Hunter Economic Zone (HEZ)
Traffic Impact – HEZ Precinct 1

Concept Plan

April, 2008

HEZ Pty Ltd

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1. Introduction

The purpose of this report is to assess the road and traffic impacts of HEZ Precinct 1. It includes a detailed review of existing traffic conditions, the development of a local road network traffic model, the estimation of future background and HEZ traffic generation and a traffic assessment of the network improvement plan for Precinct 1.

1.1 The study area

The proposed development is generally bounded by Leggetts Drive (MR195) to the east and Cessnock Road (MR588) to the north of the development (refer to Figure 1.1). It is anticipated that potential traffic impacts associated with the proposal will not be limited to the immediate access points, but will extend to other key intersections nearby given the size of HEZ. The "area of influence," or study area, therefore extends beyond the immediate site to include:

- John Renshaw Drive (MR588), which provides access to New England Highway (Newcastle);
- Main St/Lang St (MR 195), which provides access to Maitland;
- Leggetts Drive (MR195), which provides access to the Freemans Waterhole interchange with F3 (Sydney); and
- Cessnock St/Northcote St (MR588), which provides access to Cessnock.

The modelled links in the Study Area contain all State and Regional roads in the Weston, Kurri Kurri, Pelaw Main, Stanford Merthyr, Loxford and Buchanan area. In addition, key local roads in Kurri Kurri and Weston are also included. The study area road network includes about ten key intersections which formed the basis for detailed investigations. Figure 1.1 shows road network and its relationship with the indicative HEZ staging plan for Stage 1 to Stage 10. Precinct 1 has a net developed area of 100Ha. It encompasses all Stage 1 and part of Stage 2 in the HEZ traffic model.

1.2 Stages 1 and 2 Impact of HEZ Traffic

Hunter Economic Zone (HEZ P/L) provided PB with a staging plan on the basis of its current market research on expected sales. The staging plan has been formulated only for the HEZ P/L owned lands which total 360 hectares. It is expected that about 206 hectares of land will be sold by 2016, with the remaining 154 hectares coming onto the market between 2016 and 2024. The Precinct 1 area that is subject to this Part 3A application lies within the first 206Ha.

Table 1-1 HEZ Stages 1 and 2 shows HEZ yields and staging model scenarios tested through traffic modelling.

Table 1-1 HEZ Stages 1 and 2

Year	DEVELOPMENT				NETWORK					PEAK GENERATION
	HEZ Stage	Development in the year	Total gross developable land area	Total gross floor area, GFA		HEZ Access		Wider Network		HEZ (IN+OUT)
		(ha)	(ha)	(100sqm)	Eastern [1]	Northern [2]	3rd [3]	Pelaw Main Bypass	F32B [4]	(veh/hr)
2007		0	0	0	Yes	No	No	No	No	0
2008		20.6	20.6	721	Yes	No	No	No	No	240
2009		23.0	43.6	1526	Yes	Yes	No	No	No	510
2010		23.0	66.6	2331	Yes	Yes	No	No	No	780
2011		23.0	89.6	3136	Yes	Yes	No	No	No	1050
2012		23.0	112.6	3941	Yes	Yes	No	No	No	1310
2013		23.0	135.6	4746	Yes	Yes	No	No	No	1580
2014		23.0	158.6	5551	Yes	Yes	No	No	No	1850
2015		23.0	181.6	6356	Yes	Yes	No	No	No	2120
2016	Stg 1+2 completion	24.4	206.0	7210	Yes	Yes	No	No	No	2400
Other assumptions:										
Land sold in 2007			20.6		ha					
Incremetal land development per year			23.0		ha					
Modelled scenario										
Note:										
(1) Eastern Access = HEZ Spine Road onto Leggetts Drive										
(2) Northern Access = Station Street, south of Cessnock Road										
(3) 3rd Access = Proposed extension of Appleton Avenue to Station Street/Scott Street intersection										
(4) F32B = F3 to Branxton Link										

PB adopted a conservative trip generation rate and the actual generation is likely to be lower than that modelled. In the past, Cessnock City Council required HEZ to contribute to the construction of a by-pass road (Pelaw Main Bypass (PMB)) to minimise impacts to residents of Pelaw Main.

A base assumption of the traffic modelling undertaken by PB is that the PMB would be in place in the early stages of the HEZ development. Following a meeting between the RTA and HEZ, PB investigated the required timing of the PMB based on the current existing road capacities, the result of increased traffic generation from HEZ and background growth over time. The results of this investigation are included in Appendix A.

Originally, PB included the proposed F3 to Branxton (F32B) link in its modelling, however, due to uncertainty in construction timing, the RTA advised PB to remove it from modelling scenarios.

In summary, the following network assumptions are made in the staging traffic model:

- No F3 to Branxton link;
- Initially, only a single HEZ access to the Leggetts Drive (see Table 1-1 for access assumptions);
- Two HEZ access at Leggetts Drive and Station Street until 2016;
- Pelaw Main Bypass and associated intersections would be in place in the early stages of the HEZ development (refer to Appendix A for detailed analysis).

Figure 1.1 shows the ultimate land use distribution within HEZ, and the proposed points of access/connection with the external road network. The plan also shows HEZ two main access connections with the Leggetts Drive MR 195/proposed Pelaw Main Bypass intersection and Station Street extension.

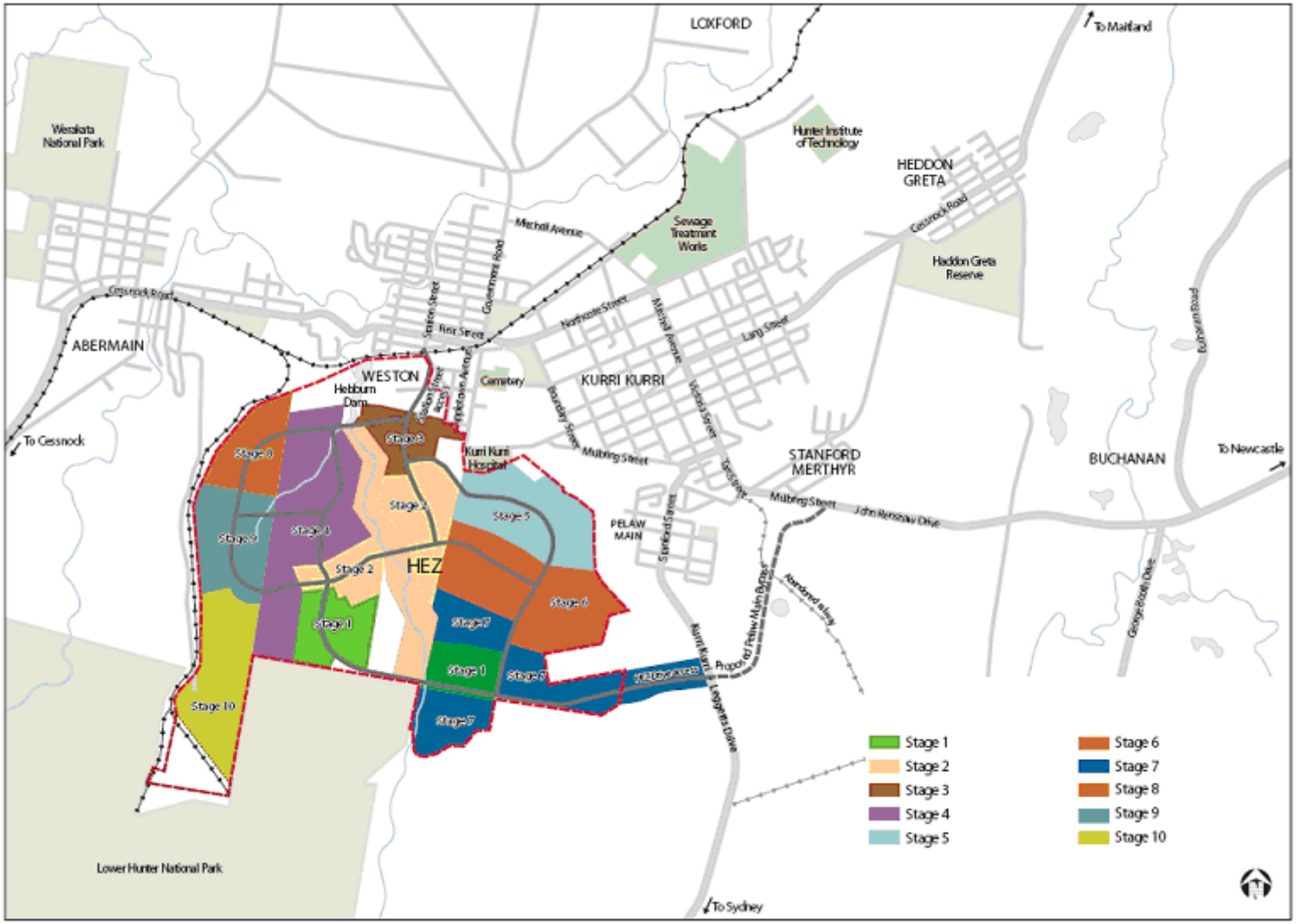

Figure 1-1 Study area road network in relation to the indicative HEZ staging plan

1.3 Study objectives and process

The purpose of a traffic study is to assess existing traffic patterns, undertake traffic projections for the study area and to conduct an evaluation of the traffic implications of the proposed HEZ development on the road network over time. The study includes an analysis of local and through traffic in Kurri Kurri and the surrounding areas.

The Lower Hunter region model was refined for the HEZ local travel conditions using a GIS and transportation planning software package called TransCAD. The strategic model was updated to calibrate for 2002 AM peak local travel conditions on the basis of traffic survey data from seven key intersections in the study area (see Section 2 and 4 for detailed survey and calibration results).

This report summarises the findings of the following investigations:

- assessment of existing travel patterns and network capacity at key intersections providing access to HEZ;
- TransCAD local road network model development (detailed modelling approach is discussed in section 4 of this report); and
- traffic projections for the study area with HEZ development (Stages 1 and 2) including background traffic growth.

The process and traffic study tasks are shown in Figure 1.2.

Traffic forecasting results have been prepared for three scenarios to quantify impact of the HEZ Stages 1 and 2 to the wider area network. To test the impact of the F3 extension from Seahampton to Branxton (F3/2B) alone, PB first ran two traffic models excluding F3/2B in the first run, but including F3/2B in the second run. The results from these two model runs provided impact of Stages 1 and 2 as a result of F3/2B on road network. Both model runs also assumed two HEZ accesses at Station Street and Leggetts Drive. An additional model run without HEZ provided incremental Stage 1 and 2 impacts. Model results in this section showed AM peak one hour two-way volumes.

Table 1-2 describes the three options tested. In summary:

- Comparing results from Options 1 and 2 implies impact due to F3/2B; and
- Comparing results from Options 1 and 3 indicates potential impact from HEZ development.

Table 1-2 Summary of Model Runs by Options for Base Network

Options	F3 to Branxton	HEZ Level
1	No	Staged 1+2
2	Yes	Staged 1+2
3	No	No(1)

Note:

(1) For consistency in the wider network, the Pelaw Main bypass was included in the future network without HEZ. Base network does not include any traffic management works including turn bans, road closure that will be required at intersections level for various options.

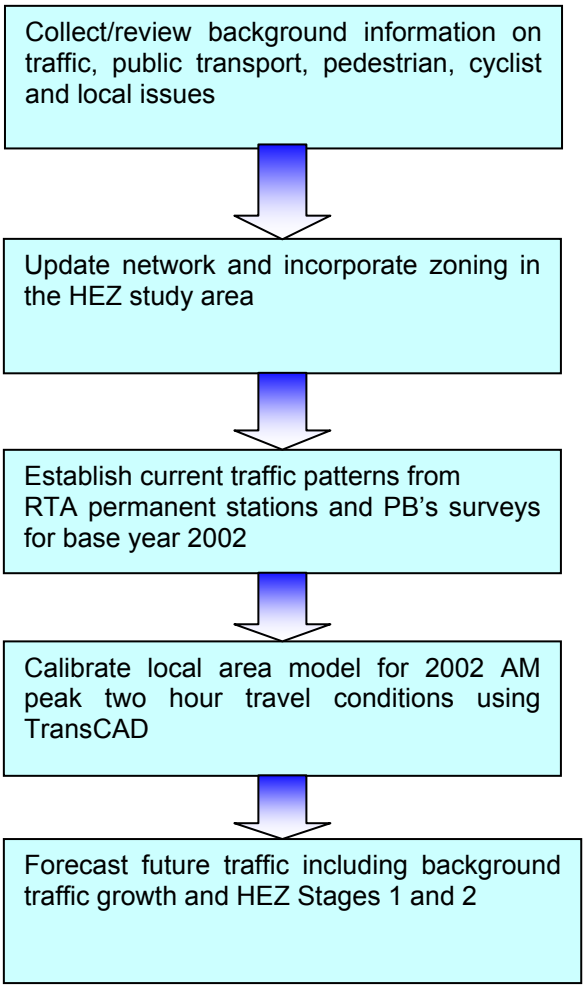

Figure 1-2 Traffic impact assessment process

1.4 Report structure

This report has the following structure:

- *Section 1*: Introduction- background of the study area and the process and objectives of this study.
- *Section 2*: Regional and Local Transport Context- existing traffic conditions and network capacity.
- *Section 3*: Industrial Trend and Context- provide a projected industry mix and indicative employment for the HEZ. A case study has been developed on the basis of land development statistics obtained from Thornton and Rutherford industrial estates in Maitland.
- *Section 4.* Traffic Forecasting Process-forecasting modelling methodology and the process of network calibration for year 2002.
- *Section 5*: Impact of the proposal-future network, intersection capacity and performance analysis for Precinct 1.
- Section 6: Summary and Conclusions.

2. Regional and Local Transport Context

PB has reviewed existing transport network and regional travel demands for the study area. This information is critical for developing a robust traffic model that provides key input to the detailed traffic impact assessment. The network and travel demand information has been coded to simulate travel patterns in the study area. The following sections provide an overview of transport characteristics for the study area in the context of network performance, traffic flow, public transport options, pedestrian/cyclist behaviour and current network capacity.

2.1 Road Network hierarchy

Roads are generally classified based on their functions and characteristics.

The current road classifications of road network within HEZ area are described as follows (see Figure 2.1):

- State Roads: has greatest arterial significance to the State's commerce, industry, and tourism. The Government funds and, through the RTA, manages State Roads and is accountable for the outcomes on these roads.
- Regional Roads: performs a significant regional function. Regional roads are often sub-arterial roads in which funding of these roads is supported by both the RTA and local councils.
- Local Roads: provide local access, carrying low volumes. These roads are managed by the local councils.

Below table summarises network functionality for the HEZ study area.

Table 2-1 Network functionality

Road Classification	Characteristics
Cessnock Road (MR 588)-State Road	Provides key east/west movement
	Generally 1 traffic lane in each direction, except between Northcote St and Railway St, which has 2 traffic lanes in each direction
Leggetts Drive (MR195)-State Road	Provides key north/south movement
	Generally 1 traffic lane in each direction
John Renshaw Drive (MR 588)-State Road	Provides key east/west movement between Kurri Kurri and Newcastle
	Generally 1 traffic lane in each direction

While the above definition is generally the case, financial responsibility for upgrading works on state and regional roads varies depending on locality, type of infrastructure improvements and nexus between new development and traffic facilities.

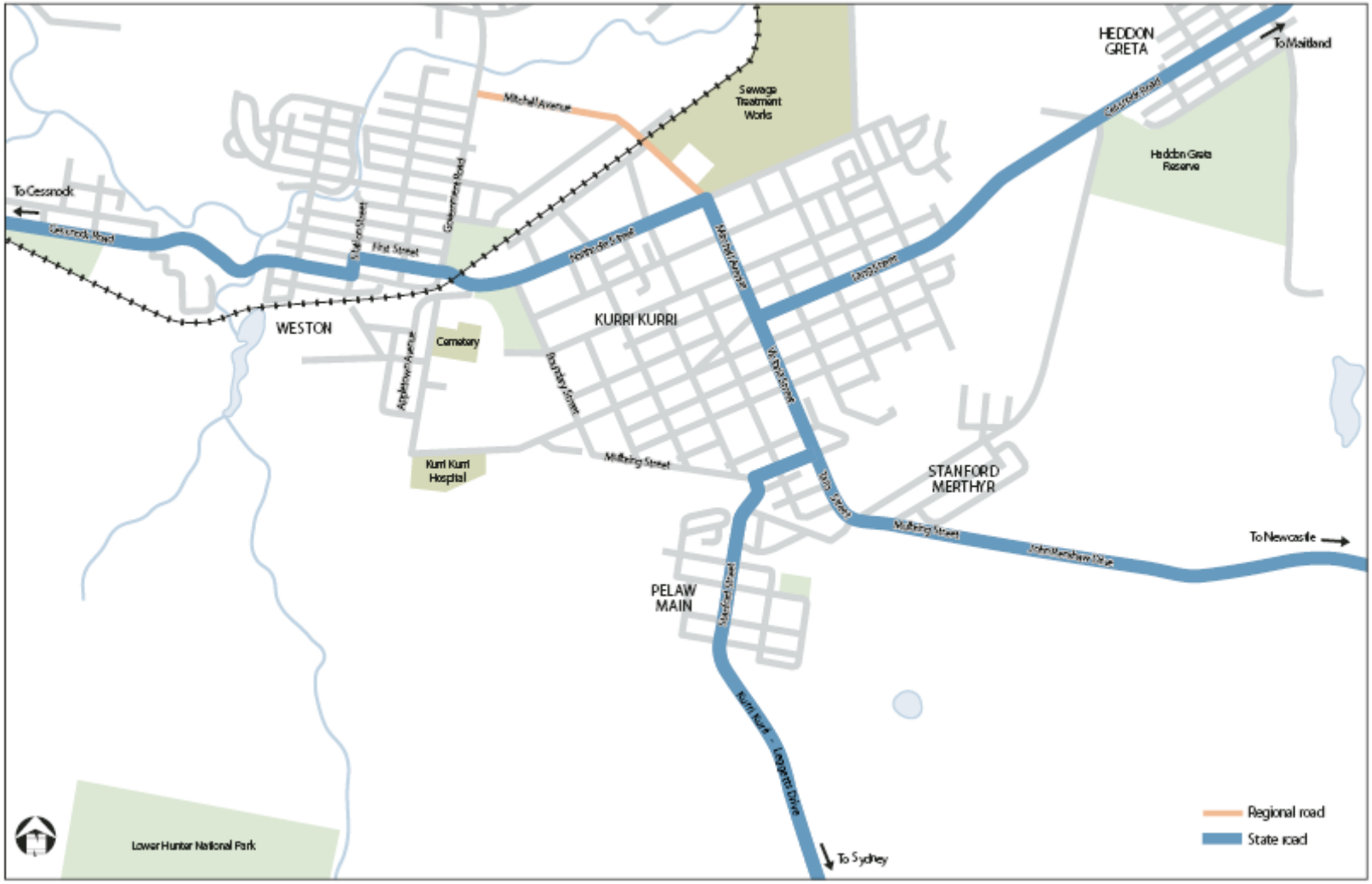

Figure 2-1 Current road classification for the HEZ study area

2.2 Journey to Work (JTW) Analysis

An analysis of 2001 Census data shows that around 91% of work trips for those working and living in Cessnock are undertaken by private vehicle, with 9% of those as a passenger. Bus travel to Cessnock workplaces represents a low 0.8%, cycling 0.7% and walking 4.6%. From these figures, it can be seen that the private vehicle is by far the dominant mode of transport to work. Walking is the only other significant mode. Typically, cyclist facilities in the area are primarily used for school and recreational trips. Table 2.2 shows JTW model share results.

Table 2-2 Journey to work mode share – Cessnock LGA 2001

Travel Modes	Mode Share (%)
Car driver	82
Car passenger	9
Bus	0.8
Rail	0
Cycle	0.7
Walk	4.6
Other	2.9
Totals	**100**

Due to the dispersed pattern of residential settlement and dispersed employment patterns in the area, it is not anticipated that walking or cycling will become a major form of transport for journey to work trips although it should be encouraged.

2.3 Public transport/pedestrian/cyclist network

The ability to provide viable, attractive and frequent alternatives to private cars within the HEZ are relatively limited due to the low existing service base and the actual population (living and working) within the area. The challenge is to reduce the number and distance of private vehicle trips in an area which is dominated by car travel and has a very limited public transport network. Residents in Cessnock and the areas around the HEZ have existing accessibility challenges such as:

- low density housing development
- low public transport use and high car dependence
- social isolation of the young, the aged and people with disabilities
- expensive taxi option, given dispersed location
- low frequency, indirect bus services
- no passenger rail system
- high youth unemployment and a need to travel to find work
- little integration in the public transport system
- isolated pockets of residential development with patterns of development that are difficult to serve using conventional bus service patterns.

