Better Transport Futures

Mark Waugh Pty Limited
ABN 67 106 169 180
Transport Planning & Engineering

Proposed Riverside Residential Subdivision, Tea Gardens NSW

Crighton Properties Pty Ltd

Traffic Impact Assessment

October 2010

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BETTER TRANSPORT FUTURES
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2 December 2011
P0355 Crighton Riverside Lot Revision Letter

Crighton Building Company
PO Box 38
Tea Gardens NSW 2324
Australia

Attn: Peter Childs

Dear Peter,

Re: Part 3A (Project and Concept Plan) application for the proposed Riverside development at Tea Gardens, NSW.

Better Transport Futures previously prepared the following report in relation to the above mentioned project:

Traffic Impact Assessment – Proposed Myall Quays Residential Development, Tea Gardens NSW– (dated 29 October 2010).

Whilst the application is now for a reduced number of lots (ie from 974 to 920 lots), the report is still considered to be current as the change will have no impact upon our findings and ensures a more robust assessment for the project.

Should you require further information, feel free to contact our offices at 02 4952 5592.

Yours Sincerely,

Sean Morgan
Manager- Traffic Engineering

Contents

Document History and Status

Issue	Rev.	Issued To	Qty	Date	Approved
Draft	Rev01	Crighton Property Pty Ltd	1	4th April 2007	M Waugh
Draft	Rev02	Crighton Property Pty Ltd	1	16th May 2007	M Waugh
FINAL	Rev03	Crighton Property Pty Ltd	1	24th May 2007	M Waugh
FINAL	Rev04	Crighton Property Pty Ltd	1	31st May 2007	M Waugh
FINAL	Rev05	Crighton Property Pty Ltd	1	29th June 2007	M Waugh
FINAL	Rev06	Crighton Property Pty Ltd	1	18th August2008	M.Waugh
FINAL	Rev07	Crighton Property Pty Ltd	1	26th August 2008	M Waugh
FINAL	Rev08	Crighton Property Pty Ltd	1	29th October 2010	M Waugh

Printed: 11 November, 2010

Last Saved: 26th August 2008

File Name: M:\MW Pty Ltd\Archived Projects\P0331-P0360\P355 Crighton Riverside\Report\P355 Crighton Myall Riverside TIA Rev08.Doc

Author: Sean Morgan

Name of Organisation: Crighton Property Group

Name of Project: Proposed Myall Quays Residential Development, Tea Gardens NSW

Name of Document: Traffic Impact Assessment Report

Document Version: FINAL

Project Number: P355

1. Executive Summary

Crighton Property Group are preparing a Part 3A (Project and Concept Plan) application for the proposed Riverside development at Tea Gardens, NSW. The concept plan development includes approximately 974 lots and associated works.

The traffic analysis task has involved the following considerations:

- whether the existing Myall Quays intersection can cater for the initial stages of development
- timing of when additional access via a second intersection with Myall Street is required
- impacts of the full concept plan development of 909 residential dwellings and 65 tourist lodges (giving 974 lots in total)
- likely further impact of the additional 1300 lots to be developed at Myall River Downs and
- the future impact of proposed industrial development to the west of Myall Street

The study investigations have revealed the following outcomes in relation to traffic and access issues:

1. Operation of the existing intersection of Myall Street and Myall Quays Boulevard was assessed as having adequate capacity to cater for the flows associated with the initial stages of the development on the site (381 lots), for both the current 2007 and future 2017 design years.
2. The existing intersection has also been analysed to assess the impact of further residential development with access via Myall Quays Boulevard. This analysis indicates that some 590 residential lots could be developed off Myall Quays Boulevard using the existing intersection. Beyond 590 lots, the junction would need to be upgraded, or an additional access provided.
3. The existing intersection when combined with the proposed second access to the north on Myall Street is able to cater for the full 974 lots under the concept plan
4. The additional access available via Toonang Drive also contributes to a higher overall level of service at the proposed access junctions.
5. The proposed Myall River Downs residential development can be accessed via a single 4-way roundabout upgrade of the existing Myall Street / Myall Quays Boulevard intersection, having adequate capacity to cater for both the Myall Quays and Myall River Downs development.
6. The second Myall Street access with development of about 500 lots of Myall River Downs would require upgrade to roundabout control, because of the additional through traffic movements.
7. With then introduction of the industrial land to the west of Myall Street, access to this activity can be catered for via a 4th leg to the second Myall Street access. This operates satisfactorily under roundabout control for both the current 2007 and future 2017 design years.

From the study, it is concluded that the existing road system beyond the site is able to cater for the traffic demands of the proposed residential development of both Myall Quays and Myall River Downs. The existing intersection control at Myall Quays Boulevard and Myall Street, when combined with a 2nd intersection (of similar design) on Myall Street, and also with access to Toonang Drive can accommodate the entire Riverside Concept Plan area (974 lots.)

The two southern intersections of Myall Street will only require upgrading at or before the development of either or both of Myall River Downs or the industrial land to the west of Myall Street.

It is recommended that the concept plan and initial stages reflect the following commitments:

1. The second access to Myall Street (as a priority controlled junction) is provided prior to the development of 500 lots within the concept plan. (i.e. before the 590 threshold.)
2. Access to be provided to Toonang Drive in line with the Concept plan staging, at say 700 lots. (i.e. before the 974 yield.)
3. The Riverside Concept plan in isolation be allowed to be developed in total (974 lots) based on the capacity of the proposed 4 intersections

4. The two southern intersections of Myall Street only to be upgraded at / before the requirement is reached for these to act as 4-way intersections. (i.e. access is triggered by either or both of Myall River Downs or the industrial land to the west of Myall Street.)

2. Introduction

2.1 Background

Mark Waugh Pty Ltd was commissioned by Crighton Property Group to prepare a Traffic Impact Assessment to support the Part 3A (Project and Concept Plan) application for the proposed Riverside development at Tea Gardens, NSW. The scope of this report has also been extended to consider the cumulative impact of likely further development of the Myall River Downs site opposite.

The work presented in this report focuses on the traffic and transport elements of the proposal in the context of the existing situation and known development plans for the area.

2.2 Purpose of Investigations

The traffic investigations documented in this report have been prepared to support the Part 3A (Project and Concept Plan) application for the proposed Riverside development at Tea Gardens, NSW. The report is required as part of the application to the Department of Planning NSW.

This report presents the findings of the traffic investigations and assessment of the proposal. It is structured as follows:

- **Chapter 2** outlines the existing situation in the vicinity of the subject site, including discussion on the planned development growth within the vicinity and road network changes to support it.
- **Chapter 3** describes the traffic and parking features of the proposal.
- **Chapter 4** details the assessment of traffic operations related to the proposal
- **Chapter 5** summarises the findings of this investigation, outlining conclusions and recommendations for the traffic operations of the site to support the application for the proposal.

3. Existing Situation

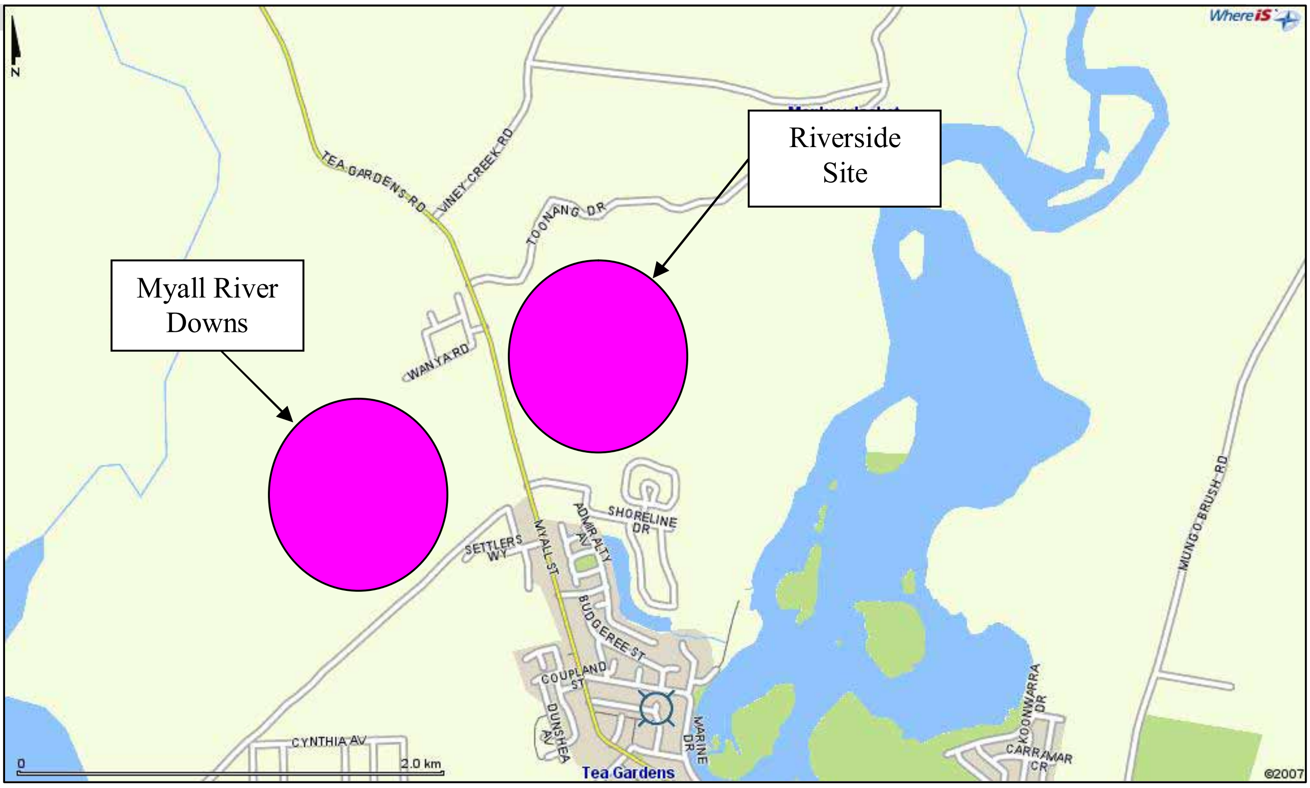
3.1 Background and Site Location

The subject site is located on a parcel of land off Myall Street, in the district of Tea Gardens. It is bounded to the south by existing residential development within Myall Quays and to the north by Toonang Drive and existing and proposed future residential development. To the west is Myall Street providing access to the greater road network. The land is currently vacant and predominantly cleared. The site is directly accessible from Myall Street, Toonang Drive and Myall Quays Boulevard.

Myall Quays and Myall River Downs are two developments located on opposite sides (east and west) of Myall Street, the main road access to the existing villages of Tea Gardens and Hawks Nest. Great Lakes Council has prepared a Development Control Plan No 30 Dated 1999 in addition to the Hawks Nest/ Tea Gardens Conservation and Development Strategy and a Local Environmental Plan. These planning documents covering the developments include potential for up to 2500 – 3000 residential dwellings, the shopping centre with supermarket, specialty retail and other services, service station, commercial centre, medical centre, restaurants and other employment lands.

Current proposals for the two sites provide for approximately 974 lots at Riverside with the Myall River Downs covering a further 1300 dwellings (approximately.)

The location of the site is shown below in **Figure 3.1**.



Source: Where Is.com

Figure 3.1 – Site Location

3.2 Local Road System

3.2.1 Road Characteristics

Myall Street

Myall Street, (Main Road 506) is the main road link to and from the villages of Tea Gardens and Hawks Nest and the Pacific Highway (H10) to the west. As an arterial road, it currently has a two lane sealed carriageway of approximately 13 metres width in the vicinity of the site. The posted speed limit adjacent to the site is a 50 kph local speed zone. Approximately ½ kilometre to the north of the site the speed limit changes to 80 kph at the fringe of the Tea Gardens urban development. Site observations and previous investigations for Myall Quays have indicated the following in relation to traffic operations:

1. Council traffic survey data from December 2001/January 2002 shows Myall Street carries an Annual Average Daily traffic (AADT) flow of 3927 vehicles per day.
2. AADT growth for Myall Street was around 5.5% between 1989 and 1998.
3. The growth rate for 1998-2002 slowed to 2.7%
4. Typical peak hour flows on Myall Street in January 2001 were observed as up to 250 vehicles per hour. Seasonal variations in flow mean that this number is considerably less in September
5. Sight distances are more than satisfactory on all approaches to the subject site
6. Existing traffic flows are relatively light with ample gaps to allow safe entering for vehicles entering the traffic stream from side roads
7. The existing route operates at a satisfactory level of service as evidenced from the lack of traffic management devices installed.
8. Pedestrian facilities in the vicinity are limited to those being installed as part of the Myall Quays development

Photo 1 – View west along Myall Street showing typical cross section

Myall Quays Boulevard
This main access road will serve the shopping centre, proposed commercial development and surrounding residential development as well as the subject site. It has been designed as a dual carriageway boulevard and ultimately with roundabout control at the intersection with Myall Street.

Photo 2 – View north along Myall Quays Boulevard showing typical cross section of southbound lanes

3.3 Traffic Volumes

3.3.1 Traffic Survey

As part of this project, traffic volume data has been collected during a survey of intersection traffic volumes at the intersection of Myall Street and Myalls Quay Boulevard. These surveys were completed on Thursday 8th Match 2007. The results of this survey are provided in **Appendix A** to this report.

The results from the traffic survey indicate that during the surveyed morning peak period (8.00 to 9.00 AM) the two-way traffic flow along Myall Street to the west of Myall Boulevard was in the order of 362 vehicles. The majority of vehicles were light vehicles, with limited heavy goods vehicles observed during the survey period. The survey showed that the westbound movement towards the Pacific Highway was the dominant flow with 193 vehicles (or 73%) whilst the eastbound movement was 169 vehicles. Allowing for background growth of 2.9% per annum this would indicate current flows would be in the order of 210 and 184 respectively.

The corresponding results from the afternoon survey show that the flows are reversed, with the dominant movement being eastbound. During the surveyed peak period (4.30 to 5.30 PM) the two-way traffic flow along Myall Street was in the order of 421 vehicles. The majority of vehicles were again light vehicles, with limited heavy goods vehicles observed during the survey period. The survey showed that the eastbound movement towards Hawks Nest was the dominant movement with 250 vehicles (or 59 %) whilst the westbound movement was 171 vehicles. Allowing for background growth of 2.9% per annum this would indicate current flows would be in the order of 272 and 186 respectively.

The traffic flows along Myall Quays Boulevard were much lower. During the morning peak period the two-way flow was 135 vehicles per hour and in the afternoon was 256, reflecting the demands associated with the shopping centre.

The results of the traffic survey are summarised in **Table3.1** below.

Table 3.1 – Traffic Volumes (2007)

Road	Peak Period	Peak flow	Mid-Block Road Capacity[2]	Volume / Capacity
Myall Street	AM peak	193 eastbound 169 westbound	900 (one-way)	0.214 0.187
	PM peak	173 eastbound 250 westbound	900 (one-way)	0.192 0.277
Myall Quays Boulevard	AM peak	76 northbound 59 southbound	900 (one-way)	0.084 0.065
	PM peak	113 northbound 143 southbound	900 (one-way)	0.125 0.159

Notes: 1. Peak flow from March 2007 traffic survey results by Mark Waugh Pty Ltd
2. RTA 2002, Urban Road Conditions Level of Service C

Table 3.1 demonstrates that both Myall Street and Myall Quays Boulevard are operating well within their technical and functional capacity levels as an arterial road (Myall Street) and local collector road (Myall Quays Boulevard). Even allowing for 2.9% growth per annum since 2007 it can be seen that the local roads would still be operating well within acceptable limits.

Using Table 4.4 from the RTA Guide to Traffic Generating Developments (reproduced below), it can be seen that the ultimate capacity for Myall Street in this location is around 1,400 vehicles per hour in one direction. For the current observed traffic flows along Myall Street it can be seen that the level of service for road users is A or B.

Table 4.4
Urban road peak hour flows per direction

Level of Service	One Lane (veh/hr)	Two Lanes (veh/hr)
A	200	900
B	380	1400
C	600	1800
D	900	2200
E	1400	2800

Source: RTA Guide to Traffic Generating Developments, version 2.2 dated October 2002.

3.4 Intersection Control and Operation

As discussed above, there are a number of intersections and driveways in the general vicinity of the subject site. These intersections are in the main simple give way controlled intersections. There are also a number of driveways to individual residential lots.

The intersection of Myall Street and Myall Quays Boulevard is the major intersection in the vicinity of the site. It provides a give way control with a central right turn lane, so that westbound through movements are not impeded by traffic waiting to turn right into the side road. There is also a left turn deceleration lane for traffic turning left into the side road off Myall Street. For traffic exiting Myall Quays Boulevard there is a left turn acceleration lane to reduce the delays for these vehicles. The layout of intersection has been reviewed on site and provides good visibility in all directions, due to the straight alignment of both of the roads.

From the RTA Road Design Guide, the intersection provides a Type AUR intersection control, with the additional benefit of the left turn deceleration and acceleration lane.

It is useful to consider the Austroads threshold levels for intersection capacity under uninterrupted flow conditions. **Table 3.2** presents these thresholds. Where traffic flows fall within these limits intersection operation is essentially at no delay or interruption for approaching drivers other than to obey the requisite road rules.

Table 3.2 Intersection Capacity – Uninterrupted Flow Conditions

Road Type	Light Crossing or turning volumes Maximum Design Hour Volumes, Two-way (vph)		
Two Lane through Roadway	400	500	650
Cross Road	250	200	100
Four Lane through roadway	1000	1500	2000
Cross road	100	50	25

Source: Austroads Guide to Traffic Engineering Practice - Part 5, 1988

For both the morning and afternoon peak periods, the survey results indicate that these limits are not met (nor are they met with background growth since the survey were completed) and that therefore the traffic experiences minimal delays, except for those associated with slowing down and speeding up to negotiate the intersection. This confirms site observations during the peak periods.

3.5 Road Network Improvements

The only known road improvements in the vicinity are those associated with the proposed access to the Riverside, Myall River Downs and adjacent industrial estate projects. The long term access arrangements for these projects make provision for upgrading intersection controls to roundabouts, and potentially also for the duplication of the road carriageway between the two nominated access points on Myall Street. These potential upgrades are discussed in later sections of this report.

It is understood there are no major road network improvements planned in the vicinity of the subject site, apart from normal road maintenance performed by Council and the RTA.

3.6 Public Transport, Pedestrians and Cyclists

Public transport in the vicinity of the site is limited. School buses provide access for school children between this area and Raymond Terrace. However, these services do not provide a high standard of service suitable for regular commuters.

Pedestrians and cyclists are able to use the public roads in the vicinity of the site. During the survey there was limited cyclist and pedestrian movements observed. Council have recently updated their BikePlan for this locality and there are a number of routes in this locality that are at various stages of construction. These routes will be completed as development in the locality occurs.

4. Proposed Development

4.1 Development and Access Arrangements

A concept plan application is to be made to the NSW Department of Planning (DoP) for approval to subdivide the subject site into around 909 residential lots, 65 tourist lodges and associated works. The development will be constructed in a number of stages. The initial stages will provide approximately 381 lots.

The plans for the residential development show that access to the subject site will initially be provided via one intersection on Myall Street which currently exists. Further intersections to Myall Street and Toonang Drive are proposed in subsequent Stages.

The intersection of Myall Street and Myall Quays Boulevard is currently constructed as a give way control. It is proposed to construct the second access on Myall Street as a give way control in an early stage of the development. Under full development and with the development of industrial land opposite the subject site which appears likely to proceed at some future date both of the Myall Street intersections will be upgraded then to 4-way roundabout control.

This assessment is for the full concept plan of 974 lots, with consideration of the first stages of 381 lots. It also considers the longer term effects of the potential continuation of the industrial estate on the western side of Myall Street, and also the development potential of Myall River Downs, assumed as a maximum potential of 1300 lots. The timing of both of these potential developments is not currently known but there effects have been taken into account in terms of determining the appropriate ultimate level of road infrastructure requirements.

Details of the concept plan and project plan are included in **Appendix D**.

4.2 Traffic Generation

The level of traffic generation from the development proposal has been assessed using the rates available from the standard RTA guidelines for Traffic Generating Developments. These Guidelines indicate a range of traffic generation rates depending on the type land use activity, including residential subdivisions.

The RTA guidelines indicate the critical movement periods for residential are during the morning and afternoon peak periods. These movements are associated with work and school trips. Morning peak flows are generally more critical, as the afternoon peak flows often occur over a longer time frame with less of a peak. For the purposes of this assessment, it has been assumed that the morning and afternoon traffic flows are similar.

The RTA Guide to Traffic Generating developments indicates that typical traffic generation rates for residential subdivisions such as the subject site are 0.85 trips per dwelling during the peaks and 9 trips per dwelling per day.

For the initial stages of 381 residential lots the peak hour flows would be in the order of 324 vehicle movements per hour and 3429 vehicle movements per day. It is considered that these rates provide the upper limit for traffic flows and that actual traffic flows could be considerably lower. A review of the current development in the locality of the site indicates that a significant portion of the current residents are retired, and therefore do not have school related trips or work related trips. Assuming the subject development also accommodates a large number of retired people, and then the traffic flows would be much lower.

For retirement units, the RTA Guide indicates that the level of generation is 0.1 to 0.2 per dwelling in the evening with no advice for the morning peak. Assuming the higher rate and applying this to the AM peak as well, it can be seen that this rate is some 25% of the rate for normal residential development. If 25% of the future lots were occupied by retired people, the composite generation rate would reduce to some 0.69 trips per lot, a reduction of 20%. As the number of lots occupied by retired people increases as a proportion, it can be seen that the composite lot rate per lot increases accordingly. With half the lots for example occupied by retied people for example, the composite generation rate would be 0.525 trips per lot.

In addition, it is important to note that a significant portion of the traffic will be contained traffic, associated with trips to the shops, schools, etc. Advice from the RTA Guide to Traffic Generating Developments indicates that typically some 25% of traffic is localised traffic, contained within the area of a development such as this and that this traffic does not use the external road network. It can be seen that the future residential development to the east of the existing commercial centre will not have to use the external road network to access the commercial centre. Whilst a trip will be generated by the dwellings, its impact on the greater road network will be zero.

Traffic demands will also be reduced due to the layout of the site, providing a positive encouragement for pedestrians and cyclists for the short trips required to the adjacent facilities and developments. It can also be seen that the home office facilities will encourage a significant portion of the future residents to work from home, using the internet and phone as part of the communication package. The location of the development discourages daily commuting to the major centre such as Newcastle, thereby attracting people who can work form home.

It is considered that with the containment of trips from the design of the site as well as a high proportion of retired people living in the area, together home based work, the normal traffic generation rate of 0.85 can be reduced by some 35%, giving an external trip generation rate of 0.55 trips per dwelling during the peak periods. Daily rates would also be reduced by a similar rate. Using these rates, the Stage One of the development (381 lots) would generate some 209 vehicles per hour two-way and the full development of 974 would generate 536 vehicle movements per hour.

4.3 Site Access

For the purposes for the project plan vehicle access to the site will be provided via two access points. The existing intersection of Myall Street and Myall Quays Boulevard will provide one access point initially whilst a second access point will be provided to the north of this existing intersection. The timing of the second intersection is discussed in Section 6 of this report. The access roads to the subject site will need to be designed in accordance with the RTA and Council requirements. There will be no direct individual property access to Myall Street, with all access provided via the internal road network.

4.4 Traffic Distribution

It is considered that the traffic distribution would be similar to the existing observed distribution. Whilst a large number of work related trips would be west towards the Pacific Highway (Raymond Terrace, Newcastle etc) it can be seen that leisure associated trips for retired people would be east towards Hawks Nest e.g. golf course, shops and the beach. This is reflected in the current distribution at the intersection of Myall Street and Myall Quays Boulevard, where in the morning peak 70% of the traffic is west bound towards the Pacific Highway. However, in the afternoon peak period the flows are nearer 60% towards the east.

For the purposes of this assessment, the traffic has been distributed in a similar manner to the existing observed splits.

4.5 Pedestrian Access

Pedestrian access to the site would be via existing facilities along Myall Street augmented by the development as proposed by the proponent. It is considered that the augmented existing facilities in the local area will be more than adequate for the proposed development. In addition, there will be an extensive network of pedestrian and cyclist (dual use) paths within the site. These paths will connect with the existing residential development adjacent to the site as well as connections to waterways and the existing shops at the entry to the subject site.

These dual use paths will tie in with the BikePlan for the Hawks Nest / Tea Gardens area recently updated by Council.

4.6 Public Transport Facilities

The location of the site means that school children in particular will require a bus run to service the site. There is an existing school bus run that operates from this area. The demands on this existing service may require additional or improved runs to service this development. It is noted that a bus route throughout the development is proposed. The school bus run could be extended through the development if required, as the layout allows for through traffic movements. In the early stages of the development, it would be beneficial to provide a bus stop and shelter adjacent to the site entry point on Myall Street in the location allowed for adjacent to the shopping centre, to provide a pick up/drop off point for schoolchildren.

The provision of school and regular bus routes to the subject site will be encouraged through discussions with the local bus company, with a view to extending and improving the existing service. This discussion will occur at the detailed design stage with the local bus company (s) as well as Council.

4.7 Site Operations and Access Arrangements

The indicative site plans for the proposed concept and initial stages are presented in **Appendix C** to this report. Overall access geometry would need to meet the requisite Council standards for residential subdivision. The internal road layout will need to be designed in accordance with Council residential subdivision code taking into account intersection controls, pedestrian requirements as well as existing road geometry requirements such as carriageway width etc.

The internal road network has been planned with careful consideration of the needs of the new community, both at the concept and project plan phase of the project. These plans will be upgraded and refined through the detailed design stage of the development in consultation with Council.

The longer term planning for the area surrounding the subject site includes development of industrial and other residential land, on both sides of Myall Street. It is envisaged that the two intersections along Myall Street that would provide the main points of access to the new areas.

