Appendix A

Public Transport Assessment (Urbanhorizon Pt Ltd)

SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE

Part 3A Concept Plan Application

Traffic and Transport

August 2013

URBANHORIZON

Moorebank Intermodal Terminal Facility
Public Transport Analysis

Final Report

Hyder Consulting

August 2011

Urbanhorizon Pty Ltd
Level 14, 109 Pitt Street, Sydney NSW 2000
tel +61 9232 8065 **fax** +61 9232 8087 philipbrogan@urbanhorizon.com.au
ABN 40 116 237 364

Moorebank Intermodal Terminal Facility - Public Transport Analysis

Prepared by

Urbanhorizon Pty Ltd
Suite 1404, 109 Pitt Street, Sydney NSW 2000
tel +61 2 9232 8065 **fax** +61 2 9232 8087 **email** philipbrogan@urbanhorizon.com.au
Web www.urbahorizon.com.au
ABN 40 116 237 364

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Executive Summary

This report details the findings of a review of the public transport needs and opportunities of an intermodal terminal facility at Moorebank in south western Sydney. The terminal and warehouse/distribution facility will provide container storage and warehousing with direct rail access.

A Transport Management and Accessibility Plan (TMAP) approach has been taken to the public transport analysis. The recommended package of measures should ensure that workers can travel to and from the Terminal facility sustainably and in a way that reduces growth in car use. The development proposal comprises terminal warehousing, distribution and ancillary uses arranged around north-south running rail line, north-south running heavy vehicle road and north-south running light vehicle road. A copy of the concept plan is provided in **Appendix A**. A total of 2,260 employees (under business as usual assumption) will be working on site at full development. The key findings are as follows:

There are a number of opportunities that can be targeted in the development of a sustainable transport plan for the development site, these include:

- The site's proximity to the higher order road network which connects to Liverpool and Holsworthy rail stations.
- Existing favourable walk mode shares comparable with those across Sydney.
- Car passenger mode shares higher than the Sydney and Liverpool averages which suggests a propensity towards public transport node drop off and pick up.

Conversely, some of the constraints that will need to be overcome include:

- Existing low bus and train mode shares within the locality.
- Existing above average car ownership across Liverpool.
- Distances separating the development site from existing public transport nodes.
- Current inaccessibility to local and regional bus services.

A Travel Demand Management (TDM) approach involving the application of strategies and initiatives to change travel behaviour and reduce travel demand is recommended for the development site. In order to limit to extent of employee generated private vehicle trips to and from the site and enhancing the viability of a weekday express bus service to and from Liverpool and Holsworthy stations, an ambitious public transport mode share of at least 30% should be targeted. The package of measures required to deliver this target mode share comprises:

Measure 1 – Travel behaviour change program

Summary – Various measures including marketing, promotion campaigns, events and Workplace Travel Plans designed to influence the mode choice of individuals by better understanding their travel needs.

Timeframe – Year 0 to year 5.

Responsibility: Proponent

Measure 2 – Reduce On-Site Car Parking Supply

Summary – Subject to compliance with relevant planning instruments, consider reductions in the proposed DCP required on site employee parking by up to 680 spaces.

Timeframe – Years 1 to 10.

Responsibility: Proponent

Measure 3 – Liverpool Station Express Bus Services

Summary – Provision of a peak express bus service to and from Liverpool Station via Moorebank Avenue and Newbridge Road.

Timeframe – Years 1 to 5 (must be implemented early to influence mode choice). Ideally the express bus links to Liverpool and Holsworthy stations should be implemented concurrently, however, if funding availability prevents this, then the link to Liverpool should be actioned first.

Responsibility: Proponent

Measure 4 – Holsworthy Station Express Bus Services

Summary – Provision of a peak express bus service to and from Holsworthy Station via Anzac and Heathcote Roads.

Timeframe – Year 1 to 7 (must be implemented early to influence mode choice).

Responsibility: Proponent

Measure 5 – Bus Interchange / Waiting Area

Summary – Provide employee bus interchange/waiting areas near the Freight Management Office and in southern sector of terminal site.

Timeframe – Year 1 - 5.

Responsibility: Proponent

Measure 6 – Bus Priority Works

Summary – Bus priority measures at key intersections as required.

Timeframe – Years 5 to year 15.

Responsibility: Proponent

Measure 7 – Walking and Cycleways

Summary – Shared or separate walking and cycle paths connecting the warehousing areas to the employee bus interchange/waiting areas and to the Moorebank Avenue bus stops.

Timeframe – Years 0 to 5.

Responsibility: Proponent

Measure 8 – Extend Bus Services 901

Summary – Extend bus route services 901 to traverse at least the northern sector of the site (via the Estate Road and Internal Road 2) possibly taking advantage of the possible future link to (the as yet unformed) Greenhills Avenue.

Timeframe – Year 0 to 5.

Responsibility: DoT

1.0 Introduction

Urbanhorizon Pty Ltd has been commissioned by Hyder Consulting to undertake a review of the public transport needs and opportunities for a proposed Intermodal Terminal Facility Moorebank. The terminal and warehouse/distribution facility will provide container storage and warehousing with direct rail access. The 83 hectare site is located on Moorebank Avenue at Moorebank (**Figure 2.1**) and currently provides Defence Department storage and distribution services.

The development proposal comprises the following uses:

- Warehouse and distribution facilities.
- Freight village uses.
- Train terminal operations.

This public transport analysis assumes a workforce of about 2,260 employees (under business as usual assumption) at full development. Hyder's main traffic report (volume 1) detailed employee assumption.

1.1 Workshop Scope

The purpose of the investigation is as follows:

- To define public transport options to achieve a favourable mode share for employee travel to and from the site once developed.
- To identify constraints and opportunities to achieving a favourable public transport outcome for the development proposal.
- To provide feedback on the layout and design of the development master plan.

1.2 Report Overview

The report comprises five sections as follows:

Executive Summary
1.0 Introduction
2.0 The Terminal Proposal
3.0 The Existing Transport Situation
4.0 Forecast Traffic & Transport Outcomes
5.0 A Suggested Package of Measures

Bibliography
Glossary

Appendix A –Concept Plan
Appendix B – Photographs

2.0 The Intermodal Terminal Proposal

The key aspects of the development proposal are summarised below.

2.1 The Site

The 83 hectare site is located on the eastern side of Moorebank Avenue to the west of the Wattle Grove residential area. Vehicular access to the site will be via multiple locations along Moorebank Avenue, a private road under the care and control of the Department of Defence. The eastern boundary abuts Greenhills Road, which is unformed in front of the site. Moorebank Avenue comprises one through lane in each direction plus turning lanes.

2.2 Development Particulars

The proposal comprises terminal warehousing, distribution and ancillary uses arranged around north-south running rail line, north-south running heavy vehicle road and north-south running light vehicle road. A new rail link connecting the SIMTA site with the Southern Sydney Freight Line forms part of the proposal. A copy of the concept plan is provided in **Appendix A**. Vehicular access will be provided at three locations along the Moorebank Avenue frontage to the site.

Warehousing

The majority of staff will work in the warehouses and distribution centres unpacking containers or preparing the contents for distribution. The terminal warehouses will operate in two shifts over part of the day. It is expected that the first shift will start prior to 07:00 and finishing around 16:00. The second shift would start at around 16:00 and finish after 12:00 midnight. Actual start and finish times are expected to be staggered to spread out parking and traffic demand.

Freight Village

The majority of office and ancillary staff would work during the normal working hours, with some staff required to support early morning and late evening shifts. Retail facilities will mainly be services such as food outlets and convenience stores for other staff. The facilities will be required to provide services during each of the main warehouse shifts.

When the site is fully operational, the proposed vehicle accesses will be as follows:

The southern access will provide left turn entry for articulated vehicles collecting containers from the intermodal terminal. This access will also be used by Terminal operations staff to access the administration facility at the Southern end of the Terminal. It may also be used as a second access for emergency purposes. It will not be used to provide routine access to the warehouses.

The northern access will be the principal site access. It will accommodate vehicles leaving the Terminal with containers, vehicles delivering full or empty containers and vehicles accessing warehouses.

2.3 Access & Mobility Principles

Sustainable travel within, to and from the development will be underpinned by a number of important access, mobility and urban design principles:

1. Maximising employee and visitor safety by separating heavy and light vehicle traffic where possible.
2. Encourage the use of non-motorised personal transport for travel by employees and visitors to the site.
3. Provide linkages to existing public transport.
4. Facilitate internal bus access via the centrally located heavy vehicle spine road to reduce trip lengths, enhance the viability of buses and encourage walking and cycling.
5. Maximise the number of vehicular and non-vehicular access points on both sides of the development.
6. Consider the applicability of demand responsive bus services.
7. Maximise the use of information systems in support of public transport.

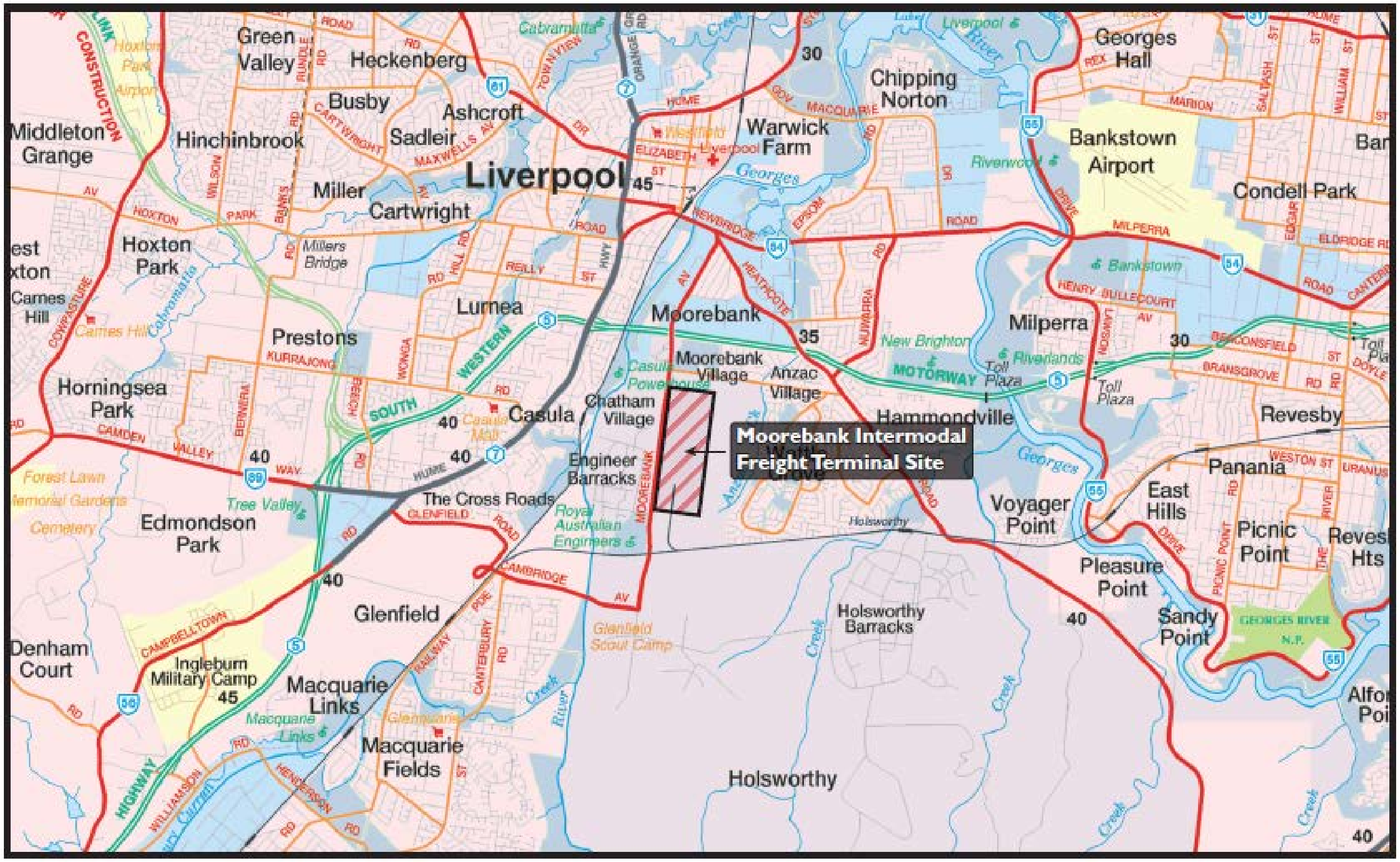


Figure 2.1 — Location of Proposed Moorebank Terminal Facility

3.0 The Existing Transport Situation

The strategic and operational context within which the development proposal sits is outlined below.

3.1 The Strategic & Policy Context

3.1.1 State Plan Targets

The State Plan describes the previous NSW Government's plans for service delivery across a range of areas. The Plan provides public transport related targets which serve as a useful base upon which to measure aspects of the development as proposed. The State Plan targets are as follows:

Improve the public transport system.

Increase the share of commute trips made by public transport:

- To and from the Sydney CBD during peak hours by 80% by 2016.
- To and from the Parramatta CBD during peak hours by 50% by 2016.
- To / from the Newcastle and Sydney CBD during peak hours by 20% by 2016.
- To and from the Wollongong CBD during peak hours by 15% by 2016.
- To and from the Liverpool CBD during peak hours by 20% by 2016.
- To and from the Penrith CBD during peak hours by 25% by 2016.

Increase the proportion of total journeys to work by public transport in the Sydney Metropolitan Region to 28% by 2016.

Provide reliable public transport.

- Trains – 92% of CityRail trains run on time across the network.
- Buses – 95% of Sydney buses run on time across the network.
- Ferries – 99.5% of Ferries run on time.

Improve the road network.

- Improve the efficiency of the road network during peak times as measured by travel speeds and volumes of Sydney's road corridors.
- 98% of incidents on principal transport routes are cleared, on average, within 40 minutes of being reported.
- Increase the proportion of container freight movement by rail out of Port Botany to 40% by 2016.

Increase walking and cycling.

- Increase the mode share of bicycle trips made in the greater Sydney Region, at a local and district level, to 5% by 2016.

Increase the number of jobs closer to home.

- Increase the percentage of the population living within 30 minutes by public transport of a city or major centre in Metropolitan Sydney.

3.1.2 Growing Liverpool 2021

Liverpool Council is developing a ten year community strategic plan called Growing Liverpool 2021. The purpose is to provide direction for the planning of the LGA in response to the anticipated increase in population from about 182,000 (2009) people to more than 220,000 people by 2021. The *State of the city Liverpool 2010* document provides a summary of some of the challenges facing the LGA. The document highlights the following travel and related statistics:

- Liverpool has grown from about 12,600 people in 1947 to about 182,000 in 2009. By 2036 a population of about 325,000 people is anticipated.
- By 2036 about 50,000 of this estimated 325,000 population will be over 65 years of age.
- Residents make an average of 3.4 trips per person on an average weekday.
- The average travel time for residents is about 34 minutes.
- Most trips are made by car, in 2006 about 62% of people in Liverpool drove to work compared with 54% for people in Sydney.
- Slightly more than 11% of people in Liverpool used public transport to travel to work compared to 18% for Sydney.
- By train in the peak hour, it takes about 54 minutes to get to Central station compared to about 40 minutes from Blacktown and 28 minutes from Parramatta.

The document highlights the following challenges:

- To maintain flexible planning controls that allow for changes in residential demand and traffic patterns.
- Continue to grow and develop Liverpool as a regional city for south western Sydney with major facilities and improved transport.
- To increase services and infrastructure in line with population growth.

3.2 The Road Network and Traffic

The development site has frontage to Moorebank Avenue, a north-south arterial road. Moorebank Avenue comprises one lane in each direction and carries about 15,000 veh/day on the average weekday. See Photographs in **Appendix B**.

The northern end of the site is about 600 metres from the M5 Motorway/Moorebank Avenue interchange. The northern part of the site is located about 2.7 kilometres from Liverpool rail station and the bus interchange located on the eastern end of Moore Street (**Appendix B**). Access to and from the site and Liverpool rail station is via Moorebank Avenue - Newbridge Road - Speed Street - Bigge Street - Moore Street. The introduction of the Liverpool to Parramatta Transitway and the volume of bus activity to and from the bus interchange means that several of the roads within the Liverpool city centre have lanes dedicated fully or partially to bus access.

3.3 Public Transport Services

3.1.1 Bus

Presently only one bus route, Route service 901 operated by Veolia, services the area in the vicinity of the site via Moorebank Avenue. 901 buses travel via Anzac Road to the north of the site with only one AM and one PM service accessing the site (south of Anzac Road to the existing DNSDC site). This is shown as a dotted line in **Figure 3.2**. These buses connect the area to Liverpool Station and then access Wattle Grove en route to Holsworthy rail station which is located about 3 kilometres to the east of the southern area of the site. The first 901 bus leaves Liverpool station at about 5:30am each weekday and the last bus returns to Liverpool station at about 8:50pm on weekday evenings. The weekday average peak frequencies are about 30 minutes and 60 minutes in the off peak.

The NSW Government has introduced a number of high frequency cross regional bus services across the Sydney metropolitan area. The network comprises 13 routes operating seven days a week departing every ten minutes during peak periods. Services operate every 15 minutes during the weekday and every 20 minutes until 8:30pm. Some services operate after 8:30pm at a frequency between 30 and 60 minutes. On weekends the buses run every twenty minutes between 7:30am and 7:30pm. The Metro services are operated by both STA and private operators.

Metro Bus M90 runs between Liverpool and Burwood via Milperra and Newbridge road. It is not accessible to the subject site, these road being located more than two kilometres to the north.

