



Transport for NSW

Beaches Link and Gore Hill Freeway Connection

Chapter 8

Construction traffic and transport

8 Construction traffic and transport

This chapter considers the potential traffic and transport impacts from the construction of the Beaches Link and Gore Hill Freeway Connection and identifies measures which address these impacts. Potential operational traffic and transport impacts are discussed in Chapter 9 (Operational traffic and transport).

A detailed traffic and transport assessment has been carried out for the project and is included in Appendix F (Technical working paper: Traffic and transport).

The Secretary's environmental assessment requirements as they relate to construction traffic and transport, and where in the environmental impact statement these have been addressed, are detailed in Table 8-1.

Avoiding or minimising impacts has been a key consideration throughout the design and development process for the Beaches Link and Gore Hill Freeway Connection project. A conservative approach has generally been used in the assessments, with potential impacts presented before implementation of environmental management measures. The environmental management measures proposed to minimise the potential impacts in relation to construction traffic and transport are included in Section 8.5.

Table 8-1 Secretary's environmental assessment requirements – construction traffic and transport

Secretary's environmental assessment requirements	Where addressed
Traffic and Transport	
1. The Proponent must assess construction transport and traffic (vehicle, marine, pedestrian and cyclists) impacts, including, but not necessarily limited to: <ul style="list-style-type: none"> a. a considered approach to route identification and scheduling of marine and land transport movements, particularly outside standard construction hours; 	Construction traffic routes are assessed in Section 8.4 . Construction traffic movements are shown in Chapter 6 (Construction work).
<ul style="list-style-type: none"> b. the number, frequency and size of construction related vehicles (passenger, marine, commercial and heavy vehicles, including spoil management movements); 	Information on construction traffic movements is presented in Chapter 6 (Construction work). Section 6.8 outlines number, frequency and size of construction vehicles.
<ul style="list-style-type: none"> c. construction worker parking; 	Construction worker parking is assessed in Section 8.4 . Temporary construction support site layouts, including provision of construction worker parking, are presented in Chapter 6 (Construction work).
<ul style="list-style-type: none"> d. the nature of existing traffic (types and number of movements) on construction access routes (including consideration of peak traffic times and sensitive road users and parking arrangements); 	The nature of existing traffic is detailed in Section 8.3 . The assessment of potential traffic impacts during construction are detailed in Section 8.4 .

Secretary's environmental assessment requirements	Where addressed
e. access constraints and impacts on public transport, pedestrians and cyclists;	Access constraints and impacts on public transport, pedestrians and cyclists is described in Section 8.4 .
f. how construction of the project affects the capacity of, and the need to close, divert or otherwise reconfigure elements of, the road, cycle and pedestrian network;	Impacts during construction on the road, cycle and pedestrian networks are detailed in Section 8.4 .
g. details of how construction and scheduling of works are to be coordinated in regard to public events and cumulative traffic impacts resulting from concurrent work on the project and other major projects, under or preparing for or commencing construction in the vicinity of the proposal;	Coordination regarding public events and recreational activities is discussed in Section 8.4.8 and Section 8.5 . Cumulative construction impacts are discussed in Section 8.4.6 .
h. alternatives to road transport of construction spoil including marine and rail options as well as potential re-use in existing land reclamation areas or in association with Resource Recovery Exceptions (if obtained from the EPA) to minimise traffic impacts on the road network;	Impacts from transportation of dredged material are discussed in Section 8.4.3 . Potential reuse of spoil is addressed in Chapter 24 (Resource use and waste management). Alternatives to road transport of construction spoil including marine and rail options are discussed in Chapter 4 (Project development and alternatives).
i. the likely risks of the project to public safety, paying particular attention to pedestrian safety and users of Middle Harbour; and	The assessment of potential traffic impacts during construction for pedestrians and users of Middle Harbour are detailed in Section 8.4 . Chapter 23 (Hazard and risk) (Section 23.2 and Section 23.3) assess the interactions between maritime traffic and tunnel infrastructure.
j. impacts to water based traffic on Middle Harbour.	Impacts to water based traffic and shipping channels during construction are discussed in Section 8.4.3 .

8.1 Strategic transport planning context

Details regarding the project's compatibility with key Australian Government and State strategic planning and transport policies are provided in Chapter 3 (Strategic context and project need). Specific transport strategies relevant to operation of the project are discussed in Chapter 9 (Operational traffic and transport).

8.2 Assessment methodology

8.2.1 Overview

The assessment methodology for construction traffic and transport impacts considered five core components:

- Road traffic
- Local roads and parking
- Public transport
- Pedestrian and cyclists (active transport)
- Maritime traffic.

The method and outputs of assessment for each of these components are summarised in Table 8-2. The construction traffic and transport assessment conservatively focused on the impacts during peak construction activities to reflect the greatest potential impact of the project. For example, the quantitative assessment of road network performance is for the highest potential construction site traffic generation per hour. These peak construction activities are likely to be short in duration and would only occur for a small proportion of the overall construction program. Typical site traffic generated per hour would therefore generally be lower than the peak site traffic numbers assessed.

Table 8-2 Overview of approach to the construction traffic and transport assessment

Project impacts	Method of assessment	Assessment output
Road traffic	Analysis of road network performance during construction based on strategic traffic forecasting and modelling of the worst case construction traffic scenario.	Quantitative assessment of road network performance with and without the project.
Local roads and parking	Analysis of changes to local road access arrangements, loss of parking spaces and availability of comparable alternative parking in nearby locations. The analysis considers both temporary impacts (ie during construction) and permanent impacts.	Qualitative assessment of local road changes. Estimate of number of lost parking spaces. Qualitative assessment of the impact of parking overflow to parking in nearby locations.
Public transport	Analysis of changes to public transport routes and stops, and service timeliness and efficiency during construction.	Qualitative assessment of impacts on public transport performance (increase or decrease in travel times).
Pedestrians and cyclists (active transport)	Analysis of temporary changes to shared user paths, cycle ways, footpaths and pedestrian crossings.	Qualitative assessment of impacts on pedestrian and cycling networks and accessibility.

Project impacts	Method of assessment	Assessment output
Maritime traffic	<p>Analysis of proposed use of the waterway including the number, type, frequency and duration of marine construction traffic.</p> <p>Simulation of marine vessels and transport of immersed tube tunnel elements.</p>	<p>Qualitative assessment of impacts on existing waterway navigation and commercial and recreational usage.</p> <p>Simulation report showing the paths of marine vessels and the area required for the transport of immersed tube tunnel elements in Middle Harbour.</p>

The assessment methodology for road traffic is described in more detail below.

8.2.2 Road traffic assessment methodology

The potential construction impacts of the project on road network performance were assessed through strategic traffic demand forecasting and traffic modelling. The assessment included modelling, which enabled existing and future traffic and transport conditions and road network performance to be characterised during construction of the project. An overview of the transport modelling methodology used in the assessment of the project is provided in Figure 8-1.

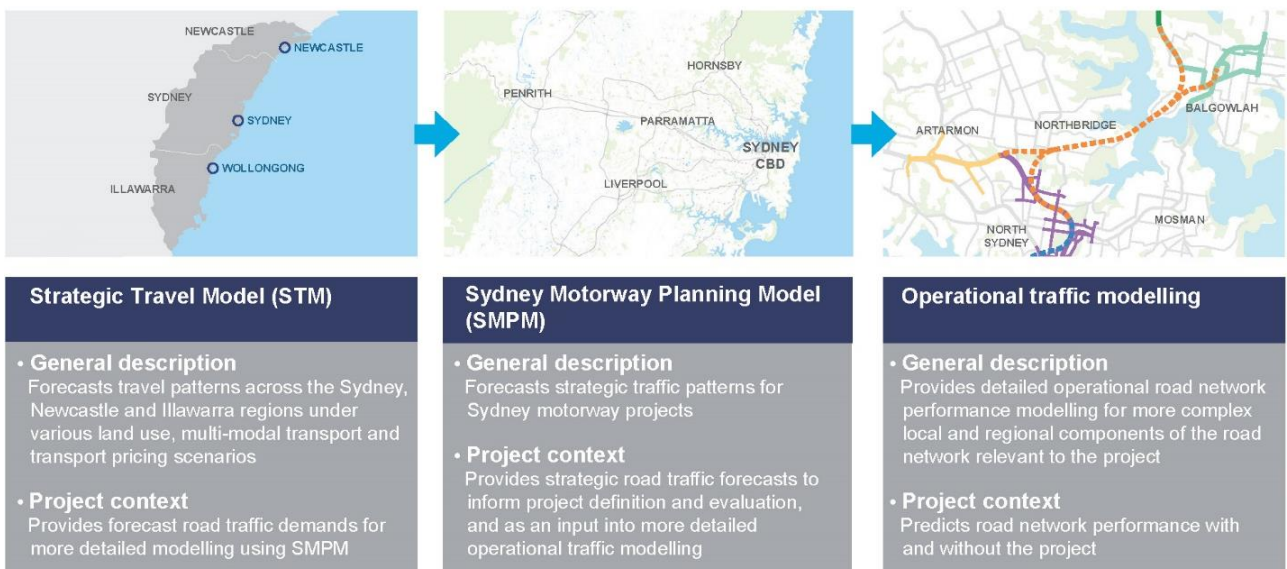


Figure 8-1 Overview of transport modelling approach

Construction traffic modelling scenarios

Construction modelling was based on construction traffic routes to and from the various temporary construction support sites. Based on the planned construction activities, the worst case construction traffic scenario was assumed to occur during the peak period of spoil removal from tunnel construction and associated surface works during 2024.

Models were developed for the AM peak (between 7am and 9am on a normal working weekday) and PM peak (between 4pm and 6pm on a normal working weekday) to assess the future performance of the road network during construction. Forecast traffic growth was taken from the Sydney Motorway Planning Model (SMPM) to derive background traffic demand. The SMPM, developed and operated by Transport for NSW, provides a platform to understand changes in future traffic patterns under different land use, transport infrastructure and pricing scenarios.

Construction traffic was then added to the background traffic. This was based on the proposed construction methodology as described in Chapter 6 (Construction work) including vehicle types,

volumes and construction traffic routes. The performance of the roads and intersections in the vicinity of the temporary construction support sites was then calculated.

The scenarios modelled to assess the impacts of construction on the road network are listed in Table 8-3. In addition, key intersections were modelled based on 2016 travel demands to characterise existing intersection performance. The SMPM model forecasts travel demands in five year increments (ie 2016, 2021, etc). The 2016 baseline year represents transport network conditions available at the time of assessment. Ongoing and continuous traffic surveys carried out by Transport for NSW indicate that the 2016 baseline year is appropriate for modelling purposes as there is little material difference between 2016 and existing (2020) traffic conditions in the project area.

Specific intersections were assessed if they would form part of a construction traffic route and the increase in construction vehicles due to the project would be greater than 50 vehicles per hour (ie the vehicle contribution was significant enough to warrant modelling).

Table 8-3 Construction traffic modelling scenarios

Model year	Without project	With project	Modelling scenario	Description
2024	✓		Base case 2024	The existing road network with no new projects or upgrades.
2024		✓	Construction 2024	Peak tunnelling and associated surface works for the project. The current road network with construction traffic movements for the project. No new projects or upgrades are included.
2024		✓	Cumulative construction 2024	Peak construction year for the Western Harbour Tunnel and Beaches Link program of works. The current road network with construction traffic movements for the project and the Western Harbour Tunnel and Warringah Freeway Upgrade project. No new projects or upgrades are included.

8.2.3 Assessment criteria

The criteria used to assess road network performance were as follows:

- At an intersection level, showing changes to traffic flow (expressed in vehicles per hour), average delay (expressed in seconds per vehicle), level of service (as defined in the *Guide to Traffic Generating Developments Version 2.2* (RTA, 2002)) and degree of saturation (expressed as the ratio of traffic volumes at an intersection to its overall capacity (V/C ratio))
- At a midblock level, showing changes on traffic volumes, volume to capacity ratio (ratio of traffic volumes at a midblock road to its overall capacity) and level of service (as defined in the *Guide to Traffic Generating Developments Version 2.2* (RTA, 2002))
- At a network level for cumulative assessments, showing changes to overall traffic demand and average speeds within the modelled areas, travel times along key routes, and changes to stopping frequencies.

8.2.4 Intersection and midblock level of service

Level of service (LoS) is a measure to describe the operational conditions and efficiency of a road or intersection. The definition of level of service generally outlines the operating conditions in terms of speed and travel time, freedom to manoeuvre, traffic interruptions, comfort and convenience, and road safety. It is a qualitative measure describing operational conditions within a roadway or

intersection, as perceived by motorists and passengers. Average delay is commonly used to assess the operational performance of intersections, with level of service used as an index.

The performance of roads can also be defined by the midblock level of service. The midblock level of service is based on the degree of saturation, which is the ratio between traffic volumes and the road capacity (V/C ratio). Satisfactory operations usually occur with a degree of saturation below 0.9. As degree of saturation approaches one, both queue length and delays increase rapidly. The level of service for freeways and motorways is calculated from vehicle density, which is the traffic volume divided by the average passenger car speed. Density is measured in passenger car units (PCU) per kilometre per lane. Passenger car units account for the amount of road space various vehicle types use. Heavy vehicles and buses use more road space than cars or light commercial vehicles and therefore have a passenger car unit greater than one.

A description of the level of service scale for intersection and midblock performance is shown in Table 8-4. There are six levels of service; labelled LoS A to LoS F. LoS A represents the best operating conditions and LoS F the poorest operating conditions. For the purposes of this assessment, LoS E and LoS F are considered unsatisfactory.

Table 8-4 Level of service criteria for intersection and midblock performance

LoS	Intersection criteria	Mid block criteria
A	Good operation	A condition of free flow in which individual drivers are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to manoeuvre within the traffic stream is extremely high, and the general level of comfort and convenience provided is excellent.
B	Good with acceptable delays and spare capacity	In the zone of stable flow where drivers still have reasonable freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience is a little less than with LoS A.
C	Satisfactory	In the zone of stable flow, but most drivers are restricted to some extent in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience declines noticeably at this level.
D	Operating near capacity	Close to the limit of stable flow and approaching unstable flow. All drivers are severely restricted in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience is poor, and small increases in traffic flow would generally cause operational problems.
E	Unsatisfactory. At capacity. At traffic lights, incidents would cause delays. Roundabouts require other control mode.	Traffic volumes are at or close to capacity and there is virtually no freedom to select desired speeds or to manoeuvre within the traffic stream. Flow is unstable and minor disturbances within the traffic stream would cause breakdown.
F	Unsatisfactory. Extra capacity required.	In the zone of forced flow, where the amount of traffic approaching a point exceeds that which can pass it. Flow breakdown occurs, and queuing and delays result.

Source: Roads and Traffic Authority (2002) Guide to Traffic Generating Developments and Austroads.

8.3 Existing environment

The existing traffic and transport environment for the project within the context of the broader road network is outlined below, along with more detailed analysis across the following local areas:

- Warringah Freeway and surrounds
- Gore Hill Freeway and Artarmon
- Northbridge to Seaforth (Middle Harbour crossing)
- Balgowlah and surrounds
- Frenchs Forest and surrounds.

8.3.1 Broader road network

Travel times and speed along key corridors

A summary of 2016 travel times and average speeds for trips for key road corridors between destinations in the Northern Beaches and lower North Shore of Sydney in the AM peak (between 7am and 9am on a normal working weekday) and PM peak (between 4pm and 6pm on a normal working weekday) is provided in Figure 8-2 and Figure 8-3. These centres are connected by motorways and major arterials with posted speeds of between 50 and 80 km/h. Typical operating speeds during peak periods are shown to be in the range of 20 to 40 km/h, indicating these corridors are operating at capacity resulting in congestion and delays.

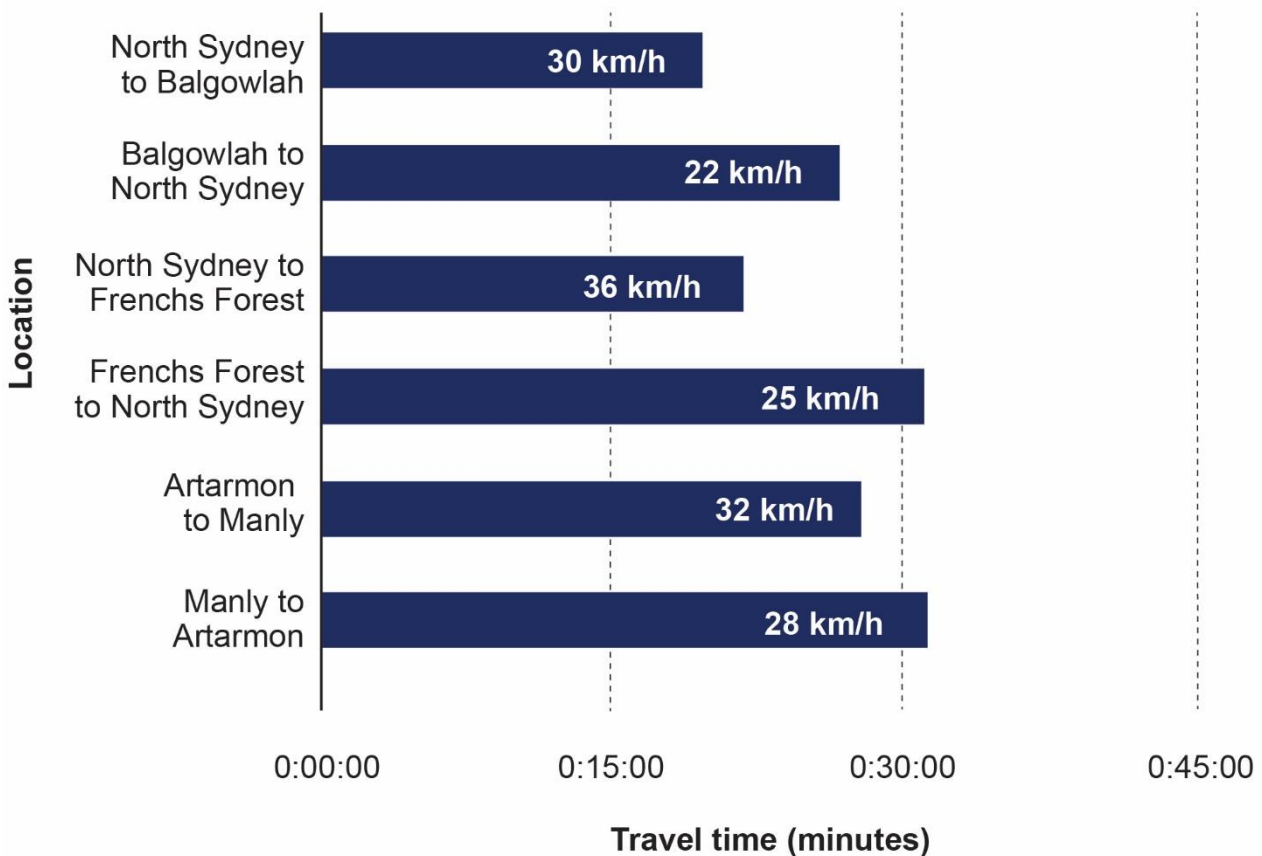


Figure 8-2 2016 AM peak travel times and average speeds along key corridors

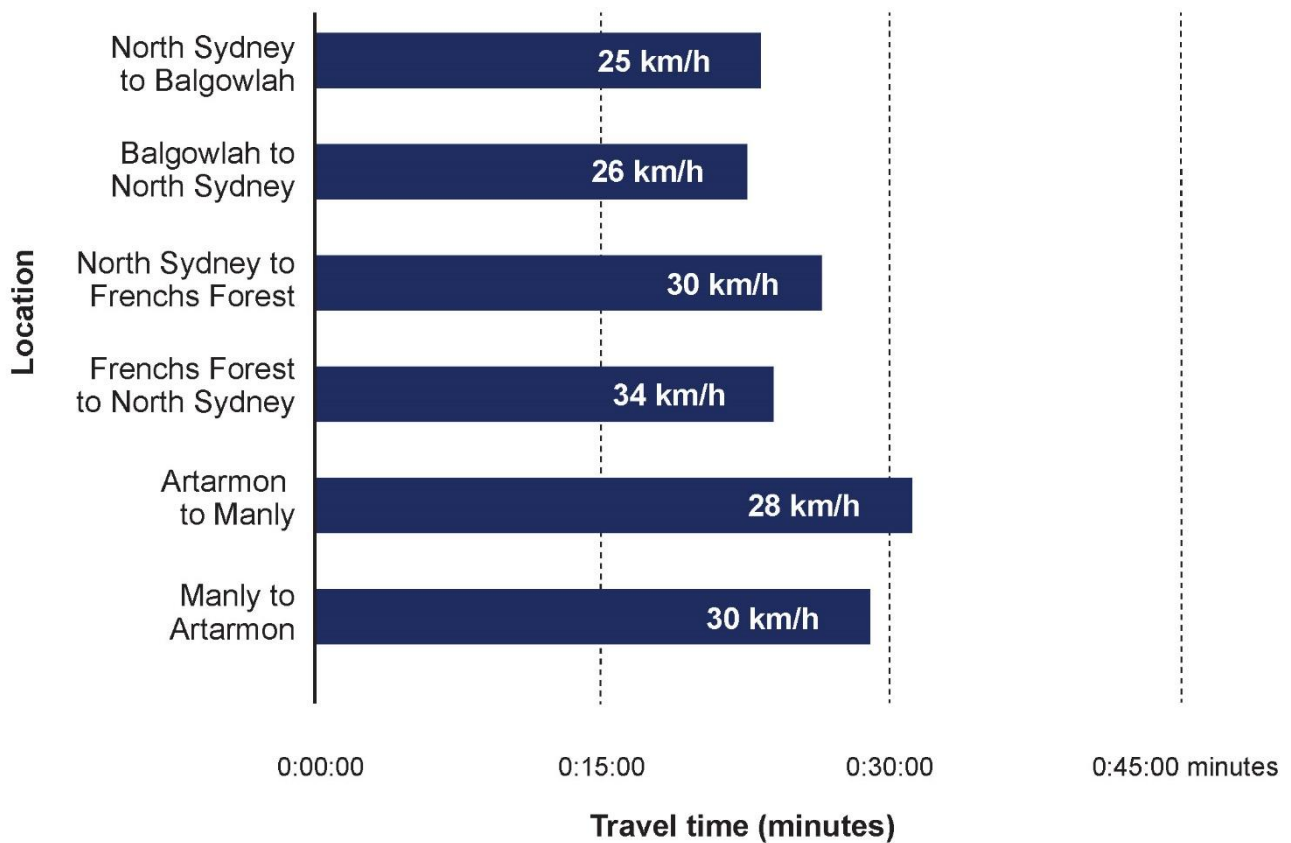


Figure 8-3 2016 PM peak travel times and average speeds along key corridors

Heavy vehicles and freight

Spit Road/Military Road and Warringah Road are both arterial commuter corridors and the movement of heavy vehicles along these roads is limited by capacity constraints and congestion, particularly during peak periods. Further, Spit Road and Military Road have access restrictions for large articulated trucks (ie B-Doubles and other Higher Mass Limit vehicles are not permitted). As such, access to the Northern Beaches for B-Doubles is currently limited to Mona Vale Road and Warringah Road.

