6.0 The M2 Upgrade Project

The NSW Government and Transurban, the operator of the M2, have agreed in principle to investigate the economic, social, environmental and financial viability of a significant upgrade of the M2.

6.1 Background

Significant commercial and residential growth in Sydney's north-west has increased peak period congestion on the M2, affecting motorists, bus passengers and businesses. On a typical work day, the M2 is used by over 100,000 vehicles and 435 Hills bus services carry over 17,000 passengers.

An upgrade of M2 will provide relief from peak period congestion and ensure that this essential transport corridor can accommodate the predicted business and residential growth over the next 25 years. Current planning for Sydney's North-West includes the establishment of 140,000 new homes and 100,000 new jobs over the next 25 years.

A technical M2 Upgrade proposal was developed by Transurban and submitted to the NSW Roads and Traffic Authority (RTA) in December 2007. The project was developed in accordance with the NSW Working with Government Guidelines for Privately Financed Projects.

The M2 Upgrade project is expected to create at least 800 new construction and engineering jobs through the life of the project.

6.2 Project details

Transurban developed the "M2 Upgrade Project" to address increasing traffic congestion by widening and upgrading critical sections of M2. It will improve accessibility to major growth areas, provide for better traffic management and safety systems, as well as new cycling and bus facilities.

The M2 Upgrade Project scope reflects comments/suggestions received from a range of stakeholders, including motorists, cyclists, local bus companies, local councils, business and the broader community.

The proposed M2 Upgrade has been declared a Major Project for the purpose of seeking planning approval. It will be assessed under Part 3A of the Environmental Planning and Assessment Act 1979.

The M2 Upgrade will include:

- Physical widening eastbound from Windsor Road on-ramp to Pennant Hills Road off-ramp by one additional lane;
- Physical widening eastbound and westbound from Pennant Hills Road to Beecroft Road by one additional lane in each direction. The bus on/off ramps near Beecroft Road would be removed to minimise land acquisition required to provide additional lanes;
- Physical widening eastbound from Beecroft Road to Lane Cove Road by one additional lane. One of the eastbound lanes east of Terrys Creek would be marked as a transit lane;
- Physical widening westbound from Lane Cove Road to Beecroft Road to reinstate the breakdown lane and provide wider through lanes;
- Physical widening of Norfolk Tunnel just east of Beecroft Road eastbound and westbound to provide an additional lane eastbound and wider lanes westbound;
- Provision of new west facing on/off-ramps at Windsor Road, Baulkham Hills. Windsor Road will be widened to accommodate turning movements between Torrs Street and Woodlands Street;
- Provision of new east facing on-ramp at Christie Road, Macquarie Park;
- Provision of new east facing off-ramp at Herring Road/Talavera Road, Macquarie Park;
- Improvement and physical widening of Talavera Road, Macquarie Park, between the entrance of Macquarie Graduate School and Alma Road to provide two through lanes in each direction with a right turn bay;
- Physical widening of Christie Road bridge, Macquarie Park, to 5 lanes over the M2 Motorway including the provision of new traffic control signals on Christie Road at the northern ramps;

- Bridge modifications on the M2 between Windsor Road and Christie Road to accommodate the widening work; and
- Intelligent Transport System (ITS) upgrades along the corridor including upgrade to the cableway.

The project is illustrated below in Figure 28.

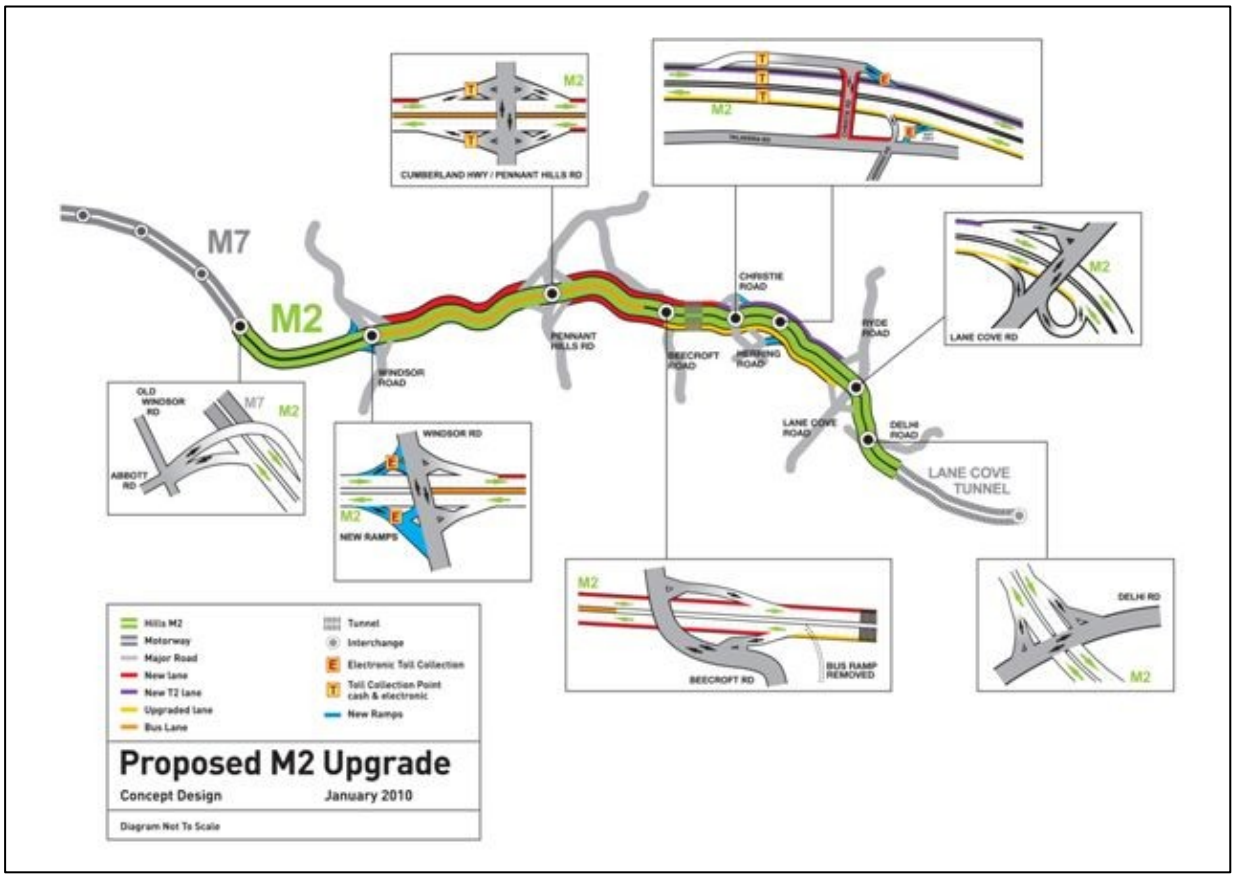


Figure 28 - M2 Upgrade Project

The proposed M2 Upgrade scope seeks to provide significantly improved travel conditions within the M2 whilst cognisant of capacity constraints at the eastern and western ends of the motorway (i.e. interface with Lane Cove Tunnel and Westlink M7). This will ensure that the widening has minimal impact on the greater network, particularly at the bridges and tunnels crossing Sydney Harbour.

Construction is expected to begin in September 2010 with a construction period of two years.

6.3 Project Objectives

The M2 provides connectivity and capacity for commuter, commercial, freight and road-based public transport. The proposed M2 Upgrade is significant to the Sydney Region as it will improve traffic flow and reduce bus travel times. The following are a summary of traffic objectives of the project:

- Support the NSW Government's State Plan, Metropolitan Strategy, Urban Transport Statement and State Infrastructure Strategy;
- Enhance the strategic road network in Sydney's north west to support economic growth;
- Connectivity between key traffic generators, residential, employment and educational precincts;

- Heavy and commercial vehicle growth to improve access and connectivity between key residential, employment and educational precincts in Sydney's north west;
- Improved safety through reduced accident rates for local and regional traffic;
- Improve travel times and network reliability by reducing congestion during peak periods for the benefit of local and regional traffic;
- Enhanced capacity of the corridor;
- Improve safety and amenity for all road users and surrounding communities;
- Improved incident management measures;
- Relieve traffic pressure on surrounding local traffic routes;
- Provide opportunities to improve land based public transport;
- Improved bus travel times and reliability;
- Improved public transport accessibility in the North West Corridor.

Section 7 of this report provides an operational impact assessment with regard to these objectives.

7.0 Operational Impact Assessment of M2 Upgrade

This section will address the DGRs relating to operation impacts of the M2 Upgrade, which are as follows:

DGRs – Operational Traffic and Transport
The Environmental Assessment must include an assessment of the operational impacts of the project, including: ▪ *traffic levels on the M2 Motorway and the impacts on the surrounding road network, including any impacts on the Lane Cove Tunnel, the M7 Westlink Motorway, and the surrounding local and regional road network.* ▪ *The assessment must also consider operational implications for public transport (particularly with respect to bus routes, interchanges and connections with the rail network), impacts on cyclists and cycle access, and any impacts on pedestrian access and safety (for those ancillary works around the Motorway corridor, as relevant).*

The M2 Upgrade project objectives include reducing levels of congestion and improving accessibility. The upgrade will result in overall reduction in travel delay; however there may be parts of the network where the upgrade may result in increased traffic volumes and localised increases in delay.

This section presents the forecast of traffic changes and effects from the Proposal by describing:-

- The Strategic Level changes – namely vehicle kilometres and vehicle hours resulting from the M2 Upgrade;
- LoS of Road Links- as defined by the US Transport and Research Board 2000 Highway and Capacity Manual.;
- Travel speeds and times;
- Intersection Operations which use a LoS descriptor for intersections as defined by the RTA;
- Road Safety; and
- Impacts on public transport.

This section presents two different future scenarios. The first future scenario being “No M2 Upgrade”, which is presented as the “base” scenario. The second scenario being with the “M2 Upgrade Project”, which is presented as the “M2 Upgrade” scenario.

7.1 Strategic Level Changes in Road Network Performance

The predicted change in travel demands on the Sydney network is shown in Table 35. The likely change in hours travelled in Table 36 and average vehicle speeds on the future network are shown by Table 37[15].

While the overall change in network vehicle kilometres travelled is small, there is an expected shift in travel from arterial and local roads (of between 0.2% - 0.5%) to travel on Motorways (0.6%) on the network. The majority of this predicted change will be within the M2 corridor, influenced by the M2 Upgrade.

There will be an overall significant reduction in vehicle hours travelled (Table 36), with up to 8.3% reduction on motorways as a result of the M2 Upgrade. Likewise, when travel speeds are compared with the “No M2 Upgrade” scenario (Table 37), the M2 Upgrade improves overall travel speed performance, including service levels for buses on the corridor.

15 The annual figures below have been calculated using the following methodology:

1. Average workday VKT and VHT summed from TUSTM four model periods – AM, IP, PM, NT
2. Annual VKT and VHT converted using an annualisation factor of 325

Table 35 - Forecast Annual Road Network Vehicle Kilometres Travelled (VKT) (millions kilometres)

Facility	2011 Base	2011 M2 Upgrade	Impact	2021 Base	2021 M2 Upgrade	Impact
Motorway	8,697	8,749	0.6%	9,862	9,924	0.6%
Arterial	14,379	14,347	-0.2%	16,407	16,368	-0.2%
Local / Sub Arterial	7,302	7,280	-0.3%	8,668	8,628	-0.5%
Sydney Network	30,379	30,376	0.0%	34,936	34,920	0.0%

Table 36 - Future Annual Road Network Vehicle Hours Travelled (VHT) (million hours)

Facility	2011 Base	2011 M2 Upgrade	Impact	2021 Base	2021 M2 Upgrade	Impact
Motorway	113.0	112.51	-0.4%	156.89	143.82	-8.3%
Arterial	351.0	348.55	-0.7%	431.70	427.95	-0.9%
Local / Sub Arterial	209.9	209.05	-0.4%	276.62	274.30	-0.8%
Sydney Network	673.8	670.10	-0.6%	853.58	846.07	-0.9%

Table 37 - Future Annual Road Network Annual Average Vehicle Speeds (kilometres per hour)

Facility	2011 Base	2011 M2 Upgrade	Impact	2021 Base	2021 M2 Upgrade	Impact
Motorway	77.0	77.8	1.0%	62.9	69.0	9.8%
Arterial	41.0	41.2	0.5%	38.0	38.2	0.6%
Local / Sub Arterial	34.8	34.8	0.1%	31.3	31.5	0.4%
Sydney Network	45.1	45.3	0.5%	40.9	41.3	0.8%

7.2 Traffic Performance of Road Links

7.2.1 Hills M2 AM Peak Flow and Resultant Levels of Service

Table 38 shows the forecast change in AM peak flows on each section and direction of the M2. As in Section 5.1, LoS has been taken at the merge point of on-ramps if present. In the upgrade case where there is no required merge with the mainline traffic, LoS has been determined on the basis of capacity and demand. In the eastbound direction, AM peak flows on a widened M2 will increase west of Pennant Hills Road by 2011 (by up to 1,350 vehicles per hour compared with the "No M2 Upgrade" scenario. Westbound peak volumes will increase less (by up to 650 vehicles per hour).

While M2 peak volumes will increase, peak volumes on competing routes such as Epping Road and North Rocks Road will reduce. This is shown in Figure 31 which illustrates those links on the network which would benefit from the increased volumes on the M2 (shown in green in Figure 31)

The levels of service on a widened M2 during peak periods (AM and PM) will improve compared with the "No M2 Upgrade" scenario, as shown on Table 38.

The LoS F shown for the section between Beecroft Road and the Main Toll Plaza may not occur. The analysis indicates that the M2 Upgrade improves the eastbound Beecroft Road merge density, however the forecast performance of this section of the motorway currently reflects a conservative assumption with

regard to uptake of the T2 lane based on surveys of vehicle occupancy undertaken under current conditions (without any incentive for car pooling).[16] However, the introduction of the T2 lane is designed to encourage car pooling. Such increases in car pooling and T2 occupancy rates would see an improvement in the forecast LoS F in this section. The operation of the T2 lane will be further investigated using micro simulation as part of detailed design.

Table 38 - Changes to M2 AM LoS

EASTBOUND DIRECTION					
From	To	2011 Base	2011 M2 Upgrade	2021 Base	2021 M2 Upgrade
Old Windsor Road	Windsor Road	C	**C**	D	**D**
Windsor Road	Pennant Hills Road	D+	C	F+	D
Pennant Hills Road	Beecroft Road	D+	D	F+	D
Beecroft Road	Christie Road	F+	D+	F+	F+
Christie Road	Lane Cove Road	D	C+	E	D+
Lane Cove Road	Delhi Road	C	**D**	D	**E**
Delhi Road	Epping Road	B	**C**	B	**C**

WESTBOUND DIRECTION					
From	To	2011 Base	2011 M2 Upgrade	2021 Base	2021 M2 Upgrade
Epping Road	Delhi Road	A	**B**	B	**C**
Delhi Road	Lane Cove Road	B+	**B+**	B+	**C+**
Lane Cove Road	Herring Road	B+	B+	C+	C+
Herring Road	Beecroft Road	B+	B+	C+	B+
Beecroft Road	Pennant Hills Road	C	B	D	C
Pennant Hills Road	Windsor Road	C+	**C+**	D+	**D+**
Windsor Road	Old Windsor Road	C	**C+**	C	**D+**

Note: **Items marked bold are not widened**
[+] indicates LoS based on constraints at on-ramp merge point.

[16] Occupany surveys undetaken by AusTraffic on Friday April 11, 2008. Surveys indicated only 13% of AM peak EB traffic between Beecroft Road and Christie Road had 2 or more occupants.

7.2.2 Hills M2 PM Peak Flow and Resultant LoS

Table 39 shows the forecast change in PM peak flows on each section and direction of the M2.