Table 3.1 – Bus Services (Routes 901, 902 & M90), 2011

Time	No. of Services per day					
	901		902		M90	
	NB	SB	NB	SB	WB	EB
Weekday AM	9	10	12	10	35	33
Weekday PM	15	14	13	13	45	39
Saturday AM	5	5	6	6	15	15
Saturday PM	7	7	7	7	26	27
Sunday AM	4	4	4	3	15	15
Sunday PM	7	6	5	7	26	27

Source: Urbanhorizon Pty Ltd, 2011

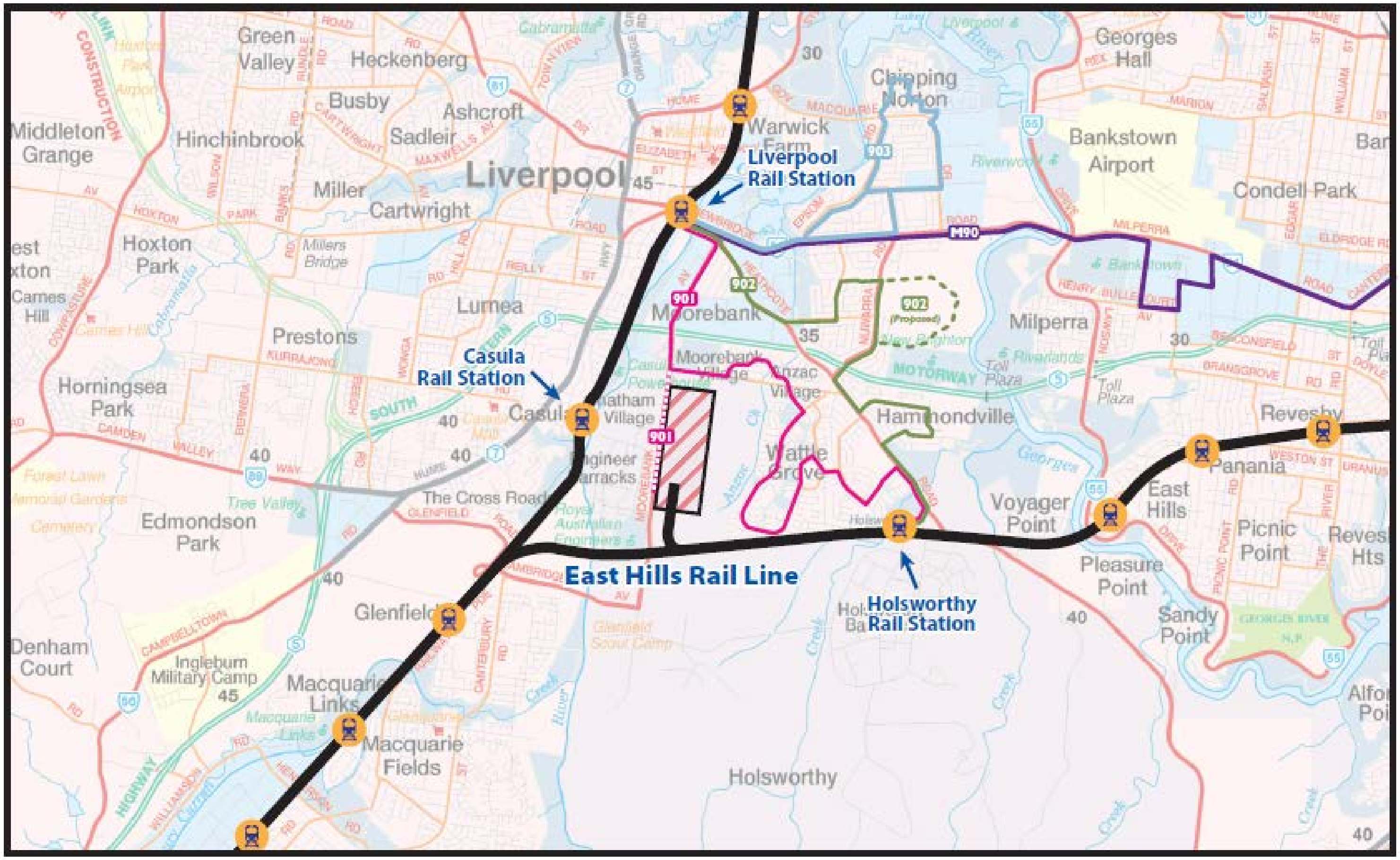


Figure 3.2 — Existing Bus Routes and Rail Network

Table 3.1 shows the numbers of bus services across the average weekday and weekend day. Routes 901 and 902 provide a limited service on weekends. Route M90, although remote from the site, operates on both weekdays and weekends at much better frequencies.

3.1.2 Rail

The site is located near the junction of the Southern and East Hills rail lines. Three rail stations are located within a 3-4 kilometre radius of the site, these being Liverpool Station (Southern Line) to the north, Casula Station (Southern Line) to the west and Holsworthy Station (East Hills Line) to the south east. The Georges River is located between the site and Casula Station. This, and the existing arrangement of the road network means that Casula Station is not as accessible to the site as the other two rail stations.

Table 3.2 shows the 2009 weekday Station entries and exits at each of the three stations. By way of comparison, the number 1 ranked station in the network was Central station with AM (6:00-9:30am) entries and exits of 8,260 and 37,720, respectively. Twenty four hour entries and exits were 85,260 pax/day. This compares with the 8,570 and 2,840 entries and exits at Liverpool and Holsworthy stations, respectively.

Table 3.2 – 2009 Weekly Station Entries/Exits

Station	2:00-6:00		6:00-9:30		9:30-15:00		15:00-18:30		18:30-2:00		24 Hours		Rank
	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	
Liverpool	160	80	2710	2250	2500	2230	2600	2890	600	1110	8570	8570	27
Holsworthy	20	30	2280	190	330	260	170	1640	40	730	2840	2840	81
Casula	0	0	100	20	40	40	30	90	10	30	180	180	233

Source: RailCorp, 2010

Vehicular access between the development site and the two nearest stations is as follows:

- Liverpool Station: Moorebank Avenue - Newbridge Road - Speed Street - Bigge Street - Moore Street.
- Holsworthy Station: Anzac Road - Wattle Grove Dr - Heathcote Road – Macarthur Dr - right into station car parking area.

3.4 Travel Behaviour & Trends

3.4.1 Transport Indicators

Table 3.3 summarises some of the key transport indicators for the Liverpool LGA and the Sydney Statistical Division sourced from the Bureau of Statistics (BTS) Household Travel Survey. Generally, Liverpool's residents exhibit higher trip making and car based mode shares than the average for Sydney. Total travel per person (km) and VKT's per person are both above the Sydney average. Mode choice in Liverpool is dominated by the car which is more than 10 percentage points higher than the Sydney Average (80% vs. 68.3%).

Table 3.3 – Transport Indicators, Liverpool LGA & Sydney SD, 2008-09

Indicator	Sydney	Liverpool
Population	4,269,000	171,000
Households	1,626,000	55,000
Trips per person	3.76	3.4
Total travel per person (km)	31.1	33.9
Model of travel (%):		
- Car Driver	47	56
- Car passenger	21.3	24
- Car combined	**68.3**	**80**
- Train	5.2	3
- Bus	5.8	4
- Walk	18.3	12
Vehicles per Household	1.51	1.72
Ave. trip length (km)	8.3	10.1
VKT per person	17.8	22.6
Ave. work trips (mins)	34	34
Daily travel time (per person)	81	75

Source: BTS HTS, 2011

There are, however, some potentially positive travel characteristics across Liverpool that may be targeted in the development of a public transport plan for the subject development site. Train is used by about 3% of Liverpool residents for journey to work trips which, although below that applying across Sydney (3% vs. 5.2%), does provide a good base upon which to develop a favourable public transport mode share for the future employees on the terminal site. The propensity to use heavy rail for JTW trips suggests that future workers on the development site may use rail in reasonable numbers providing links between the site and the rail stations are satisfactory.

Similarly, the mode share for bus use across Liverpool (4%) is also below the 5.8% average for Sydney. The review of travel patterns and mode shares at the Travel Zone (TZ) level shows that in the immediate area, current bus and rail mode shares are well below this LGA average, with only about 1% of (all purpose) trips in the AM peak from the locality currently taking place on bus. A successful public transport plan for the terminal site will need to target bus mode shares better than this current Liverpool LGA average.

The average trip lengths and travel times suggest that a high proportion of trips occur within the Liverpool LGA or to nearby areas. This propensity to 'local' travel suggests that the employment uses proposed for the site will attract workers from within or nearby the Liverpool LGA. This will assist in reducing overall trip lengths, travel times and increasing the likelihood that appropriately targeted bus services will be used for journey to work trips at the terminal site.

BTS data provided by Hyder Consulting and sourced from the 2006 Census provides information about how people travel currently in the locality. **Table 3.4** summarises this information. The local travel statistics provide an indication of how future terminal employees on the development site might travel, albeit in the absence of measures designed to achieve a more sustainable mode share. The data indicates:

- The mode share to car is above the Liverpool average.
- The mode share to car is well above the Sydney average.
- The mode shares to bus are significantly less than the Sydney average and below the Liverpool average.
- The mode share to train for production trips is less than both the Sydney and Liverpool averages.

Table 3.4 - Transport Indicators, Local Travel Zones, 2006

	Inbound Trips	**Mode Share (%)**
Train	148	2.1
Bus	62	1.0
Car driver	5,444	78
Car pax.	466	6.7
Car total	5,910	-
Other modes	328	4.7
Work home / not stated	534	7.5
Total	6,985	100

Source: Hyder Consulting, 2011 (BTS data)

The principal destinations for trips from the locality were extracted from the BTS Model trip tables. The BTS transport model produces trip information for Travel Zones (TZs) across Sydney. The review (see **Table 3.5**) reaffirms the dominance of trips made internal to the Liverpool area, about 30% of all AM peak trips (includes trips internal to the TZ). The Liverpool, Campbelltown and Fairfield LGAs are also important destinations for trips originating in the two largest trip generating TZs in the locality. Assuming that future terminal employees on the development site have the same or similar destinations, this information represents both a challenge and an opportunity. The dominance of trips made internal to the Liverpool LGA, that is, comparatively short trips, can lend itself to car based travel. Conversely, if appropriate public transport services are provided to meet the needs of these shorter trips it will be possible to achieve a mode share to public transport at the expense of car use. A good example is the provision of rapid and high frequency bus services between the terminal site and nearby rail hubs in the AM and PM peaks, and during site shift changes.

Table 3.5 – Distribution of Car Based Trips from Locality, AM Peak 2010

Zone	Dest.	Trips	%	Rank	Zone	Dest.	Trips	%	Rank
1110	Liverpool	224	28	1	**1113**	Liverpool	155	27	1
	Campbelltown	123	15	2		Campbelltown	86	15	2
	Fairfield	107	13	3		Fairfield	58	10	3
	Bankstown	65	8	4		Camden	42	7	4
	Sutherland	63	8	5		Blacktown	36	6	5
	Others	110	14			Others	89	15	
Total		**643**	**100**				**563**	**100**	

Source: Hyder Consulting, 2011

3.5 Constraints & Opportunities

There are a number of opportunities that can be targeted in the development of a sustainable transport plan for the terminal site, these include:

- A well established and under-utilised higher order road network providing direct access to and from the development site.
- The proposed terminal land use will generate mostly inbound trips in the AM peak resulting in a more balanced use of the surrounding road network.
- Employment uses that will attract workers from within or nearby the Liverpool LGA.
- Existing favourable walk mode shares comparable with those across Sydney.
- Car passenger mode shares higher than the Sydney average which may suggest a propensity towards public transport node drop off and pick up.

Conversely, some of the constraints that will need to be overcome include:

- Existing above average car ownership across Liverpool.
- Poor access to and use of rail for people within the immediate Moorebank Avenue locality.
- Distances separating the terminal site from existing public transport nodes.
- Current inaccessibility to local and regional bus services.

4.0 Forecast Traffic and Transport Outcomes

This section identifies a range of measures required to provide sustainable travel for terminal employees to and from the site over time.

4.1 Achieving a Favourable Public Transport Mode Share

An individual's decision to use public transport or car or a combination for a particular journey is a function of many factors; car availability, relative travel times and costs, availability and cost of parking and other non-quantifiable factors. Adopting a laissez-faire approach to the development will more than likely see mode shares mimic those found elsewhere in southern and western Sydney. A proactive demand management approach is required whereby public transport use is encouraged by ensuring services and facilities are in place to offer a realistic alternative to the car. The design and layout of the terminal facility must facilitate public transport use.

Travel Demand Management (TDM) involves the application of strategies and initiatives to change travel behaviour and reduce travel demand, especially for car based trips to and from the proposed development. A TDM approach seeks to bring about more efficient travel patterns and travel choices by:

- Improving transport and trip making choices.
- Providing incentives to modify the choice of mode, travel times and the need for travel.
- Enhancing land use accessibility.
- Changing policies.

There are many benefits of a TDM approach:

- Reduces car based trip making.
- Reduces road traffic congestion.
- Allows total on site car parking provision to be minimised and for land to be put to other uses.
- Encourages the use of less environmentally damaging modes such as walking, cycling and public transport.
- Health and fitness benefits through increased walking and cycling.
- Lessens the costs associated with car ownership and maintenance.

Achieving a favourable TDM outcome for the subject terminal site will require both infrastructure and non-infrastructure initiatives. Candidate initiatives include the following:

<u>Infrastructure based TDM initiatives:</u>

- Ensuring that the use of personal non-motorised transport is encouraged through appropriate warehouse layout / design and road intersection design.
- Designing and constructing the central spine road and other site roads to accommodate buses, bus infrastructure and cyclist use for employees.

- Construction of a covered bus drop off/pick up facility near the proposed Freight Management Office in the north sector of the site and another in the southern sector of the site to encourage the use of buses for access to and from the site.
- Review and rationalise the locations of 901 bus stops in the vicinity of the site to match the proposed northern terminal entry location and enhance accessibility.
- Monitor the need for additional bus priority at key intersections within and external to the site to accommodate the proposed bus service extensions forming part of the package of measures.

<u>Non-Infrastructure based TDM initiatives:</u>

- Reduce the total supply of car parking available to terminal employees on site and dedicate some of the land to the two bus drop off/pick up facilities.
- Provide peak period express buses to/from the site and Liverpool Station via Moorebank Avenue and Newbridge Roads.
- Provide peak period express buses to/from the site and Holsworthy rail station via Anzac Road, Wattle Grove Drive and Heathcote Road.
- Consider the feasibility of adjusting the Indicative Development Plan to provide for a bus only link between the 'Internal Road 2' and (the unformed) Greenhills Avenue. This will improve bus accessibility and reduce bus travel times between the site and the nearby rail stations.
- Extend bus route 901 through the site via the light vehicle road.
- Increasing peak period 901 bus service frequencies (through the site) to better match the needs of existing and future employees of the locality as terminal development proceeds.
- The introduction of a travel behaviour change program for the terminal employees.
- Provide walkways and cycleways through the terminal site linking with the proposed on site bus facility.
- Initiate a marketing and awareness campaign for all new employees on the site and in the locality to promote the TDM initiatives including:
    - Bus services linking to Liverpool and Holsworthy stations.
    - Walking and cycling facilities linking to bus stops.
- Adopt a proponent designed and funded car sharing scheme.

4.1.1 Park and Ride

It is not proposed to link the site with the passenger rail network and as such the location of the site in relation to Holsworthy rail station is such that park and ride will not form part of a public transport plan for the site. The Transport Construction Authority (TCA) has been implementing a commuter car park and interchange program over recent years. A new 520 space commuter car park was opened at Holsworthy Station in December 2009 in recognition of the high demand for park and ride at this station. The commuter car park is available for CityRail patrons only and would not accommodate the travel needs of SIMTA employees. For example, a SIMTA employee could not drive and park at Holsworthy station in order to board one of the proposed express buses to the SITA site.

4.2 Traffic & Trip Generation Estimation

The *Technical Note 3 - Traffic Generation report, Hyder, June 2011 (Volume 2 of Main Traffic Report, Appendix F)* provides details of the traffic likely to be generated by the terminal proposal at full development. **Table 4.1** below details the estimated total person trips and associated trip mode shares for the development against two development scenarios:

- Scenario A – Development as proposed (Approximately 2,260 employees) without a TDM package of measures.
- Scenario B – Development as proposed (Approximately 2,260 employees) with a TDM package of measures.

For each development future the mode share impacts have been estimated under a no TDM scenario (i.e. a traditional approach without initiatives in support of public transport) and a scenario with a TDM package of measures.

The State Plan targets aim to increase the public transport share of commuter trips across Sydney from the current 24% to 28% by 2016, a 4% increase. A 4% increase across Sydney is an ambitious target and one that relies on developments such as that proposed for Moorebank pursuing a TDM approach. The comparatively higher than average car based mode shares in the Liverpool area and the inaccessibility of the development site require that the TDM package for the site target an ambitious development specific mode share shift. In order to ensure the viability of a weekday express (an all stops or limited stops service is unlikely to be patronised by employees as it will not deliver travel times better than or similar to the private car) bus service to and from Liverpool and Holsworthy stations, a public transport mode share of at least 30% should be targeted.

If, at full development, 30% of all employees working on the site, used a bus to access Liverpool and Holsworthy rail stations, this would equate to about 680 employees. The benefits of achieving such a mode share target would be as follows:

- 680 fewer peak car trips (one way) to and from the terminal site.
- It would reduce the total on site car parking provision by about 680 car spaces, equivalent to about 15,000 square metres or 1.5 hectares of site area which could be put to more productive use.
- It would provide the patronage required to support the viability of the express bus services proposed.
- It would take pressure off the already well patronised commuter car parking facilities at Holsworthy rail station.

Assuming about 75% of employees would have an origin (AM) and destination (PM) at Liverpool station, about 9 or 10 buses would need to depart the station in the morning peak 2 hours to accommodate likely patronage under a 30% scenario. Three to four buses would be required to accommodate the remainder of employees travelling to the site from Holsworthy station.

Table 4.1 shows that a public transport share of about 30% could be achieved if a range of TDM measures are implemented as part of the development, especially the peak period bus connections to and from the rail stations. These are addressed overleaf.

A 30% public transport share is anticipated for the terminal development based on the package of measures being able to influence travel choice for inbound employee trips to the site. Major improvements in the bus and rail mode shares have been forecast to 30%. Similarly, improvements in walk and bicycle mode shares (other modes) of more than 6% can be achieved where the appropriate shared facilities are provided into and through the site. A terminal employee car mode share of about 51.5% could be achieved which would be well below both the Sydney and Liverpool LGA averages.