The largest proportion of truck movements into and out of the Northern Beaches peninsula in 2016 occurred via Mona Vale Road, likely due to lower congestion and its proximity to the M1 Sydney Newcastle Motorway and industrial areas in Mona Vale, Warriewood, Belrose and Terrey Hills.

While Mona Vale Road carries much higher volumes of heavy vehicles compared to Spit Road/Military Road and Warringah Road, the poor standard of the road, particularly through Terrey Hills and Mona Vale, likely contributed to two fatal crashes over the past 10 years. It is noted that the NSW Government is upgrading Mona Vale Road from two to four lanes between Terrey Hills and Mona Vale. The upgrade is being carried out in two stages to provide customers with a better travelling experience and to improve safety and traffic flow. Works have commenced and are anticipated to be completed in 2022.

8.3.2 Warringah Freeway and surrounds

Description

Transport network

The existing transport network within the Warringah Freeway and surrounds area is shown in Figure 8-4 and includes the suburbs of Cammeray, Neutral Bay, North Sydney, Naremburn and Waverton.

Traffic volumes and patterns

A summary of existing peak hour traffic volumes for Warringah Freeway and surrounds in the AM peak (between 7am and 9am on a normal working weekday) and PM peak (between 4pm and 6pm on a normal working weekday) is provided in Table 8-5.

Table 8-5 Existing (2016) peak hour traffic volumes – Warringah Freeway and surrounds

Road	Direction	AM peak		PM peak	
		Volume (vehicles)	Heavy vehicle percentage	Volume (vehicles)	Heavy vehicle percentage
Warringah Freeway and surrounds					
Pacific Highway south of Walker Street	Northbound	2100	4%	1410	11%
	Southbound	380	13%	580	6%
Pacific Highway south of Bay Road	Northbound	690	8%	800	7%
	Southbound	1100	7%	950	3%
Bay Road west of Pacific Highway	Eastbound	230	2%	260	1%
	Westbound	380	4%	280	2%
Berry Street east of Walker Street	Eastbound	1650	7%	2390	4%
	Westbound	-	-	-	-
Falcon Street east of Miller Street	Eastbound	1250	2%	1350	6%
	Westbound	1170	6%	1110	5%
Ridge Street east of Miller Street	Eastbound	330	5%	130	2%
	Westbound	160	9%	260	4%
Miller Street north of Ernest Street	Northbound	470	6%	730	8%
	Southbound	1050	4%	1060	3%
Ernest Street east of Miller Street	Eastbound	1070	4%	1380	4%
	Westbound	1050	1%	870	2%
Ernest Street west of Merlin Street	Eastbound	650	3%	2000	1%
	Westbound	2070	1%	990	1%
Blue Street south of Pacific Highway	Northbound	330	3%	500	1%
	Southbound	290	3%	220	1%

Road	Direction	AM peak		PM peak	
		Volume (vehicles)	Heavy vehicle percentage	Volume (vehicles)	Heavy vehicle percentage
Arthur Street north of Pacific Highway	Northbound	800	2%	610	1%
	Southbound	-	-	-	-
Alfred Street north of Mount Street	Northbound	40	9%	30	0%
	Southbound	1420	1%	730	3%
Falcon Street west of Merlin Street	Eastbound	2330	7%	2910	5%
	Westbound	3140	6%	2110	8%
Walker Street north of Pacific Highway	Northbound	830	3%	650	2%
	Southbound	290	2%	360	3%
Brook Street south of Merrenburn Avenue	Northbound	720	9%	1660	2%
	Southbound	2070	2%	1020	6%

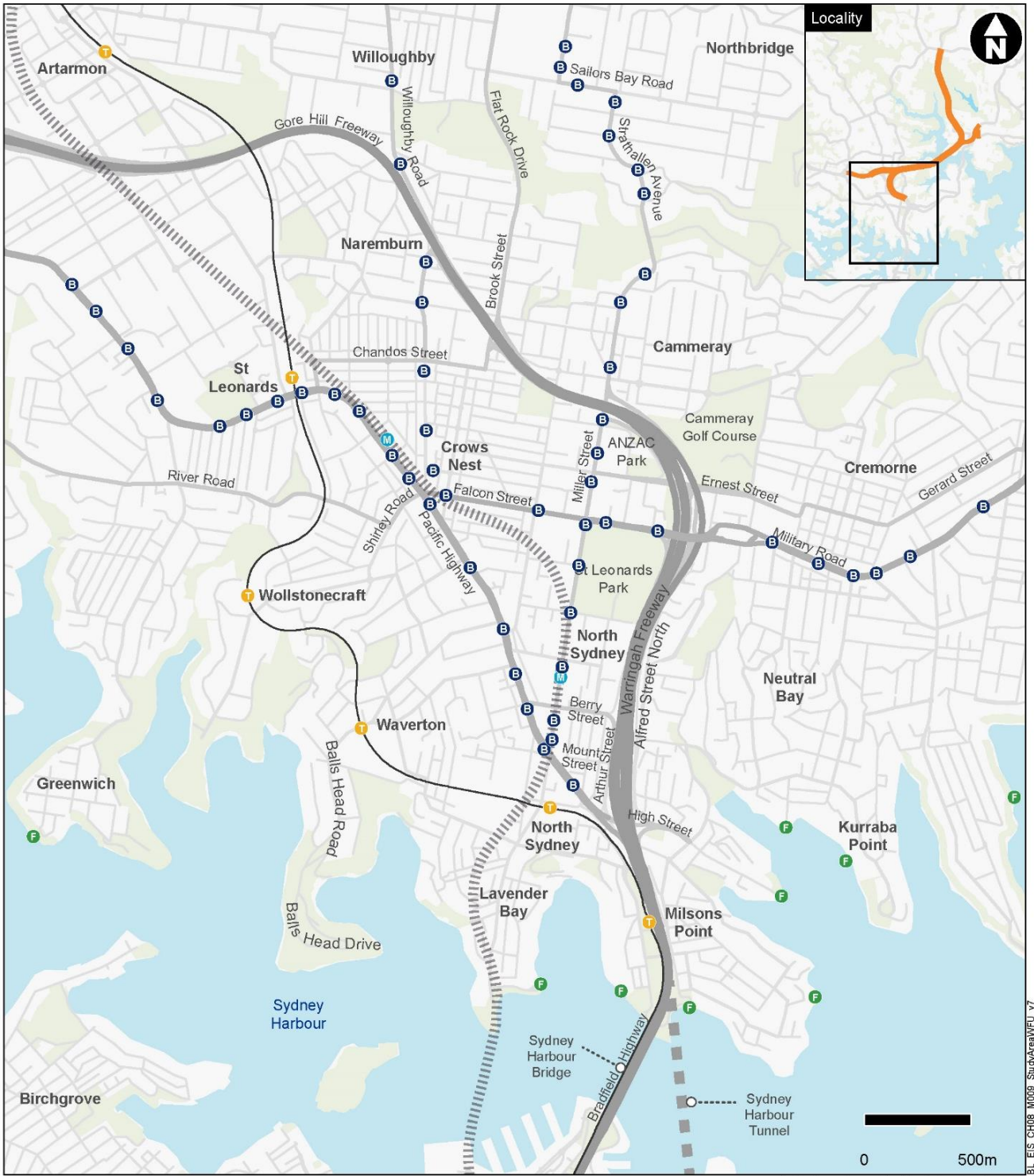
Public transport network

The Warringah Freeway and surrounds area is readily accessible via public transport.

Heavy rail services are provided at Milsons Point, North Sydney, Waverton and Wollstonecraft railway stations, which are located on the T1 North Shore and Western Line and T9 Northern Line. A new station as part of Sydney Metro City & Southwest is under construction in North Sydney (Victoria Cross station) and is expected to be operational in 2024.

The Warringah Freeway and surrounds area is a major thoroughfare for buses including services operating along the Warringah Freeway, Military Road, Miller Street and the Pacific Highway.

The area is also serviced by ferry, with ferry wharves located at McMahons Point, Milsons Point, Kirribilli, North Sydney, Neutral Bay and Kurraba Point.



Indicative only – subject to design development

Legend

Road classification

- Motorway
- Major arterial road
- Sub-arterial road
- Collector road
- Local road

Public transport infrastructure

- Heavy rail
- Tunnel
- ||| M ||| Sydney Metro City & Southwest – Chatswood to Sydenham (under construction)
- T Train stations
- F Ferry wharves
- B Bus stops on key routes

Figure 8-4 Transport network within the Warringah Freeway and surrounds area

Active transport network

The pedestrian network in the Warringah Freeway and surrounds area is well developed, with footpaths along most roads and controlled crossings at signalised intersections. Pedestrians are prohibited from walking along the Warringah Freeway. Significant pedestrian activity associated with retail and commercial activities occurs within the North Sydney CBD, including in the vicinity of several schools located west of the Pacific Highway and along Miller Street. Balls Head Reserve and other parks and reserves in the area are also associated with high levels of pedestrian activity.

The cycle network in the Warringah Freeway and surrounds area consists mostly of on-road cycle routes on local, collector and sub-arterial roads.

The Warringah Freeway presents a significant barrier to east–west movements for pedestrians and cyclists, with crossings available at select locations. Based on pedestrian and cyclist surveys carried out for the project, Mount Street was identified as the most used crossing for pedestrians due to its proximity to North Sydney CBD, while West Street was the most used crossing for cyclists. The Falcon Street underpass was identified as being under-utilised by pedestrians and cyclists during the week and on weekends.

Existing road performance

Road network performance

The Warringah Freeway is the busiest section of motorway in NSW. Congestion and delays are highest during the AM peak period, particularly for southbound traffic with queues extending as far north as the Miller Street interchange. During the PM peak, queuing and congestion is frequently observed on the northbound off ramp to Falcon Street eastbound.

Queuing and congestion are also frequently observed on connecting roads within the North Sydney CBD area, to the west of the Warringah Freeway.

Intersection performance

Modelled intersection performance under 2016 travel demands is provided in Table 8-6. The assessment indicates that the following intersections perform at an unsatisfactory level of service (LoS E or F) during the AM peak:

- Mount Street and Arthur Street
- High Street and Clark Road
- High Street and Alfred Street North.

The assessment also indicates that the Miller Street and Falcon Street intersection performs at an unsatisfactory level of service during the PM peak.

The intersection of Mount Street and Arthur Street is the primary western access to the Warringah Freeway, where traffic heading to the Sydney Harbour Bridge (Bradfield Highway) and Cahill Expressway lanes converges from Berry Street and Pacific Highway during the AM peak.

The intersection of Clark Road and High Street is the primary eastern access to the Sydney Harbour Bridge Cahill Expressway lane where traffic from Kirribilli and Neutral Bay converge. Queues from the intersection of High Street and Alfred Street North occasionally extend back through this intersection.

Table 8-6 Modelled intersection performance in the Warringah Freeway and surrounds area (AM and PM peaks in 2016)

Intersection	AM peak (8am 9am) LoS (average delay in seconds)	PM peak (5pm 6pm) LoS (average delay in seconds)
Willoughby Road/Gore Hill Freeway interchange	A (11)	B (20)
Brook Street/Warringah Freeway on ramp	C (31)	B (16)
Brook Street/Warringah Freeway off ramp	C (30)	B (22)
Brook Street/Merrenburn Avenue	C (31)	A (12)
Amherst Street/West Street	A (6)	A (10)
Amherst Street/Miller Street	B (19)	B (15)
Miller Street/Warringah Freeway on ramp	A (<5)	A (6)
Miller Street/Warringah Freeway off ramp	A (13)	A (13)
Miller Street/Ernest Street	C (34)	C (31)
Miller Street/Falcon Street	C (35)	E (69)
Ernest Street/Warringah Freeway on ramp	A (<5)	B (15)
Ernest Street/Warringah Freeway off ramp (off ramp in PM, on ramp in AM)	A (<5)	B (18)
Falcon Street/Warringah Freeway ramps (off ramp in PM, on ramp in AM)	C (38)	D (46)
Watson Street/Military Road	B (16)	C (29)
Military Road/Ben Boyd Road	A (13)	B (20)
Falcon Street/Merlin Street	B (17)	C (38)
Berry Street/Walker Street	C (32)	D (50)
Berry Street/Miller Street	C (30)	B (27)
Mount Street/Arthur Street	F (84)	C (32)
Mount Street/Walker Street	D (43)	C (31)
Pacific Highway/High Street/Arthur Street	D (53)	B (19)
Pacific Highway/Walker Street/Blue Street	D (53)	D (48)
Pacific Highway/Miller Street/Mount Street	D (52)	C (41)
Pacific Highway/Berry Street	A (9)	A (11)
Pacific Highway/Bay Road	B (21)	B (14)

Intersection	AM peak (8am 9am) LoS (average delay in seconds)	PM peak (5pm 6pm) LoS (average delay in seconds)
Miller Street/McLaren Street	B (24)	B (17)
Miller Street/Ridge Street	C (39)	B (26)
Miller Street/Carlow Street	B (14)	C (29)
High Street/Clark Road	F (>100)	C (36)
High Street/Alfred Street North	E (60)	B (18)
Mount Street/Alfred Street North	B (24)	A (11)
Ernest Street/Ben Boyd Road	A (11)	B (16)
Pedestrian crossing at Military Road	A (<5)	B (20)

Note: Cells shaded in dark grey denote an unsatisfactory LoS E or F

8.3.3 Gore Hill Freeway and Artarmon

Description

Transport network

The existing transport network within the Gore Hill Freeway and Artarmon area is shown in Figure 8-5 and includes the suburbs of Artarmon, Crows Nest, St Leonards, Cammeray, Lane Cove, Naremburn and Willoughby.

Traffic volumes and patterns

A summary of existing peak hour traffic volumes for the Gore Hill Freeway and Artarmon area in the AM peak (between 7am and 9am on a normal working weekday) and PM peak (between 4pm and 6pm on a normal working weekday) is provided in Table 8-7.

Table 8-7 Existing (2016) peak hour traffic volumes – Gore Hill Freeway and Artarmon

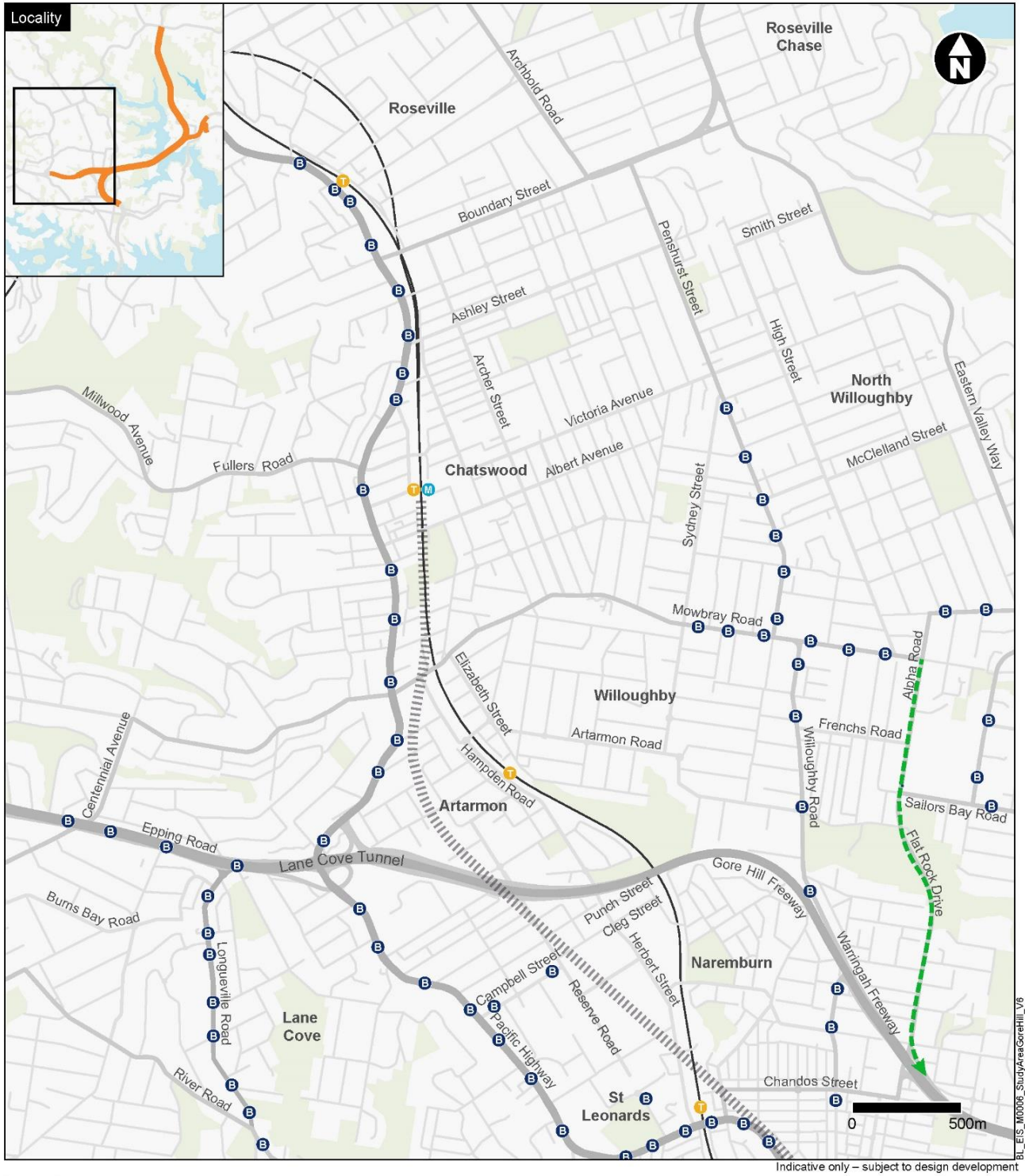
Road	Direction	AM peak		PM peak	
		Volume (vehicles)	Heavy vehicle percentage	Volume (vehicles)	Heavy vehicle percentage
Gore Hill Freeway and Artarmon					
Reserve Road north of Dickson Avenue	Northbound	520	8%	1140	1%
	Southbound	1210	3%	610	2%
Reserve Road north of Frederick Street	Northbound	320	10%	670	3%
	Southbound	690	3%	490	1%
Frederick Street east of Reserve Road	Eastbound	440	5%	560	1%
	Westbound	360	8%	420	5%
Herbert Street north of Frederick Street	Northbound	250	3%	440	1%
	Southbound	530	3%	500	2%
Cleg Street east of Herbert Street	Eastbound	110	1%	190	1%
	Westbound	120	2%	180	2%

Road	Direction	AM peak		PM peak	
		Volume (vehicles)	Heavy vehicle percentage	Volume (vehicles)	Heavy vehicle percentage
Dickson Avenue east of Reserve Road	Eastbound	250	3%	150	0%
	Westbound	130	5%	30	2%
Reserve Road south of Barton Road	Northbound	350	3%	640	1%
	Southbound	470	2%	410	1%

Public transport network

The Gore Hill Freeway and Artarmon area is highly accessible by public transport. Heavy rail services are provided at Artarmon and St Leonards railway stations, which are located on the T1 North Shore and T9 Northern Lines. A new station as part of Sydney Metro City & Southwest is under construction in Crows Nest and is expected to be operational in 2024 (refer to Figure 8-4).

The Gore Hill Freeway and Artarmon area is also a major thoroughfare for buses, including services operating along the Warringah Freeway, Gore Hill Freeway/Lane Cove Tunnel and the Pacific Highway.



Legend	
Road classification	Public transport infrastructure
— Motorway	— Heavy rail
— Major arterial road	— Sydney Metro City & Southwest – Chatswood to Sydenham (under construction)
— Sub-arterial road	— Train stations
— Collector road	— Bus stops on key routes
— Local road	— Bus route

Figure 8-5 Transport network within the Gore Hill Freeway and Artarmon area

Active transport network

The pedestrian network in the Gore Hill Freeway and Artarmon area is well developed, with footpaths alongside most roads and controlled crossings at most signalised intersections. Pedestrians are prohibited from walking along the Gore Hill Freeway and through the Lane Cove Tunnel. However, a shared user path is provided adjacent to the southern side of the Gore Hill Freeway. High pedestrian activity occurs along Hampden Road within the vicinity of Artarmon railway station, around the commercial area of Artarmon, and around the health, educational and commercial land uses in St Leonards.

The cycle network in the Gore Hill Freeway and Artarmon area consists of a mix of off-road shared user paths and on-road cycle routes on local and collector roads.

Based on pedestrian and cyclist surveys carried out for the project, the shared user path adjacent to the southern side of the Gore Hill Freeway near Hampden Road in Artarmon was identified as being used by a high number of cyclists during the week, with lower volumes recorded on weekends. This can be attributed to the path forming part of a regional cycle route connecting Naremburn, Lane Cove and Macquarie Park, with the majority of cyclists likely to be commuting to and from work. Pedestrian volumes were low both during the week and at weekends.

Existing road performance

Road network performance

The Gore Hill Freeway connects the M2 Motorway corridor with the M1 Motorway corridor through Artarmon and Willoughby. Traffic volumes are highest heading southbound in the AM peak and northbound in the PM peak, as a result of trips heading into and out of the Sydney CBD as well as local traffic from Lane Cove and Ryde.

Most traffic on Reserve Road travels to and from the Gore Hill Freeway, limiting capacity for the off ramps that often operate at or close to capacity during the AM peak.

The intersection of Longueville Road and Epping Road is the primary surface road constraint in the corridor due to the high volumes of traffic travelling to and from Lane Cove and Riverview.

Bus priority is provided on Epping Road west of Longueville Road in the form of signal priority for westbound traffic at Longueville Road and continuous bus lanes on Epping Road. Signal priority for buses is also provided for eastbound buses on Longueville Road at Pacific Highway, while eastbound buses on the Gore Hill Freeway use the 24-hour T2 transit lane that extends to Willoughby Road.