The predicted traffic volumes on M2 will increase less in the afternoon peak periods compared with the morning peaks. The changes would be between 350 and 700 per hour eastbound and between 150-850 vehicles per hour westbound

The LoS F between Pennant Hills Road and Windsor Road occurs from high volumes of merging traffic from Pennant Hills Road. Under a no project scenario this section of motorway reaches LoS F by 2011. Under the M2 Upgrade scenario this section remain LoS F from 2011, however the merge density does not get any worse (refer Appendix C). This section of the motorway only reflects LoS F for the PM peak hour and operates at a better LoS for the remaining time periods.

Table 39 - Changes to M2 PM LoS

EASTBOUND DIRECTION					
From	To	2011 Base	2011 M2 Upgrade	2021 Base	2021 M2 Upgrade
Old Windsor Road	Windsor Road	C	**C**	D	**D**
Windsor Road	Pennant Hills Road	C+	C	D+	C
Pennant Hills Road	Beecroft Road	C+	B	C+	C
Beecroft Road	Christie Road	C+	B+	D+	C+
Christie Road	Lane Cove Road	C	B+	D	C+
Lane Cove Road	Delhi Road	B	**C**	D	**D**
Delhi Road	Epping Road	B	**B**	C	**C**

WESTBOUND DIRECTION					
From	To	2011 Base	2011 M2 Upgrade	2021 Base	2021 M2 Upgrade
Epping Road	Delhi Road	C	**C**	D	**D**
Delhi Road	Lane Cove Road	C+	D+	D+	D+
Lane Cove Road	Herring Road	C+	D+	D+	D+
Herring Road	Beecroft Road	D+	D+	D+	D+
Beecroft Road	Pennant Hills Road	F	D	F	D
Pennant Hills Road	Windsor Road	F+	**F+**	F+	**F+**
Windsor Road	Old Windsor Road	D	**D**	D	**D**

Note: **Items marked bold are not widened**
+ indicates LoS based on constraints at on-ramp merge point.

7.2.3 Daily Impacts

Table 40 shows the forecast change in daily volumes on each section and direction of M2. While no direct LoS can be calculated from daily volumes, the table below is useful in demonstrating that the overall forecast impact is relatively moderate in a daily sense, with a maximum increase in the eastbound direction of 4,910 vehicles by 2021 in the section between Christie Road and Lane Cove Road. This increase can be attributed to increased volumes as a result of the eastbound widening and new trips to the M2 from the new Herring Road Ramps. The maximum daily increase in the westbound direction is 6,900 vehicles in same section.

Table 40 - Forecast Daily Impacts M2

EASTBOUND DIRECTION							
From	To	2011 Base	2011 Upgrade	2011 Impact	2021 Base	2021 Upgrade	2021 Impact
Old Windsor Road	Windsor Road	31,800	33,950	2,150	37,550	40,050	2,500
Windsor Road	Pennant Hills Road	41,200	42,000	800	49,750	51,330	1,580
Pennant Hills Road	Beecroft Road	36,150	37,450	1,300	44,750	46,830	2,080
Beecroft Road	Christie Road	40,350	42,100	1,750	49,250	51,830	2,580
Christie Road	Lane Cove Road	36,250	40,070	3,820	42,900	47,810	4,910
Lane Cove Road	Delhi Road	26,950	30,670	3,720	32,500	37,310	4,810
Delhi Road	Epping Road	19,200	21,920	2,720	25,850	29,810	3,960

WESTBOUND DIRECTION							
From	To	2011 Base	2011 Upgrade	2011 Impact	2021 Base	2021 Upgrade	2021 Impact
Epping Road	Delhi Road	18,750	21,450	2,700	24,300	27,800	3,500
Delhi Road	Lane Cove Road	27,200	31,600	4,400	30,500	35,250	4,750
Lane Cove Road	Herring Road	36,150	42,350	6,200	40,200	47,100	6,900
Herring Road	Beecroft Road	40,800	44,130	3,330	47,250	50,920	3,670
Beecroft Road	Pennant Hills Road	37,750	41,480	3,730	43,600	47,720	4,120
Pennant Hills Road	Windsor Road	43,750	45,280	1,530	50,350	52,020	1,670
Windsor Road	Old Windsor Road	33,300	38,280	4,980	37,350	42,715	5,365

7.2.4 New Access – Windsor Road Ramps

The proposed Windsor Road west facing ramps will significantly increase the accessibility of the Baulkham Hills area to the motorway network (travelling both in eastbound and westbound directions) and the employment hubs.

Figure 29 below shows forecast origins and destinations of vehicles using the west facing Windsor Road ramps at opening. The blue line represents traffic using the new west facing off-ramp, and the green line the new west facing on-ramp. A high proportion of vehicles using the ramps will be local trips accessing the suburbs within the Hills District. In particular, the suburbs of North Rocks, Baulkham Hills and Parramatta. The impact of the additional trips forecast for the Windsor Road interchange is addressed in section 7.4.3.

Table 41 below summarise forecast AM, PM peak hour ramp traffic. The dominant direction of travel in the AM peak is forecast to be eastbound and westbound during the PM peak.

Table 41 - Forecast New Ramp Traffic (Windsor Road)

Windsor Road Ramps	2011 AM Peak	2021 AM Peak	2011 PM Peak	2021 PM Peak	2011 Daily	2021 Daily
Eastbound Off-Ramp	420	450	230	250	3,800	4,120
Westbound On-Ramp	230	250	420	450	3,800	4,120

Figure 29 – Forecast Origins and Destinations of New West Facing Windsor Road Ramps traffic (Opening)

Using TUSTM the impact of the proposed ramps on the network traffic has been estimated. The development of the Project would lead to a redistribution of traffic on the road network. This redistribution results in a decrease in traffic on some roads and an increase on others. The project impact assessment identifies and quantifies both traffic increase and decrease of the network links.

The proposed ramps would remove traffic from the local road network. Figure 31 illustrates the change in volumes on links in 2021 compared with the "No M2 Upgrade" scenario. Seven Hills Road, Old Windsor Road, Power Road and Station Road are links that would have lower traffic as a result of introducing the Windsor Road West facing ramps. A summary of the forecast traffic impacts on key local roads is presented in Table 78, Table 79, Table 80 and Table 81

TUSTM forecasts that the proposed ramps would increase traffic on the western end of the M2 and Windsor Road, however there would be lower traffic on the northern sections of the Windsor Road north of Old Northern Road. Effects of increased traffic along Windsor Road and the performance of the modified Windsor Road/M2 junction are discussed in more detail in section 7.4.1.

7.2.5 New M2 Access – East Facing Herring/Christie Road Ramps

The proposed east facing Herring/Christie Road ramps will provide motorway access to Macquarie Park from the business districts of Chatswood, North Sydney and Sydney.

Figure 30 below shows forecast origins and destinations of vehicles using the new ramps at Herring Road (east facing exit ramp) and Christie Road (east facing entry ramp). The blue line represents traffic using the new east facing on-ramp, and the green line the new west facing off- ramp. The analysis shows that the majority of vehicles using the ramps will be local trips in the Macquarie Park and Macquarie University area. Trips from this local area using the new ramps extend to locations as far as the Sydney CBD and the suburbs surrounding the Sydney Airport via the interconnecting motorway system through LCT.

Table 42 below summarises forecast AM, PM peak hour ramp traffic. In the morning peak the dominant direction of travel is north-west bound, and caters for commuters travelling to Macquarie Park from the south east. In the evening peak the dominant direction of travel is reversed.

Table 42 - Forecast New Ramp Traffic (Christie/Herring)

Ramps	2011 AM Peak	2021 AM Peak	2011 PM Peak	2021 PM Peak	2011 Daily	2021 Daily
Macquarie Exit-Christie Road Eastbound On Ramp	150	200	300	350	2,320	2,680
Macquarie Exit-Herring Road Westbound Off Ramp	400	450	130	150	3,170	3,680

Figure 30 – Forecast Origins and Destinations of new East Facing Herring/Christine Road Ramp traffic (opening)

Using TUSTM the impact of the proposed ramps on the network traffic has been estimated. The development of the Project would lead to a redistribution of traffic on the road network. This redistribution results in a decrease in traffic on some roads and an increase on others. The project impact assessment identifies and quantifies both traffic increase and decrease of the network links.

The proposed ramps would remove traffic from local road network. Figure 31 illustrates the change in volumes on links in 2021 compared with the "No M2 Upgrade" scenario. Sections of Lane Cove Road, Waterloo Road and Talavera Road are the links that would have lower traffic as a result of introducing the new ramps. A summary of the forecast traffic impacts on key local roads is presented in Table 78, Table 79, Table 80 and Table 81.

TUSTM forecasts that the proposed ramps would increase traffic within the immediate vicinity of the new ramp along Talavera Road. Effects of increased traffic along Talavera Road and the performance of the widened and modified junction are discussed in more detail in section 7.4.1.

7.2.6 Effects on the surrounding road network

As previously discussed, Figure 31 illustrates the change in volumes on links in 2021 compared with the "No M2 Upgrade" scenario. Access roads to the M2 attract additional traffic in both the eastbound and westbound direction. As can be seen from Figure 31, the majority of the network in the corridor, including routes that compete with M2, such as Epping Road will benefit with significantly reduced traffic volumes from the M2 Upgrade. Individual forecast link volumes on local roads are shown in Table 78, Table 79, Table 80 and Table 81. The screenline reference refers to those shown on Figure 15.

7.2.6.1 AM Peak Conditions

Table 43 presents the forecast change in AM peak LoS on each of the local roads of the study area screenlines.

Table 43 - Changes in Local Road LoS (AM Peak)

SCL	DIR	Location	Type	2011 Base	2011 M2 Upgrade	2021 Base	2021 M2 Upgrade
1A	EB	Norwest Boulevard East of Old Windsor Road	Arterial	F	F	F	F
1B	EB	Seven Hills Road East of Merindah Road	Arterial	C	B	E	B
1D	EB	Abbott Road East of Old Windsor Road	Major Arterial	A	A	B	C
1E	EB	Old Windsor Road North of Gibbon Road	Major Arterial	F	F	F	F
1F	EB	Powers Road East of Station Road	Sub-Arterial	D	C	F	D
1G	EB	Station Road @ Mc Coy Park	Sub-Arterial	D	C	E	D
2A	EB	Castle Hill Road East of Old Northern Road	Major Arterial	F	C	F	F
2B	EB	Renown Road East of Cook Street	Sub-Arterial	F	F	F	F
2D	EB	James Ruse Road East of Windsor Road	Major Arterial	F	F	F	F
2E	EB	Church Street South of Briens Road	Major Arterial	F	F	F	F
3A	EB	The Comenarra Parkway East of Fox Valley Road	Sub-Arterial	F	F	F	F
3C	EB	Epping Road West of Vimiera Road	Major Arterial	F	F	F	F
4A	SB	Windsor Road North of M2	Major Arterial	E*	B*	F*	D*
4B	SB	Oakes Road North of M2	Sub-Arterial	F	F	F	F
4C	SB	Pennant Hills Road North of M2	Major Arterial	F	F	F	F
4D	SB	Murray Farm Road @ M2	Collector	D	D	F	F
4E	SB	Beecroft Road North of M2	Major Arterial	E	D	F	F
4F	SB	Ryde Road South of Lady Game Drive	Major Arterial	F	F	F	F

SCL	Dir	Location	Type	2011 Base	2011 M2 Upgrade	2021 Base	2021 M2 Upgrade
1A	WB	Norwest Boulevard East of Old Windsor Road	Arterial	B	B	B	B
1B	WB	Seven Hills Road East of Merindah Road	Arterial	F	F	F	F
1D	WB	Abbott Road East of Old Windsor Road	Major Arterial	A	A	B	C
1E	WB	Old Windsor Road North of Gibbon Road	Major Arterial	E	C	F	E
1F	WB	Powers Road East of Station Road	Sub-Arterial	B	B	C	C
1G	WB	Station Road @ Mc Coy Park	Sub-Arterial	D	C	E	D
2A	WB	Castle Hill Road East of Old Northern Road	Major Arterial	C	C	D	B
2B	WB	Renown Road East of Cook Street	Sub-Arterial	F	F	F	F
2D	WB	James Ruse Road East of Windsor Road	Major Arterial	E	E	F	F
2E	WB	Church Street South of Briens Road	Major Arterial	F	F	F	F
3A	WB	The Comenarra Parkway East of Fox Valley Road	Sub-Arterial	E	E	F	E
3C	WB	Epping Road West of Vimiera Road	Major Arterial	F	F	F	F
4A	NB	Windsor Road North of M2	Major Arterial	A*	C*	A*	C*
4B	NB	Oakes Road North of M2	Sub-Arterial	C	B	E	C
4C	NB	Pennant Hills Road North of M2	Major Arterial	C	B	F	E

SCL	DIR	Location	Type	2011 Base	2011 M2 Upgrade	2021 Base	2021 M2 Upgrade
4D	NB	Murray Farm Road @ M2	Collector	A	A	A	A
4E	NB	Beecroft Road North of M2	Major Arterial	B	B	B	B
4F	NB	Ryde Road South of Lady Game Drive	Major Arterial	C	C	F	F

As discussed in Section 7.2.1 and 7.2.2, the M2 Upgrade will improve LoS along the motorway, which will subsequently encourage transfer of traffic from the arterial network to the motorway and result in lower traffic and improved speeds on a number of key arterial roads. As shown in Table 43, during the AM peak it is forecast that Seven Hills Road, Powers Road, Station Road, Castle Hill Road, Old Windsor Road, Oaks Road and Pennant Hills Road will all benefit from reduced traffic volume and improved LoS and speeds. Furthermore, although Table 43 indicates that both Ryde Road and Norwest Boulevard do not show any improvement in LoS, both of these roads will benefit from reduced traffic volumes as a result of the project.

A key factor in route level of service is the efficiency of intersections. Section 7.4 presents an analysis of intersection performance.

7.2.6.2 PM Peak Conditions

Table 44 presents the forecast change in AM peak LoS on each of the local roads of the study area screenlines.