2.3.1 Bus network

As mentioned above, existing bus services to the HEZ are limited. Rover Coaches operate the only bus services through Weston. The two services which currently operate within the vicinity of the HEZ are:

- Route 160 – Newcastle via Weston (2001 annual patronage 9,576)
- Route 164 – Cessnock to Maitland via Weston (2001 annual patronage 88,596)

Table 2.3 shows bus services within the vicinity of HEZ network.

Table 2-3 Bus services to Weston CBD (July 2005)

	Cessnock		Maitland		Newcastle	
	To	**From**	**To**	**From**	**To**	**From**
Number of Services	19	19	14	14	4	4
Frequency	Hourly	Hourly	Hourly	Hourly	Infrequent	Infrequent
First Bus	7:40am	**6:45am**	6:45am	**7:10am**	7:15am	**8:15am**
Last Bus	**7:10pm**	5:55pm	**7:10pm**	6:40pm	**4:15pm**	5:15pm
Travel time (minutes)	20	20	30	30	60	65

Note: Bus travel times are measured at Weston CBD (not HEZ)

The most popular bus service is the Route 164 service between Cessnock and Maitland. This route currently makes 14 trips in each direction per day. The hourly frequency of the service restricts its ability to move large numbers of potential commuters. This route provides the best connections for future travel to the HEZ and should be the focus for any planning for new services to serve the HEZ. A further transit connection will be required to complete the additional 2km journey into the centre of the HEZ from Weston. Figure 2.2 shows the bus service network for the study area.

It is likely that with the future growth and demand provided by HEZ, an increased bus service may well be developed.

2.3.2 Rail network

The existing rail line through Kurri Kurri and to the north of the HEZ, known as the South Maitland Rail Line (SMRL), is currently used for tourist and enthusiast purposes with occasional steam trains using the line. Secondly, a daily round trip is used for the coal industry located near Cessnock to freight coal to the port of Newcastle as part of the freight rail network in the Hunter Region.

The line is a single line section allowing only one train at a time between Maitland and Weston. This means the capacity of the existing line is approximately only 6 trains per day. There is no signalling in this section of line and it currently receives a low level of maintenance.

No passenger services currently travel the SMRL. Rail passenger services in the region are limited to the City Rail network from Newcastle through Maitland to Dungog and Scone (see Figure 2.2 for rail network).

2.3.3 Pedestrian network

There are currently no paved pedestrian links to the HEZ area. As the HEZ and the adjacent council owned land to the north are progressively developed, opportunities exist to provide footpaths along all new streets as they are constructed.

A Pedestrian Accessibility and Mobility Plan (PAMP) Study was conducted on behalf of Cessnock City Council in November 2001, for the Cessnock and Kurri Kurri town centres. The PAMP has been developed and recommendations made for its implementation through a number of different stages and methods.

Through the PAMP process, a number of designated pedestrian routes have been developed in the Kurri Kurri Town Centre. These routes provide a framework of consistent and continuous movement of `travel to allow the community to undertake walking, both as a legitimate form of transport and accessible form of exercise.

Each of the precincts in HEZ have been designed to provide good pedestrian links throughout the estate.

Table 2-4 Walking travel times from HEZ

Destination	*Distance (km)*	*Travel Time (minutes)*
Weston	1.9	23
Abermain	4.6	55
Neath	6.3	76
Kurri Kurri	3.9	47
Stanford Merthyr	4.7	56
Pelaw Main	3.8	47

Note: Walking travel time based upon average speed of 5km/h using existing roads to Town Centre

Note: Walking distance measured from the centre of the HEZ

Table 2.4 above outlines the walking distances and likely travel times to adjacent centres in close proximity to the HEZ. Based on a walking speed of 5km/h, the only likely generator of pedestrian trips to the HEZ are from Weston, Kurri Kurri and Pelaw Main. The upper threshold for walking travel time is likely to be 30 minutes, therefore, only the sites on the edges of the HEZ are likely to generate walking commuter trips to external locations.

2.3.4 Bicycle network

There are currently no on or off-street bicycle paths located within the vicinity of the HEZ. On-road cycle paths, off-road cycle paths and shared use paths (paths for cyclists and pedestrians) provide an incentive for residents to use cycling as their transport mode, for work or other purposes such as school or recreation. Besides regional bus services, cycling is the only other mode that is likely to reduce private vehicle trips in HEZ.

Pedestrian/cycleways have been provided by HEZ and are an integral component of the internal road design.

Table 2-5 Cycling travel times from HEZ

Destination	Distance (km)	Travel Time Bicycle (minutes)	Travel Time Car (minutes)
Weston	1.9	6	2
Abermain	4.6	14	5
Neath	6.3	19	7
Cessnock	12.2	37	12
Aberdare	10.9	33	11
Kurri Kurri	3.9	12	4
Stanford Merthyr	4.7	14	5
Pelaw Main	3.8	12	4
Heddon Greta	7.15	22	7
Gillieston Heights	12.2	37	12
Maitland	16.3	49	16

Note: Cycling travel time based upon average speed of 20km/h using existing roads

Note: Car travel time based upon average speed of 60km/h using existing roads

Table 2.5 above outlines the travel time and distances for cyclists travelling to the HEZ from adjacent centres. The travel time calculations suggest that the extent of the cycling trip catchment for the HEZ will extend from Neath in the west to Stanford Merthyr in the east and includes Weston, Abermain, Kurri Kurri and Pelaw Main. These centres should be the focus for promoting commuter travel by bicycle to the HEZ. The report titled *"Sustainable Transport in the Lower Hunter Region"* by Transit Planners (2003) identified the potential for increased bicycle based trips to the HEZ. It recommended that off-road cycleways be constructed between Weston and Cessnock and Maitland. Based on the travel time analysis above, it is more likely that cycle based travel will be restricted to the centres located within 25 minutes cycling time of the HEZ.

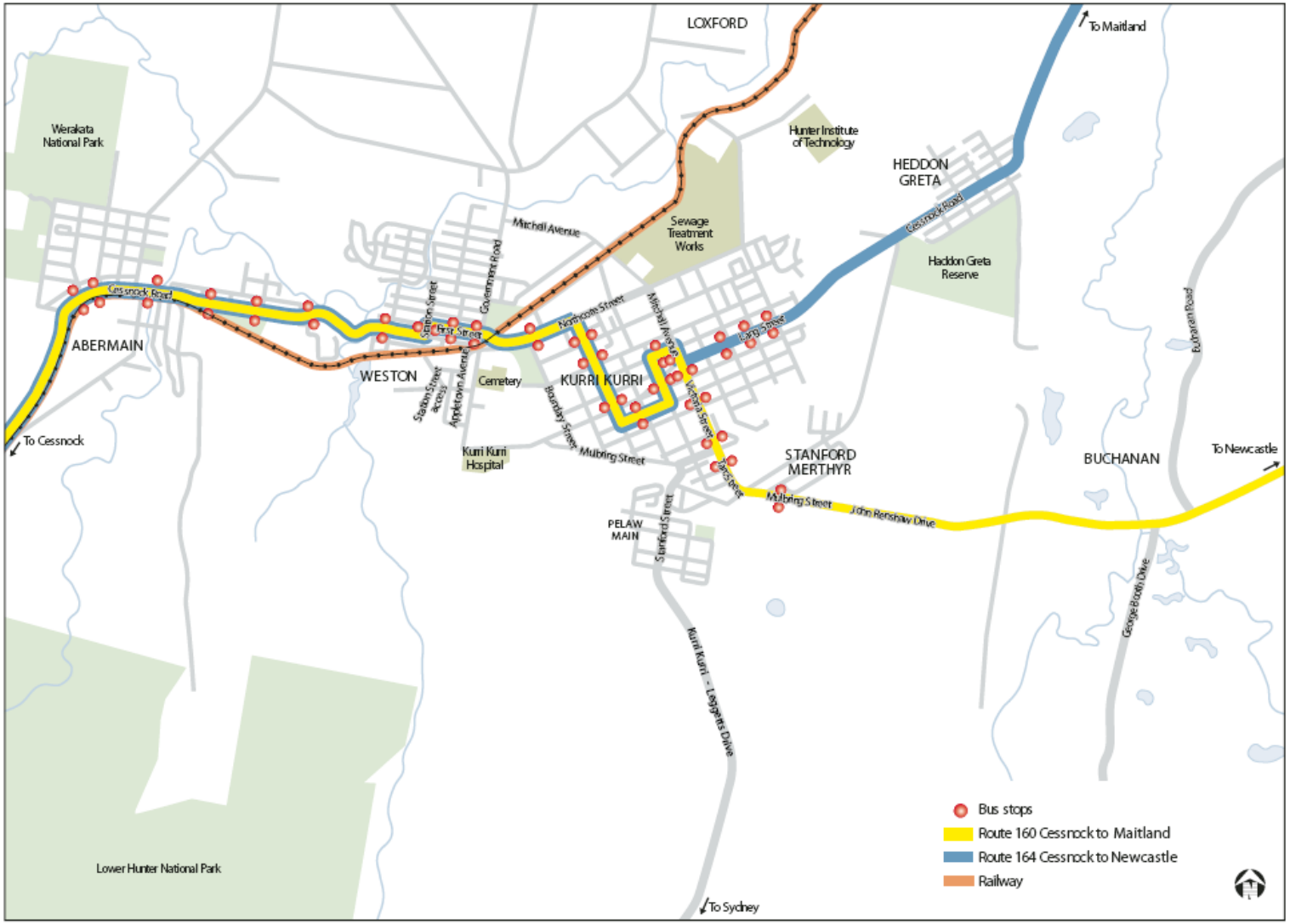

Figure 2-2 Current bus services/network for the HEZ study area

2.4 Traffic flows

This section quantifies historical traffic growth, peak hour traffic flows and current capacity on key roads and intersections within the study area. This provides a context within which to consider likely traffic changes that would result from the HEZ proposal. To support this analysis, PB used comprehensive traffic surveys on key intersections conducted in 2002 for AM and PM peak periods. Traffic data recorded by the RTA are also used to establish current traffic characteristics within HEZ study area. The RTA has agreed to the traffic generation numbers adopted by PB for HEZ.

2.4.1 Historical growth

Historical traffic data on key State Roads MR 195 and MR 588 has been used as a basis for determining traffic growth through HEZ study area. Table 2.6 shows the average annual daily traffic (AADT) data for the last nine years between 1995 and 2004. The results in Table 2.6 indicate annual traffic growth rates for MR 195 and MR 588, range between 0.5% and 2% for the 1995 to 2001 period. The increase in traffic in 2004 indicated recent acceleration of growth on both routes. This could be attributed to local traffic as a result of new developments, with some increases in domestic tourism.

Table 2-6 AADT on Cessnock Road in the vicinity of the proposed development

Station	Route	Location	1995	1998	2001	2004	Annual Growth (95-01)
05.459	MR 195	Kurri Kurri-N of Hebburn St	5,275	4,829	5,752	6,822	1.5%
05.151	MR 195	N of White Bridge Rd	3,079	3,136	3,267	4,095	1.0%
05.010	MR 588	Kurri Kurri-N of Aberdare St	11,236	11,228	12,612	16,099	1.9%
05.194	MR 588	Neath-at Railway Crossing	11,862	11,844	12,246	12,875	0.5%

2.4.2 Traffic flows across screenlines

To assist traffic flow analysis for this study, a series of screenlines have been defined and shown in Figure 2.3. These are theoretical lines across which traffic flows on individual routes are summed to quantify traffic flows along the corridor. Eight screenlines defined by A to H has been identified to capture traffic flows from the east, west, north and south. This has the ability to identify increase in traffic on key travel routes as a result of background traffic growth and the HEZ proposal. Count data for seven intersections (see Figure 2.4 for count locations) has been used to form the screenlines.

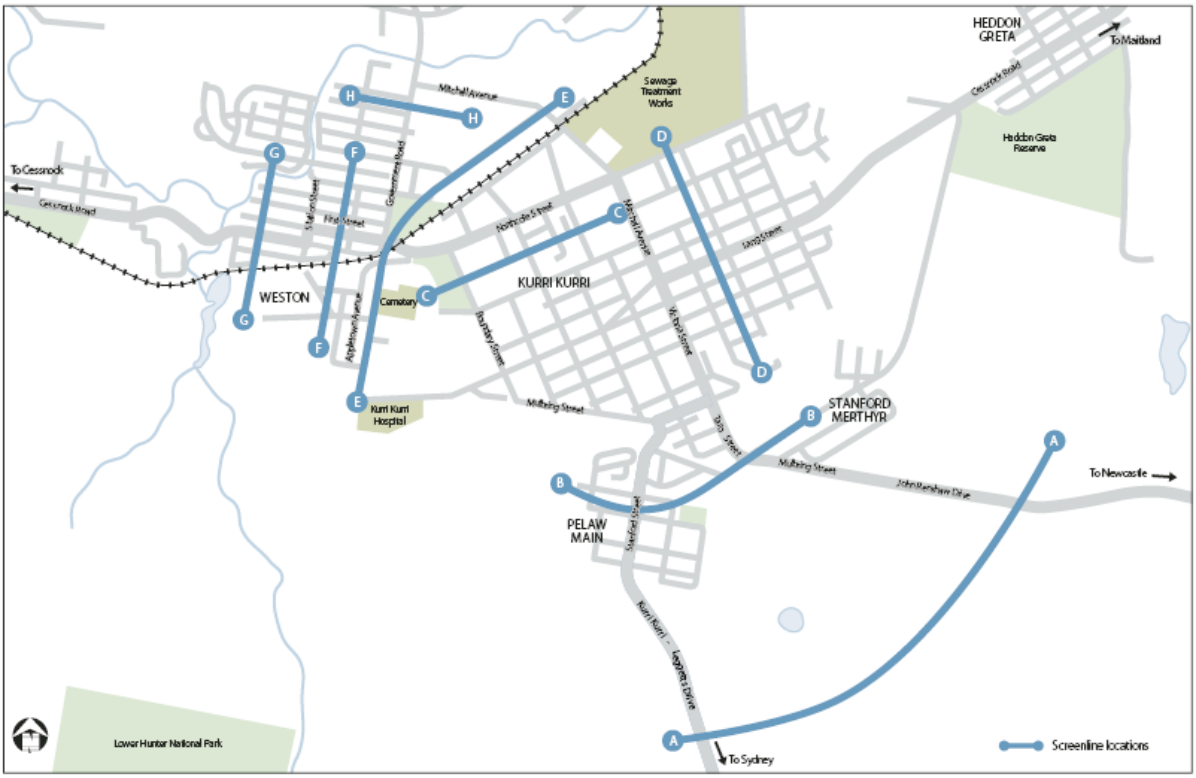

Figure 2-3 Screenline locations

Table 2.7 below shows results of traffic flows across screenlines for 2002 peak traffic conditions. The traffic data was also compared with nominal capacities of individual roads which cross each screenlines in order to identify corridor capacity constraint. These capacities are based on AUSTROADS guidelines. They are a useful indicative guide for planning purposes. However, actual system capacity depends on intersection operation, side friction and turning bays, which also impact capacity.

Table 2-7 2002 traffic flows across screenlines (AM peak hour)

Roads/Screenlines	2002 Survey			Normal One Way Capacity
	NB/EB	SB/WB	TOTAL	
Screenline A				
John Renshaw Dr	638	606	1,244	1,800
Leggetts Drive	203	162	365	1,800
Sub-Total	841	768	1,608	3,600
Screenline B				
Tarro Street	598	611	1,209	1,400
Stanford Street	203	162	365	1,400
Sub-Total	801	773	1,574	2,800
Screenline C				
Mitchell Avenue	597	519	1,116	2,800
Boundary Street	140	150	290	800

Roads/Screenlines	2002 Survey			Normal One Way Capacity
	NB/EB	SB/WB	TOTAL	
Alexandra Street	10	10	20	800
	747	678	1,426	4,400
Screenline D				
Northcote Street	109	100	209	800
Lang Street	357	365	722	1,800
Sub-Total	466	465	931	2,600
Screenline E				
Mitchell Avenue	226	212	438	1,600
First Street	609	523	1,131	1,600
Appleton Road	42	35	77	800
Sub-Total	877	770	1,647	4,000
Screenline F				
First Street	544	22	567	1,600
Cessnock Road	0	435	435	1600
	554	457	1002	3,200
Screenline G				
Cessnock Road	513	563	1,076	1,800
Sub-Total	513	563	1,076	1,800
Screenline H				
Government Road	98	97	195	1,400
Sub-Total	98	97	195	1,400

Following points are noted from Table 2.7:

- most vehicles travel to HEZ study area via John Renshaw Drive (MR 588) and Leggetts Drive (MR 195). The peak hour volume across this screenline is about 1600 vehicles per hour;
- traffic on eastern corridor via Lang Street is about 900 vehicles per hour;
- traffic through Kurri Kurri (screenline C) shows about 1450 vehicles per hour;
- via the eastern corridor to and from Cessnock, traffic volumes are in the order of 1000 vehicles per hour;
- traffic on the northern corridor (screenline H) via Government Road shows very low volumes, about 200 vehicles per hour;
- on the basis of traffic volumes presented in Table 2.7 and corresponding capacity, all eight screenlines reveal capacity for growth;
- thus it is reasonable to conclude that, currently, the study area network has no capacity deficiency.

2.5 Peak hour volumes on individual roads

The 2002 traffic counts data at individual roads have been analysed for both AM and PM peak traffic conditions. The results are presented in a sequential way on the state road, regional road and local roads with in HEZ study area. Figure 2.4 presents AM peak hour flows and Figure 2.5 presents PM peak hour flows on the existing network. The AM peak hour is between 8:30AM and 9:30AM. The PM peak traffic is between 3:30PM and 4:30PM. An analysis of count data indicate that the following intersections are heavily used by the through and local traffic.

- Cessnock Road/Station St
- Northcote Road/Mitchell Av
- Lang St/Victoria St/Mitchell Av; and
- Victoria St/Tarro Street/Railway St

The following Section 2.6 determines the network performance of these intersections on the basis of traffic data presented in Figures 2.4 and 2.5.