It is understood that the longer term planning for the area surrounding the subject site includes the development of approximately 15,000 m^2 industrial uses and other residential land, on both sides of Myall Street. It is envisaged that the two intersections along Myall Street that would provide the main points of access to these new areas would be controlled ultimately by roundabouts.

The technical analysis for the development of the site in relation to the form of intersection control required to provide satisfactory access for the residential site is discussed further in **Section 6.**

4.8 Parking Requirements

It can be seen that the new development will require parking for the residents but that it can be contained within the site. As per Council design requirements, there will be garage requirements for the future development as well as driveway requirements etc.

It is considered that all future parking for the development can be contained on site and that there is no further requirement to review parking for the development.

4.9 Other developments

There are a number of other key developments proposed in the general vicinity of the site. These include:

- Myall River Downs incorporating an additional approximately 1300 lot residential lots
- Industrial floor space of approximately 15,000 m^2

Timing of implementation of these two developments is expected to be beyond the timeframe planned for development of the Riverside project. Both of the developments will impact upon access to Myall Street in the long term, with access to these sites proposed at 4 way intersections as upgrades of the two Riverside access points, to minimise the number of access points to the main road Myall Street. The industrial development which is at the preliminary stages of planning is proposed to have access via two access points on Myall Street, the access to the existing industrial land, and via a fourth leg to the proposed second access into the Riverside site..

The preliminary plans for the Riverside development indicate that access in the long term would be provided via two 4-way roundabout controlled intersections that would provide access to the subject residential development as well as Myall River Downs, and the future industrial development.

It is important to note however that both the Myall River Downs and the future industrial development have not yet been approved. However, when assessing the access options for the subject residential development the impact of this industrial land should be taken into account, to ensure robustness of intersection design.

The assessment of intersection controls and staging of access considered in Section 6 of this report has taken the above planning timeframe into consideration.

5. Urban Design Principles

5.1 Urban Design Principles

The Riverside development provides an opportunity to contribute to the integration of land use and transport integration, through the adoption of urban design principles that encourage the full range of transport alternatives for visitors and residents of the site. The transport goals for the development are outlined below. **Appendix E** to the report includes a more detailed working paper describing the principles of encouraging a change in travel behaviour through the provision of alternative transport considered early in the development process.

5.1.1 Riverside Transport Objectives

The following transport objectives have been put forward as part of the concept master plan for the Riverside site:

Pedestrians:

- Improve the Pedestrian Environment
- Promote walking as principle local transport through and to the site.
- Give pedestrians priority over vehicles within the site
- Enhance walking linkages - provide direct links within the site and to neighbouring attractions to encourage walking as key local transport. Provide signage with travel times to local attractions
- Provide pedestrian links through proposed green/ open spaces
- Provide pedestrian linkages back to Myall Street and the local shopping centre
- Provide a high standard of pedestrian accessibility / mobility within and to the site with continuity, consistency of materials, signposting, lighting

Vehicle Access and Movement:

- Primary vehicle access (including service vehicles) from Myall Street and Myall Quay Boulevard
- In line with promoting pedestrian priority for the site minimise vehicle crossing points of footpath areas
- Promote traffic calming within the local road system to enhance pedestrian safety
- Consider reducing road widths to improve pedestrian environment in areas of high pedestrian activity, low vehicle usage and high residential amenity (but still allowing for essential vehicle access and movement)

Public Transport:

- Promote access to public transport from the site using local shops as focal point for access to bus services, with a high degree of permeability for local service access to the site
- Provide high quality bus facilities at Myall Street and Myall Quay Boulevard

Cycling:

- Consider nominating a route for cyclists around (rather than through) the site to protect and enhance the environment in high pedestrian activity areas

Parking:

- Provide requisite parking on site to match development needs
- Recognize parking requirement for storage of vehicles
- Manage on street parking adjacent to site for maximum benefit of site activities (Cafes etc.)

These objectives were taken into account in the development of the site concept Master plan.

6. Assessment of Transport Operations

6.1 Staging Assumptions

For the purposes of considering the impacts of the proposed development including the assumed staging of implementation, the relationship to other potential development in the area has been assumed as summarised in **Table 6.1** below. The process of analysis has involved the following:

1. Assess the ability of the existing Myall Quays intersection to cater for the initial stages of 381 lots
2. If spare capacity is still available, assess the ability of the existing Myall Quays intersection to cater for a portion of the concept plan development threshold up to the level of 974 lots.
3. When capacity of the existing Myall Quays intersection is reached, assess the capacity of the proposed second access under priority control to cater for the remainder of the concept plan development threshold up to the level of 974 lots.
4. Consider the impacts of the additional access points onto Toonang Drive also available to access Myall Street to the north.
5. Add a portion of the Myall River Downs Project to the existing Myall Quays intersection, upgrading to roundabout control if necessary
6. Add additional development from the Myall River Downs Project. Assess the capacity of the 2nd Riverside access, upgrading to roundabout control if necessary
7. Add the industrial development via a 4th leg to the 2nd Riverside access, upgrading to roundabout control if necessary.

This process of analysis of the development staging is iterative, and assumes the timing of the Riverside Downs and Industrial development post dates the Subject Riverside development.

Table 6.1 Site Access and staging Assumptions

Stage	Development Staging	Myall Quays intersection	Proposed 2nd access
	Riverside - 381 lots	Existing	
	Riverside - 590 lots	Existing	
	Riverside - 974 lots	Existing	T intersection
	Riverside - 974 lots + 500 Myall River Downs	4-way Rbt	T intersection
	Riverside - 974 lots + 1300 Myall River Downs	4-way Rbt	3-way Rbt
	Riverside - 974 lots + 1300 Myall Down + Industrial	4-way Rbt	4-way Rbt

The results of this process in terms of intersection performance and recommendations for staged implementation of the proposed junctions on Myall Street

6.2 Site Access Operations

It is proposed to provide all vehicle access to the site via two access points on Myall Street and two on Toonang Drive. One of these access points is already constructed (Myall Quays Boulevard) whilst the second access to the west will be built as part of a later stage of the development. It has been identified that during the initial stages of the development both of these intersections will be give way controlled, but that improved access control i.e. roundabout control will be required to facilitate full development of this site and the industrial land on the opposite side of Myall Street. The timing of the development of the roundabout controls will be tied to the various development staging, ensuring that adequate levels of service are maintained. The analysis here assesses the immediate needs of the subject residential development.

6.3 Road Network Performance and Capacity

From **Table 3.1**, the current peak one-way hourly traffic flows along Myall Street is in the order of 250 vehicles westbound in the PM peak and 193 vehicles per hour one-way in the AM peak. From Table 4.4 of the RTA Guide to Traffic Generating Developments it can be seen that the level of service for the current flows is B and A respectively. This assumes the heavy good vehicles content is in the order of 5% and that the road is relatively flat in this location.

Upon completion of the initial stages of the development with 381 residential lots on the subject site, there could be up to 209 vehicles per hour generated by the development during the critical morning and afternoon peak periods. Assuming 70% of this traffic has an origin/destination to the west towards the Pacific Highway, it can be seen that traffic flows along Myall Street could increase by nearly 150 vehicles per hour one-way in the critical direction (westbound AM peak, eastbound PM peak). This would increase the total hourly flows from the current critical peak westbound flow of 150 vehicles per hour in the AM peak to 300 vehicles per hour. In the afternoon peak the critical eastbound flow on Myall Street would increase from 173 vehicles hour to 323 vehicles per hour.

This would mean that there would no change to the existing level of service of B for road users along Myall Street to the west of the development access points. Level of service B is defined as "*This level is in the zone of stable flow and drivers still have reasonable freedom to select their desired speed and to manoeuvre within the traffic stream, although the general level of comfort and convenience is less than that of the level of Service A*". It is considered that the additional traffic generated by the development will have an acceptable impact upon the existing operation of Myall Street.

Typically, as traffic flows increase along a length of road drivers habits alter. The main change is that people alter their time of travel where possible to avoid travelling during the peak periods. This effectively increases the duration of the peak hour along the key routes whilst reducing the absolute peak demand along a road during the critical peak periods. This is particularly relevant for retired people, as they will choose to avoid driving in the peak hours where possible to avoid delays and congestion.

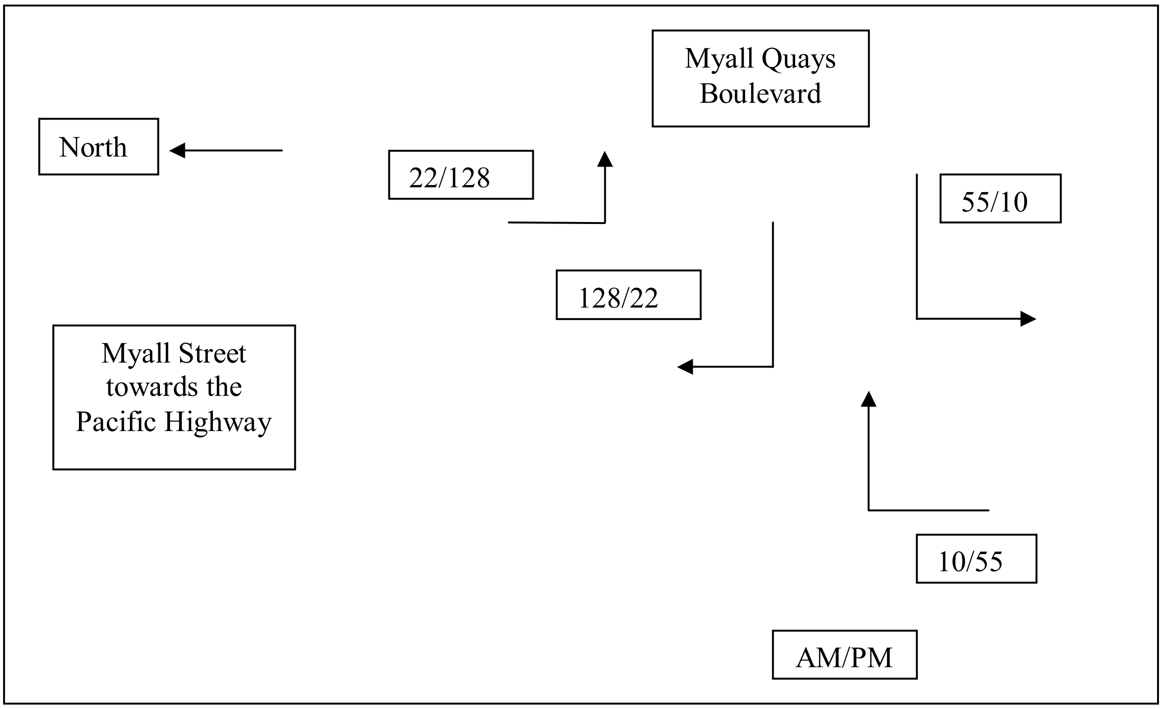
The key issue will therefore be the operation of the intersection of Myall Street and the two access points.

6.4 Traffic Distribution

For the initial stages of the development, it is proposed to utilise the existing intersection only (at Myall Quays Boulevard), as all of the additional traffic associated with the development of 381 residential lots can be accommodated by the existing intersection. As the development proceeds beyond this initial stage, it can be seen that traffic can be distributed from the development via four separate access points with three connections to Myall Street.

It is considered that 70% of the traffic will wish to head north from the site towards Raymond Terrace and Newcastle via the Pacific Highway during the morning peak period as per the existing observations. The layout of the site allows ease of choice for drivers to use any of the four entry/exit points to gain access to the greater road network. It is considered that 35% of the traffic will use the southern intersection (existing give way controlled intersection at Myall Quays Boulevard) whilst the remaining 65% of the traffic will use the future access points to the north.

Using the above assumptions, the future traffic flows associated with the initial development of 381 lots are presented below.



The above traffic flows have been used for the analysis of the impact of the subject site at the intersection of Myall Street and Myall Quays Boulevard..

6.5 Intersection Operation

6.5.1 Initial Stages (381 lots)

The additional traffic associated with the initial stages of the development has been determined using the future flows associated with the development shown above. The intersections have been assessed using the standard computer package Sidra. Sidra is a traffic analysis tool developed originally by the Australian Road Research Board. It calculates the amount of delay to vehicles using an intersection, and gives a level of service rating which indicates the relative performance of the nominated intersection treatment. Levels of service of A to C are considered to be satisfactory, a level of service of D is acceptable, and levels of E and F are considered unsatisfactory. Sidra also calculates the degree of saturation, which indicates the amount of **spare capacity** available.

See **Appendix D** for full definition of SIDRA results.

The proposed development will be constructed over a number of stages, as required by market demand for the residential lots. As a worst case scenario, it has been assumed that the initial development (381 lots) is constructed entirely in 2010. The additional development flows shown above have been added to the current observed traffic flows to assess the performance of the intersection with the additional flows.

The results of the analysis for the existing intersection control with the additional traffic generated by 381 lots are shown overleaf in **Table 6.2**.

Table 6.2 – Intersection of Myall Street and Myall Quays Boulevard, current intersection layout, 2007 traffic flows plus 381 lots (AM/PM)

MOVEMENT	DEGREE OF SATURATION	AVERAGE DELAY (SEC/VEH)	LEVEL OF SERVICE	95th PERCENTILE BACK OF QUEUE
Right turn in to Myall Quays Boulevard	0.065/0.134	9.0/9.8	A/A	2/5
Right turn out Myall Quays Boulevard	0.293/0.119	13.7/14.3	B/B	12/4
Through N-bound	0.074/0.049	0.0/0.0	A/A	0/0
Through S-bound	0.068/0.087	0.0/0.0	A/A	0/0

NB: Average delay, degree of saturation and level of service for the most delayed movement

The above analysis shows that with the full stage one of the development (381 of the residential lots) the existing intersection control at Myall Street and Myall Quays Boulevard are adequate. The level of service and associated delays will be similar to the existing situation and existing road users will notice minimal increases in delays and congestion at this intersection.

The intersections have also been assessed for the future design year of 2017. The through traffic movements on Myall Street have been increased by 25%, representing an annual increase of 2.5% in background traffic flows. The results of this analysis are presented in **Table 6.3** below.

Table 6.3 – Intersection of Myall Street and Myall Quays Boulevard, current intersection layout, 2017 traffic flows plus 381 lots (AM/PM)

MOVEMENT	DEGREE OF SATURATION	AVERAGE DELAY (SEC/VEH)	LEVEL OF SERVICE	95th PERCENTILE BACK OF QUEUE
Right turn in to Myall Quays Boulevard	0.066/0.140	9.1/10.0	A/A	2/5
Right turn out Myall Quays Boulevard	0.328/0.132	15.4/15.5	C/C	14/4
Through N-bound	0.092/0.062	0.0/0.0	A/A	0/0
Through S-bound	0.084/0.094	0.0/0.0	A/A	0/0

NB: Average delay, degree of saturation and level of service for the most delayed movement

The above results indicate that the existing priority controlled intersections will continue to provide a high level of control for all road users over a 10 year design timeframe for the initial stages of the development (381 lots). The approach road capacity on Myall Street is also satisfactory as a two lane road configuration, and does not require upgrading to cater for the initial stages of the development.

6.5.2 Concept Plan and Development Staging

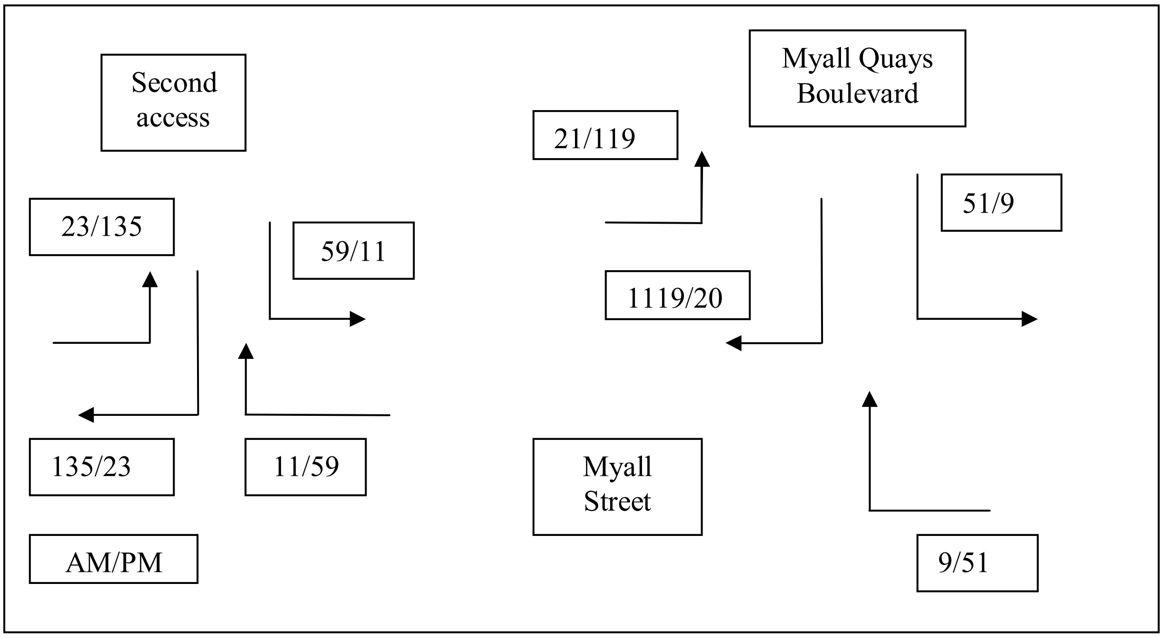
The relationship of the to the overall concept plan and surrounding development has been tested as follow:

1. Introduction of the 2nd Myall Street access at or before completion of 381 lots.
2. Increase the level of lots developed from the concept plan, up to a maximum of 974 lots
3. Continue to increase level of lots developed from the concept plan, up to a maximum of 974 lot
4. Determine the point at which the intersection of Myall Quays Boulevard and Myall Street needs to be upgraded to roundabout control
5. Increase the development in Myall River downs (opposite the site and access onto Myall Street / Myall Quays Boulevard intersection (Max 1300 lots overall)
6. Assess the level of traffic on Myall Street, between the intersection at Myall Quays Boulevard and the future second access and determine road geometry i.e. 1 or 2 lanes in each direction
7. Assess the level of traffic on Myall Street, north and south of the roundabouts and determine at what point the road needs to be upgraded to 4 lanes

6.5.3 Project Development – Stage One and Two (974 lots)

The full development at Myall Quays will provide 974 residential lots. During the first stage, access will be via the existing single access point at the priority controlled intersection of Myall Quays Boulevard and Myall Street. During the development of the Riverside site a second access will be provided to the north of the existing intersection, providing a priority controlled intersection similar to the intersection of Myall Quays Boulevard and Myall Street. The development will also ultimately provide connections to Toonang Drive.

Once the second access is to Myall Street is constructed, it can be seen that traffic from Myall Quays will be distributed between these two access points. The total flows associated with the development of 974 lots, including the current traffic flows using Myall Quays Boulevard are shown below:



The second access has been assessed to review the capacity of this intersection with the additional traffic associated with the full development of 974 residential lots. (This is a conservative approach as there will be some traffic that will make use of the connections to Toonang Drive.) The analysis has allowed for the additional through movements associated with the flows at the existing intersection as well as background traffic growth to the future design year of 2012. The results of the analysis for the second intersection are shown below in Table 6.4.

Table 6.4 – Intersection of Myall Street and 2nd Access, Priority Control intersection layout, 2012 traffic flows plus 974 lots (AM/PM)

MOVEMENT	DEGREE OF SATURATION	AVERAGE DELAY (SEC/VEH)	LEVEL OF SERVICE	95th PERCENTILE BACK OF QUEUE
Right turn in to Myall Quays Boulevard	0.016 / 0.080	9.2 / 10.8	A / A	1 / 3
Right turn out Myall Quays Boulevard	0.450 / 0.084	21.5 / 18.8	B / B	21 /3
Through w-bound	0.190 / 0.089	0.0 / 0.0	A / A	0 / 0
Through e-bound	0.103 / 0.194	0.0 / 0.0	A / A	0 / 0

NB: Average delay, degree of saturation and level of service for the most delayed movement

The above analysis shows that with the proposed second access point, the full development of 974 lots can be developed at Myall Quays through the combination of the existing priority controlled intersection of Myall Street and Myall Boulevard together with the second priority controlled intersection. The additional connections to the north via Toonang Drive will also be available and will actually result in a better overall level of service in the area.

With the development of Myall River Downs on the western side of Myall Street from Myall Quays, the intersection of Myall Quays Boulevard and Myall Street will need to be upgraded to a roundabout control, to allow for a 4-way intersection. The Myall River Downs development could potentially yield an additional 1300 residential lots (maximum) when fully development. It is considered that the traffic generation rates for this residential development will be similar to the Myall Quays development, with 0.55 trips per lot during the peak periods. Using this rate, the impact of the traffic associated with this development has been assessed on the 4-way roundabout controlled intersection of Myall Quays Boulevard and Myall Street.

It has been assumed as a worst case scenario that this development could occur within a 5 year design frame. Therefore the background traffic flows on Myall Street have been increased by 2.5% per annum for the future design year of 2012. The Myall River Downs development flows have then been added to this base flow. The results of the Sidra analysis are presented in **Table 6.5** overleaf:

Table 6.5 – Intersection of Myall Street and Myall Quays Boulevard, roundabout intersection layout, 2012 traffic flows plus 974 lots (Myall Quays) plus 1300 lots (Myall River Downs) AM/PM

MOVEMENT	DEGREE OF SATURATION	AVERAGE DELAY (SEC/VEH)	LEVEL OF SERVICE	95th PERCENTILE BACK OF QUEUE
Right turn in to Myall Quays	0.117/0.288	14.0/14.5	B/B	5/15
Right turn out Myall Quays	0.338/0.146	13.4/45.6	B/B	19/7
Right turn into Myall River Downs	0.222/0.487	12.9/13.1	B/B	12/33
Right turn out Myall River Downs	0.319/0.070	14.1/12.5	B/B	15/3
Through w-bound	0.195/0.282	6.5/7.2	A/A	10/15
Through e-bound	0.222/0.487	6.1/6.3	A/A	12/33

NB: Average delay, degree of saturation and level of service for the most delayed movement

The above analysis for the 4-way roundabout controlled intersection shows that the proposed roundabout has adequate capacity to cater for the residential development at Myall Quays (974 lots) plus the Myall River Downs residential development (1300 lots maximum).

A further analysis test has been completed at the intersection of Myall Street and the second access to Myall Quays. Whilst the Sidra analysis indicates that the roundabout at the intersection of Myall Quays has adequate capacity, the additional traffic from Myall River Downs will impact upon the operation of the intersection of the second access point to Myall Quays and Myall Street. As the through movements increase on the main road, the delays for the turning traffic increase.

To assess the impact of the Myall River Downs development at this intersection, a series of tests were completed to determine the cut-off point for the satisfactory operation of this intersection. By a series of iterative tests, it was determined that 500 lots could be developed on Myall River Downs without providing unacceptable delays at the intersection of Myall Street and the second access to Myall Quays. Beyond this level of development at Myall River Downs, the turning movements at the intersection of Myall Quays and the second access became unacceptable.

The results for the analysis of the second access, with 974 lots developed on Myall Quays and 500 lots at Myall River Downs are shown below in Table 6.6.

Table 6.6 – Intersection of Myall Street and 2nd Access, Priority Control intersection layout, 2012 traffic flows plus 974 lots and 500 lots Myall River Downs(AM/PM)

MOVEMENT	DEGREE OF SATURATION	AVERAGE DELAY (SEC/VEH)	LEVEL OF SERVICE	95th PERCENTILE BACK OF QUEUE
Right turn in to Myall Quays Boulevard	0.016 / 0.096	9.3 / 11.9	A / A	1 / 3
Right turn out Myall Quays Boulevard	0.623 / 0.127	32.9 / 25.8	C / B	31 / 4
Through w-bound	0.267 / 0.125	0.0 / 0.0	A / A	0 / 0
Through e-bound	0.121 / 0.268	0.0 / 0.0	A / A	0 / 0

NB: Average delay, degree of saturation and level of service for the most delayed movement

Beyond the development of 500 lots at Myall River Downs, the second access to Myall Quays will need to be upgraded to ensure acceptable delays for the traffic turning in and out of Myall Quays. As an interim access, the intersection can be upgraded to a three-way roundabout. The results for the analysis of this 3-way roundabout are provided in **Table 6.7** below:

Table 6.7 – Intersection of Myall Street and 2nd Access, Priority Control intersection layout, 2012 traffic flows plus 974 lots and 1300 lots Myall River Downs(AM/PM)

MOVEMENT	DEGREE OF SATURATION	AVERAGE DELAY (SEC/VEH)	LEVEL OF SERVICE	95th PERCENTILE BACK OF QUEUE
Right turn in to Myall Quays 2nd access	0.023 / 0.068	12.2 / 11..3	B / B	1 / 3
Right turn out Myall Quays 2nd access	0.109 / 0.024	12.5 / 15.1	B / B	5 / 1
Through w-bound	0.409 / 0.165	5.2 / 4.5	A / A	35 /9
Through e-bound	0.183 / 0.450	4.5 / 4.8	A / A	10 / 29

The above analysis shows that with the provision of a 3-way roundabout at the second access point for Myall Quays, the full development at Myall River Downs of 1300 lots (maximum) can be developed as well as the 974 lots at Myall Quays.

The final consideration of future proposed development involves the construction of an industrial area to the west of Myall Street. The plans for this development indicate that access would be provided opposite the proposed second access to Myall Quays, via a 4-way roundabout controlled intersection as well as via the existing industrial access to the north on Myall Street. This new access would involve the introduction of a 4th leg at this intersection.

