6.3.2 Intersection Performance during AM Peak Period (Project Case)

The forecast intersection average delays and LOS for the 2018 and 2028 AM peak period Project Case Scenario are illustrated in Figure 6.1 and Figure 6.2.

**Figure 6.1: Project Case Intersection Delays and LOS - AM Peak Period 2018**

Source: NBH Roadworks VISSIM Model (GTA, 2014).
Referring back to Figure 5.2 and Figure 5.4 for the analysis of intersection performance under the Do Minimal scenario, Figure 6.1 and Figure 6.2 indicate that adding the Project (including both Stages 1 and 2 upgrades) would result in a substantial improvement at all intersections along Warringah Road during the AM peak period in both 2018 and 2028.

### 6.3.3 Intersection Performance during PM Peak Period

The forecast intersection average delays and LOS for the 2018 and 2028 PM peak period Stage 2 Project scenario are illustrated graphically in Figure 6.3 and Figure 6.4.
As demonstrated for the AM peak period, referring back to Figure 5.3 and Figure 5.5 for the analysis of intersection performance under the Do Minimal scenario, Figure 6.3 and Figure 6.4 indicate that adding the Project (including both Stages 1 and 2) would result in a substantial improvement at all intersections along Warringah Road during the PM peak period in both 2018 and 2028.
6.3.4 Summary

The data indicates that with the proposed Road Connectivity (Stage 1 Project) and Network Enhancement (Stage 2 Project) Works, fewer intersections are predicted to have delays in excess of 90 seconds and to operate at LOS F compared with the Do Minimal scenario.

During the AM peak period the intersections along the Warringah Road corridor will generally operate with LOS E or better with acceptable average delays forecast at each of the intersections. The only exception being the Warringah Road / Forest Way intersection which is predicted to operate with a LOS F during the 2018 AM peak period, this is a result of queuing from the bus stop located at Maxwell Parade just after the merge point between the slot and surface traffic lanes.

The Frenchs Forest Road / Wakehurst Parkway and Forest Way / Adams Street intersections are predicted to experience poor intersection operation and average delays in excess of 120 seconds during the AM peak period (LOS F).

During the PM peak period the intersections along the Warringah Road corridor will generally operate with LOS E or better with acceptable average delays forecast at each of the intersections. The only exception being the Warringah Road / Government Road / Ellis Road intersection which is predicted to operate with a LOS F and with delays in excess of 90 seconds in 2018 and 120 seconds in 2028. Although this intersection is outside the works area for the Project (Stage 1 and 2) further investigation may be warranted in future.

6.4 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) - surface lanes only
- 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 6.5.
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 AM peak hour (7:00 to 8:00am) for the Do Minimal and the Stage 2 scenario for 2018 and 2028 are provided in Table 6.6.

**Table 6.6: Average Vehicle Speeds (km/h) – AM Peak Hour**

<table>
<thead>
<tr>
<th>Route</th>
<th>Direction</th>
<th>Do Minimal</th>
<th>Project Case</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>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>

[1] Surface traffic on Warringah Road only (excluding traffic in the slot).

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

The data indicates that during the AM peak period that the Project Case average vehicle speeds are generally anticipated to increase against the Do Minimal scenario. It is noted that the speeds presented for Warringah Road (Route 1) are for traffic on the surface lanes and not traffic in the slot. The slot traffic would be expected to operate with greater average speeds as this traffic avoids the Wakehurst Parkway, Hilmer Street and Forest Way traffic signals. The modelling predicts a minor deterioration in travel speeds for the 2018 scenario southbound on the Forest Way-Wakehurst Parkway route. This is partially as a result of the additional traffic on the network as a result of the NBH development.

The average speed for the three routes for the PM peak hour (4:00 to 5:00pm) for the Do Minimal and the Project scenario for 2018 and 2028 are provided in Table 6.7.
### Table 6.7: Average Vehicle Speeds (km/h) – PM Peak Hour

<table>
<thead>
<tr>
<th>Route</th>
<th>Direction</th>
<th>Do Nothing 2018</th>
<th>Do Nothing 2028</th>
<th>Stage 2 Works 2018</th>
<th>Stage 2 Works 2028</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Westbound</td>
<td>30</td>
<td>31</td>
<td>33 [1]</td>
<td>37 [1]</td>
</tr>
<tr>
<td>Route 2: Forest Way-Warringah Road</td>
<td>Eastbound</td>
<td>18</td>
<td>21</td>
<td>17</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Westbound</td>
<td>21</td>
<td>23</td>
<td>27</td>
<td>22</td>
</tr>
<tr>
<td>Route 3: Forest Way-Wakehurst Parkway South</td>
<td>Northbound</td>
<td>17</td>
<td>17</td>
<td>28</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>Southbound</td>
<td>12</td>
<td>18</td>
<td>13</td>
<td>16</td>
</tr>
</tbody>
</table>

[1] Surface traffic on Warringah Road only (excluding traffic in the slot).

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

The data indicates that during the PM peak period that the Project Case average vehicle speeds are generally anticipated to increase against the Do Minimal scenario.

### 6.5 Regional Impacts

#### 6.5.1 Unreleased Demand

A key measure of the performance of the road network model is “unreleased demand”. This is a measure of the traffic demand that is unable to be accommodated by the capacity of the road network during the period of the model simulation, due to sustained high levels of congestion within the area over the model period. In reality, this presents itself as queuing on the approaches to the area network and an extended duration of congested conditions.

The modelling results provided in Chapter 5 indicate that under the Do Minimal Case, approximately 12-14 percent in 2018 and 10-17 percent in 2028 of the peak period traffic demands would be unable to enter the modelled study area during each three-hour peak period. The 2012 Base Condition modelling indicates that currently only 2 percent of peak hour traffic demands are unable to enter the modelled study area during each of the peak periods. This indicates the existing road network is at capacity to service current demands, and 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 Stage 2 Project is expected to mitigate the full impacts of the NBH and background traffic growth.

As the design of the Stage 2 Project 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 to accommodate induced demands from other nearby roads. However, as traffic volumes are lower during the off-peak periods, there could be some spare road capacity outside the peak periods.

However, it is not expected that these travel time improvements would be sufficient to result in a significant change in the regional travel patterns.

#### 6.5.2 Impacts to Regional Road Network

RMS has provided analysis of traffic volumes out of their strategic model with and without the Project for the AM peak period in 2021 and 2036. It is noted that whilst the traffic volume...
forecasts incorporate the Stage 2 Project they do not 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 have been calculated using the RMS strategic model for the scenarios with and without the Project Case. The percentage difference for each of the links between each scenario is provided in Table 6.8.

**Table 6.8: Forecast Impact of Project on Regional Traffic Volumes**

<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>

Source: RMS Strategic Traffic Forecasting Model

With the Project, 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 Stage 2 of the Project 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 (e.g. between Killara and Narabeen 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 Project Works may result in some motorists selecting to use the Warringah Road corridor instead of the alternative route. If this was to occur, the Stage 2 Project 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.

### 6.6 Intersections Adjacent to Study Area

The Stage 2 Project increases the capacity of the Warringah Road corridor within the project study area. The enhancement works mitigate the additional traffic generation from background traffic growth and the NBH by providing more capacity in the study area network.
The modelling indicates that there is additional unreleased demand outside of the study area at the adjacent intersections. As such, once the Project is complete it is predicted that there will be congestion at the following locations:
- Warringah Road / Government Road
- Warringah Road / Currie Road / Brown Street
- Forest Way / Adams Street.

Future works will be required at these intersections to alleviate the congestion caused by the additional traffic present on the network. These works could include:
- Provision of indented bus bays to minimise delays to through traffic from stopped buses
- Capacity upgrades at the adjacent intersections (new and/or extended turn lanes)
- Alterations to the existing phasing at intersections.

Any changes to the surrounding road network should be undertaken as a separate study, and not part of the Stage 2 Project.

6.7 Overview of Other Operational Impacts

6.7.1 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 5.2.

Improvements to Existing Bus Stops

As part of the Stage 2 Project, the southbound bus stop on Forest Way opposite the Forestway Shopping Centre would be extended to cater for two buses.

Changes to Bus Stop Locations

A westbound bus stop is currently provided on Warringah Road immediately south of Fitzpatrick Avenue (east). In the future this bus stop would be located at the merge point of the Forest Way and Warringah Road surface lanes and as such, the Stage 2 Project concept design indicates that this bus stop is to be removed with passengers serviced by the nearby bus stop on Warringah Road at Maxwell Parade, located 220m further south.

Removing the bus stop from Fitzpatrick Avenue to Maxwell Parade will increase the walking distance for residents on Fitzpatrick Avenue and surrounds. It is noted that the travel distance for these residents could be further increased should the bus stop at Maxwell Parade also be relocated to address anticipated congestion issues (subject to further investigation by Roads and Maritime).

In order to improve the public transport catchment of this area consideration could be given to rerouting a bus along Fitzpatrick Avenue in place of travelling along Warringah Road (any change to bus routes would be at the discretion of TfNSW).

Travel Speeds for Buses within the Project Area

Within the project area, the only continuous east-west route is via Frenchs Forest Road. Some services use sections of Warringah Road, but not the whole length within the project area. The average speeds for the bus route along Frenchs Forest Road for the 7:00–8:00am and 4:00–
5:00pm peak hour for the Do Minimal, Project Case Scenarios for 2018 and 2028 are provided in Table 6.9.

Table 6.9: Average Bus Speeds on Frenchs Forest Road (km/h)

<table>
<thead>
<tr>
<th>Period</th>
<th>Direction</th>
<th>Do Minimal 2018</th>
<th>Stage 1 Project 2018</th>
<th>Stage 2 Project 2018</th>
<th>Do Minimal 2028</th>
<th>Stage 1 Project 2028</th>
<th>Stage 2 Project 2028</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM Peak</td>
<td>Eastbound</td>
<td>11.6</td>
<td>14.9</td>
<td>14.7</td>
<td>10.4</td>
<td>14.9</td>
<td>14.7</td>
</tr>
<tr>
<td></td>
<td>Westbound</td>
<td>8.8</td>
<td>7.4</td>
<td>12.3</td>
<td>9.5</td>
<td>8.3</td>
<td>12.5</td>
</tr>
<tr>
<td>PM Peak</td>
<td>Eastbound</td>
<td>10.3</td>
<td>14.2</td>
<td>13.7</td>
<td>10.9</td>
<td>14.3</td>
<td>13.8</td>
</tr>
<tr>
<td></td>
<td>Westbound</td>
<td>14.8</td>
<td>16.9</td>
<td>17.5</td>
<td>11.6</td>
<td>10.9</td>
<td>15.0</td>
</tr>
</tbody>
</table>

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

The data in Table 6.9 indicates that during the AM and PM peak periods in the Project Case, average bus speeds are anticipated to improve against the Do Minimal scenario.

The two major contributors to the bus travel time along Frenchs Forest Road are:

1. The dwell time at bus stops (assumed to be an average of 20 seconds per bus stop)
2. The delay incurred at signalised intersections.

The predicted future average bus speeds are still less than the TfNSW target speed for suburban roads of 18-25 km/h. One key contributing factor to this is the delay buses would likely encounter at the Frenchs Forest Road/Wakehurst Parkway intersection.

In general, there was a reduction in traffic flows utilising Frenchs Forest Road in the Stage 2 Project relative to the Stage 1 Project. However, with the objective of achieving a better overall performance of the area road network, the model reflects the re-optimisation of signalised intersections along Frenchs Forest Road, particularly at the intersection with Wakehurst Parkway. With traffic volumes on Frenchs Forest Road through this intersection reducing from the Stage 1 Case to the Stage 2 Case, capacity has been reallocated to Wakehurst Parkway, increasing delays slightly for eastbound movements during both AM and PM peaks. Otherwise, Table 6.9 shows that the average speed of buses on Frenchs Forest Road increases with the Stage 2 Project Case.

In this regard, the improvements in bus travel speeds along Frenchs Forest Road could theoretically be further increased with adjustments to signal timing at the Frenchs Forest Road/Wakehurst Parkway intersection, to meet specific standards for bus operations. However, in the particular case of the Frenchs Forest Road corridor, there would be other network implications, particularly along Wakehurst Parkway, if the target bus speeds are to be achieved.