Table 4.1 – Estimated Trip Generation with and without TDM Package

Development. Scenario	**Estimated Trips and Mode Share**			
	No TDM Package		**With TDM Package**	
	Trips	**%**	**Trips**	**%**
Total Person Trips				
P Trans Modes				
Train	95	2.1	226	5.0
Bus	45	1.0	1356	30
Total	140	3.1	1582	35.0
Car Mode				
Car dr	3,526	78	2,102	46.5
Car pax	303	6.7	226	5.0
Total	3,829	84.7	2,328	51.5
Other Modes				
Other	212	4.7	271	6.0
W home/stated	339	7.5	339	7.5
Total	551	12.2	610	13.5
Total	**4,520**	**100**	**4,520**	**100**

Source: Urbanhorizon Pty Ltd

1. TDM = Travel Demand Management.
2. 4,520 = Assumes the forecast 2,260 employees will generate 2 terminal trips per day.
3. 30% public transport mode share applied to bus only. Rail-bus trips will be linked trips.
4. Forecast 'work at home/did not work' % held constant.

The following measures are designed to influence and change travel behaviour to bring about sustainable travel to and from the development site. The costs of the measures are likely to be such that a staged approach would be required as development progresses across the site. The staging below assumes that development will occur over a 20 year period (full development in 2031).

4.2.1 Non Infrastructure Measures

A travel behaviour change program comprising a Moorebank Intermodal Terminal Facility car sharing scheme and marketing and awareness campaign will need to be implemented in the early phases of the development. The marketing and awareness campaign will embrace the following:

- Information explaining that a package of measures to support travel by modes other than just car will be implemented in a staged manner over time.
- Travel information on both a specific Moorebank Intermodal Terminal Facility website and Liverpool Council's website including a description of the measures to be put in place in the short, medium and longer term.
- Regular marketing and promotion campaigns and events designed to influence the mode choice of employees by better understanding their travel needs.
- The operators on the site will be encouraged to implement a Workplace Travel Plan for its employees to encourage and enable employees and visitors to take advantage of modes other than just car for trips to and from the site. Workplace travel planning information is available on the NSW Premier's Council for Active Living (PCAL) Website.
- An aggressive campaign to both promote the express bus services linking the site to the rail network at Liverpool and Holsworthy rail stations and communication that on site car parking provision for employees will be limited.
- Consideration of the imposition of pay and display parking for all day employee parking in conjunction with the introduction of parking time restrictions on streets external to the terminal site.
- Car sharing databases will need to be prepared and maintained.
- A bicycle loan scheme will be required for movement across the terminal site.

Bus Travel

The above non-infrastructure short term measures will need to be supported by one or more infrastructure measures designed to influence travel behaviour change for employees from day one. Having regard to the findings of the above TZ review, the provision of a peak express bus service to and from Liverpool Station via Moorebank Avenue and Newbridge Roads will be important. The service may need to be funded by the proponent and would need to provide travel times of less than 10 minutes between the site entry and station.

In order to achieve the ambitious mode shares it will be necessary to provide high service frequencies of not greater than 10 minutes in the AM and PM peaks periods. That is, in the AM peak (6-9am) as employees travel to the terminal site, a bus will need to depart the station every 5-10 minutes. Similarly, in the PM, return buses will need to operate on a 5-10 minute frequency or better. Outside the peaks, bus service frequencies of 30 minutes should be maintained. This measure may need to be supported by targeted bus priority measures at key intersections which can be monitored over time. See **Figure 4.1**.

Supporting a bus service during the early phases of development will be challenging and will necessitate proponent intervention and funding. For illustration purposes assume in the early phases there are 1,000 employees active on site all of whom could take public transport. If 30% or about 300 of these workers travelled by bus then it would require about 6 or 7 buses in the AM and PM peaks. This would grow over time as indicated above and depending on the split of demand between Liverpool and Holsworthy rail stations.

Rail Capacity

Liverpool station is located on the Southern Line. RailCorp data reaffirms that in March 2010 the average load factor (rail seats to passenger ratio) was about 125% between 7:50 and 8:50am. Given that a larger proportion of the terminal workers will choose to travel to and from the site outside the network peaks, the Southern line is expected to be able to accommodate the growth in demand generated by the ambitious public transport mode share target. Similarly, the East Hills line had average load factors above 100% between 7:50 and 8:50am but has the capacity to absorb the extra demand generated by the terminal development on the shoulders of the peak periods.

4.2.2 Other Measures

As development progresses, other measures would need to be put in place to encourage public transport use. On the western side of the site, a similar peak express bus service to and from Holsworthy Station via Heathcote Road will need to be implemented. As with the Liverpool station service, the service may need to be funded by the proponent and could provide travel times of about 5 minutes. No bus priority works would be required along the route.

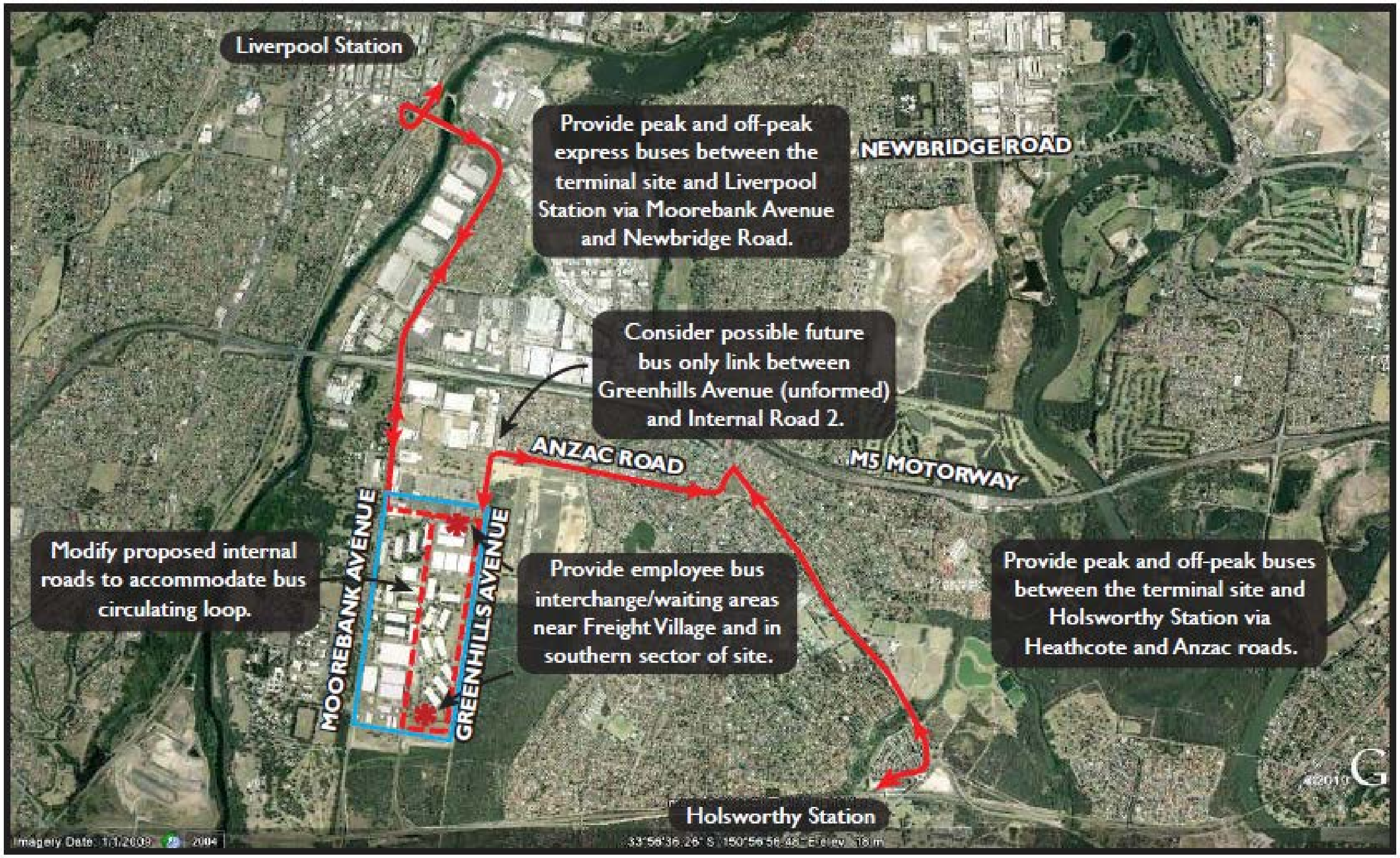
In addition to these peak period express services, the route of 901 buses could be altered to traverse at least the northern sector of the site (via the Estate Road and Internal Road 2) taking advantage of a possible future link to (the unformed) Greenhills Avenue. 901 buses currently travel east-west along Anzac Road, some of the buses could remain on Anzac Road while some route services could be deviated via the northern part of the terminal site. This would supplement the proposed express services to and from the rail stations. Critical to the success of the above measures will be the provision of accessible walking and cycle paths to ensure good access to bus stops within and on the periphery of the terminal site.

4.2.3 Possible Long Term Measures

In the longer term there may be the opportunity to introduce a cross regional Metro bus service that uses the M5 Motorway and deviates to access the terminal site and other nearby demand generators. Deviation of the existing M90 services from Newbridge Road would not be feasible.

4.2.4 Cumulative Mode Share Benefits

The combined impact of the bus and rail focussed measures will be to achieve terminal site specific mode share increases above those applying across Liverpool at the moment. A terminal employee public transport mode share shift of about 30% is considered feasible. If a reasonable proportion of employees work within the region, then substantial trip reduction benefits can be achieved. This could manifest itself in a 2-3% increase in walk mode share at the expense of car based trips.



Source: (C) Google 2010

Figure 4.1 — Suggested Package of (Infrastructure) Measures

URBANHORIZON Level 14, 109 Pitt Street, Sydney NSW 2000, tel: 02 9232 8065 fax: 02 9232 8087 email: philipbrogan@urbanhorizon.com.au

5.0 A Package of Measures

Adopting a Transport Management and Accessibility Plan (TMAP) approach to the development will ensure sustainable trip making to and from the development. This will be achieved by investment in a suggested package of measures within and external to the site.

5.1 Suggested Package of Measures

Measure 1 – Travel behaviour change program

Summary – Various measures including marketing, promotion campaigns, events and Workplace Travel Plans designed to influence the mode choice of individuals by better understanding their travel needs.

Timeframe – Year 0 to year 5.

Responsibility: Proponent

Measure 2 – Reduce On-Site Car Parking Supply

Summary – Subject to compliance with relevant planning instruments, consider reductions in the proposed DCP required on site employee parking by up to 680 spaces.

Timeframe – Years 1 to 10.

Responsibility: Proponent

Measure 3 – Liverpool Station Express Bus Services

Summary – Provision of a peak express bus service to and from Liverpool Station via Moorebank Avenue and Newbridge Road.

Timeframe – Years 1 to 5 (must be implemented early to influence mode choice). Ideally the express bus links to Liverpool and Holsworthy stations should be implemented concurrently, however, if funding availability prevents this, then the link to Liverpool should be actioned first.

Responsibility: Proponent

Measure 4 – Holsworthy Station Express Bus Services

Summary – Provision of a peak express bus service to and from Holsworthy Station via Anzac and Heathcote Roads.

Timeframe – Year 1 to 7 (must be implemented early to influence mode choice).

Responsibility: Proponent

Measure 5 – Bus Interchange / Waiting Area

Summary – Provide employee bus interchange/waiting areas near the Freight Management Office and in southern sector of terminal site.

Timeframe – Year 1 - 5.

Responsibility: Proponent

Measure 6 – Bus Priority Works

Summary – Bus priority measures at key intersections as required.
Timeframe – Years 5 to year 15.
Responsibility: Proponent

Measure 7 – Walking and Cycleways

Summary – Shared or separate walking and cycle paths connecting the warehousing areas to the employee bus interchange/waiting areas and to the Moorebank Avenue bus stops.
Timeframe – Years 0 to 5.
Responsibility: Proponent

Measure 8 – Extend Bus Services 901

Summary – Extend bus route services 901 to traverse at least the northern sector of the site (via the Estate Road and Internal Road 2) possibly taking advantage of the possible future link to (the as yet unformed) Greenhills Avenue.
Timeframe – Year 0 to 5.
Responsibility: DoT

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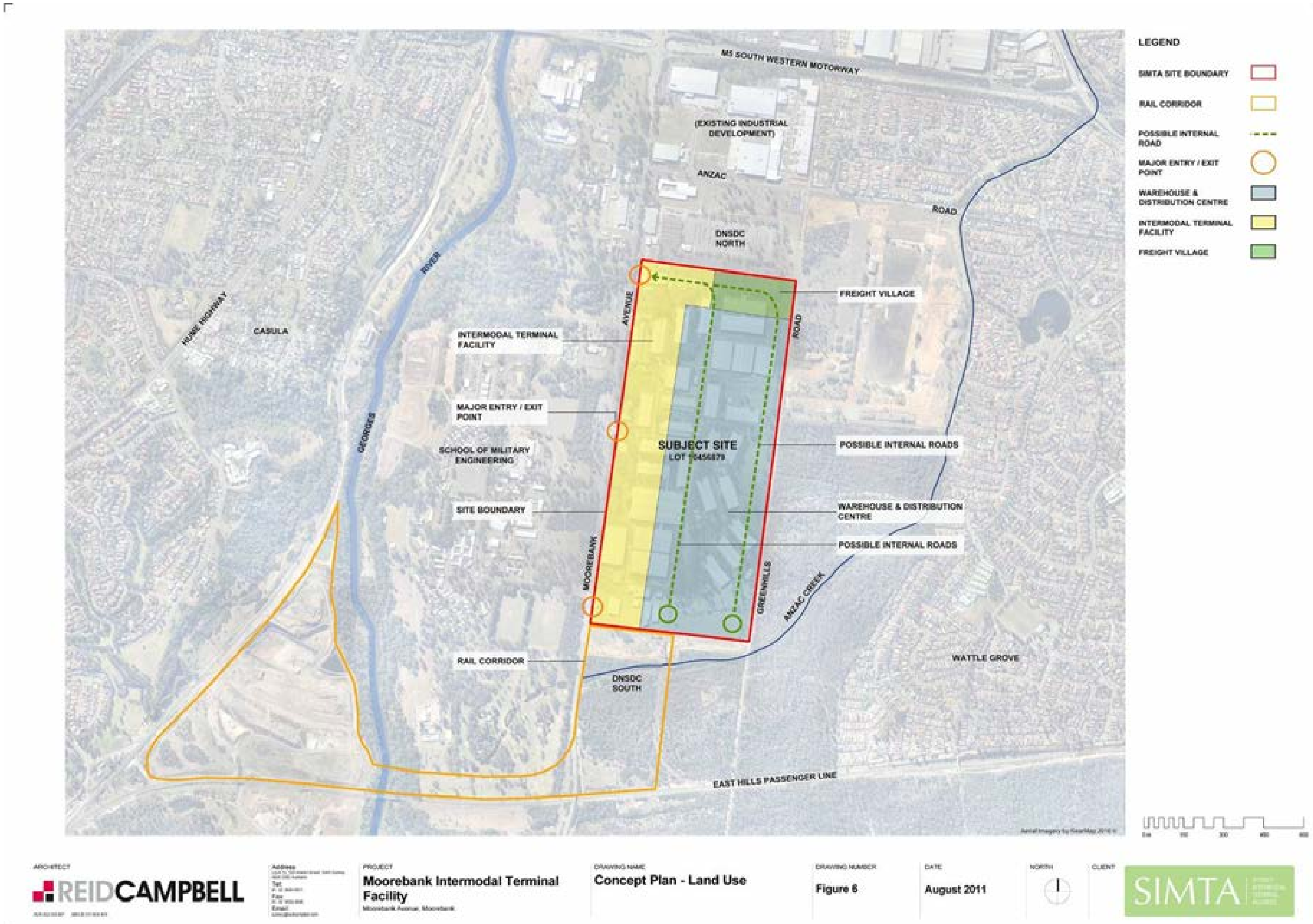
Glossary

AADT	Average Annual Daily Traffic
BTS	Bureau of Transport Statistics (Transport for NSW & formerly TDC)
COAG	Council of Australian Governments
DCP	Development Control Plan
DNSDC	Defence National Storage and Distribution Centre
DoP	Department of Planning (Now DP&I)
Down	Rail movement away from the Sydney CBD
EA	Environmental Assessment (formerly EIS)
ECRL	Epping to Chatswood Rail Link
EIS	Environmental Impact Statement (now referred to as EA)
EPA	Environmental Planning & Assessment Act, 1979
GFA	Gross floor area.
IA	Infrastructure Australia
JTW	Journey to Work
LGA	Local Government Area
LoS	Level of Service
Pax	Passengers
PCAL	(NSW) Premiers Council for Active Living
RTA	Roads and Traffic Authority
SEPP	State Environmental Planning Policy
STA	State Transit Authority.
STM II	Strategic Travel Model (mode share model operated by BTS)
TCA	Transport Construction Authority (previously TIDC)
TDM	Travel Demand Management
TIDC	Transport Infrastructure Development Corporation (now TCA)
TMAP	Transport Management and Accessibility Plan.
TOD	Transit Oriented Development
TZ	Travel Zone
Up	Rail movement towards the Sydney CBD
VKT	Vehicle Kilometres Travelled
VPD	Vehicles per day
VPH	Vehicles per hour

Appendix A – Concept Plan



Appendix B – Photographs

Photograph B1 - Looking south along Moorebank Avenue at Terminal Site, July 2011.

Photograph B2 - Looking east along Anzac Road near the Terminal Site, July 2011.

Photograph B3 - Looking north along Moorebank Avenue at the Terminal Site, July 2011.

Photograph B4 - Looking towards Moore Street entry to Liverpool Station bus interchange, July 2011.