The impact of the proposed industrial development has been assessed for the future design year of 2017. This has allowed for the full development of the Myall Quays residential development (974 lots), full development at Myall River Downs residential site (1300 lots) and provision of 15,000 m^2 of general industrial area. The RTA Guide to Traffic Generating Developments has been used to determine the volume of traffic associated with this development, with a rate of 1 trip per 100 m^2 used to assess the impact.

It has been assumed (conservatively) that all of the industrial traffic will access Myall Street via a single access with a 4-way roundabout proposed. The analysis has been completed for the future design of 2017, with 2.5% growth allowed for through traffic flows along Myall Street. The results of the analysis for the 4-way roundabout are presented in Table 6.8 overleaf:

Table 6.8 – Intersection of Myall Street and 2nd Access, 4-way roundabout, 2017 traffic flows plus 974 lots (Myall Quays) plus 1300 lots (Myall River Downs) plus 15,000 m^2 Industrial AM/PM

MOVEMENT	DEGREE OF SATURATION	AVERAGE DELAY (SEC/VEH)	LEVEL OF SERVICE	95th PERCENTILE BACK OF QUEUE
Right turn in to Myall Quays 2nd access	0.023 / 0.070	12.9 / 11.4	B / B	1 / 3
Right turn out Myall Quays 2nd access	0.134 / 0.025	13.3 / 15.6	B / B	7 / 1
Right turn into Industrial area	0.276 / 0.529	11.6 / 11.9	B / B	16 /38
Right turn out Industrial area	0.012 / 0.058	16.1 / 12.9	B / B	1 / 2
Through w-bound	0.612 / 0.210	6.1 / 4.6	A / A	48 / 12
Through e-bound	0.275 / 0.531	4.6 / 5.2	A / A	16 / 38

The above analysis confirms that with the full development of Myall Quays (974 lots), Myall River Downs (1300 lots maximum) and the Industrial development (15,000 m^2) the 4-way roundabout at the second access point to Myall Quays will have adequate capacity to cater for the predicted traffic flows.

6.5.4 Toonang Drive Access

The traffic analysis completed here has conservatively assumed that all access from the development will use the proposed new access points on Myall Street. It should be noted that the development also proposes access at two points onto Toonang Drive to the north of the subject site, and so it can be expected that some traffic will use this route. Base traffic flows on Toonang Drive were not recorded, however based on the level of development noted it is expected that peak flows along this route would be of the order of 100 vehicles per hour. The level of traffic use of Toonang Drive will be influenced by the design form of the internal road network of the proposed estate, where it is not intended to encourage this as a major access route for the estate. It is likely that some of the traffic assigned in the previous analysis to use the second Myall Street access would in fact use the Toonang Drive access. If this were as high as 50% (which is considered unlikely) this would be in the order of 75 vehicles per hour at peak times. This would place the traffic flows within the environmental capacity limits of a local road, and with an existing built form observed as a sealed bitumen road with a pavement width of approximately 6 metres and shoulders of about 1.2 meters, it is considered that the road is capable of accommodating this level of traffic. It is likely in fact that because of the internal design proposed for the estate more traffic will use the Myall Street access.

6.6 Road Safety

6.6.1 Intersection of Myall Street and Myall Quays Boulevard

The intersection of Myall Street and Myall Quays Boulevard is a RTA Type AUR intersection, with shoulder widening to allow for westbound through movements on Myall Street to continue without being impeded by traffic turning right into Myall Quays Boulevard. There are also left turn deceleration and acceleration lanes provided. The intersection is located on a straight section of road and as such offers good visibility on all approaches. The available visibility exceeds the requirements of the RTA Road Design Guide and as such it is considered that the intersection provides a safe and acceptable layout. The layout is clearly laid out and offers a high level of access.

It is considered that this intersection provides a safe and appropriate location and layout for the proposed residential development.

With the future upgrade of this intersection to a roundabout control (when the industrial land is developed opposite the site) the safety will be increased further, as the hazards associated with the right turn movements will be significantly reduced with a roundabout control. Roundabouts provide a higher level of control compared with a give way controlled intersection. It is considered that a roundabout at this location will provide a safe and appropriate level of control at this intersection.

It is considered that the proposed second access can also operate in a safe and appropriate manner, initially also as a RTA Type AUR intersection. This second access will have a similar layout to the intersection of Myall Street and Myall Quays Boulevard and will provide good visibility on all approaches that exceed the requirements. This intersection will be designed in accordance with the RTA Road Design Guide and Council requirements.

The levels of traffic generated by this project plan proposal are able to be accommodated through the two priority controlled intersections. The timing of the provision of roundabout control will therefore be determined by the rate of development, particularly the proposed industrial land, on the opposite side of Myall Street and the future development of the Riverside site under the concept plan.

6.7 Pedestrian and Cyclist Facilities

Encouraging pedestrian movement through an improved overall environment for walking is a key principle of the Riverside concept plan. The concept allows for promotion of walking as principle local transport through and to the site. Where ever possible pedestrians would be given priority over vehicles within the site, with walking linkages enhanced to provide direct links within the site and to neighbouring attractions to encourage walking. Signage with travel times to local attractions would also be considered. Pedestrian links would be provided through proposed green/ open spaces with linkages back to Myall Street and the local shopping centre

Overall it is proposed to provide a high standard of pedestrian accessibility / mobility within and to the site with continuity, consistency of materials, signposting, lighting and so on.

Cyclists can use the roads within the development and pedestrians will be provided with footpaths along the side of the roads within the development. There will also be a number of off road combined footway/cycle ways that will provide a high level of convenience and comfort for pedestrians and cyclists.

It is considered that the site has been well designed for pedestrian and cyclist access and permeability. The future design will be discussed with Council to ensure the aims of the BikePlan prepared by Council can be achieved through this development site.

6.8 Public Transport

It is proposed to promote access to public transport from the site using the local shops as focal point for access to bus services, with a high degree of permeability for local service access to the site. The concept plan has considered the provision of a number of roads within the internal structure that are capable of accommodating bus operations. The proposal focuses on the provision of high quality bus facilities at Myall Street and Myall Quay Boulevard as a recognised transport node for the area.

It is considered that there will be an increase in demand for the school bus runs that currently operate along Myall Street. The additional demand can be accommodated by augmenting the existing bus service in this location. A new bus stop should be considered adjacent to the site on Myall Street to service the development. Provision has already been made in Myall Street here for the inclusion of a bus stop. A future route through the development should also be considered for the school bus run.

6.9 Road Capacity - Myall Street

In order to determine the proportion of existing road space used by forecast traffic flows, the nominal capacity of each road segment needs to be determined. The Volume to Capacity Ratio (V/C Ratio) is an accepted measure for evaluating operating condition of roads and the potential breakdown in traffic flow, which results in delay or reductions in travel speed along a link in urban environment.

As traffic volumes on a road link grow towards the capacity value, travel speeds deteriorate from the free flow speed. When the volume on a link is at capacity (i.e. the V/C ratio reaches 100% or 1.0), the average free flow travel speed is not constant and can reduce significantly under certain conditions.

The peak movement along a traffic lane has been used for the analysis of mid-block performance with each traffic lane assumed to be capable of accommodating 1,400 vehicles per hour before traffic speed is significantly impacted. The V/C Ratio at capacity for the mid-block performance assessment has been assumed 1,400 vehicles per hour as 100% or 1.0. This is consistent with performance measures presented in the RTA's Guide to Traffic Generating Development (SEPP 11) and Austroads Guide to Traffic Engineering Practice Part 2: Road Capacity (1988).

The above mid-block operating criterion has been applied here to evaluate road link operations in the forecast with development of Riverside scenarios.

The increased development levels will substantially increase the traffic volumes on Myall Street. Current traffic flows are relatively low but with the increased residential (and future industrial development) flows this will increase. The total traffic flows associated with the residential development at both Myall Quays and Myall River Downs have been used. The two-way traffic flows on Myall Street to the west of Myall Quays Boulevard will be 1226 vehicles per hour in the AM peak and 1222 vehicles per hour in the PM peak. The peak directional flow will be 933 vehicles per hour.

Based on the above criteria for mid block capacity it can be seen that Myall Street will continue to operate at satisfactory levels as a 2 lane road.

6.10 Internal Road Network

The project plan and concept plan illustrating the proposed general layout of the site are included in **Appendices C** to this report. The overall layout and access arrangements have been designed to meet the nominated transport objectives and to provide an environment that favours the pedestrian whilst still allowing vehicular access where required. Some movement corridors are exclusively pedestrian only. Others have been designed with sufficient width for cars and where required to allow for service vehicle access. The overall alignment of on site roads has been developed to provide an environment that encourages low speed vehicle movement, improving overall safety and enhancing the pedestrian friendly environment. This is reinforced through a consistent hierarchy of road forms that reinforces the principles of movement in all forms in appropriate local environments that promote and enhance the overall safety and amenity of the area. Access geometry would meet the requisite standards for vehicle movement, with the basic principles of urban design guidelines such as AMCORD applied to reinforce the desired vehicle environment.

The designated speed of roads within the estate would be that of a normal residential area. That is the normal 50 kph speed limit would apply.

The planning that has been undertaken as part of the development of the concept plan and initial stages for the Riverside development has considered a wide range of factors in terms of the function of the various local roads within the development. This has included a combination of road typologies that have been chosen to suit specific road environments, from quiet local streets where it is intended that the motor car does not dominate, to allowing sufficient space on collector routes for alternate transport (bus) services.

Of particular concern in this regard is the tendency for nearly all local authorities to err on the conservative side and insist on road carriageway widths that are excessive and that encourage vehicle speeds that are too high. This not only impinges on the overall safety of neighbourhoods, it also results in a higher maintenance burden for the council's who inherit the wider roads (more pavement to maintain) and also then have to maintain the various speed control devices also. Narrower carriageway pavements suited to the road function can avoid this in the first place.

It is intended that by applying appropriate widths and road alignments in the first instance it is not then necessary to implement other forms of traffic calming that have become widely accepted as they are retrofitted into older road networks where the basic design has not considered the mix of road safety amenity and environmental issues that are a part of current planning techniques.

The full range of design features will not be evident until detail design is completed, but can include features such as threshold treatments, intersection priority controls (stop and give way signs) as measures of speed control within the estate. It is also possible to offset parking at some locations so that the overall perception of width of carriageway is lessened and hence speeds are influenced positively (reduced) without the need to introduce draconian measures such as speed humps into a new estate.

The road design elements have been chosen to incorporate open swale drains etc to integrate the design with the open space and other elements of the overall concept plan.

Extensive discussions have been held with Great Lakes Council Officers regarding the road design standards. All issues have been resolved, and design principles have been adopted that will achieve appropriate Council pavement standards.

7. Summary, Conclusions and Recommendations

7.1 Summary

From the study work, the following summary is provided:

1. The subject site is located on a parcel of land within Tea Gardens. The initial stages of the development will provide some 381 residential dwellings with associated road network and off street parking from a potential 909 residential lots (maximum) and 65 tourist lodges (giving 974 lots in total) in the overall concept plan.
2. All vehicle access to the initial stages will be provided off Myall Street. Access will be provided via the existing intersection of Myall Street and Myall Quays Boulevard and a future new access to the north of this intersection is to be subsequently commissioned.
3. Existing traffic flows have been surveyed at the intersection of Myall Street and Myall Quays Boulevard and the overall traffic flows are low and well within the existing road capacity.
4. The traffic flows associated with the initial stages of 381 lots have been determined using the RTA Guide to Traffic Generating Developments together with a reduction for internal traffic movements, a high proportion of retired residents (as per the existing situation) and an allowance for home based business. Taking these reductions into account, this guide indicates there could be some 209 vehicles per hour associated with the proposed development during the peak periods. The traffic has been assigned to the road network in a similar manner to the existing surveyed flows at the intersection of Myall Street and Myall Quays Boulevard.
5. The operation of the existing intersection of Myall Street and Myall Quays Boulevard has been assessed using the standard computer program Sidra. The Sidra analysis indicates that the existing intersection control will have adequate capacity to cater for the flows associated with the initial stages of the development on the site, for both the current 2007 and future 2017 design years.
6. The intersection has then been analysed further to assess the impact of further residential development with access via Myall Quays Boulevard. This Sidra analysis indicates that some 590 residential lots could be developed off Myall Quays Boulevard using the existing intersection control. Beyond 590 lots, this intersection on its own would need to be upgraded to a roundabout control.
7. The existing intersection when combined with the proposed second access to the north on Myall Street is able to cater for the full 974 lots under the concept plan
8. The additional access available via Toonang Drive also contributes to a higher overall level of service at the proposed access junctions, and along Myall Street by allowing greater dispersal of traffic flows.
9. The assessment has then taken into account the proposed Myall River Downs residential development. Plans for this development indicate some 1300 residential lots could be developed on this land. Traffic generation rates are again expected to be lower than normal, due to home based business as well as retired residential reducing peak hour demands. Access to these lots will be provided via a roundabout controlled intersection at Myall Street and Myall Quays Boulevard, with a fourth leg providing access to these lots.
10. The Sidra analysis indicates that a single 4-way roundabout will have adequate capacity to cater for both the Myall Quays and Myall River Downs development. Delays and congestion for all road users would be acceptable. Again, this analysis has been completed for the future design year of 2017.
11. Additional testing of the second Myall Street access with development of Myall River Downs indicates that this junction would require upgrade to roundabout control as a 3 leg intersection, because of the additional through traffic movements. Analysis indicates this would occur at a development level of approximately 500 lots.

12. With the introduction of the industrial land to the west of Myall Street, access to this activity can be catered for via a 4th leg to the second Myall Street access. This operates satisfactorily under roundabout control for both the current 2007 and future 2017 design years.
13. If the industrial land were to commence development prior to Myall River Downs, then the need for the 4th leg and roundabout control at the 2nd Myall Street access is triggered by this activity.
14. The existing layout of the intersections on Myall Street provides a clear and easily understood layout. Sight visibility lines on all approaches are good and it is considered that existing intersection of Myall Street and Myall Quays Boulevard can provide a safe and appropriate layout to cater for the predicted flows associated with the development.
15. The future need to upgrade intersections on Myall Street to roundabout control will be determined by the rate of development of the proposed Myall River Downs residential development and the industrial land on the opposite side of Myall Street to Myall Quays and not by the Riverside concept plan development based on the known timing of developments.
16. The existing two lane configuration of Myall Street will provide adequate capacity for all road users including this proposed residential development.
17. The internal road layout will be designed in accordance with the Council requirements.
18. Pedestrians and cyclists will be catered for with a combination of off-road and on-road facilities and will tie in with Councils BikePlan for the locality.
19. The development will require access for children to the existing school bus runs to Raymond Terrace. As part of the development a bus stop and shelter are to be provided adjacent to the entry points on Myall Street.
20. A bus route is proposed to be implemented in consultation with the local bus company through the development.
21. Extensive discussions have been held with Great Lakes Council Officers regarding the road design standards. All issues have been resolved, and design principles have been adopted that will achieve appropriate Council pavement standards.

7.2 Conclusion

From the study, it is concluded that the existing road system beyond the site is able to cater for the traffic demands of the proposed residential development of both Myall Quays and Myall River Downs. The existing intersection control at Myall Quays Boulevard and Myall Street when combined with a 2nd intersection (of similar design) on Myall Street, together with access to Toonang Drive can accommodate the entire Riverside Concept Plan area (974 lots.)

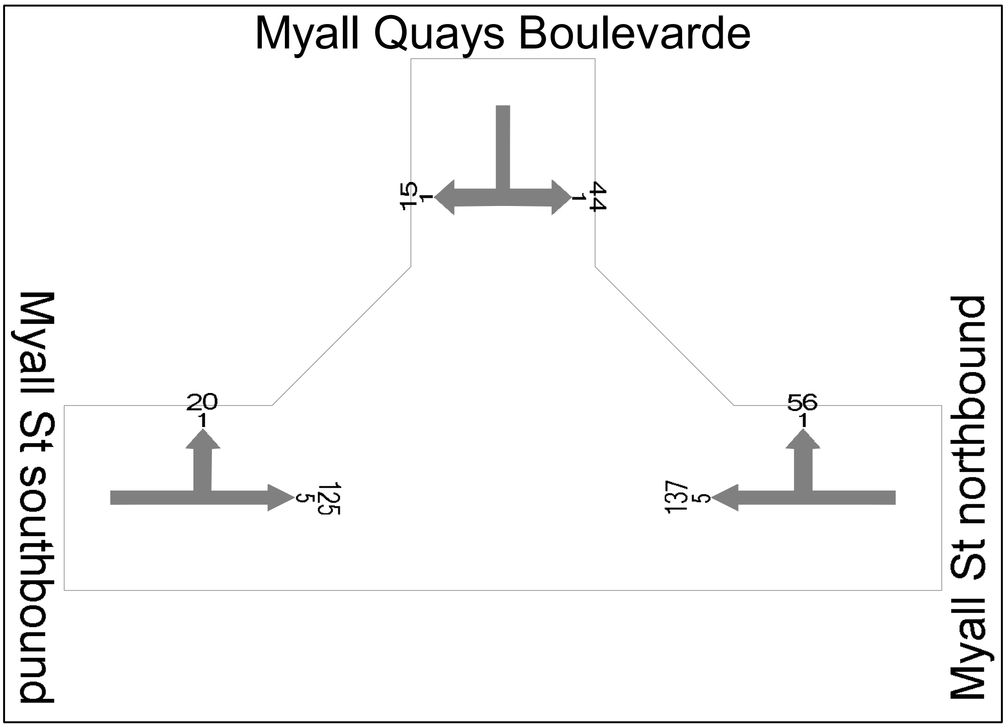
The two southern intersections of Myall Street will only require upgrading at or before the development of either or both of Myall River Downs or the industrial land to the west of Myall Street.

7.3 Recommendations

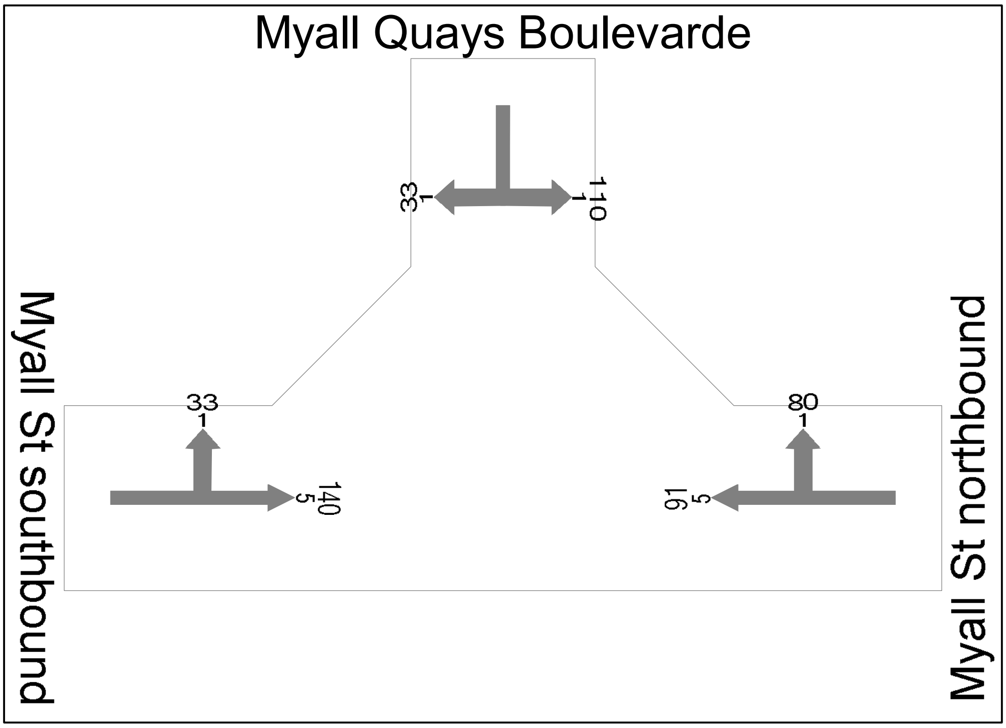
In consideration of the staging of the Concept Plan it is recommended that the concept plan reflect the following commitments:

1. The second access to Myall Street (as a priority controlled junction) be provided prior to the development of 500 lots within the concept plan. (i.e. before the 590 threshold.)
2. Access to be provided to Toonang Drive in line with the Concept plan staging, at say 700 lots. (i.e. before the 974 yield.)
3. The Riverside Concept plan in isolation be allowed to be developed in total (974 lots maximum) based on the capacity of the proposed 4 intersections
4. The two southern intersections of Myall Street only to be upgraded at / before the requirement arises for these to act as 4-way intersections. (i.e. access is triggered by either or both of Myall River Downs or the industrial land to the west of Myall Street.)

Appendix A Traffic Survey Results



2007 AM peak existing traffic flows – Myall Street and Myall Quays Boulevard

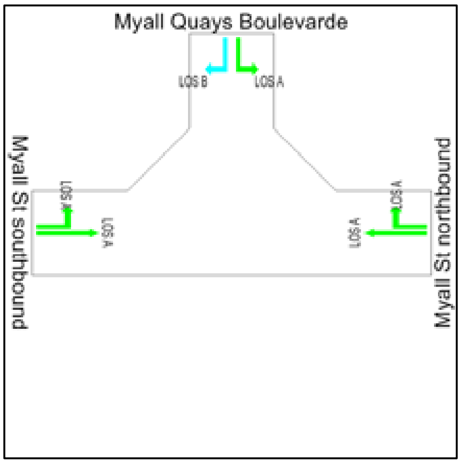


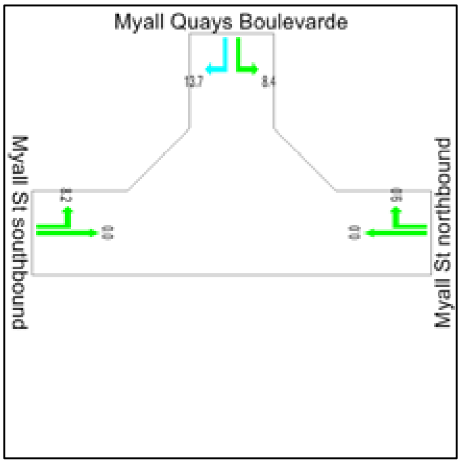
2007 PM peak existing traffic flows – Myall Street and Myall Quays Boulevard

Appendix B Sidra Intersection Modelling Results

Intersection Summary
Myall St and Myall Quays Boulevard
2007 AM flows base plus 381 lots One access

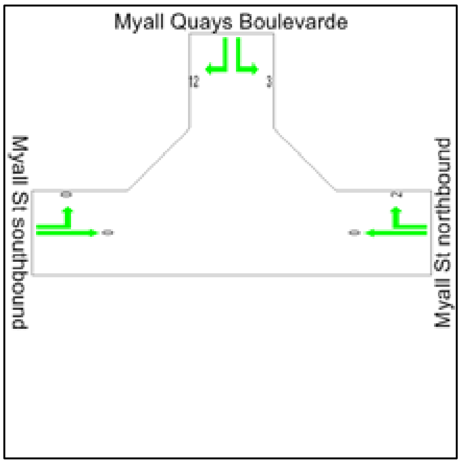
Performance Measure	Vehicles	Persons
Demand Flows - Total	645 veh/h	968 pers/h
Percent Heavy Vehicles	2.9 %	
Degree of Saturation	0.293	
Effective Intersection Capacity	2200 veh/h	
95% Back of Queue (m)	12 m	
95% Back of Queue (veh)	1.7 veh	
Control Delay (Total)	1.09 veh-h/h	1.64 pers-h/h
Control Delay (Average)	6.1 s/veh	6.1 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS B	
Total Effective Stops	266 veh/h	399 pers/h
Effective Stop Rate	0.41 per veh	0.41 per pers
Proportion Queued	0.21	0.21
Travel Distance (Total)	391.1 veh-km/h	586.6 pers-km/h
Travel Distance (Average)	606 m	606 m
Travel Time (Total)	7.6 veh-h/h	11.4 pers-h/h
Travel Time (Average)	42.6 secs	42.6 secs
Travel Speed	51.2 km/h	51.2 km/h
Operating Cost (Total)	264 $/h	264 $/h
Fuel Consumption (Total)	39.1 L/h	
Carbon Dioxide (Total)	98.0 kg/h	
Hydrocarbons (Total)	0.152 kg/h	
Carbon Monoxide (Total)	6.18 kg/h	
NOX (Total)	0.210 kg/h	

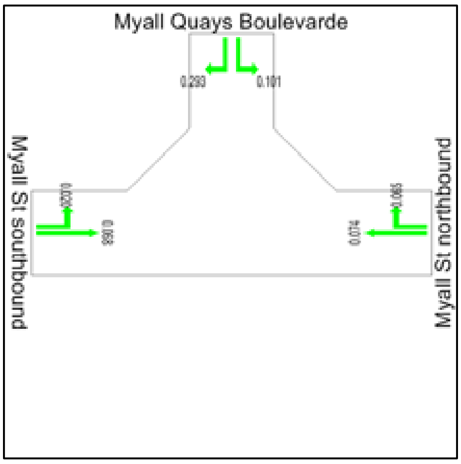




Level of service

Delays



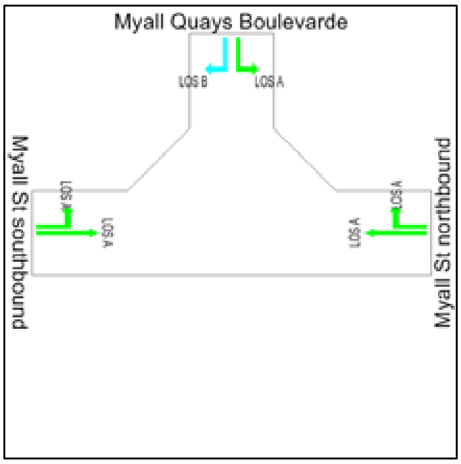


95th percentile queue

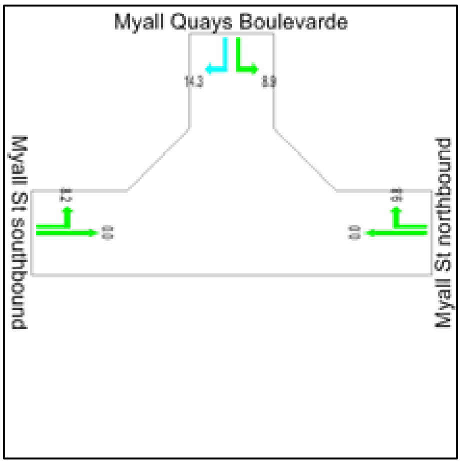
Degree of saturation

Intersection Summary
Myall St and Myall Quays Boulevard
2007 PM flows base+381 lots one access