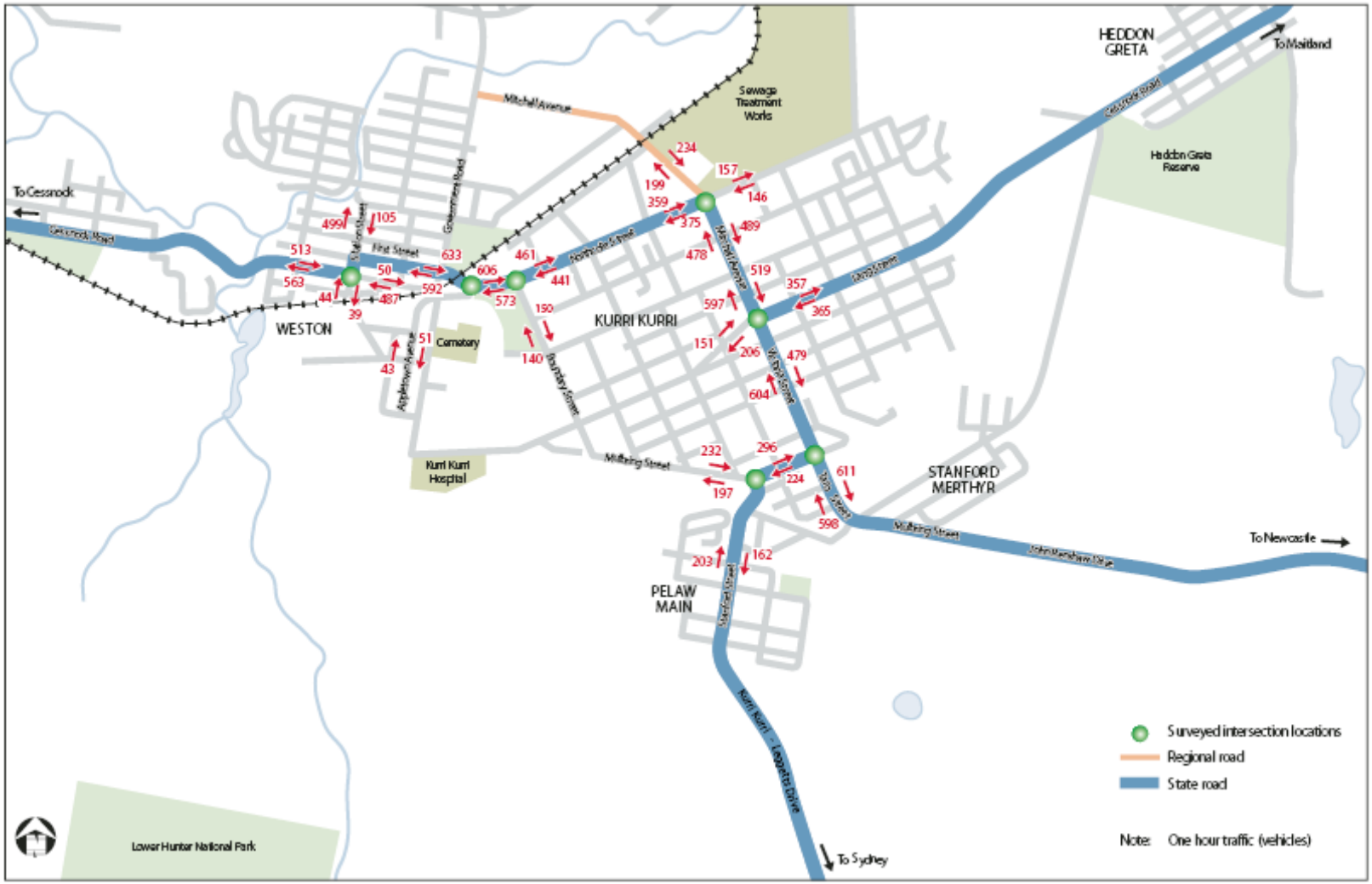

Figure 2-4 Existing AM peak traffic on HEZ study area network

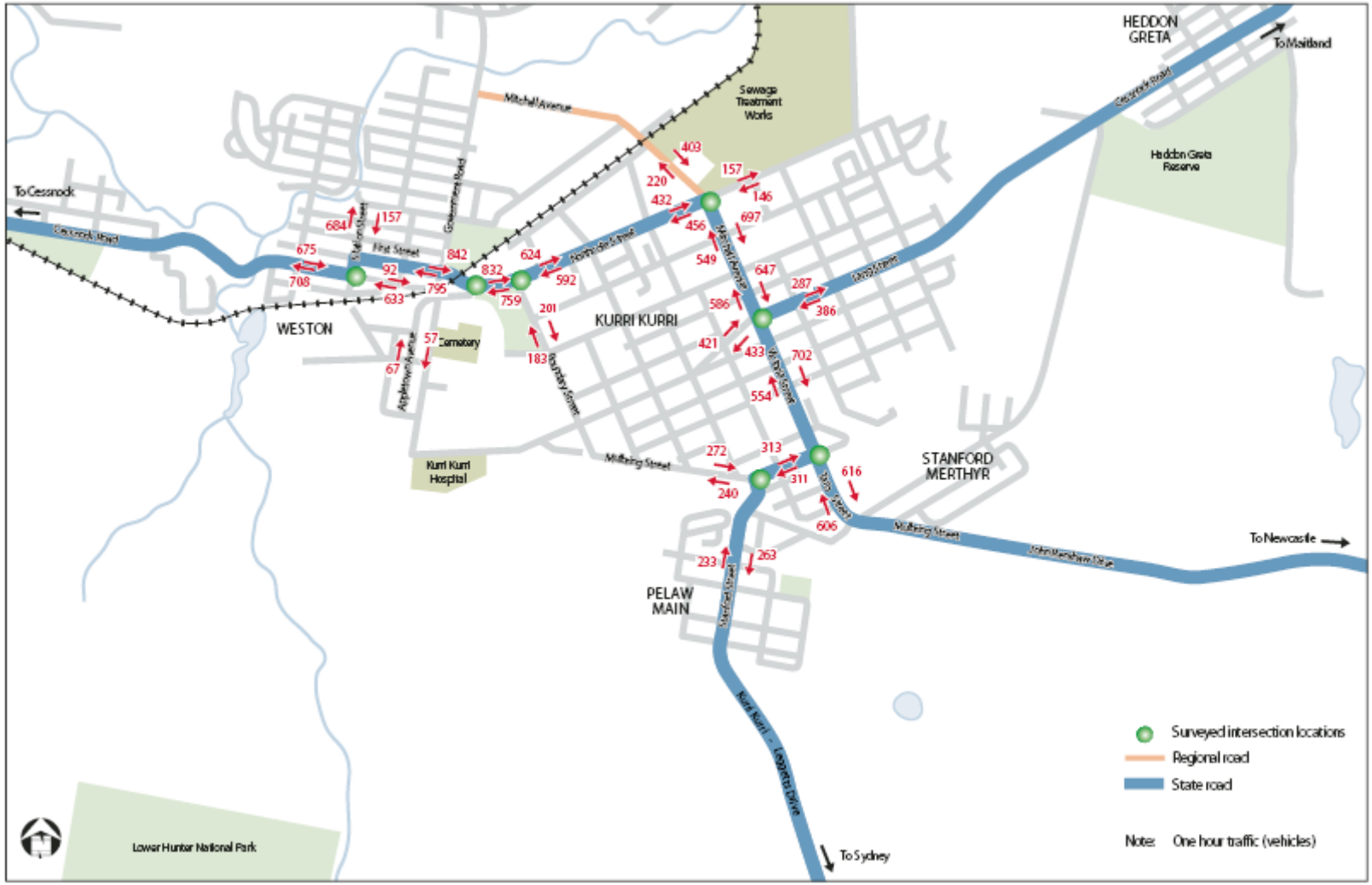

Figure 2-5 Existing PM peak traffic on HEZ study area network

2.6 Network capacity

The operation of key intersections within the study area was assessed using the aaSIDRA (SIDRA) intersection modelling software. SIDRA calculates intersection performance measures such as:

- level of service
- degree of saturation
- average delay
- maximum queue length.

Table 2.8 presents intersection performance criteria based on RTA guidelines.

Table 2-8 Level of service criteria for intersections

Level of Service	Average Delay (seconds per vehicle)	Traffic Signals, Roundabout	Give Way and Stop Signs
A	Less than 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity. At signals, incidents will cause excessive delays. Roundabouts require other control mode	At capacity; requires other control mode
F	Greater than 71	Unsatisfactory with excessive queuing	Unsatisfactory with excessive queuing; requires other control mode

Source: RTA Guide to Traffic Generating Developments, 2002

The intersection modelling was undertaken for seven key intersections for both morning and evening peak hour. Following assumptions are made in intersection modelling:

- the signalised intersection Cessnock Road/Station Street, intersection layout and phasing arrangements were obtained from the RTA Traffic Control System (TCS) plans, and surveyed average cycle times were entered into SIDRA;
- an inter-green time of six seconds was assumed for all intersections;
- phase times were estimated by SIDRA to provide optimised performance under the prevailing traffic flows and intersection geometric layout with the given phasing arrangement;
- the analyses take into consideration the pedestrian impact to the intersection performance at signalised intersections by specifying to SIDRA the actual walking distance on approaches where pedestrian crossings are available; and
- at roundabout and priority controlled intersections, the geometry was obtained from aerial photography and confirmed on site.

Table 2.9 shows intersection performance results for AM and PM peak critical peak hour.

Table 2-9 Intersection analysis results using surveyed data (2002)

Intersection	Control Type	AM Peak			PM Peak		
		DOS	Delay	LoS	DOS	Delay	LoS
Cessnock Rd / Station St	Fixed Signals	0.78	18	B	1.00	21	B
Northcote St / Appleton Ave	Giveway Control	0.37	11	A	0.43	23	B
Northcote St / Boundary St	Stop Control	0.31	15	B	0.41	17	B
Northcote St / Mitchell Ave	Roundabout	0.36	11	A	0.42	11	A
Mitchell Ave / Lang St	Roundabout	0.43	14	A	0.49	14	A
Railway St / Tarro St	Roundabout	0.27	13	A	0.41	14	A
Railway St / Stanford St	Giveway Control	0.28	10	A	0.34	10	A

Source: SIDRA model

Note (1): DoS = Degree of Saturation, LoS = Level of Service, Average Delay in seconds and Maximum Queue in metres.

Note (2): Intersection delays and LOS for signalised and roundabout intersections are based on average intersection delays while for priority controlled intersections, it is based on average delays of the worst movements.

The results presented in Table 2.9 indicate intersection performance as set out below:

- The Cessnock Road/Station Street intersection is operating at LoS “B” during both peaks. However, the PM peak DoS is high, as some approach traffic may reach to capacity level.
- All other analysed intersections are operating satisfactorily under current traffic conditions, with a LoS “A” to “B”.

In conclusion, the existing network within HEZ study area does not show any significant capacity issues.

3. Employment generation scenarios for HEZ

In terms of employment generation, this is entirely dependent on industry mix, and the density of employment in those industries. The tendency towards low density industrial parks, which comprise largely warehousing and storage, and employ only 10 employees per hectare are offset to a degree by the demand for small lots (3500 to 5000 square metres) with a relatively high level of employment densities approaching 40 employees per hectare. In addition, recent business practice which has seen the consolidation of company administration and office functions with manufacturing, warehousing and storage, have resulted in employment densities returning to 15 to 20 employees per hectare. The indicative industry mix and employment density for the HEZ is detailed in Table 3.1.

Table 3-1 Indicative industrial mix and projected employment density

Industry	Employees Per Hectare	Industry Mix (%)	Employee		Projected Employment on Completion
			Stages 1-4 (325ha)	Stages 5-10 (430ha)	
Construction	15	15	731	968	1,699
Wholesale Trade	15	20	975	1,290	2,265
Manufacturing	15	20	975	1,290	2,265
Retail Trade	20	15	975	1,290	2,265
Transport and Storage	15	15	731	968	1,699
Property and Business Services	40	10	1,300	1,720	3,020
Other	15	5	244	323	566
	19	100	5,931	7,848	13,779

Employment densities of between 15 and 40 employees per hectare have been adopted for each industry type that is likely to locate in the HEZ. The mix of industries outlined in Table 3.1 (above) provides the basis for developing indicative employment generation in each sector. Manufacturing will provide a large proportion of the projected total employment for the HEZ. Construction, transport and storage, and other industries make up a lower proportion of total employment as result of likely lower employment densities, despite a similar proportion of the industry mix. The total (Stages 1 to 10) indicative employment generation for the HEZ is projected to be about 13,700 employees from these land use assumptions.

Employment densities of 28 employees per hectare, assumed by the Roads and Traffic Authority for traffic generation purposes (Table 3.2), are unlikely to be reached in the majority of industrial sectors expected to locate at the HEZ.

However property and business services, and other professional functions required to service the industrial area, are likely to generate significantly higher employment

densities (approximately 40 per hectare). These are purely office functions, requiring small premises and employing relatively high numbers of staff.

Therefore the average employment density is expected to be approximately 19 employees per hectare, rather than RTA's 28 employees per hectare, and total employment closer to approximately 13,700 than 21,000. The RTA has agreed with this.

Table 3-2 RTA standard comparative table - indicative industrial mix and projected employment density

Industry	Employees Per Hectare	Industry Mix (%)	Employee		Projected Employment on Completion
			Stages 1-4 (NDA - 325ha)	Stages 5-10 (NDA-430ha)	
Construction	28	15	1,365	1,806	3,171
Wholesale Trade	28	20	1,820	2,408	4,228
Manufacturing	28	20	1,820	2,408	4,228
Retail Trade	28	15	1,365	1,806	3,171
Transport and Storage	28	15	1,365	1,806	3,171
Property and Business Services	28	10	910	1,204	2,114
Other	28	5	455	602	1,057
	28	100	9,100	12,040	21,140

3.1 Summary

From the available information, and on the basis of both local and regional trends, projections for both employment density and industry mix have been developed for the HEZ. The rate of take up in this location is closely linked to market forces, competition between industrial estates and the supply and demand of industrial land for each industry type and size and therefore may vary depending on these market circumstances. However, for traffic impact assessment purposes an indicative time frame of 10 years has been assumed for Stages 1 and 2 development (206Ha).

4. Traffic Forecasting Process

4.1 Model overview

The Lower Hunter Regional traffic model was used to assess the likely changes in traffic patterns and demands arising from the development of the HEZ and to identify potential constraints in road capacity. This traffic model (TransCAD) was developed as part of the National Highway F3 to Branxton Link traffic study for the State Government. The model represents the weekday daily and AM peak period (between 7:00 and 9:00) traffic conditions associated with the assumed future road network and land use developments. The model covers the entire Lower Hunter region, comprising the six Statistical Local Areas (SLAs) of Newcastle – inner, Newcastle – Remainder, Lake Macquarie, Cessnock, Maitland and Port Stephens. The model network includes all National, State and Regional roads, and local roads generally down to the level of collector road.

PB updated this base model (with the growth of background traffic) to include the HEZ development and the access to the site as described in Section 1.3. A comparison of the estimated traffic conditions for the updated network conditions with those for the base model (or background traffic conditions) provided a good indication of the incremental impacts of the HEZ Precinct 1 development on the performance of the road network and of further capacity constraints that might arise. The network model was run for years 2002 for AM peak two hour period future traffic conditions. The medium land use projection has been used to determine background traffic conditions consistent with the regional traffic model.

The network modelling was supplemented by more detailed assessments of selected key intersections using the SIDRA intersection model for AM and PM peak hours. The PM peak hour travel pattern was a mirror of the AM peak, using PM peak hour factors derived from traffic counts. This model provides more detailed analysis of intersection performance indicators including delays, queue lengths and levels of service than is provided by TransCAD.

4.2 Local area model calibration

Model calibration is the process by which the initial model inputs and parameters are adjusted in a logical and controlled manner until the model matches a set of observed values. This calibration process confirms that appropriate parameters are chosen, thus ensuring that when the model is used in forecast mode that the results will be consistent with the inputs and current behavioural responses. Three measures were computed as part of the HEZ local study area model calibration. They are:

- the correlation coefficient (R^2) for region-wide observed traffic counts versus estimated volumes should be greater than 0.95
- the percent Root Mean Square Error (%RMSE)

$$\%RSME = \frac{\left(\sum_j \left(Model_j - Count_j\right)^2 / \left(Number\ of\ Counts - 1\right)^{0.5} * 100\right)}{\left(\sum_j Count_j / NumberofCounts\right)}$$

  should be < 30 percent.
- comparison between surveyed and modelled intersection performance

In the HEZ local model, the R^2 for observed, compared with modelled volumes, for 46 directional traffic counts is 0.96, which meets the criteria (See Figure 4.1).

The calculated difference between model and counts for HEZ local Study area is lower than the target RMSE above. For the study area, the %RMSE is 18% percent, which includes state, regional and local roads. This meets the recommended criteria.

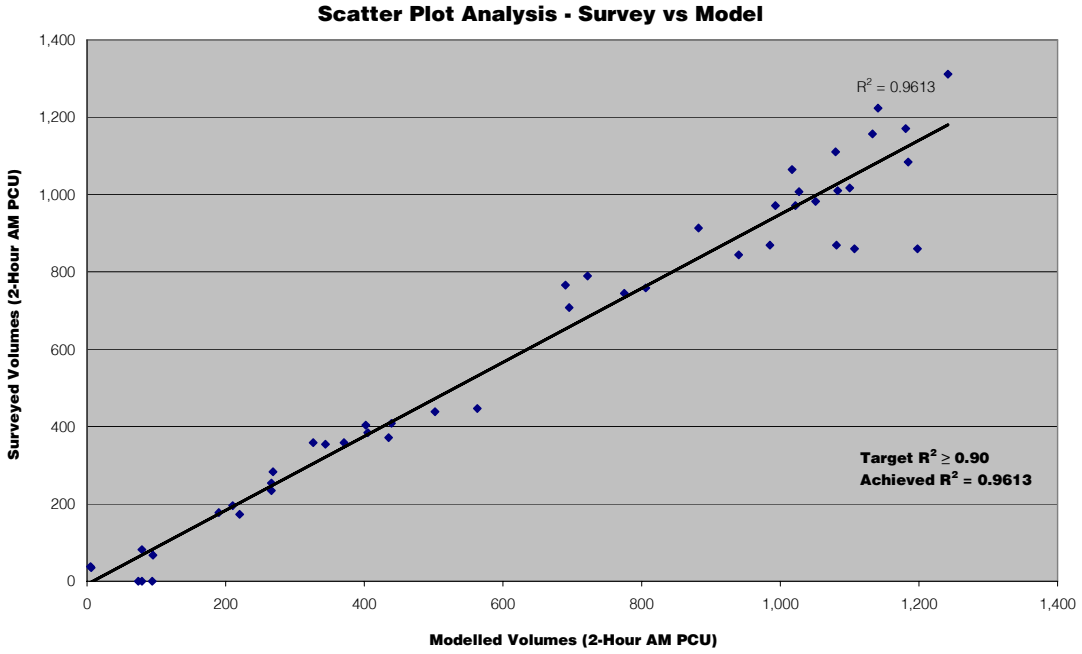

Figure 4-1 Correlation coefficient plot-surveyed vs modelled two hours volumes

Table 4.1 presents AM peak 2 hours calibrated traffic volumes for year 2002 traffic conditions. From Table 4.1 it is seen that total modelled volume for all types of roads in the study area varies between 6% and 7% from the actual volumes.

Table 4-1 Comparison of surveyed flows (vehicles) with modelled Flows – AM peak two hours in 2002

Road	Location	2002 Survey		2002 Model		Difference		% Difference	
		NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB
Station Street	North of Cessnock Road	845	178	947	173	102	-5	11%	-3%
Cessnock Road	West of Station Street	870	954	947	992	77	38	8%	4%
Appleton Avenue	South of Cessnock Road	73	87	79	66	6	-21	8%	-32%
Northcote Street	East of Appleton Avenue	1,027	971	1,132	957	105	-14	9%	-1%
Northcote Street	West of Appleton Avenue	1,073	1,003	1,146	985	73	-18	6%	-2%
Boundary Street	South of Cessnock Road	238	254	233	253	-5	-1	-2%	0%
Northcote Street	East of Boundary Street	782	748	890	735	108	-13	12%	-2%
Mitchell Avenue	South of Northcote Street	811	829	971	1,020	160	191	16%	19%
Northcote Street	East of Mitchell Avenue	184	170	192	172	8	2	4%	1%
Mitchell Avenue	North of Northcote Street	337	396	400	425	63	29	16%	7%
Northcote Street	West of Mitchell Avenue	608	635	761	718	153	83	20%	12%
Victoria Street	South of Lang Street	1,024	812	832	822	-192	10	-23%	1%
Lang Street	East of Mitchell Avenue	605	619	686	735	81	116	12%	16%
Mitchell Avenue	North of Lang Street	1,012	879	1,045	1,061	33	182	3%	17%
Lang Street	West of Mitchell Avenue	256	349	275	350	19	1	7%	0%
Tarro Street	South of Railway Street	1,013	1,036	1,181	1,244	168	208	14%	17%
Victoria Street	North of Railway Street	943	845	832	822	-111	-23	-13%	-3%
Railway Street	West of Tarro Street	501	379	428	357	-73	-22	-17%	-6%
Stanford Street	South of Railway Street	344	274	387	343	43	69	11%	20%
Mulbring Street	West of Stanford Street	393	334	370	344	-23	10	-6%	3%
Total		**12,939**	**11,752**	**13,734**	**12,574**	**795**	**822**	**6%**	**7%**

The performance indicators of selected intersections based on actual counts was compared to those with modelled turning volumes. Table 4.2 presents comparison between level of service and intersection delays. Operational parameters for the surveyed intersections are close to those based on the modelled volumes. The results

implied that intersections without actual counts could be assessed with a certain degree of confidence in the future.

Table 4-2 Intersection Performance comparison between surveyed and modelled for AM peak hour

Intersections	Controls	Surveyed			Modelled		
		DoS	Delays	LoS	DoS	Delays	LoS
Cessnock Rd / Station St	Fixed Signals	0.70	17	B	0.82	20	B
Northcote St / Appleton Ave	Giveway Control	0.37	11	A	0.36	15	B
Northcote St / Boundary St	Stop Control	0.31	15	B	0.29	14	A
Northcote St / Mitchell Ave	Roundabout	0.36	11	A	0.42	11	A
Mitchell Ave / Lang St	Roundabout	0.43	14	A	0.4	14	A
Railway St / Tarro St	Roundabout	0.27	13	A	0.3	13	A
Railway St / Stanford St	Giveway Control	0.28	10	A	0.28	10	A

Thus, it was reasonable to conclude that the calibration of the existing situation is acceptable and can form the basis for the modelling of future conditions.