There are five bus stops located in close proximity to each other on Frenchs Forest Road, at which all buses along Frenchs Forest Road are required to stop. This, in part, also contributes to the slower than normal bus speeds. Should the number of bus stops be reduced, the average bus travel speed would increase.

In addition to the above it is noted that average speeds along Warringah Road will increase for all vehicles and as such, bus speeds for services using Warringah Road (or part of) would also improve.

Opportunities to Improve Future Public Transport Services

Transport for NSW (TfNSW) is currently reviewing the bus network that services the wider Northern Beaches area, to inform the design and delivery of the Northern Beaches Bus Rapid Transit (BRT) project (including kerbside BRT between Mona Vale and the Sydney CBD). Completion of the Northern Beaches BRT is a key action in the NSW Government’s Northern Beaches Transport Plan.

As part of its work to deliver the Northern Beaches Transport Action Plan, TfNSW is working with Warringah Council and Roads and Maritime to identify and investigate medium and long-term bus servicing scenarios for the Frenchs Forest precinct, to complement the Project. Service improvements will include an improved cross-regional bus service connecting Manly and Dee Why to Chatswood via Frenchs Forest. This east-west service is shown in the Northern Beaches Transport Action Plan, connecting at Frenchs Forest with a direct route from Terrey Hills to the Sydney CBD. Services will be progressively upgraded to operate at a minimum frequency of every 15 minutes in both directions from 6am to 7pm every weekday, and every 10 minutes during commuter peak periods within these times. With the completion of the Project, consideration can be given to the operation of some peak services as limited stops/express services using Warringah Road in place of Frenchs Forest Road, for faster regional commuter travel.

For the longer term, a new east-west bus route parallel to Frenchs Forest Road and Warringah Road will be explored with Warringah Council in the context of Council’s planning for the future local road network in the Frenchs Forest precinct, currently being progressed as part of the Northern Beaches Hospital Precinct Structure Plan. It is understood that Council is continuing to work with the relevant State agencies, including conducting supplementary traffic and transport modelling beyond what has been undertaken in this Project, to support the transport and access requirements (including bus services) arising from potential land use changes.

Also in the long term, the conversion of Warringah Road surface-level kerbside lanes, and/or the reconfiguration of signalised intersections, to support peak period bus priority operations would be able to be investigated, subject to customer demand and an assessment of wider road network impacts from changed traffic management conditions.

6.7.2 Pedestrians and Cyclists

Pedestrian Infrastructure

As part of the Stage 2 Network Enhancement Works new pedestrian facilities will be provided along the length of Warringah Road. The Stage 2 works will complement the pedestrian upgrades proposed to be delivered as part of the Stage 1 Connectivity Works generally along Frenchs Forest Road, Wakehurst Parkway and Forest Way.

The existing pedestrian bridge across Warringah Road west of Forest Way will be replaced with a new shared pedestrian/cycle bridge, while a new shared pedestrian/cycle bridge across Warringah Road will be provided to the west of Hilmer Street. The new pedestrian bridge will provide a grade-separated connection for pedestrians crossing Warringah Road from the residential catchments to the south to The Forest High School and NBH to the north.

An at-grade signalised pedestrian crossing of the Warringah Road surface lanes will be provided on the east side of the Warringah Road / Wakehurst Parkway intersection.

A series of new shared-path and footpath facilities will be provided in the study area as part of the Stage 2 Network Enhancement Works and will connect into the network established as part of the Stage 1 Project. Specifically the paths to be provided as part of the Stage 2 Project are summarised below.

3.0m Wide Shared Paths:
- Warringah Road south side between Fitzpatrick Avenue East and Allambie Road
Warringah Road north side between Forest Way and Wakehurst Parkway

2.5m Wide Shared Paths:
- Wakehurst Parkway east side between Warringah Road and Aquatic Drive
- Allambie Road west side between Warringah Road and Rodborough Road
- Forest Way east side between Warringah Road and Stage 1 Project

1.5m Wide Footpaths:
- Forest Way west side between Warringah Road and Stage 1 Project
- Aquatic Drive extension from existing Aquatic Drive to Wakehurst Parkway
- Warringah Road north side between Wakehurst Parkway and Allambie Road
- Wakehurst Parkway (west side) between Warringah Road and Frenchs Forest Road West

An overview of the additional pedestrian paths to be provided as part of the Stage 1 and 2 works are illustrated in Figure 6.6.

Figure 6.6: Overview of proposed pedestrian facilities to be delivered as part of Stages 1 and 2

The new facilities will improve connectivity between the key activity nodes within the study area including from the residential catchments to the south of Warringah Road to the Forestway Shopping Centre, the Forest High School and the NBH. In addition east-west pedestrian movements along the Warringah Road corridor will be facilitated by the new shared-path network.
Cycle Infrastructure

There are limited bicycle facilities on, or traversing, the existing road network of the Project study area. Proposed bicycle routes as identified in the Warringah Bike Plan (Warringah Council, 2014) are summarised below:

- Warringah Road (east of Allambie Road) – on-road bike route
- Warringah Road (west of Fitzpatrick Avenue East) – off-road bike route
- Forest Way – off-road bike route
- Wakehurst Parkway – on-road bike route

The shared path network identified in Figure 6.6 would facilitate bicycle movements and includes routes along Warringah Road, Forest Way and Wakehurst Parkway. The shared path network proposed as part of the Stage 2 Project would complement the proposed future on and off-road bicycle network proposed by Warringah Council and as part of the Stage 1 Project. The 3.0m wide shared path on the south side of the Warringah Road carriageway between Allambie Road and Fitzpatrick Avenue East would deliver a 1.9km section of any future bike route along this corridor and could tie into any future sections of this route.

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 should be considered.

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 the signalised intersections would provide a safe crossing for cyclists at these locations who use these proposed paths.

The provision of the above cycling facilities is in accordance with the general recommendations of the Sydney’s Cycling Futures.

6.7.3 Road Safety

Vehicular Traffic

The Stage 2 Network Enhancement Works separate Warringah Road through traffic from turning traffic by providing a slot for through traffic to bypass surface traffic turning movements. In addition a number of the surface intersections along Warringah Road are to be upgraded and are listed below:

- Forest Way / Warringah Road
- Warringah Road / Hilmer Street
- Warringah Road / Wakehurst Parkway
- Warringah Road / Allambie Road (south side – Stage 2)

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 are probably due to the existing traffic congestion during the peak periods within the study area.

The Stage 2 Network Enhancement Works are 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.
Key areas where the Stage 2 Network Enhancement Works are predicted to improve road safety include:

- the grade separation of through traffic and turning traffic on Warringah Road may reduce the frequency of rear end collisions along Warringah Road (this may however be offset by an increased risk of crashes where the surface and slot traffic merge)
- the removal of some of the through traffic at the surface intersections may reduce the frequency of collisions at intersections along Warringah Road
- reduced risk taking by road users by not accepting shorter gaps to make lane changes, which is more typical in a congested network.

Pedestrians and Cyclists

As indicated in Section 6.7.2, the Stage 2 Project includes the provision of grade-separated shared pedestrian/cycle crossings of Warringah Road at Forest Way (replace existing facility) and Hilmer Street (new facility), as well as signalised pedestrian crossings across Hilmer Street and NBH access with Warringah Road and at the intersection of Warringah Road and Wakehurst Parkway. The provision of the grade separated crossings will provide improved safety for pedestrians and cyclists crossing Warringah Road.

The existing crash statistics in Section 2.12 indicate that there has been one pedestrian accident on Warringah Road within the study area for the nominated period. The accident occurred at the eastern end of the study area at the Warringah Road / Government Road intersection. The presence of only one pedestrian accident along this stretch of Warringah Road indicates that there is no specific crash trend.

6.7.4 Localised Intersection and Access Changes

As part of the Stage 2 Project the following intersections will have altered movements compared to their current operation:

- Wakehurst Parkway / Aquatic Drive
- Warringah Road / Maxwell Parade
- Warringah Road / Fitzpatrick Avenue (East)
- Warringah Road / Laneway (between Hilmer Street and Bantry Bay Road).

The current access arrangement currently provided at all other intersections within the Stage 2 Project study area will be maintained, noting that traffic using Warringah Road will be required to use either the slot (through traffic) or surface lanes (turning traffic).

Wakehurst Parkway / Aquatic Drive

Aquatic Drive currently forms a cul-de-sac east of Wakehurst Parkway. As part of the Stage 2 Project it is proposed to continue Aquatic Drive westbound to form a new priority controlled intersection with Wakehurst Parkway. The proposed intersection would cater for left in, right in and left out movements (ie. the right turn out of Aquatic Drive into Wakehurst Parkway would be prohibited). The additional connection to Aquatic Drive would have a positive impact in increasing the precinct’s accessibility by allowing vehicles to access the precinct directly from Wakehurst Parkway rather than having to access the precinct from Warringah Road. This will also alleviate the already congested Warringah Road / Allambie Road intersection where vehicles are currently funnelled to access this precinct.

Vehicles would be able to undertake the left turn onto Wakehurst Parkway and the right turn into Aquatic Drive in the shadow of the Warringah Road / Wakehurst Parkway intersection. However, it is envisaged that limited breaks in north and southbound traffic would allow vehicles to turn
right from Aquatic Drive into Wakehurst Parkway and as such, the movement is prohibited. This would require vehicles seeking to travel north and west from the precinct to still use the Warringah Road / Allambie Road intersection.

As a result of the above intersection modifications, Aquatic Drive will accommodate both through vehicle movements as well as local vehicle access and as such, it is predicted that traffic volumes on Aquatic Drive will increase. While access to the area served by Aquatic Drive will improve, the increase in traffic will result in increased delays to traffic exiting from the connecting roads (ie. Madison Way, Aquatic Centre access, access driveways to the business parks).

Warringah Road / Maxwell Parade

The existing Warringah Road / Maxwell Parade intersection caters for full turning movements. In the future the intersection will be located approximately 100m downstream of the merge point between the slot and surface lanes. As part of the Stage 2 Project it will be necessary to restrict the left turn into Maxwell Parade for traffic in central lanes exiting from the slot. It is predicted that the following impacts would occur if the left turn movement for vehicles accessing from the central slot lanes was permitted:

- Vehicles slowing to turn left into Maxwell Parade would reduce the through capacity of vehicles at the merge point (higher potential for rear end accidents)
- Vehicles from the tunnel lanes would be required to weave across the surface lane merge point to access the left lane to enter Maxwell Parade.

Vehicles from the kerbside lane would be permitted to turn left into Maxwell from Warringah Road westbound during all periods (including peak hours). Signage may be considered in the slot to restrict the turn to be from the kerbside lane only.

Westbound vehicles on Warringah Road travelling in the central slot lanes would be required to access Maxwell Parade by turning left from Warringah Road into Currie Road 650m south of Maxwell Parade. The additional travel time and distance required is not considered unreasonable noting the safety benefits of restricting the existing manoeuvre.

Warringah Road / Fitzpatrick Avenue (East)

The existing Warringah Road / Fitzpatrick Avenue (East) intersection caters for left in and left out movements to the westbound carriageway of Warringah Road. In the future the intersection will be located at the merge point between the Warringah Road surface lanes and the Forest Way traffic lanes. As part of the Stage 2 Project it is proposed to prohibit left turn movements from the Warringah Road surface lanes into Fitzpatrick Avenue (East). It is predicted that the following impacts would occur if the left turn movement was maintained:

- Vehicles slowing to turn left into Fitzpatrick Avenue (East) would impact the through capacity of vehicles at the merge point (higher potential for rear end accidents)
- Vehicles from Forest Way may be tempted to weave across the surface lane merge point to access the left lane to enter Fitzpatrick Avenue (East).

It is noted that the existing left in / left out access to Fitzpatrick Avenue (West) from the Warringah Road eastbound carriageway will be maintained.