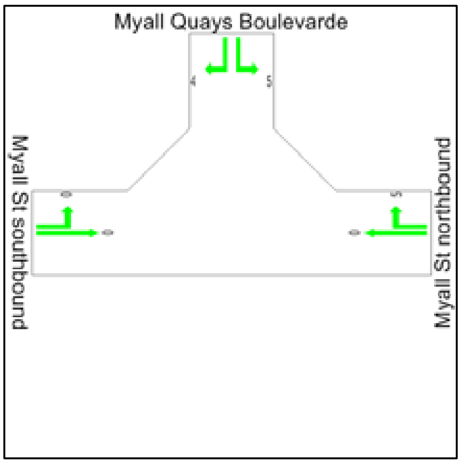
Performance Measure	Vehicles	Persons
Demand Flows - Total	739 veh/h	1109 pers/h
Percent Heavy Vehicles	2.3 %	
Degree of Saturation	0.140	
Effective Intersection Capacity	5285 veh/h	
95% Back of Queue (m)	5 m	
95% Back of Queue (veh)	0.7 veh	
Control Delay (Total)	1.31 veh-h/h	1.96 pers-h/h
Control Delay (Average)	6.4 s/veh	6.4 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS B	
Total Effective Stops	340 veh/h	510 pers/h
Effective Stop Rate	0.46 per veh	0.46 per pers
Proportion Queued	0.18	0.18
Travel Distance (Total)	448.2 veh-km/h	672.3 pers-km/h
Travel Distance (Average)	606 m	606 m
Travel Time (Total)	8.8 veh-h/h	13.2 pers-h/h
Travel Time (Average)	42.8 secs	42.8 secs
Travel Speed	51.0 km/h	51.0 km/h
Operating Cost (Total)	305 $/h	305 $/h
Fuel Consumption (Total)	46.1 L/h	
Carbon Dioxide (Total)	115.3 kg/h	
Hydrocarbons (Total)	0.183 kg/h	
Carbon Monoxide (Total)	7.83 kg/h	
NOX (Total)	0.256 kg/h	



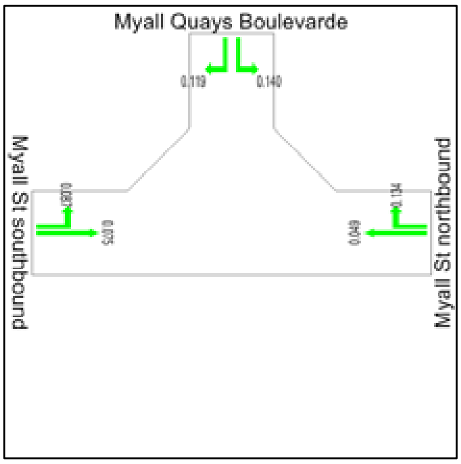
Level of service



Delays



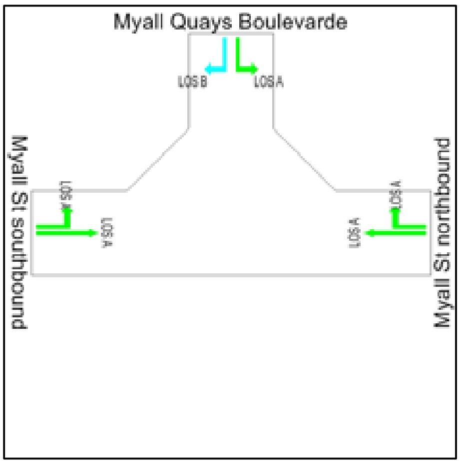
95th percentile queue

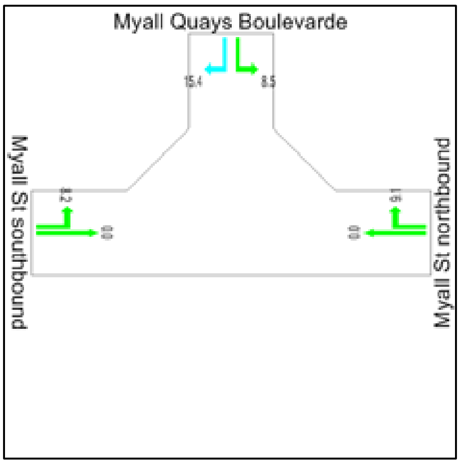


Degree of saturation

Intersection Summary
Myall St and Myall Quays Boulevard
2017 AM flows base plus 381 lots One access

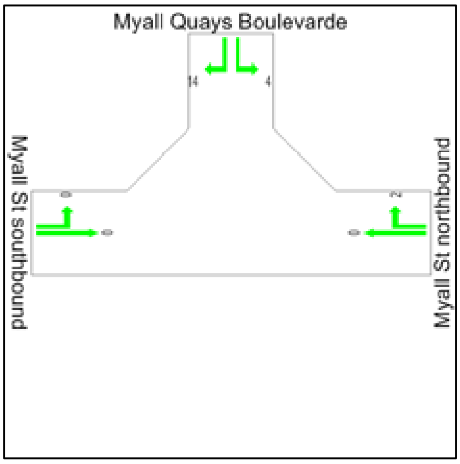
Performance Measure	Vehicles	Persons
Demand Flows - Total	713 veh/h	1070 pers/h
Percent Heavy Vehicles	3.1 %	
Degree of Saturation	0.328	
Effective Intersection Capacity	2177 veh/h	
95% Back of Queue (m)	14 m	
95% Back of Queue (veh)	2.0 veh	
Control Delay (Total)	1.17 veh-h/h	1.76 pers-h/h
Control Delay (Average)	5.9 s/veh	5.9 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS C	
Total Effective Stops	276 veh/h	414 pers/h
Effective Stop Rate	0.39 per veh	0.39 per pers
Proportion Queued	0.21	0.21
Travel Distance (Total)	432.3 veh-km/h	648.5 pers-km/h
Travel Distance (Average)	606 m	606 m
Travel Time (Total)	8.4 veh-h/h	12.6 pers-h/h
Travel Time (Average)	42.4 secs	42.4 secs
Travel Speed	51.5 km/h	51.5 km/h
Operating Cost (Total)	289 $/h	289 $/h
Fuel Consumption (Total)	42.6 L/h	
Carbon Dioxide (Total)	106.5 kg/h	
Hydrocarbons (Total)	0.164 kg/h	
Carbon Monoxide (Total)	6.43 kg/h	
NOX (Total)	0.224 kg/h	

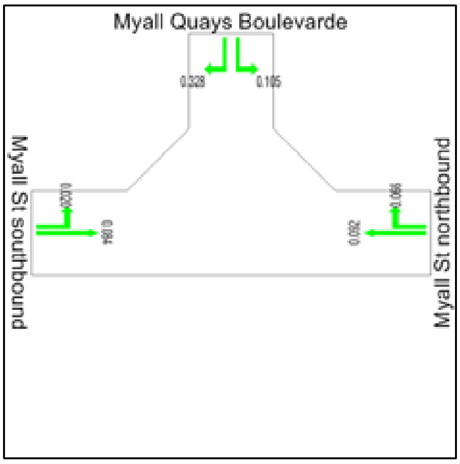




Level of service

Delays



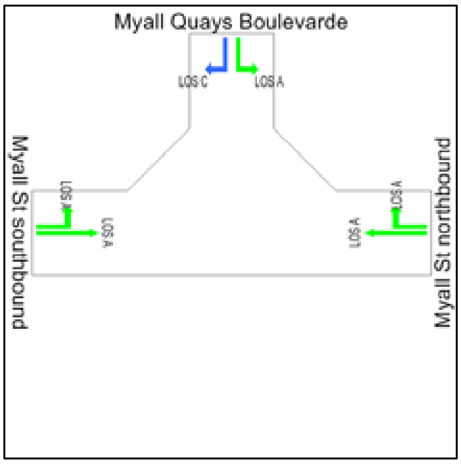


95th percentile queue

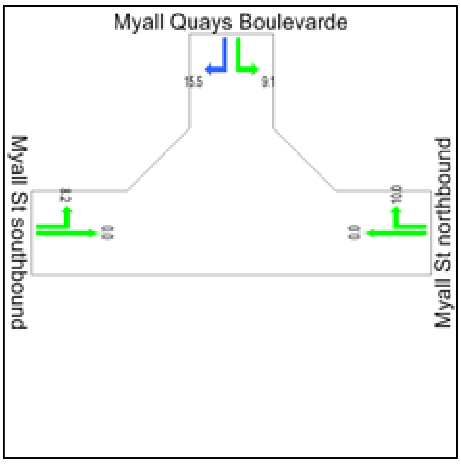
Degree of saturation

Intersection Summary
Myall St and Myall Quays Boulevard
2017 PM flows base+381 lots one access

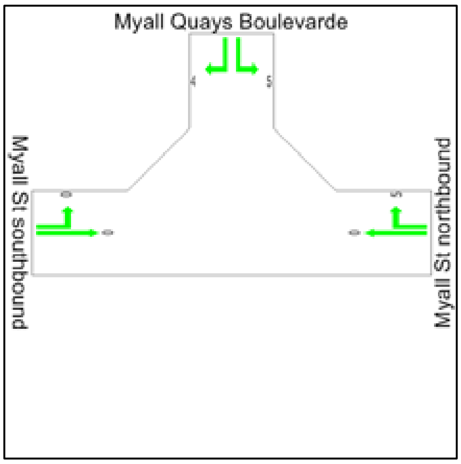
Performance Measure	Vehicles	Persons
Demand Flows - Total	800 veh/h	1200 pers/h
Percent Heavy Vehicles	2.5 %	
Degree of Saturation	0.146	
Effective Intersection Capacity	5485 veh/h	
95% Back of Queue (m)	5 m	
95% Back of Queue (veh)	0.7 veh	
Control Delay (Total)	1.34 veh-h/h	2.01 pers-h/h
Control Delay (Average)	6.0 s/veh	6.0 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS C	
Total Effective Stops	346 veh/h	519 pers/h
Effective Stop Rate	0.43 per veh	0.43 per pers
Proportion Queued	0.18	0.18
Travel Distance (Total)	485.2 veh-km/h	727.8 pers-km/h
Travel Distance (Average)	606 m	606 m
Travel Time (Total)	9.4 veh-h/h	14.2 pers-h/h
Travel Time (Average)	42.5 secs	42.5 secs
Travel Speed	51.4 km/h	51.4 km/h
Operating Cost (Total)	327 $/h	327 $/h
Fuel Consumption (Total)	49.1 L/h	
Carbon Dioxide (Total)	122.8 kg/h	
Hydrocarbons (Total)	0.193 kg/h	
Carbon Monoxide (Total)	8.04 kg/h	
NOX (Total)	0.268 kg/h	



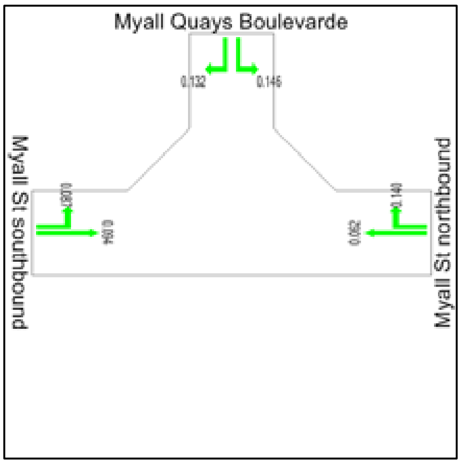
Level of service



Delays



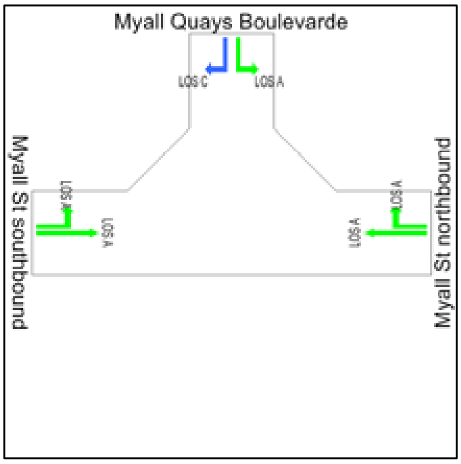
95th percentile queue



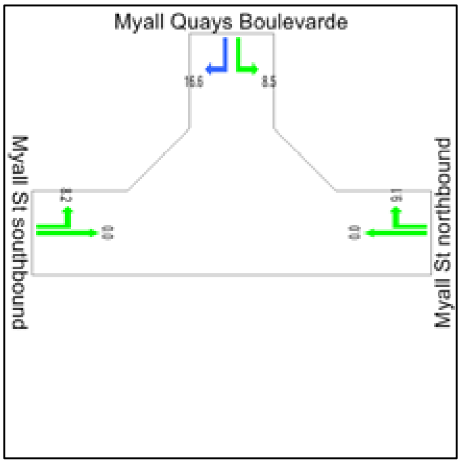
Degree of saturation

Intersection Summary
Myall St and Myall Quays Boulevard
2012 AM flows base plus 590 lots One access

Performance Measure	Vehicles	Persons
Demand Flows - Total	793 veh/h	1190 pers/h
Percent Heavy Vehicles	2.5 %	
Degree of Saturation	0.453	
Effective Intersection Capacity	1751 veh/h	
95% Back of Queue (m)	24 m	
95% Back of Queue (veh)	3.4 veh	
Control Delay (Total)	1.64 veh-h/h	2.46 pers-h/h
Control Delay (Average)	7.4 s/veh	7.4 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS C	
Total Effective Stops	381 veh/h	572 pers/h
Effective Stop Rate	0.48 per veh	0.48 per pers
Proportion Queued	0.26	0.26
Travel Distance (Total)	480.8 veh-km/h	721.2 pers-km/h
Travel Distance (Average)	606 m	606 m
Travel Time (Total)	9.7 veh-h/h	14.5 pers-h/h
Travel Time (Average)	43.9 secs	43.9 secs
Travel Speed	49.7 km/h	49.7 km/h
Operating Cost (Total)	333 $/h	333 $/h
Fuel Consumption (Total)	49.2 L/h	
Carbon Dioxide (Total)	123.1 kg/h	
Hydrocarbons (Total)	0.194 kg/h	
Carbon Monoxide (Total)	8.02 kg/h	
NOX (Total)	0.267 kg/h	



Level of service



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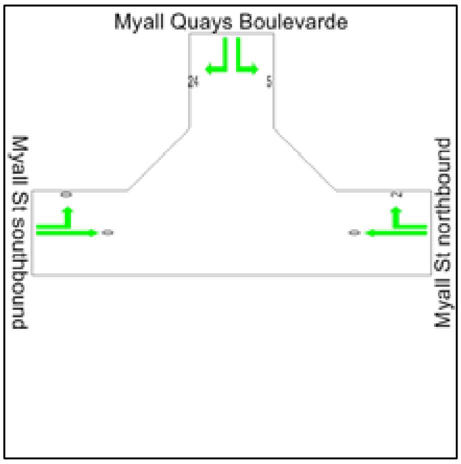
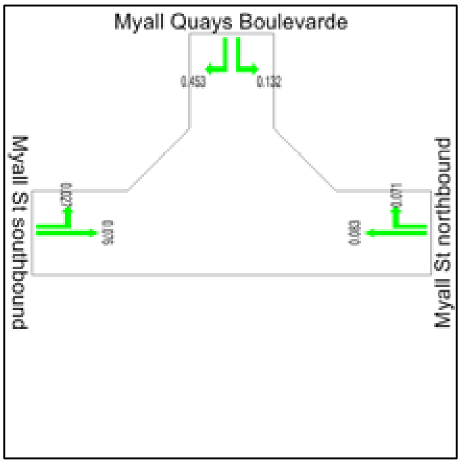


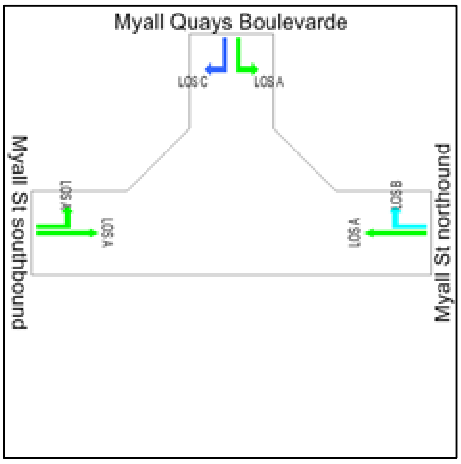
95th percentile queue



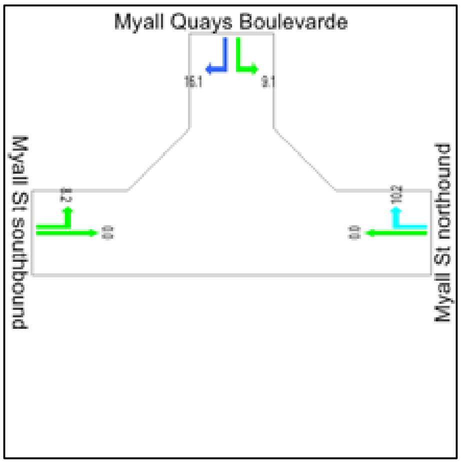
Degree of saturation

Intersection Summary
Myall St and Myall Quays Boulevard
2012 PM flows base+590 lots one access

Performance Measure	Vehicles	Persons
Demand Flows - Total	864 veh/h	1296 pers/h
Percent Heavy Vehicles	2.2 %	
Degree of Saturation	0.176	
Effective Intersection Capacity	4913 veh/h	
95% Back of Queue (m)	7 m	
95% Back of Queue (veh)	0.9 veh	
Control Delay (Total)	1.63 veh-h/h	2.44 pers-h/h
Control Delay (Average)	6.8 s/veh	6.8 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS C	
Total Effective Stops	419 veh/h	628 pers/h
Effective Stop Rate	0.48 per veh	0.48 per pers
Proportion Queued	0.20	0.20
Travel Distance (Total)	523.8 veh-km/h	785.7 pers-km/h
Travel Distance (Average)	606 m	606 m
Travel Time (Total)	10.4 veh-h/h	15.5 pers-h/h
Travel Time (Average)	43.2 secs	43.2 secs
Travel Speed	50.5 km/h	50.5 km/h
Operating Cost (Total)	360 $/h	360 $/h
Fuel Consumption (Total)	54.3 L/h	
Carbon Dioxide (Total)	135.8 kg/h	
Hydrocarbons (Total)	0.217 kg/h	
Carbon Monoxide (Total)	9.33 kg/h	
NOX (Total)	0.303 kg/h	



Level of service



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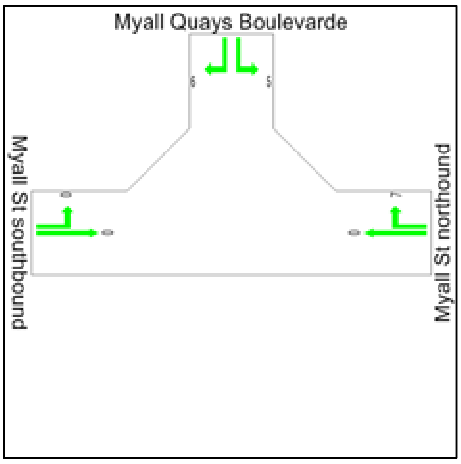
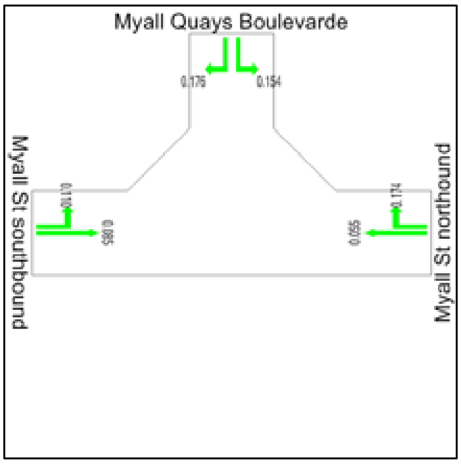


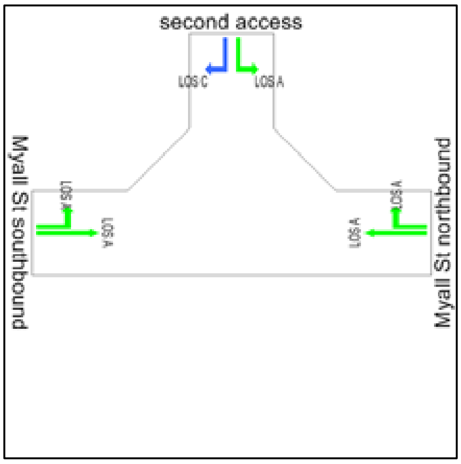
95th percentile queue



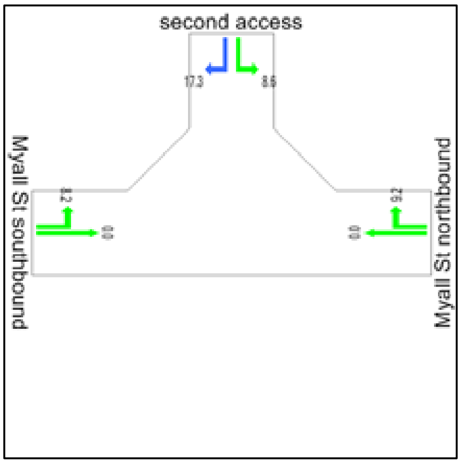
Degree of saturation

Intersection Summary
2nd access and Myall St
2017 AM flows base+974

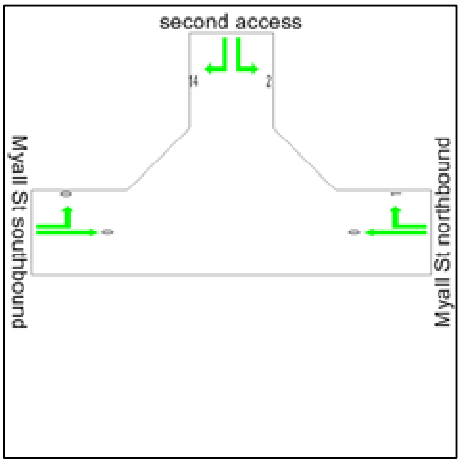
Performance Measure	Vehicles	Persons
Demand Flows - Total	721 veh/h	1082 pers/h
Percent Heavy Vehicles	4.0 %	
Degree of Saturation	0.335	
Effective Intersection Capacity	2152 veh/h	
95% Back of Queue (m)	14 m	
95% Back of Queue (veh)	2.0 veh	
Control Delay (Total)	0.87 veh-h/h	1.31 pers-h/h
Control Delay (Average)	4.3 s/veh	4.3 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS C	
Total Effective Stops	184 veh/h	276 pers/h
Effective Stop Rate	0.26 per veh	0.26 per pers
Proportion Queued	0.15	0.15
Travel Distance (Total)	437.1 veh-km/h	655.7 pers-km/h
Travel Distance (Average)	606 m	606 m
Travel Time (Total)	8.2 veh-h/h	12.2 pers-h/h
Travel Time (Average)	40.8 secs	40.8 secs
Travel Speed	53.5 km/h	53.5 km/h
Operating Cost (Total)	279 $/h	279 $/h
Fuel Consumption (Total)	40.0 L/h	
Carbon Dioxide (Total)	100.2 kg/h	
Hydrocarbons (Total)	0.145 kg/h	
Carbon Monoxide (Total)	4.90 kg/h	
NOX (Total)	0.195 kg/h	