Table 44 - Changes in Local Road LoS (PM Peak)

SCL	DIR	Location	Type	2011 Base	2011 M2 Upgrade	2021 Base	2021 M2 Upgrade
1A	EB	Norwest Boulevard East of Old Windsor Road	Arterial	B	B	E	D
1B	EB	Seven Hills Road East of Merindah Road	Arterial	B	B	C	B
1D	EB	Abbott Road East of Old Windsor Road	Major Arterial	A	A	A	C
1E	EB	Old Windsor Road North of Gibbon Road	Major Arterial	F	C	F	F
1F	EB	Powers Road East of Station Road	Sub-Arterial	B	B	C	C
1G	EB	Station Road @ Mc Coy Park	Sub-Arterial	B	B	C	B
2A	EB	Castle Hill Road East of Old Northern Road	Major Arterial	F	F	F	F
2B	EB	Renown Road East of Cook Street	Sub-Arterial	A	A	A	A
2D	EB	James Ruse Road East of Windsor Road	Major Arterial	B	B	C	B
2E	EB	Church Street South of Briens Road	Major Arterial	F	F	F	F
3A	EB	The Comenarra Parkway East of Fox Valley Road	Sub-Arterial	C	C	C	B
3C	EB	Epping Road West of Vimiera Road	Major Arterial	F	F	F	F
4A	SB	Windsor Road North of M2	Major Arterial	E*	B*	E*	C*
4B	SB	Oakes Road North of M2	Sub-Arterial	E	C	F	E
4C	SB	Pennant Hills Road North of M2	Major Arterial	D	C	E	B
4D	SB	Murray Farm Road @ M2	Collector	A	A	A	A
4E	SB	Beecroft Road North of M2	Major Arterial	B	B	B	B
4F	SB	Ryde Road South of Lady Game Drive	Major Arterial	F	E	F	F

SCL	Dir	Location	Type	2011 Base	2011 M2 Upgrade	2021 Base	2021 M2 Upgrade
1A	WB	Norwest Boulevard East of Old Windsor Road	Arterial	B	B	F	F
1B	WB	Seven Hills Road East of Merindah Road	Arterial	C	C	F	F
1D	WB	Abbott Road East of Old Windsor Road	Major Arterial	A	A	B	C

SCL	DIR	Location	Type	2011 Base	2011 M2 Upgrade	2021 Base	2021 M2 Upgrade
1E	WB	Old Windsor Road North of Gibbon Road	Major Arterial	F	C	F	F
1F	WB	Powers Road East of Station Road	Sub-Arterial	C	B	D	B
1G	WB	Station Road @ Mc Coy Park	Sub-Arterial	B	B	C	C
2A	WB	Castle Hill Road East of Old Northern Road	Major Arterial	F	F	F	B
2B	WB	Renown Road East of Cook Street	Sub-Arterial	F	F	F	F
2D	WB	James Ruse Road East of Windsor Road	Major Arterial	C	C	E	C
2E	WB	Church Street South of Briens Road	Major Arterial	F	F	F	F
3A	WB	The Comenarra Parkway East of Fox Valley Road	Sub-Arterial	F	F	F	F
3C	WB	Epping Road West of Vimiera Road	Major Arterial	F	F	F	F
4A	NB	Windsor Road North of M2	Major Arterial	A*	C*	A*	C*
4B	NB	Oakes Road North of M2	Sub-Arterial	C	C	D	B
4C	NB	Pennant Hills Road North of M2	Major Arterial	F	E	F	F
4D	NB	Murray Farm Road @ M2	Collector	A	A	A	A
4E	NB	Beecroft Road North of M2	Major Arterial	D	C	F	F
4F	NB	Ryde Road South of Lady Game Drive	Major Arterial	F	E	F	F

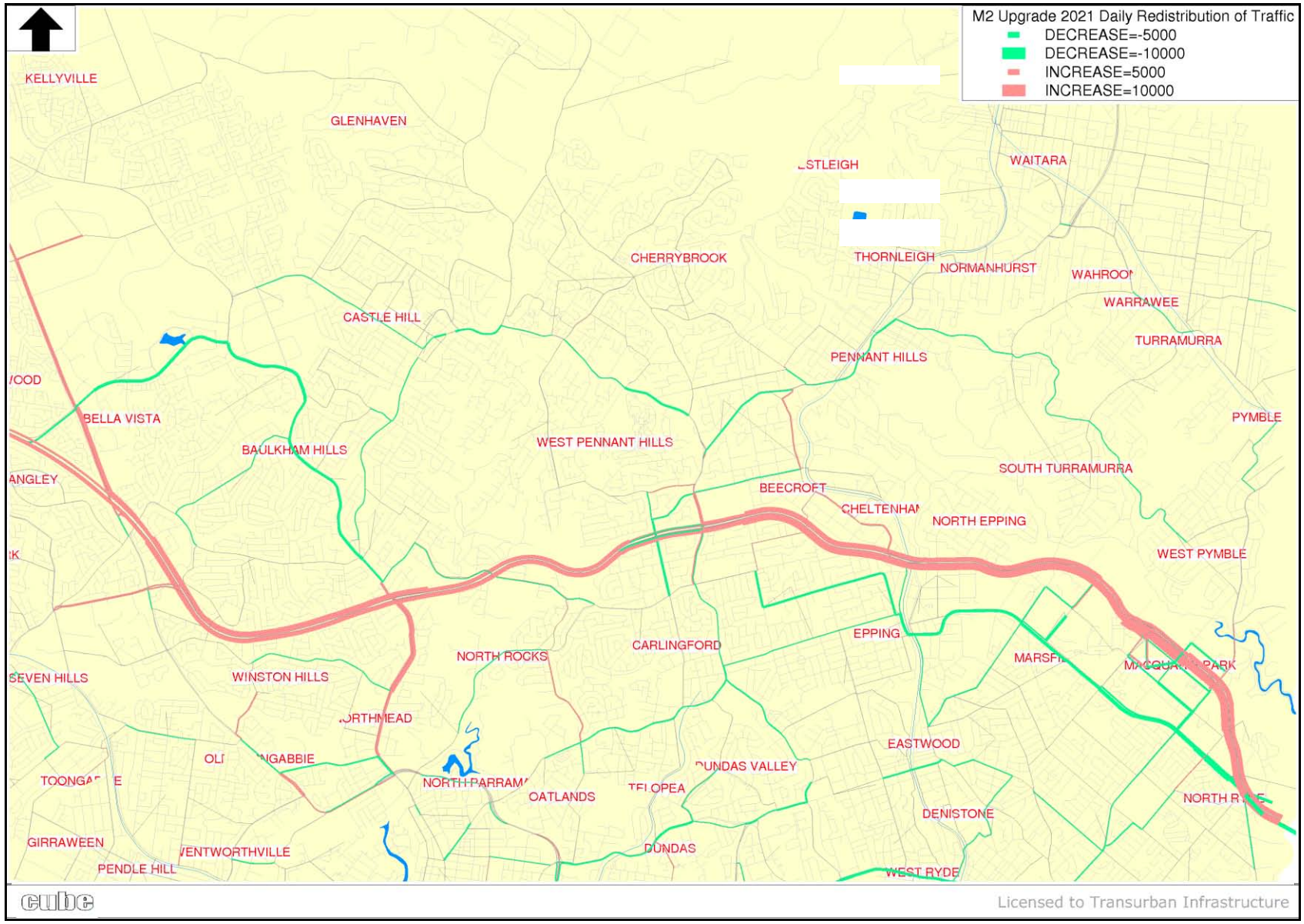
As shown in Table 44, during the PM peak it is forecast that Norwest Boulevard, Seven Hills Road, Powers Road, Station Road, Castle Hill Road, Old Windsor Road, Oaks Road, Ryde Road and Pennant Hills Road will all benefit from reduced traffic volume and improved LoS and speeds.

A key factor in route level of service is the efficiency of intersections. Section 7.4 presents an analysis of intersection performance.

7.2.6.3 Daily Conditions

Changes In daily flows are presented in Figure 31 below. Table 82 and Table 83 in Appendix B present the daily forecasts and associated impacts for both the 'Base' and 'Upgrade' scenarios for 2011 and 2021.

Figure 31 – Daily Project Flow Differences for 2021



7.2.6.4 Operational Impact on Lane Cove Tunnel

The operational impact of M2 Upgrade on LCT is discussed in this section, with particular attention to the conditions at the M2/LCT interface.

Table 45 below details the forecast AM and PM peak traffic flows at the western portal of the LCT. As shown the M2 Upgrade is expected to increase traffic through this section in both directions and both peak periods. Of particular importance is the EB section during the AM peak, which already displays signs of congestion at the merge between Epping Road and LCT. The M2 Upgrade is forecast to increase traffic through this section by up to 13% by 2021; however, despite this increase in peak hour volume as shown in Figure 32, the merge performance of this section will remain satisfactory. This is due to reduced traffic volume on Epping Road improving the operation of this merge, and confirms the objective of the Project to encourage longer distance travel along the motorway network.

Table 45 - LCT Western Portal, AM & PM Peak Traffic Flows

Peak Flows		2009	2011 Base	2011 M2 Upgrade	% Change	2021 Base	2021 M2 Upgrade	% Change
LCT	AM-IB	3,497	3,516	3,662	4%	3,713	4,182	13%
LCT	AM-OB	2,451	2,570	2,620	2%	3,488	3,568	2%
LCT	PM-IB	2,166	2,355	2,564	9%	3,360	3,708	10%
LCT	PM-OB	3,139	3,281	3,381	3%	3,700	3,800	3%

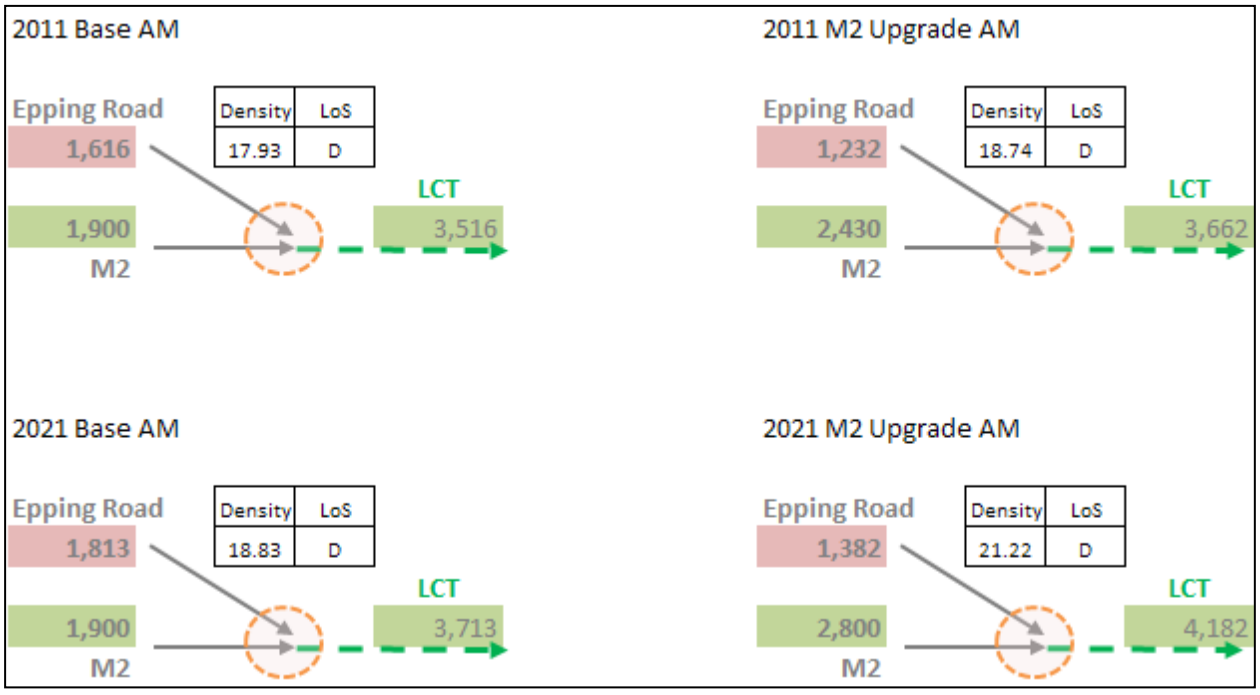


Figure 32 - Future Merge Performance of Epping Road / LCT

7.2.6.5 Operational Impact on M7

During the AM peak there is currently congestion and poor travel speeds eastbound at the M7/M2 interface which is caused by a lack of downstream capacity on M2, particularly at the Norfolk Tunnel (refer Section 3.3). The additional eastbound lane between Windsor Road and Terry's creek will resolve this issue by providing additional capacity and removing the merging conflict at Windsor and Pennant Hills Roads.

On opening of the M7, traffic at Pennant Hills plaza received a significant uplift and is demonstration that the M7 route via to M2 and off to Pennant Hills Road is attractive against the alternative "cross-city" route of Cumberland Highway and Pennant Hills Road with no use of M2. The widening of this eastbound section (Windsor Road to Pennant Hills Road) will again improve the M7 / M2 level of service and further entice transfer off the non-motorway route, providing uplift to M7.

The new west-facing ramps at Windsor Road provide new opportunity and accessibility between M2 and M7. Traffic at the new Windsor Road ramps, over and above that diverting from the Pennant Hills Road Plaza, will be new traffic to the M2 for its short section and will be coming from either the M7 (estimated to 80%) or Abbott Road (estimated to be 20%). However not all of the new trips between M7 and the new Windsor Road ramps will be new to M7 as many will be simply travelling further as their prior route may have been M7 and earlier exit/entry (e.g. Sunnyholt Road, Norwest Boulevard).

Section 7.2.6 summarises impacts and provides resultant V/C ratio at screenline 1C - WM7 East of Old Windsor Road.

7.3 Travel Times and Speeds

As link volumes increase, speeds reduce, LoS decreases and travel times increase. This section summarises forecast improvement in travel time and speeds for trips using the M2 and the new access points.

7.3.1 Long Distance M2 Travel Time Benefits

Table 46 summarises the modelled changes in travel time on the M2 and its route alternative in the AM and PM peak periods in 2011 and 2021. The start/end points are M2/Old Windsor Road and Epping Road/LCT.

Table 46 - M2 and Surrounds Travel Time Impacts

		2011 Base	2011 Upgrade	Change	2021 Base	2021 Upgrade	Change
M2	AM-IB	38	23	-15	50	31	-19
Alternative	AM-IB	59	52	-7	67	62	-5
M2	PM-OB	29	22	-7	36	30	-6
Alternative	PM-OB	48	45	-3	52	50	-2

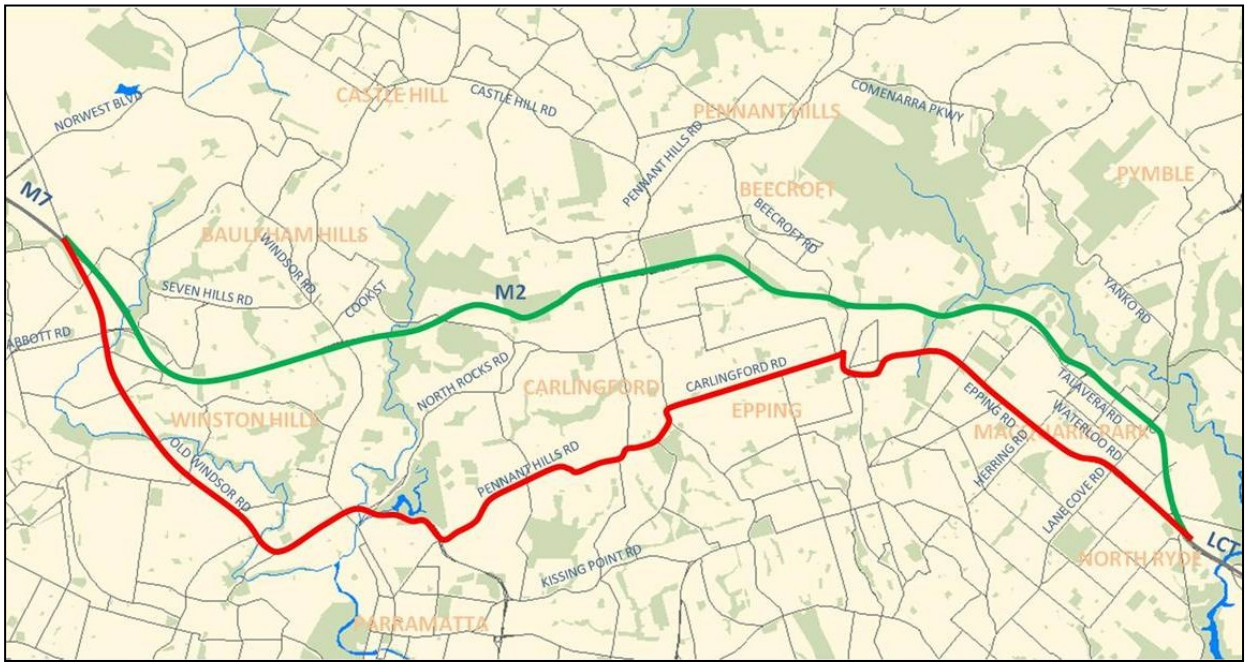


Figure 33 - Travel Time Analysis Routes

An overall 40% saving (19 minutes) in the AM peak is predicted for long-distance end to end trips using the upgraded M2 compared with the "No M2 Upgrade" scenario. In the PM peak, savings of up to 6 minutes are predicted. This can be compared to time savings on the alternative free-route of 5 minutes (AM peak) and 2 minute (PM peak) respectively.

7.3.2 Travel Time Benefits of New West Facing Windsor Road Ramps

The proposed ramps will provide an alternative route to the local arterial and sub-arterial road network, which would lead to travel time saving for trips between suburbs such as Blacktown, Seven Hills, Quakers Hill and southern parts of Baulkham Hills and northern Parramatta LGA's. An example of a route where travel time savings would be experienced is shown below in Figure 34. The proposed M2/M7 route is highlighted green and the alternative route along Old Windsor Road and Seven Hills Road is highlighted red. The travel time savings indicated by TUSTM using new west facing ramps (green line) is 4 minutes in the peak directions in both the AM and PM peak periods.