Following the restriction of the left turn into Fitzpatrick Avenue (East) westbound vehicles on Warringah Road would be required to access this road via the Hilmer Street intersection with the Warringah Road surface lanes. For vehicles accessing Fitzpatrick Avenue (East) from the east this will represent a minimal increase in travel time and distance. However, vehicles accessing Fitzpatrick Avenue (East) from Forest Way will now be required to turn left from Forest Way into Warringah Road and turn right into Hilmer Street from the surface lanes. This additional
requirement is not considered unreasonable noting the safety benefits of restricting the existing manoeuvre.

6.7.5 Changed Access Arrangements

The property at 357 Warringah Road and 2-8 Rodborough Road currently has one access point to Allambie Road and four to Rodborough Road. The access to Allambie Road is unrestricted and as such, vehicles can access the vehicle access point legally from either direction on Allambie Road (including right turns in). The access is located approximately 20m south of the Warringah Road / Allambie Road signalised intersection. The modelling indicates that when a vehicle is propped to turn right into this access point (giving way to southbound traffic) it restricts the capacity of the adjacent signalised intersection. In order to maintain capacity at the adjacent intersection it is therefore recommended that the access point be restricted to left in left out movements only.

The four access points to Rodborough Road also servicing the site allow for fully directional access and as such, the amended vehicle access arrangement would have minimal impact on users of the site.

6.7.6 Car Parking

On-street car parking is not permitted along Warringah Road or Wakehurst Parkway within the study area. As such the Stage 2 Project will not impact on the car parking supply on Warringah Road itself. The widening of Warringah Road to the south will result in the loss of some on-street car parking on Bantry Bay Road, Hilmer Street and Fitzpatrick Avenue East.

A summary of the total number of spaces anticipated to be lost as a result of the Stage 2 Project are summarised in Table 6.10.

Table 6.10: Loss of Car Parking from Stage 2 Project

<table>
<thead>
<tr>
<th>Road</th>
<th>Side of the Road</th>
<th>Existing Restriction</th>
<th>Number of Spaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bantry Bay Road</td>
<td>East</td>
<td>2P</td>
<td>20 spaces (90 degree spaces)</td>
</tr>
<tr>
<td>Bantry Bay Road</td>
<td>West</td>
<td>2P</td>
<td>4 spaces</td>
</tr>
<tr>
<td>Hilmer Street</td>
<td>East</td>
<td>Unrestricted</td>
<td>2 spaces</td>
</tr>
<tr>
<td>Hilmer Street</td>
<td>West</td>
<td>Unrestricted</td>
<td>6 spaces</td>
</tr>
<tr>
<td>Fitzpatrick Avenue East</td>
<td>North</td>
<td>Unrestricted</td>
<td>4 spaces</td>
</tr>
<tr>
<td>Fitzpatrick Avenue East</td>
<td>South</td>
<td>Unrestricted</td>
<td>2 spaces</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>38 spaces</strong></td>
</tr>
</tbody>
</table>

Table 6.10 indicates that a total of 38 spaces will be required to be removed as part of the Stage 2 Project, incorporating 24 time restricted spaces (2P) and 14 unrestricted spaces. The spaces are typically lost along the frontages of properties that will be acquired as part of the Stage 2 Project.

The existing on-street spaces on Bantry Bay Road primarily service the Bantry Bay Road strip shops, which will be acquired as part of the Stage 2 Project and as such will no longer be generating parking demand. Some car parking would still be provided for the Brick Pit reserve. Similarly, the car parking spaces to be lost on Hilmer Street currently service the properties that currently abut them which will also be acquired as part of the Stage 2 Project.

In this regard the car parking spaces lost on Bantry Bay Road and Hilmer Street are commensurate with the reduction in demand from the acquired properties.
Some six spaces will be lost from Fitzpatrick Avenue East as a result of the works required to accommodate the shared path and slot portal. These spaces typically cater for car parking demands generated by the abutting residential properties. Observations indicate that the existing on-street car parking demands in the vicinity of the Fitzpatrick Avenue East / Warringah Road intersection where these spaces will be lost are typically low. Observations indicate that any displaced car parking demands (albeit minor) could be accommodated further down Fitzpatrick Avenue East or Panorama Crescent.

Based on the above the anticipated loss of on-street car parking spaces is not anticipated to impact detrimentally on existing on-street parking occupancies.

Further assessment of the impacted parking areas would be undertaken if required, this could include detailed car parking surveys of the car parking spaces to be lost and the adjacent car parking areas.

6.7.7 Impacts to The Forest High School

This section presents the proposed changes to existing conditions on Warringah Road outside The Forest High School as part of the Stage 2 Project. The Forest High School active frontage is to Frenchs Forest Road with minimal interaction between the school and its Warringah Road frontage. Notwithstanding the Stage 2 Project will have the following impacts on the school:

- Provision of a new 3.0m wide shared path along the Warringah Road frontage of the school to replace the existing footpath facility provided.
- Provision of a grade separated pedestrian crossing of Warringah Road at Hilmer Street connecting the school to the residential properties to the south of Warringah Road.
- Reduction in traffic volumes on Frenchs Forest Road as a result of the increased east-west capacity being created on the Warringah Road corridor.

6.8 Summary of Stage 2 Project Impacts

6.8.1 Network Performance

The traffic analysis undertaken for the Stage 2 Project indicates that the road upgrades will provide a significant improvement in network statistics compared to the Do Minimal scenario. Furthermore it is predicted that there will be a slight improvement in the network operation during the AM peak period for the 2018 and 2028 scenario when compared to the 2012 Base Condition (ie existing operation without the NBH). There will however be a slight deterioration in the network operation during the PM peak period for the 2018 and 2028 scenario when compared to the 2012 Base Condition.

In the AM peak period, the modelling indicates a 9 percent increase in average travel speeds for 2018 compared to the 2012 Base Condition and an increase of 8 percent in 2028. The modelling indicates an increase in unreleased demand during the AM peak period compared to the 2012 Base Condition but a reduction against the Do Minimal scenario (up to 84 percent reduction in 2018 with a reduction in unreleased demand from 5,971 (Do Minimal) to 930 (Stage 2)).

Whilst in the PM peak period, the modelling indicates a 30 percent increase in average travel speeds for 2018 compared to the Do Minimal Project and an increase of 49 percent in 2028. The modelling indicates an increase in unreleased demand during the PM peak period compared to the 2012 Base Condition but a reduction against the Do Minimal scenario (up to 68 percent reduction in 2028 with a reduction in unreleased demand from 8,871 (Do Minimal) to 2,857 (Stage 2)).
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, however the number and severity of locations will be less than the Do Minimal scenario and also following the Stage 1 Project.

The proposed Stage 2 Project provides sufficient road capacity to cater for the traffic generated by the NBH and background growth. Importantly Stage 2 provides the network enhancement needed (above Stage 1) to deliver improved network performance in the longer term.

The average speed and total travel time for the 2012 base year, Do Minimal scenarios and the Stage 2 Project for 2018 and 2028 are illustrated in Figure 6.7 and Figure 6.8.

**Figure 6.7: Comparison of Average Speeds, km/h**

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

The Stage 2 Project improves the operation of the Warringah Road corridor significantly. The 2012 Base Condition modelling indicates that two of the five intersections along Warringah Road within the study area currently operate with a LOS F. Under the Do Minimal scenario all five of the Warringah Road intersections within the study area are predicted to operate with a LOS F.

The Stage 2 Project separates the Warringah Road through traffic from turning surface road traffic at the intersections with Forest Way, Hilmer Street and Wakehurst Parkway and as a result only two of the five intersections along the corridor are predicted to operate with a LOS F in 2018 and only one in 2028. The intersections of Warringah Road with Wakehurst Parkway and Forest Way (2028 scenario only), which currently operate with LOS F, are predicted to operate with LOS of E or better.

An overview of the intersection LOS for 2018 and 2028 is provided in Figure 6.9 and Figure 6.10. The data indicates that following the Stage 2 Project there will be an increase in the number of intersections operating with LOS A-D and a decrease in the number of intersections operating with a LOS F compared to the 2012 Base Condition and the Stage 1 Project for 2018 and 2028.
Figure 6.9: Summary of Intersection LOS - 2018, AM and PM

Note: The number of intersections assessed in the 2012 and future year (2018, 2028) cases is different due to the new intersections that are created to provide access to the hospital and also the new intersection on Wakehurst Parkway at Aquatic Drive.

Figure 6.10: Summary of Intersection LOS - 2028, AM and PM

Note: The number of intersections assessed in the 2012 and future year (2018, 2028) cases is different due to the new intersections that are created to provide access to the hospital and also the new intersection on Wakehurst Parkway at Aquatic Drive.
The following intersections are still predicted to operate at LOS F after the completion of the Stage 2 Project in 2018 and 2028 during the AM or PM peak periods (or both):

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

All other intersections within the study area are predicted to operate with a LOS E or better for the AM and PM peak periods in 2018 and 2028.
7. Construction Traffic Impacts

This chapter provides an assessment of the impacts of activities associated with construction of the Stage 1 and Stage 2 projects on traffic and transport within the NBH precinct.

It is noted that the detailed sequence of construction activities relating to the Stage 2 Network Enhancement Works, as well as the Stage 1 works, are not yet fully known, 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 Stage 1 and Stage 2 projects, a general framework of network management principles, guidelines and parameters that would assist is set out in this Chapter.

The SEAR’s relating to construction traffic and transport impacts were introduced in Table 1.1, against which, a number of principles have been determined:

- **Capacity** - Maintain the current capacity of the road network during peak periods throughout construction of the project
- **Performance** - Ensure that while capacity may be reduced during the off-peak periods, commensurate with lower demands, the network performance shall be no worse than during peak periods
- **Network integrity** - Maintain operation of all intersections between state managed roads and provide alternative access to all streets
- **Public transport** - Minimise impacts on bus routes, stop locations and travel times
- **Active transport** - Where interruptions to movement are required, provide safe alternative routes and guidance for cyclists and pedestrians that minimise detour and interaction with other traffic
- **Project site access** - Manage and minimise impacts of construction traffic ingress/egress on general traffic and activities in the vicinity of sites
- **Lane management** - Accommodate temporary reassignment of reserved lanes for general traffic, or for reallocation of turning and approach lanes at intersections
- **Parking** - Minimise impact on access to parking opportunities and between alternative parking locations and the activities they support
- **Haulage routes** - Ensure that vehicles associated with construction activities use the most appropriate routes for their journeys and minimise their impact on other traffic and activities within the corridors through which they travel
- **Construction access** - ensure adequate provision of access to the NBH site for construction activities associated with the NBH

The following sections describe the scope of construction activities proposed and provide quantitative and qualitative assessment of the impacts of construction activities in accordance with the above principles.

7.1 Construction Activities

7.1.1 General

The following assessment is based on the construction details outlined in the ‘NBH Enabling Roadworks Stage 2 BIS Construction Methodology Primary Notes’ document prepared by Evans & Peck Pty Ltd.

The general construction activities for the Stage 2 Project comprise:
- Spoil haulage by heavy vehicles
- Delivery of construction materials
- Delivery of oversized structural material (beams, decking, etc.)
- Movements of construction equipment
- Light vehicle movements (vans, utility pick-ups) associated with construction staff and contractors.