Intersection performance

Modelled intersection performance under 2016 travel demands is provided in Table 8-8. The assessment indicates that the intersection of Epping Road, Longueville Road and Parklands Avenue is currently performing at an unsatisfactory level of service (LoS E) in the PM peak. This intersection has limited capacity due to the high volume of westbound traffic that conflicts with right turn traffic from Longueville Road south. Delays on the eastern approach of this intersection are also exacerbated by buses stopping at the Lane Cove interchange, which block traffic turning left into Longueville Road.

Table 8-8 Modelled intersection performance in the Gore Hill Freeway and Artarmon area (AM and PM peaks in 2016)

Intersection	AM peak (8am 9am) LoS (average delay in seconds)	PM peak (5pm 6pm) LoS (average delay in seconds)
Epping Road/Longueville Road/Parklands Avenue	D (48)	E (63)
Longueville Road/Pacific Highway	C (42)	C (36)
Pacific Highway/Howarth Road/Norton Lane	A (7)	A (7)
Pacific Highway/Gore Hill Freeway interchange	B (23)	B (23)
Reserve Road/Gore Hill Freeway interchange	D (47)	C (29)
Reserve Road/Dickson Road	A (14)	B (19)
Reserve Road/Barton Road	A (11)	A (6)

Note: Cells shaded in dark grey denote an unsatisfactory LoS E or F

8.3.4 Northbridge to Seaforth (Middle Harbour crossing)

The project includes the crossing of Middle Harbour, extending from Northbridge in the south to Seaforth Bluff in the north. Construction of the project would also involve navigation through the outer part of Sydney Harbour (referred to as the Outer Harbour). These areas are described as follows:

- Outer Harbour is a wide waterway between Sydney Heads, the Opera House at Bennelong Point and Admiralty House at Kirribilli Point
- Middle Harbour borders the western side of the Outer Harbour, extending west of Middle Head and Grotto Head.

The Outer Harbour is relatively deep and wide, with water depths generally exceeding 20 metres below chart datum (the zero-reference point from which tidal heights and chart soundings are calculated) between South Head and North Head, decreasing to eight metres chart datum between Grotto Point and Middle Head.

The water depths in Middle Harbour are highly variable, ranging from three metres chart datum at the sand bar at the entrance to Middle Harbour, up to 26 metres chart datum on the eastern side of the Spit Bridge. Upstream of the Spit Bridge, the water depths are more than 20 metres chart datum with depths decreasing towards the heads of each of the bays off the main Middle Harbour channel. The depth of the channel at the proposed crossing location is particularly deep, up to 32 metres chart datum at its deepest point.

The entrance to Middle Harbour is about 750 metres wide, decreasing to a waterway width of about 165 metres at the Spit Bridge. Upstream of the Spit Bridge, the width of the waterway is generally about 400 metres, decreasing towards the heads of each of the bays of the main Middle Harbour channel. At the location of the proposed harbour crossing, the navigation width between the headland at Northbridge and the existing moorings and jetties near Seaforth Bluff is about 350 metres.

Spit Bridge (refer to Figure 8-6), spans 227 metres across Middle Harbour, connecting Mosman and Seaforth. When closed, the bridge presents a barrier to boats with heights greater than five or six metres above the water level (depending on tides). Clearance height under the bridge when closed is as follows:

- 4.7 metres at highest astronomical tide under the opening span
- 5.7 metres at highest astronomical tide under the first fixed span at the northern end.

Spit Bridge has scheduled daily openings to allow boats that are above the clearance height to pass through. When the bridge is open, the navigational channel between the piers of the lifting span is 24.3 metres wide. Current scheduled bridge opening times are listed in Table 8-9.

Table 8-9 Current Spit Bridge scheduled opening times

Weekday	Weekends and public holidays
10.15 am	8.30 am
11.15 am	10.00 am
1.15 pm	11.30 am
2:15 pm	2.30 pm
8.15 pm	4.30 pm
9.15 pm (during daylight saving only)	6.30 pm
	8.30 pm
	9.30 pm

Source: Transport for NSW (2019)

Users of Middle Harbour can be divided into three main groups: recreational users, community groups and clubs; commercial operators; and government organisations. Middle Harbour and the Outer Harbour are also used for recreational purposes, as well as some private uses. These are discussed in detail below and shown in Figure 8-6.

Recreational users, community groups and clubs

Middle Harbour supports a wide range of water based recreational activities. Key community groups and clubs using Middle Harbour include:

- Paddle craft users and clubs
- Recreational fishers
- Sailing and yacht clubs
- Scout and guide clubs
- Marine Rescue NSW.

Mosman Rowing Club, Northbridge Sailing Club, and two sea scout groups regularly use the waterway upstream of Spit Bridge, regularly traversing the location of the proposed Middle Harbour crossing. Marine Rescue NSW has its base for Middle Harbour located at The Spit.

Several boat storage and boat launching facilities are located in Middle Harbour that provide storage for recreational seagoing vessels. These include:

- Marina facilities
- Boat ramps
- Moorings.

Commercial marina facilities generally offer a wide range of premium services for the boating community, while boat ramp facilities attract smaller craft, typically from a larger geographical area.

The boat ramps in Middle Harbour are generally in good condition attracting a range of users that would navigate through all parts of Middle Harbour and the Outer Harbour. These vessels are typically not registered with a community group or club. The sand ramp used for informal launching in Clontarf Reserve is infrequently used, with users limited to surfboat rowers from nearby surf lifesaving clubs and other small craft.

In addition to marinas and boat ramps, numerous mooring fields are located throughout Middle Harbour. These include commercially and privately leased moorings with defined areas for vessels registered with a club or marina. Key facilities are outlined in Table 8-10. Recreational vessels which use these facilities would use the waterway upstream and downstream of Spit Bridge.

Table 8-10 Marinas, boat ramps and mooring fields within Middle Harbour

Facility	Location
Marinas	<ul style="list-style-type: none"> • Middle Harbour Yacht Club in Mosman • Smiths Boatshed Marina in Mosman • Fergusons Boat Shed in Mosman • D'Albora Marina in Mosman • Cammeray Marina in Cammeray • Northbridge Marina in Northbridge • Castlecrag Marina in Castlecrag • Roseville Bridge Marina in Roseville • Clontarf Marina in Clontarf.
Boat ramps	<ul style="list-style-type: none"> • Tunks Park boat ramp in Cammeray • Roseville Bridge boat ramp in Killarney Heights • An informal sand ramp at Clontarf Reserve in Clontarf.
Mooring fields	<ul style="list-style-type: none"> • Fisher Bay • Sandy Bay • The Spit • Pearl Bay • Beauty Point • Quakers Hat Bay • Long Bay • Willoughby Bay • Salt Pan Creek • Northbridge • Sailors Bay • Castlecrag • Pickering Point • Powder Hulk Bay • Seaforth.

Most of the yachts in the marinas around Spit Bridge (particularly Middle Harbour Yacht Club) and in the nearby mooring fields are used for racing and are registered with Middle Harbour Yacht Club. They are used around once a week on average, with most of the activity occurring downstream of Spit Bridge.

Other moored vessels, including motor cruisers and cruising yachts, are used less frequently and typically do not belong to a community group or club. These vessels travel upstream and downstream of Spit Bridge.

Three houseboats with permanent land access are located near the head of Pearl Bay. Several private jetties, pontoons and mooring pens are located at private residences on the foreshore of Seaforth Bluff, Long Bay and Sailors Bay.

Commercial operations within Middle Harbour

Most businesses that conduct commercial operations in Sydney Harbour are located in the Inner Harbour (ie the area between Outer Harbour and Parramatta River), particularly around The Bays and Darling Harbour. Vessels associated with commercial operations transit the Outer Harbour, and do not typically enter Middle Harbour. Access to Middle Harbour for deep draft vessels is restricted by water depth over the sand bar at the entrance to Middle Harbour.

A limited number of commercial operators are located in or navigate through Middle Harbour as summarised below.

Water taxis and charter companies

Several water taxi companies operate within Sydney Harbour, with some operators providing private harbour tours and charter services. A limited number of yacht charter and boat hire companies are located in Middle Harbour, including:

- Champagne Sailing in Clontarf, with pick up locations including Balmoral, Clontarf and Middle Harbour Yacht Club
- Eco Boats Hire in Northbridge.

Vessels from charter companies further afield may also enter Middle Harbour.

Jungle Float mobile water park

Jungle Float is a floating mobile waterpark that is about 11 metres long and three metres wide and can accommodate groups of up to 40 people. It is anchored about 20 metres off Clontarf Beach when in use. The Jungle Float allows participants to swing, dive, jump and/or slide into the water. Participants are required to swim to the floating waterpark from Clontarf Beach.

Government operations within Middle Harbour

Royal Australian Navy

HMAS Penguin, an Australian Defence Force facility, is located at Balmoral in Middle Harbour. Its primary purpose is to provide trained personnel to the fleet. A naval water exclusion zone is established around the facility. The navy also operates facilities in the Inner Harbour and Outer Harbour, but vessels from these facilities rarely enter Middle Harbour.

Water Police, Transport for NSW, and Department of Planning, Industry and Environment (Regions, Industry, Agriculture & Resources)

The NSW Police Marine Area Command, Transport for NSW, and the Department of Planning, Industry and Environment (Regions, Industry, Agriculture & Resources) are located in the Inner Harbour and require access to the waterway to perform their duties. Transport for NSW is the owner of several seawall assets in Sydney Harbour and is responsible for managing seabed leases, which may be held by private leases or commercial organisations such as marinas.

Navigation restrictions

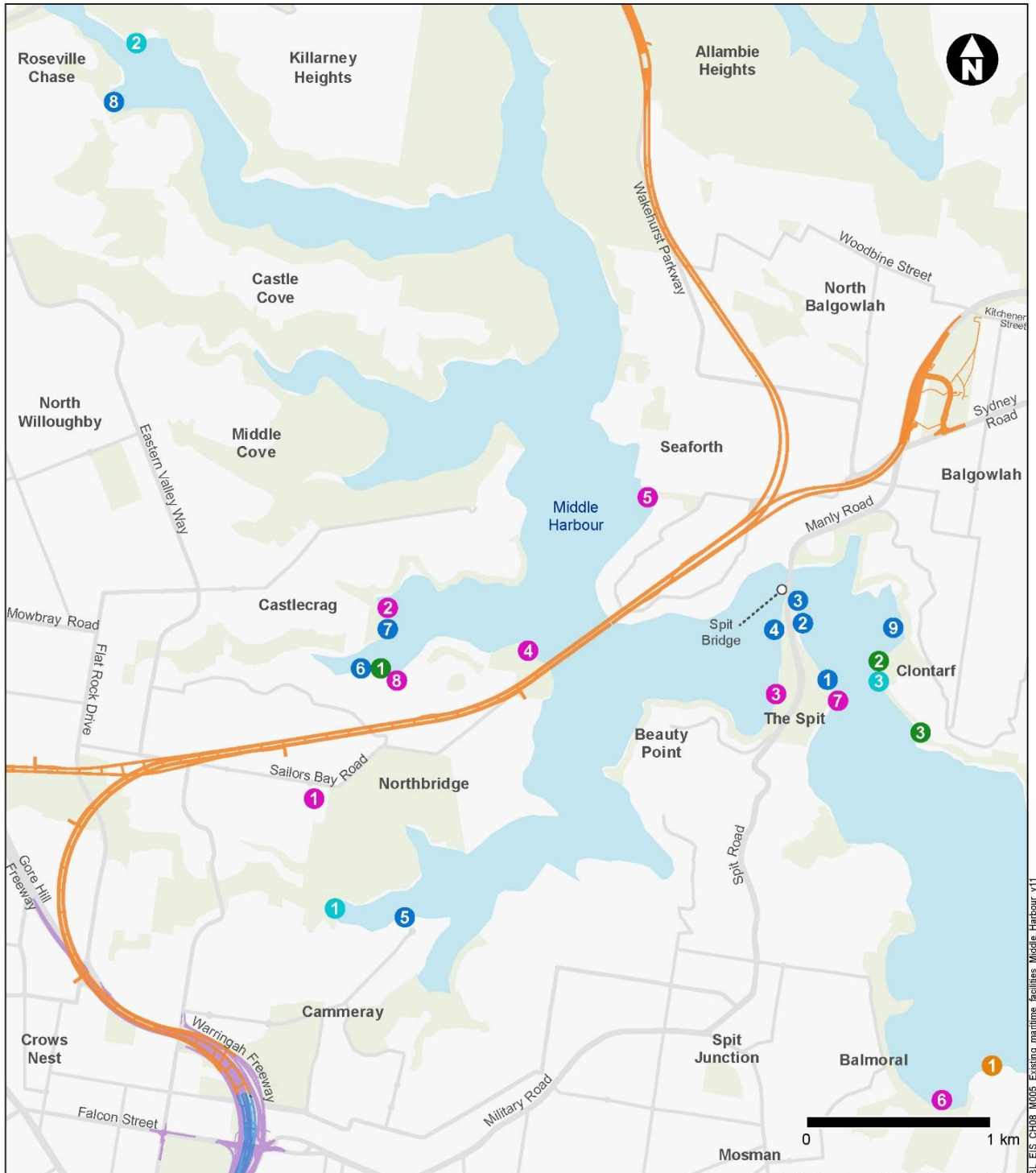
Relevant navigation restrictions within Middle Harbour include:

- An exclusion zone around the HMAS Penguin at Balmoral
- A four knots zone between Clontarf Point and Parriwi Point extending upstream to D'Albora Marina and the eastern end of Peach Tree Bay, including the area around Spit Bridge
- Vessels traveling at more than six knots are required to maintain 30 metres from all vessels, land or structures (including moorings)
- A speed limit of 12 knots is imposed on vessels exceeding 30 metres in length when navigating within Middle Harbour
- Spit Bridge when closed presents a barrier to boats with heights greater than five or six metres above the water level (depending on tides). Passage of boats that are above the clearance height is restricted to scheduled daily bridge openings (see Table 8-9).

Additional restrictions may be imposed by an aquatic event such as a race, competition or exhibition. An aquatic licence issued by Transport for NSW may be required for organised activities on navigable waters that restrict the availability of those waters for normal use by the public. Transport for NSW may elect to establish an exclusion zone around the activity.

The shallow depth at the entrance to Middle Harbour limits the type of vessels that can navigate through the harbour, restricting the passage of larger vessels. Vessels that transit through Middle Harbour, including at the location of the proposed crossing, would generally be up to 25 metres in length. However, most vessels would be less than 10 metres in length.

Access under Spit Bridge has limited width clearance. Vessels wider than 24 metres are unable to navigate between the bridge piers due to the fixed fender protection.



Legend

Operational features

Beaches Link

Connecting projects

Western Harbour Tunnel
Warringah Freeway Upgrade

Boat launching facilities

- 1 Tunks Park, Cammeray
- 2 Roseville Bridge, Killarney Heights
- 3 Clontarf Reserve sand ramp, Clontarf

Community groups and clubs

- 1 Northbridge Sea Scouts
- 2 Sailors Bay Sea Scouts
- 3 Mosman Rowing Club
- 4 Northbridge Sailing Club
- 5 Seaforth Sailing Club
- 6 Balmoral Sailing Club
- 7 Middle Harbour Amateur Sailing Club
- 8 Northbridge Baths

Commercial operators

- 1 Eco Boat Hire Sydney
- 2 Jungle Float Mobile Water Park
- 3 Champagne Sailing Sydney

Government organisations

- 1 H.M.A.S Penguin

Private and commercial marinas

- 1 Middle Harbour Yacht Club, The Spit
- 2 Smiths Boatshed Marina, The Spit
- 3 Fergusons Boat Shed, The Spit
- 4 D'Albora Marina, The Spit
- 5 Cammeray Marina, Cammeray
- 6 Northbridge Marina, Northbridge
- 7 Castlecrag Marina, Castlecrag
- 8 Roseville Bridge Marina, Roseville
- 9 Clontarf Marina, Clontarf

Indicative only – subject to design development

Figure 8-6 Existing maritime facilities in Middle Harbour near the project

8.3.5 Balgowlah and surrounds

Description

Transport network

The existing transport network within the Balgowlah and surrounding areas is shown in Figure 8-7 and includes the suburbs of Balgowlah, Mosman, North Balgowlah and Seaforth.

Traffic volumes and patterns

A summary of existing peak hour traffic volumes for Balgowlah and surrounds in the AM peak (between 7am and 9am on a normal working weekday) and PM peak (between 4pm and 6pm on a normal working weekday) is provided in Table 8-11.

Table 8-11 Existing (2016) peak hour traffic volumes – Balgowlah and surrounds

Road	Direction	AM peak		PM peak	
		Volume (vehicles)	Heavy vehicle percentage	Volume (vehicles)	Heavy vehicle percentage
Balgowlah and surrounds					
Spit Road south of Parriwi Road	Northbound	1280	11%	2670	6%
	Southbound	2780	7%	1610	7%
Manly Road south of Sydney Road	Northbound	1540	8%	3050	5%
	Southbound	2760	11%	1650	6%
Sydney Road east of Manly Road	Eastbound	460	8%	1010	4%
	Westbound	940	7%	750	6%
Burnt Bridge Creek Deviation west of Condamine Street	Northbound	970	7%	1790	7%
	Southbound	1350	13%	1050	6%

Public transport network

The Balgowlah and surrounds area includes major bus corridors along Spit Road/Manly Road, Sydney Road and Burnt Bridge Creek Deviation.

Balgowlah and surrounds are also served in part by the Northern Beaches B-Line bus service, which provides a high capacity, limited stops service to Sydney CBD.



Indicative only – subject to design development

Legend	
Road classification	Public transport infrastructure
Motorway	Bus stops on key routes
Major arterial road	Ferry wharf
Sub-arterial road	B-Line
Collector road	
Local road	

Figure 8-7 Transport network within Balgowlah and surrounds

Active transport network

The pedestrian network in the Balgowlah and surrounds area is well developed with footpaths along most roads and controlled crossings at most signalised intersections. Significant pedestrian activity occurs along Spit West Reserve, around the marinas at the southern end of Spit Bridge, and within the vicinity of the Balgowlah and Manly Vale local town centres on Sydney Road and Condamine Street.

The cycle network in the area consists of a mixture of off-road shared user paths and on-road cycle routes on local and collector roads. Based on pedestrian and cyclist surveys carried out for the project, the shared user path adjacent to the eastern side of Burnt Bridge Creek Deviation near Kitchener Street was identified as being used by a moderate number of pedestrians and cyclists both during weekdays and on weekends. These volumes are attributed to the shared user path providing links to The Spit cycle route, and to the Northern Beaches, accommodating commuter cyclists on weekdays and recreational users on weekends.

Existing road performance

Road network performance

Military Road, Spit Road, Manly Road, Burnt Bridge Creek Deviation, Condamine Street and Pittwater Road form the primary arterial road corridor between the Northern Beaches and Sydney CBD. Traffic volumes along these roads are highest heading southbound in the AM peak and northbound in the PM peak as a result of commuters travelling between the Northern Beaches and the Sydney CBD. Sydney Road also carries high traffic volumes providing access to Balgowlah and Manly.

The primary constraint for southbound traffic is the Spit Bridge, which frequently causes queues extending from the bridge to the intersection of Manly Road and Sydney Road. This also results in southbound queues on Burnt Bridge Creek Deviation and eastbound and westbound queues on Sydney Road.

Bus priority is provided at the intersection of Manly Road/Burnt Bridge Creek Deviation/Sydney Road, with bus lanes provided in both directions on Burnt Bridge Creek Deviation, southbound bus lanes provided on Manly Road, and westbound bus lanes provided on Sydney Road.

Intersection performance

Modelled intersection performance under 2016 travel demands is provided in Table 8-12. The assessment indicates that most intersections within the Balgowlah and surrounds area currently perform at a satisfactory level of service. The Frenchs Forest Road and Sydney Road intersection currently performs poorly during the PM peak, particularly on the western approach.

Table 8-12 Modelled intersection performance in the Balgowlah and surrounds area (AM and PM peaks in 2016)

Intersection	AM peak (8am 9am) LoS (average delay in seconds)	PM peak (5pm 6pm) LoS (average delay in seconds)
Sydney Road/Manly Road/Burnt Bridge Creek Deviation	D (52)	D (44)
Frenchs Forest Road/Sydney Road	B (19)	F (>100)
Sydney Road/Condamine Street	B (20)	B (24)
Condamine Street/Burnt Bridge Creek Deviation	B (28)	B (19)
Sydney Road/Maretimo Street	A (9)	A (9)

Note: Cells shaded in dark grey denote an unsatisfactory LoS E or F

8.3.6 Frenchs Forest and surrounds

Description

Transport network

The existing transport network within the Frenchs Forest and surrounds area is shown in Figure 8-8 and includes the suburbs of Frenchs Forest, Killarney Heights and Seaforth.

Traffic volumes and patterns

In 2015, Transport for NSW commenced construction on the Northern Beaches Hospital road upgrade project which affected traffic conditions near the Northern Beaches Hospital. Construction works on the Northern Beaches Hospital road upgrade project were completed in August 2020. Permanent traffic counts on Warringah Road at Beacon Hill indicate that there was a substantial reduction in traffic volumes in 2016 by up to 17 per cent over the average weekday, indicating that construction activities in Frenchs Forest substantially reduced traffic volumes during the peak construction period. As a result, existing traffic volumes has been conservatively modelled based on 2012 pre-construction levels. Permanent traffic count data shows that by 2017, daily traffic volumes returned to 2012 levels, indicating that traffic conditions have generally returned to preconstruction levels and that there has been negligible growth in peak period traffic volumes through the area. Since completion of the Northern Beaches Hospital road upgrade project, updated data unaffected by COVID-19 is not readily available to assess if the grade separation works have influenced traffic. Traffic data for 2012 was therefore considered suitable to model existing traffic volumes.