5. The Impact of the Proposal

5.1 Industrial land traffic generation factors

PB recently undertook surveys in Hunter Valley business parks/industrial areas to estimate the likely trip generation for the proposed HEZ in comparison to the trip generation figures generally applied from the RTA guidelines. The differences were quite marked. The differences in employment levels directly influenced travel behaviour.

RTA trip generation guidelines provide a broad peak hour trip generation rate for known industry types including business parks where developments may occur across a range of industrial land use types in an integrated complex. While these are the recognised standards under infrastructure SEPP, there are cautions about using RTA's trip generation rates which include:

- the base industry surveys were undertaken during over 10 years ago and production methods, employment rates and logistics have changed;
- business parks in the survey ranged in size from some 7,300 m^2 to 38,200 m^2 of GFA, and the implications of size were not accounted for in the single ratios for generation. The ultimate HEZ development will yield 3,020,000 m^2 of GFA, so it is well outside the range surveyed;
- in the RTA surveys, higher employee density were present in the large industrial estates (28 employees per developable hectare) but this far exceeds the employee yields discovered in the Hunter of 18-19 employees per hectare.

PB forecasted trip generation rates for HEZ industrial development for the following two cases:

- using RTA trip generation rates for three scenarios of industrial land uses; and
- using trip generation rates from recent surveys.

It is noted that RTA trip generation guidelines provide limited information on trip generation rates for industry mixes as found in Thornton and Rutherford industrial estates where the recent surveys were done. To help compare the figures, PB broadly classified adopted industrial mixes from the following trip generation categories:

- business park (factory/warehouse);
- business park (office showroom);
- factories;
- warehouses.

Table 5.1 overleaf shows that while the mix of industrial uses does impact on the overall forecast trips, the difference is not significant. The peak hour traffic to and from the fully developed HEZ would range between 22,650 and 25,142, a difference of 10%, well within forecasting error for 20 year forecast. A likely result would be around 24,000 peak hour trips using RTA trip generation guidelines.

The trip generation rate was further investigated using survey results from Thornton and Rutherford Industrial Estates. Maitland Council provided detailed industrial land survey data for both sites. PB conducted traffic tube counts on all access roads to the industrial estates which potentially captured 100 percent industrial site related traffic. Any through traffic that may influence survey results is accepted within the forecast. Table 5.2 overleaf provides base land use and traffic data used to derive trip generation rate for each site. This generation rate reflects actual industrial mix. Key conclusions from Table 5.2 include:

- even with selecting the highest hourly volumes over the week from AM and PM peak hours, trip generation rates from Thornton North were a third of RTA's general rate, and at Rutherford, it was about an eighth;
- applying the recent survey data, once fully developed, HEZ could be expected to generate/attract between 6,000 and 10,000 peak hours trips compared to the 24,000 or so from applying RTA generation rates;
- looking at all the factors, a reasonable estimate for peak hour trip generation/attraction from a fully developed HEZ would be in the range of 10,000 total trips to be distributed across the two external connections with the road network based on the split with external attractors/generators from the strategic model. The RTA has agreed with this.
- risks from applying an excessive rate would include designs in excess of demand that discourage all but car access to the site and unnecessary concern in the community from overstating likely traffic levels when looking at environmental impacts.

Table 5-1 Peak hour trip generation under three development mix scenarios (based on RTA rates)

HEZ Stages	GFA (ha)	% Industrial mix	GFA (ha)	GLA (ha)	Development	Peak Trip Rate	Generation Rate Basis	Two way Trips
Case 1								
1 to 10	302	10%	30.2	22.65	Business Park-Office/Showroom	1.2	100sqm GLFA	2,718
		90%	271.8	203.85	Business Park-Factory/Warehouse	1.1	100sqm GLFA	22,424
			0	0	Factories	1	100sqm GFA	0
			0	0	Warehouses	0.5	100sqm GFA	0
	302	**100%**	**302**	**226.5**				**25,142**
Case 2								
1 to 10	302		0	0	Business Park-Office/Showroom	1	100sqm GLFA (two way)	0
			0	0	Business Park-Factory/Warehouse	1.2	100sqm GLFA (two way)	0
		50%	151	113.25	Factories	1	100sqm GFA	15,100
		50%	151	113.25	Warehouses	0.5	100sqm GFA	7,550
	302	**100%**	**302**	**226.5**				**22,650**
Case 3								
1 to 10	302	10%	30.2	22.65	Business Park-Office/Showroom	1	100sqm GLFA (two way)	2,265
		50%	151	113.25	Business Park-Factory/Warehouse	1.2	100sqm GLFA (two way)	13,590
		20%	60.4	45.3	Factories	1	100sqm GFA	6,040
		20%	60.4	45.3	Warehouses	0.5	100sqm GFA	3,020
	302	**100%**	**302**	**226.5**				**24,915**

Note :Assume-100 m^2 GFA equals to 75 GLA

Table 5-2 Comparative trip generation from industrial estates survey (1-hour peak)

Site Related Traffic on all Access Roads

	Car + Truck		Car		Truck	
	Rutherford	Thornton North	Rutherford	Thornton North	Rutherford	Thornton North
	2-Way	2-Way	2-Way	2-Way	2-Way	2-Way
AM Peak Traffic	561	736	473	543	120	193
PM Peak Traffic	657	794	582	618	118	213

Source: Traffic Tube Counts July 2005 Notes: Cars and truck may not add up due to different max days selected

Traffic Generation Rate (site related cars and trucks on all access roads)

	Car + Truck		Car		Truck	
	Rutherford	Thornton	Rutherford	Thornton	Rutherford	Thornton
Total 2005 Developed Land (ha)	127.1	60.6	127.1	60.6	127.1	60.6
Assume 40% of developed land is GFA (ha)	50.8	24.2	50.8	24.2	50.8	24.2
Peak Trip Generation Rate / 10,000sqm GFA	12.9	32.8	9.3	22.4	2.4	8.0
Peak Trip Generation Rate / 100sqm GFA	0.13	0.33	0.09	0.22	0.02	0.08

Note: Potential Traffic Generation of HEZ Development based on Sample Sites; Assume 40% of land (minus buffer zone) is gross floor area (GFA)

All vehicles (car + truck)

HEZ Stages	Total Land size (ha)	Land size minus buffer zone (ha)	GFA (ha)	Peak Trip Gen Rate (trip/100sqm GFA)		Peak Trip Generation		
				Rutherford Rates	Thornton Rates	Rutherford Rates	Thornton Rates	Average (2 sites)
Stages 1 to 4	360	325	130	0.13	0.33	1,680	4,258	2,969
Stages 5 to 10	504	430	172	0.13	0.33	2,222	5,634	3,928
Total	**864**	**755**	**302**	**0.13**	**0.33**	**3,902**	**9,892**	**6,897**

5.2 Future traffic conditions

Future traffic conditions in and around HEZ study area will be influenced by the combined factors of background traffic growth and by changes to transport network. Background traffic growth will be affected by the change in population and employment. The following section is a summary of model results tested on 2010 background traffic demand with HEZ Stages 1 and 2.

5.2.1 Network- Impact of F3/2B

The F3/2B proposed link is some 40 km in length, and is planned to be constructed for freeway standard with dual two lane carriageways, and grade separated interchanges at six access points with the F3 Freeway at Seahampton, Buchanan, Kurri Kurri, Loxford, Allandale and Branxton.

The funding for the project has yet to be committed, and no announcement on the start of construction has been made. Due to uncertainty in funding of this project, RTA has suggested PB to model the HEZ traffic impact without F3/2B. To understand the network implication of this project in relation to the HEZ site, we have selected a wider area network for reporting traffic forecasts.

A summary of the differences of not having F3/2B is shown in Table 5.3 on key roads, while Table 5.4 provides detailed two-way forecast volumes for Stage 1 and 2 for the AM peak one hour.

Table 5-3 Summary of F3/2B Impact on the Wider Network

Key Roads	Impact Not having F3/2B	Quantify Traffic Impacts
MR220 (Branxton Toronto Road) between F3 at Freemans Waterhole interchange and MR195 (Leggetts Drive)	Negative	Traffic increase by about 400 vehicles per hour (vph) compared with F3/2B no build option.
MR220 (Lake Road) west of Leggetts Drive	Negative	Traffic increase by 370 vph.
MR195 (Leggetts Drive) between Mulbring and Kurri Kurri	Negative	Traffic increase by about 230 vph.
MR588 (John Renshaw Drive, JRD) between Kurri Kurri and F3/2B proposed interchange at Buchanan	Negative	This section of MR588 runs parallel to the F3/2B link. Without this link, traffic increases by varying amount depending on the F3/2B interchange locations. For instance, traffic increase by 950 vph to 1050 vph on JRD/Victoria Street between proposed F3/2B interchange at Buchanan and Lang Street/Main Road. While there is a 340 vph increase on Mitchell Avenue south of Northcote Street, it is largely offset by proposed interchanges at Main Road, Hart Road. It is noted, F3/2B link will redistribute traffic for the entire network depending on users origin and destination and their preferred route choices with the new link.

Key Roads	Impact Not having F3/2B	Quantify Traffic Impacts
MR527 (George Booth Drive) between F3 at Seahampton and proposed interchange at Buchanan	Negative	MR527 runs parallel to the F3/2B link. Without this link, traffic increases about 1250 vph on MR527. HEZ traffic contributes about 530 vph (38% of the link volume). See Section 5.2.2 for HEZ traffic contributions for other locations.
Main Road/ Lang Street between Kurri Kurri and F3/2B proposed interchange	Positive	Traffic decrease by 800 vph on the Main Road, west of proposed Kurri Kurri interchange. Less traffic decreases (about 350 vph) on the Lang Street built up section between Mitchell Avenue and Cantwell Street. Potential traffic loss at this section is attributable to origin/destination of trips via residential access roads.
Sawyers Gully Road /Major Lane	Negative	With the increased congestion on the New England Highway particularly during peak period, MR527 (George Booth Drive), MR588 (John Renshaw Drive) and Sawyers Gully/Major Lane provide alternative route from Newcastle to Greta. Without F3/B2, traffic will increase about 50 to 100 vph on Sawyers Gully/Major Lane as drivers seek less congested route.
Government Road between Northcote Street and Hart Road	Positive	Traffic decrease by about 160 vph, mainly due to the absence of the F3/2B Hart Road interchange.
Cessnock Road/First Street between Government Road and HEZ Station Street access	Positive	Traffic decrease at this section by 30 vph to 160 vph due to direct influence of F3/2B Hart Road interchange. Without F3/2B, traffic redistributed to various travel routes.

Table 5-4 AM Peak One Hour Traffic Forecast with HEZ Stages 1 and 2 (206Ha) - Options 1 and 2 – Impact of F3/2B

ID	Road	Location	OPT 2 With F3/2B	OPT 1 Without F3/2B	Difference for F3/2B	% Change
2	Cessnock Road	West of Station Street	1310	1200	-110	-9%
3	Station Street	North of Cessnock Road	690	660	-30	-5%
4	First Street	West of Hall Street	650	610	-40	-6%
5	Cessnock Road	West of Government Road	990	830	-160	-16%
6	Government Road	North of Cessnock Road	590	430	-160	-28%
7	Northcote Street	West of Boundary Street	1460	1490	30	2%
9	Boundary Street	North of Deakin Street	350	360	10	4%
11	Mitchell Avenue	South of Northcote Street	950	1290	340	35%
12	Main Road	West of Kurri Kurri Interchange/ East of Cantwell Street	1670	870	-800	-48%
13	Lang Street	West of Merthyr Street	1450	1100	-350	-24%
14	Station Street	South of Cessnock Road (HEZ northern access)	810	730	-80	-11%
19	MR588 John Renshaw Drive	East of Pelaw Main Bypass/ West of F32B Buchanan Interchange	2050	3090	1040	51%
20	Leggetts Drive	South of Wallsend Street/North of HEZ Eastern Access	180	230	50	24%
21	HEZ Spine Road	West of Leggetts Drive (HEZ Eastern Access)	1560	1660	100	6%
22	Pelaw Main Bypass	East of Leggetts Drive	1920	1990	70	4%
45	Victoria Street	South of Lang Street	130	1070	940	754%
49	Northcote Street (Railway Bridge)	West of Appleton Avenue	1370	1390	20	2%
38	Sawyers Gully Road	North of Metcalfe Lane	640	690	50	8%
39	Majors Lane	East of Lovedale Road	490	590	100	20%
29	MR220 Branxton-Toronto Road	Between F3 and MR195 (Leggetts Drive)	690	1100	410	58%
30	MR220 Lake Road	West of MR195 Leggetts Drive	1000	1370	370	37%
31	MR195 Leggetts Drive	South of HEZ Spine - Pelaw Main Bypass Intersection	1220	1450	230	18%
34	MR527 George Booth Drive	South of John Renshaw Drive (MR588)	190	1430	1240	666%
33	MR527 George Booth Drive	North of F3 Freeway	150	1400	1250	858%

5.2.2 Network- Impact of HEZ Stage 1 and Stage 2

This section describes the impact of HEZ staged development on the wider road network for AM peak one hour traffic condition. The traffic model assumed the network changes noted below:

- No F3/2B for both Options 1 and 3;
- Two HEZ accesses- the northern access at Station Street and the eastern access at Leggetts Drive;
- Pelaw Main bypass and RTA programmed works were assumed for both Options 1 and 3 for consistent network modelling.

Under the Staged 1 and 2 HEZ development, PB modelled an additional 2400 HEZ-generated vehicles on the road network for one hour. Model results are summarised in Table 5.5. Traffic may change on any road link as a combined effect of background growth, network changes and HEZ traffic. We have quantified the causes separately, in particularly HEZ's contribution. We have done a "select link" analysis to quantify exclusively traffic increase on wider road network due to HEZ. It is noted HEZ traffic contribution may differ on some locations due to background growth and network attribute changes.

The column named "Change due to HEZ and Network Attribute" (Column 6) in Table 5.5 represents traffic change due to combined effect of background growth, network changes and HEZ. The column named "HEZ Traffic Contribution and % HEZ Traffic Contribution" (Columns 7 and 8) in Table 5.5 represents HEZ traffic contribution alone.

Key model outcomes in Table 5.5 indicate the following increase in traffic attributable to HEZ Stage 1 and Stage 2 development in the AM peak hour:

- HEZ traffic at the access on Station Street is about 730 vehicles per hour. About 30% HEZ traffic uses this access and remaining 70% uses the eastern access at Leggetts Drive. The users of HEZ Station Street access traffic are mainly:
  - from Cessnock, Branxton, upper Hunter via Cessnock Road, about 210 HEZ traffic (18% increase);
  - from Maitland, Heddon Greta via Main Road/Lang Street and then Mitchell Avenue, Northcote Street (Railway overbridge), about 320 vph HEZ traffic (about 23% increase). This also includes 100 vph HEZ traffic with origin/destination at Kurri Kurri local area;
  - from Sawyers Gully, Loxford, Greta, and partly Weston via Sawyers Gully Road and then Government Road, about 170 vph HEZ traffic (about 41% increase).
- Minor increase in HEZ traffic on Victoria Street and Leggetts Drive as the majority of traffic from Maitland, Heddon Greta, would prefer to use the northern access at Station Street.
- HEZ traffic at the eastern access on Leggetts Drive is about 1,660 vph. The main user of this access having origins of new traffic are:
  - from Newcastle, Lake Macquarie via George Booth Drive (MR 527). About 530 vph HEZ traffic (about 38% increase) on the MR527 (north of F3);

- from Newcastle, part of Maitland (Thornton, Beresfield) via John Renshaw Drive (MR588). About 420 vph HEZ traffic (about 31% increase) on MR588, east of George Booth Drive;
- from East Maitland via Buchanan Road. About 200 HEZ traffic (about 36% increase) on the Buchanan Road north of John Renshaw Drive;
- from Sydney via Branxton, Toronto Road (MR220). About 340 vph HEZ traffic (about 30% increase) on the MR220, north of F3;
- from Kearsley, Elrington via Lake Road. About 100 HEZ traffic (about 7% increase) on the Lake Road, west of Leggetts Drive (MR195).

The above analysis has supported the view that HEZ would have impact upon the wider road network, if the F3/2B project did not proceed, in particularly on the state road including George Booth Drive (MR527), John Renshaw Drive (MR588) and Branxton-Toronto Road/ Lake Road (MR220).

Table 5-5 AM Peak One Hour Traffic Forecast for Options 1 and 3 showing HEZ Traffic Contribution (No F3/2B)

ID	Road	Location	OPT 3 Background but No HEZ	OPT 1 Background plus HEZ Stages 1 and 2	Change due to HEZ and Network Attributes	HEZ Traffic Contribution	% HEZ Traffic Contribution
2	Cessnock Road	West of Station Street	950	1200	250	210	18%
3	Station Street	North of Cessnock Road	560	660	100	110	16%
4	First Street	West of Hall Street	520	610	90	90	15%
5	Cessnock Road	West of Government Road	400	830	430	400	48%
6	Government Road	North of Cessnock Road	230	430	200	170	41%
7	Northcote Street	West of Boundary Street	1110	1490	380	330	22%
9	Boundary Street	North of Deakin Street	370	370	0	10	4%
11	Mitchell Avenue	South of Northcote Street	980	1290	310	280	22%
12	Main Road	West of Kurri Kurri Interchange/ East of Cantwell Street	580	870	290	180	21%
13	Lang Street	West of Merthyr Street	810	1100	290	220	20%
14	Station Street	South of Cessnock Road	0	730	730	730	100%
19	MR588 John Renshaw Drive	East of Pelaw Main Bypass/ West of F32B Buchanan Interchange	2140	3090	950	1160	37%
20	Leggetts Drive	South of Wallsend Street/ North of HEZ Eastern Access)	220	230	10	40	19%
21	HEZ Spine Road	West of Leggetts Drive (HEZ Eastern Access)	0	1660	1660	1660	100%
22	Pelaw Main Bypass	East of Leggetts Drive	1010	1990	980	1120	56%
45	Victoria Street	South of Lang Street	1070	1070	0	60	5%
49	Northcote Street (Railway Bridge)	West of Appleton Avenue	1060	1390	330	320	23%
38	Sawyers Gully Road	North of Metcalfe Lane	540	690	150	160	23%
41	Old Maitland Road	North of Majors Lane	580	690	110	100	15%
53	Wollombi Road	East of Old North Road	560	650	90	70	11%
29	MR220 Branxton-Toronto Road	Between F3 and MR195 (Leggetts Drive)	710	1100	390	330	30%
30	MR220 Lake Road	West of MR195 Leggetts Drive	1320	1370	50	90	7%
31	MR195 Leggetts Drive	South of HEZ Spine – Pelaw Main Bypass Intersection	1050	1450	400	500	34%
35	MR588 John Renshaw Drive	East of George Booth Drive (MR527)	1030	1360	330	420	31%
34	MR527 George Booth Drive	South of John Renshaw Drive (MR588)	930	1430	500	540	37%
33	MR527 George Booth Drive	North of F3 Freeway	910	1400	490	530	38%
36	Buchanan Road	North of John Renshaw Drive (MR588)	350	550	200	200	36%

6. Intersection Capacity Improvements for Stage 1 and Stage 2 (206Ha)

6.1.1 Principles

The road network will need to be extended and/or upgraded progressively over the next 34 years to cater for the forecast increase in traffic volumes which will result from both the ultimate HEZ development and the general growth in traffic passing through the region. The timing of the individual road and intersection capacity improvements for Stage 1 and 2 would depend on a number of factors, but the prime factor would be the rate of development within HEZ. It has been assumed for the purpose of predicting traffic that this will occur at an average rate of 23 hectares per annum between 2006 and 2016 followed by a rate of about 18.9 hectares per annum between 2016 and 2024. The rate of development for Crown and Mindaribba land was unknown, but we assumed average 31.5 hectares per annum between 2024 and 2040.

The performances of key intersections were assessed under different future scenarios to determine the extent of any intersection improvements that might be attributable to HEZ development. Estimates of turning movements at the intersections for each stage of development were derived from the network traffic model.