A summary of the indicative enabling works and construction activities for the Stage 2 Project is provided in Table 7.1.
### Table 7.1: Overview of Stage 2 Project Indicative Enabling Works and Construction Activities

<table>
<thead>
<tr>
<th>Component</th>
<th>Indicative Works</th>
<th>Approx. Duration</th>
</tr>
</thead>
</table>
| Enabling works (including utility relocation)  | ○ Surveys works and investigative works, including condition surveys of buildings and infrastructure and geotechnical investigations  
○ Property acquisitions  
○ Road and intersection modifications and installation of traffic controls and signage  
○ Installation of environmental control measures  
○ Public utility protection and/or relocations and adjustments  
○ Heritage salvage or conservation works  
○ Minor clearing works | 12 months |
| Construction of administrative and support compounds | ○ Establishment of erosion and sedimentation control measures and erection of site fencing  
○ Clearing and levelling the site to facilitate drainage  
○ Construction of pre-fabricated or purpose-built temporary offices, crib sheds and storage sheds, supplemented by existing dwellings  
○ Construction of hard stand areas | 3 months |
| Warringah Road surface road westbound           | ○ Vegetation clearing  
○ Public utility protection and/or relocations and adjustments  
○ Construction of the new westbound lanes on the southern side of Warringah Road  
○ Installation of retaining walls on the southern side of Warringah Road  
○ Installation of permanent noise barriers for identified impacted properties on the southern side of the road widening works  
○ Switch traffic onto new westbound alignment to enable construction of the slot | 12 months |
| Slot construction                               | ○ Installation of rows of piles for slot construction  
○ Excavation of soil between rows of piles  
○ Installation of soil anchors and shotcrete  
○ Excavation of rock to the designed depth  
○ Installation of subsoil drainage  
○ Installation of slot pavement  
○ Install pump station at pavement low point  
○ Linemarking and signage | 18 months |
| Major intersection works                         | ○ Adjustment of turning traffic to allow access for cover construction  
○ Installation of piles and excavation  
○ Installation of cover abutments, planks and concrete deck  
○ Switching of traffic to the newly constructed cover | 12 months |
| Other intersection works                         | ○ Construction of new connections at Hilmer Street and Aquatic Drive | 9 months |
| Shared pedestrian/ cyclist bridges              | ○ Construction of foundation and piers  
○ Installation of bridge abutments  
○ Installation of pre-fabricated deck units  
○ Surface finishing | 9 months |
| Road network integration works                   | ○ Integration of the new works with the existing road network | 15 months |
| Testing and commissioning                        | ○ Testing of variable message signs | 6 months |
| Finishing works                                  | ○ Removal of temporary works  
○ Removal of site compounds and facilities  
○ Landscaping and rehabilitation of affected areas  
○ Post construction condition surveys  
○ Removal of environmental controls  
○ Removal of construction site related traffic signage  
○ Site clearing and disposal of waste | 3 months |

Source: Evans & Peck Pty Ltd Primary Notes
7.1.2 Program

Stage 1 and Concept Approval was provided 29 June 2015 and this included the utility relocation for both Stage 1 and Stage 2. Construction of Stage 2 will not commence until planning approval is granted which is anticipated in early 2016. An overview of the indicative program (by activity) is provided in Table 7.2.

Table 7.2: Stage 2 Project Construction Program (Indicative Only)

<table>
<thead>
<tr>
<th>Construction Activity</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enabling works</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establishment of compounds</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utilities relocation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Warringah Road westbound</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slot construction</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major intersection works</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minor intersection works</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New road connections</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pedestrian and cyclist bridges</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Testing and commissioning</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project completion</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Source: Evans & Peck Pty Ltd Primary Notes

The Stage 1 Connectivity Works are anticipated to be completed prior to the completion of the Stage 2 Project however there would be some overlap between the Stage 1 and 2 Projects. Notwithstanding both the Stage 1 and Stage 2 Projects would be completed by the opening of the NBH in 2018.

7.1.3 Construction Method

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.

During detailed design of the project, a detailed work method would be refined and finalised, considering the 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 SEAR’s conditions of approval and to Roads and Maritime specifications. A component of the CEMP will be a construction traffic management plan(s).

7.1.4 Construction Staging Area

The project would need to be constructed while maintaining traffic flows and not reducing capacity during peak hour periods and other critical times. There are very limited opportunities to locate construction compounds within the road corridor, with no prolonged road closures.
anticipated. The construction staging area would need to accommodate the storage of materials, equipment and vehicles for the project and to provide a site office. In this regard two potential site compounds have been identified:

- South of the Allambie Road / Aquatic Drive intersection
- Northeast corner of the Warringah Road / Wakehurst Parkway intersection

At this stage it is not yet known whether both or just one of the above construction compound locations will be used for the project. The construction compound(s) would be utilised for the duration of the construction period for both Stage 1 and Stage 2 of the project.

**General Provisions**

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

- Hardstand - The whole area would be covered in hardstand.
- 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. The compound(s) would be securely fenced with temporary fencing. All necessary signage advising the general public of access restrictions would be provided.

Figure 7.1 shows the locations of the two potential construction compounds.

**Figure 7.1: Proposed Construction Compound Locations**
Allambie Road Compound

Minor works would be undertaken to the existing roundabout at the intersection of Aquatic Drive and Allambie Road, to provide direct access to the site from the roundabout. The site would have fully directional access to Allambie Road and Aquatic Drive from the access.

An indicative layout for the primary site is shown in Figure 7.2.

Figure 7.2: Proposed Layout for Allambie Road Construction Compound Site

Warringah Road Compound

As a result of environmental sensitivities along the Wakehurst Parkway interface vehicle access to the site would be provided from Warringah Road. The site access would be restricted to left in/left out movements to/from Warringah Road only.
7.1.5 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, installation of infrastructure such as shared pedestrian/cyclist bridges 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.

7.2 Cumulative Construction Traffic Impact

There are two key proposed developments in the surrounding area whose construction activities are expected to coincide with those of the Project:

- NBH
- 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 Construction

The construction period of the Project would overlap with the construction of the NBH, and additional traffic movements generated by construction activities would impact significantly on the traffic and transport operations in the precinct. Both projects would use the arterial road network (ie Warringah Road, Wakehurst Parkway and Forest Way) for construction access routes, and these additional construction traffic movements would further consume limited capacity on the network, particularly if undertaken during peak commute periods.

The Northern Beaches Hospital (Stage 2) - Preliminary Construction Traffic Management Plan (Hyder, 2014) indicates that the hospital construction activities would generally be limited to the NBH site, with construction access via Warringah Road (north side), initially via Bantry Bay Road, then via the NBH southern entry (Gate 1) when the remaining sections of Bantry Bay Road will need to be demolished as part of the NBH project. There would be minimal overlaps with the Stage 1 Project construction works on Frenchs Forest Road, as NBH construction access would be limited to Warringah Road. However, there would be cumulative construction impacts during the Stage 2 Project. The additional construction activities from the NBH and Stage 2 Project construction works would likely increase travel times on Warringah Road.

Mona Vale Road Upgrade

Roads and Maritime is also proposing upgrades to Mona Vale Road that are aimed at improving safety and traffic efficiency. There are three stages 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 7.4.
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 Project 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.

Figure 7.4: Mona Vale Road Upgrade Components

7.3 Stage 2 Project Construction Impacts

The construction traffic from Stage 1 has been assessed separately and as such this assessment considers the additional traffic associated with the Construction of the Stage 2 Project (both in isolation and in combination with Stage 1).

The Stage 2 Project construction activities will generate transport and traffic impacts that could 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 Stage 2 Project could 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 to pedestrian access arrangements to The Forest High School from the Warringah Road frontage 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 4 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 immediate vicinity of the precinct.

7.4 Construction Traffic Generation

The construction programs for the Stage 1 and 2 Projects indicate that there will be some overlap between construction periods. As such, there will be 3 construction scenarios that will need to be considered as part of the Project, summarised as follows:

i. Stage 1 construction works only
ii. Stage 1 and 2 construction works
iii. Stage 2 construction works only

An overview of the traffic generation for Stages 1 and 2 is provided below.

7.4.1 Stage 1 Project Traffic Generation

The daily construction traffic volume estimates for the Stage 1 Project have been sourced from the TTIA for Stage 1 and Concept Proposal EIS and are reproduced below:

- Up to 100 heavy vehicle movements (ie 50 heavy vehicles in and out)
- Up to 30 light vehicle movements (external to the compound)
- Up to 100 light vehicle movements (between the compound and works zone)

A total of up to 230 daily vehicle movements were forecast as part of the Stage 1 Project.

7.4.2 Stage 2 Project Traffic Generation

In order to better determine the likely traffic generation associated with the Stage 2 Project construction activities reference has been made to the Northern Beaches Hospital Enabling Roadworks - Stage 2 EIS Construction Methodology (Evans & Peck Pty Ltd, 2014).

The anticipated daily truck movements are presented in Table 7.3.
Table 7.3: Estimated Average Daily Truck Generation

<table>
<thead>
<tr>
<th>Description</th>
<th>Average Number of Trucks Per Day</th>
<th>Daily Movements (in / out)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spoil Removal for Warringah Road westbound lanes</td>
<td>80</td>
<td>160</td>
</tr>
<tr>
<td>Concrete and architectural panels for Warringah Road retaining walls</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>Concrete for piles</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>Steel cages for piles</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Spoil removal from slot</td>
<td>80</td>
<td>160</td>
</tr>
<tr>
<td>Concrete for slot shotcrete</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Architectural facing panels for slot</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>Intersection cover planks</td>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>Pedestrian deck units</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Pavement materials</td>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>245</strong></td>
<td><strong>490</strong></td>
</tr>
</tbody>
</table>

Source: Northern Beaches Hospital Enabling Roadworks - Stage 2 EIS Construction Methodology Primary Notes (Evans & Peck Pty Ltd, 2014)

Table 7.3 indicates that the Stage 2 construction works are anticipated to generate in the order of 490 daily truck movements to the study area.

There are anticipated to be 120 employees on-site at each day as part of the Stage 2 works. Assuming that two thirds of staff access the compound by private vehicle (as driver) there would be a total of 160 vehicle movements (80 in / 80 out) generated.

Consistent with the Stage 1 Project it has been once again assumed that there would be 100 vehicle movements between the compound and the Stage 2 Project works area.

7.4.3 Traffic Generation Scenarios

A summary of the combined traffic generation from Stages 1 and 2 is provided in Table 7.4.

Table 7.4: Traffic Generation Summary – Stages 1 and 2

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Traffic Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stage 1 Project</td>
</tr>
<tr>
<td>Heavy Vehicle (to/from compound)</td>
<td>100</td>
</tr>
<tr>
<td>Light Vehicle (to/from compound)</td>
<td>30</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>130</strong></td>
</tr>
</tbody>
</table>

Utilising the daily traffic generation estimates presented in Table 7.4 the following sets out the daily traffic estimates for each construction scenario:

- Stage 1 construction works only: 130 daily movements
- Stage 1 and 2 construction works: 780 daily movements
- Stage 2 construction works only: 650 daily movements.

It is further noted that the level of traffic activity is anticipated to vary across the course of the day. An assessment of the traffic generation across the course of the day during Stages 1 and 2 is provided in Table 7.5.
Table 7.5: Construction Traffic Generation Across the Day (to/from Compound)

<table>
<thead>
<tr>
<th>Period of the Day</th>
<th>Indicative Proportion of Traffic per Assessment Period</th>
<th>Indicative Traffic Generation per Assessment Period</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Heavy Vehicles</td>
<td>Light Vehicles</td>
</tr>
<tr>
<td>AM Peak Period (6 to 9am)</td>
<td>10%</td>
<td>25%</td>
</tr>
<tr>
<td>Interpeak (9am to 3pm)</td>
<td>45%</td>
<td>25%</td>
</tr>
<tr>
<td>PM Peak Period (3 to 6pm)</td>
<td>15%</td>
<td>25%</td>
</tr>
<tr>
<td>Out of Work Hours (6pm to 6am)</td>
<td>30%</td>
<td>25%</td>
</tr>
</tbody>
</table>

7.5 Construction Vehicle Access Routes

It is envisaged that the works area and compound will be serviced by a variety of heavy vehicle sizes. Indeed there may be requirements to use over dimensioned and over massed vehicles when transporting plant, construction equipment and large construction components (such as bridge spans for the slot construction).

As previously detailed Forest Way, Warringah Road (west of the project area) and Wakehurst Parkway (north of the project area) are approved by Roads and Maritime for B-double use (ie. for vehicles up to and including B-double vehicles).

The exact haulage routes would depend on the origin of materials and/or destination for soil to be removed, however, it is envisaged that the Forest Way/Mona Vale Road route would be most utilised by heavy vehicles accessing the works area to and from the west.

A broader distribution has been adopted for the light vehicle traffic.

A summary of the proposed vehicle access routes is provided in Table 7.6.