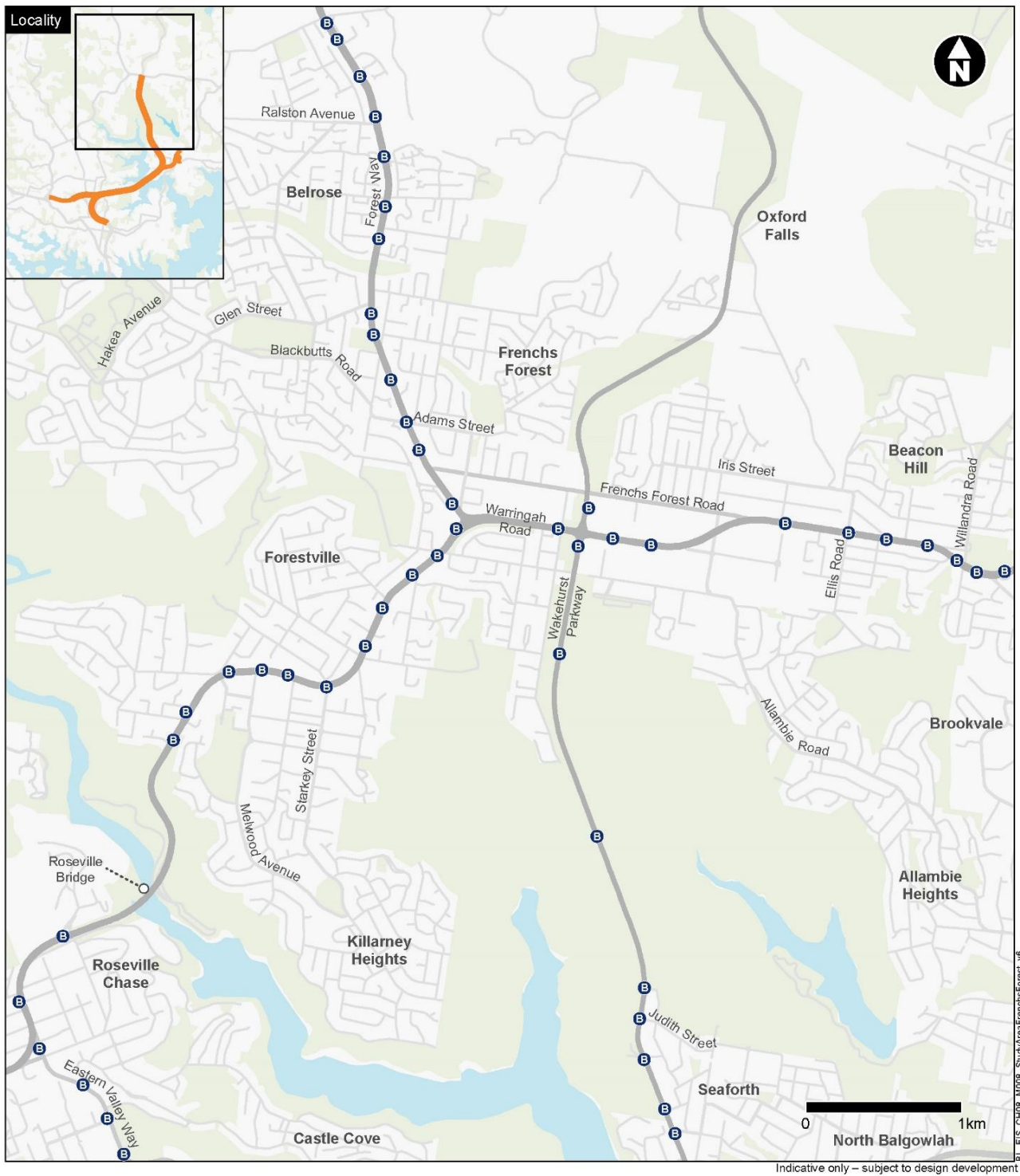
A summary of existing peak hour traffic volumes for Frenchs Forest and surrounds in the AM peak (between 7am and 9am on a normal working weekday) and PM peak (between 4pm and 6pm on a normal working weekday) is provided in Table 8-13.

Table 8-13 Existing (2016) peak hour traffic volumes – Frenchs Forest and surrounds

Road	Direction	AM peak		PM peak	
		Volume (vehicles)	Heavy vehicle percentage	Volume (vehicles)	Heavy vehicle percentage
Frenchs Forest and surrounds					
Wakehurst Parkway north of Burnt Street	Northbound	620	4%	680	4%
	Southbound	440	8%	670	2%
Wakehurst Parkway north of Judith Street	Northbound	830	3%	830	3%
	Southbound	580	6%	860	2%
Wakehurst Parkway north of Kirkwood Street	Northbound	860	2%	800	3%
	Southbound	540	7%	820	1%
Warringah Road west of Wakehurst Parkway	Eastbound	2320	6%	3430	2%
	Westbound	3080	4%	2820	2%
Warringah Road east of Wakehurst Parkway	Eastbound	1690	7%	2140	2%
	Westbound	1460	5%	2160	2%

Public transport network

The Frenchs Forest area is well served by buses, with Warringah Road and Forest Way being major bus corridors for services to Sydney CBD, Chatswood, Terrey Hills and Belrose. A number of bus routes also operate along the Wakehurst Parkway. As part of the recent Growth Services Program 2018-2019, several new and expanded services are now in operation and support the Northern Beaches Hospital. Further, a rapid bus service, similar in nature to that of the existing B-Line, is proposed between Dee Why and Chatswood and is anticipated to be operation before the project commences construction.



- Legend**
- | | |
|----------------------------|--|
| Road classification | Public transport infrastructure |
| — Motorway | Ⓟ Bus stops on key routes |
| — Major arterial road | |
| — Sub-arterial road | |
| — Collector road | |
| — Local road | |

Figure 8-8 Transport network within the Frenchs Forest area and surrounds

Active transport network

The pedestrian network in the Frenchs Forest area is limited with no footpaths alongside Wakehurst Parkway or on most local roads. However, footpaths are provided alongside other arterial roads and controlled crossings are provided at most signalised intersections. Significant pedestrian activity occurs around the Warringah Aquatic Centre, and in the vicinity of the Frenchs Forest local town centre on Warringah Road and Forest Way.

The cycle network in the Frenchs Forest area consists of a mixture of off-road shared user paths and on-road cycle routes on local and collector roads. The regional strategic cycle network provides connections between Frenchs Forest and surrounds and Balgowlah, Manly and Narrabeen. Off-road shared user paths are provided at the following locations:

- Karingal Crescent Reserve
- Shared pedestrian and cyclist bridge connecting Karingal Crescent Reserve and Forest Way
- Between Wakehurst Parkway north of Warringah Road and Frenchs Forest Road East, west of Inverness Avenue
- Shared pedestrian and cyclist bridge connecting Warringah Aquatic Centre and Bantry Bay Road
- Allambie Road between Aquatic Drive and Eaton Square
- Shared pedestrian and cyclist bridge across Warringah Road west of the intersection of Forest Way
- Shared pedestrian and cyclist bridge across Warringah Road on the western side of the intersection with Hilmer Street.
- Manly Dam Bike Tracks within Manly Dam Reserve, east of Wakehurst Parkway.

In addition, the Northern Beaches Hospital road upgrade project was completed in August 2020 and included upgrades for pedestrians and cyclists including shared user bridges at Hilmer Street and Forest Way, as well as the provision of shared user paths and footpaths on sections of Warringah Road, Wakehurst Parkway, Forest Way, Aquatic Drive and Allambie Road.

Existing road performance

Road network performance

Warringah Road and Forest Way carry high traffic volumes throughout the day, with Warringah Road providing a key route to and from North Sydney and the Sydney CBD via Eastern Valley Way. Wakehurst Parkway also forms an alternative north-south route to Pittwater Road, providing a sub-arterial connection between Narrabeen and Seaforth.

Warringah Road and Forest Way are also major bus corridors in the area. A southbound kerbside bus lane is provided on Wakehurst Parkway between Warringah Road and Frenchs Forest Road East and priority signalling for buses is provided westbound on Warringah Road east of Wakehurst Parkway and southbound on Forest Way north of Warringah Road.

The Northern Beaches Hospital road upgrade project, completed in August 2020, included the construction of three grade-separated underpasses on Warringah Road, allowing for traffic heading eastbound and westbound on Warringah Road to bypass the intersections of Wakehurst Parkway, Forest Way and Hilmer Street. The project also involved local road network upgrades and localised widening.

Intersection performance

Due to reductions in traffic volumes in 2016 associated with construction activities of the Northern Beaches Hospital road upgrade project, existing intersection performance has been conservatively modelled based on 2012 preconstruction levels.

The *Northern Beaches Hospital Stage 2 Network Enhancement Works environmental impact statement* (Roads and Maritime Services, 2015c) identifies that road network performance following the grade separation of Warringah Road would be slightly improved in the morning peak period when compared to 2012 road network performance. However, the assessment identified that road network performance would be slightly worse in the evening peak period when compared to 2012 road network performance due to additional traffic generated by the Northern Beaches Hospital. Overall, network performance at Frenchs Forest and surrounds would not be materially changed due to the Northern Beaches Hospital Stage 2 Network Enhancement Works. The use of 2012 for baseline conditions is therefore considered a reasonable proxy for current conditions with the Northern Beaches Hospital Stage 2 Network Enhancement Works operational.

Modelled intersection performance under 2012 travel conditions is provided in Table 8-14. The assessment indicates that several intersections within the Frenchs Forest and surrounds area currently perform at or above capacity.

Table 8-14 Modelled intersection performance in Frenchs Forest and surrounds (AM and PM peaks in 2012)

Intersection	AM peak (8am 9am) LoS (average delay in seconds)	PM peak (5pm 6pm) LoS (average delay in seconds)
Wakehurst Parkway/Frenchs Forest Road East	F (>100)	E (67)
Warringah Road/Allambie Road	E (65)	D (56)
Wakehurst Parkway/Warringah Road	F (>100)	D (48)
Warringah Road/Hilmer Street	E (58)	D (49)
Warringah Road/Forest Way	F (>100)	C (34)
Forest Way/Naree Road	A (>5)	A (7)
Warringah Road/Brown Street/Currie Road	F (70)	A (11)
Warringah Road/Starkey Street	C (37)	A (10)
Warringah Road/Darley Street	B (20)	B (22)
Warringah Road/Forestville Avenue	B (16)	B (28)

Note: Cells shaded in dark grey denote an unsatisfactory LoS E or F

8.4 Assessment of potential impacts

During construction, the project would affect the surrounding road network as a result of the following:

- Construction vehicles using the surface road network, especially heavy vehicles transporting spoil
- Surface road works requiring temporary traffic, cyclist and/or pedestrian diversions, road occupation and temporary road closures
- Temporary changes to speed limits.

Construction impacts related to maritime traffic and transport are discussed in Section 8.4.3.

Mitigation and management measures detailed in Section 8.5 would be implemented where appropriate during construction to reduce potential traffic and transport impacts during construction.

Details of construction activities and the location and timing of construction works, including temporary construction support site layouts and provision of construction worker parking, are presented in Chapter 6 (Construction work).

8.4.1 Warringah Freeway and surrounds

Road network impacts

The anticipated routes to and from the Cammeray Golf Course (BL1) and Flat Rock Drive (BL2) construction support sites within the Warringah Freeway and surrounds area are summarised in Chapter 6 (Construction work), along with the respective daily maximum construction vehicle volumes.

Intersection and midblock performance with construction traffic

The performance of intersections within the Warringah Freeway and surrounds area with the introduction of construction traffic would generally remain the same as conditions without the project. However, the following intersections would experience a change in level of service:

- Warringah Freeway/Brook Street interchange would worsen from LoS B to LoS C during the AM peak
- Brook Street/Merrenburn Avenue would worsen from LoS C to LoS D during the PM peak.

These impacts would be minor and both intersections would continue to operate satisfactorily during construction.

A new signalised intersection would also be provided for access to the Flat Rock Drive construction support site (BL2) and would operate at LoS A during construction.

The intersection performance results for the road network operating under the worst case construction traffic scenario (2024) during the AM and PM peak periods are summarised in Table 8-15.

Table 8-15 Modelled intersection performance in the Warringah Freeway and surrounds area (AM peak (8am-9am) and PM peak (5pm-6pm) during construction in 2024)

Intersection/ peak period	Base case 2024 (without construction traffic)				Construction case 2024 (with construction traffic)			
	Demand flow (vehicles per hour)	Average delay (seconds)	LoS	V/C	Demand flow (vehicles per hour)	Average delay (seconds)	LoS	V/C
Warringah Freeway/Falcon Street interchange								
AM peak	13,670	N/A*	F*	>1	14,140	N/A*	F*	>1
PM peak	14,000	N/A*	F*	>1	14,650	N/A*	F*	>1
Warringah Freeway/Ernest Street interchange								
AM peak	6410	N/A*	C*	0.60	6520	N/A*	C*	0.61
PM peak	5910	N/A*	D*	0.58	6060	N/A*	D*	0.60
Ernest Street/Merlin Street/BL1 construction support site access								
AM peak	2910	7	A	0.49	2980	8	A	0.49
PM peak	3220	9	A	0.78	3320	10	A	0.81

Intersection/ peak period	Base case 2024 (without construction traffic)				Construction case 2024 (with construction traffic)			
	Demand flow (vehicles per hour)	Average delay (seconds)	LoS	V/C	Demand flow (vehicles per hour)	Average delay (seconds)	LoS	V/C
Ernest Street/Miller Street								
AM peak	3290	20	B	0.65	3330	20	B	0.65
PM peak	3700	32	C	0.79	3700	32	C	0.79
Warringah Freeway/Miller Street interchange								
AM peak	5160	N/A*	C*	0.79	5200	N/A*	C*	0.81
PM peak	5270	N/A*	D*	0.89	5270	N/A*	D*	0.89
Warringah Freeway/Brook Street interchange								
AM peak	5240	N/A*	B*	0.82	5430	N/A*	C*	0.85
PM peak	6530	N/A*	C*	0.89	6730	N/A*	C*	0.89
Brook Street/Merrenburn Avenue								
AM peak	3340	92	F	>1	3460	>100	F	>1
PM peak	3240	40	C	>1	3380	47	D	>1
Flat Rock Drive/BL2 construction support site access								
AM peak	-				2590	5	A	0.56
PM peak	-				2770	5	A	0.67

Note: Cells shaded in dark grey denote an unsatisfactory LoS E or F

*Interchanges were modelled as a network, where level of service is based on speed efficiency (SIDRA level of service criteria for networks) and not average vehicle delay.

The midblock performance (level of service) during construction would be unchanged when compared to the performance under conditions without the project at all locations except for:

- Miller Street north of Ernest Street in the southbound direction, where midblock performance would reduce from LoS B to LoS C during the AM peak
- Ernest Street west of Merlin Street in the eastbound direction, where midblock performance would reduce from LoS B to LoS C during AM peak
- Falcon Street west of Merlin Street in the eastbound direction, where midblock performance would reduce from LoS D to LoS E during the PM peak
- Falcon Street west of Merlin Street in the westbound direction, where midblock performance would reduce from LoS B to LoS C during the PM peak
- Brook Street south of Merrenburn Avenue in the southbound direction, where midblock performance would reduce from LoS C to LoS D during the PM peak.

Almost all midblock locations listed above would continue to operate with spare capacity and at a satisfactory level of service during construction, except for Falcon Street west of Merlin Street in the eastbound direction during the PM peak. However, this section of road is already operating close to the LoS D/E threshold; the additional vehicles are not expected to cause any major additional capacity issues for this road during construction.

The midblock performance results for the road network operating under the worst case construction traffic scenario (2024) during the AM and PM peak are summarised in Table 8-16.

Table 8-16 Modelled midblock performance in the Warringah Freeway and surrounds area (AM peak (8am-9am) and PM peak (5pm-6pm) during construction in 2024)

Location/ direction	Capacity (PCU)	AM Peak						PM Peak					
		Base case 2024 (without construction traffic)			Construction 2024 (with construction traffic)			Base case 2024 (without construction traffic)			Construction 2024 (with construction traffic)		
		Volume (PCU)	V/C	LoS	Volume (PCU)	V/C	LoS	Volume (PCU)	V/C	LoS	Volume (PCU)	V/C	LoS
Miller Street north of Ernest Street													
Northbound ¹	900 (AM) 1900 (PM)	660	0.74	D	660	0.74	D	880	0.47	C	880	0.47	C
Southbound ²	2900 (AM) 1900 (PM)	1180	0.41	B	1220	0.42	C	1380	0.73	D	1380	0.73	D
Ernest Street east of Merlin Street													
Eastbound	1900	1250	0.66	D	1300	0.68	D	1580	0.83	E	1580	0.83	E
Westbound	1900	1030	0.54	C	1030	0.54	C	890	0.47	C	890	0.47	C
Ernest Street west of Merlin Street													
Eastbound	1900	780	0.41	B	820	0.43	C	2120	>1	F	2190	>1	F
Westbound	2900	2120	0.73	D	2170	0.75	D	1060	0.36	B	1120	0.39	B
Falcon Street west of Merlin Street													
Eastbound	3900	2590	0.67	D	2740	0.70	D	3140	0.80	D	3330	0.85	E
Westbound	5900	3520	0.60	D	3670	0.62	D	2370	0.40	B	2560	0.43	C
Brook Street south of Merrenburn Avenue													
Northbound	1900	900	0.48	C	990	0.52	C	1940	>1	F	2030	>1	F
Southbound	1900	2150	>1	F	2240	>1	F	1120	0.59	C	1210	0.64	D

Note: Cells shaded in dark grey denote an unsatisfactory LoS E or F

1: Miller Street north of Ernest Street in the northbound direction has a clearway in operation during the evening peak period only.

2: Miller Street north of Ernest Street in the southbound direction has a clearway in operation during the morning peak period only.

Impacts on local roads and parking

As part of the Western Harbour Tunnel and Warringah Freeway Upgrade project, the Ernest Street/Merlin Street intersection would be modified with the addition of a north approach allowing site access to the Cammeray Golf Course construction support site (BL1). This would be a secondary access point, with primary access for heavy vehicles to be provided directly to and from the Warringah Freeway. Up to 10 parking spaces on Ernest Street would be removed as part of the Western Harbour Tunnel and Warringah Freeway Upgrade project to provide suitable access to the Cammeray Golf Course construction support site (BL1), with access maintained while the construction support site is operational. Clearways operate on Ernest Street during peak periods; therefore, any closure of the kerbside lane associated with the Cammeray Golf Course construction support site (BL1) would only result in loss of parking outside peak periods. The availability of parking on nearby local roads such as Ernest Street (east of Merlin Street), Oaks Avenue and Park Avenue would also reduce the impact of losing these parking spaces outside of peak periods. As such, the overall impact would be considered negligible.

Car parking areas for construction workers would be provided at the Cammeray Golf Course (BL1) and Flat Rock Drive (BL2) construction support sites. Worker parking would be maximised within the constraints of the respective temporary construction support site. The number of car parking spaces would be determined during construction planning.

Where on-site parking is not provided or where provision of on-site parking cannot accommodate the full construction workforce, the workforce would be actively encouraged to avoid parking on the surrounding road network. To minimise the potential parking impacts on the surrounding road network, parking will be actively managed using the following mitigation measures:

- The construction workforce would be encouraged to use public transport where feasible, with key bus corridors including Pacific Highway, Warringah Freeway, Miller Street, Falcon Street and Military Road. In addition, the T1 North Shore and T9 Northern Lines are accessible from North Sydney, St Leonards and Waverton railway stations
- Where public transport availability to temporary construction support sites is limited, shuttle bus transfers may also be provided from public transport centres where required.

Impacts on public transport

In Cammeray, there are no bus routes that travel on Ernest Street in the vicinity of the Cammeray Golf Course construction support site (BL1) and therefore there would be negligible impacts to the bus network due to construction vehicles travelling to and from this site. The use of traffic signals for the Flat Rock Drive construction support site (BL2) access would impact buses that use Flat Rock Drive and Brook Street. This would increase bus travel times slightly as buses could be required to stop at the new traffic lights while construction vehicles access the site. Overall impacts would be negligible given that the intersection would generate an additional five seconds of delay on average.

No direct impacts on heavy rail services or ferry services are anticipated during construction.

Impacts on active transport

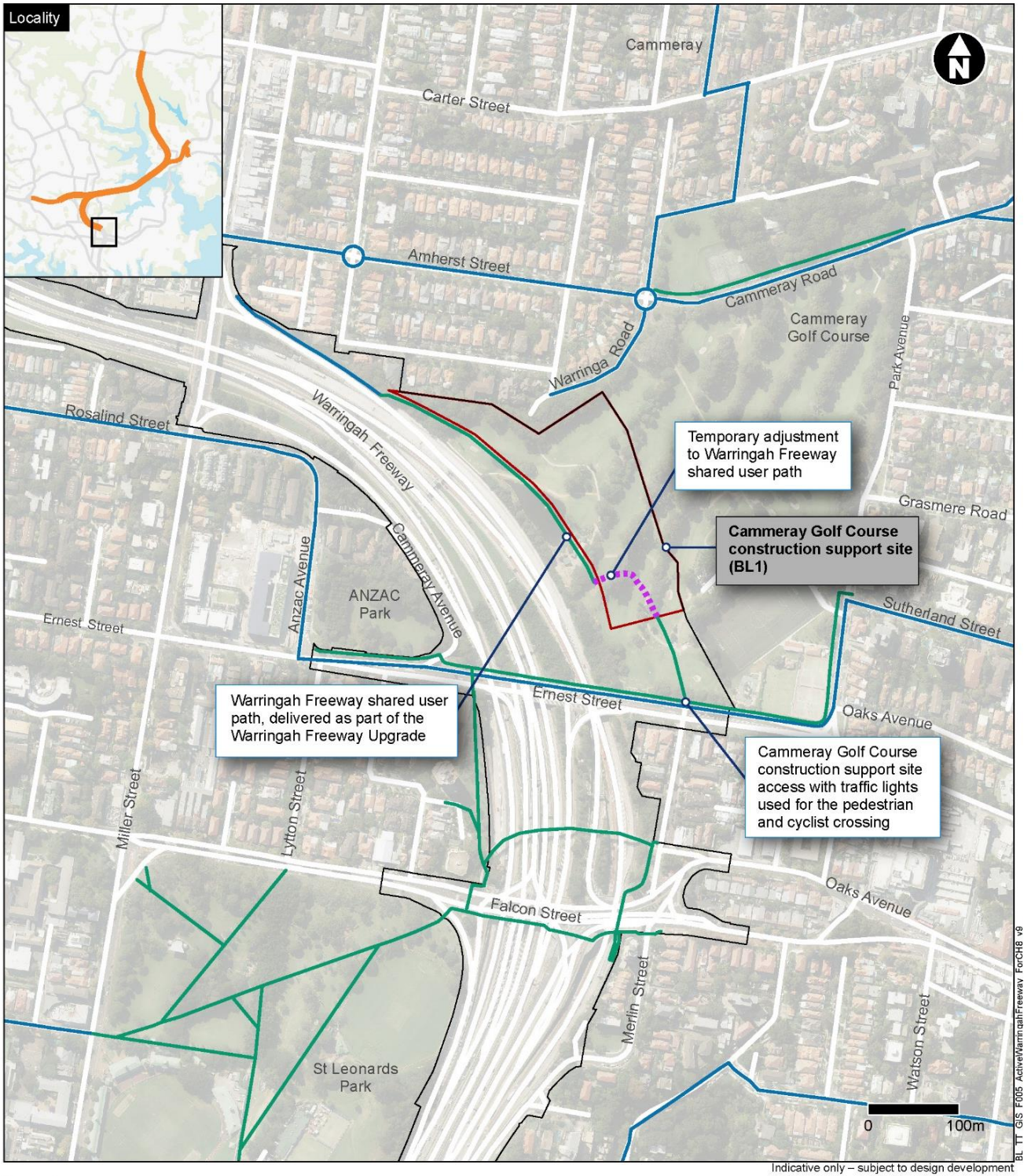
Potential impacts on the active transport network within the Warringah Freeway and surrounds area during construction are summarised in Figure 8-9. Potential impacts on active transport around Naremburn are summarised in Figure 8-10.