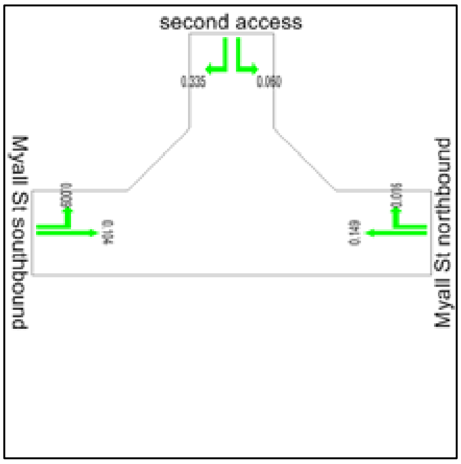
Level of service



Delays



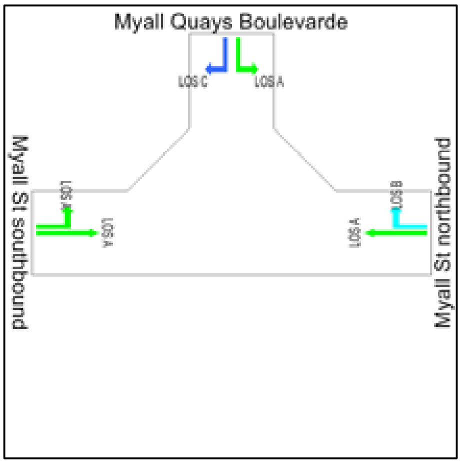
95th percentile queue

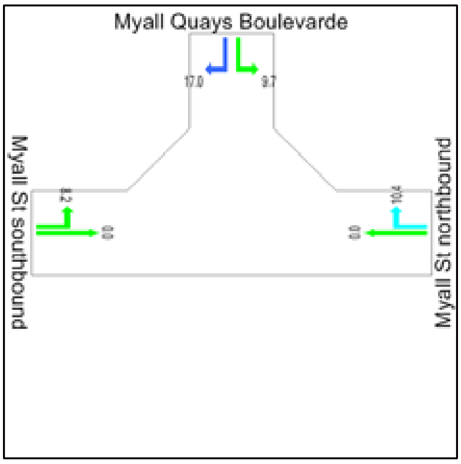


Degree of saturation

Intersection Summary
2nd access and Myall St
2017 PM flows base+974

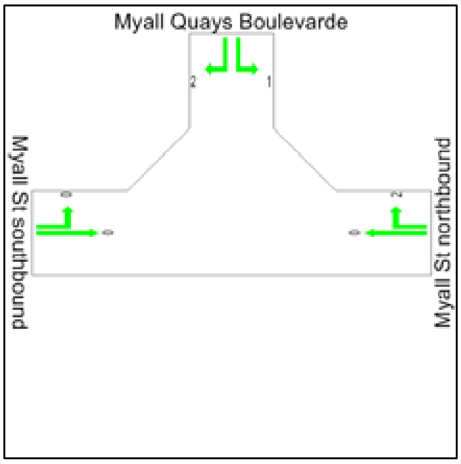
Performance Measure	Vehicles	Persons
Demand Flows - Total	721 veh/h	1082 pers/h
Percent Heavy Vehicles	4.0 %	
Degree of Saturation	0.163	
Effective Intersection Capacity	4421 veh/h	
95% Back of Queue (m)	2 m	
95% Back of Queue (veh)	0.3 veh	
Control Delay (Total)	0.61 veh-h/h	0.91 pers-h/h
Control Delay (Average)	3.0 s/veh	3.0 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS C	
Total Effective Stops	158 veh/h	238 pers/h
Effective Stop Rate	0.22 per veh	0.22 per pers
Proportion Queued	0.06	0.06
Travel Distance (Total)	436.8 veh-km/h	655.2 pers-km/h
Travel Distance (Average)	606 m	606 m
Travel Time (Total)	7.9 veh-h/h	11.8 pers-h/h
Travel Time (Average)	39.4 secs	39.4 secs
Travel Speed	55.4 km/h	55.4 km/h
Operating Cost (Total)	271 $/h	271 $/h
Fuel Consumption (Total)	39.5 L/h	
Carbon Dioxide (Total)	98.9 kg/h	
Hydrocarbons (Total)	0.142 kg/h	
Carbon Monoxide (Total)	4.82 kg/h	
NOX (Total)	0.193 kg/h	

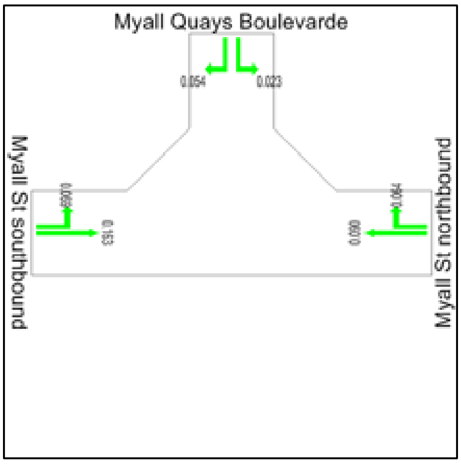




Level of service

Delays



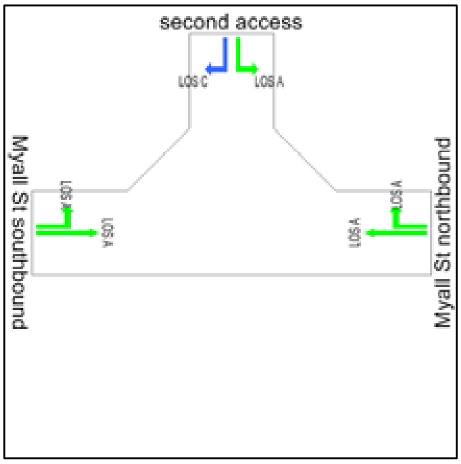


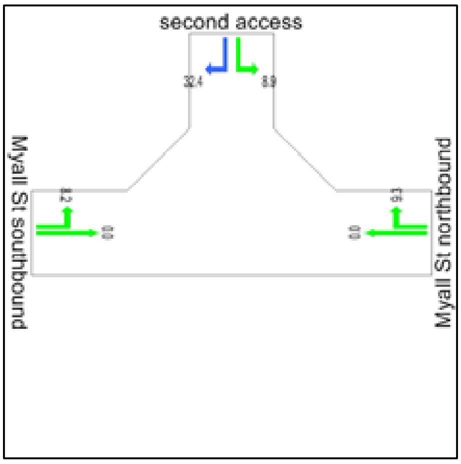
95th percentile queue

Degree of saturation

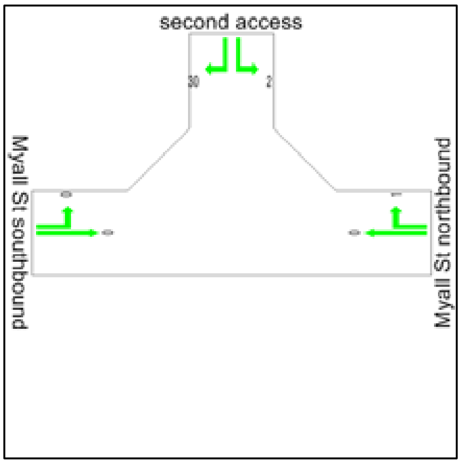
Intersection Summary
2nd access and Myall St
2012 2nd access+974+500 lots

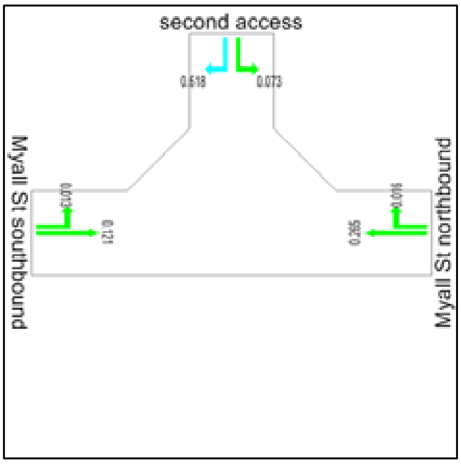
Performance Measure	Vehicles	Persons
Demand Flows - Total	1017 veh/h	1526 pers/h
Percent Heavy Vehicles	4.2 %	
Degree of Saturation	0.618	
Effective Intersection Capacity	1644 veh/h	
95% Back of Queue (m)	30 m	
95% Back of Queue (veh)	4.3 veh	
Control Delay (Total)	1.66 veh-h/h	2.49 pers-h/h
Control Delay (Average)	5.9 s/veh	5.9 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS C	
Total Effective Stops	246 veh/h	369 pers/h
Effective Stop Rate	0.24 per veh	0.24 per pers
Proportion Queued	0.16	0.16
Travel Distance (Total)	616.6 veh-km/h	924.9 pers-km/h
Travel Distance (Average)	606 m	606 m
Travel Time (Total)	11.9 veh-h/h	17.9 pers-h/h
Travel Time (Average)	42.3 secs	42.3 secs
Travel Speed	51.6 km/h	51.6 km/h
Operating Cost (Total)	404 $/h	404 $/h
Fuel Consumption (Total)	56.2 L/h	
Carbon Dioxide (Total)	140.6 kg/h	
Hydrocarbons (Total)	0.201 kg/h	
Carbon Monoxide (Total)	6.36 kg/h	
NOX (Total)	0.264 kg/h	





Level of service Delays

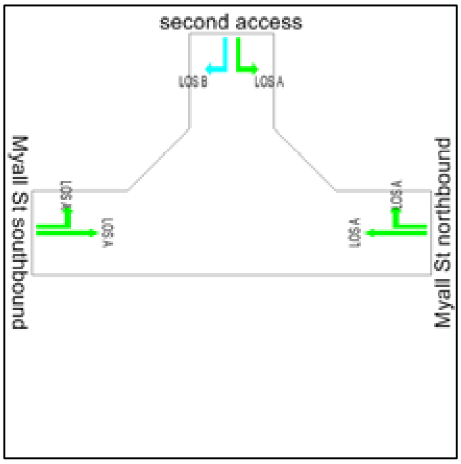


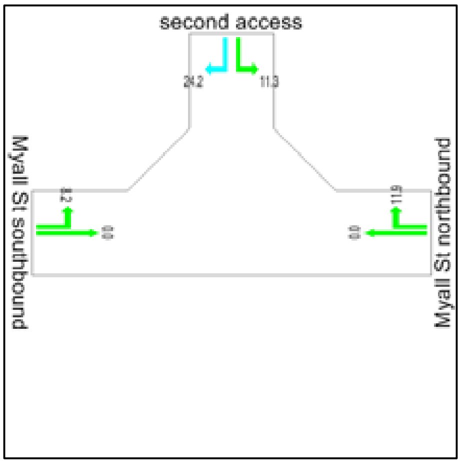


95th percentile queue Degree of saturation

Intersection Summary
2nd access and Myall St
2012 2nd access+974+500 lots

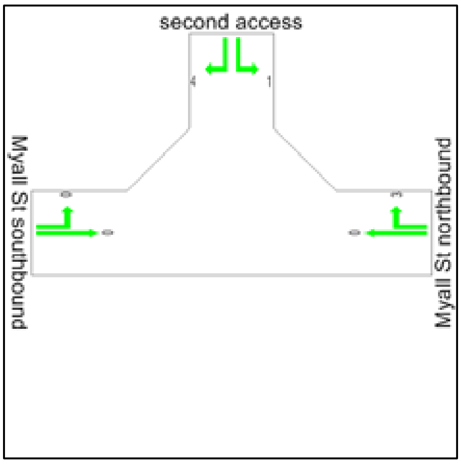
Performance Measure	Vehicles	Persons
Demand Flows - Total	976 veh/h	1464 pers/h
Percent Heavy Vehicles	4.1 %	
Degree of Saturation	0.266	
Effective Intersection Capacity	3674 veh/h	
95% Back of Queue (m)	4 m	
95% Back of Queue (veh)	0.5 veh	
Control Delay (Total)	0.77 veh-h/h	1.15 pers-h/h
Control Delay (Average)	2.8 s/veh	2.8 s/pers
Level of Service	Not Applicable	
Level of Service (Worst Movement)	LOS B	
Total Effective Stops	185 veh/h	277 pers/h
Effective Stop Rate	0.19 per veh	0.19 per pers
Proportion Queued	0.07	0.07
Travel Distance (Total)	591.4 veh-km/h	887.1 pers-km/h
Travel Distance (Average)	606 m	606 m
Travel Time (Total)	10.6 veh-h/h	15.9 pers-h/h
Travel Time (Average)	39.2 secs	39.2 secs
Travel Speed	55.7 km/h	55.7 km/h
Operating Cost (Total)	363 $/h	363 $/h
Fuel Consumption (Total)	52.4 L/h	
Carbon Dioxide (Total)	131.3 kg/h	
Hydrocarbons (Total)	0.185 kg/h	
Carbon Monoxide (Total)	5.90 kg/h	
NOX (Total)	0.248 kg/h	

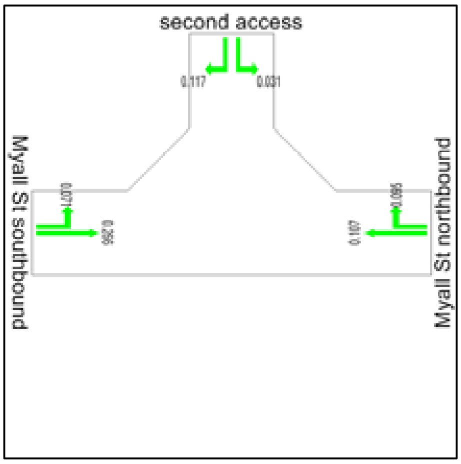




Level of service

Delays



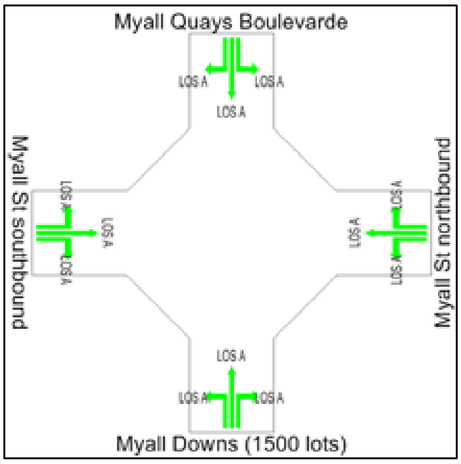


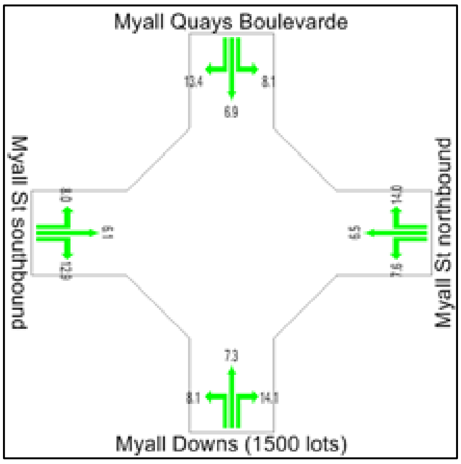
95th percentile queue

Degree of saturation

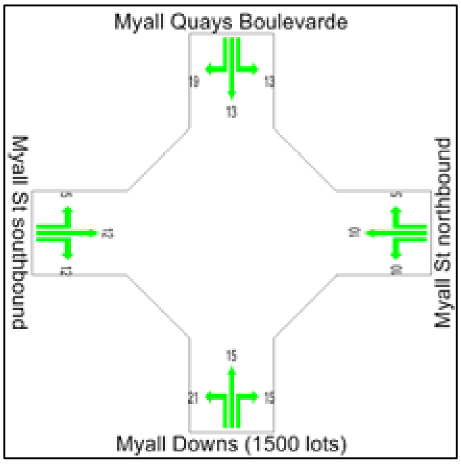
Intersection Summary
Myall St and Myall Quays Boulevard
2012 AM flows base+974 lots + 1300 lots Myall Downs

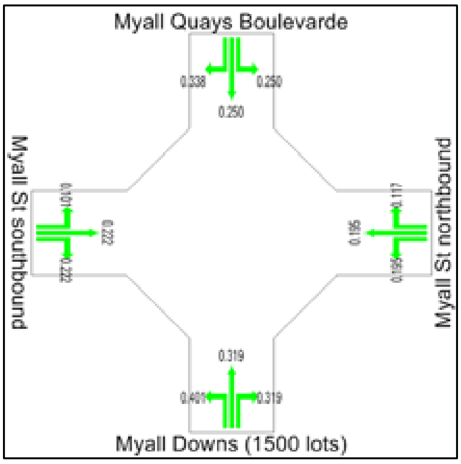
Performance Measure	Vehicles	Persons
Demand Flows - Total	1924 veh/h	2886 pers/h
Percent Heavy Vehicles	1.2 %	
Degree of Saturation	0.401	
Effective Intersection Capacity	4794 veh/h	
95% Back of Queue (m)	21 m	
95% Back of Queue (veh)	3.0 veh	
Control Delay (Total)	5.26 veh-h/h	7.89 pers-h/h
Control Delay (Average)	9.8 s/veh	9.8 s/pers
Level of Service	LOS A	
Level of Service (Worst Movement)	LOS B	
Total Effective Stops	1339 veh/h	2008 pers/h
Effective Stop Rate	0.70 per veh	0.70 per pers
Proportion Queued	0.60	0.60
Travel Distance (Total)	1208.4 veh-km/h	1812.6 pers-km/h
Travel Distance (Average)	628 m	628 m
Travel Time (Total)	25.9 veh-h/h	38.9 pers-h/h
Travel Time (Average)	48.5 secs	48.5 secs
Travel Speed	46.6 km/h	46.6 km/h
Operating Cost (Total)	898 $/h	898 $/h
Fuel Consumption (Total)	134.7 L/h	
Carbon Dioxide (Total)	336.8 kg/h	
Hydrocarbons (Total)	0.559 kg/h	
Carbon Monoxide (Total)	26.12 kg/h	
NOX (Total)	0.800 kg/h	





Level of service Delays

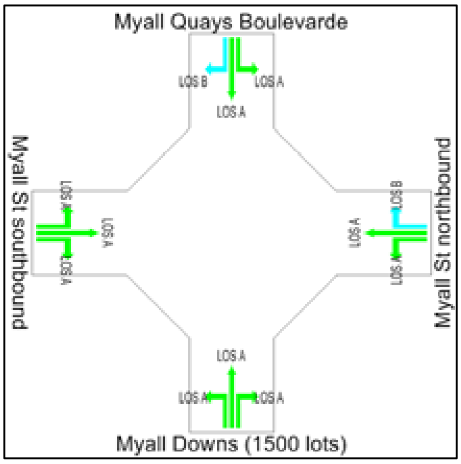




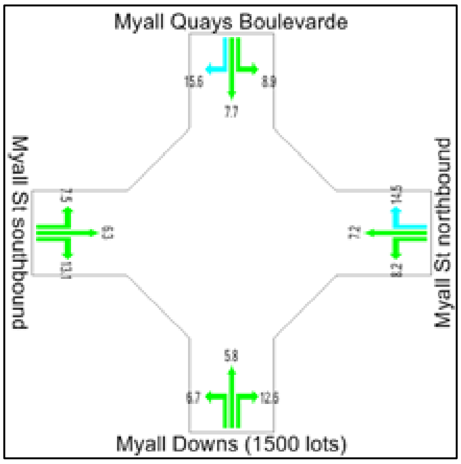
95th percentile queue Degree of saturation

Intersection Summary
Myall St and Myall Quays Boulevard
2012 PM flows base+974 lots +1300 lots Myall Downs

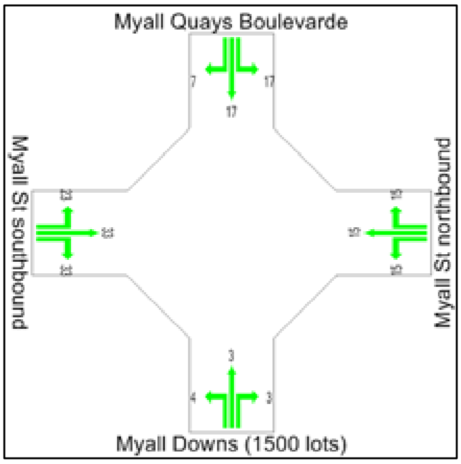
Performance Measure	Vehicles	Persons
Demand Flows - Total	2015 veh/h	3023 pers/h
Percent Heavy Vehicles	1.5 %	
Degree of Saturation	0.487	
Effective Intersection Capacity	4139 veh/h	
95% Back of Queue (m)	33 m	
95% Back of Queue (veh)	4.6 veh	
Control Delay (Total)	5.58 veh-h/h	8.38 pers-h/h
Control Delay (Average)	10.0 s/veh	10.0 s/pers
Level of Service	LOS A	
Level of Service (Worst Movement)	LOS B	
Total Effective Stops	1410 veh/h	2115 pers/h
Effective Stop Rate	0.70 per veh	0.70 per pers
Proportion Queued	0.63	0.63
Travel Distance (Total)	1266.2 veh-km/h	1899.4 pers-km/h
Travel Distance (Average)	628 m	628 m
Travel Time (Total)	27.3 veh-h/h	41.0 pers-h/h
Travel Time (Average)	48.8 secs	48.8 secs
Travel Speed	46.3 km/h	46.3 km/h
Operating Cost (Total)	950 $/h	950 $/h
Fuel Consumption (Total)	143.7 L/h	
Carbon Dioxide (Total)	359.4 kg/h	
Hydrocarbons (Total)	0.595 kg/h	
Carbon Monoxide (Total)	28.05 kg/h	
NOX (Total)	0.857 kg/h	



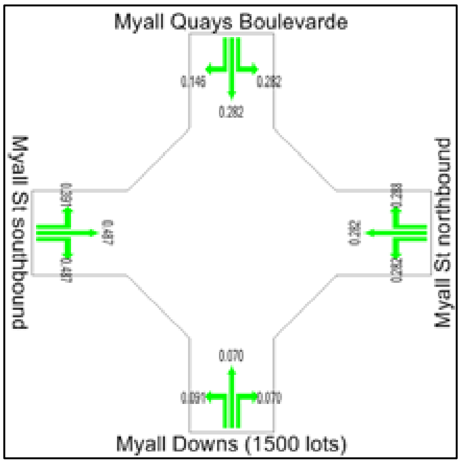
Level of service



Delays



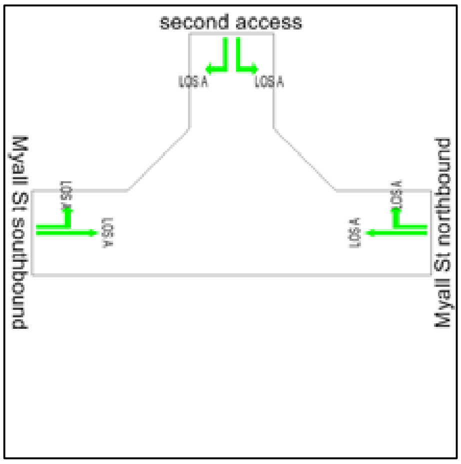
95th percentile queue

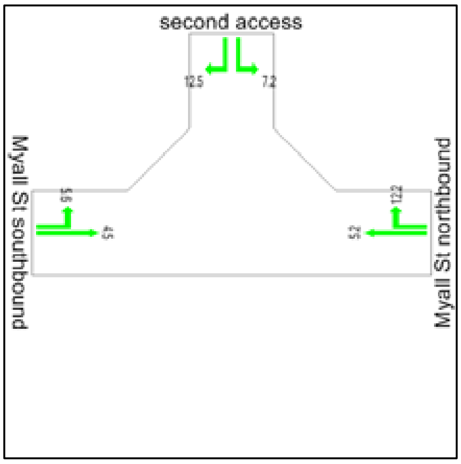


Degree of saturation

Intersection Summary
2nd access and Myall St
2012 AM flows base+974+1300 roundabout

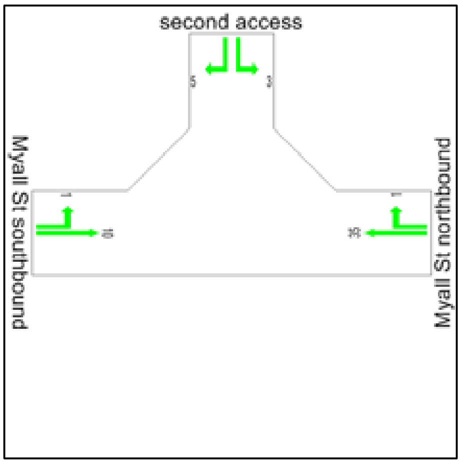
Performance Measure	Vehicles	Persons
Demand Flows - Total	1238 veh/h	1857 pers/h
Percent Heavy Vehicles	4.4 %	
Degree of Saturation	0.490	
Effective Intersection Capacity	2527 veh/h	
95% Back of Queue (m)	35 m	
95% Back of Queue (veh)	4.8 veh	
Control Delay (Total)	2.08 veh-h/h	3.12 pers-h/h
Control Delay (Average)	6.0 s/veh	6.0 s/pers
Level of Service	LOS A	
Level of Service (Worst Movement)	LOS B	
Total Effective Stops	586 veh/h	880 pers/h
Effective Stop Rate	0.47 per veh	0.47 per pers
Proportion Queued	0.33	0.33
Travel Distance (Total)	764.4 veh-km/h	1146.5 pers-km/h
Travel Distance (Average)	617 m	617 m
Travel Time (Total)	15.3 veh-h/h	22.9 pers-h/h
Travel Time (Average)	44.4 secs	44.4 secs
Travel Speed	50.0 km/h	50.0 km/h
Operating Cost (Total)	543 $/h	543 $/h
Fuel Consumption (Total)	85.9 L/h	
Carbon Dioxide (Total)	215.1 kg/h	
Hydrocarbons (Total)	0.331 kg/h	
Carbon Monoxide (Total)	15.54 kg/h	
NOX (Total)	0.503 kg/h	