Appendix B

Technical Note 4
Existing Road Network Capacity

SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE

Part 3A Concept Plan Application

Traffic and Transport

August 2013

SYDNEY INTERMODAL TERMINAL ALLIANCE (SIMTA)

MOOREBANK INTERMODAL TERMINAL FACILITY (MITF)

TECHNICAL NOTE 4

EXISTING ROAD NETWORK CAPACITY ISSUES

Hyder Consulting Pty Ltd
ABN 76 104 485 289
Level 5, 141 Walker Street
Locked Bag 6503
North Sydney NSW 2060
Australia
Tel: +61 2 8907 9000
Fax: +61 2 8907 9001
www.hyderconsulting.com

SYDNEY INTERMODAL TERMINAL ALLIANCE (SIMTA)

MOOREBANK INTERMODAL TERMINAL FACILITY (MITF)

TECHNICAL NOTE 4

EXISTING ROAD NETWORK CAPACITY ISSUES

Author	Nick Cottman, Alen Krljic, Meysam Ahmadpour, Mukit Rahman	
Checker	Mukit Rahman	
Approver	Neil McMillan	

Report No 4

Date June 2013

This report has been prepared for Sydney Intermodal Terminal Alliance (SIMTA) in accordance with the terms and conditions of appointment for Technical Note 4 dated July 2010. Hyder Consulting Pty Ltd (ABN 76 104 485 289) cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

REVISIONS

Revision	Date	Description	Prepared By	Approved By
A	28/03/11	DRAFT for client review	NC	MR
B & C & D	14/07/11	DRAFT	MR	
E	08/08/11	Updated in line with Halcrow's review and comments	MR	NM
F	1/06/13	Updated for Concept Application submission	MR	NM

CONTENTS

APPENDICES

EXECUTIVE SUMMARY

The SIMTA Moorebank Intermodal Terminal Facility (SIMTA proposal) is proposed to be located on the land parcel currently occupied by the Defence National Storage and Distribution Centre (DNSDC) on Moorebank Avenue, Moorebank, south west of Sydney. SIMTA proposes to develop the DNSDC site into an intermodal terminal facility and warehouse/distribution facility, which will offer container storage and warehousing solutions with direct rail access.

The SIMTA site, approximately 83 hectares in areas, is currently owned by SIMTA and tenanted by the Department of Defence to accommodate the Defence Storage and Distribution Centre. The SIMTA site is legally identified as Lot 1 in DP1048263 and zoned as General Industrial under Liverpool City Council LEP 2008.

Hyder has prepared this technical note to document the existing road network capacity issues around the Moorebank site using new traffic survey data and a micro-simulation model (Paramics) developed for assessing the SIMTA proposal.

The SIMTA site is located in the Liverpool Local Government Area. It is 27 kilometres west of the Sydney CBD, 16 kilometres south of the Parramatta CBD, 5 kilometres east of the M5/M7 Interchange, 2 kilometres from the main north-south rail line and future Southern Sydney Freight Line, and 0.6 kilometres from the M5 motorway.

The SIMTA proposal will be undertaken as a staged development. An annual operating capacity of one million TEUs is anticipated in the ultimate stage, when fully developed.

In order to understand and quantify the current road network capacity issues around the Moorebank site, Hyder have undertaken road network capacity assessment. This assessment involved the development and interrogation of a purpose-built micro-simulation model of the core Moorebank road network. Intersection analysis, based on the core area Paramics assessment, indicated some ten intersection-related operational issues within the “core” area (see Figure E1).

While some of these issues do not necessarily reflect an overcapacity situation for the entire intersection, any further increase on the demand from both future background and SIMTA site traffic at these locations should be assessed. A weaving analysis was undertaken on the M5 West Motorway between Hume Highway and Moorebank Avenue using Paramics. Based on the modelling analysis, there appears to have weaving problem on the M5 for the eastbound traffic.

The assessment has reviewed traffic modelling data contained in the Halcrow’s traffic and transport report prepared for the proposed M5 West Widening Project (M5 West widening, Environmental Assessment, September 2010, Roads and Traffic Authority). The report identified network capacity issues in a wider network. Hyder has summarised some eleven network capacity issues within the inner area (see Figure E1). Figure E1 shows ”core” and “inner” area road network in the context of SIMTA site.

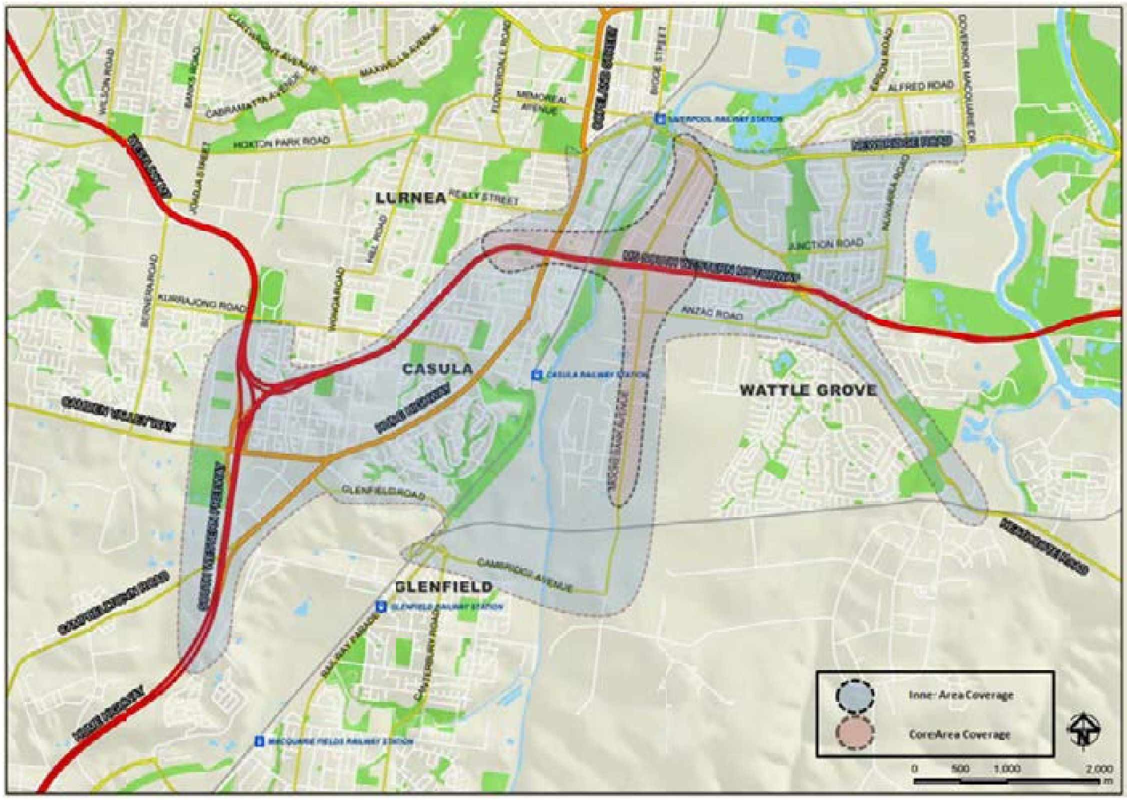


Figure E-1 Core and Inner Area Road Network

1 INTRODUCTION

Hyder has prepared this technical note to document existing road network capacity and operational issues around the Moorebank site.

1.1 Background

The SIMTA Moorebank Intermodal Terminal Facility (SIMTA proposal) is proposed to be located on the land parcel currently occupied by the Defence National Storage and Distribution Centre (DNSDC) on Moorebank Avenue, Moorebank, south west of Sydney. SIMTA proposes to develop the DNSDC site into an intermodal terminal facility and warehouse/distribution facility, which will offer container storage and warehousing solutions with direct rail access.

The SIMTA site, approximately 83 hectares in areas, is currently owned by SIMTA and tenanted by the Department of Defence to accommodate the Defence Storage and Distribution Centre. The SIMTA site is legally identified as Lot 1 in DP1048263 and zoned as General Industrial under Liverpool City Council LEP 2008.

The parcels of land to the south and south west that would be utilised for a proposed rail link are referred to as the rail corridor. The proposed rail corridor covers approximately 65 hectares and adjoins the Main Southern Railway to the north. Existing land use includes vacant land, golf course, extractive industries, and a waste disposal depot.

The SIMTA site is located in the Liverpool Local Government Area. It is 27 kilometres west of the Sydney CBD, 16 kilometres south of the Parramatta CBD, 5 kilometres east of the M5/M7 Interchange, 2 kilometres from the main north-south rail line and future Southern Sydney Freight Line, and 0.6 kilometres from the M5 motorway.

Figure 1 shows the SIMTA proposal in the context of road and rail network.

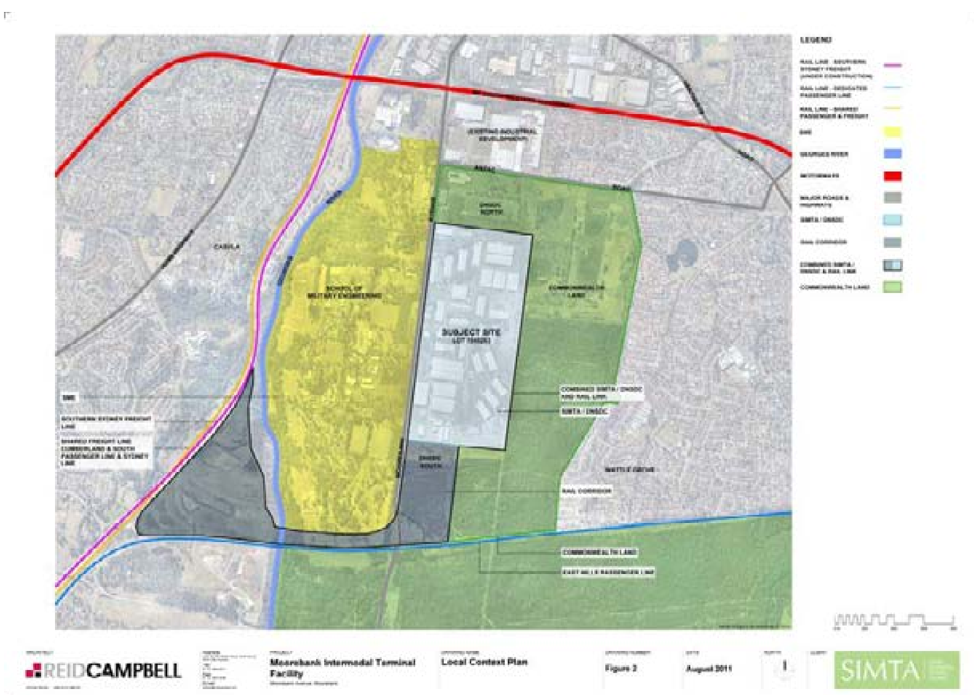


Figure 1 **Moorebank Intermodal Freight Terminal Site (SIMTA proposal)**

The SIMTA proposal for the Moorebank site comprises the following key components:

- **Rail Link** – new rail link connecting the SIMTA site with the Southern Sydney Freight Line. The detailed design of the rail infrastructure comprising the rail link will be subject to a further application and approval process.
- **Intermodal Terminal** – the terminal is proposed to include on-site freight rail sidings to accommodate local freight trains to Port Botany. Freight will arrive by rail and be transported to the warehouse and distribution facilities within the SIMTA site, or be directly loaded on to trucks for transport to warehouses and nearby logistics centres. Exports and empty freight containers will be transported to the facility by truck and then loaded onto rail for transport back to Port Botany. The terminal is expected to contain four rail sidings, with areas for container handling and storage, and is anticipated to have the capacity to handle up to 1 million twenty foot equivalent units (TEUs) per annum.
- **Empty Container Storage** – will be provided within the site. Empty containers would either be packed on-site ready for transport to the port by rail, or trucked to off-site locations where they would be packed and returned to the SIMTA site to be loaded onto rail and transported to the port.
- **Warehouse and Distribution Facilities** - approximately 300,000m^2 of warehouses with ancillary offices will be constructed to the east of the intermodal terminal. These buildings are proposed to be constructed in stages in response to site servicing availability and market demands. It is expected that warehouses will range in size, depending on tenant needs.
- **Freight Village** – approximately 8,000m^2 of support services will be provided on site. These may include site management and security offices, meeting rooms, driver facilities and convenience retail and business services.

The project will be undertaken as a staged development and it is intended that an overall Master Plan, for the entire site, be undertaken for the purpose of applying for Concept Plan approval under Part 3A of the Environmental Planning and Assessment Act 1979.

1.2 Purpose of Technical Note

The Director-General, along with the RMS, Transport NSW and Liverpool City Council are interested in understanding the potential impact of the proposed SIMTA proposal in Moorebank. These authorities have outlined their key concerns in their responses to the Director-General's Requirements (DGR's 24 December 2010). Transport network capacity issues are highlighted as a key area of interest in each response.

In order to understand and quantify the current road network performance around the Moorebank site, Hyder have undertaken road network capacity assessment for the core area. This assessment involved the development and interrogation of a purpose-built micro-simulation model (Paramics) of the core Moorebank road network. The assessment has reviewed traffic modelling data contained in the Halcrow's traffic and transport report prepared for the proposed M5 West Widening Project (M5 West widening, Environmental Assessment, September 2010, Roads and Traffic Authority).

- A Paramics model was developed using existing and available traffic modelling and survey data for core area.
- The core micro-simulation modelling study was undertaken to assess the current network operational issues.
- Typical week day peak hours (AM and PM) were considered as these represented the critical time periods for capacity assessment.

- Road traffic demand matrices for the core area micro-simulation model were estimated from recent traffic counts and an origin-destination survey on the M5 Motorway at Moorebank interchange.

1.3 Document Structure

This technical note is composed of the following sections:

Executive Summary – provides a summary of the network capacity assessment.
Chapter 1: Introduction – outlines the project context and purpose of this report.

Chapter 2: Scope and Key Network – defines the study area and key roads.

Chapter 3: Core Area Network Operation – summarises the network capacity and operational issues identified in the core area of impact through micro-simulation assessment.

Chapter 4: Broader Capacity Issues – summarises the capacity issues identified outside the "core" area from modelling data contained in the proposed M5 West Widening Traffic and Transport Report prepared by Halcrow for the RMS, September 2010.

2 STUDY AREA NETWORK

In general, the road network impacts of the SIMTA proposal will decline with greater distance from the site, Therefore, Hyder has adopted a three-tiered approach to the assessment of road network impacts:

1 “Core” area.

2 “Inner” area.

3 “Wider” area.

The “core” area, defined below, was modelled in Paramics and determined the SIMTA impact immediately to the surrounding road network. In general, the core area is bounded by the following roads:

- M5 Motorway between Hume Highway and Heathcote Road (east and west);
- Hume Highway (north and south);
- Moorebank Avenue between Newbridge Road and Cambridge Avenue (north and south);
- Anzac Road (east)

The inner area boundary was largely determined from Hyder’s strategic modelling investigation and network capacity issues identified in the Halcrow’s traffic and transport report prepared for the proposed M5 West Widening Project (M5 West widening, Environmental Assessment, September 2010, Roads and Traffic Authority). The SIMTA impact in the “inner area” is likely to be more homogeneous, travelling along the primary routes only (e.g. Hume Highway, M5 Motorway and M7 Motorway). The network operational impact from SIMTA in the “inner area” is expected to be low.

A strategic transport modelling assessment was undertaken for the “wider” area impact assessment.

2.1 Core Area

Hyder has developed the concept of the “core area” which aims to report traffic impact in those parts of the network that are of critical significance to the project. Within the local vicinity of the SIMTA site it is important to assess intersection capacities and network connectivity at a high level of detail. This will enable a robust assessment of the impact of traffic movements to and from the SIMTA site on the immediate road network. Hyder has undertaken a detailed micro-simulation modelling assessment of the “core area of impact” and forms the base-line for this level of assessment. The approximate core area is shown in Figure 2. The concept of core area in micro simulation modelling has also been supported by RMS in a recent Traffic Modelling Guideline published by RMS in February 2013.

2.2 Key Roads

The core area includes the following key roads:

- **M5 Motorway (between Hume Highway and Moorebank Avenue)** – The M5 Motorway is a principal arterial from Sydney CBD to the South West and M7 Motorway. This motorway has up to four lanes in each direction between Moorebank Avenue and Hume Highway intersections.

- **Hume Highway** –Hume Highway is a main traffic route from the South West to the North East of Sydney. The core study area includes the Hume Highway interchange with the M5 motorway. This interchange provides access to M5 eastbound (on ramp) and can be accessed through M5 westbound (off ramp). The interchange does not provide access to the M5 westbound and cannot be accessed through the M5 eastbound.
- **Moorebank Avenue** – Moorebank Avenue is currently a two lane undivided road (one lane on each direction) between Cambridge Avenue and M5 and four lane undivided road (two lane on each direction) between M5 and Newbridge Road. This road provides a north-south link between Liverpool and Glenfield. It also forms a grade separated crossing (Single Point Diamond interchange) with M5. The core study area includes the section between Newbridge Road and Chatham Avenue.
- **Heathcote Road** – This road is generally a four-lane arterial road and runs north-south between Moorebank and Heathcote, where it links to the Southern Freeway (F6). The core area includes Heathcote Road intersection with Moorebank Avenue.
- **Anzac Road** – Anzac Road is an east-west local road that connects Moorebank Avenue and Heathcote Road. It provides access to Moorebank Business Park and the residential area of Wattle Grove. This is generally a two-lane undivided road. The core study area includes the section between Yulong Close and Moorebank Avenue.