Conflicts between pedestrians and/or cyclists using the footpaths or shared user paths near the Cammeray Golf Course construction support site (BL1) and Flat Rock Drive construction support site (BL2) would be managed through traffic lights to control of movements at the site entry/exit.

The access arrangements at Cammeray Golf Course construction support site (BL1) would be established as part of the Western Harbour Tunnel and Warringah Freeway Upgrade project. The shared user path along Warringah Freeway near Cammeray Golf Course would be realigned to travel along the rear of the Cammeray Golf Course construction support site (BL1) until the Ernest Street/Merlin Street intersection as part of the Warringah Freeway Upgrade. Minor impacts to

pedestrians and cyclists are anticipated given that existing connectivity would be maintained and a short additional travel distance of up to 100 metres. In addition, heavy vehicles at the Cammeray Golf Course construction support site (BL1) would be directed to access the site directly to and from the Warringah Freeway.

The temporary adjustment of the Flat Rock Reserve shared user path (parallel to Flat Rock Drive, on the western side of the construction support site) would be required to accommodate the Flat Rock Drive construction support site (BL2). This path would be temporarily realigned along the western perimeter of the construction support site, resulting in an additional travel distance of up to 100 metres (refer to Figure 8-10). The existing walking tracks along the eastern perimeter of the site would be largely maintained with two minor temporary diversions required. Given that existing connectivity would be maintained and the small potential increase in travel distance, impacts on pedestrians and cyclists using the shared user path are anticipated to be minor.



Legend

Construction features

- Construction support site boundary
- Construction footprint

Existing active transport infrastructure

- Existing off-road shared user path
- Existing on-road cycle path

Adjusted active transport infrastructure

- Warringah Freeway shared user path detour

Figure 8-9 Active transport impacts within the Warringah Freeway and surrounds area during construction



Legend

Construction features

- Construction support site boundary
- Construction footprint

Existing active transport infrastructure

- Existing off-road shared user path
- Existing on-road cycle path

Adjusted active transport infrastructure

- Flat Rock Reserve shared user path detour

Figure 8-10 Active transport impacts around Naremburn during construction

8.4.2 Gore Hill Freeway and Artarmon

Road network impacts

The anticipated routes to and from the Punch Street (BL3), Dickson Avenue (BL4), Barton Road (BL5), and Gore Hill Freeway median (BL6) construction support sites are summarised in Chapter 6 (Construction work), along with the respective daily maximum construction vehicle volumes.

Intersection and midblock performance with construction traffic

The performance of intersections within the Gore Hill Freeway and Artarmon area with the introduction of construction traffic would generally remain the same as conditions without the project. However, the following intersections would experience a change in level of service:

- Gore Hill Freeway/Reserve Road interchange would worsen from LoS E to LoS F during the AM peak. The intersection already performs poorly during the AM peak
- Reserve Road/Dickson Avenue would worsen from LoS B to LoS C during the PM peak
- Herbert Street/Frederick Street would worsen from LoS B to LoS C during the PM peak.

The impacts at the Reserve Road/Dickson Avenue and Herbert Street/Frederick Street intersections would be minor and both intersections would continue to operate satisfactorily during construction.

The intersection performance results for the road network operating under the worst case construction traffic scenario (2024) during the AM and PM peak periods are summarised in Table 8-17.

Table 8-17 Modelled intersection performance in the Gore Hill Freeway and Artarmon area (AM peak (8am-9am) and PM peak (5pm-6pm) during construction in 2024)

Intersection/ peak period	Base case 2024 (without construction traffic)				Construction case 2024 (with construction traffic)			
	Demand flow (vehicles per hour)	Average delay (seconds)	LoS	V/C	Demand flow (vehicles per hour)	Average delay (seconds)	LoS	V/C
Gore Hill Freeway/Reserve Road interchange								
AM peak	3890	N/A*	E*	>1	4200	N/A*	F*	>1
PM peak	3990	N/A*	F*	>1	4200	N/A*	F*	>1
Reserve Road/Dickson Avenue								
AM peak	1980	17	B	0.57	2160	20	B	0.68
PM peak	2000	27	B	0.74	2130	29	C	0.82
Reserve Road/Frederick Street								
AM peak	1140	9	A	0.43	1230	9	A	0.48
PM peak	1300	10	A	0.42	1400	10	A	0.46
Herbert Street/Frederick Street								
AM peak	1390	22	B	0.76	1490	24	B	0.81
PM peak	1750	28	B	0.79	1850	31	C	0.87

Intersection/ peak period	Base case 2024 (without construction traffic)				Construction case 2024 (with construction traffic)			
	Demand flow (vehicles per hour)	Average delay (seconds)	LoS	V/C	Demand flow (vehicles per hour)	Average delay (seconds)	LoS	V/C
Herbert Street/Cleg Street								
AM peak	1110	12	A	0.43	1210	12	A	0.45
PM peak	1480	17	B	0.48	1580	18	B	0.51

*Interchanges were modelled as a network, where level of service is based on speed efficiency (SIDRA level of service criteria for networks) and not average vehicle delay

Note: Cells shaded in dark grey denote an unsatisfactory LoS E or F

The midblock performance (level of service) during construction would be unchanged from performance under conditions without the project at all locations, except for the following:

- Reserve Road north of Frederick Street in the southbound direction would worsen from LoS D to LoS E in the AM peak, and from LoS C to LoS D in the PM peak
- Herbert Street north of Frederick Street in the northbound and southbound direction would worsen from LoS C to LoS D in the PM peak
- Cleg Street east of Herbert Street in the eastbound direction would worsen from LoS A to LoS B during the PM peak.

The midblock performance results for the road network operating under the worst case construction traffic scenario (2024) during the AM and PM peak periods are summarised in Table 8-18.

Table 8-18 Modelled midblock performance in the Gore Hill Freeway and Artarmon area (AM peak (8am-9am) and PM peak (5pm-6pm) during construction in 2024)

Location/ direction	Capacity (PCU)	AM Peak						PM Peak					
		Base case 2024 (without construction traffic)			Construction 2024 (with construction traffic)			Base case 2024 (without construction traffic)			Construction 2024 (with construction traffic)		
		Volume (PCU)	V/C	LoS	Volume (PCU)	V/C	LoS	Volume (PCU)	V/C	LoS	Volume (PCU)	V/C	LoS
Reserve Road north of Dickson Avenue													
Northbound	1900	610	0.32	B	680	0.36	B	1180	0.62	D	1230	0.65	D
Southbound	1900	1290	0.68	D	1430	0.75	D	680	0.36	B	780	0.41	B
Reserve Road north of Frederick Street													
Northbound	900	370	0.42	C	420	0.46	C	680	0.76	D	730	0.81	D
Southbound	900	670	0.74	D	750	0.83	E	500	0.55	C	580	0.64	D
Frederick Street east of Reserve Road													
Eastbound	900	430	0.47	C	510	0.57	C	570	0.63	D	650	0.72	D
Westbound	900	410	0.46	C	460	0.51	C	430	0.48	C	470	0.53	C
Herbert Street north of Frederick Street													
Northbound	900	260	0.29	B	350	0.38	B	470	0.52	C	550	0.61	D
Southbound	900	550	0.62	D	600	0.66	D	510	0.57	C	550	0.62	D
Cleg Street east of Herbert Street													
Eastbound	900	110	0.13	A	180	0.20	A	200	0.22	A	270	0.30	B
Westbound	900	130	0.15	A	130	0.15	A	180	0.20	A	180	0.20	A

Location/ direction	Capacity (PCU)	AM Peak						PM Peak					
		Base case 2024 (without construction traffic)			Construction 2024 (with construction traffic)			Base case 2024 (without construction traffic)			Construction 2024 (with construction traffic)		
		Volume (PCU)	V/C	LoS	Volume (PCU)	V/C	LoS	Volume (PCU)	V/C	LoS	Volume (PCU)	V/C	LoS
Dickson Avenue east of Reserve Road													
Eastbound	900	260	0.29	B	320	0.35	B	180	0.20	A	200	0.22	A
Westbound	900	150	0.16	A	200	0.22	A	240	0.27	B	250	0.28	B
Reserve Road south of Barton Road													
Northbound	900	390	0.43	C	400	0.45	C	660	0.73	D	680	0.75	D
Southbound	900	510	0.56	C	520	0.58	C	420	0.47	C	430	0.48	C

Note: Cells shaded in dark grey denote an unsatisfactory LoS E or F

Impacts on local roads and parking

The installation of traffic lights at the intersection of Pacific Highway with Dickson Avenue would result in the following impacts on traffic:

- Temporary lane closures on Pacific Highway during removal of existing median and line-marking, minor pavement works and relocation of the existing bus stop on Pacific Highway west of Dickson Avenue
- Temporary closure of Dickson Avenue during linemarking, minor kerb adjustment and minor pavement works
- Removal of about six motorbike parking spaces and three time-limited (four-hour) car parking spaces.

The existing mail zone on Dickson Avenue would be permanently relocated in proximity to the existing zone. Relocation of the mail zone would be carried out in consultation with Australia Post.

Temporary lane and road closures would be carried out outside peak periods and the impacts of these closures would be low.

Several roads would form part of construction vehicle routes within the Gore Hill Freeway and Artarmon area, including:

- Reserve Road
- Dickson Avenue
- Frederick Street
- Herbert Street
- Punch Street
- Hampden Road
- Barton Road
- Butchers Lane.

Most heavy vehicles accessing the construction area would be travelling to and from the Punch Street construction support site (BL3), with all other sites operating as smaller support sites and generating a substantially lower number of heavy vehicle movements. Relatively low impacts are anticipated on Hampden Road, Barton Road, Butchers Lane and Reserve Road north of Gore Hill Freeway given the low number of construction vehicles on these roads (maximum of 120 light vehicle and 60 heavy vehicle movements per day).

At peak production, the Punch Street construction support site (BL3) would generate a maximum of 580 light vehicle and 370 heavy vehicle movements per day while the Dickson Avenue construction support site (BL4) would generate a maximum of 500 light vehicle and 90 heavy vehicle movements per day at peak production. This would occur for a relatively short duration during peak construction period, with typical truck movements generally becoming less frequent throughout the course of construction. These vehicles would travel on Reserve Road south of Gore Hill Freeway, Dickson Avenue, Frederick Street, Herbert Street, Punch Street or Cleg Street. Across the broader network, construction traffic would access the construction site via the motorway network, where practical, to minimise impacts on local roads. Although these construction traffic volumes are relatively high in the context of existing traffic volumes, impacts on the local road network are anticipated to be low as these roads would operate with spare capacity during construction and form a direct route for construction vehicles to access the arterial road network.

Lambs Road between Punch Street and Cleg Street would be closed to allow for the Punch Street construction support site (BL3). Existing access to this section of Lambs Road is via Cleg Street and Punch Street, and therefore access impacts due to this closure would be minor. Periodic short-term closures of Reserve Road, Hampden Road, Dickson Avenue and Punch Street would also be

required during construction. Given the extensive local road network in Artarmon, vehicles would have multiple alternative routes available during these interim closures. Potential detour roads include Herbert Street, Carlotta Street, Campbell Street, Frederick Street and Cleg Street.

Construction works in Artarmon would require the temporary and permanent removal of on-street parking spaces including the following:

- The closure of Lambs Road in conjunction with the requirement to detour pedestrians and cyclists due to adjustments to the Gore Hill Freeway shared user path resulting in the permanent loss of up to 25 parking spaces on Lambs Road and Punch Street
- Construction works at Artarmon Park requiring about six on-street parking spaces on Hampden Road to be removed temporarily for the duration of construction
- Short-term temporary removal of an additional 20 on-street parking spaces on Hampden Road during northern abutment works
- The potential temporary removal of up to 10 parking spaces on other local roads such as Cleg Street, Dickson Avenue and Barton Road to provide suitable access to the temporary construction support sites in the Artarmon area.

The cumulative loss of parking spaces associated with the establishment of temporary construction support sites may have some impact on on-street parking in surrounding streets in Artarmon that currently have high parking demand. The availability of on-street parking in the vicinity of the temporary construction support sites has the potential to be reduced for the duration of construction.

Some car parking would be provided at Punch Street (BL3), Dickson Street (BL4), and Barton Road (BL5) and Gore Hill Freeway median (BL6) construction support sites. Worker parking would be maximised within the constraints of the respective temporary construction support site. The number of car parking spaces would be determined during construction planning.

Where on-site parking is not provided or where provision of on-site parking cannot accommodate the full construction workforce, the workforce would be actively encouraged to avoid parking on the surrounding road network. To minimise the potential parking impacts on the surrounding road network, parking will be actively managed using the following mitigation measures:

- Construction workforce would be encouraged to use public transport where feasible, with key bus corridors including Pacific Highway, Gore Hill Freeway and Epping Road. In addition, the T1 North Shore and T9 Northern Lines are accessible from Artarmon and St Leonards railway stations
- Where public transport availability to temporary construction support sites is limited, shuttle bus transfers may also be provided from public transport centres where required.

It is noted that the acquisition of property for the Punch Street (BL3) and Dickson Avenue (BL4) construction support sites would result in a minor reduction in parking demand that would otherwise be generated by businesses currently located at these sites.

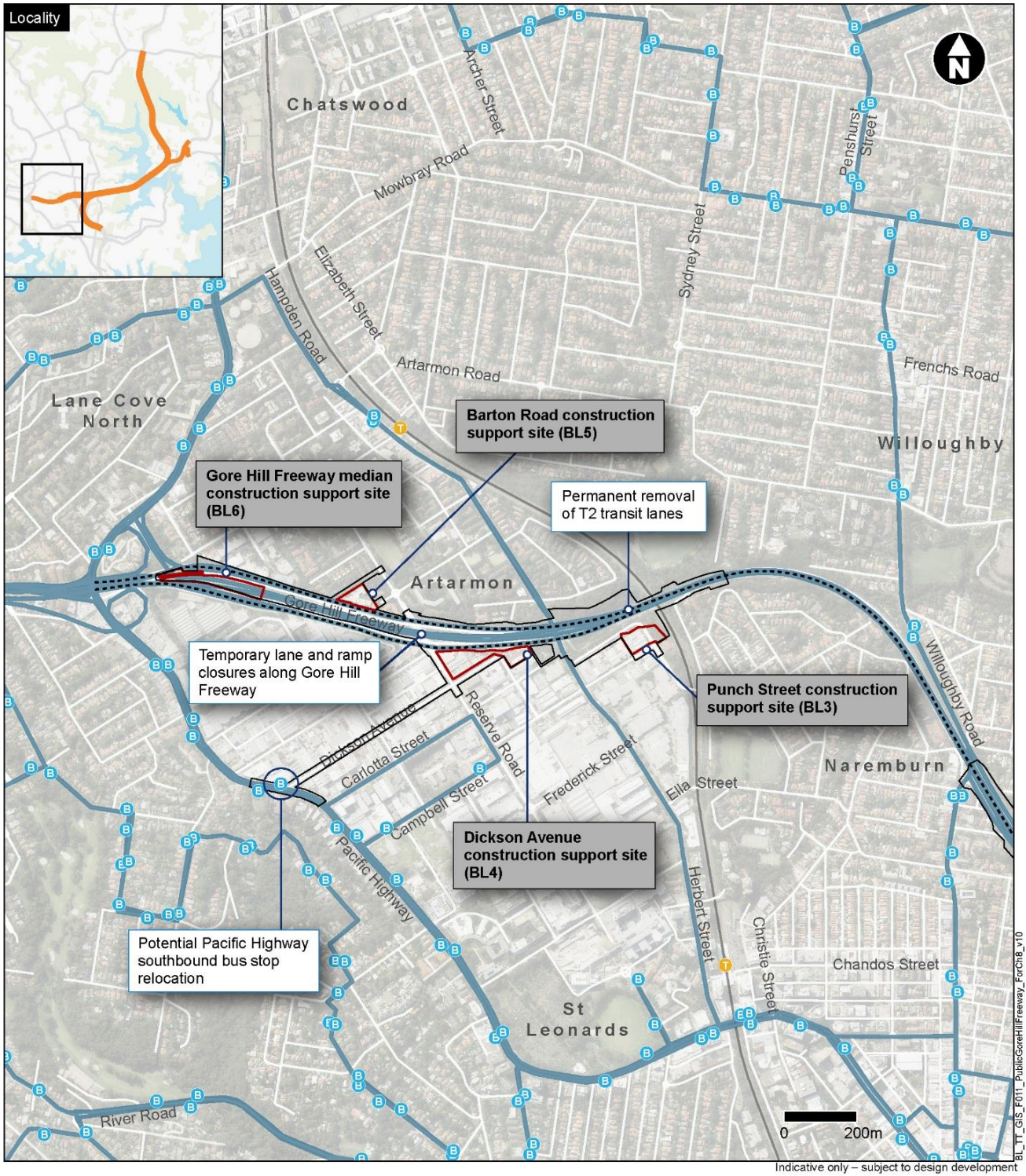
Impacts on public transport

Impacts on public transport within the Gore Hill Freeway and Artarmon area are shown in Figure 8-11.

Construction works in the Gore Hill Freeway and Artarmon area would require interim lane and ramp closures along the Gore Hill Freeway, which may impact bus travel times and reliability. Where practical, works would be scheduled outside peak periods to minimise disruption to bus services. The T2 transit lanes currently in operation in both directions along the Gore Hill Freeway would be converted to general traffic lanes to allow for construction of the Gore Hill Freeway Connection and to improve lane utilisation, however their removal is not expected to materially impact bus travel times.

The southbound bus stop located on Pacific Highway near Dickson Avenue would be permanently relocated during the construction works required to upgrade the Pacific Highway/Dickson Avenue intersection. Bus stop relocation would be determined in consultation with relevant stakeholders, including other divisions of Transport for NSW, and advanced notification would be provided to affected bus customers. Bus stops would be relocated within walking distance from their existing position to minimise disruption, where reasonable and feasible.

No direct impacts on heavy rail services are anticipated during construction.



Legend

Construction features

- Construction support site boundary
- Construction footprint

Public transport infrastructure

- Bus route
- T2 transit lane
- Heavy rail
- Bus stop
- Train station

Figure 8-11 Public transport impacts within the Gore Hill Freeway and Artarmon area during construction

Impacts on active transport

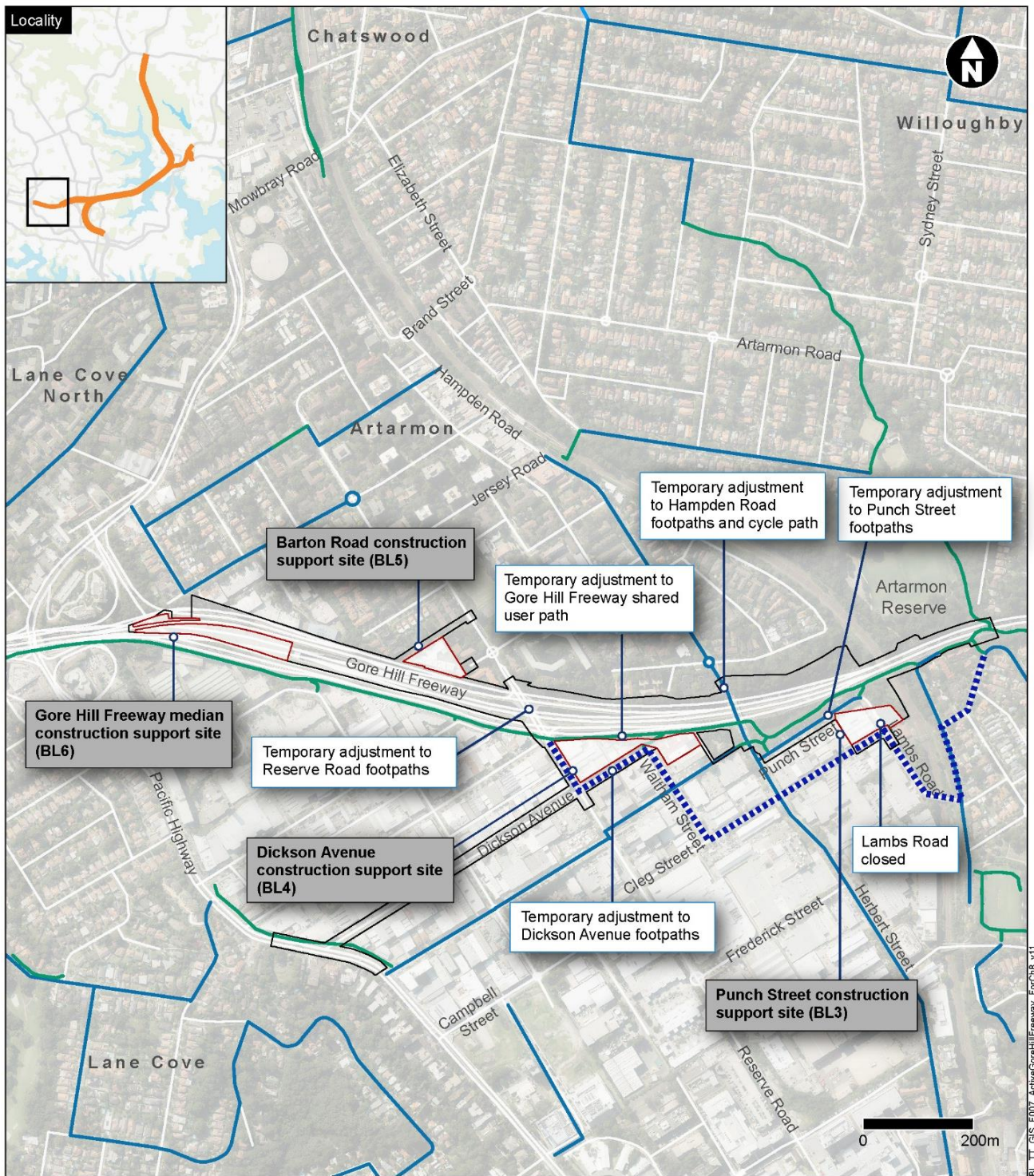
Impacts on the active transport network within the Gore Hill Freeway and Artarmon area are shown in Figure 8-12.