Table 7.6: Adopted Construction Traffic Distributions

<table>
<thead>
<tr>
<th>Direction</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Heavy Vehicles</td>
</tr>
<tr>
<td>Northwest via Forest Way</td>
<td>80%</td>
</tr>
<tr>
<td>Southwest via Warringah Road</td>
<td>15%</td>
</tr>
<tr>
<td>North via Wakehurst Parkway</td>
<td>5%</td>
</tr>
<tr>
<td>South via Wakehurst Parkway</td>
<td>-</td>
</tr>
<tr>
<td>East via Warringah Road</td>
<td>-</td>
</tr>
</tbody>
</table>

In developing the travel paths and traffic volumes estimates to each of the compounds the following assumptions have been made:

- The assessment assumes Stages 1 and 2 of construction are taking place (ie worst case scenario)
- Excludes trips from the compounds to the works area
- Assumes that the Forest Way / Frenchs Forest Road intersection has been signalised to cater for full turning movements
- A 50:50 split of traffic generation to each compound
- Traffic is distributed on average throughout each of the assessment periods (ie hourly for the three hours during the AM peak period)

An overview of the preferred travel routes for vehicles accessing each of the potential compounds is illustrated in Figure 7.5 and Figure 7.6.
7.6 Construction Traffic Impact

7.6.1 Impact on Surrounding Roads

Utilising the above traffic generation estimates and distributions an estimate of the future construction traffic volumes are presented in Figure 7.7 to Figure 7.10. Specifically each of the
figures identifies the existing, during construction and percentage change in traffic volumes at key locations in the road network.

It is noted that the existing traffic volumes have generally been sourced from 24 hour tube counts undertaken by TTM Group in December 2013.
**Figure 7.7: AM Peak Hour Construction Traffic Generation Impacts**

<table>
<thead>
<tr>
<th>Location</th>
<th>Existing</th>
<th>Construction</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LV</td>
<td>HV</td>
<td>Tot.</td>
</tr>
</tbody>
</table>

**Location 1**

- **Northbound**: 1988 LV, 178 LV, 2176 HV, 1992 LV, 192 HV, 2184 HV, 0.2% LV, 0.8% HV, 0.3% Tot.
- **Southbound**: 2534 LV, 277 LV, 3212 HV, 2536 LV, 279 HV, 3215 HV, 0.1% LV, 0.5% HV, 0.1% Tot.

**Location 2**

- **Eastbound**: 2371 LV, 241 LV, 2612 HV, 2381 LV, 251 HV, 2632 HV, 0.4% LV, 3.9% HV, 0.7% Tot.
- **Westbound**: 2429 LV, 370 HV, 2799 HV, 2432 LV, 375 HV, 2807 HV, 0.1% LV, 1.5% HV, 0.3% Tot.

**Location 3**

- **Eastbound**: 1511 LV, 82 HV, 1683 HV, 1511 LV, 83 HV, 1684 HV, 0.0% LV, 0.1% HV, 0.1% Tot.
- **Westbound**: 1596 LV, 150 HV, 1746 HV, 1597 LV, 150 HV, 1747 HV, 0.0% LV, 0.0% HV, 0.0% Tot.

**Location 4**

- **Northbound**: 871 LV, 116 HV, 986 HV, 123 LV, 996 HV, 1289 HV, 0.2% LV, 6.8% HV, 1.0% Tot.
- **Southbound**: 1530 LV, 139 HV, 1669 HV, 1535 LV, 147 HV, 1682 HV, 0.3% LV, 5.6% HV, 0.8% Tot.

**Location 5**

<table>
<thead>
<tr>
<th>Location 5</th>
<th>Existing</th>
<th>Construction</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LV</td>
<td>HV</td>
<td>Tot.</td>
</tr>
<tr>
<td><strong>Eastbound</strong></td>
<td>658</td>
<td>14</td>
<td>672</td>
</tr>
<tr>
<td><strong>Westbound</strong></td>
<td>447</td>
<td>23</td>
<td>469</td>
</tr>
</tbody>
</table>

**Location 6**

- **Eastbound**: 713 LV, 18 HV, 731 HV, 713 LV, 18 HV, 731 HV, 0.0% LV, 0.0% HV, 0.0% Tot.
- **Westbound**: 680 LV, 42 HV, 622 HV, 682 LV, 47 HV, 629 HV, 0.3% LV, 12.4% HV, 1.0% Tot.

**Location 7**

- **Northbound**: 491 LV, 33 HV, 524 HV, 492 LV, 33 HV, 525 HV, 0.0% LV, 1.5% HV, 0.1% Tot.
- **Southbound**: 833 LV, 160 HV, 993 HV, 833 LV, 160 HV, 994 HV, 0.1% LV, 0.3% HV, 0.1% Tot.

**Location 8**

- **Northbound**: 622 LV, 43 HV, 665 HV, 623 LV, 46 HV, 669 HV, 0.2% LV, 0.0% HV, 0.0% Tot.
- **Southbound**: 898 LV, 173 HV, 1072 HV, 901 LV, 173 HV, 1074 HV, 0.2% LV, 0.7% HV, 0.3% Tot.

**Location 9**

- **Northbound**: 757 LV, 37 HV, 794 HV, 758 LV, 37 HV, 795 HV, 0.2% LV, 0.0% HV, 0.1% Tot.
- **Southbound**: 625 LV, 33 HV, 662 HV, 629 LV, 35 HV, 664 HV, 0.1% LV, 0.0% HV, 0.1% Tot.

**Location 10**

- **Northbound**: 728 LV, 38 HV, 766 HV, 730 LV, 43 HV, 773 HV, 0.3% LV, 12.8% HV, 0.9% Tot.
- **Southbound**: 1091 LV, 57 HV, 1148 HV, 1098 LV, 62 HV, 1160 HV, 0.5% LV, 8.6% HV, 0.9% Tot.
### Figure 7.8: Interpeak Peak Hour Construction Traffic Generation Impacts

<table>
<thead>
<tr>
<th>Location 5</th>
<th>Existing</th>
<th>Construction</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LV HV Tot.</td>
<td>LV HV Tot.</td>
<td>LV HV Tot.</td>
</tr>
<tr>
<td>Eastbound</td>
<td>510 12 522</td>
<td>510 12 522</td>
<td>0.0% 0.0% 0.0%</td>
</tr>
<tr>
<td>Westbound</td>
<td>313 14 327</td>
<td>314 24 337</td>
<td>0.0% 6.5% 2.9%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location 6</th>
<th>Existing</th>
<th>Construction</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LV HV Tot.</td>
<td>LV HV Tot.</td>
<td>LV HV Tot.</td>
</tr>
<tr>
<td>Eastbound</td>
<td>635 18 653</td>
<td>635 18 653</td>
<td>0.0% 0.0% 0.0%</td>
</tr>
<tr>
<td>Westbound</td>
<td>395 21 414</td>
<td>395 21 414</td>
<td>0.0% 0.0% 0.0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location 7</th>
<th>Existing</th>
<th>Construction</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LV HV Tot.</td>
<td>LV HV Tot.</td>
<td>LV HV Tot.</td>
</tr>
<tr>
<td>Northbound</td>
<td>649 40 689</td>
<td>649 40 689</td>
<td>0.0% 0.0% 0.0%</td>
</tr>
<tr>
<td>Southbound</td>
<td>741 59 800</td>
<td>741 59 800</td>
<td>0.0% 0.0% 0.0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location 8</th>
<th>Existing</th>
<th>Construction</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LV HV Tot.</td>
<td>LV HV Tot.</td>
<td>LV HV Tot.</td>
</tr>
<tr>
<td>Northbound</td>
<td>637 47 684</td>
<td>637 47 684</td>
<td>0.0% 0.0% 0.0%</td>
</tr>
<tr>
<td>Southbound</td>
<td>772 97 867</td>
<td>772 97 867</td>
<td>0.0% 2.9% 0.5%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location 9</th>
<th>Existing</th>
<th>Construction</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LV HV Tot.</td>
<td>LV HV Tot.</td>
<td>LV HV Tot.</td>
</tr>
<tr>
<td>Northbound</td>
<td>695 57 756</td>
<td>695 57 756</td>
<td>0.1% 0.0% 0.1%</td>
</tr>
<tr>
<td>Southbound</td>
<td>695 34 729</td>
<td>695 34 730</td>
<td>0.1% 0.0% 0.1%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location 10</th>
<th>Existing</th>
<th>Construction</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LV HV Tot.</td>
<td>LV HV Tot.</td>
<td>LV HV Tot.</td>
</tr>
<tr>
<td>Northbound</td>
<td>546 29 575</td>
<td>548 40 588</td>
<td>0.4% 38.5% 2.3%</td>
</tr>
<tr>
<td>Southbound</td>
<td>546 29 575</td>
<td>548 40 588</td>
<td>0.4% 38.5% 2.3%</td>
</tr>
</tbody>
</table>
Figure 7.9: PM Peak Hour Construction Traffic Generation Impacts

<table>
<thead>
<tr>
<th>Location</th>
<th>Existing</th>
<th>Construction</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LV HV Tot.</td>
<td>LV HV Tot.</td>
<td>LV HV Tot.</td>
</tr>
<tr>
<td>Northbound</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Southbound</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location 1</td>
<td>2848 222</td>
<td>3069 224</td>
<td>3072</td>
</tr>
<tr>
<td>Location 2</td>
<td>2932 242</td>
<td>3181 292</td>
<td>3198</td>
</tr>
<tr>
<td>Location 3</td>
<td>2036 73</td>
<td>2303</td>
<td>2304</td>
</tr>
<tr>
<td>Location 4</td>
<td>1455 127</td>
<td>1577</td>
<td>1460 134</td>
</tr>
<tr>
<td>Location 5</td>
<td>547 17</td>
<td>564</td>
<td>547 17</td>
</tr>
<tr>
<td>Location 6</td>
<td>635 27</td>
<td>663</td>
<td>635 27</td>
</tr>
<tr>
<td>Location 7</td>
<td>629 64</td>
<td>693</td>
<td>629</td>
</tr>
<tr>
<td>Location 8</td>
<td>892 64</td>
<td>956</td>
<td>893</td>
</tr>
<tr>
<td>Location 9</td>
<td>308</td>
<td>316</td>
<td>2949</td>
</tr>
<tr>
<td>Location 10</td>
<td>1092 57</td>
<td>1150</td>
<td>1098</td>
</tr>
<tr>
<td>Location 11</td>
<td>1455 127</td>
<td>1577</td>
<td>1460 134</td>
</tr>
<tr>
<td>Location 12</td>
<td>547 17</td>
<td>564</td>
<td>547 17</td>
</tr>
<tr>
<td>Location 13</td>
<td>629 64</td>
<td>693</td>
<td>629</td>
</tr>
<tr>
<td>Location 14</td>
<td>892 64</td>
<td>956</td>
<td>893</td>
</tr>
<tr>
<td>Location 15</td>
<td>308</td>
<td>316</td>
<td>2949</td>
</tr>
<tr>
<td>Location 16</td>
<td>1092 57</td>
<td>1150</td>
<td>1098</td>
</tr>
</tbody>
</table>

Traffic and Transport Impact Assessment // Issue: D
Northern Beaches Hospital, Stage 2 EIS - Network Enhancement Works
Figure 7.10: Out of Hours Work Peak Hour Construction Traffic Generation Impacts