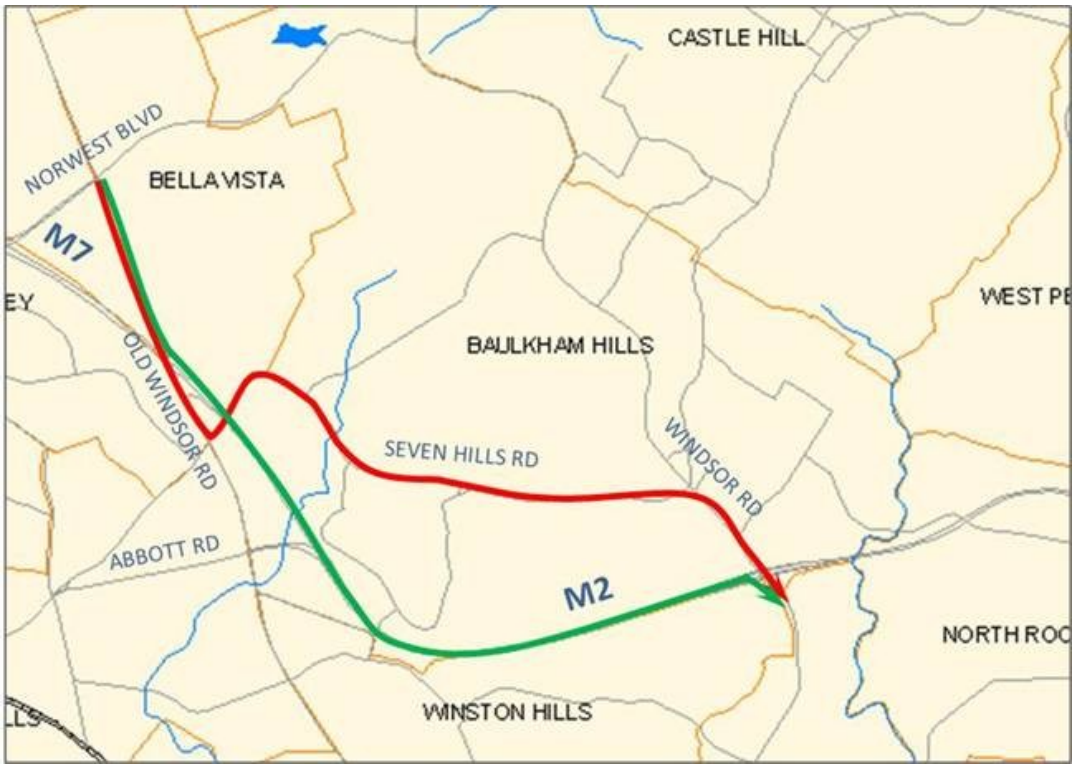


Figure 34 –Comparison of Travel Time between – New West Facing Windsor Road Ramps

7.3.3 Travel Time Benefits of New East Facing Herring/Christie Road Ramps

The proposed ramps will provide an alternative route to the local arterial and sub-arterial road network, which would lead to travel time saving for trips travelling to/from Macquarie Park and business areas of Chatswood, North Sydney, Sydney and suburbs such as Mossman, Neutral Bay and Cremorne . An example of a route where travel time savings would be experienced during the AM peak is shown below in Figure 35 and an example of travel time savings in the PM peak in Figure 36:

- the AM M2 route, which is from Lane Cove River to Macquarie Park using M2;
- the AM alternative route which from Lane Cove River to Macquarie Park using Epping Road and Herring Road;
- the PM M2 route which is from Macquarie Park to Lane Cove River using M2; and
- the PM alternative route which is from Macquarie Park to Lane Cove River using Talavera Road, Lane Cove Road and Epping Road.

For the AM peak northbound direction the travel time savings of the M2 route is forecast to be 3 minutes when compared to the alternative along Epping Road and Herring Road. For the PM southbound direction the travel time savings of the M2 route is forecast to be 5 minutes when compared with Talavera Road, Lane Cove Road and Epping Road.

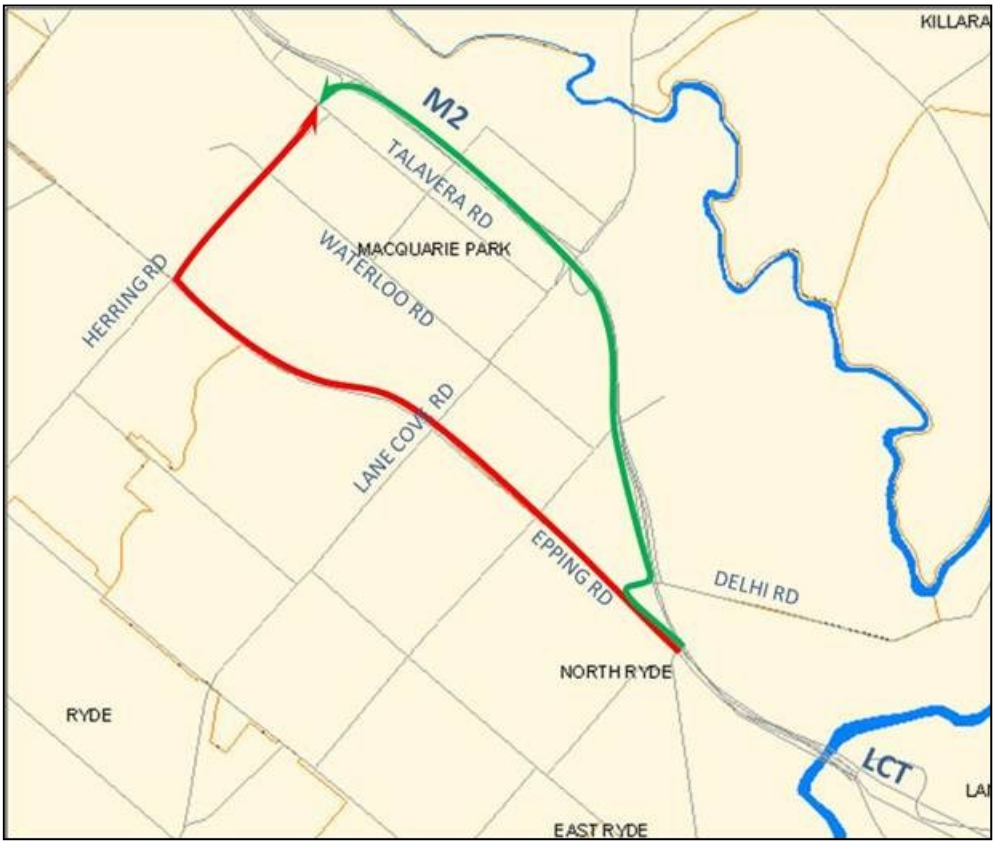


Figure 35 - Comparison of AM Peak Travel Time – New East Facing Herring Road Off Ramp

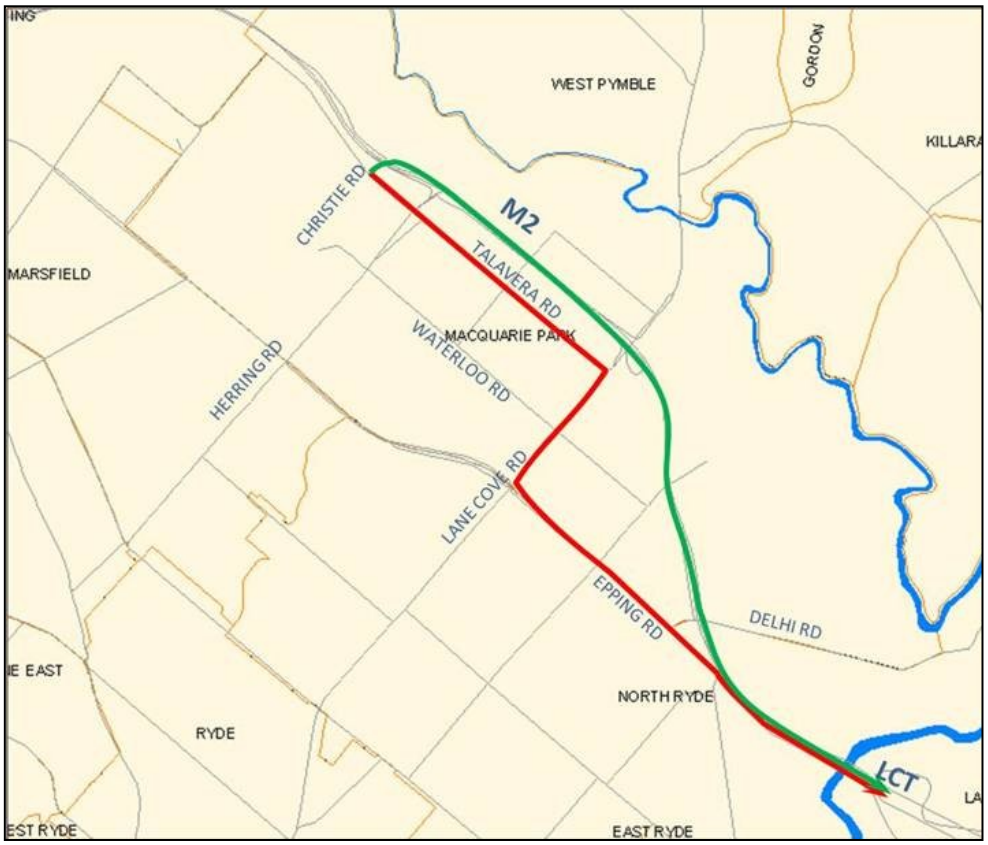


Figure 36 – Comparison of PM Peak Travel Time – New East Facing Christie Road On Ramp

7.4 Intersection Performance

Whilst operating conditions at a majority of intersections in the study area will not change significantly, new ramps on the M2 Motorway will significantly change operations at the Windsor Road, Herring Road, Talavera Road and Christie Road intersections.

7.4.1 Hills M2 Interchange modification and mitigation

As part of the M2 Upgrade, the following modifications are proposed to mitigate the effects of additional traffic using the intersections of Windsor Road/M2 (I1), Christie/Talavera (I3) and Herring/Talavera (I4):

7.4.1.1 Talavera Rd Intersections

- University Roundabout to Christie Road eastbound - increase from 1 to 2 lanes (starting just after roundabout), plus longer left turn lane;
- Christie Road to University Roundabout westbound - increase from 1 to 2 lanes (merging just prior to roundabout). Parking to be removed in both directions.
- Christie Road to Herring Road eastbound - same layout of 2 lanes and bus only right turn lane;
- Herring Road to Christie Road westbound - increase from 2 to 3 lanes (1 lane being a right turn lane to Christie Rd).
- Herring Road to Alma Road eastbound - same layout of 2 lanes plus 1 right turn lane;
- Alma Road to Herring Road westbound - increase from 1 to 2 through lanes, plus 1 additional right turn lane to M2 (from 1 to 2 lanes).

7.4.1.2 Christie Rd bridge and Intersection

- Northbound increase from 1 to 2 lanes, to accommodate a new right turn lane to the new ramp;
- Southbound increase from 2 to 3 lanes.

7.4.1.3 Windsor Rd Intersection

- Oakland Ave to M2 southbound - existing layout of 3 lanes and left turn to M2, plus two new right turn lanes to the new west-facing ramp;
- M2 to Oakland Ave northbound - same as existing layout of 3 lanes.
- M2 to Woodlands Street southbound - same as existing layout of 3 lanes merging to 2 lanes;
- Woodlands St to M2 northbound - increase from 2 to 3 lanes for 175m to the south, plus one new left turn lane to the new west-facing ramp and one additional right turn lane to the M2 (i.e. increase from 1 to 2 lanes).

Table 47: AM Peak Comparison of Intersection Performance with and without M2 Upgrade.

	2011 BASE AM			2011 M2 UPGRADE AM			2021 BASE AM			2021 M2 UPGRADE AM		
	LOS	Average Delay	DOS	LOS	Average Delay	DOS	LOS	Average Delay	DOS	LOS	Average Delay	DOS
I1 - Windsor Road - M2 ramps	B	25	1.00	B	21	0.89	E	58	>1.0	C	29	1.00
I2 - Pennant Hills Rd - M2 ramps	C	29	0.87	B	28	0.84	E	65	>1.0	C	42	0.95
I3 - Christie Rd - Talavera Rd	F	90	>1.0	C	40	0.91	F	>120	>1.0	F	>120	>1.0
I4 - Herring Rd - Talavera Rd	C	35	0.72	E	57	0.92	C	34	0.80	F	92	>1.0
I7 - Lane Cove Rd - M2 ramps	A	12	0.82	A	12	0.89	D	49	>1.0	D	48	>1.0
I5 - Herring Rd - Waterloo Rd	D	47	0.93	D	46	0.94	F	>120	>1.0	F	>120	>1.0
I6 - Khartoum Rd - Talavera Rd	C	41	0.62	C	37	0.65	C	37	0.72	C	33	0.75
I8 - Lane Cove Rd - Talavera Rd	E	58	>1.0	B	20	0.82	D	56	>1.0	A	13	0.88
I9 - Lane Cove Rd - Waterloo Rd	F	>120	>1.0	D	48	0.91	F	>120	>1.0	F	106	>1.0
I10 - Lane Cove Rd - Epping Rd	F	96	>1.0	D	49	0.78	F	>120	0.96	F	71	0.82
I11 - Windsor Rd - Cook Rd	F	>120	>1.0	F	>120	>1.0	F	>120	>1.0	F	>120	>1.0
I12 - Herring Rd - Epping Rd	E	63	1.00	E	63	1.00	F	107	>1.0	F	90	>1.0

A critical finding of the above analysis is that the M2 Upgrade will contribute to improved performance of intersections on adjoining roads that are feeder routes to M2 as well as those serving local traffic.

The proposed access to Macquarie Park will provide direct freeway access for trips travelling from the business districts of Chatswood, North Sydney, and Sydney CBD and North Sydney suburbs. This will result in less traffic accessing Macquarie Park via the busy Lane Cove Road corridor and will reduce delay and improve intersection performance at the intersections of Lane Cove Road/Waterloo Road, Lane Cove Road/Talavera Road and Lane Cove Road/Epping Road.

The proposed modifications to the intersections of Christie Road/Talavera Road will provide additional capacity to this junction and reduce delay by 50 seconds from LoS F to LoS C in 2011, while still catering for the forecast increased traffic accessing Macquarie Park through this junction. For Herring Road/Talavera Road the dealy is forecast to increase by 22 seconds from LoS C to LoS E in 2011. While this reflects a slight increase in delay at Herring Road/Talavera Road, the combined delay at Herring Road/Talavera Road and Christie Road/Talavera Road will reduce in 2011 AM peak by a total of 28 seconds, from 125 to 97 seconds. By 2021 both Christie Road/Talavera Road and Herring Road/Talavera Road are forecast to operate at LoS F, the forecast LoS F for these junction does not reflect the improvement in junction performance as a result of the M2 Upgrade works. Appendix D provides more detailed results and shows a forecast reduction in delay from 495 to 190 seconds – a reduction of over 5 minutes during the AM peak for the Christie Road/Talavera Road intersection. Furthermore, the combined delay at Herring Road/Talavera Road and Christie Road/Talavera Road will reduce in 2021 AM peak by a total of 247 seconds (over 4 minutes), from 529 to 282 seconds. However, by 2021 the forecast increase in delay for Herring Road/Talavera Road during the AM peak is 58 seconds, which results in a change in LoS from C to F. This is due to the concept design providing insufficient capacity for

the left turn movement from the proposed Herring Road ramp to Talavera Road eastbound. Further analysis has shown that if an additional flared left turn is provided for the movement from Herring Road to Talavera Road then the LoS for the intersection will improve from LoS F to LoS E. An improved design solution will be investigated as part of the detailed design phase of this project to ensure that the forecast LoS of this junction is acceptable.

The proposed modifications of the M2/Windsor Road interchange will cater for the additional forecast traffic and improve the LoS from the base situation from LOS E to LOS C during the AM Peak (2021).