Intersection performance simulations were run for model options (Stages 1 and 2) with, and without HEZ. Network performance was measured by Level of Service (LoS). The Intersection improvements were identified by a three step process:

- Firstly, base future network model was run with the existing network;
- Secondly, potential improvements were identified at each intersection and network level;
- Thirdly, SIDRA model was run iteratively until a satisfactory LoS was obtained for key intersections;

For consistent comparison between options (with and without HEZ) and to identify incremental intersection improvements, we assessed a total of 16 key intersections LoS with the performance due to HEZ Stage 1 and 2 development assuming two accesses at Station Street and Leggetts Drive (refer to

Table 6-2, see page 43). Improvement options for critical intersection were identified and tested to determine optimal LoS.

PB also assumed the following parameters for SIDRA intersection simulations:

- lane configurations were based on existing layout, unless specified as an improved option (based on the previously advised RTA improvements works). Cessnock Road/Station Street signal phasing is based on RTA's TCS plan;
- for sign controlled intersection, critical gap and follow up headways for minor roads were assumed to be:
  - left turn (4.5 sec, 2.5 sec)
  - through (5 sec, 3 sec)
  - right turn (5.5 sec, 3.5 sec).

The above parameters were consistent with the values suggested in Austroads' *Guide to Traffic Engineering Practice-Part 5: Intersection at Grade*.

Comparing intersections' LoS results from Table 6.1 (am) and Table 6.2 (pm) demonstrated that, five intersections would be expected to fail due to the combined impact of background and HEZ Stages 1 and 2 (206Ha) traffic growth on base[1] network, these being:

- First Street/Government Road/Cessnock Road/Northcote Street
- Leggetts Drive/Lake Road
- George Booth Drive/John Renshaw Drive
- John Renshaw Drive/Buchanan Road
- John Renshaw Drive/F3.

It should be noted that even without Stages 1 and 2 of HEZ, George Booth Drive/John Renshaw Drive, John Renshaw Drive/Buchanan Road and F3/John Renshaw Drive intersections show capacity problems during peak periods.

[1] Base network does not include any traffic management works (including turn bans, road closure that will be required for satisfactory intersection LoS).

Table 6-1 Intersection Performance Showing Stages 1 and 2 (206Ha) HEZ Impact for AM Peak (combined impact of background and HEZ traffic growths)

ID	Intersection	Intersection Control	OPT3 (No HEZ) AM Peak				OPT1 (With Staged HEZ) AM Peak			
			DoS	Delays	LoS	Comments	DoS	Delays	LoS	Comments
01	Cessnock Road / Station Street (HEZ Northern Access)	Signals	0.62	18	B	No capacity problem	1.00	26	B	85 vph LT from Station Street to Cessnock Road; Ave delay of 55 sec;4 vehicle queue
02	Northcote Street / Appleton Avenue	Priority	0.37	16	B	No capacity problem	0.57	39	C	No capacity problem
03	Northcote Street / Boundary Street	Priority	0.34	13	A	No capacity problem	0.41	16	B	No capacity problem
04	Northcote Street / Mitchell Avenue	Roundabout	0.38	10	A	No capacity problem	0.44	10	A	No capacity problem
05	Mitchell Avenue / Lang Street	Roundabout	0.27	9	A	No capacity problem	0.54	10	A	No capacity problem
06	Railway Street / Tarro Street	Roundabout	0.24	8	A	No capacity problem	0.26	8	A	No capacity problem
07	Railway Street / Stanford Street	Priority	0.14	8	A	No capacity problem	0.15	8	A	No capacity problem
08	Leggetts Drive / HEZ Spine Road / Pelaw Main Bypass (HEZ Eastern Access)	New Signals	0.58	22	B	-	0.84	35	C	No capacity problem
09	John Renshaw Drive / Bypass	New Roundabout	0.32	14	A	-	0.67	14	A	No capacity problem
10	Northcote Street / Alexandra Street	Priority	0.19	15	B	No capacity problem	0.35	24	B	No capacity problem
11	First Street / Government Road/Cessnock Road/Northcote Street	Priority	0.25	19	B	No capacity problem	1.00	>70	F	191 vph (north approach) T&RT from Government Road; Ave. delay of 200 sec; 25 vehicle queue
12	Boundary Street/Lang Street	Roundabout	0.12	8	A	No capacity problem	0.12	8	A	
13	Leggetts Drive/Lake Road (MR195/MR220)	Priority	0.64	27	B	No capacity problem	1.19	>70	F	235 vph RT from Lake Road to Leggetts Drive; Ave. delay of 410 sec; 52 vehicle queue
14	George Booth Drive/John Renshaw Drive (MR527/MR588)	Priority	0.81	>70	F	26 vph RT from GBD to JRD Ave. delay of 126 sec; 2 vehicle queue	1.93	>70	F	Excessive delays and queues from GBD and RT from JRD
15	John Renshaw Drive/Buchanan Road	Priority	0.87	54	D	199 vph RT from Buchanan to JRD Ave. delay of 99 sec; 14 vehicle queue	> 2.00	>70	F	361 vph RT from Buchanan to JRD; Excessive delays and queues
16	John Renshaw Drive/F3	Roundabout	> 2.00	>70	F	Most of movements reached to capacity	> 2.00	>70	F	Most movements reach capacity

Table 6-2 Intersection Performance Showing Stages 1 and 2 (206Ha) HEZ Impact for -PM Peak (combined impact of background and HEZ traffic growths)

ID	Intersection	Intersection Control	OPT3 (No HEZ) PM Peak				OPT1 (With Staged HEZ) PM Peak			
			DoS	Delays	LoS	Comments	DoS	Delays	LoS	Comments
01	Cessnock Road / Station Street (HEZ Northern Access)	Signals	0.47	24	B	No capacity problem	1.00	46	D	180 vph LT from Cessnock to Station; Ave. delay of 33 sec 4 vehicle queue
02	Northcote Street / Appleton Avenue	Priority	0.34	16	B	No capacity problem	0.55	37	C	No capacity problem
03	Northcote Street / Boundary Street	Priority	0.31	13	A	No capacity problem	0.37	15	B	No capacity problem
04	Northcote Street / Mitchell Avenue	Roundabout	0.42	10	A	No capacity problem	0.73	13	A	No capacity problem
05	Mitchell Avenue / Lang Street	Roundabout	0.27	9	A	No capacity problem	0.40	9	A	No capacity problem
06	Railway Street / Tarro Street	Roundabout	0.26	8	A	No capacity problem	0.27	8	A	No capacity problem
07	Railway Street / Stanford Street	Priority	0.13	8	A	No capacity problem	0.13	9	A	No capacity problem
08	Leggetts Drive / HEZ Spine Road / Pelaw Main Bypass (HEZ Eastern Access)	New Signals	0.57	21	B	-	0.72	35	C	No capacity problem
09	John Renshaw Drive / Bypass	New Roundabout	0.30	14	A	-	0.67	17	B	No capacity problem
10	Northcote Street / Alexandra Street	Priority	0.22	15	B	No capacity problem	0.28	25	B	No capacity problem
11	First Street / Government Road/Cessnock Road/Northcote Street	Priority	0.37	24	B	No capacity problem	0.89	>70	F	129 vph (north approach) T&RT from Cessnock Road; Ave. delay of 152 sec; 13 vehicle queue
12	Boundary Street/Lang Street	Roundabout	0.12	8	A	No capacity problem	0.11	8	A	
13	Leggetts Drive/Lake Road (MR195/MR220)	Priority	0.82	34	C	No capacity problem	> 2.00	>70	F	361 vph RT from Lake to Leggetts Excessive delay and queue
14	George Booth Drive/John Renshaw Drive (MR527/MR588)	Priority	0.83	>70	F	54 vph RT from GBD to JRD; Ave. delay of 222 sec; 7 vehicle queue	1.63	>70	F	Excessive delay and queue from GBD and RT from JRD
15	John Renshaw Drive/Buchanan Road	Priority	0.77	46	D	156 vph RT from Buchanan to JRD Ave. delay of 67 sec; 8 vehicle queue	1.73	>70	F	208 vph RT from Buchanan to JRD Excessive delay and queue
16	John Renshaw Drive/F3	Roundabout	> 2.00	>70	F	Most of movements reached to capacity	> 2.00	>70	F	Most of movements reached to capacity

Note: For priority controlled intersection, LoS is determined by critical movements delay.

Two new intersections (see Figure 6-1 and 6-2 for conceptual layout) are required in conjunction with the Pelaw Main Bypass:

- Leggetts Drive/HEZ Spine Road/Pelaw Main Bypass signals; and
- John Renshaw Drive/Pelaw Main Bypass roundabout.

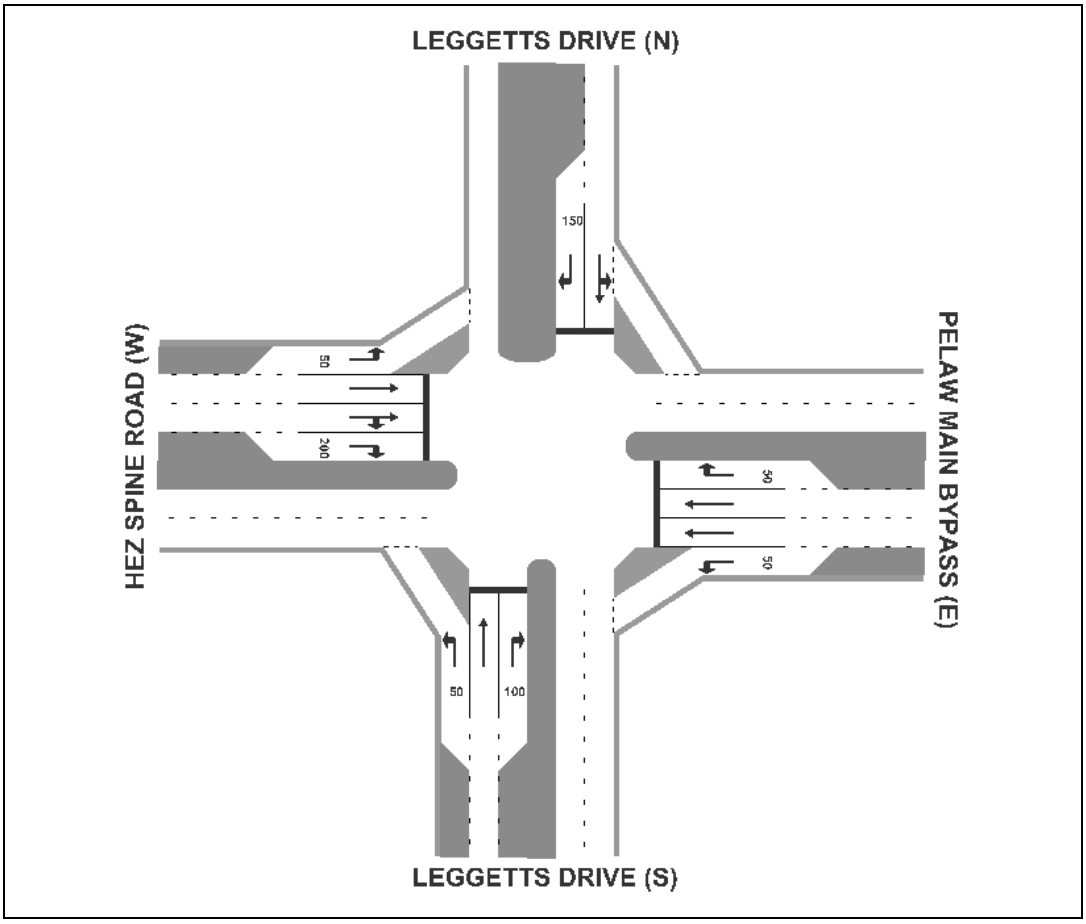

Figure 6-1 New Intersection with Leggetts Dr, HEZ Spine Rd and Pelaw Main Bypass

The Leggetts Drive/HEZ Spine Road intersection is currently approved as a temporary access for Hunter Enviro Mining and will require upgrading immediately to a type C at the start of Precinct 1. A sketch of the proposed type C intersection follows. It has been designed such that all the upgrading work will be completed on the western side and its layout modified to allow pavement retention for the future upgrading to a signalised intersection.

The type C intersection was also analysed for capacity to confirm how much of Precinct 1 could be developed before the second access at Station Street was required. Modelling determined that between 20.6Ha and 43.6Ha of Precinct 1 development is the trigger to require the second access. PB recommends the correct timing of the second access should be determined by ongoing modelling of the business types making up the first 20Ha.

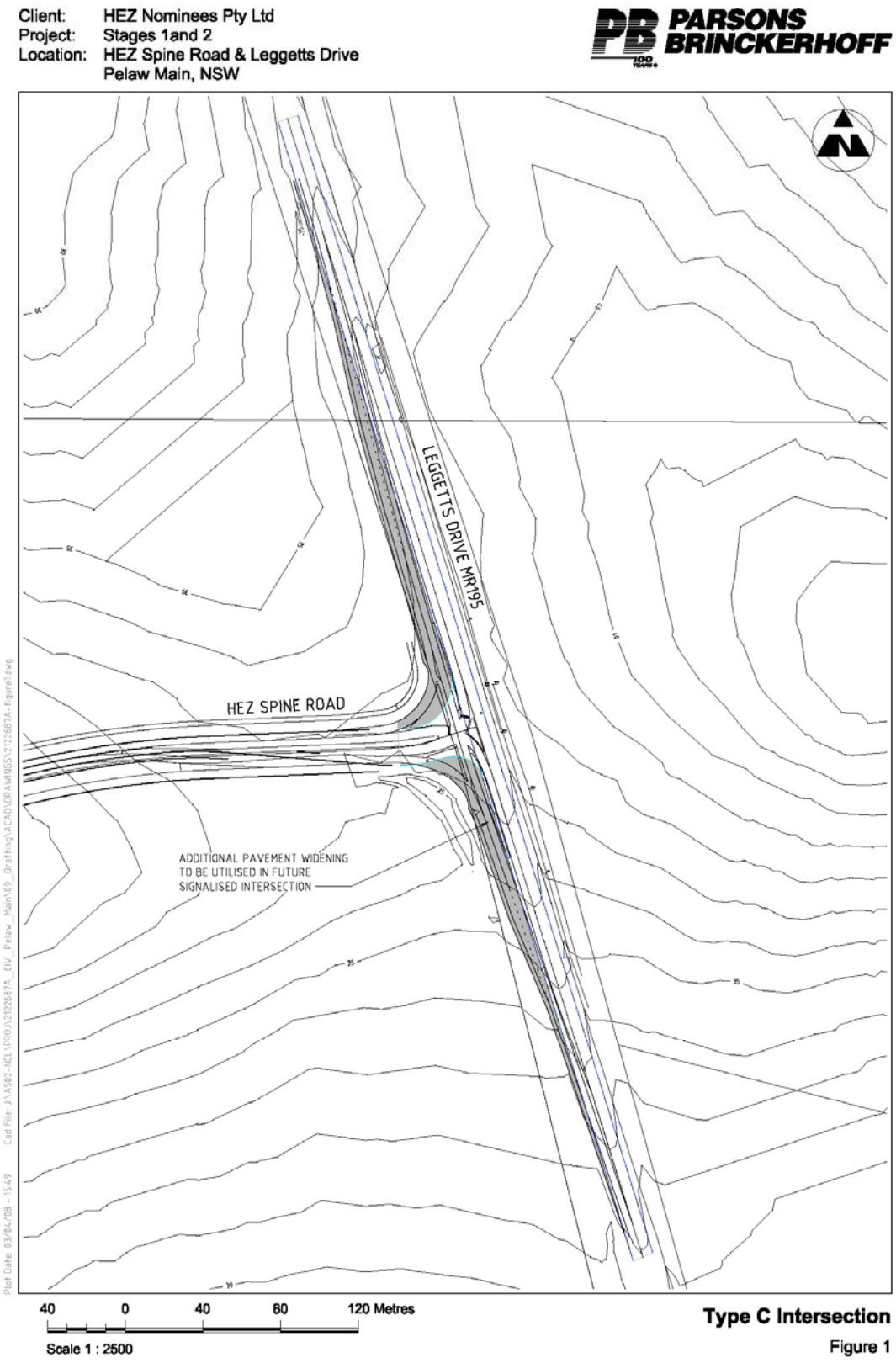

Figure 6-2 Type C intersection at HEZ Eastern Access

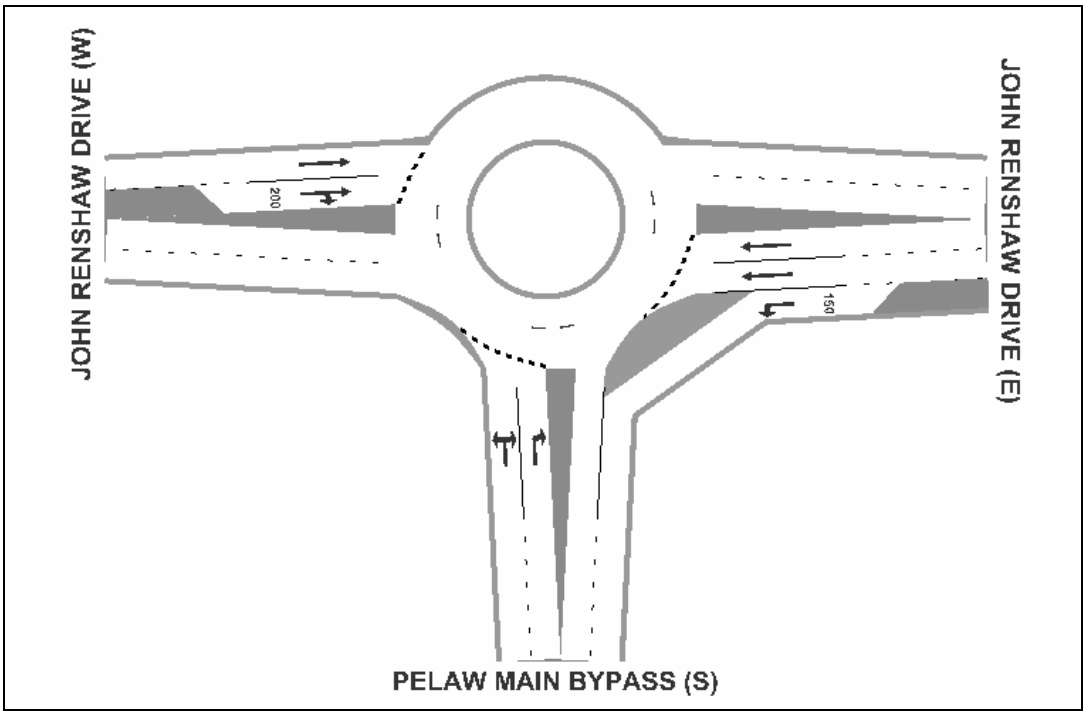

Figure 6-3 New Intersection with John Renshaw Drive and Pelaw Main Bypass

Based on Tables 6.1 and 6.2, the five intersections below would have some capacity constraints (DoS =1 or >1.0) with background growth and the completion of Stage 2 (206Ha) of HEZ:

- First Street/Government Road/Cessnock Road/ Northcote Street;
- Leggetts Drive/Lake Road (MR195/MR220)
- George Booth Drive/John Renshaw Drive (MR527/MR588); and
- John Renshaw Drive/Buchanan Road.
- John Renshaw Drive/F3

RTA has advised that new signals at First Street/Government Road/Cessnock Road/ Northcote Street would create safety issues and therefore, would not be a feasible improvement. Hence, PB has investigated traffic management measures that would reduce southbound traffic on Government Road, which was the critical movement responsible for the intersection's unsatisfactory performance. Under this traffic management scheme, we assumed network changes below.

- Install concrete median in the Government Road/Mitchell Avenue and Tenth Street intersection in such a way that it would prevent southbound HEZ traffic from using Government Road (see Figure 6.4).
- The southbound traffic would get access to HEZ via existing Northcote Street/Mitchell Avenue roundabout. This traffic diversion would reduce southbound traffic on the First Street/Government Road/Cessnock Road/ Northcote Street intersection.