<table>
<thead>
<tr>
<th>Location 1</th>
<th>Existing</th>
<th>Construction</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northbound</td>
<td>2895 168 3063 2898 169 3064</td>
<td>0.0% 0.7%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Southbound</td>
<td>1859 107 1966 1859 109 1968</td>
<td>0.0% 1.0%</td>
<td>0.1%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location 2</th>
<th>Existing</th>
<th>Construction</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastbound</td>
<td>2795 187 2980 2797 194 2981</td>
<td>0.1% 3.7%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Westbound</td>
<td>2266 167 2433 2267 172 2431</td>
<td>0.1% 2.4%</td>
<td>0.2%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location 3</th>
<th>Existing</th>
<th>Construction</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastbound</td>
<td>1754 49 1979</td>
<td>0.0% 0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Westbound</td>
<td>1264 61 1379</td>
<td>0.0% 0.0%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location 4</th>
<th>Existing</th>
<th>Construction</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northbound</td>
<td>1473 99 1571 1473 105 1578</td>
<td>0.1% 6.0%</td>
<td>0.4%</td>
</tr>
<tr>
<td>Southbound</td>
<td>1301 51 1352 1302 57 1358</td>
<td>0.1% 11.6%</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location 5</th>
<th>Existing</th>
<th>Construction</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastbound</td>
<td>401 8 409 401 8</td>
<td>0.0% 0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Westbound</td>
<td>370 9 379 371 12</td>
<td>0.1% 34.3%</td>
<td>0.9%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location 6</th>
<th>Existing</th>
<th>Construction</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastbound</td>
<td>464 18 486 464 18</td>
<td>0.0% 0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Westbound</td>
<td>434 14 448 435 11</td>
<td>0.2% 27.3%</td>
<td>1.1%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location 7</th>
<th>Existing</th>
<th>Construction</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northbound</td>
<td>1100 18 1118</td>
<td>0.0% 2.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Southbound</td>
<td>506 31 537 506 31</td>
<td>0.0% 0.0%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location 8</th>
<th>Existing</th>
<th>Construction</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northbound</td>
<td>1018 50 1068</td>
<td>0.0% 0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Southbound</td>
<td>627 48 675 628 49</td>
<td>0.1% 1.9%</td>
<td>0.2%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location 9</th>
<th>Existing</th>
<th>Construction</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northbound</td>
<td>659 27 686 660 27</td>
<td>0.0% 0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Southbound</td>
<td>749 8 757 749 8</td>
<td>0.0% 0.0%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location 10</th>
<th>Existing</th>
<th>Construction</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northbound</td>
<td>182 10 192 183</td>
<td>0.5% 38.5%</td>
<td>2.4%</td>
</tr>
<tr>
<td>Southbound</td>
<td>182 10 192 183</td>
<td>0.5% 38.5%</td>
<td>2.4%</td>
</tr>
</tbody>
</table>
The assessment indicates that the additional construction traffic volumes typically equate to less than 1% of the existing traffic volumes on the road network throughout the day. It is noted that larger percentage increases in truck volumes are anticipated, however, this is as a result of the low existing truck volumes rather than a significant additional level of truck movements.

Given the above it is not anticipated that the additional traffic generated during the construction period would have a noticeable impact on the existing operation of the surrounding road network.

It is recommended that an updated assessment be undertaken once the preferred construction compound arrangements have been determined and preferred truck routes confirmed by the project construction team.

**NBH Construction Traffic Impact**

In addition to the project construction traffic movements there will be additional traffic generated by the construction of the NBH itself. In this regard reference to the Health Infrastructure Stage 2 EIS indicates that the NBH is predicted to generate some 240 heavy vehicle movements per day during construction. These vehicles will be generated during the AM, PM and interpeak periods, but not during out of hours periods.

Adopting a similar distribution as for the project works (refer to Table 7.5) a summary of the traffic generation over the course of the day for the NBH is presented in Table 7.7.

**Table 7.7: Construction Traffic Generation Across the Day (to/from Compound)**

<table>
<thead>
<tr>
<th>Period of the Day</th>
<th>Proportion of Heavy Vehicle Traffic per Assessment Period</th>
<th>Heavy Vehicle Traffic Generation per Assessment Period</th>
<th>Additional Heavy Vehicles per Hour During Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM Peak Period (6am to 9am)</td>
<td>15%</td>
<td>38</td>
<td>13vph</td>
</tr>
<tr>
<td>Interpeak (9am to 3pm)</td>
<td>65%</td>
<td>162</td>
<td>27vph</td>
</tr>
<tr>
<td>PM Peak Period (3pm to 6pm)</td>
<td>20%</td>
<td>50</td>
<td>17vph</td>
</tr>
</tbody>
</table>

The additional traffic generated by the construction of the NBH equates to less than 0.1% of the existing traffic on Warringah Road in the vicinity of the site (refer to location 2 in figures above) for each assessment period.

**7.6.2 Other Considerations**

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.

It is likely that during the construction of the Stage 1 Project and the NBH, traffic conditions on the Frenchs Forest Road corridor would deteriorate such that through traffic on Frenchs Forest Road would divert to Warringah Road, increasing traffic demand on Warringah Road between Forest Way and Allambie Road (beyond those presented in Table 7.7), and further impacting on operating conditions.

Similarly, when the Stage 1 Project works are completed, but the Stage 2 Project works on Warringah Road are continuing some through vehicles may detour to Frenchs Forest Road (which would have increased capacity as a result of the completed Stage 1 Project).

When both Frenchs Forest Road and Warringah Road traffic capacities are restricted as a result of concurrent construction staging (ie. during the Stage 1 and 2 Project construction periods), 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. As such, any concurrent closures should be limited to off peak periods when traffic demands are lower (ie. nighttime and weekends).

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. It also reinforces the requirement to maintain peak period traffic capacity throughout the study area network in order to manage and mitigate these impacts.

Roads and Maritime would prepare a Construction Traffic Management Plan to manage construction traffic associated with the Stage 1 and 2 Projects.

7.7 Theoretical Impact of Road Closures on Traffic Capacity

During the construction of the Stage 2 works there will be requirements to alter temporarily the characteristics of the existing Warringah Road carriageway. These may be required as a result of the constrained works zone or to provide safe distance between construction zones/workers and live traffic. Temporary alterations to Warringah Road could include:

i Reduction in traffic lanes
ii Reduction in lane widths
iii Reduction in lateral clearance
iv Reduction in speed limits.

In order to identify the potential impacts of amending the above road characteristics reference has been made to the Highway Capacity Manual (HCM) 2000 and the Austroads Guide to Traffic Management.

7.7.1 Reduction in Traffic Lanes

Chapter 5 of the Austroads Guide to Traffic Management Part 3 provides guidance on the carriageway capacities based on the number of traffic lanes. It is noted that the lane capacity values are generic only and do not account strictly for widening at intersections, parking considerations, signal timings, etc. They do provide a comparison of capacities should the number of lanes be altered. The findings are reproduced in Table 7.8.

<table>
<thead>
<tr>
<th>No. of Traffic Lanes</th>
<th>Carriageway Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>900vph</td>
</tr>
<tr>
<td>2</td>
<td>1,800vph</td>
</tr>
<tr>
<td>3</td>
<td>2,800vph</td>
</tr>
</tbody>
</table>

(Source: Table 5.1: Typical mid-block capacities for urban roads with interrupted flow - Austroads Part3: Traffic Studies and Analysis).

When additional capacity at intersections and measures to ensure priority is given to the major road the uninterrupted lane capacity increases up to 1,400 vph per lane. Current observations on Warringah Road indicate maximum hourly flows of 1,470 vph per lane westbound during the AM peak and 1,250 vph per lane eastbound during the PM peak periods.

A reduction in traffic lanes would result in a proportionate reduction in through capacity. Given that the road network is currently operating at capacity during peak periods there would not be enough latent capacity to accommodate lane closures on Warringah Road during peak periods.
The number of lanes at midblock and at intersections must be maintained during peak periods to ensure that adequate capacity exists in the network to accommodate the existing demands. There would be opportunities to implement short-term lane closures during off-peak periods, such as during the night when hourly traffic volumes on Warringah Road are significantly less than peak period volumes.

### 7.7.2 Reduction in Lane Widths

Chapter 21 of the HCM on ‘Multilane Highways’ provides guidance on the relationship between lane widths and the free flow speeds of roads. The findings are reproduced in Table 7.9.

<table>
<thead>
<tr>
<th>Lane Width (m)</th>
<th>Reduction in Free Flow Speed (km/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.6m</td>
<td>0.0</td>
</tr>
<tr>
<td>3.5m</td>
<td>1.0</td>
</tr>
<tr>
<td>3.4m</td>
<td>2.1</td>
</tr>
<tr>
<td>3.3m</td>
<td>3.1</td>
</tr>
<tr>
<td>3.2m</td>
<td>5.6</td>
</tr>
<tr>
<td>3.1m</td>
<td>8.1</td>
</tr>
<tr>
<td>3.0m</td>
<td>10.6</td>
</tr>
<tr>
<td>&lt; 3.0m</td>
<td>Not Assessed</td>
</tr>
</tbody>
</table>

Source: Exhibit 21-4 from Chapter 21 of the Highway Capacity Manual 2000

It is noted that the current traffic lane widths along Warringah Road through the study area are generally 3.1m wide less than the (Roads and Maritime) optimal lane width of 3.5m wide. Therefore the compromised lane widths currently provided on Warringah Road are likely already resulting in lower free flow speeds for vehicles. This is in part reflected by the existing average travel speeds along Warringah Road presented in Section 4 which indicate peak hour average speeds of below 35 km/h which are less than the signposted speed of 70 km/h.

Warringah Road represents a key freight route for the Northern Beaches and accordingly carries significant heavy vehicle volumes. It is therefore recommended that traffic lane widths on Warringah Road not be provided at less than 3m wide. As such, any reduction in lane widths from 3.1m to 3.0m (or similar) is unlikely to have an impact on the operation or capacity of Warringah Road.

### 7.7.3 Reduction in Lateral Clearance

Chapter 21 of the HCM on ‘Multilane Highways’ provides guidance on the relationship between lateral clearances and the free flow speeds of roads. The findings are reproduced in Table 7.10.
Table 7.10: Adjustment for Lateral Clearance to Free Flow Speed

<table>
<thead>
<tr>
<th>Total Lateral Clearance [1] (m)</th>
<th>Reduction in Free Flow Speed (km/h)</th>
<th>Total Lateral Clearance [1] (m)</th>
<th>Reduction in Free Flow Speed (km/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.6</td>
<td>0.0</td>
<td>3.6</td>
<td>0.0</td>
</tr>
<tr>
<td>3.0</td>
<td>0.6</td>
<td>3.0</td>
<td>0.6</td>
</tr>
<tr>
<td>2.4</td>
<td>1.5</td>
<td>2.4</td>
<td>1.5</td>
</tr>
<tr>
<td>1.8</td>
<td>2.1</td>
<td>1.8</td>
<td>2.1</td>
</tr>
<tr>
<td>1.2</td>
<td>3.0</td>
<td>1.2</td>
<td>2.7</td>
</tr>
<tr>
<td>0.6</td>
<td>5.8</td>
<td>0.6</td>
<td>4.5</td>
</tr>
<tr>
<td>0.0</td>
<td>8.7</td>
<td>0.0</td>
<td>6.3</td>
</tr>
</tbody>
</table>

[1] Sum of the lateral clearance to the left shoulder and median (to a maximum of 1.8m each side).

(Source: Exhibit 21-5 from Chapter 21 of the HCM)

Reducing the total (or combined) lateral clearance on six lane roads such as Warringah Road will result in a minor reduction in free flow speeds.

For example should the lateral clearance be reduced to 0m (barriers either side of the carriageway) there would be a reduction in the free flow speed of 6.3 km/h. The base free flow speed is typically the design or signposted speed (ie. 70 km/h for Warringah Road during normal operating conditions), reducing the lateral clearance to 0m from 3.6m+ would reduce the theoretical traffic speed to 63.7 km/h.

The speed surveys presented in Section 4 indicate that peak hour average speeds of Warringah Road in the study area average between 20 to 26 km/h during the AM peak period and 30 to 33km/h during the PM peak period. This indicates that the existing speeds along Warringah Road are already significantly below their theoretical free flow speeds as a result of congestion and delays at downstream intersections along the corridor.

In this regard it is considered that a reduction in lateral clearance would have negligible impact on existing speeds during peak periods noting the already reduced travel speeds. Outside of peak periods when the network is not congested reduced lateral clearance would result in a lowering of average travel speeds.

7.7.4 Reduction in Speed Limits

Throughout the construction works there may be times when the speed limit along Warringah Road is required to be reduced from the signposted speed of 70 km/h. Under free flow conditions reduced speed limits typically reduce the capacity of a road however in this instance peak hour average speeds along Warringah Road are already well below the posted speed limit. In this regard a reduced speed limit for Warringah Road would unlikely have a major impact on the capacity of the corridor, noting that a number of 40km/h school speed zones are already present in the study area during the AM peak period.