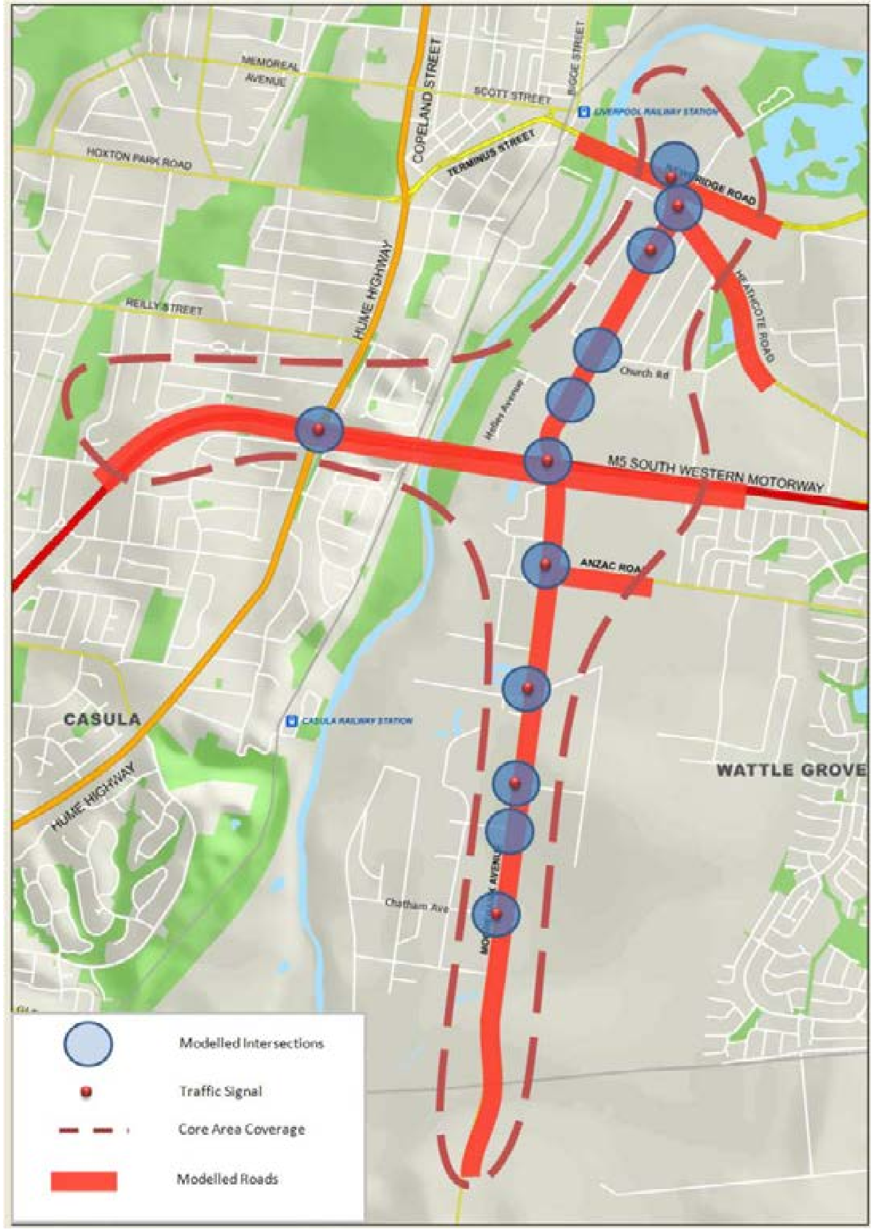


Figure 2 "Core" Area of Impact and Modelled Roads and Intersections

3 CORE AREA NETWORK OPERATION

This chapter summarises the road network capacity and operational issues identified within the core study area. These issues have been determined through the development of a micro-simulation model of the core study area. The findings were also based on field observations and traffic survey data.

3.1 Traffic Data

An extensive traffic survey was carried out in 2010. Data were collected across the core modelling area and used for micro-simulation calibration and validation. The traffic data surveys included for both AM and PM peak period:

- Mid-block tube counts for the period of one week for three mid block locations;
- Mid-block video counts during morning and afternoon peak periods on M5;
- Intersection turning counts during morning and afternoon peak periods for ten intersections;
- Queue length surveys for five key intersections;
- Origin-destination (OD) survey of the M5 eastbound weaving section.

All count data were used to calibrate the model. The OD survey was used for the supplementary M5 weaving analysis. Intersection queue data were further used for model validation.

Table 1 summarises the current traffic volumes at these key roads in the vicinity of SIMTA site. The results show that:

- Moorebank Avenue near the SIMTA site carries about 17,500 vehicles per day. Heavy vehicle proportion is about 5% of total traffic.
- Traffic volume on Anzac road is low, in the order of 9,500 vehicles per day.
- The M5 Motorway over the Georges River carries about 128,500 vehicles per day. Heavy vehicle proportion on M5 is about 10% and is consistent with data observed on other sections of M5, for example, at Hammondville Toll Plaza (about 10% heavy vehicle).

In general, on the M5, the highest morning and evening peak hour flows are observed between the Hume Highway and Moorebank Avenue in the order of 4,000 to 5,500 vehicles per hour in either east bound or westbound direction. There is a significant volume of traffic entering and leaving the M5 at Moorebank, Hume Highway and Heathcote Road interchanges.

Table 1 Traffic volumes on key roads in year 2010

Roads/Locations	Daily Traffic	Heavy vehicle percentage (%)
Moorebank Avenue - South of Anzac Road	17,500	5%
Anzac Road - East of Moorebank Avenue	9,500	6%
M5 Motorway - West of Moorebank Avenue [1]	128,500	10%
M5 Motorway – East of Moorebank Avenue [1]	110,000	10%
Cambridge Avenue - East of Canterbury Road [1]	16,000	4%

Note: 1 = Daily traffic was estimated from peak hour counts undertaken for this study. Peak to daily factors were estimated from BTS data. The count data has been rounded.

The RMS provided Hyder historical traffic growth on the M5 over Georges River between 2005 and 2009. The daily traffic data suggests that traffic on the M5 at this location has grown by 3.75% per annum significantly higher than growth data observed on the M5 at Hammondville Toll Plaza (between 1.5% and 1.7% per annum). The growth difference on M5 is driven by actual capacity available at different sections of the M5. The lower growth rate on the M5 (at Hammondville Toll Plaza) also suggests the peak period capacity constrains and in general the South West Motorway is reaching its ultimate capacity.

Appendix A described detailed traffic survey undertaken for this study.

3.2 Paramics Modelling

The Paramics models used for core area network capacity issues are described here briefly. Details of the model, including data collection, network and demand development, calibration and validation, is described in Appendix A (Micro-simulation Model Summary Report).

3.2.1 Calibration and Validation

Paramics models were calibrated and validated according to the RMS's Paramics modelling guidelines. The models represented 2010 traffic conditions for both AM peak and PM peak periods:

- AM peak period between 7:00 and 9:00, and
- PM peak period between 16:00 and 18:00

Hyder developed an analytical model based on HCM2000 methods to assess the performance of the M5 weaving section in AM and PM peak periods. The results of the HCM2000 modelling were compared with micro-simulation outputs to serve as an independent check of the model's ability to replicate weaving behaviour. Detailed model calibration and validations are documented in Appendix A.

3.3 Network Capacity

3.3.1 Level of Service (LoS)

Intersection Levels of Service (LoS) was assessed using the standard NSW Level of Service criteria for intersections (see Table 2 below).

Table 2 LoS Criteria for intersection capacity analysis

Level of Service	Average Delay per Vehicle (secs/veh)	Traffic Signals, Roundabout	Give Way & Stop Signs
A	<14	Good operation	Good operation
B	15 to 28	Good with acceptable delays & spare capacity	Acceptable delays & spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity & accident study required
E	57 to 70	At capacity; at signals, incidents will cause excessive delays Roundabouts require other control mode	At capacity, requires other control mode
F	>70	Unsatisfactory with excessive queuing	Unsatisfactory with excessive queuing

Source: RTA Guide to Traffic Generating Developments

Tables 3 and 4 show AM and PM peak LoS results from Paramics model for the following five key intersections where operational issues are identified. They area:

- Moorebank Avenue / Anzac Rd;
- M5 Motorway / Moorebank Avenue;
- M5 Motorway / Hume Highway;
- Moorebank Avenue / Heathcote Road and
- Newbridge Road / Moorebank Avenue.

In Paramics, LoS value can be adversely affected by the effects of queue spill-back through upstream intersection. The length of approach over which the delay is measured can be limited to the distance between signalised intersections. Particularly this condition was found on the northern section of Moorebank Avenue near Heathcote Road and Newbridge Road. In both Tables 3 and 4, the LoS values are shown for all approaches to determine the operational issues for particular movements.

In general, the analysis determined LoS between B and E for key intersections. The modelling result indicates that some movements at these five intersections are operating close to or at capacity level with low LoS between D and F. Regular overflow queues are observed on Moorebank Avenue (north of M5) and Newbridge Road.

The following section 3.2.2 assessed detailed operational issues for five key intersections.

Table 3 Level of Service Summary AM Peak

Model :2010 AM					
Intersection	**Approach**	**Average Delay**	**LoS (Delay)**	**Overall Average Delay**	**Intersection LoS**
Moorebank Avenue-Anzac Road (Signal)	North	33	C	24	B
	East	26	B		
	South	22	B		
	North Slip Lane	3	A		
M5 Motorway-Moorebank Avenue[1] (Signal)	North -Right Turn	28	B	24	B
	North- Through	26	B		
	East	21	B		
	South - Right Turn	29	C		
	South – Through	28	B		
	West	24	B		
	North - Slip Lane	17	B		
	East -Slip Lane	14	A		
	South - Slip Lane	11	A		
M5 Motorway-Hume Highway (Signal)	North	37	C	33	C
	East - Right Turn	69	E		
	South - Right Turn	61	E		
	South – Through	14	A		
	East - Left Turn	30	C		
	North - Slip Lane	63	E		
Moorebank Avenue-Heathcote Road[2] (Signal)	North	17	B	67	E
	East	45	D		
	South - Right Turn	102	F		
	South – Through	86	F		
Moorebank Avenue-Newbridge Road[3] (Signal)	East - Through	87	F	34	C
	East - Left Turn	24	B		
	South - Right Turn	31	C		
	South - Left Turn	11	A		
	West - Right Turn	50	D		
	West – Through	26	B		

1- Halcrow's traffic and transport report prepared for the proposed M5 West Widening Project indicates LoS B
2- Halcrow's traffic and transport report prepared for the proposed M5 West Widening Project indicates LoS F
3- Halcrow's traffic and transport report prepared for the proposed M5 West Widening Project indicates LoS D

Paramics Model Code: 2010 AM_TZ019_BC_RevL Link: F:\AA003210\D-Calculations\Traffic and Modelling_POST DGR\Modelling\Paramics\1- Hyder's Paramics\0- Pre DGR Base Models\1- 2010 AM\2010 AM_TZ019_BC_RevL

Table 4 Level of Service Summary PM Peak

Model :2010 PM					
Intersection	**Approach**	**Average Delay**	**LoS (Delay)**	**Overall Average Delay**	**Intersection LoS**
Moorebank Avenue-Anzac Road (Signal)	North	24	B	22	B
	East	32	C		
	South	16	B		
	North-Slip Lane	2	A		
M5 Motorway-Moorebank Avenue[1] (Signal)	North -Right Turn	27	B	26	B
	North- Through	30	C		
	East	28	B		
	South - Right Turn	35	C		
	South – Through	33	C		
	West	30	C		
	North - Slip Lane	16	B		
	East -Slip Lane	14	A		
	South - Slip Lane	14	A		
M5 Motorway-Hume Highway (Signal)	North	23	B	40	C
	East - Right Turn	132	F		
	South - Right Turn	58	E		
	South – Through	7	A		
	East - Left Turn	57	E		
	North - Slip Lane	66	E		
Moorebank Avenue-Heathcote Road[2] (Signal)	North	12	A	50	D
	East	62	E		
	South - Right Turn	83	F		
	South – Through	117	F		
Moorebank Avenue-Newbridge Road[3] (Signal)	East - Through	39	C	39	C
	East - Left Turn	36	C		
	South - Right Turn	89	F		
	South - Left Turn	15	B		
	West - Right Turn	65	E		
	West – Through	6	A		

1. Halcrow's traffic and transport report prepared for the proposed M5 West Widening Project indicates LoS B
2. Halcrow's traffic and transport report prepared for the proposed M5 West Widening Project indicates LoS F
3. Halcrow's traffic and transport report prepared for the proposed M5 West Widening Project indicates LoS D

Paramics Model Code: 2010 PM_TZ019_BC_RevL Link: F:\AA003210\D-Calculations\Traffic and Modelling_POST DGR\Modelling\Paramics\1- Hyder's Paramics\0- Pre DGR Base Models\2- 2010 PM\2010 PM_TZ019_BC_RevL

3.3.2 Network Operational Issues

Further network operational analysis indicated some ten intersection-related issues within the “core” area. While some of these issues do not necessarily reflect an overcapacity situation for the entire intersection, any further increase on the demand from both future background and SIMTA traffic at these sections should be investigated thoroughly. The identified intersection operational issues are summarised in Figure 3.

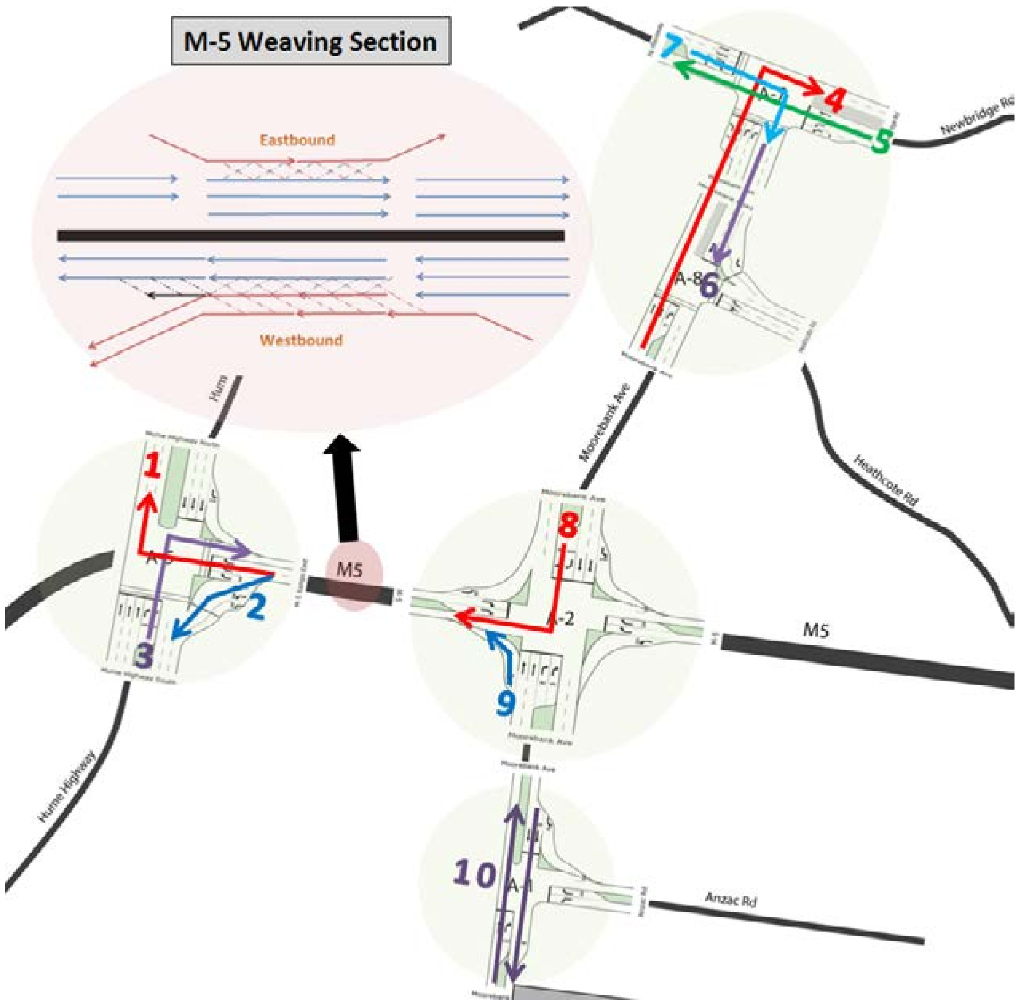
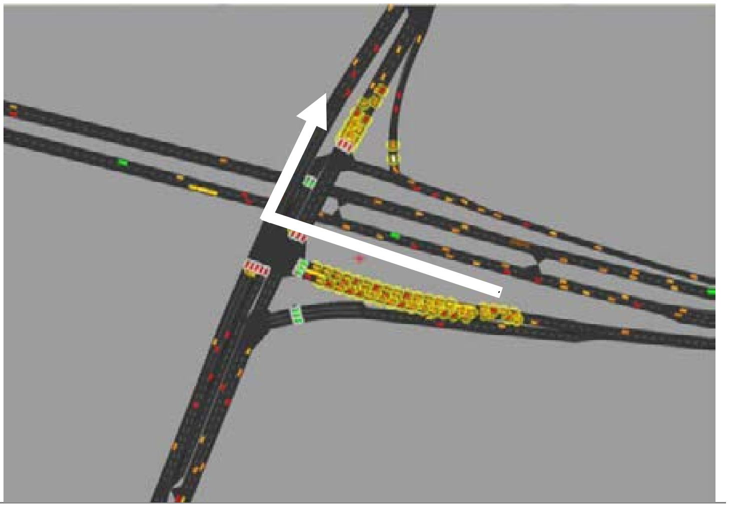
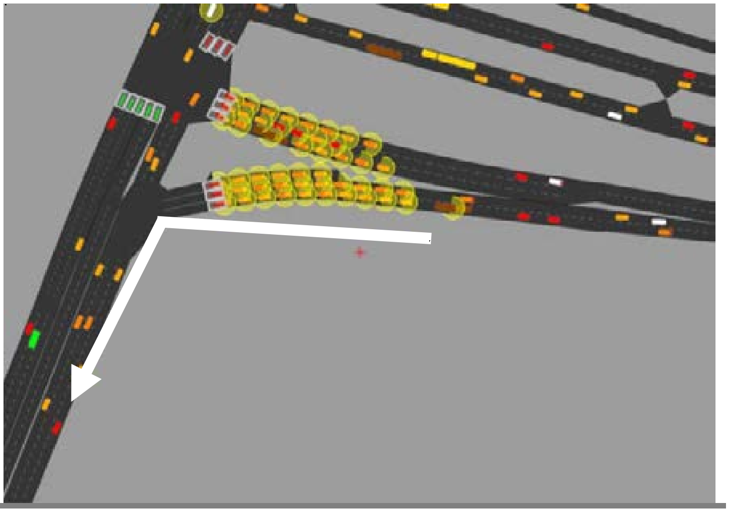


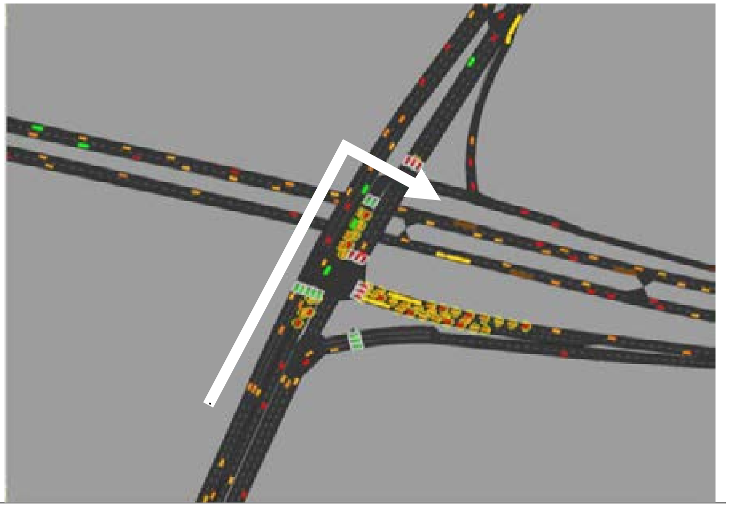
Figure 3 Core Study Area Capacity Issues