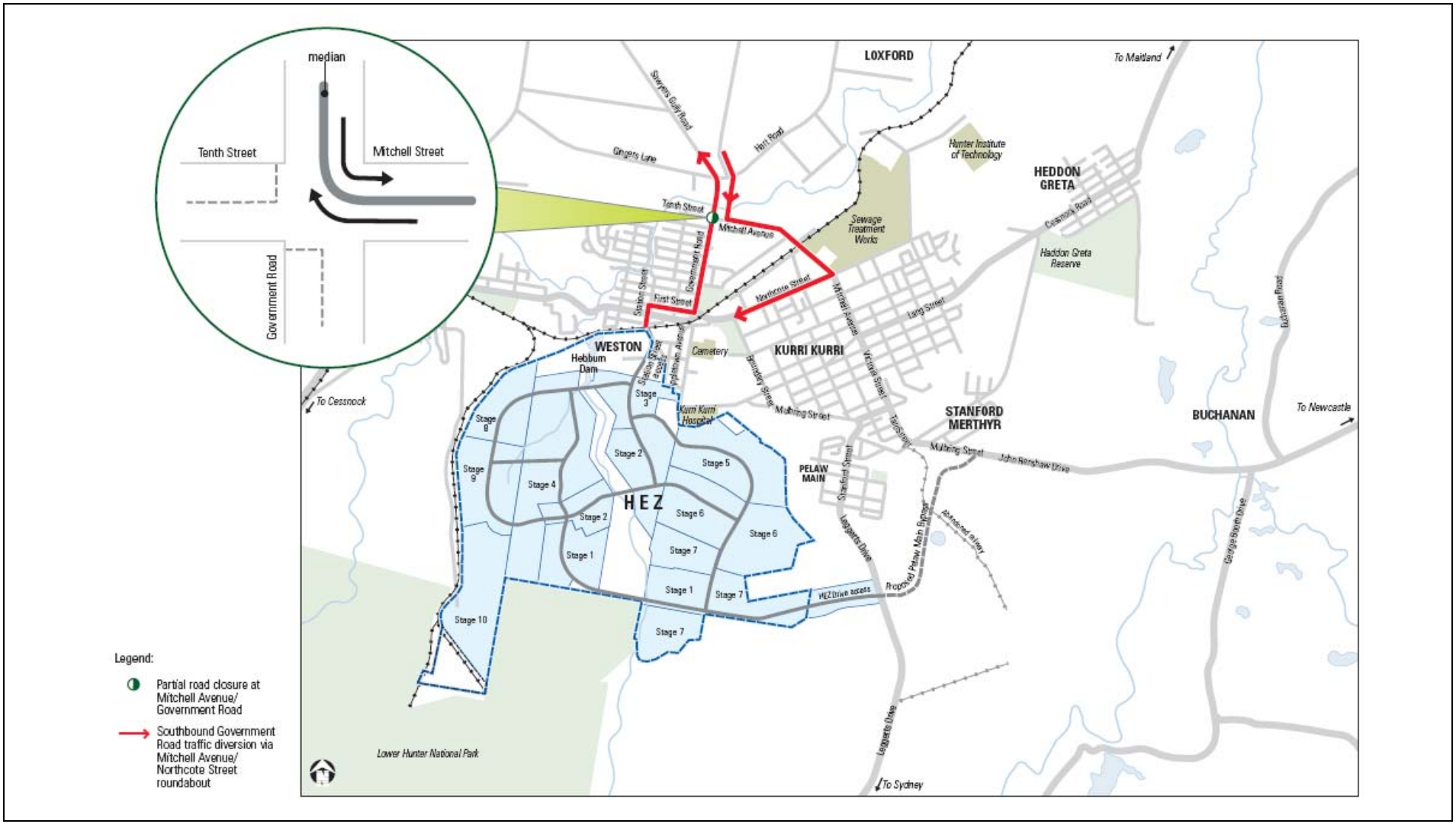

Figure 6-4 Conceptual Government Road Traffic Management Measures

We have referred to this management scheme as “Government Road traffic management” measure from this point in the report.

TransCAD model was re-run with “Government Road traffic management” in place and all 16 key intersections were reanalysed. As per below, four intersections would require some form of upgrade (under two HEZ accesses –Station Street and Leggetts Drive) to cope with demand from HEZ “area sold Stages 1 and 2” (206Ha):

- Cessnock Road/Station Street (see figure 6.5);
- Leggetts Drive/Lake Road (MR195/MR220) (see figure 6.6);
- George Booth Drive/John Renshaw Drive (MR527/MR588) (see figure 6.7); and
- John Renshaw Drive/ Buchanan Road.

Table 6.3 shows intersection LoS with improved configuration. Works at each critical intersection that provided an optimum LoS were also included in Table 6.3. Figure 6.5 to Figure 6.7 are schematic diagrams for improved intersections.

The performance of John Renshaw Drive/F3 roundabout was mainly governed by the regional and long distance traffic demand. Currently, this intersection operates close to capacity level and long queues can form at all approaches during peak periods. Without the HEZ development, this intersection falls to LoS F. Upgrading options for this intersection are extremely complex, and depend on a number of factors, including whether the F3 to Raymond Terrace link is available. With this new link, a grade separation may be viable option; however, such an investigation should not form part of this report. Leggetts Drive/Lake Road would require capacity improvements under the combined demands from regional background traffic growth and HEZ Stages 1 and 2 with no F3/2B. However, we believe that any such upgrading works on Leggetts Drive/Lake Road would be redundant should the F3/2B proceed.

Table 6-3 Improved Intersection Performance for Stages 1 and 2 (Two HEZ Accesses)

ID	Intersection	Intersection Control	OPT1-Improvement (AM)			OPT1-Improvement (PM)			Upgrade Works
			DoS	Delays	LoS	DoS	Delays	LoS	
01	Cessnock Road / Station Street (HEZ Northern Access)	Signals	0.69	30	C	0.86	47	D	Minor upgrade works include: -continuous left turn lane on the southern approach at Station Street; existing western side parking at Station Street will be affected -extend left turn lane to 50 m on the eastern approach at Cessnock Road (see Figure 6-5)
02	Northcote Street / Appleton Avenue	Priority	0.63	47	D	0.55	28	B	
03	Northcote Street / Boundary Street	Priority	0.42	18	B	0.63	34	C	
04	Northcote Street / Mitchell Avenue	Roundabout	0.64	12	A	0.92	18	B	
05	Mitchell Avenue / Lang Street	Roundabout	0.57	10	A	0.42	9	A	
06	Railway Street / Tarro Street	Roundabout	0.26	8	A	0.27	8	A	
07	Railway Street / Stanford Street	Priority	0.14	8	A	0.13	9	A	
08	Leggetts Drive / HEZ Spine Road / Pelaw Main Bypass (HEZ Eastern Access)	New Signals	0.84	35	C	0.70	35	C	
09	John Renshaw Drive / Bypass	New Roundabout	0.67	14	A	0.67	17	B	
10	Northcote Street / Alexandra Street	Priority	0.44	24	B	0.28	25	B	
11	First Street / Government Road/Cessnock Road/Northcote Street	Priority	0.44	35	C	0.80	>70	F	"Critical movement fail only for PM peak with average. delay of 75 sec; 5 vehicle queue DoS is 0.80 below critical value of 1.0. No upgrade option is recommended for this small number of queue vehicles."
12	Boundary Street/Lang Street	Roundabout	0.12	8	A	0.11	8	A	
13	Leggetts Drive/Lake Road (MR195/MR220)	New Roundabout	0.49	9	A	0.48	10	A	Install new 2 lane roundabout. Reduce approach speed to 60 kph. (see Figure 6.6)
14/ 15	Buchanan Road/John Renshaw Drive/George Booth Drive	New Roundabout	0.50	8	A	0.56	8	A	Install new 2 lane roundabout. Buchanan Road needs to align making northern approach of the roundabout. Reduce approach speed to 60 kph (Figure 6.7)

Note: The shaded area represents improved LoS with upgrade works; For priority controlled intersection, LoS is determined by the delay for critical movements only.

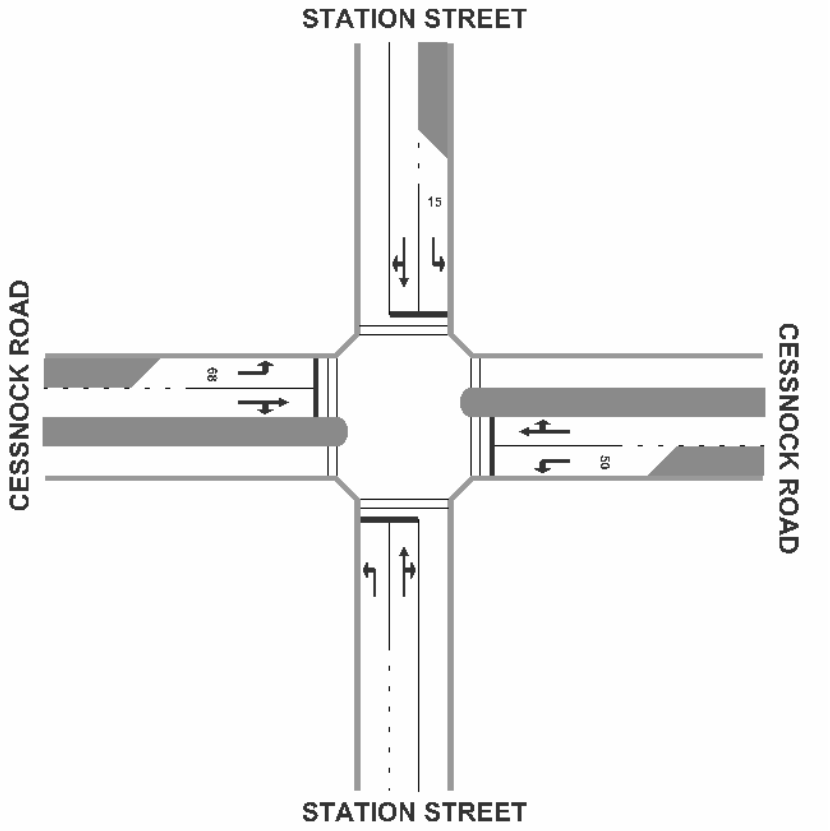

Figure 6-5 Intersection Improvements – Case 1(Cessnock Road/Station Street)

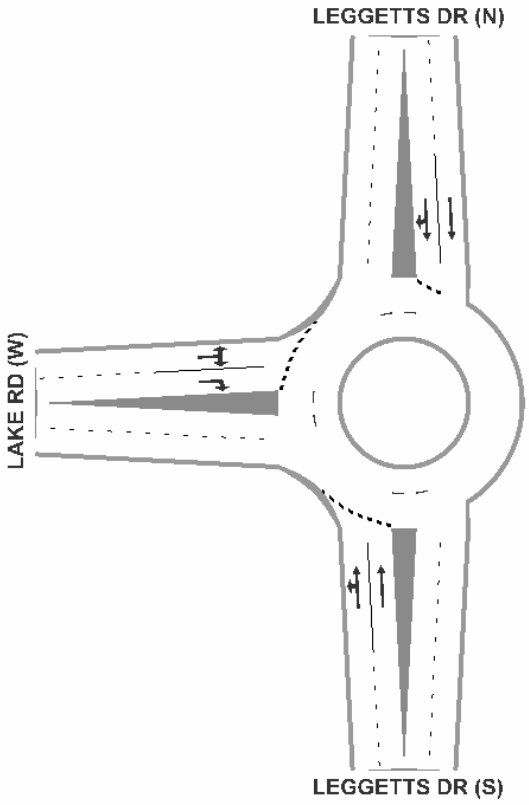

Figure 6-6 Intersection Improvements by 2016 - Case 1 (Leggetts Drive/Lake Road)

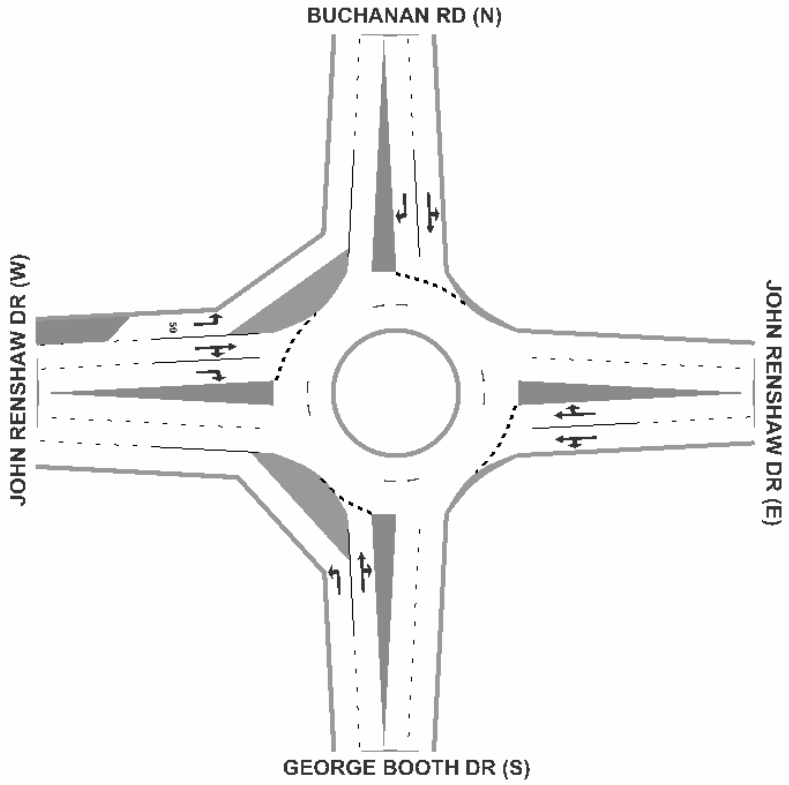

Figure 6-7 Intersection Improvements - Case 1 (JRD/GBD/Buchanan Road)

Table 6-4 Summary of intersection improvement and timing without F3/2B

ID	Intersection	Upgrading Works between 2006 and 2016	Indicative Timing of Upgrading Works/HEZ Staging Thresholds
			206 ha
01	Cessnock Road / Station Street (HEZ Northern Access)	Minor upgrade to existing signals until 2016 (Figure 6.4)	✓
02	Leggetts Drive / HEZ Spine Road / Pelaw Main Bypass (HEZ Eastern Access)	Install new signals (Figure 6.1)	✓[1]
03	John Renshaw Drive / Pelaw Main Bypass	Install new roundabout (Figure 6.2)	✓[1]
04	Leggetts Drive/Lake Road (MR195/MR220)	Install new roundabout (Figure 6.5)	✓[2]
05	Buchanan Road/John Renshaw Drive/George Booth Drive	Install new roundabout (Figure 6.6). Align Buchanan Road to form northern approach of the roundabout	✓[3]

Notes:

1 Pelaw Main Bypass and associated intersections including Leggetts Drive/HEZ Spine Road and John Renshaw Drive/Pelaw Main Bypass would be built when the capacity constraints in the existing road network are approaching saturation.

2 Intersection would require upgrading if F3/2B were not constructed at the completion of HEZ 206 ha .

3 Intersection would require upgrading if F3/2B were not constructed at the completion of HEZ 206 ha.,.

7. Stages 1 and 2 Link Capacity Improvements

7.1.1 Principles

In formulating a strategy for the future development of the regional and local road network, consideration was given to the performance of the network as measured by level of service. Level of service (LoS) is a term used to describe the potential for delay during traffic operation, usually in peak demand situations. It is a simple performance indicator which describes the interaction of vehicles in the traffic stream. As traffic volumes increase on a given section of road, motorists will experience possible reductions in speed, increased difficulty in manoeuvring within the traffic stream and reduced gaps between vehicles. Accordingly there is a reduction in the "level of service" as the traffic volume increases. A reduction in level of service occurs incrementally with increased traffic and would eventually reach a point when additional road capacity may be required to maintain acceptable performance.

Level of service is difficult to measure in the field, and surrogate measures are often used. The letters A-F are often assigned to different ranges of operating conditions with LOS, A representing the best and F the worst. Level of service ratings of F are commonly considered unacceptable. Technical Publications (including *Guide to Traffic Engineering Practice Part 2 Roadway Capacity*- Austroads, *The Highway Capacity Manual* –TRB and RTA's *Guide to Traffic Generating Developments*) provide an indication of the thresholds for each level of service range. These thresholds are sometimes referred to as maximum service flows which are derived from volume to capacity ratios.

For the purpose of determining maximum acceptable service flows for roads in the wider road network surrounding HEZ, a LoS threshold of E was selected.

7.1.2 Approach

On the basis of above principles, the timing for the implementation of the individual road capacity improvements was estimated as follows:

- The first step involved using the traffic model to predict traffic volumes on road links corresponding to Stages 1 and 2 of the HEZ development. Assumptions were initially made on which road improvements may be required for each stage of development when volumes exceeded the LoS threshold.

- In the second step, timing estimates for the road improvements were refined. A spreadsheet was used to interpolate between estimates of traffic volumes between each of the stages to determine the year when the traffic volume on specific road links would reach the maximum LoS E threshold.

- In the third step, a reconnaissance survey was undertaken on the state/regional road which would be significantly affected due to HEZ traffic but without relief from an F3/2B. Key routes included, MR220 Branxton-Toronto Road/ Lake Road, MR195 Leggetts Drive, MR588 John Renshaw Drive, MR527 George Booth Drive, Main

Road/Cessnock Road, Buchanan Road and Sawyers Gully Road. We have reported LoS at these locations covering all routes in Table 7-2 (see Page 56).

- LoS band from A to E was assigned for urban and rural roads separately on the basis of design speed, overtaking lanes, etc. As described in Table 7-1, rural road capacity would be for flat terrain with a design speed of 100 kilometres per hour (KPH). For 80 KPH design speed, the threshold levels would be 85%-95% of the figure quoted below. No adjustment was made to roads with design speed 90 KPH, since operating LoS for this category of rural road will be similar to those 100KPH roads. Urban road levels would apply to streets in Weston and Kurri Kurri, and the figures are given for a single lane, rather than the two-lane totals given for rural roads. Threshold capacity for a mountainous rural road would be significantly lower, and we have used this value for the section of George Booth Drive through Sugarloaf, which is mountainous. Our LoS bands for urban and rural roads were derived from published guidelines, are described in Table 7-1 below:

Table 7-1 Assumed Link LoS Thresholds

LoS Band	Urban (one way, vph/lane)	Rural (two way, vph/lane) Flat Terrain	Rural (two way, vph/lane) Mountainous
A	200		
B	380	590	230
C	600	970	410
D	900	1550	680
E	1400	2500	1400

7.1.3 Widening of Road Sections

Determining an acceptable level of service, and hence the point at which road improvements are required, was not a straight forward, or simple task. The decision to upgrade any rural road, particularly duplication of carriageway for a full section should be investigated carefully, not only on the basis of single LoS result. Other factors would include duration of congestion, and the extent of road affected by a queue. Whilst LoS thresholds in Table 7-1 are indicative figures, it should be noted that:

- The actual capacity of the rural and urban road link may vary plus or minus 10%-20% depending on location of an overtaking lane or associated intersection capacity. Similarly, actual traffic volumes will also vary from the forecasts as they were based on land use occupancy assumptions for a given point in time.

- Level of service will reduce progressively over time and motorists' perceptions of traffic conditions would adjust accordingly. The rigid application of a fixed threshold does not indicate catastrophic failure when exceeded, or even when the road may become dysfunctional. The LoS value is a guide only, and should be interpreted carefully.

- The performance of the road network is being assessed for one peak hour. As traffic conditions become more congested, so some motorists will choose to adjust the timing of their trip to avoid the worst congestion. This change in motorists' behaviour may occur until such time as traffic conditions improve and then motorists may revert to previous trip patterns. This behaviour change is difficult to forecast at this point in time. Road congestion should be measured periodically on the basis of actual traffic conditions, rather than forecasts.

- Bearing in mind such limitations, PB has undertaken a preliminary LoS analysis on the basis of a peak hour traffic forecast, existing road function and carriageway characteristics. As in the intersection LoS analysis, we have undertaken this mid block LoS analysis for the development of Stages 1 and 2.