7.8 Assessment of Proposed Road Closures

As part of the Stage 2 Project construction works the number of “live” traffic lanes on Warringah Road may at times be reduced between Government Road and Altona Avenue. The lane closures will typically occur off-peak (ie. during the night) when traffic volumes on Warringah Road are at their lowest.

Roads and Maritime has nominated road closure periods (time of day and day of week) where road closures or lane restrictions could take place. These are outside the critical peak hour.
periods and other critical network periods during the week and weekend, therefore intending to maintain the existing level of network capacity during these important times.

The document details the closure type (road shoulder or traffic lane), day of the week and relevant times and is summarised in Table 7.11 and Figure 7.11.

**Table 7.11: Summary of Road Closure Periods**

<table>
<thead>
<tr>
<th>Location</th>
<th>Closure Type</th>
<th>Days of the Week</th>
<th>Times</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warringah Road (eastbound carriageway) and Frenchs Forest Road (eastbound carriageway) [Shown in Green in Figure 7.11]</td>
<td>Shoulder</td>
<td>Mon – Fri</td>
<td>10:00am to 3:00pm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sun – Thu</td>
<td>10:00pm to 5:00am</td>
</tr>
<tr>
<td></td>
<td>1 of 3 lanes</td>
<td>Sun – Thu</td>
<td>10:00pm to 5:00am</td>
</tr>
<tr>
<td></td>
<td>2 of 3 lanes</td>
<td>Sun – Thu</td>
<td>11:00pm to 5:00am</td>
</tr>
<tr>
<td>All Other Carriageways and Roads [Shown in Blue in Figure 7.11]</td>
<td>Shoulder</td>
<td>Mon – Fri</td>
<td>10:00am to 3:00pm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sun – Thu</td>
<td>8:00pm to 5:00am</td>
</tr>
<tr>
<td></td>
<td>1 of 3 lanes</td>
<td>Sun – Thu</td>
<td>8:00pm to 5:00am</td>
</tr>
<tr>
<td></td>
<td>2 of 3 lanes</td>
<td>Sun – Thu</td>
<td>9:00pm to 5:00am</td>
</tr>
</tbody>
</table>

Source: RMS December 2014.

The existing number of westbound traffic lanes will be maintained between 5:00am to 8:00pm with lane closures possible between 8:00pm and 5:00am Sunday to Friday. Whilst the existing number of traffic lanes will be maintained for eastbound traffic between 5:00am to 10:00pm Sunday to Friday, with lane closures possible between 10:00pm and 5:00am. The eastbound capacity is maintained for longer than the westbound to cater for the later outbound traffic demand (ie people returning home from the city in the evening).

An assessment of the existing Warringah Road traffic volumes (ie. not including the construction traffic volumes) against the future lane capacities is provided in Figure 7.12 and Figure 7.13 for the westbound (inbound) and eastbound (outbound) carriageways, respectively. The assessment is
based on an indicative uninterrupted capacity of 1,400vph per lane (sourced from Austroads and detailed below in Section 7.7.1).

It is noted that the traffic volumes for the assessment have been sourced from Warringah Road at Melwood Avenue approximately 1.9km southwest of Forest Way. However, it is noted that this section of Warringah Road carries comparable daily traffic volumes to the works area (refer to Figure 7.12) and is considered appropriate for assessment purposes.

**Figure 7.12: Warringah Road (west of Melwood Avenue, Forestville) - Westbound Lane Capacities**

![Figure 7.12: Warringah Road (west of Melwood Avenue, Forestville) - Westbound Lane Capacities](source)

With the exception of a brief period in the AM peak, the assessment indicates that the existing traffic volumes are contained within the envelope of lane capacity. It is noted that the existing westbound traffic volume on Warringah Road (weekday inbound) nears the reduced lane capacity.
capacity at 5:00am. As a consequence of this early start to the peak traffic period in this part of the network, we recommend ensuring that at least 2 lanes are provided from 4:00am on weekday mornings. This will ensure adequate capacity is available to accommodate the onset of peak traffic and to limit the potential for early traffic congestion to impact long into the AM peak period.

It is not proposed to reduce the number of lanes during the AM peak period and as such, there would be no change in the lane capacity at 7:00am when the existing demands exceed the current theoretical lane capacity.

7.9 Other Considerations

7.9.1 Public Transport Impacts

The construction of the Stage 2 Project would require changes to public transport operations in the precinct, primarily along Warringah Road. The majority of existing bus stops on Warringah Road would at some stage throughout the Stage 2 Project works be relocated, most within the same general local area.

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.

The Stage 2 Project construction will primarily impact on buses that operate along Warringah Road and Wakehurst Parkway including Bus Routes 137, 169, 280 and L60. There will likely be “knock on” effects for buses on routes that travel across the works area along Warringah Road.

Impacts by the Stage 2 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, 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.

7.9.2 Walking and Cycling Impacts

The most significant impact to active transport with the Stage 2 Project construction is on disruption to pedestrian activity on footpaths along Warringah 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.

While there are no existing designated cycle routes in the study area that would be impacted by the Stage 2 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.

7.9.3 Safety Impacts

The construction of the Stage 2 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.
• Gawking or rubber necking by motorists which can slow traffic or increase distraction therefore potential for crashes (gawk screens are a good solution to this).
• 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.

7.9.4 Broader Network Impacts

During the construction of the Stage 2 Project, it is expected that travel times would be higher due to the impacts of the various construction activities on traffic movement, including the implementation of reduced speed limits for road works within the construction area. However, as the major alternative 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 Warringah Road corridor construction zone would be required for any substantial shift in traffic volumes to these two alternative routes.

However, if the travel times between the Warringah Road corridor and the alternative routes (Mona Vale Road or Spit Road/Military Road) were similar, the increase in travel time during the construction phase may result in some motorists switching to either alternative route (Mona Vale Road or Spit Road/Military Road) instead of Warringah Road. If this was to occur, the Project 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 2 Project.

In addition to the above, if partial road closures were to occur during the PM 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 at these times.

It is however noted that there may be similar capacity constraints as a result of the concurrent upgrade works on the Mona Vale Road corridor.

7.9.5 Impacts on Parking

On-street car parking is currently prohibited on Warringah Road, Forest Way, Wakehurst Parkway and Allambie Road within the study area. Whilst it is anticipated that some on-street car parking will be permanently lost as part of the Stage 2 Project (refer to Section 6.7.6), it is not anticipated that any additional on-street car parking will be lost as part of any temporary works associated with the Stage 2 Project.

7.9.6 Impacts on The Forest High School

Vehicle and pedestrian access to The Forest High School is generally provided from the Frenchs Forest Road frontage. As a result the impacts on the school from the Stage 2 Project construction works will be minor compared to the Stage 1 Project construction works.
The Stage 2 Project construction works on Warringah Road would however bring about the following potential transport impacts:

- Reduced travel speeds and increased travel times for staff, parents and students accessing the school.
- Temporary diversions to pedestrian footpaths and crossings.
- Increased exposure to risk for school students and staff associated with increased construction traffic movements, including heavy vehicles and equipment.

7.9.7 Impacts on Frenchs Forest Public School

Frenchs Forest Public School is located on the north west corner of the intersection of Forest Way with Warringah Road, but set back considerably from the road reserve with vehicular access via Grace Avenue to the west and pedestrian, cycle and bus access via the protected slip lane adjacent to the eastbound approach to the intersection.

The impacts of construction activity and traffic on the activities and patrons (students and teachers) of the Frenchs Forest Public School would be similar to those for The Forest High School listed above – related generally to the reduced travel speeds, inconvenience due to temporary diversions for pedestrians and cyclists, and increased exposure to risk due to construction traffic.

7.9.8 Construction Hours

Subject to other environmental impacts (i.e., 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.

7.9.9 Property Access

Access to properties along affected roads would need to be maintained during construction. It is noted that only a few properties have direct vehicle access to Warringah Road within the Stage 2 Project works area with the majority of these properties to be acquired for road widening. However, in any circumstances where vehicular access is required to be restricted, alternative temporary 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.

7.9.10 Road Safety Audits

Road safety audits will be carried out at key stages of the Stage 2 Project, including at detailed design and during and post construction. These audits will identify any potential safety risks to road users and identify actions to mitigate or remove these safety risks.

7.10 Mitigation Measures

Table 7.12 sets out the set of mitigation measures that would need to be implemented in order to manage the impacts of the construction of the project. It also shows likely timing, as well as responsibility for the mitigating measures.
Table 7.12: Summary of Road Closure Periods

<table>
<thead>
<tr>
<th>Impact</th>
<th>Traffic and Transport Impact Management Measures</th>
<th>Responsibility</th>
<th>Timing</th>
</tr>
</thead>
</table>
| Construction traffic impacts| A construction traffic management plan would be developed and implemented as part of the Stage 2 Project. The construction traffic management plan would focus on maintaining general traffic flow and specifying appropriate site accesses and construction traffic routes. It would include:  
  o Traffic Control Plans showing the access arrangements and the detail of required signs and devices  
  o Pedestrian and Cyclist Management Plans  
  o Workplace Travel Plan/s for construction workers  
  o Consultation strategy for access requirements to adjacent properties including The Forest High School and Frenchs Forest  
  o Hours of operation, including prohibitions on queuing outside sites prior to commencement of work.  
  o Road safety audit requirements.  
  o Any localised improvements/adjustments to existing traffic management arrangements.                                                                                                                                 | Contractor      | Pre-construction |
<p>|                             | All workers and subcontractors engaged on site will be required to undergo a site induction. The induction will include permitted access routes to and from the construction site for all vehicles, as well as standard environmental, workplace health and safety, driver protocols and emergency procedures. | Contractor      | Pre-construction Construction |
|                             | Subject to safety reasons and other environmental impacts (eg. noise), construction traffic movements would be limited to off-peak periods, with peak period construction staggered to minimise construction traffic during these periods. | Contractor      | Pre-construction Construction |
|                             | Priority would be given to the use of the arterial road network for construction vehicle access routes.                                                                                                                                               | Contractor      | Pre-construction Construction |</p>
<table>
<thead>
<tr>
<th>Impact</th>
<th>Traffic and Transport Impact Management Measures</th>
<th>Responsibility</th>
<th>Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative construction traffic impacts</td>
<td>Consultation would be undertaken with Health Infrastructure to coordinate scheduling of construction activities and deliveries. Consultation would be undertaken with Health Infrastructure regarding the need for construction access to the hospital site to focus on the Warringah Road/ Bantry Bay Road intersection.</td>
<td>Roads and Maritime</td>
<td>Pre-construction Construction</td>
</tr>
<tr>
<td>Property access</td>
<td>Access to properties along affected roads would be maintained during construction. The need for any alternative and/or temporary access arrangements would be agreed with affected property managers/owners.</td>
<td>Contractor</td>
<td>Construction</td>
</tr>
<tr>
<td>Operational traffic</td>
<td>An operational traffic review would be undertaken within 12 months of opening of the Stage 2 Project to confirm the operational traffic impacts of the project on Warringah Road, Forest Way and Wakehurst Parkway in close proximity to the hospital. The assessment would be based on actual transport surveys (traffic counts, speed surveys) and will assess the levels of service at major intersections within the assessed road network. Where necessary, the outcomes of the operational traffic review would be used to identify any additional feasible and reasonable measures to be implemented where it is determined that the level of service has significantly deteriorated as a result of the Stage 2 Project, compared to the levels described in Chapter 6.</td>
<td>Roads and Maritime</td>
<td>Operation</td>
</tr>
</tbody>
</table>
8. Summary

8.1 Overview

Rocks and Maritime Services (Roads and Maritime) is proposing a suite of road works to enhance arterial and sub-arterial road network connectivity and capacity in the proposed NBH precinct at Frenchs Forest, to be known as the NBH - Road 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 2 Network Enhancement Works (Stage 2 Project). A separate traffic and transport impact assessment was prepared to accompany the Stage 1 and Concept Proposal EIS which is currently being considered by the Department of Planning and Environment.