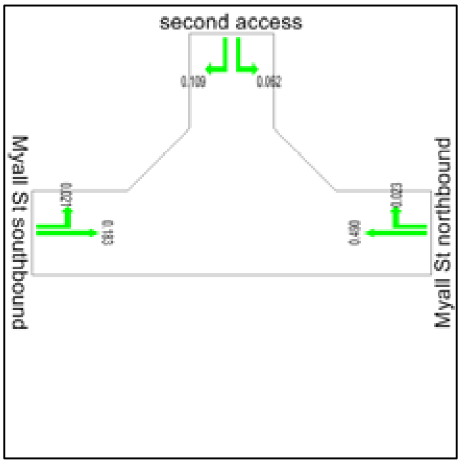




Level of service

Delays



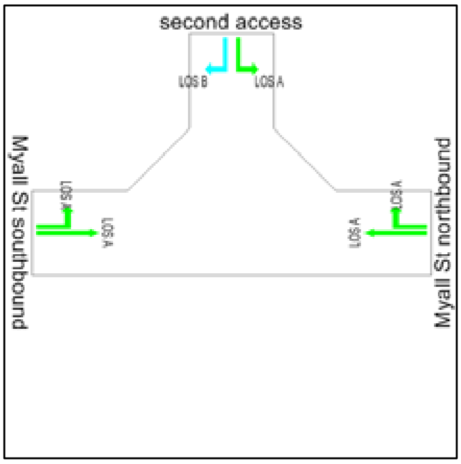


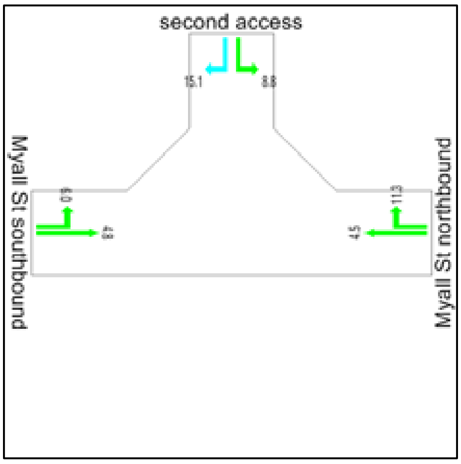
95th percentile queue

Degree of saturation

Intersection Summary
2nd access and Myall St
2012 PM flows base+974+1300 Downs

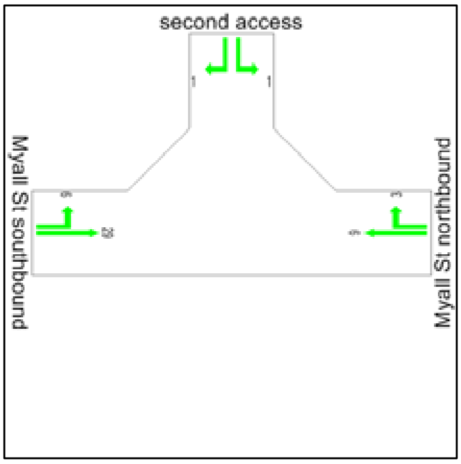
Performance Measure	Vehicles	Persons
Demand Flows - Total	1220 veh/h	1830 pers/h
Percent Heavy Vehicles	4.4 %	
Degree of Saturation	0.450	
Effective Intersection Capacity	2708 veh/h	
95% Back of Queue (m)	29 m	
95% Back of Queue (veh)	4.0 veh	
Control Delay (Total)	1.82 veh-h/h	2.73 pers-h/h
Control Delay (Average)	5.4 s/veh	5.4 s/pers
Level of Service	LOS A	
Level of Service (Worst Movement)	LOS B	
Total Effective Stops	513 veh/h	770 pers/h
Effective Stop Rate	0.42 per veh	0.42 per pers
Proportion Queued	0.21	0.21
Travel Distance (Total)	749.4 veh-km/h	1124.1 pers-km/h
Travel Distance (Average)	614 m	614 m
Travel Time (Total)	14.6 veh-h/h	21.9 pers-h/h
Travel Time (Average)	43.1 secs	43.1 secs
Travel Speed	51.3 km/h	51.3 km/h
Operating Cost (Total)	519 $/h	519 $/h
Fuel Consumption (Total)	81.9 L/h	
Carbon Dioxide (Total)	205.2 kg/h	
Hydrocarbons (Total)	0.312 kg/h	
Carbon Monoxide (Total)	14.38 kg/h	
NOX (Total)	0.474 kg/h	

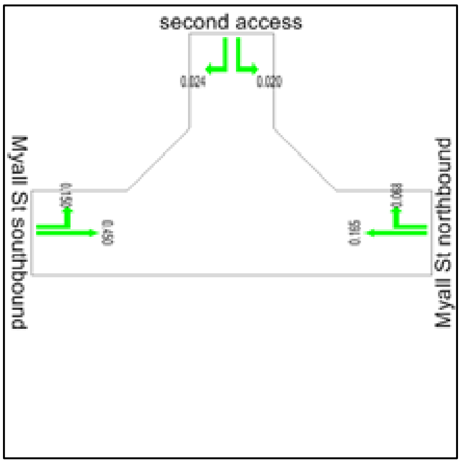




Level of service

Delays



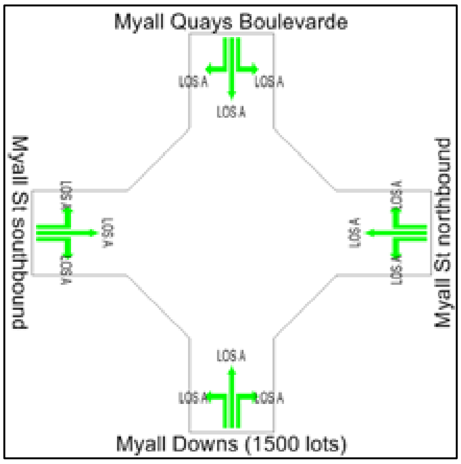


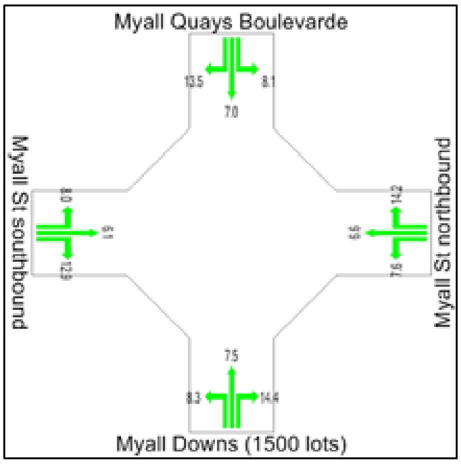
95th percentile queue

Degree of saturation

Intersection Summary
Myall St and Myall Quays Boulevard
2012 AM flows base+974+1300+industrial roundabout

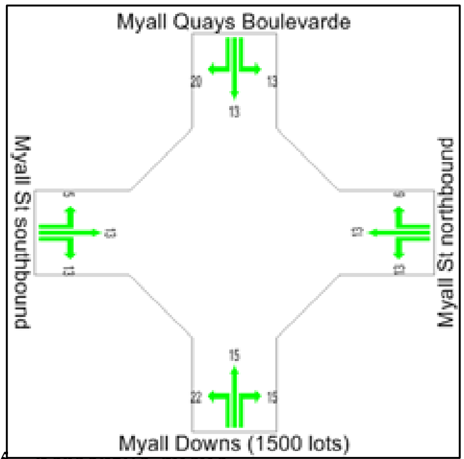
Performance Measure	Vehicles	Persons
Demand Flows - Total	1973 veh/h	2960 pers/h
Percent Heavy Vehicles	1.3 %	
Degree of Saturation	0.410	
Effective Intersection Capacity	4813 veh/h	
95% Back of Queue (m)	22 m	
95% Back of Queue (veh)	3.1 veh	
Control Delay (Total)	5.41 veh-h/h	8.11 pers-h/h
Control Delay (Average)	9.9 s/veh	9.9 s/pers
Level of Service	LOS A	
Level of Service (Worst Movement)	LOS B	
Total Effective Stops	1385 veh/h	2078 pers/h
Effective Stop Rate	0.70 per veh	0.70 per pers
Proportion Queued	0.62	0.62
Travel Distance (Total)	1238.4 veh-km/h	1857.5 pers-km/h
Travel Distance (Average)	628 m	628 m
Travel Time (Total)	26.6 veh-h/h	39.9 pers-h/h
Travel Time (Average)	48.5 secs	48.5 secs
Travel Speed	46.6 km/h	46.6 km/h
Operating Cost (Total)	921 $/h	921 $/h
Fuel Consumption (Total)	138.4 L/h	
Carbon Dioxide (Total)	346.3 kg/h	
Hydrocarbons (Total)	0.574 kg/h	
Carbon Monoxide (Total)	26.87 kg/h	
NOX (Total)	0.823 kg/h	

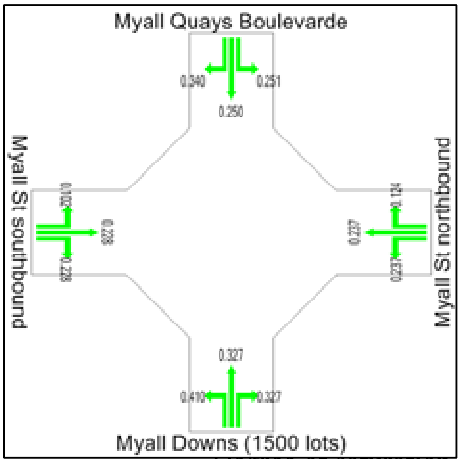




Level of service

Delays



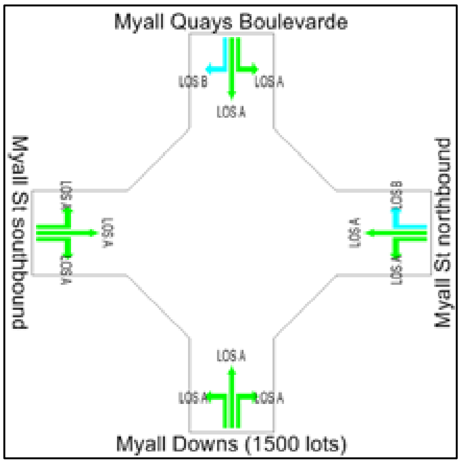


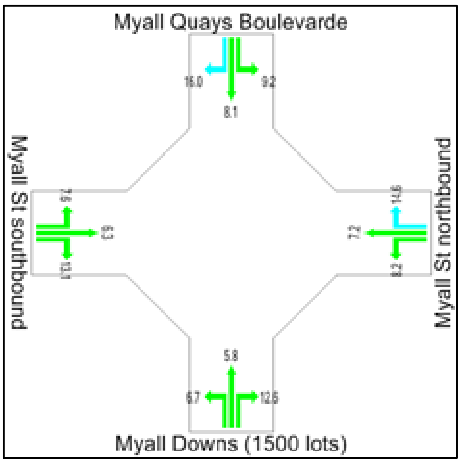
95th percentile queue

Degree of saturation

Intersection Summary
Myall St and Myall Quays Boulevard
2012 PM flows base+974+1300+Industrial roundabout

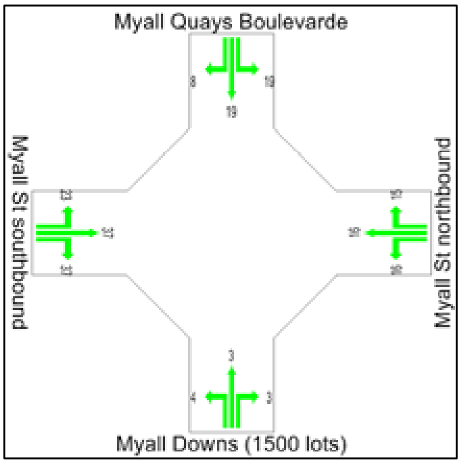
Performance Measure	Vehicles	Persons
Demand Flows - Total	2064 veh/h	3096 pers/h
Percent Heavy Vehicles	1.6 %	
Degree of Saturation	0.521	
Effective Intersection Capacity	3960 veh/h	
95% Back of Queue (m)	37 m	
95% Back of Queue (veh)	5.1 veh	
Control Delay (Total)	5.73 veh-h/h	8.59 pers-h/h
Control Delay (Average)	10.0 s/veh	10.0 s/pers
Level of Service	LOS A	
Level of Service (Worst Movement)	LOS B	
Total Effective Stops	1452 veh/h	2178 pers/h
Effective Stop Rate	0.70 per veh	0.70 per pers
Proportion Queued	0.65	0.65
Travel Distance (Total)	1296.2 veh-km/h	1944.3 pers-km/h
Travel Distance (Average)	628 m	628 m
Travel Time (Total)	28.0 veh-h/h	42.0 pers-h/h
Travel Time (Average)	48.8 secs	48.8 secs
Travel Speed	46.3 km/h	46.3 km/h
Operating Cost (Total)	974 $/h	974 $/h
Fuel Consumption (Total)	147.6 L/h	
Carbon Dioxide (Total)	369.2 kg/h	
Hydrocarbons (Total)	0.610 kg/h	
Carbon Monoxide (Total)	28.84 kg/h	
NOX (Total)	0.882 kg/h	

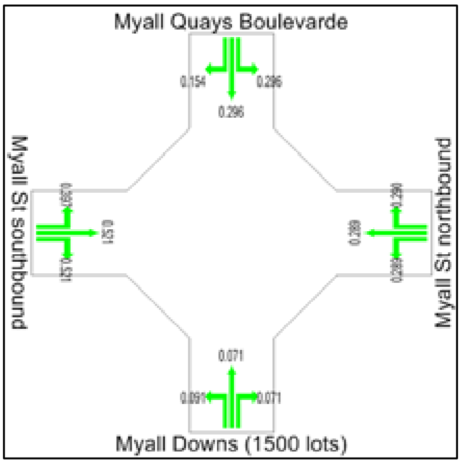




Level of service

Delays



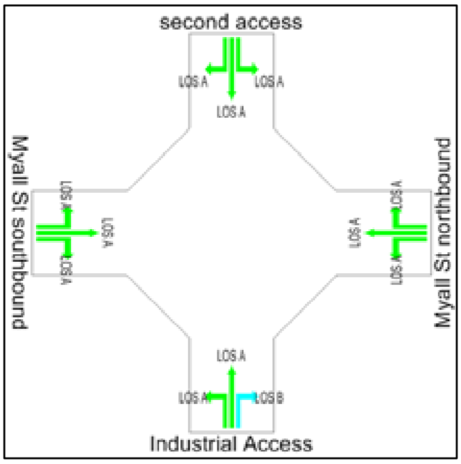


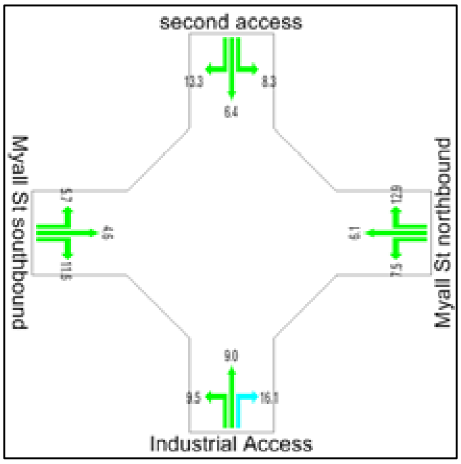
95^{th} percentile queue

Degree of saturation

Intersection Summary
2nd access and Myall St
20012 AM flows base+974+1300+Industrial roundabout

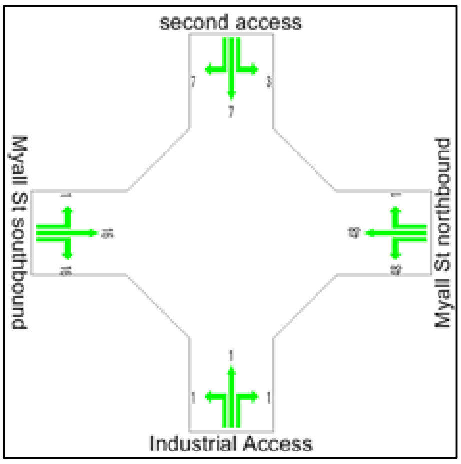
Performance Measure	Vehicles	Persons
Demand Flows - Total	1514 veh/h	2271 pers/h
Percent Heavy Vehicles	5.0 %	
Degree of Saturation	0.614	
Effective Intersection Capacity	2465 veh/h	
95% Back of Queue (m)	48 m	
95% Back of Queue (veh)	6.5 veh	
Control Delay (Total)	2.93 veh-h/h	4.39 pers-h/h
Control Delay (Average)	7.0 s/veh	7.0 s/pers
Level of Service	LOS A	
Level of Service (Worst Movement)	LOS B	
Total Effective Stops	811 veh/h	1216 pers/h
Effective Stop Rate	0.54 per veh	0.54 per pers
Proportion Queued	0.45	0.45
Travel Distance (Total)	937.3 veh-km/h	1406.0 pers-km/h
Travel Distance (Average)	619 m	619 m
Travel Time (Total)	19.2 veh-h/h	28.7 pers-h/h
Travel Time (Average)	45.5 secs	45.5 secs
Travel Speed	48.9 km/h	48.9 km/h
Operating Cost (Total)	685 $/h	685 $/h
Fuel Consumption (Total)	110.0 L/h	
Carbon Dioxide (Total)	275.6 kg/h	
Hydrocarbons (Total)	0.426 kg/h	
Carbon Monoxide (Total)	20.60 kg/h	
NOX (Total)	0.655 kg/h	

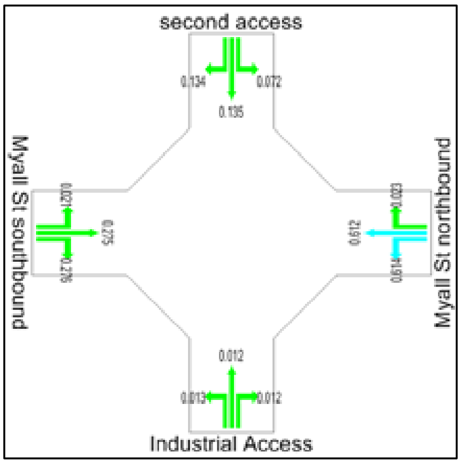




Level of service

Delays



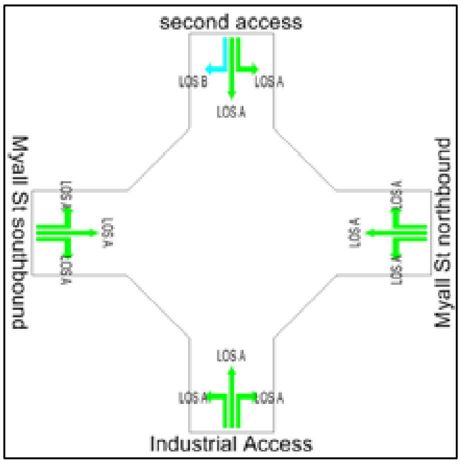


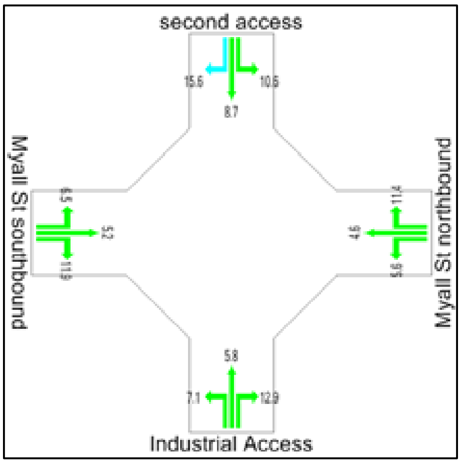
95th percentile queue

Degree of saturation

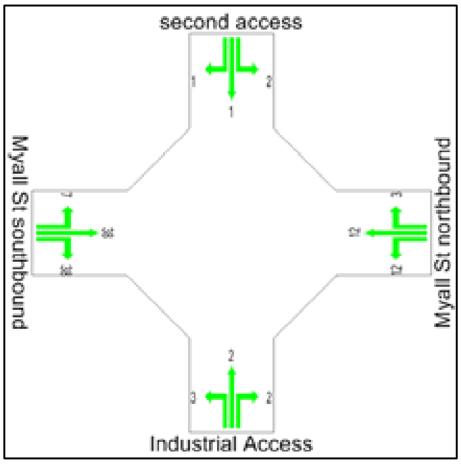
Intersection Summary
2nd access and Myall St
2017 PM flows base+974+1300+Industrial

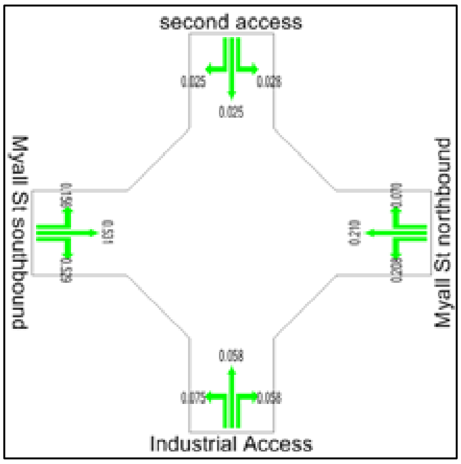
Performance Measure	Vehicles	Persons
Demand Flows - Total	1502 veh/h	2253 pers/h
Percent Heavy Vehicles	4.9 %	
Degree of Saturation	0.531	
Effective Intersection Capacity	2827 veh/h	
95% Back of Queue (m)	38 m	
95% Back of Queue (veh)	5.3 veh	
Control Delay (Total)	2.49 veh-h/h	3.74 pers-h/h
Control Delay (Average)	6.0 s/veh	6.0 s/pers
Level of Service	LOS A	
Level of Service (Worst Movement)	LOS B	
Total Effective Stops	705 veh/h	1057 pers/h
Effective Stop Rate	0.47 per veh	0.47 per pers
Proportion Queued	0.33	0.33
Travel Distance (Total)	924.0 veh-km/h	1385.9 pers-km/h
Travel Distance (Average)	615 m	615 m
Travel Time (Total)	18.4 veh-h/h	27.6 pers-h/h
Travel Time (Average)	44.1 secs	44.1 secs
Travel Speed	50.2 km/h	50.2 km/h
Operating Cost (Total)	658 $/h	658 $/h
Fuel Consumption (Total)	105.3 L/h	
Carbon Dioxide (Total)	263.8 kg/h	
Hydrocarbons (Total)	0.404 kg/h	
Carbon Monoxide (Total)	19.16 kg/h	
NOX (Total)	0.620 kg/h	





Level of service Delays





95th percentile queue Degree of saturation

Appendix C Criteria for interpreting results of SIDRA

1-Level of Service (LoS)

LoS	Traffic Signals and Roundabouts	Give Way and Stop Signs
A	Good	Good
B	Good, with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	Satisfactory	Satisfactory, but requires accident study
D	Operating near capacity	Near capacity and requires accident study
E	At capacity, excessive delay: roundabout requires other control method	At capacity, requires other control mode
F	Unsatisfactory, requires other control mode or additional capacity	Unsatisfactory, requires other control mode

2-Average Vehicle Delay (AVD)

The AVD is a measure of operational performance of an intersection relating to its LoS. The average delay should be taken as a guide only for an average intersection. Longer delays may be tolerated at some intersections where delays are expected by motorists (e.g. those in inner city areas or major arterial roads).

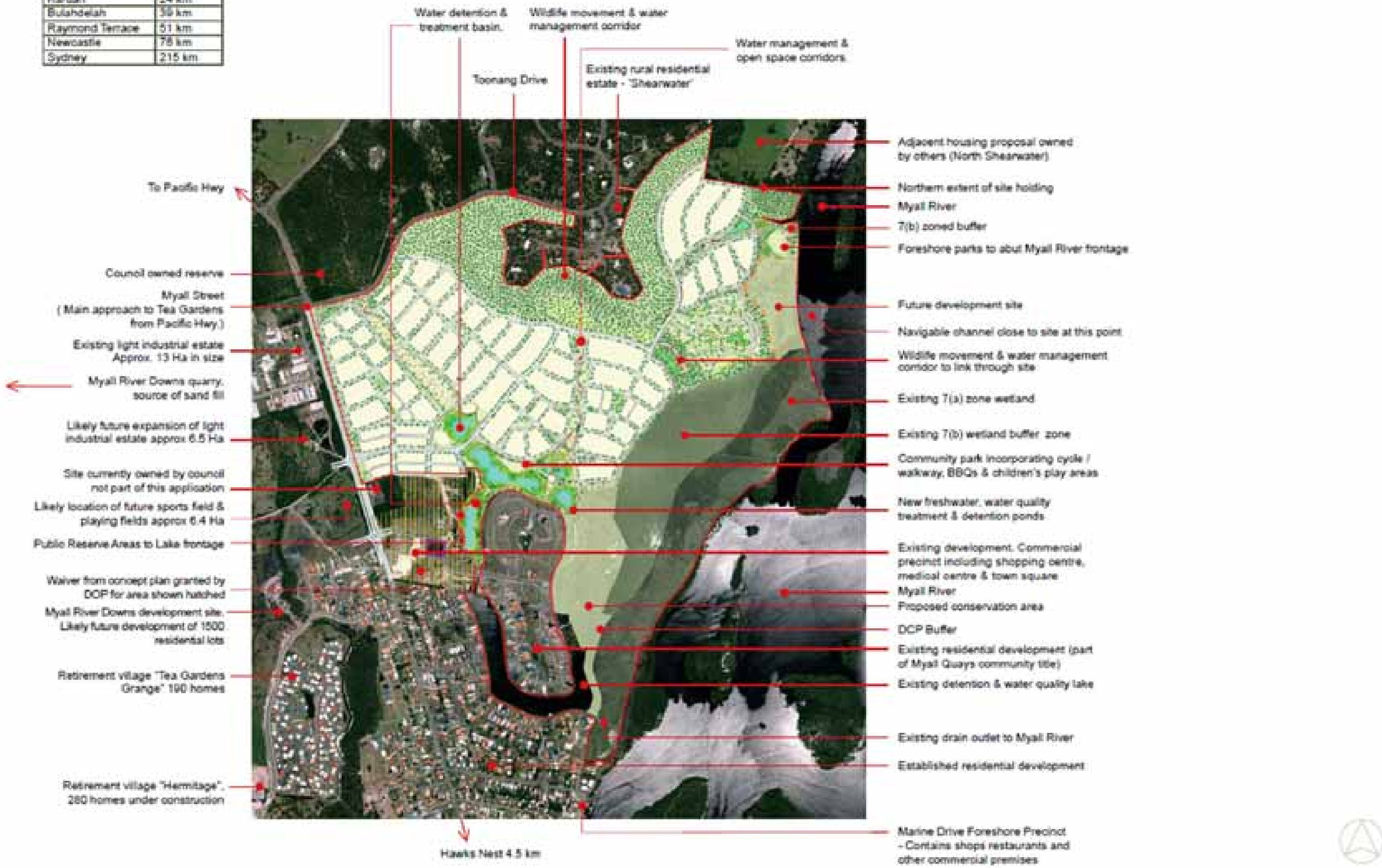
LoS	Average Delay / Vehicle (secs)	Traffic Signals and Roundabouts	Give Way and Stop Signs
A	Less than 15	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	28 to 42	Satisfactory	Satisfactory but accident study required
D	42 to 56	Operating near capacity	Near capacity, accident study required
E	56 to 70	At capacity, excessive delays: roundabout requires other control mode	At capacity; requires other control mode
F	Exceeding 70	Unsatisfactory, requires additional capacity	Unsatisfactory, requires other control mode

3-Degree of Saturation (D/S)

The D/S of an intersection is usually taken as the highest ratio of traffic volumes on an approach to an intersection compared with the theoretical capacity, and is a measure of the utilisation of available green time. For intersections controlled by traffic signals, both queues and delays increase rapidly as DS approaches 1.0. An intersection operates satisfactorily when its D/S is kept below 0.75. When D/S exceeds 0.9, queues are expected.