Table 7-2 Link LoS Results

ID	Road	Location	Road Classification	Land Use	OPT 3 No F3/2B (Background but no HEZ)	OPT 1 No F3/2B (Background plus HEZ Stages 1 and 2)
2	Cessnock Road	West of Station Street	Main/State	Urban	C	D
3	Station Street	North of Cessnock Road	Main/State	Urban	C	C
4	First Street	West of Hall Street	Main/State	Urban	C	C
5	Cessnock Road	West of Government Road	Main/State	Urban	C	D
6	Government Road	North of Cessnock Road	Local	Urban	A	A
7	Northcote Street	West of Boundary Street	Main/State	Urban	C	E
9	Boundary Street	North of Deakin Street	Local	Urban	A	A
11	Mitchell Avenue	South of Northcote Street	Main/State	Urban	A	A
12	Main Road	West of Kurri Kurri Interchange/ East of Cantwell Street	Main/State	Urban	B	D
13	Lang Street	West of Merthyr Street	Main/State	Urban	C	D
14	Station Street (HEZ Northern access)	South of Cessnock Road	Local	Urban	A	C
19	MR588 John Renshaw Drive	East of Pelaw Main Bypass/ West of F32B Buchanan Interchange	Main/State	Rural	E	F
20	Leggetts Drive	South of Wallsend Street/ North of HEZ Eastern Access)	Main/State	Rural	B	B
21	HEZ Spine Road – 2 lane (1lane each direction)	West of Leggetts Drive (HEZ Eastern Access)	Local	Urban	A	E
22	Pelaw Main Bypass-2 lane (1 lane each direction)	East of Leggetts Drive	Main/State	Rural	D	E
45	Victoria Street	South of Lang Street	Main/State	Urban	A	A
49	Northcote Street (Railway Bridge)	West of Appleton Avenue	Main/State	Urban	C	D

ID	Road	Location	Road Classification	Land Use	OPT 3 No F3/2B (Background but no HEZ)	OPT 1 No F3/2B (Background plus HEZ Stages 1 and 2)
62	Appleton Avenue-Station Link (HEZ Northern 3rd Access) 2 lane (1 lane each direction)	East of Station Street	Local	Urban	-	-
38	Sawyers Gully Road	North of Metcalfe Lane	Regional	Rural	B	C
41	Old Maitland Road	North of Majors Lane	Regional	Rural	C	C
53	Wollombi Road	East of Old North Road	Regional	Rural	B	C
29	MR220 Branxton-Toronto Road	Between F3 and MR195 (Leggetts Drive)	Main/State	Rural	C	D
30	MR220 Lake Road	West of MR195 Leggetts Drive	Main/State	Rural	D	D
31	MR195 Leggetts Drive	South of HEZ Spine - Pelaw Main Bypass Intersection	Main/State	Rural	D	D
35	MR588 John Renshaw Drive	East of George Booth Drive (MR527)	Main/State	Rural	D	D
34	MR527 George Booth Drive	South of John Renshaw Drive (MR588)	Main/State	Rural	C	D
33	MR527 George Booth Drive	North of F3 Freeway	Main/State	Rural	E	E
36	Buchanan Road	North of John Renshaw Drive (MR588)	Regional	Rural	B	B

8. Pelaw Main Bypass

Pelaw Main Bypass will connect John Renshaw Drive with Leggetts Drive in Kurri Kurri. As the introduction of the HEZ will progressively change the local land use pattern and increase traffic pressure on local roads, the proposed Bypass will improve the network connectivity, providing a more direct route option for traffic on John Renshaw Drive to reach the HEZ, as well as improve the accessibility between centres such as Cessnock and Newcastle. It will enhance the access to the HEZ in the east and relieve the traffic pressure on other roads through Kurri Kurri. Timing of the Pelaw Main Bypass is discussed as follows in this section.

8.1.1 Mapping of Site Constraints

An inspection of the physical constraints associated with the possible increase in usage of the Stanford Street through Pelaw Main was conducted on the 16th of August 2007. The field survey was conducted to highlight any existing traffic constraints, address key issues and provide additional comments on the effect of the proposed HEZ development. Table 8.1 below summarises the existing constraints and provides relevant comments.

Table 8-1 Traffic Constraints Inspection Summary

Key Issues	Existing Constraints	Comments*
The bridge on Leggetts Drive.	Upon entry to the bridge, there are no road shoulders. From both directions there is a slight right turn into the bridge and a short entry grade into the bridge, thus exiting the bridge there is a slight left turn and exit grade.	The bridge, from entry to exit points, is approximately 20m long and bridges over a minor drainage channel. There is adequate signage upon entry and exit of the bridge indicating the required left or right turns. At the time of the inspection, a number of heavy vehicles used the bridge with ease and there did not look to be any traffic or safety issues associated with that usage. The bridge also spans a small bike path/walkway. See photos 1-3 at the back of this report for further detail.
Physical Condition of the section of road in question (Stanford St/Leggetts Dr).	Generally, the entire section of the road is in good condition with the bitumen having no major potholes. Up to date signs and line marking are highly visible adding to the safety of the road. The majority of the road has an adequate shoulder width for car parking. The only section of the road that has no shoulder or road reserve is that of the bridge on Leggetts Drive. The section of road is predominately one lane in each direction with the exception of the dual lane roundabout and turning lanes at intersections. The only sharp (90°) turn is found at the intersection of Stanford Street / Railway Street / Mulbring Street.	The lane width of this section of road is approximately 4m, with a shoulder width of bitumen ranging from 2-3m. In addition to the bitumen shoulder, there were grassed road reserve areas that added to the overall width of the road. Currently, there seemed to be no major issue with the heavy vehicles using this section of road. There were no adverse effects on other road users, as the road adequately handled the heavy vehicles constantly using it.
Location of local schools, and safety concerns with student crossing on	Pelaw Main Primary School is approximately 500m, and two blocks away from Stanford Street.	There is a 40km/hr speed zone outside the school, but this finishes at the intersection of Bellbird Street and Abermain Street. Additionally, there is a pedestrian crossing on Stanford Street

Key Issues	Existing Constraints	Comments*
Stanford Street.		adjacent to the Hebburn Street intersection, which would serve children crossing Stanford Street. There is also sufficient signage and road marking` indicating the upcoming pedestrian crossing for motorists. It is only a small local school, so there would not be significant numbers of children using Stanford Street. See photo 4 for further details.
Number of houses fronting to Stanford Street through Pelaw Main village.	There are 47 houses fronting Stanford Street through Pelaw Main village.	The houses fronting Stanford Street through Pelaw Main village should notice minimal increase in noise, as there are no major rising grades on the road and there would be minimal stopping and/or starting of heavy vehicles, as there is only one pedestrian crossing in the village that is rarely used.
General condition of Stanford Street / Railway Street / Mulbring Street intersection.	The left turn from Railway Street into Stanford Street has a turning lane and an extended shoulder. The traffic travelling from Stanford Street into either Railway Street or Mulbring Street has right-away and does not yield; all other turns from this intersection must yield before turning. The turn to and from Stanford Street and Railway Street is approximately a 90° turn.	This intersection is well signed and marked. Its only hazard with this intersection is that it serves a combination of three roads and one parking access to the local pub, which may struggle to maintain levels of service under increased traffic loads. See photos 5-7 for further details.
General condition of Railway Street / Tarro Street roundabout.	There are no real constraints associated with this roundabout.	The roundabout is in good condition, with extensive new signage and line work which is highly visible. The single lane roads entering the roundabout all divide into two lanes prior to the roundabout thus the roundabout is a two lane roundabout. Once off the roundabout the two lanes then merge back into one lane. At the time of the inspection heavy vehicles had no difficulty navigating the roundabout, or where they a hazard to other road users. See photos 8-10 for further details.
General condition of Mulbring Street / Maitland Street intersection.	The only constraint along this route was the single lane for right turns into Maitland Street and most of the existing traffic overtakes turning vehicles by entering the shoulder of the road.	This intersection could easily be upgraded by adding a passing lane on the current the road shoulder; this would improve overall traffic flow. There is a left and right turning lane out of Maitland Street and a left turning lane for cars entering Maitland Street from Taro Street (heading east). See photo 11 for further details.

Note the entire section of Stanford Street has a 50km/hr speed limit, until exiting Pelaw Main towards the HEZ site where it increases to 100km/hr.

From the above investigations, it is evident that Stanford Street through Pelaw Main had no significant constraints on its use, particularly by large vehicles, associated with road alignment, bridge, road/intersection sight distance and pedestrian crossing.

8.1.2 Impact of Pelaw Main Bypass on the Broader Road Network

While PMB will provide direct access to HEZ traffic from the east, it will also help link regional travel routes between Maitland, Newcastle, Lake Macquarie and Cessnock.

Figure 8.1 shows the impact on the broader road network, with and without PMB, in PB's traffic model for all future cases The red marked routes were those that could be affected without PMB. The green marked routes indicated those affected with PMB in place (F3/2B is not in place).

Potential traffic users of PMB would be motorists travelling:

- between Newcastle and Cessnock via John Renshaw Drive and Lake Road
- between Newcastle and HEZ (eastern access) via John Renshaw Drive
- between Newcastle/Lake Macquarie and Cessnock via George Booth Dr and Lake Road
- between East Maitland and Cessnock via Buchanan Road and Lake Road
- between East Maitland and HEZ (eastern access) via Buchanan Road

Without a PMB, regional background and HEZ-bound traffic would divert to a number of potential travel routes (showed in red colour), these include:

- Cessnock Road, Northcote Road, Mitchell Ave, Victoria Street, Tarro Street through Kurri Kurri
- Lang Street, Main Road through Heddon Greta
- Stanford Street, Leggetts Drive through Pelaw Main

Having forecast the above travel pattern, we also looked at how HEZ–bound traffic would access the site with and without PMB. Figures 8.2 and 8.3 show the potential routes that could be used by HEZ traffic in the surrounding road network. Key findings were:

- Without PMB in place, about 20 percent more HEZ traffic would use the northern access at Station Street than cases with the PMB. This traffic change would reduce available intersection capacity along the Cessnock Road and Northcote Street routes; and
- Traffic increase on Stanford Street through Pelaw Main.

The next section quantifies the impact on the road and intersections without PMB with varying levels of development at HEZ.

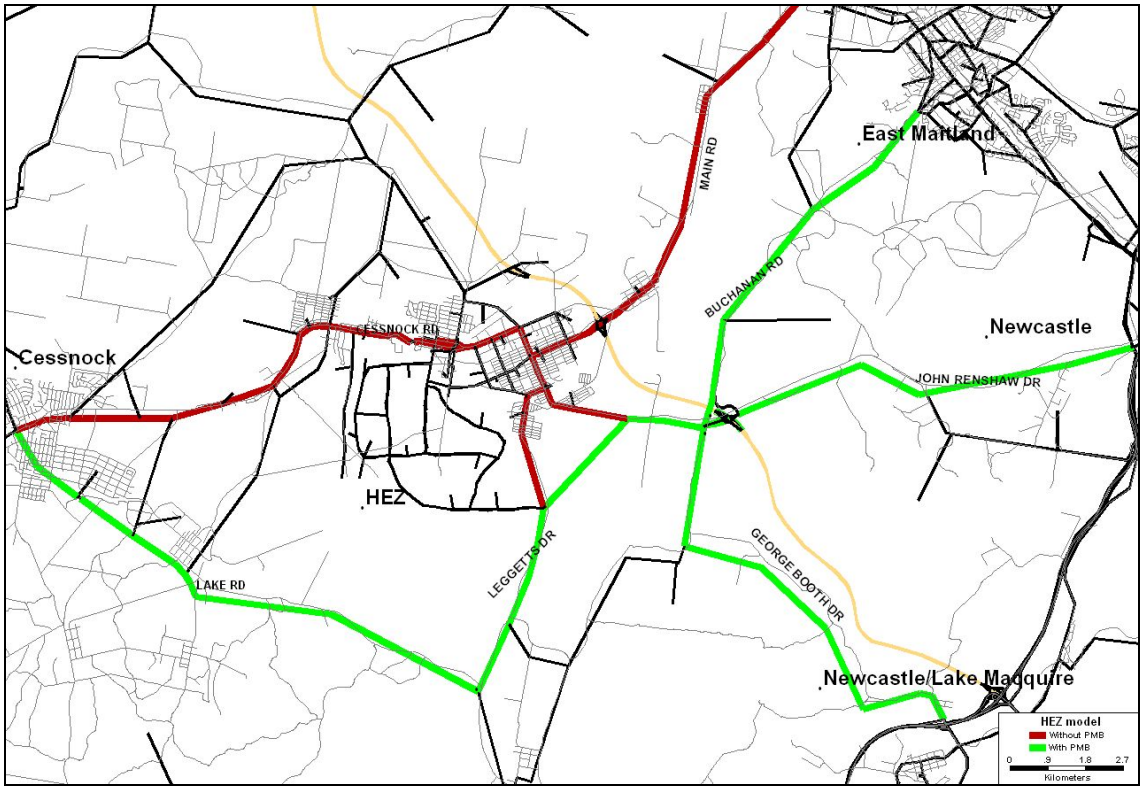

Figure 8-1 PMB impact on broader network

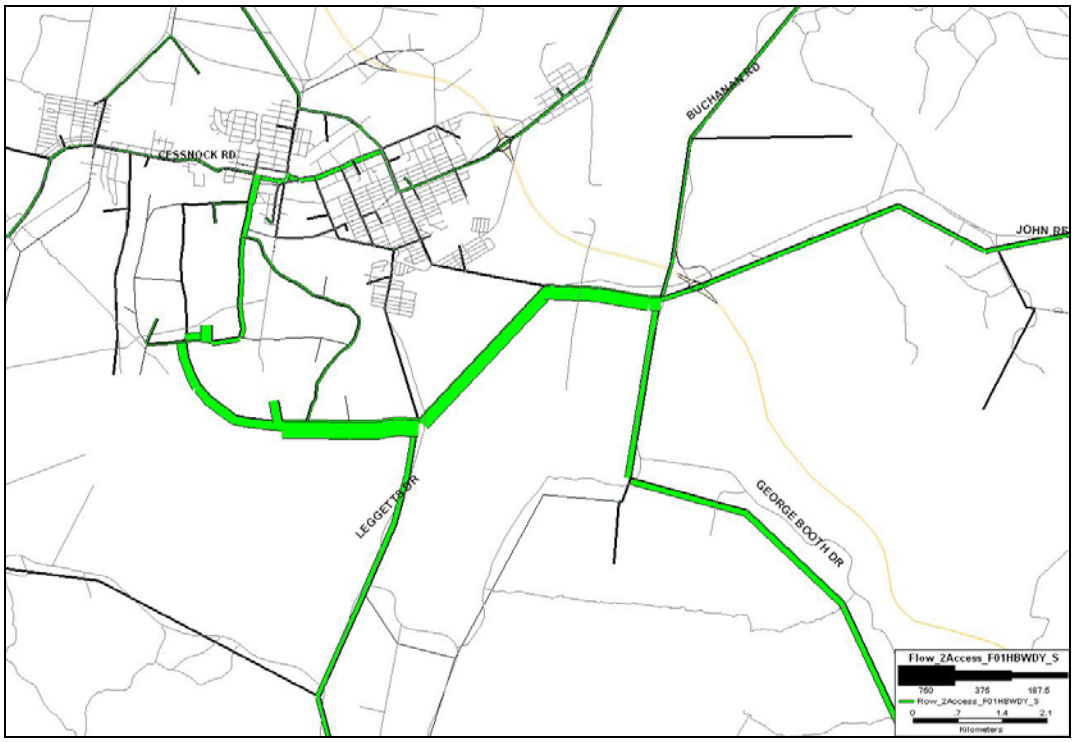

Figure 8-2 Traffic routes being used <u>with PMB</u> (showing only HEZ work trips AM peak 2 hrs at 67 ha of development)

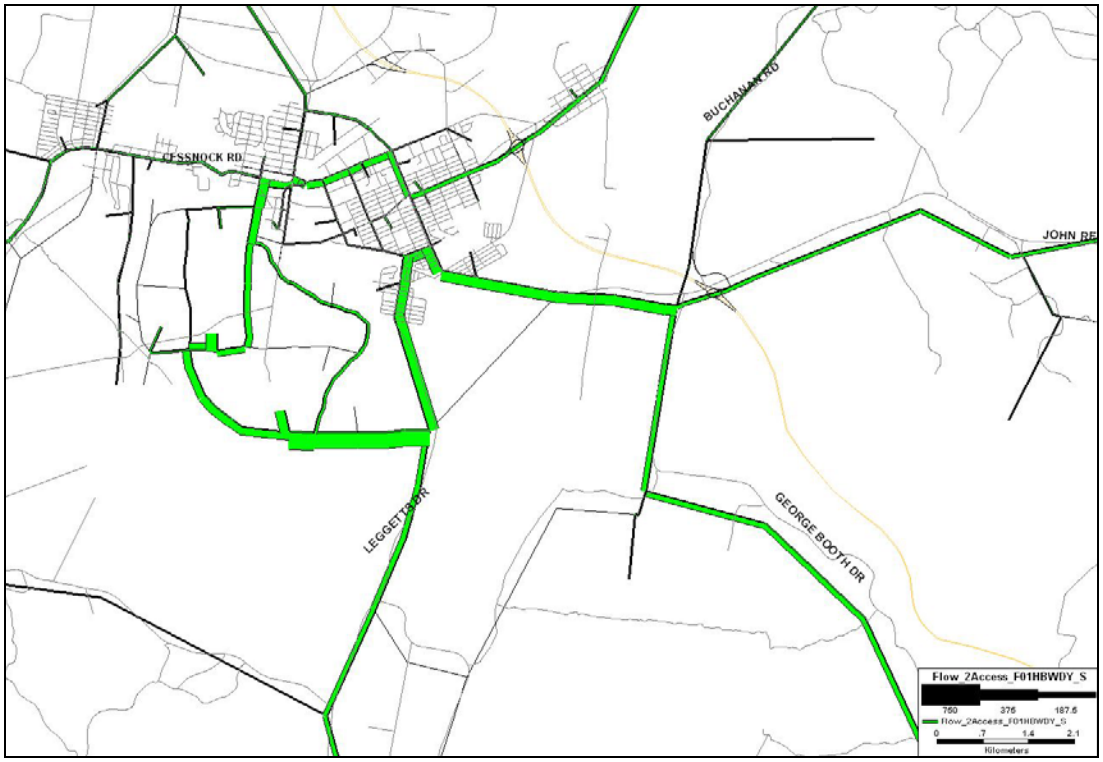

Figure 8-3 Traffic routes being used <u>without PMB</u> (showing only HEZ work trips AM peak 2 hrs at 67 ha of development)

8.1.3 Impacts on roads and intersections

In assessing HEZ's impact on roads and intersections, we looked at traffic volumes on the broader road network comprising both regional and local roads. We forecast traffic levels at 26 road locations in relation to estimated road capacity and forecast future level of service (LoS) at 15 key intersections. With this investigation, traffic indicators were reviewed under four traffic scenarios:

1. S1, background traffic growth for 2010 without HEZ
2. S2, background traffic plus 67 ha of HEZ for 2010
3. S3, background traffic growth for 2016 without HEZ
4. S4, background traffic plus 206 ha of HEZ for 2016

In conjunction with the above, we also ran a number of models to vary the amount of development at HEZ to identify critical development thresholds so that the scenarios did not allow intersection LoS to fall below level D. This was an iterative process and the above four scenarios provided sufficient input to estimate the HEZ threshold capacity. Table 8.1 presents the forecast results for scenarios S1 and S2, demonstrating the impact of HEZ with 67 ha of occupation. The result indicates HEZ would increase traffic on key regional and local roads by varying amounts. In 2010, peak hour traffic on Leggetts Drive just north of HEZ eastern access would increase from 350 to 680 vehicles. The increased traffic volumes on Leggetts Drive are still comfortably within its capacity as a state road (as stipulated in the RTA road hierarchy plan). Table 8.2 shows

HEZ traffic comparative impacts on regional and local roads for 67 ha and 206 ha of occupation, respectively.

In determining the HEZ threshold capacity, intersection operation is more critical than the capacity of road links between intersections. In general, intersection LoS A to C represents satisfactory operation, while D represents “near capacity” and E represents “at capacity”. Table 8.3 and Table 8.4 presented LoS for 15 intersections for scenarios S1 and S2. Modelling results estimated LoS would reduce to between C and D for 5 intersections during AM peak and 6 intersections during PM peak, attributable to a combination of background traffic growth and HEZ traffic. Two intersections along Northcote Street showed LoS D, indicating limited spare capacity with 67ha of HEZ. Potential HEZ growth beyond 67 ha would further reduce LoS at both intersections and trigger upgrading works to increase intersection capacity. Modelling results from the above investigation indicate the existing road network in Kurri Kurri has the capacity to accommodate up to 67 ha of HEZ development without upgrading works, although some intersections would be close to capacity and therefore subject to occasional delays. Table 8.5 and Table 8.6 shows LoS results under a scenario with 206 ha of HEZ occupied in 2016. At this level of HEZ traffic generation, LoS at key intersections would be reduced to an unsatisfactory level of F, indicating that upgrading is required to avoid significant delays.

On the basis of this additional modelling, the following conclusions are made:

5. The state and local road network has the capacity to accommodate approximately 67 ha of additional HEZ development, which is now assumed to be occupied around 2010, without the need for major upgrading works including the PMB; and
6. In terms of traffic demand, the critical timing for major infrastructure improvements, intersection upgrading and/or construction of the PMB, occurs shortly after 2010, based on current market take-up rates, or when development at HEZ exceeds 67 ha. However, this should be reviewed with actual traffic data over time.