Modifications to the active transport network around Artarmon would be required during construction of the Gore Hill Freeway Connection, resulting in the following potential impacts:

- Reinstatement of the eastern footpath on Hampden Road, including diversion of pedestrians to the western footpath
- Temporary adjustment of the southern footpath on Punch Street adjacent to the Punch Street construction support site (BL3) boundary. Users would be diverted to Clegg Street resulting in an increase in travel distance of about 70 metres, which is considered a minor impact
- Temporary adjustment of the shared user path along Gore Hill Freeway between Reserve Road and Station Street impacting up to 150 pedestrians and cyclists who currently use the shared user path during the weekday peak periods. Alternative routes would divert these users via Station Street, Francis Road, Lambs Road, Cleg Street and Reserve Road, resulting in an additional travel distance of about 550 metres. This would have a moderate impact on pedestrians and a minor impact on cyclists, and would be managed by providing advanced notification to the community and appropriate linemarking and signage to clearly show the proposed detour route to pedestrians and cyclists.

Northern abutment works on Hampden Road would impact cyclists who currently travel on the road shoulder on either side of Hampden Road. During construction, one lane in each direction would be provided and cyclists would be required to travel on-road in traffic. Impacts would be minor given that these works are short in duration and parking would be removed on both sides of the road.

Periodic diversions of pedestrians to footpaths opposite construction activities or use of traffic control may also be required to ensure the safety of pedestrians, particularly on Punch Street, Dickson Avenue and Reserve Road. Residents may also be escorted through the work sites when accessing properties to ensure safe passage. Targeted engagement with affected residents would be carried out before and throughout the construction works in accordance with the relevant community and stakeholder engagement protocols for the project.



Legend

Construction features

- Construction support site boundary
- Construction footprint

Existing active transport infrastructure

- Existing off-road shared user path
- Existing on-road cycle path

Adjusted active transport infrastructure

- Gore Hill Freeway shared user path detour

Figure 8-12 Active transport impacts within the Gore Hill Freeway and Artarmon area during construction

8.4.3 Northbridge to Seaforth (Middle Harbour crossing)

Overview of maritime movements and activities

This section describes potential impacts from maritime movements and associated activities during construction of the immersed tube tunnel and establishment and operation of the Middle Harbour south cofferdam (BL7), Middle Harbour north cofferdam (BL8) and Spit West Reserve construction support site (BL9), along with the temporary mooring facility east of Clive Park in Middle Harbour to be used as a storage facility for immersed tube tunnel segments. This would result in an increase in marine traffic in Middle Harbour. Maritime construction vessel routes and volumes are summarised in Chapter 6 (Construction works).

The construction vessels would primarily include:

- Construction barges (including barges with cranes) for delivering construction materials, removing dredged and excavated material, or for other construction activities
- Dredging vessels
- Tugboats for manoeuvring barges
- Transport vessels for workers.

Movement of spoil barges would be controlled by the Port Authority of NSW's Vessel Traffic Service, which provides continuous monitoring of marine vessels within Middle Harbour.

The construction activities within Middle Harbour would require the establishment of localised maritime speed restrictions around construction equipment and facilities. Changes to maritime speeds would result in increased transit time for recreational, commercial and government vessels passing through the construction works area in Middle Harbour. The increased transit time would be relatively minor.

Potential road related impacts from the use of Spit West Reserve construction support site (BL9) are discussed in Section 8.4.4.

Maritime navigation impacts

Construction activities that would impact navigation in Middle Harbour are shown in Figure 8-13 and include the following:

- Construction of Middle Harbour north and south cofferdam temporary structures (BL7 and BL8) including excavation within the cofferdams. This would also include construction of the interface structures within the cofferdams and the establishment of appropriately controlled marine traffic exclusion zones required to ensure the safety of both the waterway users and the project's construction workforce
- Establishment and operation of the Spit West Reserve construction support site (BL9)
- Transport of partially constructed steel shell immersed tube tunnel units to Spit West Reserve construction support site (BL9)
- Dredging activities between Northbridge and Seaforth Bluff in preparation for the installation of immersed tube tunnels
- Piling for immersed tube tunnel unit supports between Northbridge and Seaforth Bluff, restricting navigation widths to about 100 metres
- Installation of the immersed tube tunnel elements, which would be carried out during up to six closures (likely two full closures and four partial closures) of Middle Harbour between Northbridge and Seaforth for a period of up to 48 hours during weekdays
- Barge movements to and from the project temporary construction support sites

- A temporary mooring facility east of Clive Park in Middle Harbour to be used as a storage facility for completed immersed tube tunnel units
- Boat movements transporting the construction workforce.

Prolonged periods of high maritime construction activity would occur over about three months of the construction program while the following activities are carried out:

- Concreting of interface structures
- Dredging of sediment and rock
- Transport of partially completed and completed immersed tube tunnel units.

Exclusion zones would be set up around the cofferdams, reducing navigation width to about 220 metres between the cofferdams. These zones would be marked by lit yellow buoys as specified by the Harbour Master to clearly identify the exclusion zones and facilitate the safe passage of vessels travelling within the vicinity of the cofferdams. Dredging activities and the installation of immersed tube tunnel support piles would also restrict navigational movements. The use of primary silt curtains during dredging activities would reduce navigation widths to about 100 metres. Impacts due to the reduced navigation widths would be manageable, with specific mitigations detailed in Section 8.5.

Navigation impacts in the Outer Harbour would not be considered substantial due to the lower frequency of construction vessel movements and the increased space the Outer Harbour provides for manoeuvrability.

Simulation model

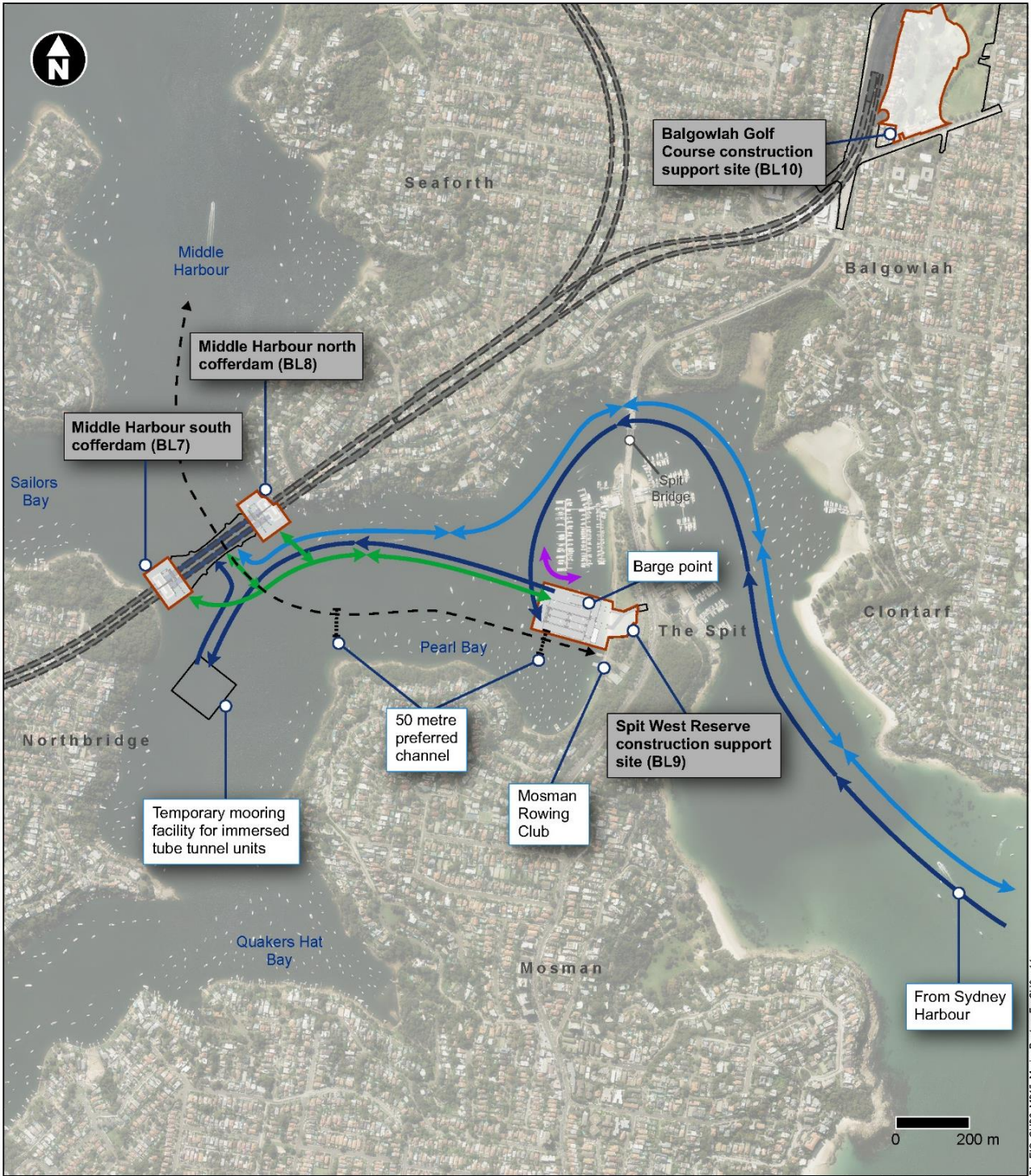
A model was prepared to simulate the transport of the partially constructed steel shell immersed tube tunnel units and identify any restrictions and towage requirements for the safe movement of vessels to and from the Outer Harbour, using the navigation channel through and between the Spit Bridge piers to berths at Spit West Reserve construction support site (BL9). The model found that the transportation of the partially constructed immersed tube tunnel units to the Spit West Reserve construction support site (BL9), and transportation of the completed immersed tube tunnel elements subsequently to the temporary mooring location before immersion, would be feasible and could be carried out safely based on the proposed methodology (refer to Chapter 6 (Construction works)).

Impacts on recreational users, community groups and clubs

Generally, recreational users, community groups and clubs downstream of the Spit Bridge would not be substantially impacted by construction activities in Middle Harbour due to the limited construction activities and associated vessel interactions in this part of the harbour.

Upstream of the Spit Bridge, Mosman Rowing Club would be located adjacent to the Spit West Reserve construction support site (BL9) and in the vicinity of construction vessel movements between the temporary construction support site, cofferdams, dredging and support piling works and the temporary mooring location. This has the potential to impact rowing club operations if not appropriately managed during construction. Measures to reduce and manage impacts on the operation of the Mosman Rowing Club would include avoiding impacts on the land based (ie via Spit West Reserve) or water based approaches to the club and maintaining the current 50 metre width of the navigation channel between the moorings on approach to the club where possible. Figure 8-13 shows the proposed rowing route and adjacent construction facilities and movements within Middle Harbour. This and other suitable management measures as required would be developed in consultation with the Mosman Rowing Club during construction planning.

Construction work, in particular dredging activities and the use of associated silt curtains, has the potential to impact the operation of the Northbridge Sailing Club. This club hosts races for dinghies and other sail craft that typically occupy the waterway in the immediate vicinity of the proposed Middle Harbour crossing. Opportunities to minimise and manage potential impacts, including the relocation of their racecourses to upstream of the Middle Harbour crossing, would be investigated prior to construction in consultation with the club.



Indicative only – subject to design development

BL EIS CH06 M015 MarineRoutes ForCH8 v14

Legend

Construction features

- Driven tunnel
- Immersed tube tunnel
- Construction footprint
- Construction support site

Maritime traffic routes

- Immersed tube tunnel transportation route
- Route for offshore disposal
- Marina access
- Proposed Mosman Rowing Club route

- Marine construction traffic routes for dredging, cofferdams and permanent transition structures

Figure 8-13 Maritime navigation impacts during construction

Impacts on commercial operations within Middle Harbour

Except for Eco Boat Hire at Northbridge, there is minimal commercial boating traffic that would be impacted by the construction activities. Furthermore, Eco Boat Hire charter small vessels that would always be permitted to traverse the crossing location during construction due to their size. The exception would be during the two full closures of the Middle Harbour crossing for immersion of the two central tunnel units which would be limited to about 48 hours per closure. There are no larger commercial operators known to navigate within the vicinity of, or through, the crossing location. Impacts on commercial operations within Middle Harbour are considered negligible.

Construction equipment and vessel movements would give way to larger vessels in the Outer Harbour or offshore areas (eg vessel movements associated with offshore disposal of dredged material) and would follow the Harbour Master's directions. Impacts on commercial operators in the Outer Harbour are also considered negligible due to the lower frequency of interaction with construction vessel movements and the increased space the Outer Harbour provides for manoeuvrability.

Impacts on government operations within Middle Harbour

Royal Australian Navy

The construction activities associated with the harbour crossing would not impact on navigation to and from HMAS Penguin at Balmoral. This is due to the HMAS Penguin being located away from the main construction activities, the width of the harbour at this location reducing the proximity to construction vessel movements, and the low number of naval vessels accessing the facility, reducing the potential interaction with construction vessel movements.

Water Police, Transport for NSW, and Department of Planning, Industry and Environment (Regions, Industry, Agriculture & Resources)

Impacts on government users would be limited to a minor increase in travel times resulting from imposed speed restrictions during construction. Speed restrictions would not apply to Water Police in an emergency.

Impacts on swing moorings and marina berths

About 45 swing moorings located in Pearl Bay would be temporarily relocated for about 48 months during construction due to the location of a casting facility off Spit West Reserve. About 10 swing moorings in Seaforth would also require temporary relocation due to the Middle Harbour north cofferdam (BL8). These moorings would be relocated for about 48 months, and likely just to the west of their existing locations in Middle Harbour, in consultation with the lease holders and therefore impacts on boat users due to the displaced moorings is considered to be minor.

Deliveries of immersed tube tunnel units between the temporary construction support sites may require a small number of additional swing moorings west of Bradys Point to be temporarily relocated. If required, arrangements would be determined in consultation with the lease holder(s). Impacts on any additional relocated moorings would be limited to a relatively small change to their location.

The location of the Middle Harbour north cofferdam (BL8) at Seaforth would also prohibit access to three private marina berths. Temporary alternative marina berths would be provided for about 48 months at marinas nearby.

8.4.4 Balgowlah and surrounds

Road network impacts

The anticipated routes to and from the Spit West Reserve (BL9), Balgowlah Golf Course (BL10), and Kitchener Street (BL11) construction support sites are summarised in Chapter 6 (Construction work), along with the respective daily maximum construction vehicle volumes.

Intersection and midblock performance with construction traffic

The performance of intersections (level of service) within the Balgowlah and surrounds area with the introduction of construction traffic would generally remain the same as conditions without the project. The intersection Manly Road/Sydney Road/Burnt Bridge Creek Deviation would worsen from LoS C to LoS D during the PM peak. In addition, the intersection of Spit Road/Parriwi Road/Spit West Reserve car park/BL9 construction support site access would worsen from a LoS B to LoS C also during the PM peak.

Direct access from the Balgowlah Golf Course construction support site (BL10) to Burnt Bridge Creek Deviation would be provided, which would reduce the potential traffic impacts possible at the Manly Road/Sydney Road/Burnt Bridge Creek Deviation intersection were access to the temporary construction support site provided from Sydney Road.

The Sydney Road/Maretimo Street intersection would improve from LoS E to LoS A during the AM peak and from LoS F to LoS A during the PM peak. This improvement would occur as a result of the proposed traffic signals at the intersection during construction and the addition of a northern approach that would provide access to the Balgowlah Golf Course construction support site (BL10). However, traffic signals at this intersection would increase delays for vehicles travelling east–west on Sydney Road that do not experience any delay under the existing configuration. The additional delays under traffic signal operation are considered to be minor.

The intersection performance results for the road network operating under the worst case construction traffic scenario (2024) during the AM and PM peak periods are summarised in Table 8-19.

Table 8-19 Modelled intersection performance in Balgowlah and surrounds (AM peak (8am-9am) and PM peak (5pm-6pm) during construction in 2024)

Intersection/ peak period	Base case 2024 (without construction traffic)				Construction case 2024 (with construction traffic)			
	Demand flow (vehicles per hour)	Average delay (seconds)	LoS	V/C	Demand flow (vehicles per hour)	Average delay (seconds)	LoS	V/C
Spit Road/ Parriwi Road/ Spit West Reserve car park/ BL9 construction support site access								
AM peak	4850	8	A	0.73	5070	8	A	0.76
PM peak	5370	21	B	0.89	5700	31	C	0.94
Manly Road/ Sydney Road/ Burnt Bridge Creek Deviation								
AM peak	4740	49	D	0.91	4860	54	D	0.95
PM peak	5680	34	C	0.92	5840	45	D	0.99
Sydney Road/ Maretimo Street/ BL10 construction support site access								
AM peak	1460	70	E	0.24	1560	10	A	0.35
PM peak	1830	>100	F	0.27	1970	12	A	0.50

Note: Cells shaded in dark grey denote an unsatisfactory LoS E or F

The midblock performance during construction would be comparable to performance under conditions without the project at all locations, with the exception of Sydney Road east of Manly Road in the eastbound direction which would reduce from LoS C to LoS D during the PM peak. However, it is expected that Sydney Road in this location and direction would still operate with spare capacity and at a satisfactory level of service during construction.

The midblock performance results for the road network operating under the worst case construction traffic scenario (2024) are summarised in Table 8-20 during the AM and PM peak periods.

Table 8-20 Modelled midblock performance in Balgowlah and surrounds (AM peak (8am-9am) and PM peak (5pm-6pm) during construction in 2024)

Location/ direction	Capacity (PCU)	AM Peak						PM Peak					
		Base case 2024 (without construction traffic)			Construction 2024 (with construction traffic)			Base case 2024 (without construction traffic)			Construction 2024 (with construction traffic)		
		Volume (PCU)	V/C	LoS	Volume (PCU)	V/C	LoS	Volume (PCU)	V/C	LoS	Volume (PCU)	V/C	LoS
Spit Road south of Parriwi Road													
Northbound	2900	3110	>1	F	3250	>1	F	1820	0.63	D	2010	0.69	D
Southbound	2900	1520	0.52	C	1670	0.58	C	2960	>1	F	3160	>1	F
Manly Road south of Sydney Road													
Northbound	2900	1720	0.59	D	1830	0.63	D	3400	>1	F	3550	>1	F
Southbound	2900	3270	>1	F	3390	>1	F	1840	0.63	D	1990	0.69	D
Sydney Road east of Manly Road													
Eastbound	1900	520	0.28	B	590	0.31	B	1080	0.57	C	1160	0.61	D
Westbound	2900	1060	0.37	B	1130	0.39	B	830	0.28	B	910	0.31	B
Burnt Bridge Creek Deviation west of Condamine Street													
Northbound	2900	1070	0.37	B	1070	0.37	B	2040	0.70	D	2040	0.70	D
Southbound	2900	1620	0.56	C	1620	0.56	C	1150	0.40	B	1160	0.40	B

Note: Cells shaded in dark grey denote an unsatisfactory LoS E or F

Impacts on local roads and parking

All roads in the Balgowlah area that form part of construction vehicle routes are state or regional roads.

The Sydney Road/Maretimo Street intersection would be modified during construction, with an additional approach to allow access to the Balgowlah Golf Course construction support site (BL10) from Sydney Road. Providing traffic signals at the intersection would be beneficial to vehicles performing a right turn into or out of Maretimo Street including to and from the Northern Beaches Secondary College Balgowlah Boys Campus, which currently have to give way to multiple conflicting movements under the priority controlled intersection arrangement. In addition, construction vehicles exiting the temporary construction support site would be required to give way to vehicles turning left from Maretimo Street and would not conflict with vehicles turning right. Traffic movements north-south (and vice versa) through the intersection between Maretimo Street and the Balgowlah Golf Course construction support site (BL10) (and future access road) would not be permitted.

Access to the Kitchener Street construction support site (BL11) to and from the Burnt Bridge Creek Deviation is considered unlikely to result in significant impacts to traffic.

Car parking areas for construction workers would be provided at the Balgowlah Golf Course construction support site (BL10). Therefore, no loss of parking on adjacent local streets is anticipated during construction. Public parking spaces would be removed from the existing Balgowlah Golf Course car park during construction. These spaces are used for both the golf course and for the nearby Balgowlah Oval, but as the golf course would no longer be in operation during construction and alternative parking is available on Pickworth Avenue, impacts would be negligible.

The Spit West Reserve construction support site (BL9) and Kitchener Street construction support site (BL11) would have limited parking for supervision staff. The construction workforce at the Middle Harbour south cofferdam (BL7), Middle Harbour north cofferdam (BL8), Spit West Reserve construction support site (BL9) and Kitchener Street construction support site (BL11) would park at the Balgowlah Golf Course construction support site (BL10) and be transported to the site by shuttle bus (where required). The Spit West Reserve construction support site (BL9) would be accessed from the existing Spit West Reserve entry from Spit Road.

The construction workforce would also be encouraged to use public transport where possible, with key bus corridors (including the Northern Beaches B-Line) including Military Road, Spit Road, Manly Road, Sydney Road, Burnt Bridge Creek Deviation and Condamine Street.