Table 48 - PM Peak Comparison of Intersection Performance with and without M2 Upgrade

	2011 BASE			2011 M2 UPGRADE			2021 BASE			2021 M2 UPGRADE		
	LOS	PM Average Delay	DOS	LOS	PM Average Delay	DOS	LOS	PM Average Delay	DOS	LOS	PM Average Delay	DOS
I1 - Windsor Road - M2 ramps	B	28	1.00	B	19	0.70	C	31	1.00	B	21	0.83
I2 - Pennant Hills Rd - M2 ramps	E	59	>1.0	D	49	0.99	F	>120	>1.0	F	>120	>1.0
I3 - Christie Rd - Talavera Rd	A	6	0.57	A	5	0.56	A	12	0.75	A	9	0.58
I4 - Herring Rd - Talavera Rd	B	16	0.72	B	22	0.77	C	34	0.79	C	40	0.84
I7 - Lane Cove Rd - M2 ramps	A	6	0.79	A	6	0.75	A	9	0.91	A	9	0.83
I5 - Herring Rd - Waterloo Rd	C	35	0.8	C	36	0.85	D	52	>1.0	E	63	>1.0
I6 - Khartoum Rd - Talavera Rd	A	14	0.82	B	16	0.83	E	57	0.95	F	>120	>1.0
I8 - Lane Cove Rd - Talavera Rd	F	99	>1.0	F	109	>1.0	F	>120	>1.0	F	>120	>1.0
I9 - Lane Cove Rd - Waterloo Rd	E	66	>1.0	D	53	0.93	F	110	>1.0	E	57	0.97
I10 - Lane Cove Rd - Epping Rd	F	77	>1.0	C	31	0.88	F	86	0.99	C	37	0.94
I11 - Windsor Rd - Cook Rd	D	45	1	D	43	1.00	F	95	>1.0	F	>120	>1.0
I12 - Herring Rd - Epping Rd	D	57	0.94	D	56	0.94	E	67	>1.0	E	65	1.00

Similarly to the AM peak, during the PM peak there is forecast less traffic accessing Macquarie Park via the busy Lane Cove Road corridor and will reduce delay and improve intersection performance at the intersections of Lane Cove Road/Waterloo Road and Lane Cove Road/Epping Road.

The proposed modifications to Christie Road/Talavera Road and Herring Road/Talavera Road will ensure they junctions operate with satisfactory LoS while catering for the forecast increase in traffic accessing Macqaurie Park via these new ramps during the PM Peak. The intersection of Khartoum Road / Talavera Road is forecast to operate at LoS F as a result of the M2 Upgrade by 2021 during the PM peak, however, this delay and LoS could be reduced by further modification to the signal phases, and will be investigated further as part of detailed design.

The proposed modifications of the M2/Windsor Road interchange will cater for the additional forecast traffic and improve the LOS from the do nothing situation from LOS C to LOS B during the PM Peak (2021)

7.5 Impacts on M2 from Potential F3-M2 Connection

As discussed in section 4.3.4.1 the completion of the F3M2 Link 'purple' with west facing connections will increase future demand between M7 and Pennant Hills.

As shown below in Table 49 and Table 50 the F3-M2 'purple' connection is forecast to increase demands in both directions of the M2 west of Pennant Hills in both peaks. The largest increase is during the PM peak where the section westbound between Pennant Hills Road and Windsor Road is forecast to increase by 15% and the section between Windsor Road and Old Windsor Road by 19%. In order to adequately cater for these demands then widening of the M2 motorway between Pennant Hills and Old Windsor Road would be warranted, and would need to be considered as part of any future project appraisal.

Table 49 - Forecast increase in AM Peak Demand from F3M2 'purple' Connection

EASTBOUND DIRECTION				
From	To	2021 M2 Upgrade AM Peak	2021 Upgrade with F3M2 'Purple' Connection AM Peak	% Impact
Old Windsor Road	Windsor Road	3,400	3,700	9%
Windsor Road	Pennant Hills Road	4,800	5,100	6%

WESTBOUND DIRECTION				
From	To	2021 M2 Upgrade AM Peak	2021 Upgrade with F3M2 'Purple' Connection AM Peak	% Impact
Pennant Hills Road	Windsor Road	3,650	3,850	5%
Windsor Road	Old Windsor Road	3,050	3,250	7%

Table 50 - Forecast increase in PM Peak Demand from F3M2 'purple' Connection

EASTBOUND DIRECTION				
From	To	2021 M2 Upgrade PM Peak	2021 Upgrade with F3M2 'Purple' Connection PM Peak	% Impact
Old Windsor Road	Windsor Road	3,400	3,750	10%
Windsor Road	Pennant Hills Road	4,150	4,500	8%

WESTBOUND DIRECTION				
From	To	2021 M2 Upgrade PM Peak	2021 Upgrade with F3M2 'Purple' Connection PM Peak	% Impact
Pennant Hills Road	Windsor Road	4,300	4,950	15%
Windsor Road	Old Windsor Road	3,450	4,100	19%

7.6 Impacts on Pedestrians and Pedestrian Access

The M2 Upgrade will require some changes to existing pedestrian facilities. Table 51 summarises these changes. The majority of facilities will not change.

Table 51 – Changes to Pedestrian Facilities from the M2 Upgrade Project

Map ID	Location	Facility Type	M2 Upgrade Impacts
1	Old Windsor Rd	Traffic Signals	No change
2	Sierra Pl Reserve	Shared use path under M2	No change
3	Langdon Road	Road Bridge over M2	No change
4	Gooden Reserve footbridge (Intersection of Romulus Street and Junction Road)	Pedestrian Overpass	No change
5	Intersection of Ixion Street and Junction Road	Pedestrian Overpass	No change
6	Langdon Road	Road Bridge over M2	No change
7	Cropley Drive	Road Bridge over M2	No change
8	Watkins Road	Road Bridge over M2	No change
9	Windsor Road	Road Bridge over M2	Modifications to intersection would add crossings on the western side.
10	Barclay Road	Road Bridge over M2 (and pedestrian ramp to M2 bus stop)	No change
11	Yale Close	Pedestrian Underpass	No change
12	Oakes Road	Road Underpass (and pedestrian ramp to M2 bus stop)	No change
13	Pennant Hills Road	Road Bridge over M2	No change
14	Devlins Creek	Paths under M2 bridge	No change
15	Kirkham St / Murray Farm Road	Road Bridge	No change
16	Kent Street	Pedestrian Overpass	No change
17	Beecroft Road	Road Bridge over M2	No change
18	Constance Close	Road over M2 Road Tunnel	No change
19	Norfolk Road	Road over M2 Road Tunnel	No change
20	Sutherland Road	Pedestrian Underpass (and Emergency Vehicle use)	No change
21	Vimiera Road	Pedestrian Underpass	No change
22	Busaco Road	Road under M2	No change
23	Culloden Road	Road Bridge over M2	No change
24	Christie Road	Road Bridge over M2	Footpath may move to west side of bridge with signalised crossing of the ramp required. Intersection with Talavera would be modified with longer crossing on north link, 5 lanes not 3, with significant increase in traffic northbound on Christie Road bridge. Timing on signals will be modified.

Map ID	Location	Facility Type	M2 Upgrade Impacts
25	Herring Road/Talavera Road	At Grade	Crossing on north link of intersection would now have two-way traffic due to new off ramp. Timing on signals will be modified.
26	Khartoum Road	Road under M2	No change
27	Lane Cove Road	Road Bridge over M2	No change
28	Wicks Road	Road under M2	No change
29	Delhi Road	Road Bridge over M2	No change
30	Epping Road	Road Bridge over M2	No change

7.7 Impacts on Road Safety

Congestion effects related to speed are the most significant factor that contributes to accidents on the M2. The M2 Upgrade is designed to alleviate congestion with a consequent reduction expected in the accident rates.

The benefits in terms of accident reduction may not be limited to the M2 Motorway, as the reduction in congestion on parallel routes may also result in safer driving conditions on the arterial road network.

Table 52 indicates how the M2 Upgrade may improve accidents in the current hotspots.

Table 52 – Road Safety Improvements from the M2 Upgrade Project

Hot Spot ID	Location	M2 Upgrade Impacts
1	East of Windsor Rd Overpass	-Eastbound widening between the Windsor Rd on-ramp and Pennant Hills Rd off ramp will remove the need for traffic entering from Windsor Road to merge with heavy mainline volumes from Westlink M7 and Abbott Road. -This interchange is expected to operate more safely and smoothly as a result of traffic entering from Windsor Road not having to merge with heavy volumes on the mainline. -Alleviation of queues on Windsor Road from the eastbound Windsor Road merge may reduce the numbers of nose to tail accidents.
2	Pennant Hills Rd Interchange	-Eastbound widening east of Pennant Hills Road will remove the need for traffic entering from Pennant Hills Road to merge with heavy mainline volumes. -This interchange is expected to operate more safely and smoothly as a result of traffic entering from Pennant Hills Road not having to merge with heavy volumes on the mainline.
3	Norfolk Tunnel and approaches	-Sun glare issues will remain, however the M2 Upgrade will result in a significant reduction in traffic densities within and on approach to the tunnel during peak periods. This coincides with the times that sun glare is at its worst and may help to reduce accidents in this section. -Tunnel widening will result in wider lanes in the westbound directions and reinstatement of the breakdown lane. This will allow vehicles to get out of the mainline traffic flow in the event of an accident or breakdown and could help reduce the risk of secondary accidents. -Replacement of the existing tunnel lighting system with a new system and installation of a tunnel wall lining will combine to increase the brightness in the tunnel. This should allow drivers to better adapt to tunnel lighting conditions upon entering and is expected to result in a reduction in accidents. -Enhancements to communications and surveillance systems and egress arrangements to improve tunnel safety in the event of an emergency.
4	Main Toll Plaza	-The “Express Lanes” project resulted in cash lanes being moved to the left hand side of the toll plaza. This has already improved road safety at this location. -The M2 Upgrade should further improve the safety of this location with adjustments to the lane configurations at this location designed to accommodate 100 kph design speed.
5	Mainline carriageway	The emergency bays within the widened sections will be reconfigured to allow easier entry and exit.

7.8 Impacts on Cyclists

The Upgrade project restores the westbound breakdown lane between Lane Cove Road and Beecroft Road, which was reconfigured as a temporary third westbound lane in 2007 and necessitated the exclusion of cyclists from this section. In order to allow cyclists to rejoin the motorway from the current detour route, a temporary access point was provided at the Beecroft Road westbound exit. However, cyclists will be allowed to return to use the breakdown lane instead of the off motorway detour route that was provided; providing a shorter and more direct route for cyclists travelling westbound through this section. Furthermore, the proposed west facing Windsor Road and east facing Herring/Christie Road ramps will provide new access points for cyclists. In particular, the new east facing ramps at Herring/Christie Road will provide improved accessibility between Macquarie University and North Sydney and Sydney CBD.

7.9 Commercial Vehicle Movements

The completion of Westlink M7, linked to the M2, has created a key route for freight vehicle travel between the Hume Highway to the south and the F3 to the North. This has generated significant growth in warehousing and distribution facilities along the M7 corridor.

Heavy vehicle traffic has grown significantly along M2 west of the Pennant Hills Road ramps. This increase in traffic would primarily be from diversion off the toll-free Cumberland Highway through to

Pennant Hills Road and the F3. The increase in traffic that pays both M7 and Hills M2 Pennant Hills toll demonstrates the willingness for trucks to pay higher tolls provided travel time savings are available.

The completion of the M2 Upgrade will significantly improve travel conditions for M2 commercial vehicles and will continue to provide high levels of service for trucks. The M2 Upgrade will reduce travel times compared to the "No M2 Upgrade" scenario thereby reducing truck volumes and consequent truck noise and emission impacts on the local road network.

7.10 Emergency Service Vehicles

The reinstatement of a shoulder westbound between Lane Cove Road and Beecroft road will provide better access for emergency service vehicles in response to an accident or incident along the motorway within the reconfigured section.

7.11 Public Transport

The main benefits to bus services are:

- Reduced traffic congestion pinch points on the M2 as results of increased capacity; and
- changes to bus access arrangements.

7.11.1 Increased Road Capacity

The additional capacity on the M2 will facilitate continued growth in bus use by improving bus travel times and service reliability. Improvements for buses will result from reducing delays at and on approach to existing pinch points where buses are not protected by bus lanes. Key improvement areas for buses are:

- The provision of a T2 lane eastbound between Terrys Creek and Lane Cove Road will provide an additional eastbound road capacity and also provide buses with priority through a section currently congested during the AM Peak. This will assist eastbound services.
- Widening of the M2 Motorway from Beecroft Road to Lane Cove Road with an additional lane in each direction in this section of the M2 Motorway where buses currently use the general traffic lanes, is expected to benefit both buses and cars. An additional traffic lane in each direction will reduce traffic congestion for motorists and buses through this section providing improved bus travel times and reliability eastbound and westbound. The current M2 Motorway configuration includes three lanes in the westbound direction, but to achieve this, narrower lanes are required and this necessitates reduced speed limits. In addition, the configuration drops from three to two lanes beyond Beecroft Rd, resulting in queues forming back and delaying westbound buses during the PM peak. The M2 Upgrade will allow the westbound speed limit to be restored to 100km/h and resolve the delays from queuing caused by the lane drop.
- An additional eastbound traffic lane will be provided on the M2 Motorway between Windsor Road and Pennant Hills Road. In this section buses use the median bus lanes and are protected from traffic congestion. However the additional eastbound lane is expected to reduce upstream traffic queuing west of Windsor Road which currently delays bus services.
- Christie Road Changes – as part of the new access ramps, additional lanes are proposed on the Christie Road Bridge and Talavera Road. These changes will result in a higher level of service at the Talavera Road / Christie Road intersection than would occur without the proposed M2 upgrade. The higher levels of service will lead to a reduction in travel times for bus services exiting the M2 Motorway to access the Macquarie Centre.

The increased road capacity will provide bus travel time savings of up to 5 minutes as well as improving service reliability. A summary of the travel times during the AM and PM peaks is illustrated in Table 53.

Table 53 - Forecast Improvement to Bus Travel Times along Hills M2 [1]

		2011 Base	2011 Upgrade	Change	2021 Base	2021 Upgrade	Change
M2	AM-IB	16	12	-4	18	13	-5
M2	AM-OB	12	12	0	12	12	0
Alternative Route	AM	31	29	-2	32	32	0
M2	PM-IB	12	12	0	13	12	-1
M2	PM-OB	25	20	-5	26	22	-4
Alternative Route	PM	51	52	1	55	53	-2

Notes: (1) Modelled travel time assumes no stopping

(2) Alternate Route (Figure 26) - Old Windsor, Pennant Hills Rd, Carlingford Rd, Epping Rd

Reduced traffic congestion on the M2 may also attract motorists who use the alternate surrounding road network, for example, motorists who are avoiding congestion on the M2. Any reduction in traffic volumes on the surrounding road network (e.g. Epping Road) will also improve bus operations in those locations. See Figure 6 for bus routes that would benefit.

7.11.2 Effects of Access Change

The removal of bus only ramps from the M2 to and from Beecroft Road will require bus services, Routes 611 and 740, to be rerouted. This will result in reduced access to Epping Railway Station.

Bus only ramps were planned with an expectation of strong demand for commuters to transfer from bus to rail at Epping Railway Station. Bus services were expected to feed the railway. Historic patronage data show that this transfer is small compared with strong growth for direct city services.

Routes 611 and 740 also connect Epping Railway Station to Macquarie University and Macquarie Centre. With the opening of the new Epping to Chatswood Rail Link this movement is less important as these trips can now be made by rail. Other bus services would also continue to make this movement from Epping Railway through the University and Shopping Centre.

Routes 611 and 740 can be rerouted to exit the M2 via Christie Road off-ramp and provide more direct and faster access to the university and Macquarie Shopping Centre. Hillsbus are also considering extending Route 611 into Macquarie Business Park. The new route and extended service would be more attractive for workers in the area than the existing arrangement.

The resulting bus services using the Christie Road off-ramp by time of day are illustrated in Table 54.

Weekday bus trip numbers would increase from the existing 57 to 80 per workday. These figures are based on services currently exiting via the Beecroft Road bus ramp switching to the Christie Road exit.