Appendix D Site Concept Plans

Distance to:	
Pacific Hwy	12 km
Karuah	24 km
Bulahdelah	39 km
Raymond Terrace	51 km
Newcastle	78 km
Sydney	215 km



Riverside
Tea Gardens Australia

DRAWING TITLE
CONTEXT PLAN

APPLICATION
Part 3a Submission to N.S.W. D.O.P.

DATE	SCALE	DRAWING No.	REVISION
October 2010	1:7000 @ A1	R.C. -01	L

CRIGHTON PROPERTIES

Better Transport Futures

Mark Waugh Pty Limited
ABN 67 106 169 180
Transport Planning & Engineering

ROAD TYPES	DETAILS
Arterial #1	Road 18m, 5m median, green space & development
Arterial #2	Road 14m, 5m median, green space & development
Connector	Road 17m, 5m median, development both sides
Secondary Arterial #1	Road 13m, 1.5m centre bay, development both sides
Secondary Arterial #2	Road 13m, 1.5m centre bay, green space & development
Secondary Arterial #3	Road 13m, 1.5m centre bay, green space & development
Linkroad #1	Road 11m, development both sides
Link Road #2	Road 11m, green space & development
Street #1	Road 7.5m, development both sides
Street #2	Road 7.5m, green space & development
One Way	Road 5m, development both sides
Access Way	Lane 7.5m reserve, 3.5m road
Lane Way	Lane 8m reserve, 5.5m road
Bush Fire Trail	4m wide access (no permanent vehicular access)
Existing Roads	Existing NA
Intersection 1	Intersection to be upgraded to roundabout as required by development of Myall River Downs
Intersection 2	Roundabout to be provided at intersection as required by development of Myall River Downs

Riverside
Tea Gardens Australia

DRAWING TITLE
STREET HIERARCHY PLAN

0m 500m

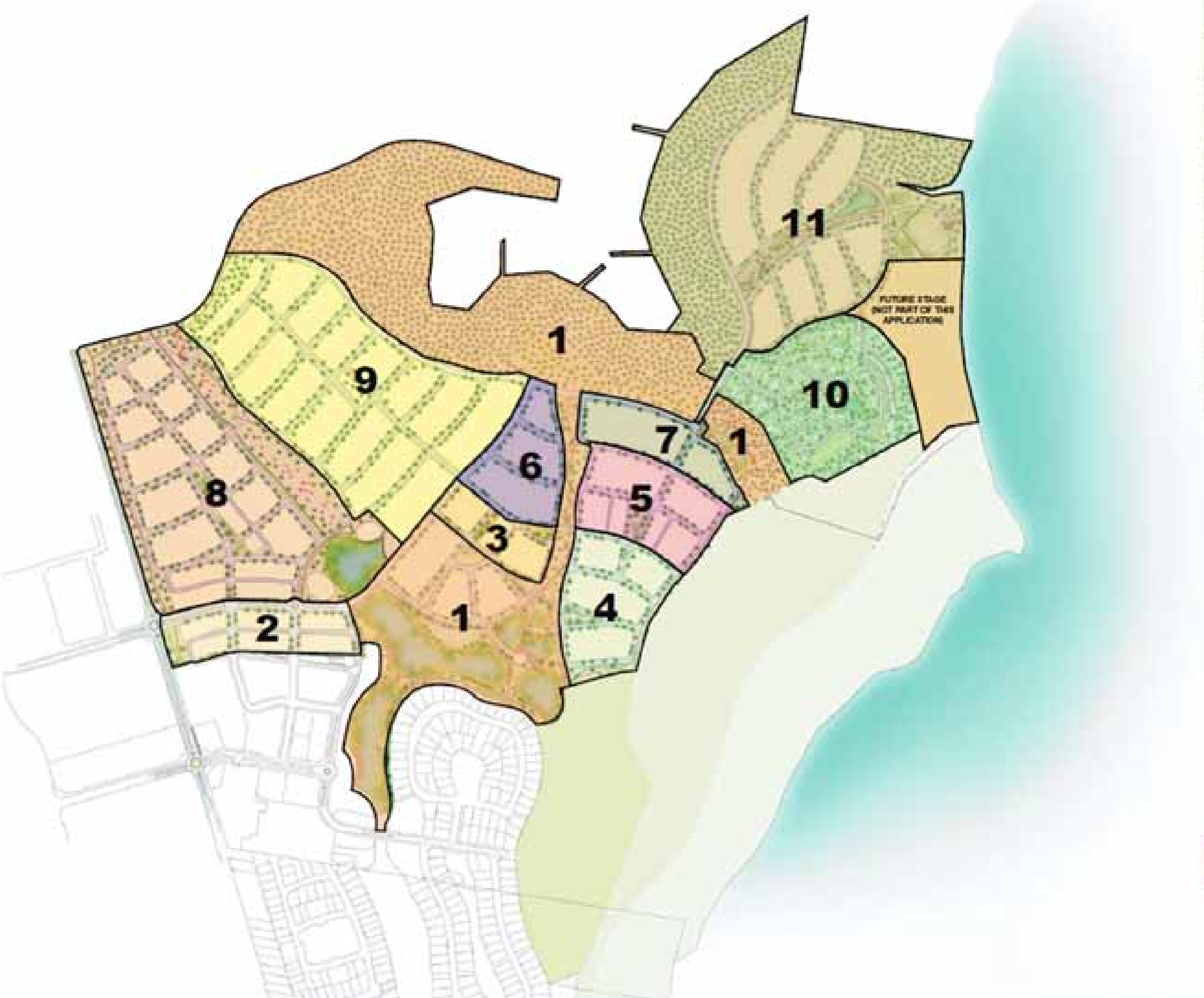
APPLICATION
Part 3a Submission to N.S.W. D.O.P.

DATE	SCALE	DRAWING No.	REVISION
October 2010	1:4000 @ A1	R.C. -05	L

CRIGHTON PROPERTIES

Better Transport Futures

Mark Waugh Pty Limited
ABN 67 106 169 180
Transport Planning & Engineering



STAGING DETAILS (INDICATIVE)

Stage	No. of Dwellings	Details other Inclusions	Approx. Registration Date (Year)
1	46	Stage 1 to include establishment & partial embellishment of primary water management corridors.	2011
2	37	Includes second connection to Myall Street.	2012
3	28		2012
4	53		2012
5	58		2013
6	48		2013
7	40		2014
8	184 (Approx)		2014
9	255 (Approx)	Includes completion of embellishment of community park, wildlife movement corridor. Includes provision of second community facility. Second access to Riverside.	2016
10	65 (Approx)	Includes new access to Toonang Drive & 4th community facility.	2016
11	160 (Approx)	Includes final access to Toonang Drive & finalisation of water management structures.	2018
Total	974		

Note: Plan illustrates staging of land release areas only. For detailed construction sequencing refer to engineering drawings for further detail.

Riverside
Sea Gardens Australia

DRAWING TITLE
STAGING PLAN

0m 500m

APPLICATION
Part 3a Submission to N.S.W. D.O.P.

DATE	SCALE	DRAWING No.	REVISION
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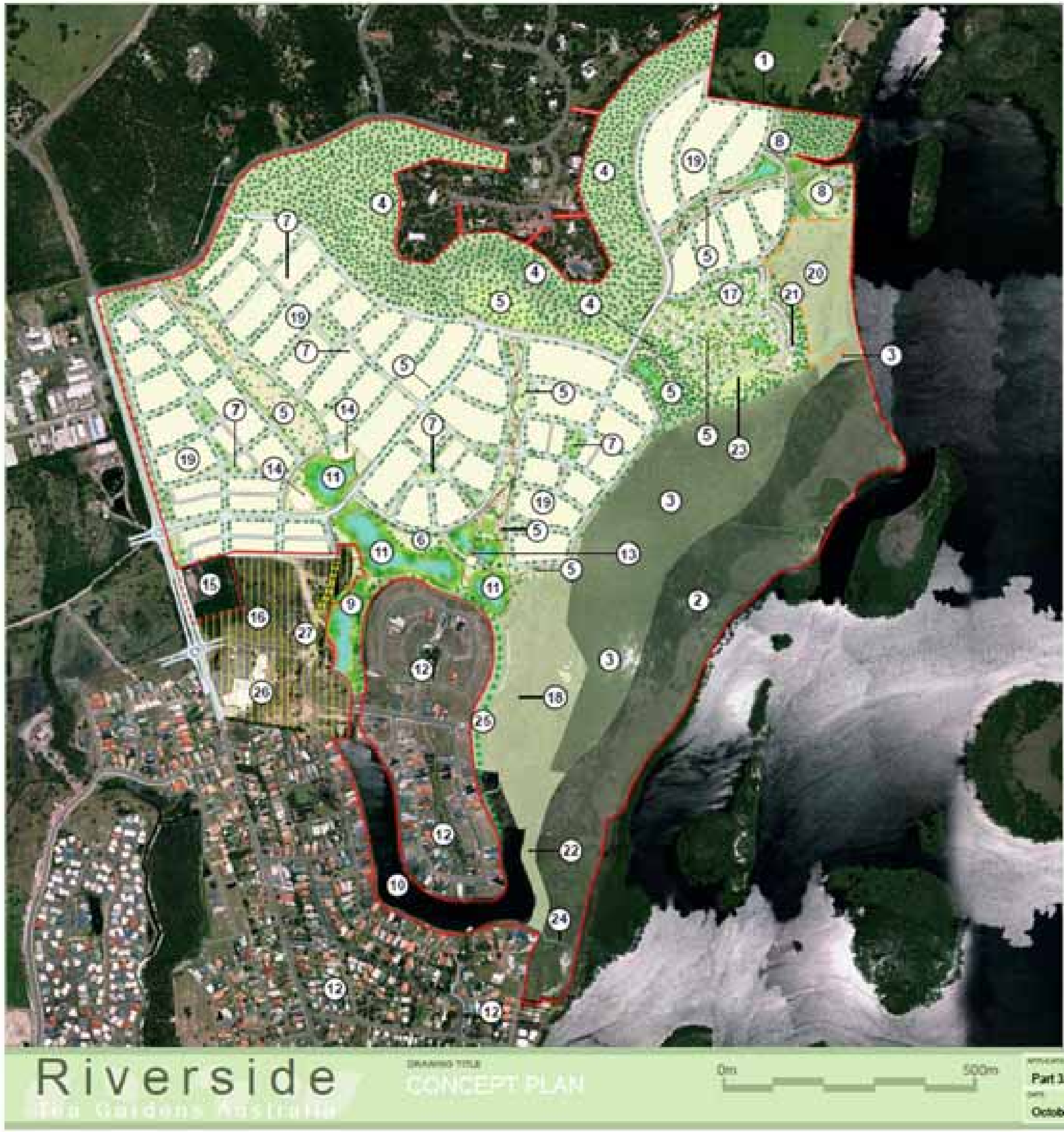
CRIGHTON PROPERTIES

Appendix E Urban Design Principles



Item	Description
1	Extent of concept plan area 'Riverside' at Tea Gardens.
2	Existing 7(a) wetland zone.
3	Existing 7(b) buffer zone.
4	Wildlife movement corridor.
5	Water management & open space corridors.
6	Community parks incorporating walking/cycle ways, BBQs, children's play area equipment.
7	Community pocket parks.
8	Myall foreshore park including structured and unstructured open space.
9	New fresh water, water quality management & detention ponds.
10	Existing detention and water quality lake.
11	New fresh water, water quality management & detention ponds.
12	Existing residential development.
13	Precinct community facilities.
14	Future precinct community facilities.
15	Site area currently owned by Great Lakes Council.
16	Separate medium density/commercial precint (not part of this application-current waver issued by DoP.)
17	Tourist lodgings precinct.
18	Additional land proposed for conservation.
19	Proposed residential lot development to be developed under community title.
20	Future development site.
21	Existing house.
22	DCP buffer.
23	Location of known midden & buffer.
24	Existing drain outlet to Myall River.
25	Existing drainage swale
26	Existing shopping centre/medium density approvals
27	Future connecting road

Land Use Legend

Total Site	Ha	%
Open Space		
- Wetlands (zoned 7a)	28.4	12.8
- Buffer Zones (zoned 7b)	20.6	9.2
- Additional Conservation Buffer	12.3	5.5
- Wildlife Corridors	32.8	14.8
- Myall Foreshore Park	5.6	2.5
- Drainage Corridors, Ponds & Large Parks	23.1	10.4
- Pocket Parks	2.6	1.2
- Existing detention & water quality lake	6.7	3.0
Total	132.1 Ha	59.4%
Built Upon Area		
- Residential (including roads & community facilities)	77.2	34.7
- Tourist/Residential (Lodgings)	8.2	3.7
- Future Development Site	5.0	2.2
Total	90.4 Ha	40.6%
Total	222.5 Ha	100%

1. Introduction

1.1 Background

This paper presents a range of transport objectives confronting new land development projects, outlining some solutions that will aid in realising State Government planning objectives of reducing the demand for car based travel by focussing on improved choice in transport alternatives.

It is not the intent that the Riverside development should act on all or any of the these initiatives beyond those documented in the transport report principles, rather the information is presented here to provide an understanding of the complexity of the transport task in our cities and to show that there is no one solution or one organisation that can deliver such a significant change in our travel behaviour.

There are more and more opportunities emerging to achieve a development shift and contribute to the choice to use alternate transport modes, such as the proposal to redevelop the Riverside development.

The commitment of developers to implement a range of initiatives to achieve a development with a difference, including influencing transport behaviour is one of the major challenges to achieving sustainable change.

Transport initiatives relating to development site are discussed and illustrated to demonstrate how a positive focus on alternative transport modes and urban form can be used to provide better choices focussed on alternative transport to the private motor vehicle.

1.2 Masterplan Goals and Principles

The Concept Plan for the Riverside development aims to match the Governments stated general objectives in the areas of Transport, and Air Quality. These objectives and the identified opportunities are described below:

Transport Goal

- "To provide a transport system that provides for the efficient movement of people and goods, which increases transport options and which is based on ecological sustainability."

Opportunities to Improve Development Practice

Principal 1: To utilise linkages to regional public transport.

Principal 2: To maximise the efficiency of the local street network to reduce trip lengths, enhance the viability of public transport and encourage cycling and walking as viable alternatives.

Principal 3: To improve regional and metropolitan linkages.

Air Quality Goal

"To ensure that occupants of the site are not exposed to higher levels of air pollution than elsewhere in the greater metropolitan region; and that the site's use generates air pollution at a significantly lower rate than previous development areas.

Opportunities to Improve Development Practice

Principal 1: To encourage an increased use of alternative modes of transport and reduced reliance on the use of the private car.

Principal 2: To restrict non-transport sources of air pollution.

Both the Transport and Air Quality goals of the Masterplan emphasise alternative transport as a positive measure towards achieving ecological sustainability. There is also a strong emphasis on reducing dependency on the private motor vehicle.

1.3 Integrated Planning

Regional Planning Strategies for the Greater Metropolitan Region (GMR) have been revised and updated. "Cities for the 21st Century" and the complementary "Integrated Transport Strategy" document the integrated strategies which are now being applied at the broader metropolitan scale. Principles include:

- a focus on developing a more compact urban form
- developing sites which can maximise use of existing infrastructure
- developing sites with good access to major transport corridors and employment centres
- greater choice in housing types, especially multi-household dwellings
- reducing dependency on the private motor car.

Again the general philosophy of improved accessibility to alternative transport and reduction of dependency on the private motor vehicle is emphasised.

1.4 Contributing Towards Transport Alternatives

This paper summarises the key transport features providing access to the proposed development of the Riverside development. It has been produced to demonstrate that the proposal is consistent with the State Government's initiatives for transport accessible development, and integrating land use and transport within the Greater Metropolitan Region, and the overall philosophy of reducing car dependency.

Graphical representations of the regional and local context of the development adapted from current planning and transport strategies indicate the strategic fit of the site. On site initiatives are also discussed and illustrated to demonstrate the likely provision for and encouragement of transport alternatives.

Arising from the examination is the development of the local and regional transport links associated with the project

2. Improving Development Practice

2.1 General

Cooperation and integration of transport services are essential to ensure attractive transport alternatives aimed at reducing car dependency. This will require the support of the developer, local councils, state authorities and transport operators to achieve a successful outcome.

The Riverside Development as an example of improved urban development practice will include the following transport initiatives:

- □ Provision of a pedestrian links catering for movement to and through the site. Possibly also cycle links that may present attractive and real alternatives to using cars for local travel.
- □ Local buses could use demand responsive and innovative services similar possibly to the "Nepean Nipper" model used in western Sydney, and the Perth CATS, from early in the development cycle to ensure travellers have a viable choice to the private car.
- □ Provide linkages through the site to external pedestrian and cyclist networks. Linkages may possibly be matched by complimentary facilities developed by Council to complete access to other key sites and activities in the area.

The following pages represent a sample of development practice initiatives that could be an integral part of the Riverside Development. Some will require the cooperation and support of government. Others will require initiation by developer and transport operators.

2.2

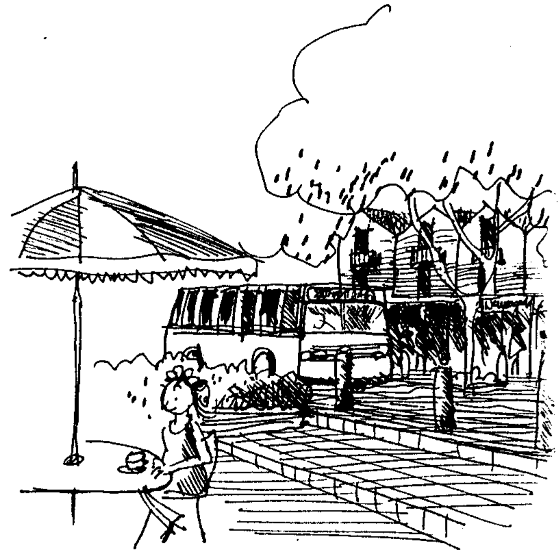
2.2.1 Public Transport Planning

Issues

The planning of public transport services is a matter of operating vehicles on the available infrastructure to meet the requirements of as many users as possible. For rail services, trains are clearly constrained to run where the rails are; the variations are largely limited to frequency, timing and stopping patterns. For road-based services, the flexibility is much greater. This can be a minus as well as a plus, because the complex service patterns that result are not always easy for people to understand.

Principles

- □ Physical planning should not unduly constrain the public transport operator's power to serve his or her markets.
- □ Services can and should be tailored to user requirements, which vary not only by area but also by time of day.



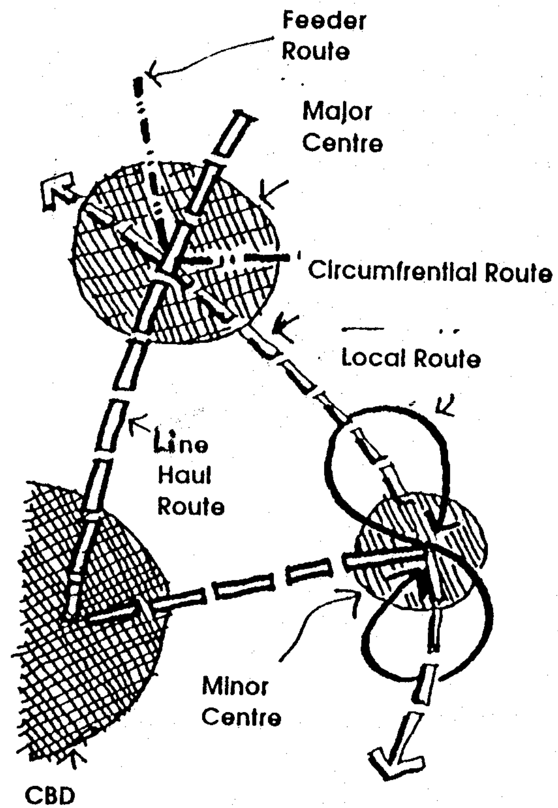
2.2.2 Transport Routes

Issues

While some routes are determined by structural corridors (eg. rail lines, or activity corridors along main roads), the planning of the majority of local routes is the prerogative of the operator. Many trade-offs have to be made: between direct routes and routes with large enough catchment; between serving different destinations when demand does not conveniently fall in linear corridors; and between flexibility and “presence”. Demand does not usually remain the same all day and there is no reason why public transport services should; but this makes them harder to understand.

Principles

- ◻ Maximise the match between travel needs and vehicles.
- ◻ Ideally, plan on the basis of area-specific data about travel; but if this is not available population data from the census can be used within a GIS to assist route planning.
- ◻ It is not enough to make sure people are within reach of a bus route; the bus must take them somewhere they want to go.



Possible Applications

From the Riverside development perspective, there is some scope for improving infrastructure to support public transport on the road system adjacent to the site.

From an operational perspective (by other) there are a wider series of initiatives such as performance based contracts for bus operators that give the operators the freedom to plan their routes provided that the quality criteria specified in the contracts are met or exceeded. The criteria could cover such items as minimum frequencies at different times of day, the minimum proportion of the population to be within reasonable access of bus routes, and maximum fares to be charged. Contracts should not specify routes.

Possible Applications

The nature of routes will depend on the demand patterns involved. Solutions available include various combinations of line-haul service (to get between two points of demand concentration as quickly as possible), feeder services (to collect and distribute demand over low-density areas and other varieties of local service). Networks can be built up from routes as grids, "hub and spoke" arrangements, figure of eight or whatever configuration local circumstance demands.

The Riverside development is well located adjacent to a new shopping centre and it represents a clear focus for the local area as a transport node. It will be best served by pedestrian routes connecting to Myall Street which performs as the arterial corridor and "Line Haul" Route to other activity centres such as Raymond Terrace and Newcastle.

2.2.3 Demand Responsiveness

Issues

The big attraction of the car (if you have access to one) is that it is always there, ready to go anywhere. The principal merit of public transport is its ability to group people in various ways and provide a relatively low-cost common means of transport for the group. The increasing complexity and fragmentation of human behaviour in urban areas poses a challenge for public transport to respond to. Greater responsiveness to personal needs is required in future. This calls for a sharpening of the skills and techniques used by service planners.

Public Transport access to the wider region is available from the nearby Newcastle Station and bus interchange.

General Applications

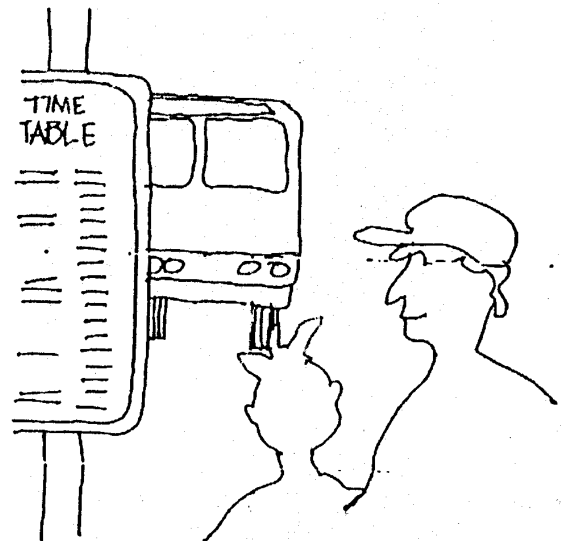
- □ Melding of various communications and control technologies to create “Personal Public Transport” systems, and affordable personalised transit services, has been promoted and feasibility studies are underway in several Australian locations. The control technology already exists within courier and taxi operations, but not in the public communications infrastructure.
- □ The sharing of taxis in various ways offers more immediate possibilities, where regulations permit.
- □ “Hail and Ride” services, where buses pick up and set down wherever it is safe to do so rather than at designated stops, is another step towards greater flexibility in meeting user requirements.

2.2.4 Information Systems

Issues

Operating in a way which takes advantage of strategies, maintains the system and, where appropriate, upgrades it is the best way to maximise the benefits of good design and provides a return on substantial capital expenditure.

A reliable and easily understood information system is essential to encourage new users of public transport.



General Applications

- Information must be understandable, many people cannot read timetables. A portion of the population will not be functionally literate, or may not be able to read English.
- Reassurance is important. Reliance on out-of-date information is a common fear. Regular updating even without change to provide higher perception of accuracy.
- Information channels can be used for promotion as well as description of services.
- Addition of premium services at higher rates may be an option, where market opportunities exist.
- Dismantling the traditional barriers between modes, for instance buses and taxis, may lead to a more flexible system, as has happened in other Australian centres.

2.2.5 Monitoring of Transport Demand Patterns

Issues

Two major elements are monitoring user friendliness and transit accessibility performance.

Increasing public transport mode split is often used as a measure of success. However, this does not assess aspects such as private car occupancy for attraction of walk/cycle trips to public transport.

Walking is the more environmentally friendly means of mobility. The greater the proportion of trips that can be undertaken on foot and the more enjoyable the non-motorised and multi-mode trips, the better the opportunity to minimise car dependency.

Possible Applications

Conventional monitoring mechanisms applicable to achievement of better transport accessibility performance could include:

- Increase in proportion of journeys taken by public transport.
- Improvement in **trip quality** on public transport (reduction in waiting and travel times, enhanced travel comfort). This may be measured by user interviews as well as by quantitative service levels.
- Improvements in **trip quality** for non-motorised modes. This may be measured by increase in trips undertaken by non-motorised modes as well as by levels of satisfaction expressed in user interviews.
- Improvement in **quality of place** of transport waiting areas and centres. This may be measured by pedestrian counts as well as by levels of satisfaction expressed through interviews.

The results of these monitoring activities could be fed into an ongoing review of development guidelines to refine the provisions making them both more user friendly and more effective in providing alternatives to car dependency.