Table 8-2 Future traffic forecast (AM peak one hour)

ID	Road	Location	S1 No HEZ	S2 -67 Ha HEZ	Change due to HEZ	% Change due to HEZ
2	Cessnock Road	West of Station Street	1290	1370	80	6%
3	Station Street	North of Cessnock Road	700	750	50	7%
4	First Street	West of Hall Street	660	700	40	6%
5	Cessnock Road	West of Government Road	590	770	180	31%
6	Government Road	North of Cessnock Road	250	180	-70(1)	-28%
7	Northcote Street	West of Boundary Street	1470	1610	140	10%
9	Boundary Street	North of Deakin Street	340	340	0	0%
11	Mitchell Avenue	South of Northcote Street	1390	1560	170	12%
12	Main Road	West of Kurri Kurri Interchange/ East of Cantwell Street	700	820	120	17%
13	Lang Street	West of Merthyr Street	920	1050	130	14%
14	Station Street (HEZ Northern Access)	South of Cessnock Road	-	300	300	-
19	MR588 John Renshaw Drive	West of F32B Buchanan Interchange	1730	2050	320	18%
20	Leggetts Drive	South of Wallsend Street/ North of HEZ Eastern Access)	350	680	330	94%
21	HEZ Spine Road	West of Leggetts Drive (HEZ Eastern Access)	-	490	490	-
45	Victoria Street	South of Lang Street	1380	1410	30	2%
49	Northcote Street (Railway Bridge)	West of Appleton Avenue	1370	1530	160	12%
38	Sawyers Gully Road	North of Metcalfe Lane	600	640	40	7%
41	Old Maitland Road	North of Majors Lane	610	620	10	2%
53	Wollombi Road	East of Old North Road	590	600	10	2%
29	MR220 Branxton-Toronto Road	Between F3 and MR195 (Leggetts Drive)	960	1070	110	11%
30	MR220 Lake Road	West of MR195 Leggetts Drive	920	950	30	3%
31	MR195 Leggetts Drive	South of HEZ Spine	360	530	170	47%
35	MR588 John Renshaw Drive	East of George Booth Drive (MR527)	900	1040	140	16%
34	MR527 George Booth Drive	South of John Renshaw Drive (MR588)	740	910	170	23%
33	MR527 George Booth Drive	North of F3 Freeway	710	880	170	24%
36	Buchanan Road	North of John Renshaw Drive (MR588)	250	280	30	12%

Note: (1) Government Road traffic management is potential to reduce HEZ traffic on Government Road.

Table 8-3 Incremental HEZ traffic impact (AM peak one hour)

ID	Road	Location	S2 67 Ha HEZ	S4 206 Ha HEZ	HEZ traffic increase	% HEZ traffic increase
2	Cessnock Road	West of Station Street	1370	1470	100	7%
3	Station Street	North of Cessnock Road	750	810	60	8%
4	First Street	West of Hall Street	700	760	60	9%
5	Cessnock Road	West of Government Road	770	1050	280	36%
6	Government Road	North of Cessnock Road	180	250	70	39%
7	Northcote Street	West of Boundary Street	1610	1900	290	18%
9	Boundary Street	North of Deakin Street	340	370	30	9%
11	Mitchell Avenue	South of Northcote Street	1560	1840	280	18%
12	Main Road	West of Kurri Kurri Interchange/ East of Cantwell Street	820	1240	420	51%
13	Lang Street	West of Merthyr Street	1050	1480	430	41%
14	Station Street (HEZ Northern Access)	South of Cessnock Road	300	820	520	173%
19	MR588 John Renshaw Drive	West of F32B Buchanan Interchange	2050	2670	620	30%
20	Leggetts Drive	South of Wallsend Street/ North of HEZ Eastern Access)	680	1470	790	116%
21	HEZ Spine Road	West of Leggetts Drive (HEZ Eastern Access)	490	1560	1070	218%
45	Victoria Street	South of Lang Street	1410	1470	60	4%
49	Northcote Street (Railway Bridge)	West of Appleton Avenue	1530	1810	280	18%
38	Sawyers Gully Road	North of Metcalfe Lane	640	800	160	25%
41	Old Maitland Road	North of Majors Lane	620	800	180	29%
53	Wollombi Road	East of Old North Road	600	760	160	27%
29	MR220 Branxton-Toronto Road	Between F3 and MR195 (Leggetts Drive)	1070	1500	430	40%
30	MR220 Lake Road	West of MR195 Leggetts Drive	950	1200	250	26%
31	MR195 Leggetts Drive	South of HEZ Spine	530	1000	470	89%
35	MR588 John Renshaw Drive	East of George Booth Drive (MR527)	1040	1080	40	4%
34	MR527 George Booth Drive	South of John Renshaw Drive (MR588)	910	1730	820	90%
33	MR527 George Booth Drive	North of F3 Freeway	880	1700	820	93%
36	Buchanan Road	North of John Renshaw Drive (MR588)	280	670	390	139%

Table 8-4 Intersection LoS for 67ha of HEZ-(AM peak)

ID	Intersection	Intersection Control	S1 (No HEZ) AM Peak				S2 (With 67 Ha HEZ) AM Peak			
			DoS	Delays	LoS	Comments	DoS	Delays	LoS	Comments
01	Cessnock Road / Station Street (HEZ Northern Access)	Signals	0.81	19	B		0.82	21	B	
02	Northcote Street / Appleton Avenue	Priority	0.49	33	C		0.67	53	D	LoS D = Near capacity
03	Northcote Street / Boundary Street	Priority	0.37	14	A		0.40	17	B	
04	Northcote Street / Mitchell Avenue	Roundabout	0.50	11	A		0.66	12	A	
05	Mitchell Avenue / Lang Street	Roundabout	0.36	9	A		0.49	10	A	
06	Railway Street / Tarro Street	Roundabout	0.35	8	A		0.44	9	A	
07	Railway Street / Stanford Street	Priority	0.17	10	A		0.26	11	A	
08	Leggetts Drive / HEZ Spine (HEZ Eastern Access)	Seagull	-	-	-		0.26	11	A	
10	Northcote Street / Alexandra Street	Priority	0.30	23	B		0.42	33	C	
11	First Street / Government Road/Cessnock Road/Northcote Street	Priority	0.33	25	B		0.42	36	C	
13	Boundary Street/Lang Street	Roundabout	0.13	8	A		0.14	8	A	
14	Leggetts Drive/Lake Road (MR195/MR220)	Priority	0.74	23	B		0.90	38	C	
15	George Booth Drive/John Renshaw Drive (MR527/MR588)	Roundabout	0.69	13	A		0.87	20	B	
16	John Renshaw Drive/Buchanan Road	Priority	0.47	25	B		0.73	40	C	
17	John Renshaw Drive/F3	Roundabout	> 1.40	> 100	F	LoS F = Over capacity	> 1.40	> 100	F	LoS F = Over capacity

Table 8-5 Intersection LoS for 67ha of HEZ-(PM peak)

ID	Intersection	Intersection Control	S1 (No HEZ) PM Peak				S2 (With 67 Ha HEZ) PM Peak			
			DoS	Delays	LoS	Comments	DoS	Delays	LoS	Comments
01	Cessnock Road / Station Street (HEZ Northern Access)	Signals	0.50	21	B		0.81	32	C	
02	Northcote Street / Appleton Avenue	Priority	0.54	34	C		0.59	43	D	LoS D = Near capacity
03	Northcote Street / Boundary Street	Priority	0.33	15	B		0.76	45	D	LoS D = Near capacity
04	Northcote Street / Mitchell Avenue	Roundabout	0.67	12	A		0.91	18	B	
05	Mitchell Avenue / Lang Street	Roundabout	0.37	9	A		0.42	9	A	
06	Railway Street / Tarro Street	Roundabout	0.38	8	A		0.57	10	A	
07	Railway Street / Stanford Street	Priority	0.17	10	A		0.28	14	A	
08	Leggetts Drive / HEZ Spine (HEZ Eastern Access)	Seagull	-	-	-		0.23	10	A	
10	Northcote Street / Alexandra Street	Priority	0.31	24	B		0.33	35	C	
11	First Street / Government Road/Cessnock Road/Northcote Street	Priority	0.35	25	B		0.46	33	C	
13	Boundary Street/Lang Street	Roundabout	0.14	8	A		0.13	8	A	
14	Leggetts Drive/Lake Road (MR195/MR220)	Priority	0.74	23	B		0.94	48	D	LoS D = Near capacity
15	George Booth Drive/John Renshaw Drive (MR527/MR588)	Roundabout	0.65	13	A		0.82	16	B	
16	John Renshaw Drive/Buchanan Road	Priority	0.41	26	B		0.57	36	C	
17	John Renshaw Drive/F3	Roundabout	> 1.40	> 100	F	LoS F = Over capacity	> 1.40	> 100	F	LoS F = Over capacity

Table 8-6 Comparison of Intersection LoS for 67ha and 206 ha of HEZ (AM peak)

ID	Intersection	Intersection Control	S2 (With 67 Ha HEZ) AM Peak				S4 (With 206 Ha HEZ) AM Peak			
			DoS	Delays	LoS	Comments	DoS	Delays	LoS	Comments
01	Cessnock Road / Station Street (HEZ Northern Access)	Signals	0.82	21	B		1.00	26	B	
02	Northcote Street / Appleton Avenue	Priority	0.67	53	D	LoS D = Near capacity	1.00	> 100	F	LoS F = Over capacity
03	Northcote Street / Boundary Street	Priority	0.40	17	B		0.53	23	B	
04	Northcote Street / Mitchell Avenue	Roundabout	0.66	12	A		1.00	30	C	
05	Mitchell Avenue / Lang Street	Roundabout	0.49	10	A		0.81	13	A	
06	Railway Street / Tarro Street	Roundabout	0.44	9	A		0.80	13	A	
07	Railway Street / Stanford Street	Priority	0.26	11	A		0.90	93	F	LoS F = Over capacity
08	Leggetts Drive / HEZ Spine (HEZ Eastern Access)	Seagull	0.26	11	A		-	-	-	
08	Leggetts Drive / HEZ Spine (HEZ Eastern Access)	Signals	-	-	-		0.84	31	C	
10	Northcote Street / Alexandra Street	Priority	0.42	33	C		0.50	47	D	LoS D = Near capacity
11	First Street / Government Road/Cessnock Road/Northcote Street	Priority	0.42	36	C		0.73	80	F	LoS F = Over capacity
13	Boundary Street/Lang Street	Roundabout	0.14	8	A		0.18	8	A	
14	Leggetts Drive/Lake Road (MR195/MR220)	Priority	0.90	38	C		> 1.40	> 100	F	LoS F = Over capacity
15	George Booth Drive/John Renshaw Drive (MR527/MR588)	Roundabout	0.87	20	B		> 1.40	> 100	F	LoS F = Over capacity
16	John Renshaw Drive/Buchanan Road	Priority	0.73	40	C		> 1.40	> 100	F	LoS F = Over capacity
17	John Renshaw Drive/F3	Roundabout	> 1.40	> 100	F	LoS F = Over capacity	> 1.40	> 100	F	LoS F = Over capacity

Table 8-7 Comparison of Intersection LoS for 67ha and 206 ha of HEZ (PM peak)

ID	Intersection	Intersection Control	S2 (With 67 Ha HEZ) PM Peak				S4 (With 206 Ha HEZ) PM Peak			
			DoS	Delays	LoS	Comments	DoS	Delays	LoS	Comments
01	Cessnock Road / Station Street (HEZ Northern Access)	Signals	0.81	32	C		1.00	49	D	LoS D = Near capacity
02	Northcote Street / Appleton Avenue	Priority	0.59	43	D	LoS D = Near capacity	1.00	> 100	F	LoS F = Over capacity
03	Northcote Street / Boundary Street	Priority	0.76	45	D	LoS D = Near capacity	0.53	29	C	
04	Northcote Street / Mitchell Avenue	Roundabout	0.91	18	B		1.27	> 100	F	LoS F = Over capacity
05	Mitchell Avenue / Lang Street	Roundabout	0.42	9	A		0.59	11	A	
06	Railway Street / Tarro Street	Roundabout	0.57	10	A		1.29	> 100	F	LoS F = Over capacity
07	Railway Street / Stanford Street	Priority	0.28	14	A		> 1.40	> 100	F	LoS F = Over capacity
08	Leggetts Drive / HEZ Spine (HEZ Eastern Access)	Seagull	0.23	10	A		-	-	-	
08	Leggetts Drive / HEZ Spine (HEZ Eastern Access)	Signals	-	-	-		0.60	23	B	
10	Northcote Street / Alexandra Street	Priority	0.33	35	C		0.36	49	D	LoS D = Near capacity
11	First Street / Government Road/Cessnock Road/Northcote Street	Priority	0.46	33	C		1.02	> 100	F	LoS F = Over capacity
13	Boundary Street/Lang Street	Roundabout	0.13	8	A		0.20	8	A	
14	Leggetts Drive/Lake Road (MR195/MR220)	Priority	0.94	48	D	LoS D = Near capacity	> 1.40	> 100	F	LoS F = Over capacity
15	George Booth Drive/John Renshaw Drive (MR527/MR588)	Roundabout	0.82	16	B		> 1.40	> 100	F	LoS F = Over capacity
16	John Renshaw Drive/Buchanan Road	Priority	0.57	36	C		> 1.40	> 100	F	LoS F = Over capacity
17	John Renshaw Drive/F3	Roundabout	> 1.40	> 100	F	LoS F = Over capacity	> 1.40	> 100	F	LoS F = Over capacity

Photographs:

Photo 1: Entry into the bridge from looking from Pelaw Main

Photo 2: The Bridge looking from the park.

Photo 3: The Bridge and the bike track/walkway looking from the park.

Photo 4: The pedestrian crossing on Stanford Street.

Photo 5: The Stanford Street / Railway Street / Mulbring Street intersection looking from Railway Street.

Photo 6: The Stanford Street / Railway Street / Mulbring Street intersection looking from Mulbring Street.

Photo 7: The Stanford Street / Railway Street / Mulbring Street intersection looking from Mulbring Street.

Photo 8: The Railway Street / Tarro Street roundabout looking from Tarro Street.

Photo 9: The Railway Street / Tarro Street roundabout looking from Tarro Street.

Photo 10: The Railway Street / Tarro Street roundabout looking from Railway Street.

Photo 11: the Mulbring Street / Maitland Street intersection looking from Mulbring Street

9. Summary of Traffic Works for HEZ Precinct 1

PB investigated potential future traffic works required for roads and intersections to service HEZ Precinct 1 if the F3/2B were not constructed. This investigation reviewed existing infrastructure, and then assessed capacity constraints for Precinct 1.

PB has measured upgrading works against HEZ actual yields with indicative development time frames. The timing has been assumed to incorporate appropriate background growth in our analysis. Intersections that will require upgrading due to demand from Precinct 1 HEZ include:

- Upgrading HEZ eastern access intersection with the Leggetts Drive and HEZ Spine Road. Initially this intersection should be constructed as C type with appropriate turning lane. This intersection will be converted to signals after the completion of 67 Ha of HEZ.
- Construction of Cessnock Road/ Station Street (HEZ northern access) between 20.6Ha and 43.6Ha of Precinct 1 development. This will occur between 2008 and 2009. PB recommend modelling of the development types that are constructed within the first 20Ha of development to allow correct determination of this timing;
- Construction of the Pelaw Main Bypass when 67Ha of HEZ development is reached in 2009/2010. It is recommended that Pelaw Main Bypass be constructed as a 2 lane, limited access road (1 lane each way) when the existing capacity in the road network approaches saturation. The following intersections will require upgrading in conjunction with the development of Pelaw Main Bypass:
  - Leggetts Drive/ HEZ Spine Road (HEZ eastern access)-new signals;
  - John Renshaw Drive/ Pelaw Main Bypass-new roundabout
- In addition, a partial road closure is recommended at the Mitchell Street / Government Road intersection.

Figure 9-1 shows schematic locations for proposed road and intersection works.

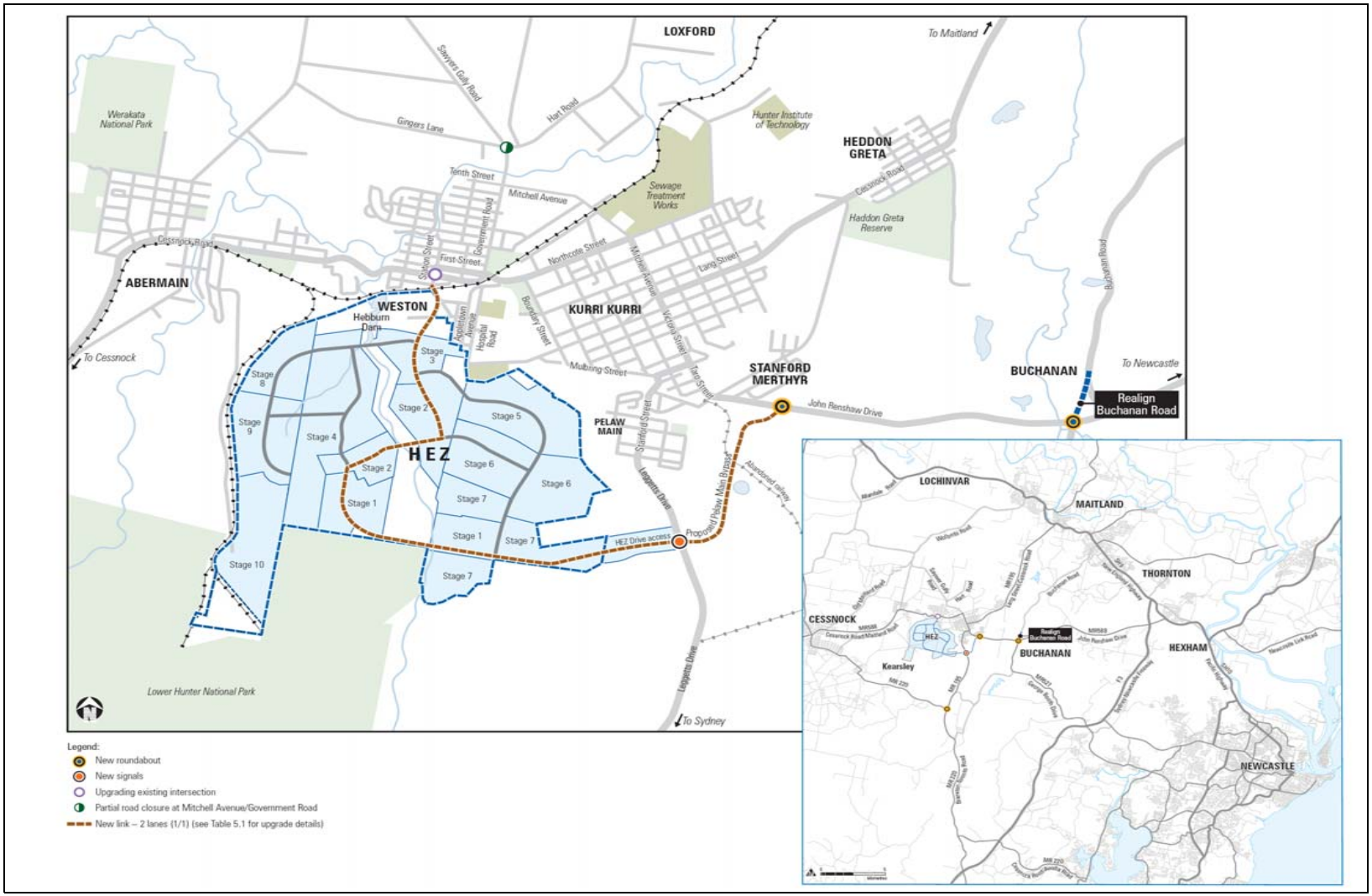

Figure 9-1 Proposed Traffic Works (HEZ Development Cap of 206 Ha) Without F3/2B

10. References

- AUSTROADS, 1988, Guide to Traffic Engineering Practice Roadway Capacity Part 2
- Road and Traffic Authority of NSW (RTA), 2002, Guide to Traffic Generating Developments
- Road and Traffic Authority of NSW (RTA), 2004, Traffic Volume Data fro Hunter Region 2004
- Road and Traffic Authority of NSW (RTA), 2001, Traffic Volume Data fro Hunter Region 2001
- Maitland Industrial Land Study (Maitland City Council), Castlecrest Consultants, 2002