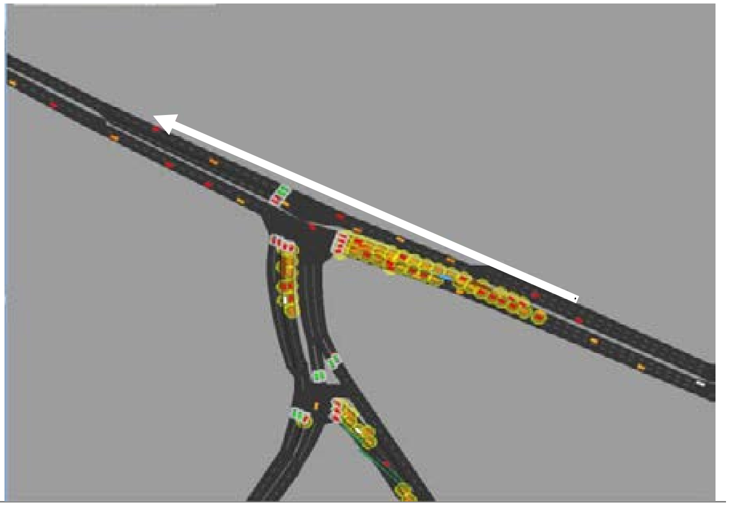
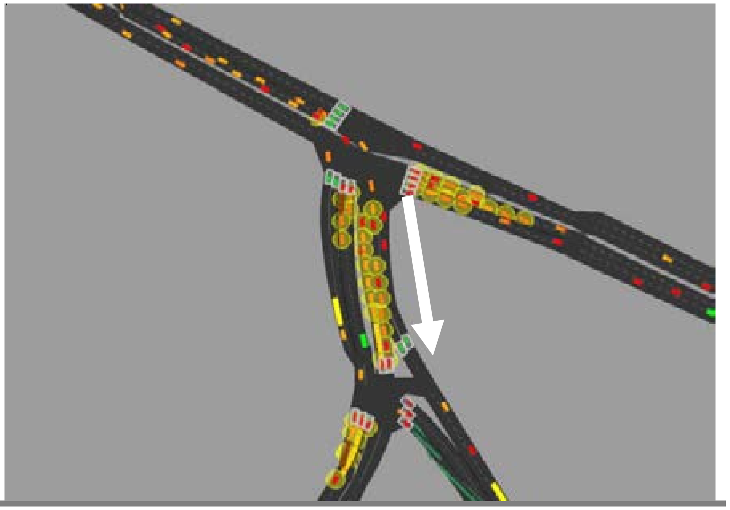
Screenshots from the Paramics models are shown in Table 5 to illustrate the location and nature of each of the “core” area issues. Vehicles highlighted in yellow are vehicles experiencing the queue / delay condition at the mentioned section(s). The turning volumes for AM and PM peak hour are shown as a stick diagram and included in **Appendix B**.

Table 5: Core Area Network operational issue

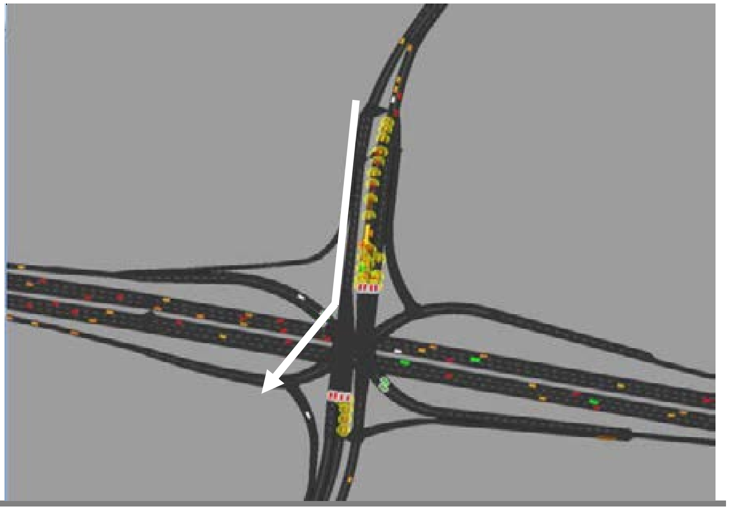
<table>
<tr><th>Intersection</th><th>Network operational issue</th><th>Paramics snapshot</th></tr>
<tr><td rowspan="2">**M5 Motorway/Hume Highway Interchange**</td><td>In general, north-south through movement demand on Hume Highway (4,800 veh/hr, two way, AM and PM Peak) is the highest. A major portion of green time is allocated for the major north south movement. Model predicts higher delays to the following movements:

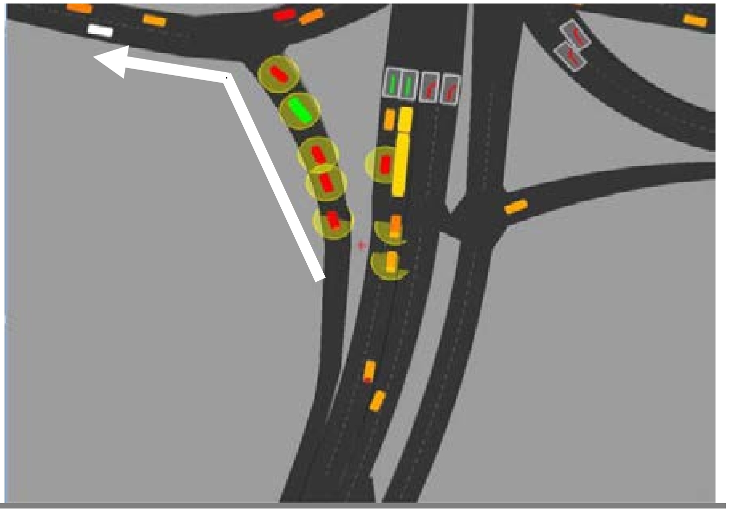
1) Right turn from westbound M5 off-ramp experiencing higher delays during both AM and PM Peak (LoS=E/F), however no queue spills back from the off-ramp onto the M5 Motorway.</td><td></td></tr>
<tr><td>2) Left turn from westbound M5 off-ramp experience slightly higher delays during PM Peak (LoS=E), however no queue spills back from the off-ramp onto the M-5 Motorway.</td><td></td></tr>
</table>

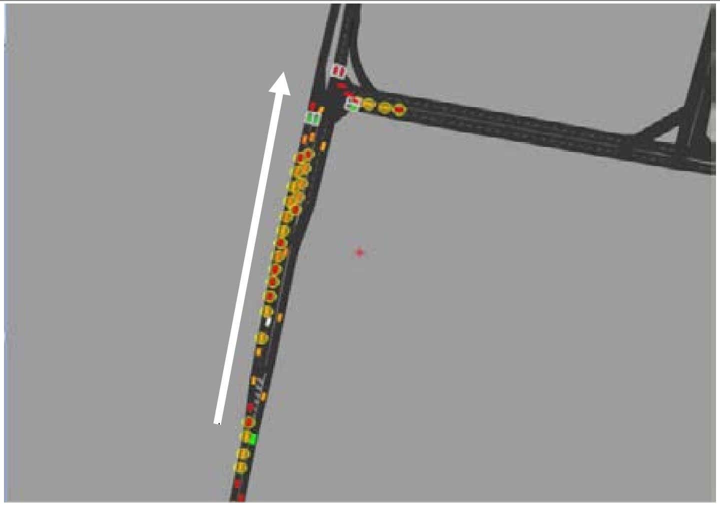
Intersection	Network operational issue	Paramics snapshot
M5 Motorway/Hume Highway Interchange	3) Right turn from Hume Highway south to M-5 eastbound on-ramp experiencing higher delays during AM and PM Peak (LoS=E), however queue exceeding right turn bay was not observed.	
Moorebank Avenue intersections with Heathcote Road and Newbridge Road	4) High turning traffic is observed at Newbridge Road/ Moorebank Avenue (1,200 veh/hr turning right and 1,100 veh/hr turning left during AM peak) intersection. Model indicates extensive delays to right turn movement from Moorebank Avenue to Newbridge Road. Model shows queuing spill back and affects the operation of adjacent Moorebank Avenue/Heathcote Road intersection (high delays to upstream northbound through movement with LoS F).	

Intersection	Network operational issue	Paramics snapshot
Moorebank Avenue intersections with Heathcote Road and Newbridge Road	5) Westbound through movement on Newbridge Road shows higher delays during AM and PM peak periods (LoS=C/F).	
	6) Southbound queue on Moorebank Avenue/Heathcote Road intersection affects upstream operation of Moorebank Avenue/Newbridge Road intersection.	

Intersection	Network operational issue	Paramics snapshot
Moorebank Avenue intersections with Heathcote Road and Newbridge Road	7) Right turn movement from Newbridge Road west to Moorebank Avenue experiences higher delays particularly during PM peak period (LoS=E). The queue occasionally spills back from right turn bay onto the main stream affecting eastbound through movement.	

Intersection	Network operational issue	Paramics snapshot
M5 Motorway/ Moorebank Avenue Interchange	8) High right turn volumes from Moorebank Avenue north onto M5 westbound on-ramp (1,200 veh/hr in PM peak) affect surface intersection performance. Model shows long queues during PM peak period. The queue occasionally spills back from right turn bay onto the main stream affecting southbound through traffic movement on the Moorebank Ave. Following Halcrow's audit report, this issue was further investigated. Reported links for LoS are amended [1].	

Intersection	Network operational issue	Paramics snapshot
M5 Motorway/ Moorebank Avenue Interchange	9) Left turn movement (Give-way slip lane) from Moorebank Avenue south onto M5 westbound on-ramp shows occasional queue. The queue was caused by high volume right turn demand from Moorebank Avenue north onto M5 westbound on-ramp. The issue 9 alone is not critical for existing condition. In the future this movement is expected to have impact from SIMTA traffic.	

Intersection	Network operational issue	Paramics snapshot
Moorebank Avenue/Anzac Road	10) Through movement along Moorebank Avenue shows occasional queue in northbound and southbound direction during AM peak and PM peak period respectively. However, these queues are clearing during each cycle time and the model does not indicate any residual queues.	 

Paramics Model Code: 2010 AM_TZ019_BC_RevL, 2010 PM_TZ019_BC_RevL

3.4 M5 Weaving Analysis

The core study area includes the M5 motorway between Moorebank Avenue and Hume Highway. These grade separated intersections are only separated by about 1km, resulting in a very limited weaving section for M5 traffic joining and leaving the M5. Figure 3 shows the lane configuration through the section.

In order to quantify the volume of weaving movements in the eastbound direction, an origin-destination survey was undertaken on the M5 between Moorebank Avenue and the Hume Highway. The survey was used in the development of the micro-simulation model, which was interrogated to understand weaving behaviour through this section. Figure 4 shows a Paramics screenshot of the M5 motorway weaving section during AM peak period. Vehicles highlighted in purple are attempting to make a lane change, but are being obstructed by other vehicles in an adjacent lane.

To quantify the performance of the M5 between Moorebank Avenue and the Hume Highway, weaving section speed (km/h), density (passenger car/km/lane) and weaving flow ratio (VR, or volume ratio) were determined from the Paramics models.

A weaving analysis using the US Highway Capacity Manual (HCM2000) method was undertaken to independently verify the findings from the Paramics model. The HCM2000 approach defines level of service (LoS) based on passenger car density, but also predicts weaving segment travel speed. The speed from HCM analysis was compared with Paramics model results. Overall the Paramics model showed weaving speeds that were reasonably consistent with the HCM2000 predictions.

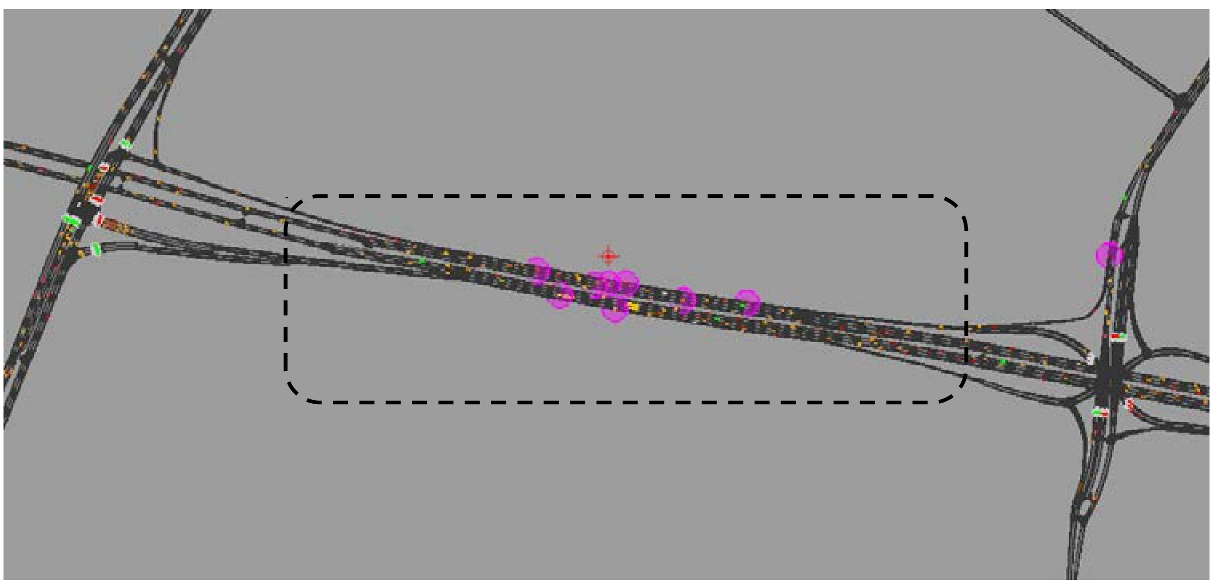


Figure 4 Paramics Screenshot: M5 Weaving Section

The weaving analysis based on the HCM2000 method and Paramics model outputs indicated low LoS E and a travel speed of approximately between 50 and 60km/h for eastbound traffic, compared with a sign-posted speed limit of 100km/h. In PM peak model predicts LoS C with travel speed approximately between 70 and 75km/h. Based on the modelling analysis, there appears to be a weaving problem on the M5 for the eastbound traffic during AM Peak.

4 BROADER CAPACITY ISSUES

Hyder has reviewed traffic modelling data contained in the traffic and transport report for the proposed M5 West Widening Project, prepared by Halcrow, for the RMS. The network capacity issues where they are likely to interact with the SIMTA site -generated traffic are identified and summarised in this section.

4.1 Capacity Issues

The proposed M5 West Widening Traffic Report identifies some eleven network capacity issues within the inner study area. These issues are described below. Figure 5 shows the broader location of capacity issues identified in that report.

Figure 5 Location of Inner Area Capacity Issues

1 **M5 westbound, between Camden Valley Way and Brooks Road** – Travel time survey data from April-May 2010 show that this section of the M5 exhibited average speeds in the PM peak hour of 45km/h; significantly below the 80km/h speed limit. This speed reduction indicates congestion in this section due to traffic from the Westlink M7 and Camden Valley Way merging with M5 outbound traffic in the evening peak. The M5 southbound lane drop from four lanes to three prior to the Campbelltown Road merge may also contribute to slower traffic conditions.

2 **M5 eastbound between Camden Valley Way and Hume Highway** – This section of the M5 is fed by traffic from the M5 northbound, the Camden Valley Way northbound on-ramp and the southbound Westlink M7. There are only two lanes provided in each direction through this section. Based on an analysis of strategic model flows (2006 peak hour) this section of the M5 is operating at LoS E, with a volume/capacity ratio of 0.96. This assessment was based on a notional motorway capacity of 2,200PCUs per hour per lane.

3 **Hume Highway/Hoxton Park Road/Macquarie Street intersection** – This intersection is operating over capacity at LoS F in the AM and PM peak hour. This assessment was based on 2009/10 modelled traffic flows. The RMS is currently evaluating an upgrade to

this intersection. Upgrades will include the provision of an eastbound to northbound left turn lane from Hoxton Park Road to the Hume Highway.

4 **Terminus Street and Newbridge Road, westbound between Hume Highway and Heathcote Road** – Travel time survey data from April-May 2010 show that this section (westbound) had an average speed of 18km/h in the PM peak; significantly below the 60km/h posted speed limit. The low travel speed is likely to be due to the four closely-spaced signalised intersections and the regular property access points along this road.

5 **Terminus Street and Newbridge Road, eastbound between Hume Highway and Heathcote Road** – This section also shows low travel speeds in the eastbound direction during the PM peak. Survey data showed an average eastbound travel speed of 24km/h; significantly below the 60km/h posted speed limit. Again this is likely to be due to the closely spaced signalised intersections and the regular access points along this road.

6 **Hume Highway/Elizabeth Drive intersection** – This intersection operates over capacity with LoS F in the AM peak, based on 2009/10 modelled traffic flows. This is primarily due to the heavy northbound movement conflicting with eastbound traffic from Liverpool South and Hoxton Park, accessing the Hume Highway and the M5 South West Motorway.

7 **Heathcote Road/Moorebank Avenue intersection** – This intersection operates poorly in both peak periods with a LoS F and LoS E in the AM and PM peaks respectively. This assessment was based on 2009/10 modelled traffic flows. However, the poor performance of this intersection is largely due to the blocking back of queues from the Heathcote Road/Newbridge Road intersection. The close spacing of these intersections allows only up to 80m of queue storage between them.

8 **Newbridge Road/Nuwarra Road intersection** – This intersection operates at capacity (LoS E) in both peak periods, based on 2009/10 modelled flows. Any increase in traffic at this intersection is likely to degrade intersection performance significantly.

9 **Newbridge Road/Governor Macquarie Drive intersection** – This intersection operates at capacity (LoS E) during both peak periods, based on 2009/10 modelled flows. Any increase in traffic at this intersection is likely to degrade intersection performance significantly.