Table 54 - Christie Road Bus Services after the M2 Upgrade

	4AM-6AM	6AM-7AM	7AM-8AM	8AM-9AM	9AM-10AM	10AM-11AM	11AM-12PM	12PM-6PM	6PM - Midnight
Total		**4**	**8**	**9**	**8**	**5**	**5**	**34**	**7**

The additional services using the Christie Road ramp will benefit from proposed widening in this section with an additional lane proposed northbound and southbound on the over-bridge.

The removal of the Beecroft Road bus ramp would only require a change in trip schedule for those that use the 740 and 611 bus services to access Epping either as their destination or to connect with other services; particularly those on the Northern railway line.

Those continuing to Macquarie Park on these services would benefit from shorter travel times as a result of using the Christie Road exit from the M2.

Those departing at Epping do have other options available to them. Table 55 presents several example trips that could currently use the 611 or 740 services and depart at Epping or connect to another public transport services to reach their destination before 8.30am.

Some of the example trips indicate longer travel times and /or more transfers for the alternative, while others indicate that the alternative would require less travel time. One of the example trips with a shorter travel time is between Stanhope Gardens and Rhodes. Although one additional train is required, the travel time for the option that utilises the North-West T-Way is 17 minutes faster than using the 740 bus to connect to the Northern line at Epping.

The North-West T-Way is a bus rapid transit line that includes a Parramatta to Rouse Hill section (opened in 2006) and a Blacktown to Parklea section (opened in 2007). The example above indicates that the North-West T-Way has added some level of redundancy to the Beecroft Road bus ramp. Residents in the North-West whom once relied on M2 bus services to destinations along the Northern line can now use the T-Way to connect to the CityRail network at stations on the Western line including Blacktown, Parramatta and Westmead.

Table 55 - Alternatives Route Comparison for Beecroft Road Bus Ramp Users

Example Trip	Route Details	
	Beecroft Bus Ramp	Alternative
Castle Hill (Showground Rd) to Epping Station	2 buses (610x and 611) **Total Walking distance:** ~1.4km **Travel time (door to door):** 1 hour 4 minutes	2 buses (T70 and 633) and 1 train (Pennant Hills to Epping) **Total Walking distance**: ~200m walk **Travel time (door to door):** 59 minutes
North Rocks (Barclay Rd) to Pennant Hills Station	1 bus (611) and 1 train (Epping to Pennant Hills) **Total Walking distance:** ~300m **Travel time (door to door):** 36 minutes	2 buses (610x and 553) and 1 train (Beecroft to Pennant Hills) **Total Walking distance**: ~500m walk **Travel time (door to door):** 44 minutes
Stanhope Gardens (Stanhope Pkwy) to Rhodes Station	1 bus (740) 1 train (Epping to Rhodes) **Total Walking distance:** 600m walk **Travel time (door to door)**: 1hr 27 mins	1 bus (T74 - T-Way) and 2 trains (Blacktown to Strathfield, Strathfield to Rhodes) **Total Walking distance:** 500m walk **Travel time (door to door)**: 1hr 10 mins

Example Trip	Route Details	
	Beecroft Bus Ramp	Alternative
Baulkham Hills (Windsor Rd) to Eastwood Station	2 buses (610x and 611) 1 train **Total Walking distance:** 1200m walk **Travel time (door to door)**: 53 mins	1 bus (630) and 1 train (Epping to Eastwood) **Total Walking distance:** 900m walk **Travel time (door to door)**: 1hr 4 mins

7.12 Summary of Proposed M2 Upgrade Outcomes

The impact of the M2 Upgrade was analysed for the 2011 and 2021 forecast years. The outcomes predicted for the upgrade include:

- Improved levels of service – despite increased traffic volumes - on the M2 through the introduction of additional lanes (including new T2 Lane/Bus Lane eastbound between Terry's Creek and Lane Cove Road) and improved accessibility at Windsor Road and Christie/Herring Roads.
- Reduced congestion and intersection delay on the surrounding road network through diversion of more regional trips to the M2 and specific improvements at isolated intersections.
- Improved safety through reduction of congestion on both the M2 and surrounding network roads.
- Benefits to bus operators and passengers through improvement of access and travel times to Macquarie Park in lieu of the underutilised Beecroft Road ramps.
- Additional pedestrian accessibility via the additional crossing at the proposed Windsor Road ramps.
- An improvement in network traffic efficiency resulting in overall vehicle operating costs associated with reduced travel times.

In summary, the proposed M2 Upgrade provides additional capacity where today's flows demonstrate it is needed and is forecast to generate significant social, environmental and economic benefits. The upgrade of capacity and accessibility along its length would provide future network users (M2 and wider network users) with improved accessibility to a greater number of destinations and improved travel conditions during peak periods in the corridor.

The Upgrade would accommodate the expected travel growth in the corridor over the next 10 years and result in corridor levels of service that are better than the "No M2 Upgrade" scenario .

8.0 Construction Impacts

8.1 Construction Site and Access

8.1.1 Work Sites

The M2 Upgrade work site extends around 14.5 km along the motorway between the Watkins Road overbridge west of Windsor Road and Lane Cove Road. The project has been divided into a series of Work Zones that are split into Work Sites for the purpose of planning and staging. The proposed work zones with work sites are generally as per Table 56;

Table 56 Proposed Work Zones with Work Sites

Work Zone	Work Site
Precinct 1 – Abbott Road to Windsor Road	New Windsor Road Ramps including Windsor Road widening
Precinct 2 – Windsor Road to Pennant Hills Road	Windsor Road to Barclay Road Barclay Road to Pennant Hills Road
Precinct 3– Pennant Hills Road to Beecroft Road	Pennant Hills Road East Bound Off Ramp Pennant Hills Road to Beecroft Road
Precinct 4 – Norfolk Tunnel (including approaches) to Terrys Creek	Norfolk Tunnel Portal Areas Norfolk Tunnel Norfolk Tunnel to Terry's Creek
Precinct 5 – Terrys Creek to Lane Cove Tunnel	Terry's Creek to Busaco Rd Western approach to the Main Toll Plaza Main Toll Plaza Eastern approach to the Main Toll Plaza Herring Road to Lane Cove Road Talavera Road (off M2)

These work sites would be serviced by a series of main compounds and laydown areas (ancillary sites) which are shown on the construction footprint drawings provided in Section 7.2.2 of the EA Report. Table 57 lists the main compounds that are expected to be set up along with the access points for each. The final list of sites would be determined in mid 2010.

Table 57 Main Compounds with Proposed Access

Precinct	Compound Name	Proposed Access
1	Windsor Road North	Entry / Exit off Torrs Street, straight onto Windsor Road
1	Windsor Road South	Entry / Exit off Windsor Road
2	Darling Mills Creek	Entry / Exit (Bridge Construction Traffic Only) off existing Windsor Road Ramps (in same direction as traffic flow)
2	Barclay Road	Entry / Exit off Perry Street, opposite Golf Club
2	Yale Close (Royal Institute for Deaf & Blind – Private Land)	Entry / Exit off Baden Powell Place & Barclay Road
3	Devlins Creek	Entry / Exit (Bridge Construction Traffic Only) off Allerton Road
4	Barombah Road	Entry / Exit off Barombah Road
4	Beecroft Road Compound (Tunnel Compound)	Left in / Left out off E/B carriageway of M2, through existing Noise Wall, alternative access off Sutherland Road
4	Terrys Creek / Somerset Street	Entry / Exit off (Bridge Construction Traffic Only) off Somerset Street
5	Vimiera Road	Left in / Left out off W/B carriageway of M2, with suitable ramps constructed, alternative access off Vimiera Road

Precinct	Compound Name	Proposed Access
5	Busaco Road	Entry / Exit off (Bridge Construction Traffic Only) Talavera Road
5	Toll Plaza	Entry 50m from EB Toll Plaza. Exit onto EB carriageway
5	Christie Rd Compound	Entry / Exit off Talavera Road
5	Macquarie Park Site	Left in / Left out (only) onto E/B carriageway of M2
5	TIDC Compound	Left in / left out off Delhi Road W/B on-Ramp, as well as Entry / Exit off Wicks Road
5	North Ryde Station Compound	Access from traffic lights on Delhi Road

8.1.2 Working Hours and Arrangements

Standard working hours for the sites would be between 7.00 am and 6.00 pm Monday to Friday and 8.00 am and 1.00 pm on Saturday. For sites accessed from the motorway, the start and finish time may be scheduled depending on the location of the site relative to the peak traffic flows but an earlier start time and later finish time could be sought. This is to minimise any impact of work vehicles entering sites during peak periods e.g. a delayed start for eastbound areas to avoid the morning peak.

Traffic Management Plans (TMPs) would be developed by the contractor to allow safe work sites to be created along the motorway and local roads i.e. non-motorway roads. These work sites would be protected by temporary concrete barriers while maintaining the lane capacity on the road by changes to the width and realignment of the lanes. The TMPs would consider the convenience and safety of all road users, including public transport, pedestrians and cyclists.

In some cases, works may have to be carried out at night or on weekends if the impacts on traffic flow by daytime lane occupancies are considered unacceptable by the M2 Motorway or RTA. Restrictions on lane occupancies on the motorway are governed by the volume of traffic. Night works on the motorway would commence after the evening peak once the traffic volumes are confirmed by the M2 Motorway Control Room (MCR) using real time data from the vehicle detection loops that are located at 500 m intervals along the motorway.

Night works on the motorway are expected to include:

- works within the median;
- the installation and removal of temporary concrete barriers;
- changing line markings;
- bridge and carriageway works; and
- cross drainage works.

The access points in and out of the work sites would be designed to minimise the potential for disruption to the general traffic caused by turning movements by construction vehicles.

8.1.2.1 Lane Capacity and Occupancies

Functionality of the M2 Motorway would be maintained throughout the construction phase of the project. To ensure that motorway traffic flow is sustained where practicable, the following objectives have been developed as a benchmark:

- Two lanes would be maintained for morning peak flow in the eastbound direction.
- Three lanes would be maintained for afternoon peak flow in the westbound direction (between Lane Cove Road and west of Beecroft Road).

- One dedicated bus lane would be maintained for bus use by tidal flow in the peak direction (between Windsor Road and Pennant Hills Road, and between Pennant Hills Road and Kent Street footbridge. The other bus lane would be taken for use as a general traffic lane during traffic management operations.
- Alternative cycle provision adopted on local roads during construction.

An initial schedule of motorway and local road lane occupancies has been developed and is generally as per Table 58. These hours of lane occupancies would vary depending on the direction relative to peak flow, volume and at weekends. The hours would be determined by M2 MCR or RTA Transport Management Centre (TMC) and are based on historical and/or live data and also take into consideration special events, holiday periods and late night shopping.

Table 58 Motorway and Local Lane Occupancies

Motorway Lane Occupancies	Proposed volume restriction	Lane Occupancy period (indicative)
1 of 2	1400 vph	Night time Saturday afternoon – Sunday
2 of 3	1400 vph	Night time
1 of 3	2800 vph	Off peak day time
Local Road Lane Occupancies		**Lane Occupancy period (indicative)**
1 of 2 1 of 3		Off peak day time Night time Saturday afternoon – Sunday
2 of 3		Night time

8.1.2.2 Norfolk Tunnel

The widening of the Norfolk tunnel is critical to the completion of the project. This would require a continuous implementation of night works and 24 hour operations during the two year construction period. TMPs will be developed to allow closure of one tunnel and maintain traffic flows by running contraflow in the other tunnel at various times. This is in line with existing maintenance practice by the M2 Motorway.

During normal weekday operations the tunnel will maintain two lanes in each direction in the morning and daytime periods. Due to the current Interim Widening arrangement for the westbound carriageway from Lane Cove Road to Beecroft Road a third lane will be made available for the evening peak period.

To achieve this, the expected sequence of lane utilisation would be in accordance with Table 4.

Initially works would be concentrated on the eastbound tunnel then the westbound tunnel would be widened to provide three 3.5 metre wide lanes plus a breakdown lane in both directions.

Table 59 Norfolk Tunnel Lane Utilisation

Stage	Works	Duration	Proposed Lane Utilisation Eastbound	Proposed Lane Utilisation Westbound
1	**Eastbound Tunnel** Surveys, Installation of Traffic Management, Adjustment of portal transition areas Service relocation Installing rockbolts in tunnel Installation of new service trench Installation of barrier within tunnel and at each portal. .	6 Months	**Daytime** 2 lanes **Night time** Closure	**Daytime** 2 lanes with 3 lanes in pm peak **Night time** Contraflow
2	**Eastbound Tunnel** Widening of the tunnel using roadheader Drainage and pavement construction. **Westbound Tunnel** Service relocation Installing rockbolts in tunnel Installation of new service trench	4 Months	**Daytime** 2 lanes **Night time** Contraflow	**Daytime** 2 lanes with 3 lanes in pm peak **Night time** Closure
3	**Eastbound Tunnel** Drainage and pavement construction. Services reinstallation	3 Months	**Daytime** 2 lanes **Night time** Closure	**Daytime** 2 lanes with 3 lanes in pm peak **Night time** Contraflow
4	**Westbound Tunnel** Service relocation Installing rockbolts in tunnel Installation of new service trench Installation of barrier within tunnel and at each portal.	5 Months	**Daytime** 2 lanes **Night time** Contraflow	**Daytime** 2 lanes with 3 lanes in pm peak **Night time** Closure
5	**Westbound Tunnel** Widening of the tunnel using roadheader Drainage and pavement construction	4 Months	**Daytime** 2 lanes **Night time** 2 lanes	**Daytime** 2 lanes with 3 lanes in pm peak **Night time** 2 lanes
6	**Westbound Tunnel** Drainage and pavement construction. Services reinstallation	2 Months	**Daytime** 2 lanes **Night time** Contraflow	**Daytime** 2 lanes with 3 lanes in pm peak **Night time** Closure

8.1.2.3 Other Arrangements

Long term contraflow arrangements would be considered as part of the traffic management schemes where appropriate and where it would benefit the road users and construction planning. Contraflow traffic management allows a carriageway to be fully closed by running traffic in both directions on the other carriageway. This, in conjunction with tidal flow or other innovations, would be reviewed by the Traffic and Transport Liaison Group (TTLG) proposed in Section 8.3.1.

8.1.3 Construction Site Access

Worksites would be accessed via both non-motorway roads and the motorway. Where possible, depending on safety and traffic constraints a motorway access point would be provided to reduce the number of site vehicles using local roads. Route selection will consider the characteristics of the road, nature of traffic using the road, restrictions on use, bus routes, schools etc. Access to worksites for delivery trucks and staff along the project is generally summarised by the following table;

Table 60 Construction Site Vehicle Access

Worksite	Vehicle Access
Motorway sites	Left in and left out directly from the motorway with some local road access if necessary
Compounds	As per Table 57
Laydown areas	Left in and left out directly from the motorway with some local road access if necessary
Local road work sites (Predominantly bridge sites)	In and out via local roads
Truck Call-up areas	Left in and left out, directly from the motorway

Table 61 lists the local roads that would be used to provide direct access to work sites and ancillary sites. Estimates of the number of vehicle movements related to each site are provided in Table 61.

The local roads are classified into groups which have general traffic characteristics as follows:

1. Major Arterial: main function is to form the principle routes for the movement of goods and people.Major arterials are divided roads and contain occasional at-grade intersections resulting in interrupted flow.
2. Arterial: main function is to form the principle routes for the movement of goods and people. Arterial roads are not divided roads and contain occasional at-grade intersections resulting in interrupted flow.
3. Sub-Arterial: arterial roads which supplement the major arterial and arterial network in providing through traffic movement to an individually determined limit that is sensitive to roadway characteristics and abutting land uses.
4. Collector: important local roads whose function is to distribute traffic between the arterial roads and the local road system, and to provide access to abutting property
5. Residential Streets: Those roads or streets not having significant through traffic function, whose function is to provide access to abutting property.

The likely level of traffic on these roads will vary along the M2 corridor and time of day.