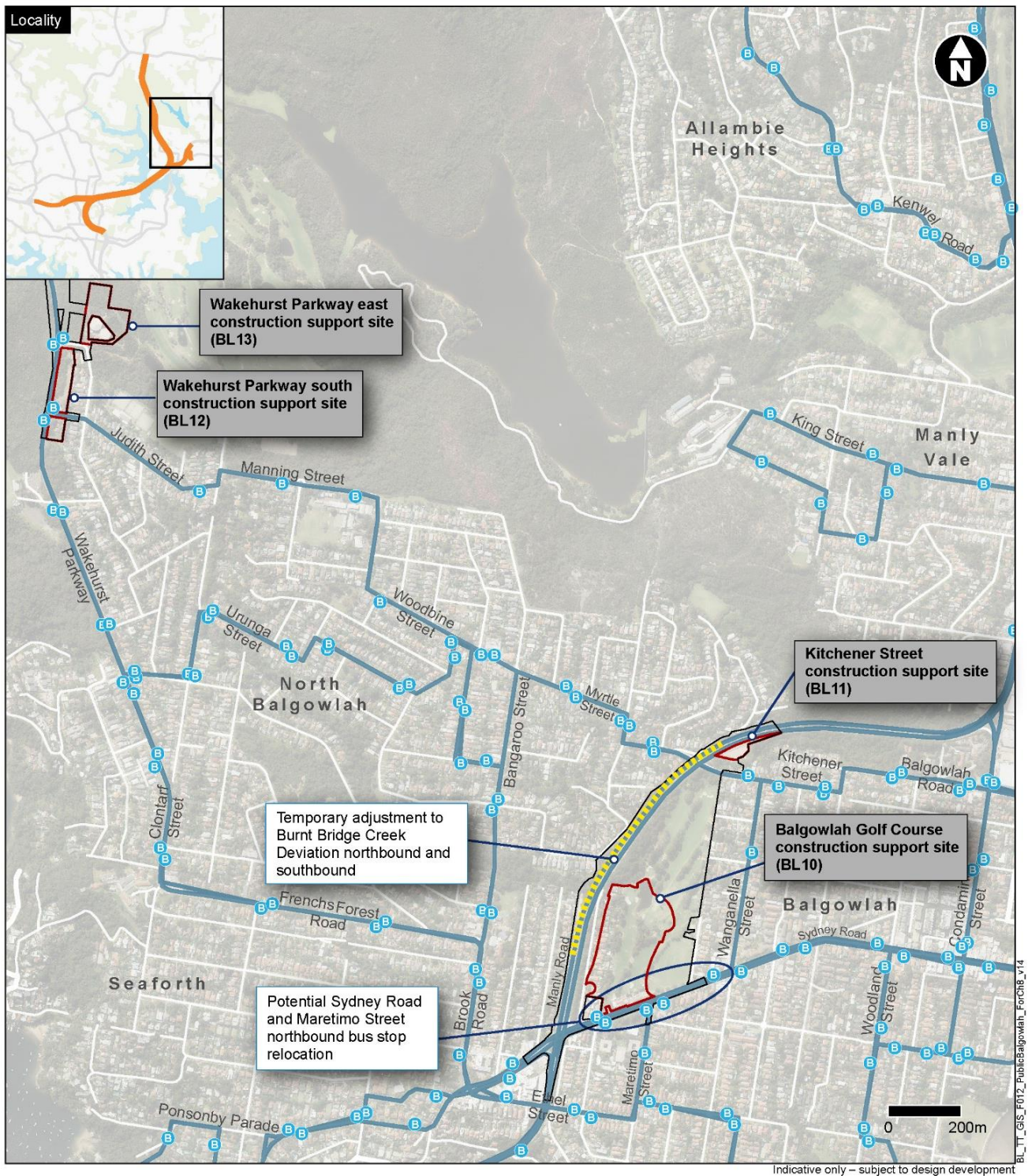
Impacts on public transport

Impacts on public transport within the Balgowlah and surrounds area are shown in Figure 8-14.

Minor adjustments to bus stops on Sydney Road may be required during construction. As a major bus corridor, bus stops on Sydney Road serve buses that provide connections to Sydney CBD, North Shore, Manly, Brookvale/Dee Why area and Mona Vale. Additional minor adjustments to bus stops may be required on Maretimo Street and would be confirmed during further design development and construction planning. These adjustments may require bus customers to walk small additional distances, slightly increasing their travel times. Disruption to bus customers would be minimised by relocating the bus stops to the closest practical alternative location. Due to the minimal relocation distances, residual impacts would be minor. Any changes to bus stop locations would be communicated to the local community and developed in consultation with relevant stakeholders including other divisions of Transport for NSW.

Construction works would also impact Burnt Bridge Creek Deviation between Sydney Road and Kitchener Street bridge, which is a major bus corridor with bus lanes operating in both directions. The current bus lanes on Burnt Bridge Creek Deviation would operate on temporary alignments near the general traffic lanes. Given that the temporary alignments would be of a similar distance to the current configuration of Burnt Bridge Creek Deviation, impacts on bus travel times would be negligible.

Community and stakeholder consultation would be carried out before the start of works to consult with and inform all road users, including bus operators, of the upcoming network changes and proposed detours.



- | | |
|---|--|
| Construction features | Public transport infrastructure |
| Construction support site boundary | Bus route |
| Construction footprint | Temporary bus lane diversions |
| | Bus stop |

Figure 8-14 Public transport impacts within Balgowlah and surrounds during construction

Impacts on active transport

Impacts on active transport network within the Balgowlah and surrounds area are shown in Figure 8-15.

Changes to the active transport network around Balgowlah during surface works would include:

- Temporary adjustment to paths at Spit West Reserve around the Spit West Reserve construction support site (BL9), specifically Fig Tree Lane, resulting in an increase in travel distance of up to 100 metres, which would be considered a minor impact due to the short detour distance
- A 50 metres temporary shared user path would be constructed within the Balgowlah Golf Course when the shared user path along the existing Burnt Bridge Creek Deviation is adjusted for the box culvert extension and the existing shared user underpass of Burnt Bridge Creek Deviation is extended. The extension of the existing shared user underpass beneath the Burnt Bridge Creek Deviation at Burnt Bridge Creek would be staged to maintain access at all times. Subject to final planning for staging of these works, additional short term detours may be required due to construction access restrictions
- A signalised pedestrian crossing would be provided at the entrance to the Balgowlah Golf Course construction support site (BL10) off Sydney Road via the traffic signals provided for the Sydney Road/Maretimo Street/Access Road intersection. This would ensure safe passage from users of the Sydney Road pedestrian bridge, including students from Northern Beaches Secondary College – Balgowlah Boys Campus, to the Balgowlah Oval.

Impacts on pedestrians and cyclists are expected to be minor given that existing connectivity would be maintained and additional travel distances via the temporary shared user path would be minimal. Appropriate linemarking and signage would be used to identify diversions and, where required, traffic controllers would ensure safe passage for users.

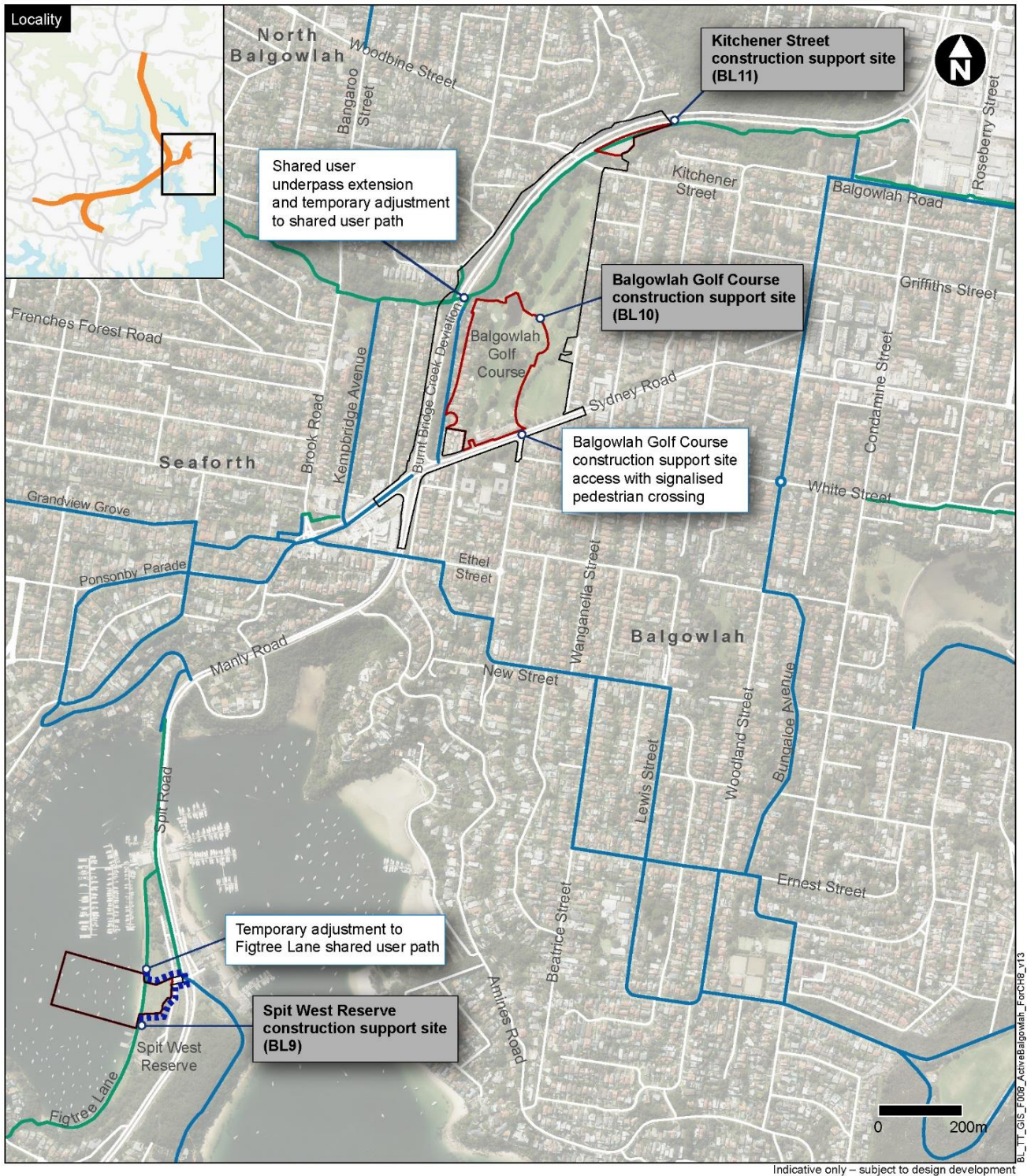


Figure 8-15 Active transport impacts within Balgowlah and surrounds during construction

8.4.5 Frenchs Forest and surrounds

Road network impacts

The anticipated routes to and from the Wakehurst Parkway south (BL12), Wakehurst Parkway east (BL13) and Wakehurst Parkway north (BL14) construction support sites within the Frenchs Forest area and surrounds are summarised in Chapter 6 (Construction work), along with the respective daily maximum construction vehicle volumes.

Intersection and midblock performance with construction traffic

The performance of intersections within the Frenchs Forest and surrounds area with the introduction of construction traffic would generally remain the same as under conditions without the project.

The closure of Kirkwood Street to general traffic at its intersection with Wakehurst Parkway is predicted to result in a redistribution of traffic to Judith Street or Burnt Street. Given the relative difficulty in performing a right turn manoeuvre out of Judith Street across Wakehurst Parkway, the assessment has assumed that existing local traffic that currently turns right out of Judith Street and Kirkwood Street would use the traffic signals at Burnt Street instead. The impacts to the performance of the Wakehurst Parkway/Judith Street intersection are considered negligible and would worsen from LoS B to LoS C during the AM peak, however would improve from LoS D to LoS C in the PM peak.

The performance of the Wakehurst Parkway/Burnt Street intersection during construction would continue to operate at an acceptable level of service notwithstanding the small volume of additional detoured vehicles generated by the changes described above.

A new intersection with traffic signals would be constructed to provide access to the Wakehurst Parkway east construction support site (BL13). During construction, this intersection would operate at LoS C during the AM peak and LoS A during the PM peak.

With construction traffic included on the road network, the Wakehurst Parkway/Warringah Road intersection would continue to operate at LoS D during the AM peak and LoS E during the PM peak, taking into account the opening of the underpass arrangements along Warringah Road as part of the Northern Beaches Hospital road upgrade project. During the PM peak the intersection is forecast to continue to operate close to capacity. The remainder of intersections in the Frenchs Forest and surrounds area would not experience a change in level of service as a result of the construction of the project.

The intersection performance results for the road network operating under the worst case construction traffic scenario (2024) are summarised in Table 8-21 during the AM and PM peak periods.

Table 8-21 Modelled intersection performance in Frenchs Forest and surrounds (AM peak (8am-9am) and PM peak (5pm-6pm) during construction in 2024)

Intersection/peak period	Base case 2024 (without construction traffic)				Construction case 2024 (with construction traffic)			
	Demand flow (vehicles per hour)	Average delay (seconds)	LoS	V/C	Demand flow (vehicles per hour)	Average delay (seconds)	LoS	V/C
Wakehurst Parkway/Burnt Street/Seaforth Oval car park								
AM peak	1160	7	A	0.42	1470	21	B	0.67
PM peak	1430	6	A	0.47	1610	17	B	0.60
Wakehurst Parkway/Judith Street/BL12 construction support site access								
AM peak	1520	27	B	0.76	1640	30	C	0.51
PM peak	1800	49	D	0.82	1870	33	C	0.53
Wakehurst Parkway/Kirkwood Street/BL12 construction support site access								
AM peak	1470	52	D	0.65	1510	45	D	0.46
PM peak	1670	71	F	0.54	1710	59	E	0.44
Wakehurst Parkway/ BL13 construction support site access								
AM peak	-	-	-	-	1580	30	C	0.91
PM peak	-	-	-	-	1810	11	A	0.70
Wakehurst Parkway/Warringah Road								
AM peak	4080	43	D	0.79	4220	44	D	0.86
PM peak	4770	57	E	0.95	4940	69	E	1.00

Note: Cells shaded in dark grey denote an unsatisfactory LoS E or F

The midblock performance during construction would be comparable to conditions without the project at all locations, except for:

- Wakehurst Parkway north of Judith Street in the northbound direction would change from LoS E to LoS F during AM peak and PM peak
- Wakehurst Parkway north of Kirkwood Street in the northbound direction would change from LoS E to LoS F during AM peak and PM peak
- Wakehurst Parkway north of Kirkwood Street in the southbound direction would change from LoS E to LoS F during PM peak.

Wakehurst Parkway north of Judith Street and north of Kirkwood Street is already operating close to LoS E/F. A small increase in traffic volume and volume to capacity ratio due to construction vehicles and general traffic diverted due to the temporary long-term closure of Kirkwood Street would not have any major additional impact on traffic performance.

The midblock performance results for the road network operating under the worst case construction traffic scenario during the AM and PM peak hours are summarised in Table 8-22.

Table 8-22 Modelled midblock performance in Frenchs Forest and surrounds (AM peak (8am-9am) and PM peak (5pm-6pm) during construction in 2024)

Location/ direction	Capacity (PCU)	AM Peak						PM Peak					
		Base case 2024 (without construction traffic)			Construction 2024 (with construction traffic)			Base case 2024 (without construction traffic)			Construction 2024 (with construction traffic)		
		Volume (PCU)	V/C	LoS	Volume (PCU)	V/C	LoS	Volume (PCU)	V/C	LoS	Volume (PCU)	V/C	LoS
Wakehurst Parkway north of Judith Street													
Northbound	900	880	0.97	E	970	>1	F	860	0.96	E	910	>1	F
Southbound	900	670	0.74	D	690	0.77	D	910	>1	F	930	>1	F
Wakehurst Parkway north of Kirkwood Street													
Northbound	900	900	1.00	E	960	>1	F	830	0.92	E	920	>1	F
Southbound	900	630	0.70	D	700	0.77	D	860	0.96	E	950	>1	F
Warringah Road west of Wakehurst Parkway²													
Eastbound	3900	1670	0.43	C	1,750	0.45	C	1940	0.50	C	2030	0.52	C
Westbound	2900	620	0.21	A	710	0.24	A	1410	0.49	C	1510	0.52	C
Warringah Road east of Wakehurst Parkway²													
Eastbound	2900	710	0.24	A	720	0.25	A	580	0.20	A	590	0.20	A
Westbound	2900	620	0.21	A	620	0.21	A	1030	0.36	B	1030	0.36	B

Note 1: Cells shaded in dark grey denote an unsatisfactory LoS E or F

Note 2: Assumed capacity on Warringah Road refers to capacity on the surface lanes adjacent to the Wakehurst Parkway intersection. Eastbound capacity on Warringah Road west of Wakehurst Parkway is greater than the eastbound capacity east of Wakehurst Parkway due to the presence of the additional short right-turn lanes.

Impacts on local roads and parking

The closure of the northern section of Kirkwood Street would be required during construction to accommodate the Wakehurst Parkway south construction support site (BL12) and associated construction activities. The impact on diverted vehicles would be minor given that several nearby alternative local roads are available, including Judith Street and Burnt Street. Access to the properties owned by Sydney Water and Telstra would also be slightly impacted, with vehicles required to access the properties via Judith Street and Kirkwood Street south.

Spoil trucks exiting the Wakehurst Parkway east construction support site (BL13) would be required to travel north on Wakehurst Parkway, minimising the impact of spoil truck movements on surrounding local roads. Spoil trucks would not be permitted to travel south through Frenchs Forest Road and Sydney Road.

Allambie Road (north of Warringah Road) and Frenchs Forest Road east are local roads that would act as part of the egress route from the Wakehurst Parkway north construction support site (BL14). Minor impacts are anticipated on these roads given the low number of construction vehicle movements of about 90 light vehicle and 50 heavy vehicle movements (egress only) per day.

Blasting may be required along Wakehurst Parkway and would require the short-term closure (up to 10 minutes) of sections of Wakehurst Parkway to general traffic. Any road closures would be carried out under traffic control and outside peak periods to ensure safety and minimise disruption to the road network.

Car parking areas for construction workers would be provided at the Wakehurst Parkway south (BL12), Wakehurst Parkway east (BL13) and Wakehurst Parkway north (BL14) construction support sites. Worker parking would be maximised within the constraints of the respective temporary construction support site. Parking for site vehicles associated with the realignment and upgrade of the Wakehurst Parkway would be managed as the works sites move and would be contained within the relevant work sites. The number of car parking spaces would be determined during construction planning.

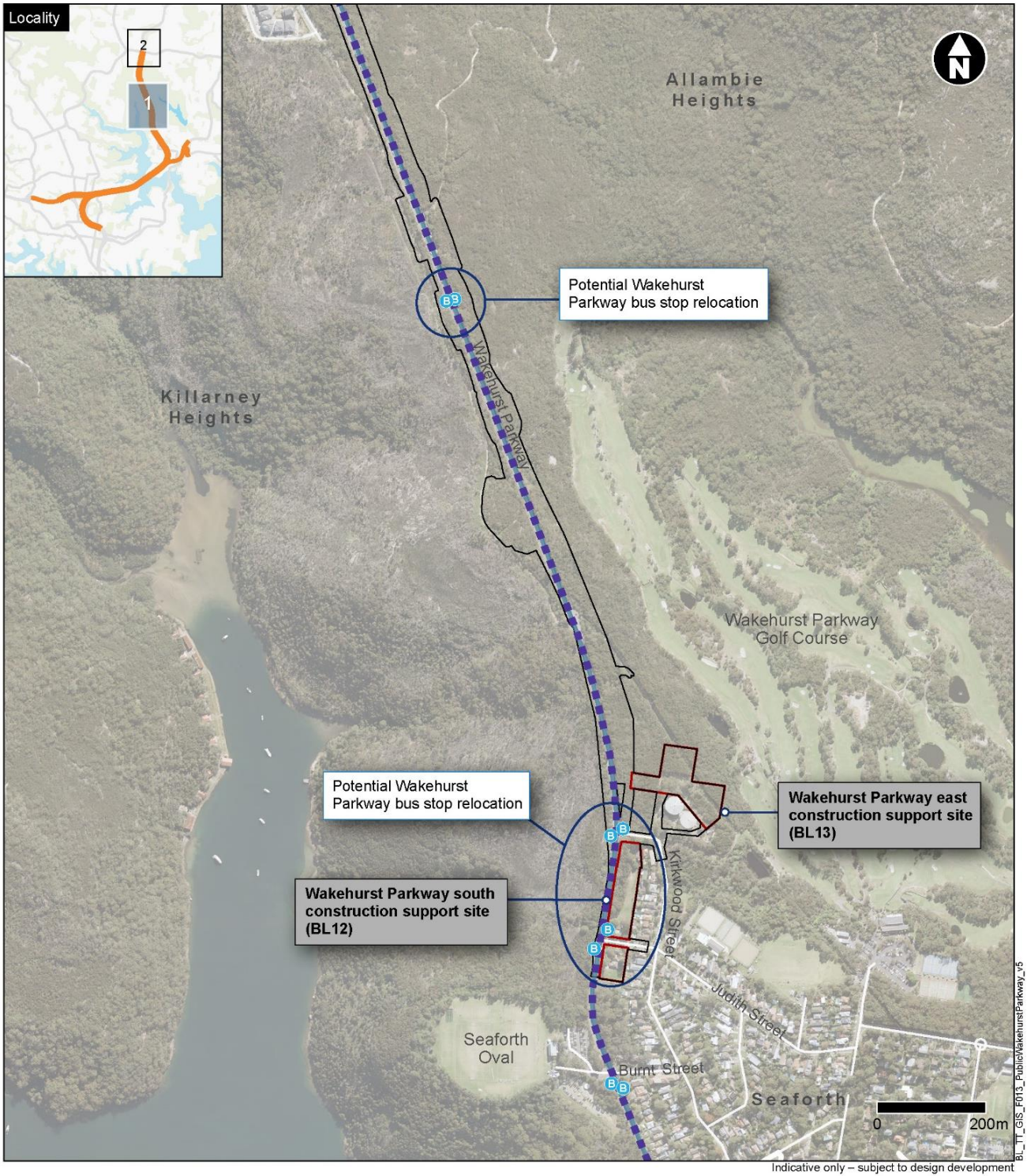
Notwithstanding, the construction workforce would be encouraged to use public transport where feasible, with key bus corridors including Warringah Road and Forest Way. Where public transport availability to temporary construction support sites is limited, shuttle bus transfers may also be provided from public transport centres where required.

Impacts on public transport

Impacts on public transport within the Frenchs Forest and surrounds area are shown in Figure 8-16 and Figure 8-17.

Bus stops within the construction footprint along Wakehurst Parkway in Seaforth, Killarney Heights and Frenchs Forest would be temporarily relocated during construction. This includes bus stops for bus services operating along Wakehurst Parkway (routes 141, 169, 173 and 169X) which provide connections to Austlink Corporate Centre, Narraweena, Manly and Sydney CBD. Adjustments to bus stops may require bus customers to walk small additional distances which would slightly increase their travel times. Bus stops would be relocated as close as practical to their existing positions to minimise disruption. As such, these impacts are expected to be minor.

Other bus stops on adjacent roads may also require temporary relocation during construction. This would be determined during construction staging and planning in consultation with relevant stakeholders, including other divisions of Transport for NSW, and advanced notification would be provided to affected bus customers. Bus stops would be relocated within walking distance of their existing position to minimise disruption where reasonable and feasible.