2.3 Cycling

2.3.1 Cycle Planning

Issues

Cycling greatly enhances individual mobility and improves personal accessibility. Speeds of 12 - 18 kph are usually achievable without difficulty. Trip lengths may be up to 20 km but are typically short (less than 5 km).

There are no significant adverse environmental effects to bicycle trips. (Cars used for short trips produce high emissions relative to distance).

The costs to the community of providing supporting infrastructure are low.

By involving exercise, cycling brings health and well-being benefits to the user.

Principles

- Recognise that cycling is an important means of transport, not only a recreational activity.
- Accept that cyclists enjoy the same rights and responsibilities as other road users. Traffic should be managed so that these rights can be exercised without undue obstruction of motorists by cyclists and undue endangering of cyclists by motorists.

- Plan and design streets to recognise the needs of cyclists (in general it is neither practical nor desirable to provide fully segregated cycle facilities on the majority of streets).

Possible Applications

Ideally local development of cycling habits will be governed by an Area Bike Plan. This requires the commitment of the local Council, and will integrate four types of approach known colloquially as the "4 E'S".

- **Engineering** works are needed to ensure that on road cycling is safe and where appropriate to provide off-road facilities.

- **Education** is an important component in relation to bicycle safety, particularly for school children.

- **Enforcement** of lawful cycling behaviour by local government and police is necessary to support the Plan.

- Pro-active **Encouragement**, principally within the domain of local government, helps to promote bicycle as a legitimate road vehicle.

The Riverside Development provides a good level of cycling infrastructure, with the potential to be integrated into Council's overall bicycle planning.

2.3.2 Cycle Routes

Issues

While most roads are legally accessible to cyclists, those that will be most favoured for cycle travel will be those which offer both direct routes to significant destinations and safe conditions. It will rarely be possible (or appropriate) to embed a network of direct, dedicated cycle routes between the links of the road network since the roads will in general offer the shortest ways. Child cyclists are a special case, for whom the appropriateness of on-road routes does not apply.

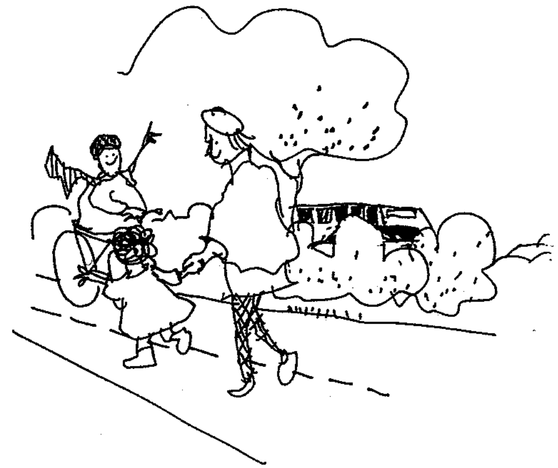
Key Points

1. Cycling needs cannot be met by either a totally off-road system or a totalling on-road system.

2. Cycle routes need to be direct.

3. Cyclists need a smooth surface.

4. Conflict between cyclists and motorist obstructs the motorist and endangers the cyclist.



The development of a comprehensive cycleway system that will link villages and neighbourhoods within our city

Principles

- Cycle routes should correspond to the main transport desire lines.
- Off-road links may be integrated with on-road routes where they improve directness.
- Roads favoured for cycle routes should allow cyclists to travel without unduly obstructing traffic.
- Permeability of local areas to cyclists can be enhanced by allowing shared use of short pedestrian links between streets.
- The planning and design of roads and streets must recognise the needs of cyclists, particularly where there is no alternative to cyclists riding in busy traffic.
- Riding surfaces should be smooth and clean, with widened kerb side lanes where appropriate.
- Clear channels for motor vehicles and bicycles should be provided at intersections.
- Short off-road sections to provide shortcuts or avoid hills are appropriate.

The above principles can be integrated into the Riverside Development.

2.3.3 Cycle Storage

Issues

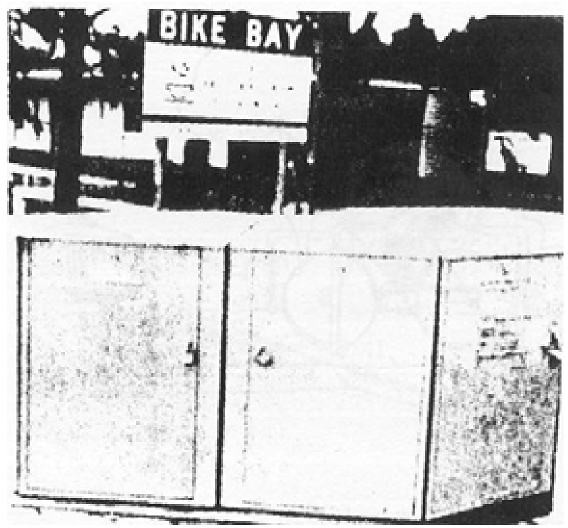
A bicycle is very vulnerable to theft - either of the machine itself or of attachments to it. A resting bicycle cannot be used for storing things the way a car can.

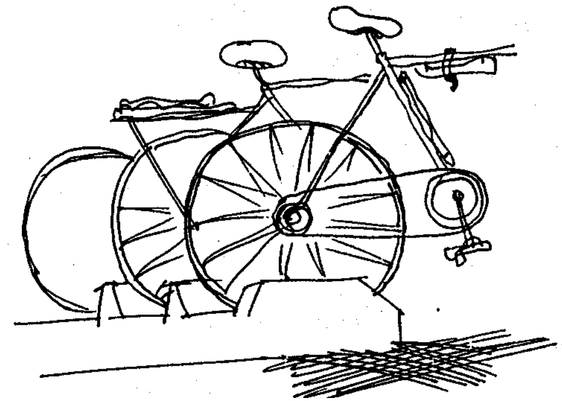
The minimum requirement for security is an immovable object to which the cycle itself can be secured. Where the machine will be left unsupervised for any length of time enclosed storage will be preferred by cyclists to protect pumps, helmets and other property. Cycle lockers are now being introduced at key transport nodes across the GMR.

These are some examples of bicycle storage facilities convenient to transport modes such as installed at Meadowbank in Sydney. Positive promotion, education and perhaps design refinements are needed to encourage effective use.

Key Points

- Storage is needed for accessories (eg. Helmets) as well as bicycles.
- Cycle storage should always be provided where car parking is provided.





Principles

At destinations it is important for cyclists to be able to secure not only bicycles but also bicycle accessories.

Dedicated bicycle storage not only helps cyclists but reduce the tendency to inappropriately secure bikes to street furniture.

Where there is no charge for use of car parking, the non-provision of cycle parking discriminates against cycling. An initial modest amount of space can be increased over time if and when cycle use increases.

Possible Applications

Cycle storage is ideally placed undercover in well-lit easily visible areas in major public areas eg. Interchanges - checked bicycles could be controlled similarly to checked luggage.

A variety of storage structures are available for example steel-U-frames or lockers. In countries with high bicycle use, high capacity storage systems can be found.

Security at public transport interchanges is particularly critical as the very presence of the bike advertises that the owner is likely to be absent for a significant time.

2.3.4 Encouragement of Cycling

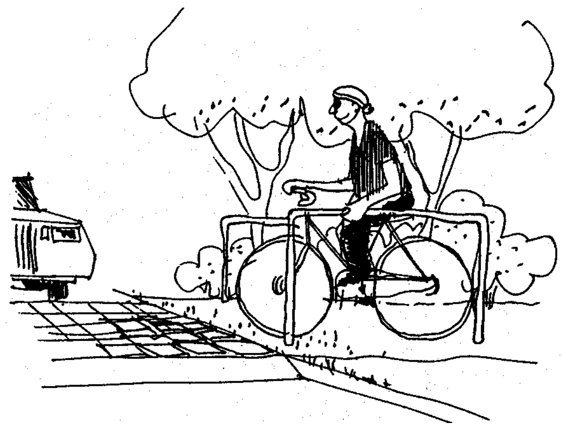
Issues

Barriers to greater use of cycles in urban areas include dangers from traffic or poor road design/condition, low load-carrying capacity, the deterrent effect of bad weather or darkness, hilliness, cycle maintenance impediments, personal hygiene implications, dress constraints and sometimes incompatibility with self-image. Physical planning alone cannot overcome these barriers. The appropriate mixture of measures will vary from area to area. One of the functions of an Area Bike Plan is to identify local priorities and develop the mixture accordingly.

A good litmus test of the cycle-friendliness of an area is the proportion of females in the cycling population. Where cycling is perceived as a hazardous activity, it will be largely the domain of young males. Failure to address cycling safety, the biggest barrier to use, or failure to provide adequate shower and changing facilities at destinations could also be regarded as discrimination against this mode.

Key Points

- ◻ Many types of facilities and activities can encourage cycling.



- The number of female cyclists tends to be more affected by cycle friendliness than that of males

Principles

- A holistic approach to cycling is required, because of the non-physical nature of many of the constraints.
- The nature and magnitude of barriers will vary from area to area and therefore local circumstances must be considered when developing strategies.

Possible Applications

A wide range of possible measures include:

- Incentives for developers to include shower rooms/lockers in commercial buildings housing significant employment.
- Short term bicycle maintenance campaigns part-funded from local/public funds.
- Promotion of fitness and appearance benefits to cyclists.
- Proficiency schemes aimed at specific groups, including middle-aged adults.

2.3.5 Cycle Planning for Schools

Issues

It is desirable to reduce motorised journeys to school where possible. Car trips require not only a vehicle on the road contributing to peak congestion and emissions (short journeys contribute a disproportionate amount of pollution), but also an adult driver who may have no role other than chauffeur. Public transport to school is dominated by bus services. These cater for two intensive travel peaks per day, one of which coincides with the peak for travel to work. School bus trips are expensive for the community to provide and limit the ability of the transport operator to provide services for other market segments. For some people, aversion to public transport in later life may stem from experiences in crowded transport to and from school. It is natural that children's social networks develop centred on schools. Non-school car journeys by children (and hence adults) can be reduced if friends living beyond walking distance can be safely and independently reached out of school hours.

Segregated cycle networks giving safe access to schools potentially bring broad transport benefits.

Principles

- ☐ The segregation of school cycle paths is highly desirable as many parents would not give their children "licence" to cycle to and from school in traffic.
- ☐ Segregated cycle networks give access to schools (especially secondary schools whose catchment areas are relatively large) for older children. This should reduce the motorised transport mode's share of journeys to and from school.

Possible Applications

- ☐ Out of school hours, segregated cycle networks centred on schools allow some substitution of chauffeured car travel by providing independent mobility for children's social trips.
- ☐ Such networks would also encourage adult use of cycling for local trips for those apprehensive about traffic.
- ☐ Extension of such cycle paths to recreational areas will further encourage adult use.

2.4 Walkability and Pedestrian Movement

2.4.1 Pedestrian Planning

Issues

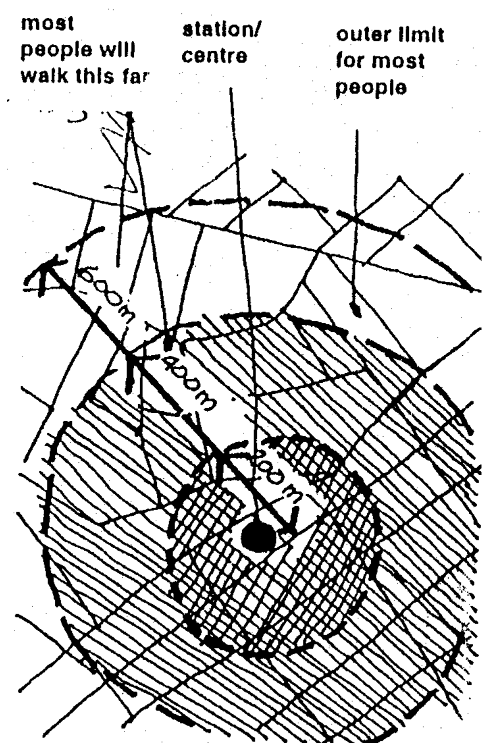
Good pedestrian planning is crucial to the concept of reduced car dependence. "Walkable" towns, neighbourhoods and developments are ones where people **choose** to walk. Safe, short walking routes take people directly to where they wish to go, including the public transport stops.

Key Points

- ☐ Services should be close to housing.
- ☐ 400m is at the upper limits of walking for many people.

Principles

- ☐ Locate as many services, including public transport stops, as close as possible to housing.
- ☐ Areas closest to services should contain higher density housing to maximise the number of people who have proximity.



- Walkable distance is not exact. Different people can walk different distances in 5 minutes. In particular, locate homes for the elderly - many of whom have neither access to a car nor the ability to walk far - close to services.
- Proximity is a measure of actual distance that needs to be walked and will not necessarily be a straight line.

Possible Applications

A common Australian measure of walkable distance is 400m. If the other techniques under this section are applied, this is probably reasonable. Otherwise it is optimistic and certainly 400m is the outer limit for many people to carry heavy parcels.

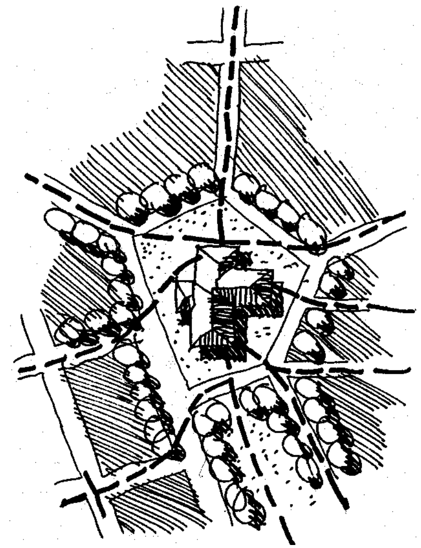
2.4.2 Connectivity/Permeability

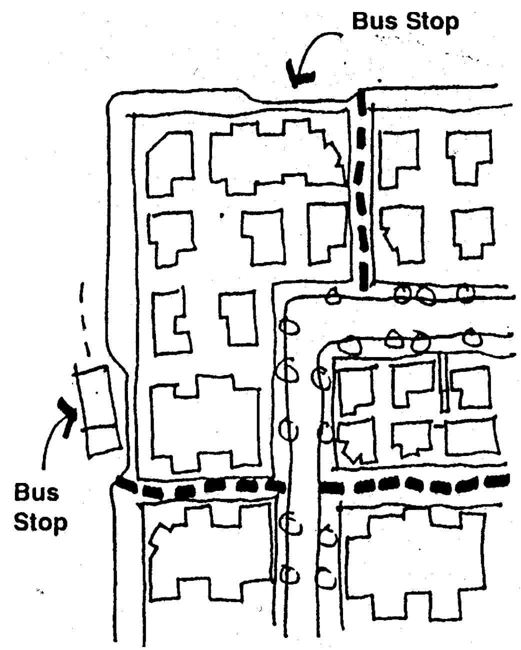
Issues

People are more likely to choose to walk if the route goes **directly** to where they wish to go.

Principles

- Try to cater directly for straight-line movement between origins and planes of interest within the design where possible.
- Provide continuous pedestrian routes; avoid dead-ends.
- In intense areas such as centres, provide a “fine grain” or scale of connections so that there are many ways to get through the area.
- Ensure that barriers such as creeks or freeways are crossed at reasonable frequency and that pedestrian access patterns focus naturally on these crossing points.





- Pedestrian connections can be created more frequently than vehicle connections. If it is apparent to drivers that walking to local services is more direct than driving they may be tempted out of the car. In residential areas, however, separation of pedestrian and vehicle routes is generally inappropriate. Vehicle routes can provide more activity, interest and surveillance provided traffic behaviour is “calmed”.

Possible Applications

Examples include:

- Measure how many people within say, 400m of a centre are actually within 400m walk. The percentage who are not, gives an index of how “impermeable” the area is. This will then indicate how effective creating new links will be.

- Street layout which allow pedestrian connection, whether or not they allow vehicle connection. See illustration for example.

2.4.3 Surveillance and Activity

Issues

People are more likely to choose to walk or let their children walk if the available routes are perceived as being interesting and safe. It has been shown that, if a route is overlooked by houses or shops, those occupants are more likely to have a sense of ownership of the space and to take responsibility for it. Perceptions (and the reality) of “stranger danger” are thus much reduced. These principles have been articulated in a number of “safety audits” in Australia in recent times. Meanwhile, many surveys show residents “fear” their streets as alien places, even if they are beautiful or superficially attractive.

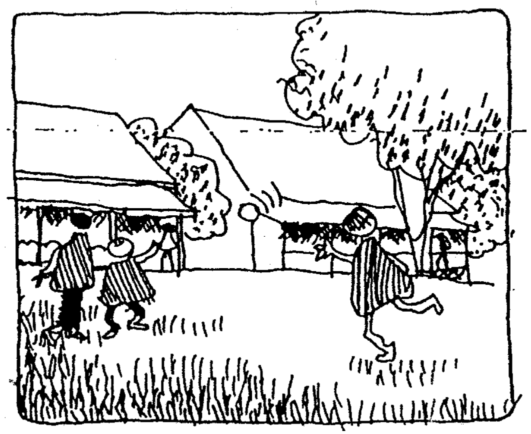
Key Points

- Perceptions of personal safety encourage walking and cycling.

- Active frontage of land uses adjoining footpaths increases the perception of personal safety.

Principles

- Pedestrian routes should, wherever possible, link and pass through locations of more intense activity.



- All pedestrian routes should be adequately lit.

- In low intensity areas particularly, vehicles in a street also provide another level of activity and surveillance and therefore separation of pedestrian and vehicle routes should generally be avoided.

- Where pedestrian links are adjacent to non-vehicular facades of houses or other activities, these activities should be designed so that they "face or address" the pedestrian area.

Possible Applications

- Pedestrian routes which pass along the **active fronts** of adjoining uses such as shopfronts, front doors and living/kitchen windows of houses. This often, but not always, means coinciding with vehicular streets.

- Parks that are overlooked by houses (see illustration), provided that the house is designed to be oriented to the park eg. Requiring central living area windows to face the park.

2.4.4 Vehicle Safety

Issues

Conflict between vehicles and pedestrians "favours" the vehicle; the pedestrian comes off worse. In residential streets children are particularly vulnerable. Busier vehicle routes become barriers to pedestrian movement. Walkability cannot be said to exist unless these conflicts and barriers are reduced to the point where people can make rational and confident decisions, for themselves or their children, to walk to where they wish to go.

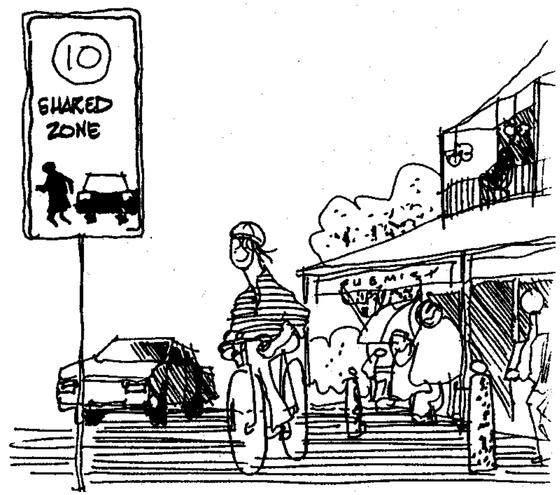
Principles

- Pedestrians can use the same space as vehicles when speeds and volumes to a lesser extent, are very low.

- Pedestrians can share (eg. on adjoining footpath) street space with vehicles where vehicle speed and volume is reasonably low.

- On all streets carrying less than 3,000 vpd, it should be assumed that people will cross at any point.

- On higher volume roads, crossing opportunities will need to be concentrated and catered for.



- ◻ In summary, the local street system should be treated so that it serves pedestrian, cyclists, and cars, not cars exclusively.

Possible Applications

- ◻ Legislation for shared spaces based on the Dutch Woonerf allows highly active, short central area streets to be "shared" between pedestrian and vehicle with maximum speed 10kph. This has been applied now at locations in NSW, Victoria and Queensland.

- ◻ There are many good examples of traffic calming to keep vehicle speed below 40-50 kph and volumes below 2,000 vpd. Increasingly, new areas have these characteristics designed in. AMCORD (The Australian Model Code of Residential Development), and other manuals provide advice on how to achieve this.

2.5 Road Management

2.5.1 Road and Street Design and Hierarchy

Issues

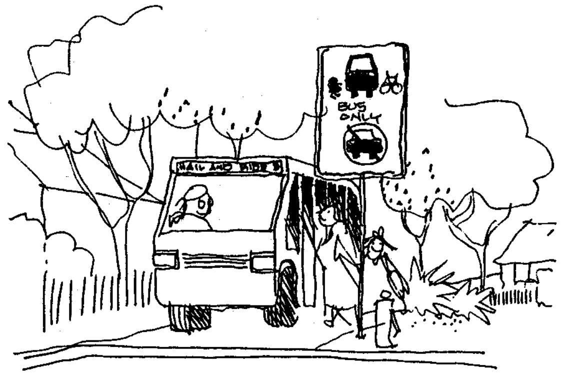
The road or street has more functions than to carry vehicles. In general three types of street environment exist. At one extreme, the vehicle function is dominant - typically, on arterial roads with major through-traffic. But even when dominant, it is not the only function (freeways excepted). For the "lower order" streets in centres or housing areas, the on-street activity is most important, and the third environment is in between, where both functions must be satisfied - typically main streets in rural towns or sub-arterial urban roads.

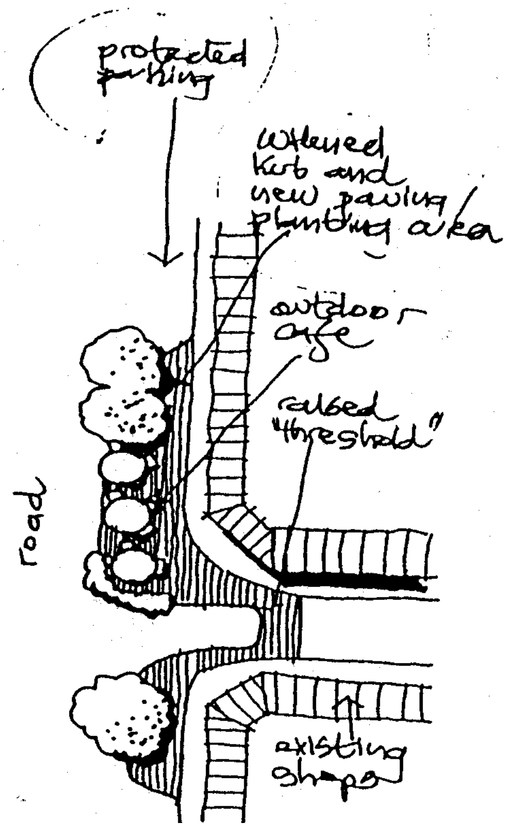
Principles

- ◻ Streets to offer a connected network for pedestrian, cyclists, and public transport.

- ◻ Provide "calm traffic" conditions on the street network in centres and residential areas.

- ◻ The measures needed to make streets safe for drivers also tend to make them boring for pedestrians - or conversely stimulating pedestrian environments require more care to traverse by car.





- Roads that carry public transport must ensure that all stops are easily accessible on foot from both sides of the road.
- Traffic engineering should have all uses in mind. Vehicle "slip lanes" (eg. Turn left at any time") can, for example undermine pedestrian crossing opportunities.

Possible Applications

- A number of detailed guides to suitable traffic engineering practice exist, for instance "Queensland Streets" (IMEAQ), "Towards Traffic Calming (FORS/WSROC) and
"Sharing the Main Street" (RTA/FORS).
- Raised platforms for pedestrian crossings of streets have been found to reduce accidents by about 90 percent. Pedestrian refuges, in general, do not reduce pedestrian accidents, although they are more effective on wider or busier roads.
- By opening the ends of the dead-end streets" with pedestrian or cycle links or bus-only connections, overall accessibility is much improved.

2.5.2 Road Demand Management

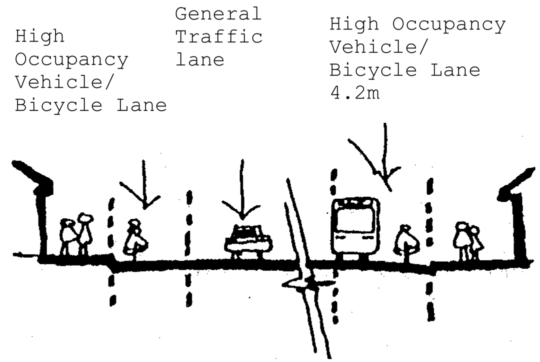
Issues

"Demand management" is not a new idea. In the past, travel demand has been managed in a way which favours the use of private motor vehicles over all other means of transport. Changes in demand management are sometimes described as the "carrot and stick" approach to reducing car dominance. This paper suggests some "carrots" which can be offered through design measures.

A basic aim is to ensure that walking, cycling and public transport appear as attractive as possible both in their own right and, where appropriate, relative to private transport.

Principles

- Judge the efficiency and effectiveness of transport infrastructure by how it moves people or goods, not how it moves vehicles.
- Ensure that any advantages through infrastructure design that one transport mode may enjoy are provided by intention rather than default. (The default option invariably favours the motor car).



Capacity constraint to low capacity vehicle, may be provided by inclusion of HOV and bicycle lanes on arterial roads

Possible Applications

- Road corridors experiencing high traffic volumes should be regarded first as demand corridors rather than traffic corridors. The most appropriate mix of transport will then depend on the mix of demand. How much power and mass does it take to move one human being? Once certain styles of transport come to prevail individual cars of high horse power and heavy mass create a traffic context in which alternative softer means of movement are less feasible and less safe.

- A variety of physical road treatments are possible. Reductions in speed limits on minor roads will increase the safety and feasibility of alternative modes, but only if they are accepted as appropriate by the community and obeyed.