10 **Heathcote Road/Nuwarra Road intersection** – This intersection operates over capacity in the AM peak with LoS F. The poor performance of this intersection is due to significant demand from the residential areas of Holsworthy and Moorebank accessing the M5 South West Motorway and Newbridge Road.

11 **M5 westbound between Henry Lawson Drive and Heathcote Road** – Based on 2006 peak period modelled traffic flows this four-lane (two lanes each direction) section of the M5 operates at capacity, with LoS E and a volume/capacity ratio of 0.94. This assessment was based on a notional motorway capacity of 2,200PCUs per hour per lane. Operating conditions improve west of Heathcote Road, where three lanes are provided in each direction.

5 INNER AREA PARAMICS MODELLING

The “inner area” boundary was largely determined from Hyder’s own strategic modelling investigation and broader network capacity issues identified in the traffic and transport report prepared for the proposed M5 West Widening Project (M5 West widening, Environmental Assessment, September 2010, Roads and Traffic Authority).

Figure 6 shows Paramics modelling network for the inner area

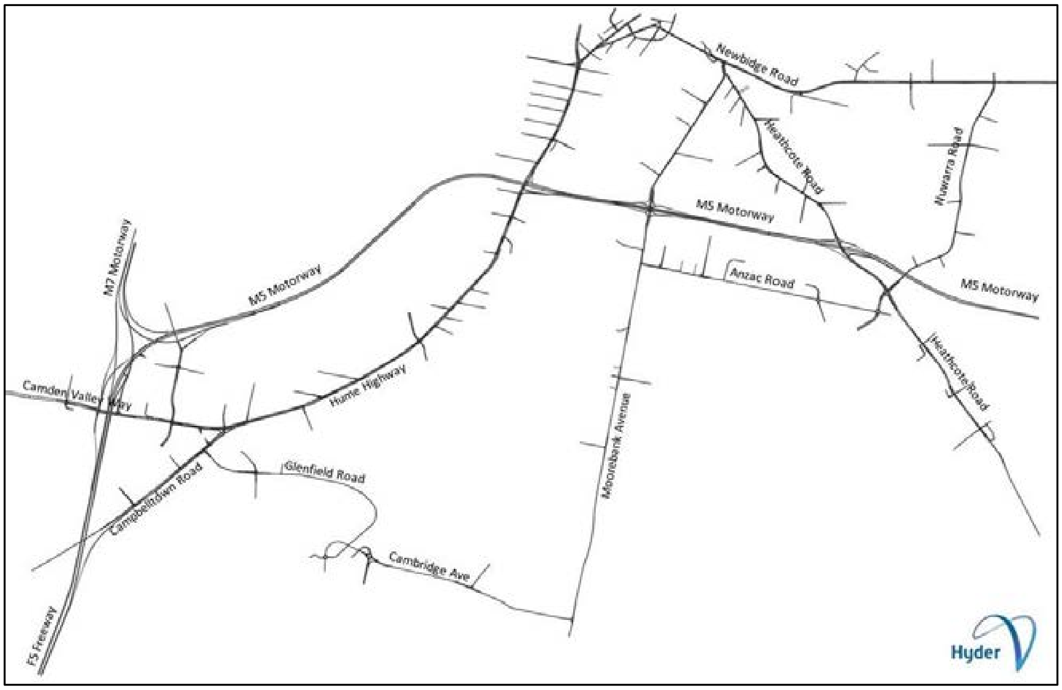


Figure 6 Inner Area Paramics Network

In general, the inner area Paramics model follows the similar modelling process undertaken for the core area. Both AM and PM peak period existing traffic conditions was modelled for inner area:

- AM peak period between 7:00 and 9:00, and
- PM peak period between 15:00 and 18:00.

In general, the inner area modelling network is bounded by the following key roads:

- **M5 Motorway** – Between F5 Freeway and Nuwarra Road overpass, including M5 interchanges with M7 Motorway, Hume Hwy, Moorebank Avenue and Heathcote Road.
- **Hume Highway and Campbelltown Road** – Between Hoxton Park Road and Hume Highway / Campbelltown Road overpass including interchange with the M5 Motorway.
- **Moorebank Avenue** – Between Cambridge Avenue and Newbridge Road.
- **Heathcote Road** – Between Newbridge Road and Macarthur Drive.
- **Anzac Road** – Anzac Road is an east-west local road that connects Moorebank Avenue and Heathcote Road.
- **Cambridge Avenue and Glenfield Road** – Between Moorebank Avenue and Campbelltown Road.

- **Macquarie Street / Terminus Street / Newbridge** – Between Hoxton Park Road and Nuwarra Road. These roads provide east-west access to Liverpool.
- **Camden Valley Way** – Between Ash Road and Campbelltown Road. This road provides access to M7 / M5 Motorway and Hume Highway.

Inner area Paramics models were calibrated and validated according to the RMS's Paramics modelling guideline. Detailed modelling results including network and demand development, calibration and validation, are documented in **Appendix C** of this report (Inner Area Paramics Model Development, Calibration and Validation).

The "inner area" Paramics modelling results confirmed that both AM and PM peak models were calibrated and validated adequately according to RMS's guideline and models are fit for the study purpose.

5.1 Revalidate Existing Network Operation

In Section 3.3 of the Transport and Accessibility Impact Assessment Report documented existing network operational issues and level of service (LoS) results. To revalidate the core area, the LoS analysis was repeated at following five key intersections (see Figure 7):

1. Moorebank Avenue / Anzac Road;
2. M5 Motorway / Moorebank Avenue;
3. M5 Motorway / Hume Highway;
4. Moorebank Avenue / Heathcote Road;
5. Newbridge Rd / Moorebank Avenue.

The forecast LoS for above key intersections is in line with previous modelling outcome.

The weaving issue on M5 Motorway between Moorebank Avenue and Hume Highway was revisited using inner area Paramics model. The weaving analysis predicts low level of service and is in line with previous modelling outcome. Detailed M5 weaving results are shown in **Appendix C.**

In addition to the above, level of service is estimated for additional eight key intersections outside the core area including (see Figure 6):

1.Hume Highway/Camden Valley Way

2. Hume Highway/Kurrajong Road
3. Hume Highway/ De Meyrick Avenue
4. Hume Highway/Hoxton Park Road
5. Newbridge Road/Speed Street
6. Newbridge Road/Nuwarra Road
7. Heathcote Road/ Nuwarra Road
8. Heathcote Road/M5 Motorway.

Appendix D summarises existing network operational issues observed from traffic model for core study area. The result shows that there are existing network capacity issues on the regional road network outside of core area. In Section 3.4 of the Transport and Accessibility Impact Assessment Report documented LoS results for key intersections outside core area.

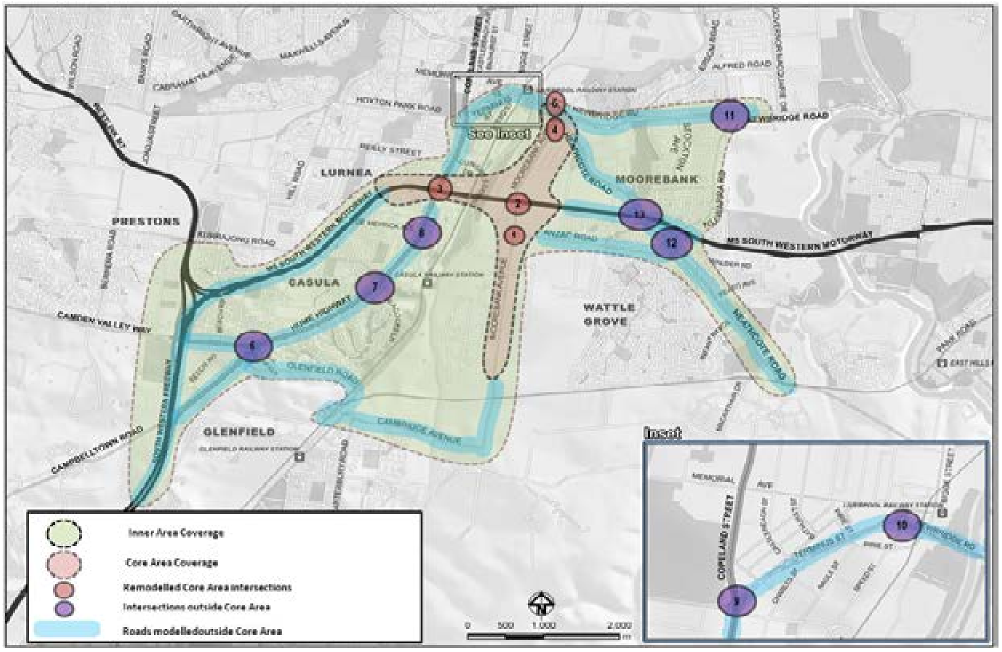


Figure 7 Inner area of impact (showing key intersections to be investigated / modelled)

5.2 Future Models

Inner area Paramics models were also developed for future year 2031 to compare the effect of SIMTA impact on road network. In Section 5.5 and Section 6-10 of the Transport and Accessibility Impact Assessment Report documented future network performance without and with SIMTA case for key intersections within core area. The level of service analysis at key intersections is repeated.

In Section 5.6 and Section 6.11 of the Transport and Accessibility Impact Assessment Report documented future level of service results without and with SIMTA case for eight key intersections outside core area. The results show that outside the core area, there is no significant adverse impact on key roads following the introduction of the SIMTA proposal. Beyond the core area, where SIMTA heavy vehicle volume increases, it is generally by a small margin.

6 FINDINGS

There are forecast capacity issues for the local and regional road network; however, modelling result suggests that these are irrespective of whether or not the SIMTA proposal proceeds. In Section 8 of the Transport and Accessibility Impact Assessment Report documented a range of infrastructure and non-infrastructure mitigation measures would be required when the SIMTA proposal is fully developed.

APPENDIX A

MICRO-SIMULATION MODEL SUMMARY REPORT CORE AREA

INTRODUCTION

Hyder Consulting (Hyder) has prepared this technical note to document the calibration and validation of the core area micro-simulation model of the Moorebank Intermodal Freight Terminal (MIFT) and surrounding area of impact.

Quadstone Paramics Microsimulation Package (Version 6.6.1) was used for core area modelling.

The microsimulation models were developed for both AM peak and PM peak periods as of follow:

- AM peak period between 7:00 and 9:00, and
- PM peak period between 16:00 and 18:00.

Road Network

The modelled road network is bounded to:

- **North** : New Bridge Road and Moorebank Avenue intersection
- **East** : M5 Motorway ,west to the M5/Heathcote Road interchange (not including M5/Heathcote Road interchange)
- **West** : M5 interchange with Hume Highway (including the interchange)
- **South** : Moorebank Avenue intersection with Chatham Avenue

Road Links

The following road links were coded in the microsimulation models

M5 Motorway – Between Moorebank Avenue and Hume Highway, including M5 interchanges with Hume Hwy and Moorebank Avenue. This section of M-5 applies 2 to 3 lanes on the eastbound and 2 to 4 lanes on the westbound direction and includes major weaving segments between two main interchanges.

Hume Highway – Between Meyrick Avenue and Congressional Drive. This section includes a six lane divided highway and a major interchange with the M5 Motorway

Moorebank Avenue – Between Chatham Avenue and Newbridge Road. This section mainly includes two lane undivided road (one lane each direction) up to south of its intersection with the M5 and provides a north-south link between Liverpool and Glenfield.

Heathcote Road – This road is generally a four-lane major road and extends north-south between Moorebank and Heathcote, where it links to the Southern Freeway (F6). .

Anzac Road – Anzac Road is an east-west local road that connects Moorebank Avenue and Heathcote Road. It provides access to Moorebank Business Park and the residential area of Wattle Grove. This is generally a two lane undivided road

Intersection Control

In total 13 traffic junctions were included in the micro simulation models. Table A1 shows the intersection name and control type.

Table A1 Major intersection in the micro simulation model

ID number	Intersection Name	Intersection Type	Control Type
A-12	Moorebank Ave/ Chatham Ave	On-Grade	Traffic Signal
A-4	Moorebank Ave/Car Park	On-Grade	Traffic Signal
A-3	Moorebank Ave/Car Park	On-Grade	Traffic Signal
A-1	Moorebank Ave/Anzac Road	On-Grade	Traffic Signal
A-2	Moorebank/M-5	Grade Separated	Traffic Signal
A-11	Moorebank Ave/Helles Ave	On-Grade	Priority
A-10	Moorebank Ave/Church Road	On-Grade	Priority
A-13	Moorebank Ave/M5 Industrial Park Access Road	On-Grade	Priority
A-9	Moorebank Ave/M5 Industrial Park Access Road	On-Grade	Signal
A-8	Moorebank Ave/Heathcote Road	On-Grade	Signal
A-7	Moorebank Ave/Newbridge Road	On-Grade	Signal
A-5	Hume Hwy/M-5	Grade Separated	Signal

Traffic Survey Data

For the study area four survey types were carried out:

- Mid-block tube counts for the period of one week for three mid block locations;
- Mid-block video counts during morning and afternoon peak periods on M-5 Freeway,
- Intersection turning counts during morning and afternoon peak periods for 10 intersections.
- Origin – Destination(O-D) survey on the M5 eastbound weaving section for AM and PM peak periods

Figure A1 shows the traffic count locations and types on the study area.

Figure A1 Mid-Block and Intersection count locations

TRAFFIC DEMAND

Source of Traffic Demand Data

In order to develop the demand matrices, available data sources in the study area were utilised. These data sets included Origin- Destination Surveys (between Hume Highway and Moorebank interchanges with M5 motorways), intersection turning counts for the peak periods, and Mid-block counts. The data sets were further processed and used in matrix estimation models. The matrix estimation was performed using TransCAD transport planning software package.

Figure A2 show the zoning system used in microsimulation models.

Figure A2 Paramics Models Zoning System

Vehicle Classification

The demand matrices were produced for three broad vehicle classes of:

- Light Vehicles;
- Trucks/Bus;
- Semi Trailer and B-Double.

Table A2 shows the proportion of the vehicles in the matrices. The proportions have been modified according to the RMS's Paramics guideline

Table A2 Vehicle Type Proportion in the Micro simulation models according to the RMS recommendation

Matrix Number	Vehicle Type	Paramics Car Type	Proportion In Paramics Matrices
1	Private Car (Small)	type 1 car	31.223
	Private Car (Medium)	type 2 car	42.437
	Private Car (Large)	type 3 car	24.835
	Taxi	type 4 car	1.504
2	LGV	type 5 LGV	55.931
	STA Mini Bus – fixed	type 6 minibus	fixed route
	Non STA Mini Bus - fixed	type 7 minibus	fixed route
	STA Bus – fixed	type 8 bus	fixed route
	fixed route	fixed route	fixed route
	OD Bus	type 10 bus	0.786
	Rigid (Light)	type 11 OGV1	5.263
	Rigid (Medium)	type 12 OGV1	32.757
	Rigid (Heavy)	type 13 OGV1	5.263
3	Semi Trailer (Light)	type 14 OGV2	12.264
	Semi Trailer (Medium)	type 15 OGV2	69.811
	Semi Trailer (Heavy)	type 16 OGV2	12.264
	B-Double (Light)	type 17 OGV2	0.943
	B-Double (Medium)	type 18 OGV2	3.774
	B-Double (Heavy)	type 19 OGV2	0.943

Temporal Distribution

Temporal traffic profiles were developed for 15-minute periods across the two hour simulation period. In addition, 30 minutes warm-up and 30 minutes cool-down periods were applied based on the count data. Figure A3 and Figure A4 show the demand profiling for the AM and PM peak models.

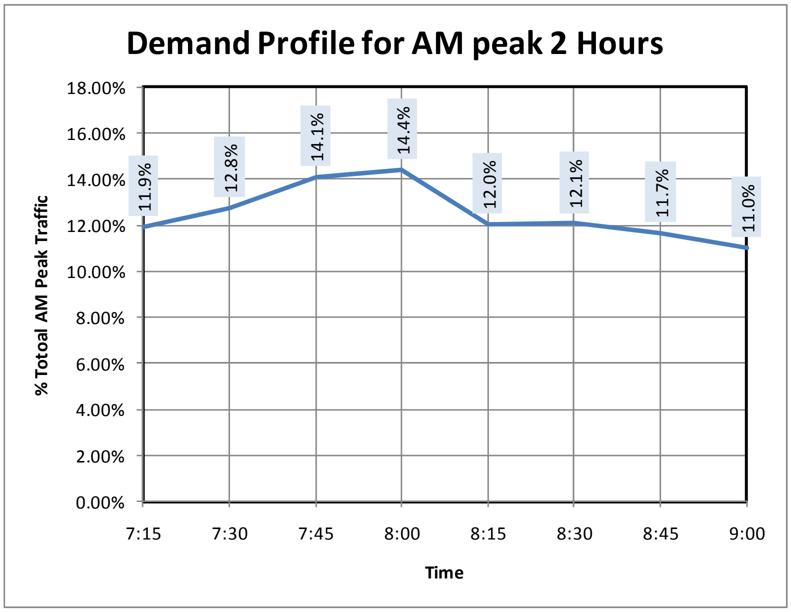


Figure A3 AM Peak Demand Profile

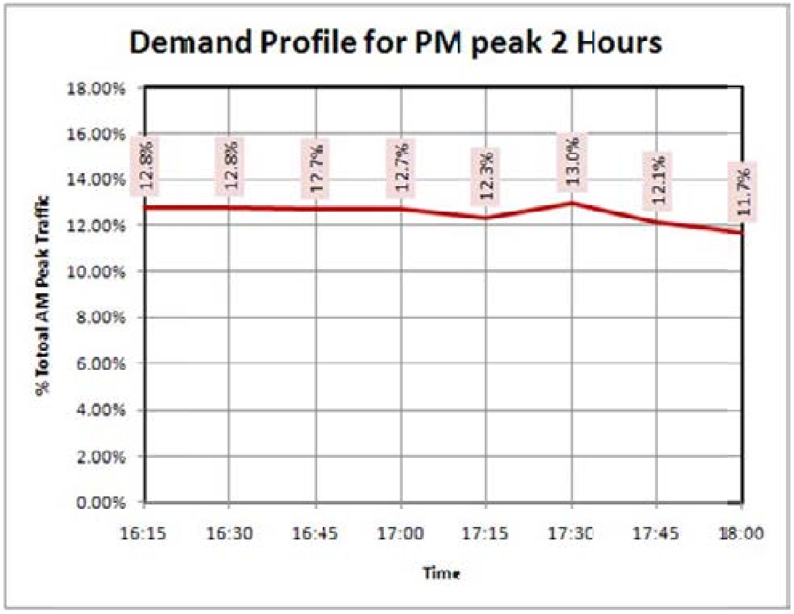


Figure A4 PM Peak Demand Profile

CALIBRATION

The base year models were calibrated against set of survey data. Model calibration is the process that adjusts model parameters to adequately reflect the observed traffic behaviour and conditions in the study area. The microsimulation calibration main guidelines were based on the following sources:

- RMS's Paramics Microsimulation Modelling guideline version 1.0 issued in May 2009;
- UK Design Manual for Roads and Bridges (DMRB) issued by the Highways Agency, UK and last amended in November 2009.