Table 61 Local Road Access to Work and Ancillary Sites

Work Zone	Non motorway roads used for access	Road Characteristics
Precinct 1 – Abbott Road to Windsor Road	Junction Road	Residential
	Torrs Street	Residential
	Craig Avenue	Residential
	Watkins Road	Residential
	Cropley Drive	Collector
	Windsor Road	Major Arterial
Precinct 2 – Windsor Road to Pennant Hills Road	Windsor Road	Major Arterial
	Cook Street	Collector
	Petrina Crescent	Residential
	Russell Street	Residential
	Dremeday Street	Residential
	Renown Road	Sub-Arterial
	Perry Street	Residential
	Barclay Road	Sub-Arterial
	North Rocks Road	Sub-Arterial

Work Zone	Non motorway roads used for access	Road Characteristics
	Baden Powell Place	Residential
	Carlton Road	Residential
	Morton Avenue	Residential
	Carmen Drive	Residential
	Oakes Road	Collector
	Coral Tree Drive	Residential
	Pennant Hills Road	Major Arterial
Precinct 3– Pennant Hills Road to Beecroft Road	Pennant Hills Road	Major Arterial
	Lamorna Avenue	Residential
	Orchard Road	Residential
	Allerton Road	Residential
	Kirkham Street	Collector
	Murray Farm Road	Collector
	Meadow Close	Residential
	Midson Road	Residential
	Ray Road	Collector
	Kent Street	Residential
	Kandy Avenue	Residential
	Barombah Road	Residential
	Beecroft Road	Major Arterial
	Cheltenham Road	Collector
	Sutherland Rd	Residential
Precinct 4 – Norfolk Tunnel (including approaches) to Terrys Creek	Somerset Street	Residential
	Norfolk Road	Collector
	Grayson Road	Residential
	Devon Street	Residential
	Pembroke Street	Collector
Precinct 5 – Terrys Creek to Lane Cove Tunnel	Somerset Street	Residential
	Crimea Road	Residential
	Vimiera Road	Collector /Residential
	Busaco Rd	Residential
	Talavera Road	Collector
	Culloden Road	Collector
	Christie Road	Residential
	Alma Road	Commercial
	Khartoum Road	Residential
	Lane Cove Road	Major Arterial
	Wicks Road	Commercial
	Epping Rd	Major Arterial
	Delhi Rd	Major Arterial

8.1.4 Construction Workforce Parking

It is anticipated that the total on-site staff and workforce would consist of up to 500 people over the duration of the construction period. Construction staff would have limited parking available at the compounds and worksites. There is also the possibility of providing temporary parking areas in locations where space and suitable access is available (a large area of land immediately south of the North Ryde station has been identified as a potential employee car park, from where Works buses could ferry staff & field operatives). Light Vehicle Works buses (15 – 20 seaters) would be used to ferry the workforce from the Main Compound area to the various work sites. The workforce would be advised on suitable parking arrangements as part of the compulsory project induction.

It is expected that a portion of the workforce would use public transport to commute to and from the work sites. Public transport and a reduction in general site vehicle movements would be promoted via the use of shuttle services from designated points collecting personnel and transporting them to site. This would minimise the number of staff using local roads for parking. The shuttle vehicles would operate at the beginning and end of each shift to get the workforce to and from the worksites. An on-demand service would then operate during the shift. The collection and delivery points for the shuttle service would vary as activities and worksites change during the length and time of the project.

Bus services along the M2 are detailed in Section 2.3.1. Bus stops that may be used by staff and workforce to access work compounds are located on the M2 at Cropley Drive (Baulkham Hills) and Barclay Road (North Rocks). The M2 bus stops at Gooden Reserve (Model Farms) and Oakes Road (Carlingford North) are likely to be too far from compounds or worksites to be used. Off the motorway there are bus stops on Windsor Road, Beecroft Road, Macquarie Park and Lane Cove Road near to the motorway compounds and worksites.

Section 2.3.2 provides the train services in the vicinity of the M2 motorway. The recently opened stations at North Ryde (Delhi Road), Macquarie Park (Lane Cove Road) and Macquarie University (Herring Road) will be suitable for staff and workforce and would be within 15 minute walking distance of compounds and worksites.

8.2 Proposed Construction Activity

8.2.1 Vehicle Movements

The M2 upgrade project involves cut and fill operations along the full length of the works. The majority of the excavation work is between the Norfolk tunnel and Windsor Road and is generally hard sandstone with low productivity rates. The excavated sandstone or other material would be transported to one of the main compound areas at the eastern end of the motorway at the TIDC or Macquarie Park compounds for stockpiling and processing (crushing etc.). The processed material would be used as select sub grade and fill for retaining walls, however it is anticipated that approximately 70,000 m^3 of surplus spoil is to be transported off site. This would require 160 – 200 truck movements on an average work day along the full length of the project during the early and mid phases when the majority of the bulk earthwork is carried out. The specific destination for these movements has not yet been determined and may potentially be used on other projects.

Possible locations for this excess material are Moorebank, Eastern Creek or the Port Botany Expansion. Transport routes would be along motorways or arterial roads where appropriate and would be detailed in the Spoil Management Plan.

Other activities such as paving, concrete placing, installation of traffic barriers and drainage would generate truck movements to and from the work sites. Table 62 and Table 63 below provide the total number of truck movements per worksite along with an estimate of the average daily movements. A vehicle movement is considered to be the trip to or from the site. The figures are based on an average working week as described in 8.1.2.

A combination of truck types e.g. tipper truck, semi trailer, truck and dog will be used on the project depending on access and productivity at each worksite or compound. For the purpose of determining vehicle movements in Table 56 and Table 57 Light Vehicles are classified as 3.5 tonnes or less and may be commercial or passenger use. All others are classified as Heavy Vehicles.

Table 62 Worksite Vehicle Movements

Description	Average Daily Heavy Vehicle Movements	Average Daily Light Vehicle Movements
EB Off Ramp Windsor Road	30	200
WB On Ramp Windsor Road	25	170
Windsor Road to Barclay Road EB	40	300
Barclay Road to Pennant Hills Road WB	50	360
Pennant Hills Road EB Off Ramp	10	80
Pennant Hills Road to Beecroft Road EB & WB	35	240
Beecroft Road to Eastern Portal	20	150
Tunnel	20	130
Eastern Portal to Terry's Creek	20	140
Terry's Creek to Busaco Road	40	270
Busaco Road to Toll Plaza	20	150
Toll Plaza	10	50
Toll Plaza to Herring Road	25	180
Herring Road to Lane Cove Road	60	420

Table 63 Compound Vehicle Movements

Compound Name	Average Daily Heavy Vehicle Movements	Average Daily Light Vehicle Movements
Windsor Road North	20	90
Windsor Road South	20	90
Darling Mills Creek (on/off M2)	25	40
Barclay Road (Not intended to be in constant use)	25	30
Yale Close	25	40
Devlins Creek (Allerton Road) (Not intended to be in constant use)	25	40
Barombah Road	30	40
Tunnel Compound	25	50
Terrys Creek (Somerset Street)	30	40
Vimiera Road (Not intended to be in constant use)	40	60
Busaco Road (Not intended to be in constant use)	25	70
Toll Plaza (on/off M2)	25	40
Christie Road (Talavera Road)	20	50
Macquarie Park Site (on/off M2)	65	125
TIDC Compound	190	800
North Ryde Station Compound	30	580

The main compounds located at the eastern end of the corridor will have the largest volume of vehicle movements associated with them. These are located in the commercial and industrial areas of North Ryde with immediate access to the M2 and major arterial roads. Due to the early start times associated with construction work there would be negligible impacts on the surrounding network in the peak periods

8.2.2 Night Works

Night works vehicle movements on the motorway would include:

- general light vehicles including staff and workforce;
- floats;
- tipper trucks;
- truck and dog;
- flatbed crane trucks;
- concrete trucks; and
- asphalting.

Around 180 truck and light vehicle movements per night, each in up to three locations across the project would be expected. The locations of the worksites will vary from week to week. These truck movements are included in the figures for total movements in Table 61 above. Due to the reduced volume of traffic at night on the motorway and the road network there is no impact expected on the operation of these roads.

Construction vehicle movements for the tunnel works include those listed above along with specialist equipment such as elevated work platforms, road header for rock excavation, drill rigs and shotcreting plant. During the excavation phase there would be up to:

- two spoil truck movements per hour;
- four shotcrete deliveries per day;.
- daily delivery of rock bolts;
- daily delivery of reinforcing fibres; and
- approximately five miscellaneous other deliveries per day.

These are included in the figures for total movements in Table 63 above. Due to the low volume of construction traffic for tunnel works on the motorway and local network there is no impact expected on the operation of these roads.

The use of night works is dictated by the restrictions on lane occupancies as discussed in Section 8.1.2. These occupancies will be operated through Traffic Management Plans approved by the RTA with suitable detours provided to minimise impacts on the local road network. Appropriate communication strategies would be implemented to ensure that the road users and adjacent community are informed prior to any works that may affect local traffic conditions.

A more detailed construction methodology would be prepared in accordance with the detailed design prior to commencement of construction works and as part of the Construction Environmental Management Plan (CEMP).

8.2.3 Special Loads

Special load deliveries for the project are anticipated for items such as:

- large bridge beams;
- paving equipment;
- and plant equipment for the tunnelling works.

These movements would in general occur at night under escort to locations on the motorway. Oversized loads would be restricted by the routes and access hours allowed by RTA. Deliveries to sites on the motorway or non-motorway roads would have minimal impact to traffic due to the low volumes experienced during the permissible hours. Some deliveries on local roads would require stop & go procedures to facilitate access by oversized loads resulting in short term closures to assist movement and unloading.

There would also be some temporary local road closures during widening works at Christie Road and Khartoum Road bridges e.g. beam installation etc. and lengthening of the Kirkham Street/Murray Farm

Road and Barclay Road bridges. These closures will be operated through TMPs approved by the RTA and appropriate Councils with suitable detours provided to minimise impacts on the local road network. In some cases single-way traffic light controlled access would be required to ensure consistent safety of the workforce operating in close proximity to traffic.

8.3 Impact on Traffic Flows

8.3.1 M2 Motorway

The construction of this project would impact on the existing traffic flows along the M2 Motorway, arterial roads and various local roads in close proximity to the motorway corridor. Those non-motorway roads that would experience some additional traffic during the construction period are the same routes that are expected to experience longer term benefits from additional capacity after the M2 Upgrade. These are identified in Tables 52 to 55.

Control of traffic on the M2 motorway is carried out by the M2 MCR working closely with the RTA TMC. Traffic is monitored on a 24 hour basis using CCTV and real time flow data from vehicle detection loops every 500 m along the carriageways. The M2 MCR has responsibility for providing permission to implement Traffic Control Plans (TCP). On non-motorway roads this authority remains with RTA TMC.

For the construction phase of the project a series of Traffic Management Plans (TMPs) will be developed and approved by M2 MCR and RTA TMC. The TMPs provide the overall plan and staging for managing traffic through and around each work site. These will be based on the new AS 1742.3-2009 Traffic Control for Works on roads and reviewed by the Traffic and Transport Liaison Group (TTLG) or a dedicated working group. The TTLG would include relevant stakeholders such as NSW Police Force, State Transit Authority, affected Bus Operators, NSW Transport and Infrastructure, RTA, NSW Taxi Council and Local Councils.

8.3.1.1 Speed Limits

The motorway would in general have a reduced daytime speed of 80 km/hr with some areas east of the tunnel reduced to 60 km/hr for periods of time during construction operations, the latter due to the alignment. The restrictions are required to accommodate works in the median to remove the existing barrier, upgrade drainage, reinstate the pavement and barrier and safety critical activities. A minimum of two lanes are maintained during the weekday daytime periods with three lanes westbound for the PM peak from Lane Cove Road to Beecroft Road.

The 70 km/hr limit westbound from Terrys Creek to Beecroft Road would remain initially but would eventually reduce as the construction staging progresses. Due to the restricted space available at the tunnel the speed would drop to 60 km/hr for longer periods to meet the lane and shoulder width standards in AS 1742.3-2009. The reduction in speed limits represents up to 2.5 minutes additional travel time in non congested periods over the 14.5 km length of widening works.

Enforcement of speed limits by Police would continue as per normal operation of the M2 motorway with potential for increased surveillance after major traffic switches when users have settled into the new configurations. Other active measures such as radar speed signage (actual vehicle speeds displayed) would be considered as part of the development of TMPs.

8.3.1.2 Motorway Lane Capacity and Occupancies

As described in Section 8.1.2 the capacity of the M2 motorway during construction is not reduced in peak periods. During peak periods the current vehicle speeds are below the proposed construction zone speed limits so the average travel time in peak periods are likely to remain unchanged. The timing of lane occupancies (Section 8.1.2) is planned to minimise the impact on the general traffic flows. For motorway lane occupancies the volume of traffic must fall below the threshold level of 1400 vph to ensure adequate capacity is available to accommodate traffic demand. Monitoring of the motorway and worksites would be carried out using CCTV and mobile patrols to assist management of incidents and maintenance of the signs and devices.

8.3.1.3 Non Motorway Impact

Road users may choose to take an alternative route (diversion) due to the reduced benefit on the motorway because of lower speed limits and lane closures. Diversion is expected mainly in the off peak

periods and particularly at night when up to 150 vehicles per hour would use the alternative routes along the full length of the M2 corridor. These alternative routes are free flowing and the additional vehicles would not create congestion due to the low volumes involved.

8.3.2 Construction Vehicle Movements

The majority of construction vehicles would access the work sites from the motorway where possible. Truck haulage would generally avoid peak periods in peak directions for productivity reasons and to limit the impact of truck movements in and out of worksites. Worksites and laydown areas are positioned along the motorway corridor so as to reduce the travel distance and time for all vehicles and the workforce.

Vehicle Management Plans (VMPs) would be developed to reduce the impact of construction vehicle movements on the motorway and non-motorway roads. Such methods include controlled access points, radio contact to drivers and off motorway truck staging. Staging sites for delivery and haulage trucks would be selected as appropriate for the capacity required and location relative to residences and other sensitive receivers. The staging sites would be agreed through the TTLG.

8.3.2.1 Impact due to local road access of work and ancillary sites

The estimated vehicle movements to worksites and compounds are provided in Table 62 and Table 63. While the preferred access is via the motorway there will be construction vehicles using the non-motorway roads. Table 61 lists the roads around the motorway that will be used to various degrees by construction related vehicles depending on the nature of the site. These are classified into groups: Residential; Collector; Sub-Arterial, Arterial and Major Arterial as described in Section 8.1.3.

Based on the existing volumes and mix of heavy vehicles it is expected that only the residential streets will have a noticeable increase in vehicle movements due to construction traffic accessing the work areas. Assessment of suitable routes and access points will be made as part of the Construction Environment Management Plan with TMPs developed to limit the impact as detailed in Section 8.6.

8.3.2.2 Selection of Construction Traffic Routes

Routes for construction vehicles to and from compounds and worksites will be developed in the context of minimising impacts on local streets and maximising use of arterial roads. The approach for development of the routes is to consider the following:

- Preference for the motorway network, arterial roads and other higher order roads;
- Restrictions on size and load of vehicles;
- Sensitive communities especially schools, hospitals, places of worship, businesses;
- Hours of operation of the sensitive communities;
- Access needs for residents, pedestrians, emergency services and buses;
- Out of hours impact on residential areas;
- Consultation with the TTLG, residents and sensitive communities; and
- Guidance from relevant documents and standards e.g. Guide to Traffic Control at Worksites (RTA).

8.3.3 Emergency Service Vehicle Movements

The M2 is used by emergency service vehicles for travel to and from call outs. Due to the potential delays in travel times during peak periods the emergency services will be regularly informed on the staging and progress of works. In off peak periods the travel time delays are related to the speed limit reduction and the impact on emergency services would be minimal.

The removal of the breakdown lane will restrict access to incidents on the motorway by emergency service vehicles. Management Plans for incidents would be developed in consultation with the emergency services, project construction team and the motorway operators taking into account the staging of construction activities, communications with M2 MCR and crossover facilities for contraflow access. Emergency service vehicles would also be able to use the tidal flow bus lane described in Section 8.5 to

avoid congested lanes to access an incident. The existing relationship with the motorway operators will provide a good basis for communication and agreement on procedures.