Legend

Construction features

- Construction support site boundary
- Construction footprint

Public transport infrastructure

- Bus route 141, 169, 173 and 169X
- Bus route
- Bus stop

Figure 8-16 Public transport impacts within Frenchs Forest and surrounds (southern area) during construction (map 1)

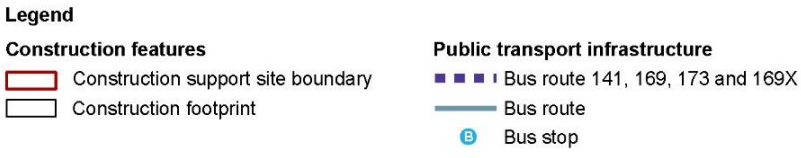


Figure 8-17 Public transport impacts within Frenchs Forest and surrounds (northern area) during construction (map 2)

Impacts on active transport

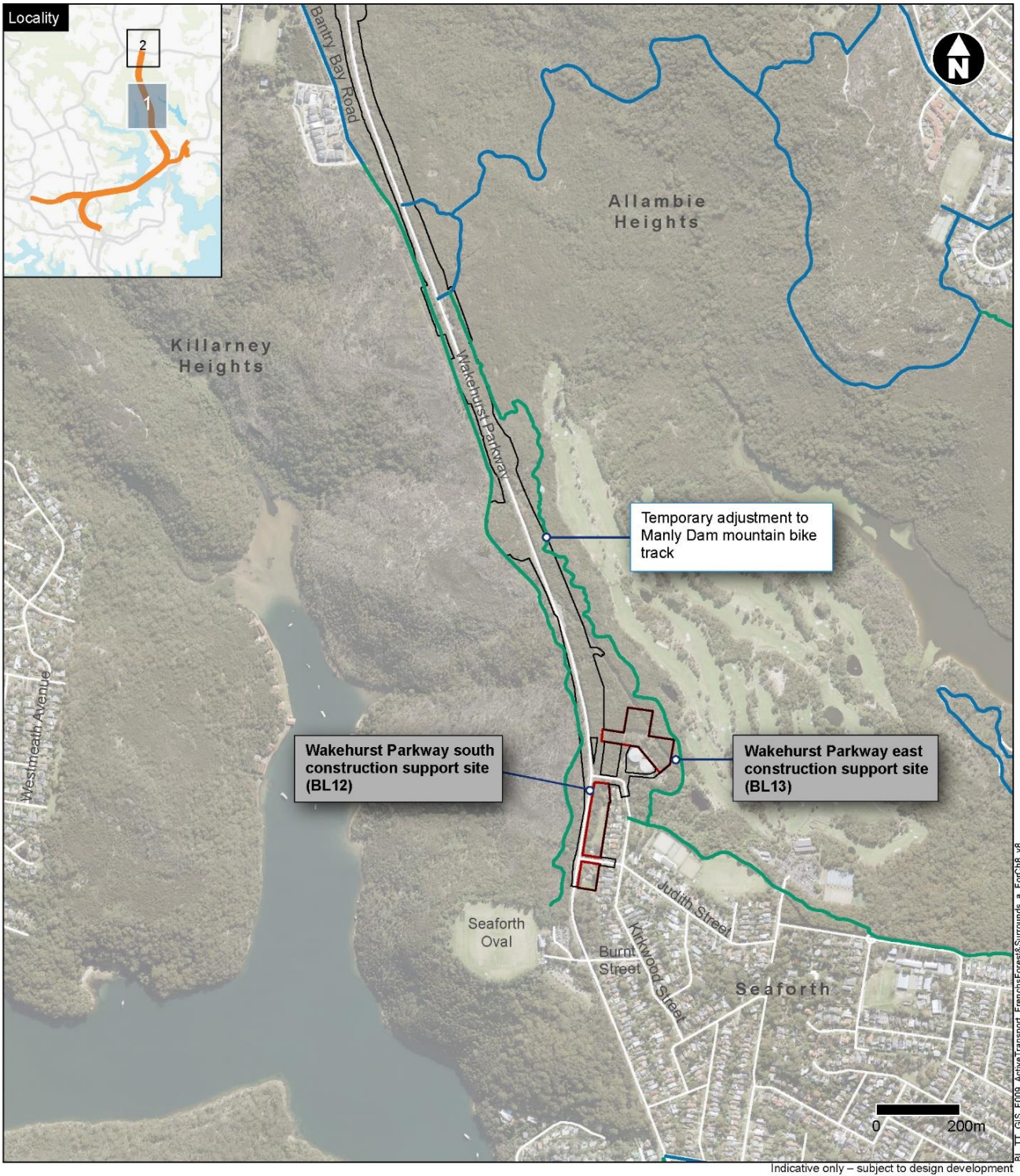
Impacts on active transport network within the Frenchs Forest and surrounds area are shown in Figure 8-18 and Figure 8-19.

New traffic lights would be installed to provide access to the Wakehurst Parkway east construction support site (BL13). Conflicts between pedestrians and cyclists using the footpath near this site and construction vehicles would be managed through the control of movements at the site entry/exit.

Temporary adjustment of some of the mountain bike tracks on either side of Wakehurst Parkway may be required. Minor detour routes would be implemented, and advanced notification of track closures provided at key locations. Construction of the three permanent shared user path underpasses along Wakehurst Parkway would be prioritised where feasible.

The existing shared user path adjacent to the Wakehurst Parkway north construction support site (BL14) would also be temporarily impacted during the use of the site. Affected areas would include the off-road shared user paths along Wakehurst Parkway, north of Warringah Road which may require minor detours. Pedestrian and cyclist access would be maintained during construction and the increase in travel distance would be negligible.

Additionally, the shared user path bridge over Wakehurst Parkway connecting the Warringah Aquatic Centre and Bantry Bay Road would be demolished and a new and lengthened replacement overpass constructed as part of the project. Construction would be staged to ensure pedestrian and cyclist access over Wakehurst Parkway would be maintained at all times.



Legend

Construction features

- Construction support site boundary
- Construction footprint

Active transport infrastructure

- Existing off-road shared user path
- Existing on-road cycle path

Figure 8-18 Active transport impacts within Frenchs Forest and surrounds (southern area) during construction (map 1)

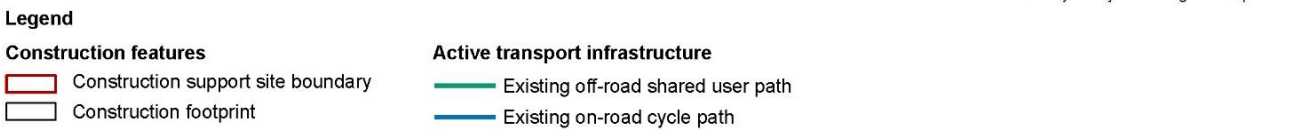
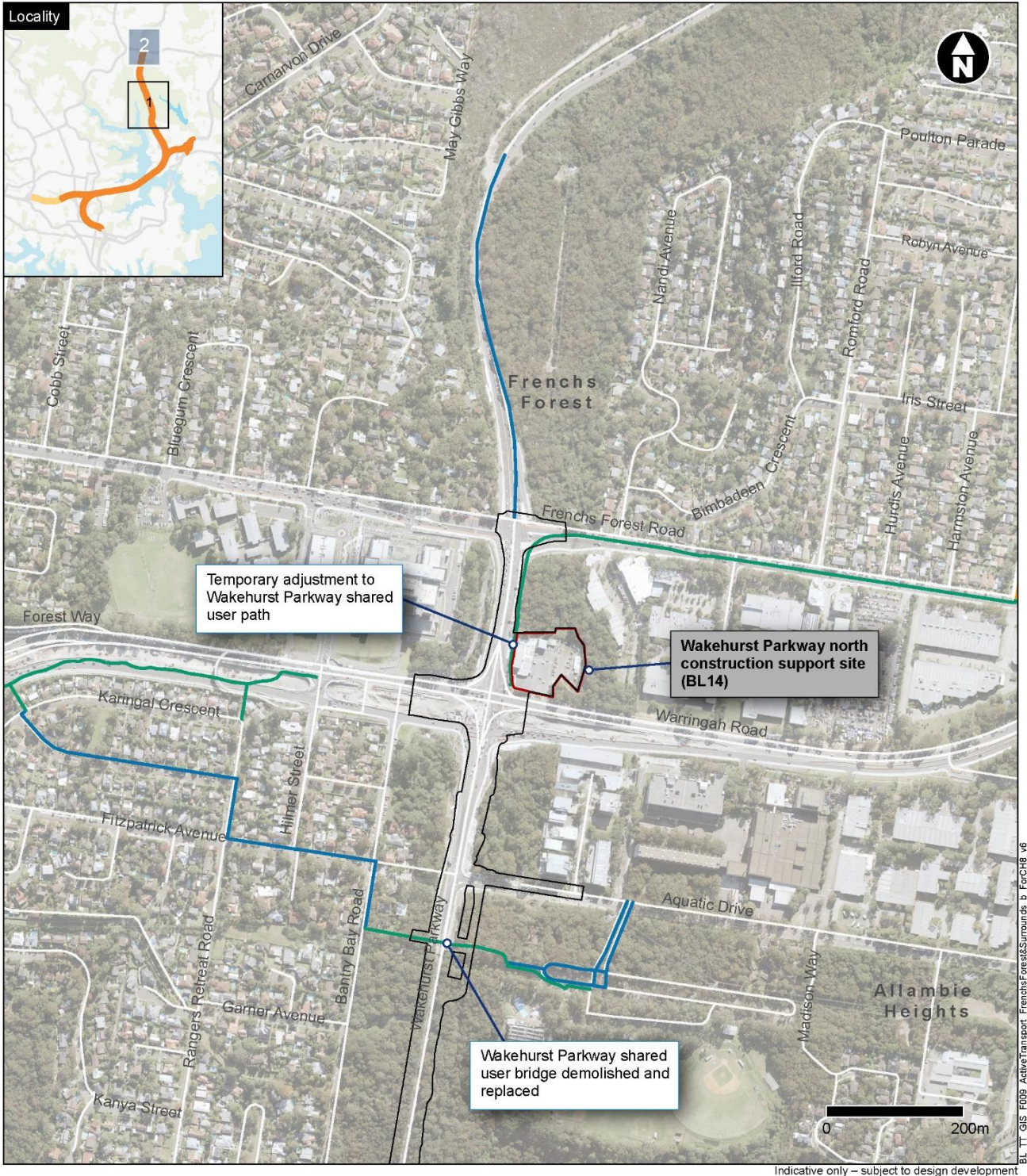


Figure 8-19 Active transport impacts within Frenchs Forest and surrounds (northern area) during construction (map 2)

8.4.6 Cumulative impacts of the project and the Western Harbour Tunnel and Warringah Freeway Upgrade project (Warringah Freeway and surrounds)

Peak cumulative construction traffic is expected in 2024, if construction of the project and the Western Harbour Tunnel and Warringah Freeway Upgrade project (subject to separate assessment and approval) are carried out concurrently.

Road network performance

Analysis of network performance in the AM and PM peak periods with the project and the Western Harbour Tunnel and Warringah Freeway Upgrade project indicates that, when compared to forecast 2024 peak period without the project conditions, cumulative construction activities in the Warringah Freeway and surrounds area have the potential to:

- Increase traffic demand by about one per cent
- Create less than one additional stop per trip
- Reduce average trip speeds by about four per cent.

Cumulative construction activities are therefore only expected to have minor and manageable impacts on overall network performance in the area.

General travel times

Modelled travel times during AM and PM peaks for key routes relevant to the project are presented in Table 8-23.

Under the cumulative construction 2024 scenario, travel times would increase by less than one minute for most routes. Predicted travel time increases between one and three minutes are expected for the following routes:

- Warringah Freeway: Gore Hill Freeway to Sydney Harbour Bridge (AM peak)
- Warringah Freeway: Gore Hill Freeway to Sydney Harbour Tunnel (AM peak)
- Warringah Freeway: Falcon Street to Sydney Harbour Bridge (PM peak)
- Miller Street: Amherst Street to Berry Street (AM peak)
- Miller Street: Berry Street to Amherst Street (PM peak).

Table 8-23 Modelled AM and PM peaks traffic travel times for key routes relevant to the project

Route/ Peak period	Direction	Base case 2024 (without construction traffic) (minutes : seconds)	Cumulative construction 2024 (with construction traffic) (minutes : seconds)
Sydney Harbour Bridge to Warringah Freeway/Falcon Street interchange			
AM peak	Northbound	04:42	04:39
	Southbound	04:02	04:01
PM peak	Northbound	03:43	03:45
	Southbound	04:16	05:32
Sydney Harbour Tunnel to Warringah Freeway/Falcon Street interchange			
AM peak	Northbound	03:51	03:57
	Southbound	04:06	04:03

Route/ Peak period	Direction	Base case 2024 (without construction traffic) (minutes : seconds)	Cumulative construction 2024 (with construction traffic) (minutes : seconds)
PM peak	Northbound	03:36	03:42
	Southbound	14:27	15:05
Sydney Harbour Bridge to Gore Hill Freeway/Pacific Highway interchange			
AM peak	Northbound	06:13	06:13
	Southbound	08:48	10:53
PM peak	Northbound	05:31	05:59
	Southbound	16:15	16:13
Sydney Harbour Tunnel to Gore Hill Freeway/Pacific Highway interchange			
AM peak	Northbound	05:22	05:28
	Southbound	08:50	11:21
PM peak	Northbound	05:19	06:01
	Southbound	19:51	20:20
Berry Street to Amherst Street via Miller Street			
AM peak	Northbound	04:10	04:05
	Southbound	07:48	09:22
PM peak	Northbound	04:34	05:36
	Southbound	13:45	10:39

As shown in Table 8-23, for Miller Street southbound the base case was observed to experience longer travel times in comparison to the 2024 cumulative construction scenario. Falcon Street/Military Road westbound between Ben Boyd Road and Miller Street is predicted experience a slight increase in congestion in the 2024 cumulative construction scenario when compared to the 2024 base case resulting in less throughput and delays at the Falcon Street left turn onto Miller Street. As the performance of the Miller Street corridor is sensitive to the traffic arrival rates from side streets, this reduction in throughput results in the observed improvement to the Miller Street southbound travel time in the 2024 cumulative construction scenario.

Intersection performance

The intersection performance results for the road network under the 'Base case 2024' (without construction vehicles) and 'Cumulative construction 2024' (with construction vehicles and proposed intersection modifications during construction) scenarios are detailed in Appendix F (Technical working paper: Traffic and transport) for the AM and PM peak periods.

In summary, the addition of construction traffic for both projects would impact the level of service at the following intersections:

- Willoughby Road/Gore Hill Freeway interchange would be reduced from LoS E to LoS F during the AM peak, and from LoS C to LoS D during the PM peak
- Brook Street/Warringah Freeway off ramp would be reduced from LoS E to LoS F during the AM peak
- Amherst Street/West Street would be reduced from LoS A to LoS B during the PM peak
- Amherst Street/Miller Street would be reduced from LoS B to LoS C during the PM peak

- Miller Street/Warringah Freeway off ramp would be reduced from LoS A to LoS C during the AM peak
- Miller Street/Falcon Street would be reduced from LoS D to LoS E during the AM peak
- Military Road/Ben Boyd Road would be reduced from LoS C to LoS D during the PM peak
- Mount Street/Arthur Street would be reduced from LoS E to LoS F during the PM peak
- Pacific Highway/Berry Street would be reduced from LoS B to LoS C during the PM peak
- Pacific Highway/Bay Road would be reduced from LoS E to LoS F during the AM peak
- High Street/Alfred Street North would be reduced from LoS A to LoS B during the AM peak
- Ernest Street/Ben Boyd Road would be reduced from LoS C to LoS D during the AM peak, and from LoS A to LoS B during the PM peak.

During the AM peak, intersections which would experience a material increase in average vehicle delay (around 30 to 40 seconds) during construction include Willoughby Road/Gore Hill Freeway interchange, intersection of Brook Street and Merrenburn Avenue and Brook Street/Warringah Freeway ramp.

During the PM peak, some intersections within the North Sydney area would experience a minor increase in average vehicle delay.

Road network changes and access arrangements

The Cammeray Golf Course construction support site (BL1) would be used for the Beaches Link and Gore Hill Freeway Connection project and the Western Harbour Tunnel and Warringah Freeway Upgrade project (subject to separate assessment and approval). This would result in cumulative traffic volumes generated to and from this site. The potential for cumulative travel impacts associated within these projects, including haulage roads and intersections traversed by construction vehicles during concurrent works, has been assessed in this section. If both projects are under construction concurrently, works at the Cammeray Golf Course construction support site (BL1) would be planned and programmed to manage any overlap between the two projects and minimise impacts on the surrounding road network and road users.

Impacts on public transport

In relation to bus times, cumulative construction activities in the Warringah Freeway and surrounds have the potential to impact corridor travel times by less than one minute for most routes. However, when compared to forecast 2024 peak period base conditions, there would be an increase in travel times between one and three minutes for the following routes:

- Southbound via Miller Street to the Sydney Harbour Bridge (AM peak)
- Northbound via the Warringah Freeway and Military Road to Ben Boyd Road (PM peak).

The most substantial potential impact is on southbound travel times via the Warringah Freeway. For Warringah Freeway routes, increased traffic demand, including potential additional traffic movements across the southbound bus lane south of Falcon Street, could increase congestion, which could impact bus travel times. This issue would be mitigated by considered and tailored construction traffic planning based on actual traffic conditions and confirmed cumulative activities at the time of construction.

Impacts on active transport and maritime activities

Impacts on active transport and maritime activities would be similar to those discussed in each of the sections above given the minimal overlap in construction activities associated with this project and the Western Harbour Tunnel and Warringah Freeway Upgrade project.

8.4.7 Cumulative impacts of the project and other projects

Peak construction activity for the project would not overlap with peak construction activities for other committed major infrastructure projects such as Sydney Metro City & Southwest and the M4-M5 Link.

There is potential for some overlap with the construction of the Sydney Metro West or other major projects within the Sydney metropolitan area, including the Channel 9 site staged residential development. Spoil trucks and other construction vehicles associated with these projects have the potential to generate cumulative impacts on the broader road network. Overall, given that spoil trucks for the project and any overlapping major projects would predominantly use only major arterial roads, potential cumulative impacts would be minor.

8.4.8 Special events impacts

Construction works would have minimal impacts on special events as the temporary construction support sites and traffic routes would not be located near venues or locations that regularly schedule events that require traffic or public transport event plans.

Water based races within Middle Harbour held by the recreational clubs along the foreshore may be impacted by marine construction traffic, as identified in Section 8.4.3.

8.5 Environmental management measures

Environmental management measures relating to construction traffic and transport impacts are outlined in Table 8-24. Environmental management measures relating to cumulative impacts, including coordination of haulage routes and road occupancy, are detailed in Chapter 27 (cumulative impacts).

Table 8-24 Environmental management measures - construction traffic and transport

Ref	Phase	Impact	Environmental management measure	Location
CTT1	Pre-construction	Construction traffic	A road condition report will be prepared, in consultation with relevant councils and road owners, identifying existing conditions of local roads that will be used by heavy vehicles associated with the project and mechanisms to repair damage to the road network (beyond normal wear and tear) caused by these movements.	BL/GHF
CTT2	Pre-construction	Maritime construction	Transport for NSW will consult with the owners and/or leaseholders and/or licence holders of jetties and moorings that require temporary relocation to determine alternative arrangements. Moorings impacted during construction will be temporarily relocated elsewhere in Middle Harbour in consultation with the lease holder(s) and coordination with the Port Authority of NSW. All efforts will be made to relocate facilities as close to their original locations as possible. Impacted mooring licence holders may be entitled to a fee waiver or fee reimbursement where appropriate.	BL

Ref	Phase	Impact	Environmental management measure	Location
CTT3	Construction	Maritime construction traffic	Construction vessels will be required to operate in a manner that minimises wash to areas of shoreline.	BL
CTT4	Construction	Maritime construction traffic	Construction marine traffic activities will be scheduled to avoid times and locations of high recreational marine traffic where feasible and reasonable.	BL
CTT5	Construction	Maritime construction traffic	Harbour closures scheduling will be carried out in consultation with Port Authority of NSW, other divisions of Transport for NSW and other relevant stakeholders.	BL
CTT6	Construction	Construction traffic	Ongoing consultation, as relevant to the location, will be carried out with Greater Sydney Operations, the Port Authority of NSW, local councils, emergency services and bus operators to minimise traffic and transport impacts.	BL/GHF
CTT7	Construction	Construction traffic	The community will be notified in advance of proposed transport network changes, and maritime restrictions through appropriate media and other appropriate forms of community liaison.	BL/GHF
CTT8	Construction	Construction traffic	Construction road traffic will be managed to minimise impacts of movements during peak periods where feasible and reasonable.	BL/GHF
CTT9	Construction	Construction traffic	Vehicle movements to and from construction sites will be managed to ensure pedestrian, cyclist and road user safety. Depending on the location, this may require manual supervision, physical barriers, temporary traffic signals and modifications to existing signals or, on occasion, police presence.	BL/GHF
CTT10	Construction	Construction traffic	Directional signage, barriers and/or linemarking will be used as required to direct and guide motorists, cyclists and pedestrians past construction sites and on the surrounding network. This will be supplemented by Variable Message Signs to advise all road users of potential delays, traffic diversions, speed restrictions or alternative routes.	BL/GHF

Ref	Phase	Impact	Environmental management measure	Location
CTT11	Construction	Construction traffic	Where provision of construction on-site parking cannot accommodate the full construction workforce, construction worker parking will be actively managed to minimise impacts on parking on local roads. Depending on the location, this will include encouraging the use of public transport and may include provision of shuttle buses for workforce transport where appropriate.	BL/GHF
CTT12	Construction	Construction traffic	Any adjustments to existing bus stops will be determined in consultation with relevant stakeholders including other divisions of Transport for NSW and advanced notification would be provided to affected bus customers. Relocations will be as close to their existing position where feasible and reasonable.	BL/GHF
CTT13	Construction	Construction traffic	Truck marshalling areas will be identified and used where feasible and reasonable, to minimise potential queueing and traffic and access disruptions in the vicinity of construction support sites.	BL/GHF
CTT14	Construction	Construction traffic	Activities requiring temporary partial road closures will be carried out outside of peak periods and/or during night time to minimise the impact of these activities on the road network where feasible and reasonable.	BL/GHF
CTT15	Construction	Construction traffic	Direct impacts to existing pedestrian and cycling facilities will be minimised where reasonable and feasible. Any detours and adjustments will be designed with consideration of user safety and convenience.	BL/GHF
CTT16	Construction	Maritime construction impacts	Consultation will be carried out with surrounding water based users of Middle Harbour including Mosman Rowing Club and Northbridge Sailing Club to minimise construction impacts.	BL

Note: BL = Beaches Link, GHF = Gore Hill Freeway Connection