8.2 Existing Conditions

8.2.1 Traffic Performance

The arterial road network within the precinct experiences high levels of traffic congestion and volatility, with several of the major intersections operating near or beyond their practical capacity. During the weekday AM peak period, the network has capacity limitations that make it particularly prone to congestion and subsequent use of local streets by through traffic (‘rat running’). The network frequently enters grid-locked conditions despite being tightly managed through access and turning restrictions, and intensive traffic signal coordination.

The traffic 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.

8.2.2 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 Waringah Road (east of Allambie Road) could accommodate 4.6 metre high vehicles.

8.2.3 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 of the study area. Within the broader 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.
8.2.4 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 including one pedestrian crash on Warringah Road at Government Road. The crash data is relatively concentrated to the arterial road intersections with the majority of crash clusters occurring along the Warringah Road corridor. The magnitude of crashes is likely due to the ‘stop-and-go’ traffic conditions arising from the heavy congestion during peak periods which is typical of a congested urban road environment.

8.3 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 488 beds and an estimated 1,300 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 members) 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.

8.4 Forecast Future Base Traffic and Transport Conditions

8.4.1 Do Minimal Scenario

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 and 2 Projects. The works associated with the Do Minimal scenario are detailed in Sections 5.1.

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 2018 Do Minimal scenario indicates:

- 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 proportions 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. Further degradation of the road network is anticipated between 2018 and 2028 under the Do Minimal scenario.

8.4.2 Stage 1 Project Case

The Stage 1 Project seeks to address part of the anticipated traffic and transport problems identified in the forecast future base scenario. The proposed road upgrades associated with the Stage 1 Project 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 (westbound) between Allambie Road and Government Road
- Upgrade of the following intersections:
  - Forest Way/Naree Road (future signals)
  - Naree Road/Frenchs Forest Road West/Rabbett Street (future signals)
  - Wakehurst Parkway/Frenchs Forest Road East/Frenchs Forest Road West (upgrade existing signalised intersection)
  - Frenchs Forest Road East/Romford Road (future signals)
  - Frenchs Forest Road East/Patanga Road/Allambie Road (future signals)
  - Warringah Road/Allambie Road (upgrade existing signalised intersection)
  - Frenchs Forest Road / Nandi Avenue (future seagull layout).

The analysis indicates that congestion levels would reduce, resulting in increased average travel speeds and reduced average delay and stops per vehicle compared to the Do Minimal scenario. In comparison to the 2018 Do Minimal scenario, the 2018 Stage 1 Project scenario indicates:

- The average traffic speeds are predicted to increase by approximately 26 percent in the AM peak period and by approximately 16 percent in the PM peak period
- The average delay per vehicle is predicted to reduce by approximately 27 percent in the AM peak period and by approximately 20 percent in the PM peak period.

The traffic 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 a 32 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. Whilst for the PM peak period the level of unreleased demand is predicted to reduce by 45 percent from 12 percent to 7 percent.

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4 There have been some minor amendments to the Stage 1 modelling scenario since the TIA for the Stage 1 Project was completed. The amendments resolved minor deficiencies that were previously present in the Stage 1 model and as such, there have been some minor changes to the modelling outputs between the Stage TIA assessment and this assessment.
The following intersections are still predicted to operate at LOS F after the completion of the Stage 1 Project 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 / Government Road
- Forest Way/ Adams Street
- Forest Way/ Naree Road
- Frenchs Forest Road/ Wakehurst Parkway
- Allambie Road / Aquatic Drive.

The above indicates that 4 of the 5 intersections along Warringah Road within the study area are anticipated to operate with LOS F during either of the peak periods.

Further degradation to the road network operation is anticipated between 2018 and 2028 with reduced average travel speeds and increased average delays forecast. The number of intersections operating at LOS F is predicted to increase from 8 to 10 between 2018 and 2028.

In summary, the traffic modelling of the forecast Stage 1 Project conditions indicate that the Stage 1 road network is capable of accommodating the traffic generation of the hospital. However, the analysis also indicates the need for further capacity improvements within the study area to accommodate the forecast traffic growth to, from and through the study area.

8.5 Transport Impacts of Stage 2 Project Case

The Stage 2 Project has been proposed in order to return the operation of the network to better than or comparable to the existing operation whilst catering for potential further development in the precinct and growth in background traffic volumes. The proposed road upgrades associated with the Stage 2 Project are summarised below:

- Warringah Road underpass from west of Forest Way to east of Wakehurst Parkway
- Eastbound and westbound surface lanes on Warringah Road either side of the underpass
- An onramp for vehicles turning right from Wakehurst Parkway (north approach) onto Warringah Road underpass
- Signalised intersections of Forest Way, Hilmer Street and Wakehurst Parkway with the Warringah Road surface lanes
- New connection at Wakehurst Parkway / Aquatic Drive intersection (left in, right in and left out movements only)
- Upgrade of the Warringah Road/Allambie Road intersection
- Grade separated pedestrian crossings of Warringah Road west of Forest Way and west of Hilmer Street.

The above road upgrades and grade separation allow through vehicles on Warringah Road to bypass the existing signalised intersections at Forest Way, Hilmer Street and Wakehurst Parkway.

8.5.1 Traffic Performance

The traffic analyses undertaken for the Stage 2 Project indicate that the road upgrades would provide an improvement in network statistics compared to the Do Minimal and Stage 1 scenarios.
A comparison of the 2018 and 2028 operation of the road network between the Do Minimal scenario and the Project Case (including the Stage 1 and Stage 2 Project Works) is provided in Table 8.1.

**Table 8.1: Proportion Change between Do Minimal Scenario and Project Case (Stage 1 and 2)**

<table>
<thead>
<tr>
<th>Network Measure (3 hours)</th>
<th>2018</th>
<th>2028</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AM</td>
<td>PM</td>
</tr>
<tr>
<td>Average speed (km/h)</td>
<td>0.10%</td>
<td>0.12%</td>
</tr>
<tr>
<td>Average delay time per vehicle (sec)</td>
<td>0.15%</td>
<td>0.16%</td>
</tr>
<tr>
<td>Proportion of vehicles unreleased</td>
<td>0.77%</td>
<td>(from 9 to 2% of total vehicles)</td>
</tr>
</tbody>
</table>

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

The above results indicate that with the proposed road upgrades associated with the Project Case, the road network is anticipated to operate with increased average speeds and reduced average delays compared to the Do Minimal scenario.

With the modelling still predicting some level of unreleased demand, there will be locations within the network where the predicted traffic volumes are still unable to enter the study area due to congestion. The proposed Stage 2 Project 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 2 Project.

The average travel speed for vehicles travelling in the underpass (from west of Forest Way to east of Allambie Road) would 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 following intersections are still predicted to operate at LOS F after the completion of the Stage 2 Project in 2018 and/or 2028 during the AM and/or PM peak periods (or both):

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

All other intersections within the study area are predicted to operate with a LOS E or better for the AM and/or PM peak periods in 2018 and/or 2028.

It is noted that the AM peak hour (8:00 to 9:00am) results are heavily influenced by congestion at the merge point between Warringah Road surface lanes and slot traffic caused by the westbound bus stop on Warringah Road at Maxwell Parade. The operation of the network during the AM peak period, particularly the Warringah Road / Forest Way intersection would be improved if this bus stop was removed or suitably relocated, however this would need further investigation.

It is further noted that whilst the Stage 2 Project includes upgrades that increases capacity on Warringah Road between Fitzpatrick Avenue and Allambie Road it does not increase the capacity of the broader Warringah Road or Forest Way corridors. In this regard it is predicted...
that increased congestion will be present at the adjacent intersections to the study area, including:

- Warringah Road/ Government Road
- Forest Way/ Adams Road
- Warringah Road/ Currie Road/ Browns Road.

Future works will be required at these intersections to alleviate the congestion caused by the additional traffic present on the network.

In summary, the traffic analysis undertaken for the Stage 2 Project indicates that the road upgrades will provide a significant improvement in network statistics compared to the Stage 1 Project. Furthermore, it is predicted that there will be a slight improvement in the network operation during the AM peak period for the 2018 and 2028 scenario when compared to the 2012 Base Condition. Due to the additional traffic generated by the NBH, there will however be a slight deterioration in the network operation during the PM peak period for the 2018 and 2028 scenario when compared to the 2012 Base Condition.

8.5.2 Public Transport Operations

There are a number of proposed modifications to the existing bus stop arrangements, summarised as follows:

- Lengthen bus stop bay on Forest Way on approach to Warringah Road
- Removal of the bus stop on Allambie Road (south of Frenchs Forest Road)
- Removal of the bus stop on Warringah Road (at Maxwell Parade)
- Rationalisation of bus stops on Warringah Road at Hilmer Street.

There are anticipated to be minor improvements to peak period bus travel speeds on Frenchs Forest Road. The increased east-west capacity on Warringah Road will attract some traffic from Frenchs Forest Road and in turn improve the operation of the Frenchs Forest Road corridor.

The main source of delays to buses will continue to be delays at signalised intersection and dwell times at bus stops.

8.5.3 Walking and Cycling

A series of new shared-path and footpath facilities will be provided in the study area as part of the Stage 2 Project and will connect into the network established as part of the Stage 1 Project.

Shared paths capable of accommodating pedestrian and cyclist movements will be provided on Warringah Road generally between Fitzpatrick Avenue and Allambie Road, as well as on parts of Wakehurst Parkway, Allambie Road and Forest Way. New and upgraded pedestrian footpaths will be provided on Forest Way, Warringah Road and Aquatic Drive.

The new facilities will improve connectivity between the key activity nodes within the study area including from the residential catchments to the south of Warringah Road to the Forestway Shopping Centre, the Forest High School and the NBH. In addition, east-west pedestrian and cyclist movements along the Warringah Road corridor will be facilitated by the new shared-path network.

8.5.4 Road Safety

The Stage 2 Project are predicted to improve road safety. The majority of existing crashes were rear end accidents resulting from stop-go traffic conditions generally occurring at intersections which is typical in a congested urban road environment. The upgrades will reduce the average
number of stops per vehicle and will also allow through vehicles to bypass the signalised intersections at Forest Way, Hilmer Street and Wakehurst Parkway. The reduction in the average number of stops per vehicle and reducing vehicle volumes through the intersection is expected to reduce the number of crashes.

The provision of grade separated shared pedestrian / cyclist crossings of Warringah Road as part of the upgrade within the study area is expected to result in improvements in pedestrian safety.

8.5.5 Car Parking

As part of the Stage 2 Project, Warringah Road is proposed to be widened to accommodate the surface lanes to the south of the slot traffic lanes. Whilst no on-street car parking is currently provided on Warringah Road car parking is provided on the minor intersecting roads. The widening to the south of the existing Warringah Road alignment will result in the loss of some existing car parking on Bantry Bay Road and Hilmer Street.

The existing car parking demands for these spaces are high and are generally generated by the adjacent land uses. The properties abutting the impacted car parking spaces are to be acquired to accommodate the widening of Warringah Road, and as such the demands associated with parking to service these properties would no longer exist in this location.

In addition some on-street car parking will be lost on Fitzpatrick Avenue East as a result of changed traffic conditions at its intersection with Warringah Road. Observations indicate that any displaced car parking demands (albeit minor) at this location could be accommodated further down Fitzpatrick Avenue East or on adjacent streets.

8.6 Construction Traffic Impacts

The construction activities associated with the project would generate traffic and transport impacts that generally involve temporary arrangements such as:

- Road or intersection closures
- Traffic diversions
- Bus rerouting and bus stop relocation
- Footpath and shared path diversions.

Potential impacts caused by construction of the Stage 2 Project 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.

An initial assessment indicates that the additional construction traffic volumes will only typically increase traffic volumes on key roads by less than 1% throughout the day, with only negligible increases anticipated during road network peak operating periods. Such an increase is not anticipated to have a noticeable impact on the operation of the surrounding road network.

A key consideration during construction is the strict requirement of Roads and Maritime for the contractor to maintain peak period traffic capacity throughout the study area network in order to manage and mitigate the above impacts. 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 staging 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.