8.3.4 Local Roads i.e. non-motorway

The local roads that are subject to project works are detailed in Table 64 along with a brief outline of the works involved. These works would require a series of lane occupancies in accordance with the parameters in Table 64 and would be detailed in TMPs. The works to lengthen the spans on Barclay Road and the Kirkham Street/Murray Farm Road would require the closure of the road for some activities. This would be subject to planning and agreement with the relevant stakeholders through the TTLG including identification of suitable detour routes and consideration of 'stop-go' restrictions, to keep the traffic on the same route, and minimise inconvenience. Appropriate communication strategies would be implemented to ensure that the users and adjacent community are informed prior to any works that may affect local traffic conditions.

Table 64 Works Affecting local roads

Location	Scope of Works
Windsor Road	Widening of road south of M2 intersection to near Woodlands Street. Tie-in works for the new ramps plus traffic signal adjustment at the interchange.
Barclay Road	Lengthening of bridge spans over M2.
Kirkham Street/Murray Farm Road	Lengthening of bridge spans over M2.
Somerset Street (east of Norfolk tunnel)	Realignment of kerbline and drainage near Gloucester Road.
Christie Road	Lengthening and widening of bridge spans over M2 and traffic signals adjustment at the interchange.
Talavera Road	Widening carriageway between Macquarie School of Management access and Alma Road and traffic signal adjustments at Christie and Herring Roads.

8.3.4.1 Residential and Business Access

The project works on Windsor Road, Somerset Street and Talavera Road will have some impact on the driveways to properties in order to make the necessary adjustments to complete the final design. Through the consultation phase prior to start of construction, property owners will have input to the agreed final design. Staging of the works would be included in the TMPs for each section.

8.3.5 Regional Traffic Flow Impacts (Spoil Haulage Routes)

Approximately 40% of all truck movements on site would be due to the excavation activities and the delivery of processed sandstone or quarry materials. Sandstone that is cut from the widening works would be taken to a stockpile area at the main compound for processing. From here it would be returned to site typically for retaining wall backfilling operations, embankments or Select Material Zone in the pavement construction. The main compound will have direct access and egress off the motorway and the truck movements associated with these works will be primarily only on the motorway.

Surplus spoil material would be transported to suitable reuse sites such as the developments at Moorebank, Eastern Creek and Port Botany expansion or appropriately licensed waste facilities. Haulage routes to these sites would use the Sydney Orbital Motorway and arterial roads at the destination in accordance with the operating licence of the facility. Further locations may arise for consideration during the construction phase. A Spoil Management Plan will be developed for the project. This plan would detail the routes to be used taking into consideration factors including time of day (peak or off-peak), time of month (school holidays), events occurring on the road network (accidents or special events) and/or EA restrictions.

8.4 Impacts on Pedestrians, Cyclists and Rail

8.4.1 Pedestrians

The only permitted pedestrian movements on the motorway are in the vicinity of the bus stops. Bus stops are located on the M2 at;

- Gooden Reserve (Model Farms),
- Cropley Drive (Baulkham Hills),
- Barclay Road (North Rocks),
- Oakes Road (Carlingford North).

Works on some of the overbridges to lengthen the spans and intersection reconfiguration would require temporary diversion of pedestrians. Access would be maintained although trips may be longer by up to one minute. These would be addressed in the TMPs that are developed for the planning and staging of the works. Table 65 outlines impact to pedestrians at bridges and intersections along the motorway due to the M2 Upgrade project.

Table 65 Works Impacting Pedestrians

Location	Facility Type	M2 Upgrade Impacts
Windsor Road	Bridge	During construction of the new ramps on the west side it is likely that all pedestrians would be diverted to the east footpath.
Barclay Road	Bridge (and pedestrian ramp to M2 bus stop)	During construction there would be one of two footpaths closed for the lengthening works at the northern end. Temporary road crossing may be used to facilitate access.
Devlins Creek (from Allerton Road to Welham Street and Austral Avenue)	Bridge	During construction some local detours for pedestrians would be required to avoid working areas. Access under the M2 from north to south would be restricted.
Kirkham Street/Murray Farm Road	Bridge	During construction there would be one of two footpaths closed for the lengthening works at the each end. Temporary road crossing may be used to facilitate access.
Beecroft Road	Bridge	During construction the footpath on the west side may be altered for the modifications to the central pier. Temporary road crossing may be used to facilitate access.
Christie Road	Bridge	During construction the footpath on the east side may be altered for the widening/lengthening works. Temporary road crossing may be used to facilitate access. Access to the council car park may be closed for some periods. An alternative car park at Talavera Road could be provided with pedestrian access across the bridge allowed.
Herring Road /Talavera Road	At Grade	During construction the footpath on the east side may be altered for the widening/lengthening works. Temporary road crossing may be used to facilitate access.
Khartoum Road	Underpass	During construction there would be one of two footpaths closed for the widening works at the each end. Temporary road crossing may be used to facilitate access

8.4.2 Cyclists

The breakdown lanes of the M2 Motorway are used primarily by commuter and training cyclists. Based on traffic counts in 2007 after the introduction of the Interim Widening between Lane Cove Road and Beecroft Road an estimated 250 cycle trips per day are made along the M2.

The project would affect cycle use from west of Windsor Road to east of Lane Cove Road due to the removal of the breakdown lane during construction. An alternative route would be provided using non-motorway roads that stay close to the alignment of the motorway where possible. A working group was

established in November 2009 for the purpose of determining an acceptable alternative route. The alternative route should desirably have the following characteristics:

- A safe and unobstructed cycle route clear of islands and hazards such as speed humps and angle parking
- The avoidance of areas of traffic congestion leading to improved cyclist safety and decreased travel times
- Delivering cyclists to areas of local significance such as shopping centres and train stations
- Gradients of 5% or less are desirable for ease of use in accordance with the RTA's NSW Bicycle Guidelines – however this will be governed by local topography and may not be possible in all sections
- Addresses requirements of relevant standards, guidelines, codes and local and regional strategies regarding the cycle route
- Use of existing or proposed cycle routes

In February 2010 GTA consultants presented to the working group on route options and indicated its preferred option. Following feedback from Bike Groups, Council and RTA a preferred route was selected and is shown in Figure 37. A report *"M2 Upgrade. Alternative Cycle Route. Preferred Route Analysis Report"* was produced. The preferred route would be further developed in consultation with the relevant cycle user groups and councils during preparation of the Environmental Assessment and its impacts would be assessed. Suitable temporary detour signage and marking would be used along the route during the construction period of around two years. It is realised that the alternative route would be longer than a M2 route. Analysis on the preferred route identification process is detailed in the GTA report: "M2 Upgrade Alternative Cycleway Route. Preferred Route analysis Report (February 2010)". This report incorporates comments and suggestions from the Cycle Working Group members and relevant local councils, with detailed responses and action taken where appropriate.

The underpass at Vimiera Road is part of a north-south route used by pedestrians and cyclists between Macquarie Park and South Turramurra. The structure will be extended to allow widening of the embankment on the northern side. Short term closures will be required for some construction activities, probably overnight, with advance notification provided to minimise disruption to users. When works are being undertaken on this underpass during normal working hours, access will be maintained for the public by means of personal escort or dedicated exclusion zone through the works at all times.

8.4.3 Rail

The rail line crossing over the M2 east of Beecroft Road is not impacted by the construction works.

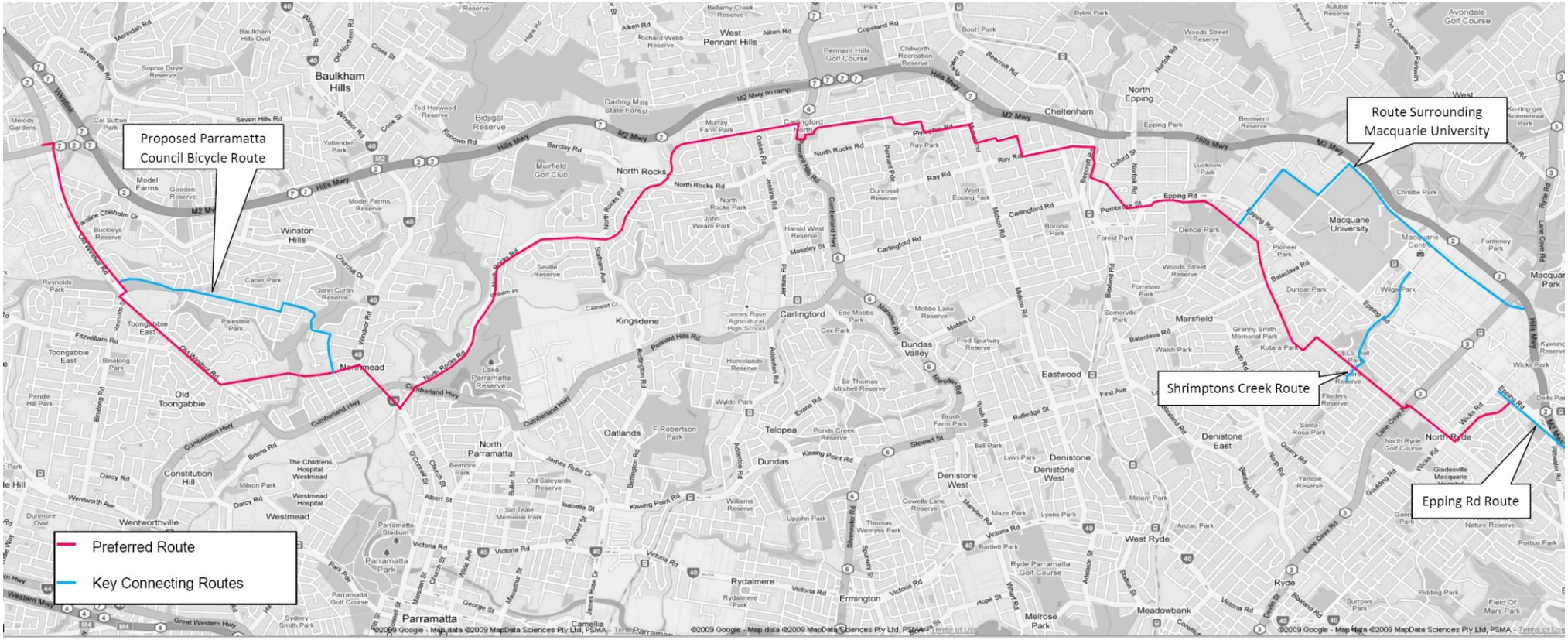


Figure 37 - Draft Cycle Detour under construction

8.5 Impacts on Bus Operation

Approximately 8 km of bus lanes are provided on the M2 between Windsor Road and Beecroft Road These run adjacent to the median and have dedicated access and egress ramps at Windsor Road (east facing), Pennant Hills Road (east facing) and Beecroft Road (west facing). East of Beecroft Road buses join the general traffic. During peak periods the bus lanes provide a congestion free journey with reliable travel times in this section.

In order to provide safe worksites for the widening activities it is proposed to create a tidal bus lane from Windsor Road to Pennant Hills Road and from Pennant Hills Road to a suitable merge point near the Kirkham Street/Murray Farm Road bridge. This tidal lane will allow buses travelling in the peak direction to travel as normal with access to the bus stops at Barclay Road and Oakes Road maintained. The contra-peak direction buses would use the general traffic lanes which are not congested. Bus routes would not be affected along this section. A detailed TMP would be developed to show how the tidal bus lane would operate including:

- Extent of the tidal lane;
- Signs and devices to advise bus drivers and road users of the operation;
- Timing and operational procedures for switching the direction of flow;
- Monitoring and incident management;
- Training requirement for all bus drivers; and
- Communication of arrangements via website etc.

The tidal flow bus lane would be further developed in consultation with the bus companies during preparation of the Environmental Assessment. A working group was established in November 2009 for this purpose and have agreed on the concept and basic arrangements. The tidal flow would operate:

- Eastbound from 4 am to 12 pm
- Westbound from 12 pm to 4 am.

The removal of the Beecroft Road bus ramps as detailed in Section 7.8.2 will require the permanent rerouting of some services, which will probably be via Christie Road. This change can be implemented at any stage during construction because the alternative route is available. The alternate route would be determined by bus operators in conjunction with the Department of Transport and Infrastructure. The timing of the demolition would be detailed in the project CEMP to minimise disruption to the general traffic on the motorway possibly during a holiday period.

As noted in Section 8.4.1 all four bus stops on the M2 motorway will not be impacted by the project works and will continue to operate in their existing configuration. Due to the implementation of tidal flow arrangements the express bus services travelling in peak direction will be required to stop at Barclay Road bus stop if there is a bus loading or unloading passengers. Bus stops on non motorway roads e.g. Windsor Road and Talavera Road will require a temporary relocation or closure during the works at that location. These changes will be detailed in the TMP and will be following consultation with the bus companies and user groups.

The reduction in speed limits in the construction zones represents up to 2.5 minutes additional travel time in non congested periods over the 14.5 km length of widening works. This would increase in congested periods as there are no bus lanes for 5.5 km from Beecroft Road to Lane Cove Road.

8.6 Traffic Management Measures during Construction

8.6.1 Traffic Management Plans

The Project Traffic Manager is responsible for the development of TMPs for all aspects of construction that will require temporary changes to the motorway and non-motorway road layout using barriers or lane occupancies. These would be in accordance with the Australian Road Rules, AS1742.3: Traffic control devices for works on s, the RTA's Traffic Control at Worksites Manual and any other relevant standard,

guide or manual. Consultation with the relevant stakeholders is managed through the TTLG as described in Section 8.3.1.

TMPs provide the overall staging for the traffic management and the detail of how subplans are managed. The content of a TMP includes:

- Traffic Control Plans showing the detail of signs and devices required for each configuration;
- Vehicle Management Plans showing access to worksites, direction of travel etc.;
- Pedestrian Control Plans;
- Management strategy for vehicles e.g. public transport, temporary bus stop relocation, tidal bus lane operation; and
- Management strategy for access to properties, schools, business activities etc.

Communication of the proposed changes will vary depending on the nature and extent of the management scheme. The options and processes for advising users and the general public of the changes would be included in the Community and Stakeholder Consultation Plan and coordinated by the TTLG to include:

- Portable and permanent Variable Message Signs;
- M2 Upgrade and RTA web sites;
- Radio advertising; and
- Metropolitan and local newspaper advertising.

8.6.2 Strategy and Objectives

The Project Traffic Manager would ensure that road user delays are kept to an absolute minimum and maintain access for all road users.

8.6.2.1 Objectives

The objectives for managing the impact of the project construction activities on traffic are:

- Safety of all road users and pedestrians;
- Minimise disruption to road users and pedestrians;
- Ensure the M2 motorway and surrounding road network continue to function;
- Limit impacts on public transport (buses);
- Minimise changes to traffic operation;
- Minimise access disruptions to adjoining properties;
- Minimise construction activities on non-motorway roads and residential areas wherever possible; and
- Avoid heavy vehicle movements in peak traffic and out of hours.

8.6.2.2 Strategies

These objectives are achieved through the planning and consultation phases and implemented during the construction phase considering the following strategies:

- Potential road user delays are identified during the planning and consultation phases;
- During the design phase develop construction staging and temporary works that avoid conflicts with the existing road network, maximises separation between work areas and travel lanes;
- Existing road network capacity to be maintained;
- Existing road characteristics and environment especially residential streets, schools, business operations, clearways, parking, places of worship etc.
- Isolate work areas from general traffic using temporary safety barriers;

- Provide remote parking facilities for workforce with shuttle services to work areas
- Develop alternative work methods to minimise impacts (e.g. utilise more efficient plant / equipment, apply different design solution);
- Provision of CCTV coverage to observe traffic flow and incidents;
- Providing mechanism for the community to report incidents and delays, eg. 1800 phone number;
- Plan all lane occupancies with the aim to: minimise the actual work area, limit obstructions and restrictions, maximise the roads capacity, and avoid peak traffic flow periods;
- Analyse traffic volume data to: identify the capacity requirements of the , assess the potential impact on traffic flows, and identify the best time to minimise the inconvenience to road users;
- Clear and concise guidance and support amongst key stakeholders involved in the TTLG and its working groups; and
- Innovation in traffic management solutions including long term contra flow arrangements.