Road Link Traffic Flows and Intersection Turn

Individual link flows and intersection turning volumes have been assessed based on the criteria detailed in Table A3

Table A3 Calibration Criteria

Calibration Criteria	Target
Difference in flow within 100 vph for flows less than 700 vph	85%
Difference in flow within 15% for lows between 700 and 2700 vph	85%
Difference in flow within 400 vph for flows more than 2700 vph	85%
GEH statistic less than 5	85%
Demand release for the base model	100%

Table A4 and Table A5 summarise the calibration achievements for the AM and PM peak models.

Table A4 2010 AM peak Paramics model calibration summary

Link			
Individual links			
Number of individual link flows (by direction)	10		
< 700 vhp	*4*		
700 - 2,700 vhp	*2*		
> 2,700 vhp	*4*		
Average link flow	2279	vph	
Meet the assessment criteria (UK-DMRB)	**Target**	**Achieved**	**Statues**
Difference in link flow within 100 for flows <700 vph	85%	100%	Pass
Difference in link flow within 15% for flows 700-2,700 vph	85%	100%	Pass
Difference in link flow within 400 for flows >2700 vph	85%	100%	Pass
GEH Statistic less than 5 of all individual modelled flow	85%	100%	Pass
Intersection			
Number of turn flows	68	(or 5 intersections)	
< 700 vhp	*54*		
700 - 2,700 vhp	*13*		
> 2,700 vhp	*1*		
Average turn flow	Mean Flow	vph	
Meet the assessment criteria (UK-DMRB)	**Target**	**Achieved**	**Statues**
Difference in link flow within 100 for flows <700 vph	85%	100%	Pass
Difference in link flow within 15% for flows 700-2,700 vph	85%	100%	Pass
Difference in link flow within 400 for flows >2,700 vph	85%	100%	Pass
GEH Statistic less than 5 of all individual modelled flow	85%	99%	Pass
Demand Release			
Meet the assessment criteria (RTA Guideline)	**Target**	**Achieved**	**Statues**
Release for the base model	100%	100%	Pass

Table A5 2010 PM peak Paramics model calibration summary

Link			
Individual links			
Number of individual link flows (by direction)	10		
< 700 vhp	*4*		
700 - 2,700 vhp	*2*		
> 2,700 vhp	*4*		
Average link flow	2289	vph	
Meet the assessment criteria (UK-DMRB)	**Target**	**Achieved**	
Difference in link flow within 100 for flows <700 vph	85%	100%	Pass
Difference in link flow within 15% for flows 700-2,700 vph	85%	100%	Pass
Difference in link flow within 400 for flows >2700 vph	85%	100%	Pass
GEH Statistic less than 5 of all individual modelled flow	85%	100%	Pass
Intersection			
Number of turn flows	68	(or 5 intersections)	
< 700 vhp	*50*		
700 - 2,700 vhp	*17*		
> 2,700 vhp	*1*		
Average turn flow	Mean Flow	vph	
Meet the assessment criteria (UK-DMRB)	**Target**	**Achieved**	
Difference in link flow within 100 for flows <700 vph	85%	100%	Pass
Difference in link flow within 15% for flows 700-2,700 vph	85%	100%	Pass
Difference in link flow within 400 for flows >2,700 vph	85%	100%	Pass
GEH Statistic less than 5 of all individual modelled flow	85%	100%	Pass
Demand Release			
Meet the assessment criteria (RTA Guideline)	**Target**	**Achieved**	
Release for the base model	100%	100%	Pass

Model Stability

The stability of the Paramics models was checked by running the model for five different seeds recommended by the RMS (seed 560, 28, 7771, 86524 and 2849) and producing the zone release graphs over time. Figure A5 and Figure A6 show the model stability graphs

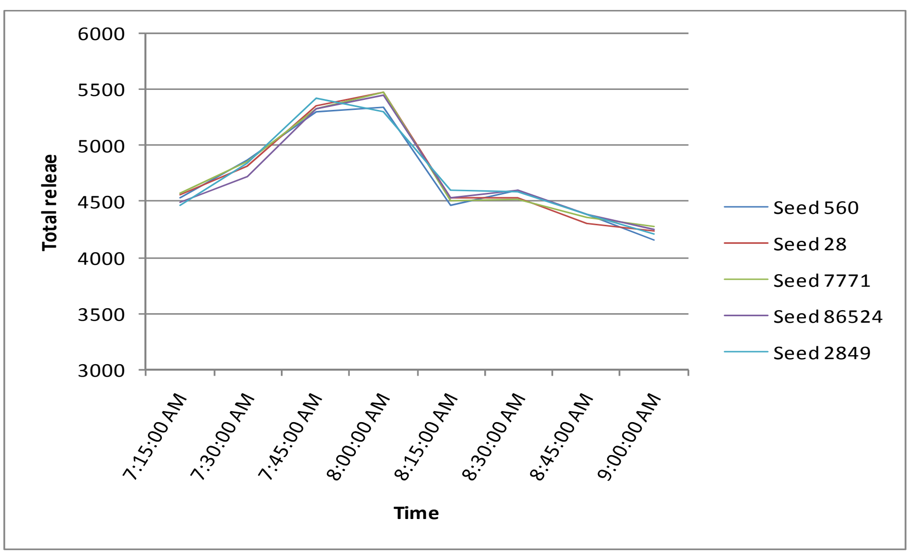


Figure A5 Model stability check - AM Peak model

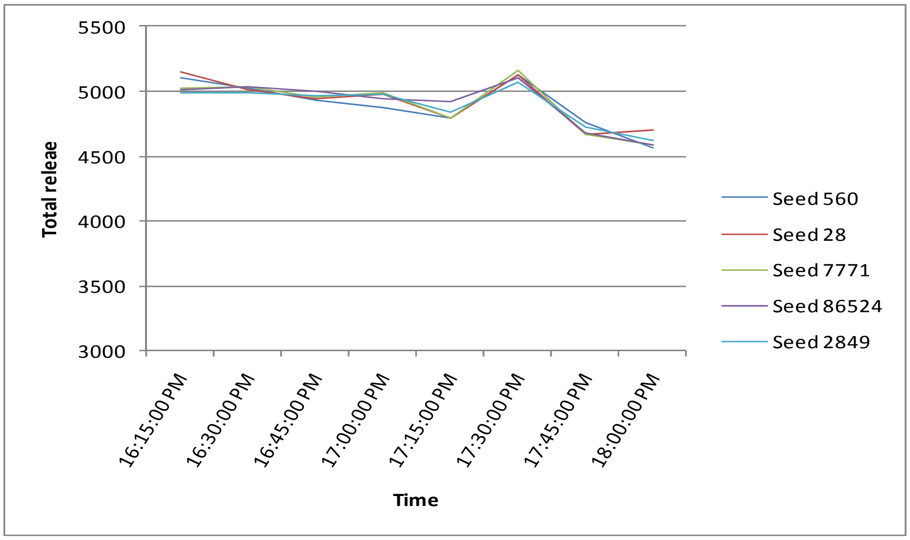


Figure A6 Model stability check - PM Peak model

VALIDATION

The Paramics models were validated against observed queue length. In addition, an analytical model based on HCM 2000 was developed to assess the performance of the weaving section in AM and PM peak periods. This was based on the Origin-Destination survey on M5 eastbound between Hume Highway Interchange and Moorebank Interchange .The results of the HCM 2000 modelling were further compared with microsimulation results to provide an independent verification of the modelled weaving section.

Queue Length Validation

In order to validate the observed queue length, extensive queue surveys were carried out during AM peak (between 7:00 to 8:00) and PM peak (between 4:00 to 5:00) for the five following key intersections in the study area:

- Moorebank Avenue/Anzac Road;
- Moorebank Avenue/ M-5 Interchange;
- Hume Highway/ M-5 Interchange;
- Newbridge Road/Moorebank Avenue; and
- Heathcote Road/ Moorebank Avenue.

The queue length data were compared for minimum, maximum, average, and 95th percentile queue length.

The results of this comparison are shown in Table A6 and A7.

Table A6 AM peak Queue length Comparison

Intersection	Approach	Lane	Paramics Models (AM Peak) Minimum	Paramics Models (AM Peak) Average	Paramics Models (AM Peak) Maximum	Paramics Models (AM Peak) 95 Percentile	Queue Surveys (AM Peak) Minimum	Queue Surveys (AM Peak) Average	Queue Surveys (AM Peak) Maximum	Queue Surveys (AM Peak) 95 Percentile
Newbridge Rd / Moorebank Ave	E	1	0	3	6	5	1	5	11	10
	E	2	0	2	4	3	2	6	14	12
	E	3	10	14	17	17	9	15	21	20
	E	4	9	12	16	16	9	14	21	20
	S	1	2	5	7	7	6	10	15	14
	S	2	2	3	5	5	1	6	12	11
	S	3	9	11	13	12	7	12	18	17
	S	4	10	11	12	12	13	20	30	28
	W	1	10	14	19	18	7	9	14	12
	W	2	10	13	16	16	5	9	13	12
	W	3	3	6	9	8	0	2	5	5
	W	4	2	5	8	7	1	3	7	6
Heathcote Rd / Moorebank Ave	N	1	0	1	3	3	0	5	8	7
	N	2	0	0	2	1	0	2	16	4
	N	3	0	2	4	3	0	3	18	6
	N	4	2	3	6	6	2	6	11	10
	E	1	0	0	0	0	0	0	0	0
	E	2	7	12	18	17	9	13	17	16
	E	3	5	7	9	9	2	10	13	16
	S	1	15	29	40	39	1	31	42	40
	S	2	5	16	26	26	1	25	37	35
	S	3	0	2	4	3	0	1	5	3
M5 / Hume Hwy	N	1	0	0	0	0	0	0	0	0
	N	2	9	13	17	17	6	12	16	15
	N	3	8	11	14	13	6	11	13	13
	N	4	8	10	13	12	7	10	16	14
	E	1	0	2	4	4	0	2	5	4
	E	2	0	1	2	2	0	2	3	3
	E	3	0	1	2	2	1	2	3	3
	E	4	6	11	16	15	10	15	21	20
	E	5	5	11	14	13	7	11	17	16
	E	6	6	13	16	15	5	11	15	15
	S	1	10	15	20	19	2	8	22	18
	S	2	11	15	23	21	3	9	21	17
	S	3	10	17	21	20	5	9	21	16
	S	4	2	5	9	8	0	4	8	7
	S	5	2	4	7	6	2	3	6	6
M5 / Moorebank Ave	N	1	0	2	3	3	0	1	3	3
	N	2	0	2	4	3	0	2	4	3
	N	3	3	4	7	7	0	4	7	6
	N	4	3	5	6	6	4	6	9	8
	E	1	0	1	4	3	0	2	7	5
	E	2	0	2	4	3	1	3	4	3
	E	3	0	1	3	3	0	2	5	4
	S	1	0	0	2	1	0	1	10	7

Intersection	Approach	Lane	Paramics Models (AM Peak)				Queue Surveys (AM Peak)			
			Minimum	Average	Maximum	95 Percentile	Minimum	Average	Maximum	95 Percentile
M5 / Moorebank Ave	S	2	4	6	8	7	5	8	10	10
	S	3	4	7	9	8	5	8	12	11
	S	4	0	2	3	3	1	3	8	6
	S	5	3	6	8	8	3	5	7	7
Anzac Rd / Moorebank Ave	N	1	0	0	0	0	0	0	0	0
	N	2	2	3	5	4	0	1	4	3
	N	3	7	10	15	15	4	10	20	16
	E	1	0	2	3	3	3	6	12	11
	E	2	2	8	12	11	3	7	10	9
	S	1	8	13	25	22	2	16	34	30
	S	2	4	9	13	13	0	3	8	6

Table A7 PM peak Queue length Comparison

Intersection	Approach	Lane	Paramics Models (PM Peak)				Queue Surveys (PM Peak)			
			Minimum	Average	Maximum	95 Percentile	Minimum	Average	Maximum	95 Percentile
Newbridge Rd / Moorebank Ave	E	1	5	12	18	17	3	7	14	13
	E	2	8	13	18	17	3	9	13	13
	E	3	10	15	20	20	5	15	24	23
	E	4	10	14	18	17	7	15	24	23
	S	1	2	4	8	7	6	10	14	14
	S	2	0	3	7	6	3	7	10	10
	S	3	8	11	13	12	3	8	11	11
	S	4	6	9	12	12	6	9	16	13
	W	1	0	3	7	7	2	4	9	8
	W	2	0	2	6	5	1	3	6	5
	W	3	5	11	18	17	9	12	15	14
	W	4	5	11	18	17	6	10	13	13
Heathcote Rd / Moorebank Ave	N	1	0	4	11	9	0	2	10	7
	N	2	1	2	4	4	0	1	4	3
	N	3	3	6	9	8	4	10	13	13
	N	4	2	7	10	10	6	11	16	15
	E	1	0	0	0	0	0	0	0	0
	E	2	7	12	16	15	10	15	21	20
	E	3	3	7	12	11	4	9	13	12
	S	1	3	6	14	13	3	8	15	14
	S	2	0	1	5	4	2	6	15	12
	S	3	0	2	6	5	0	1	3	2
M5 / Hume Hwy	N	1	0	0	0	0	0	0	0	0

Intersection	Approach	Lane	Paramics Models (PM Peak)				Queue Surveys (PM Peak)			
			Minimum	Average	Maximum	95 Percentile	Minimum	Average	Maximum	95 Percentile
M5 / Hume Hwy	N	2	12	17	23	21	5	14	19	19
	N	3	15	21	24	23	8	13	22	19
	N	4	16	19	23	22	3	11	18	18
	E	1	9	12	16	16	6	9	12	11
	E	2	5	10	15	14	4	9	14	12
	E	3	3	5	7	6	4	8	11	11
	E	4	12	14	19	18	8	15	22	21
	E	5	10	14	21	20	9	14	19	18
	E	6	11	14	21	20	7	12	19	18
	S	1	3	5	7	7	2	4	7	6
	S	2	3	5	7	6	1	4	10	8
	S	3	3	5	7	6	2	5	9	8
	S	4	0	1	2	2	0	2	3	3
	S	5	0	1	4	4	1	2	4	4
M5 / Moorebank Ave	N	1	2	6	11	10	0	4	7	6
	N	2	3	4	7	7	4	5	6	6
	N	3	4	9	12	11	5	12	18	17
	N	4	6	10	16	14	9	15	21	20
	E	1	0	1	4	3	0	3	7	6
	E	2	0	2	4	3	1	2	3	3
	E	3	0	1	3	3	0	1	3	2
	S	1	2	3	5	5	0	6	17	14
	S	2	0	2	4	4	0	3	6	5
	S	3	2	3	5	5	1	4	6	6
	S	4	0	2	4	3	1	3	4	4
	S	5	2	4	6	5	1	5	7	7
Anzac Rd / Moorebank Ave	N	1	0	0	0	0	0	0	0	0
	N	2	2	5	8	7	0	2	4	4
	N	3	7	14	17	17	7	15	22	21
	E	1	3	6	9	9	3	10	15	14
	E	2	5	9	12	12	4	8	13	12
	S	1	0	4	7	7	1	6	15	12
	S	2	2	4	8	7	0	4	12	9

In addition, the queue survey results were coupled with an extensive intersection video survey. The results of the video surveys were compared with the simulation videos for the aforementioned intersections.

Results comparison between observed and modelled queue lengths showed a good correspondence between the model and the existing intersection conditions.

Weaving Validation

Paramics models result on the M5 weaving section was compared with weaving analyses suggested by the Highway Capacity Manual (2000). This comparison provided a high level verification on the Paramics modelling results. Noting there are differences between the two modelling methods.

The average weaving section speed and density for the M5 eastbound between Hume Highway and Moorebank Avenue were recorded from the Paramics models. The corresponding weaving level of service (LoS) was determined based on the observed weaving density. The LoS results were then compared with HCM 2000 analytical models.

According to HCM 2000, level of service (LoS) criteria for weaving areas are based on average vehicle density in the section. LoS Criteria for weaving segments based on HCM 2000 is shown in Table A8.

Table A8 Weaving Segment Level of Service

	Density (pc /km/ ln)	
LOS	Freeway weaving segment	Multilane and collector-distributor weaving segments
A	≤6.0	≤8.0
B	>6.0–12.0	>8.0–15.0
C	>12.0–17.0	>15.0–20.0
D	>17.0–22.0	>20.0–23.0
E	>22.0–27.0	>23.0–25.0
F	>27.0	>25.0

Source: *HCM 2000*

Table A9 presents comparison of weaving results based on Paramics and HCM 2000. The result in Table A9 showed close match when LoS was compared. The speed prediction in weaving section from Paramics (AM peak) is relatively lower than HCM. However difference in speed predictions are within 2 to 10 km/h. Overall, both analyses predicted a lower speed and LoS in the M5 weaving section.

Table A9 Weaving Segment Analyses

	AM Peak (7-8 am)		PM Peak (5-6 pm)	
	HCM 2000	**Paramics**	**HCM 2000**	**Paramics**
Weaving segment speed (km/h)	62.96	52.29	72.82	74.58
Weaving segment density (pc/km/ln)	23.60	26.70	16.50	15.46
Weaving segment LoS	E	E	C	C
Weaving flow Ratio (VR)	0.39*		0.32	

SUMMARY

The modelling results presented above confirmed that both AM and PM peak Paramics models for core area were calibrated and validated adequately and models are fit for this study purpose.

APPENDIX B

STUDY AREA TURN AND LINK COUNTS