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BATEMANS BAY
TRAFFIC AND TRANSPORT STUDY

FOR

EUROBODALLA SHIRE COUNCIL

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1. INTRODUCTION

1.1 BACKGROUND

Batemans Bay is expected to undergo significant redevelopment within its town centre to support ongoing population growth, particularly to the south of the centre. The volume and pattern of traffic entering the centre, coupled with growing through traffic, are expected to exacerbate emerging traffic capacity and parking issues.

Rather than incrementally assessing the cumulative impacts of developments within the town centre, Eurobodalla Shire Council has initiated this study to determine 10 year and 20 year infrastructure requirements with all proposed developments in place. This will allow long term road and intersection requirements to be understood and correctly staged and apportioned to specific development sites.

The proposed bypass of the often-congested Beach Road also needs to be assessed to determine what changes the bypass will introduce to traffic patterns and hence to infrastructure requirements at intersections in the town centre.

In addition, there is a need to understand what pressures this growth will place on parking in the town centre and the likely walking, cycling and public transport provisions required.

Figure 1.1 shows the study area of this traffic and transport study.

Figure 1.1: Study Area

1.2 SCOPE

Bitzios Consulting has been commissioned by Eurobodalla Shire Council to undertake this traffic and transport study primarily using a Paramics microsimulation model which has been created as part of this study.

Specifically, the scope of work for this study involves:

- undertaking traffic surveys to determine traffic patterns and to provide data to validate the Paramics microsimulation model;
- development of the microsimulation model for a base year of 2010 and for two typical peak periods during the day;
- undertaking an assessment of current traffic, parking, walking, cycling and public transport issues;
- determining future traffic infrastructure upgrade requirements with/without the bypass in 2020 and 2030, as well as broadly identifying associated parking needs;
- determining the proportion of traffic generated by key development sites that use the infrastructure items proposed to be upgraded; and
- determining in broader terms public transport, walking and cycling facilities required in 2020 and 2030.

It is important to note that parking has been considered simply based on aggregate changes in likely demand based on traffic growth, compared to current and expected future supply. It is understood that a more comprehensive parking strategy for the CBD will be completed following this report.

2. TRAFFIC AND TRANSPORT DATA

2.1 DATA SUMMARY

Figure 2.1 maps the locations of all the available data used in the development of the Paramics model, by type.

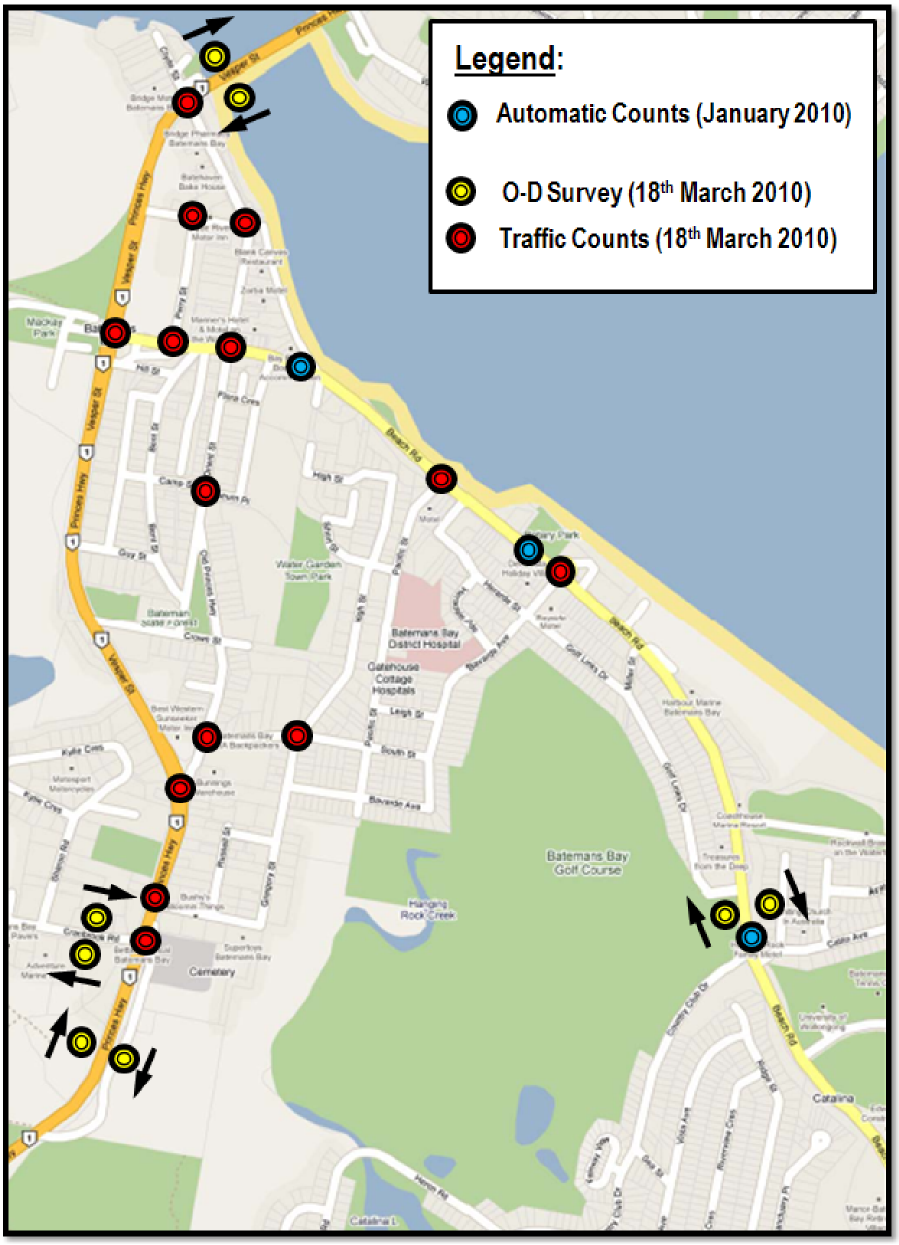


Figure 2.1: Data Type Availability Summary

2.2 AUTOMATIC COUNTS

As shown in Figure 2.1, Eurobodalla Shire Council provided MetroCount tube data for three locations along Beach Road (as shown in blue). This data was collected in January 2010 and was used to determine the peak traffic periods and subsequently establish which periods would be modelled and analysed.

The MetroCount data showed that generally there is not a substantial difference between maximum weekday and weekend traffic volumes, and that slightly higher volumes normally occur on Thursdays and Fridays. Figure 2.2 illustrates the distribution of the average weekday traffic volumes throughout the day.

It is recognised the peak tourist seasons do however generate higher traffic volumes.

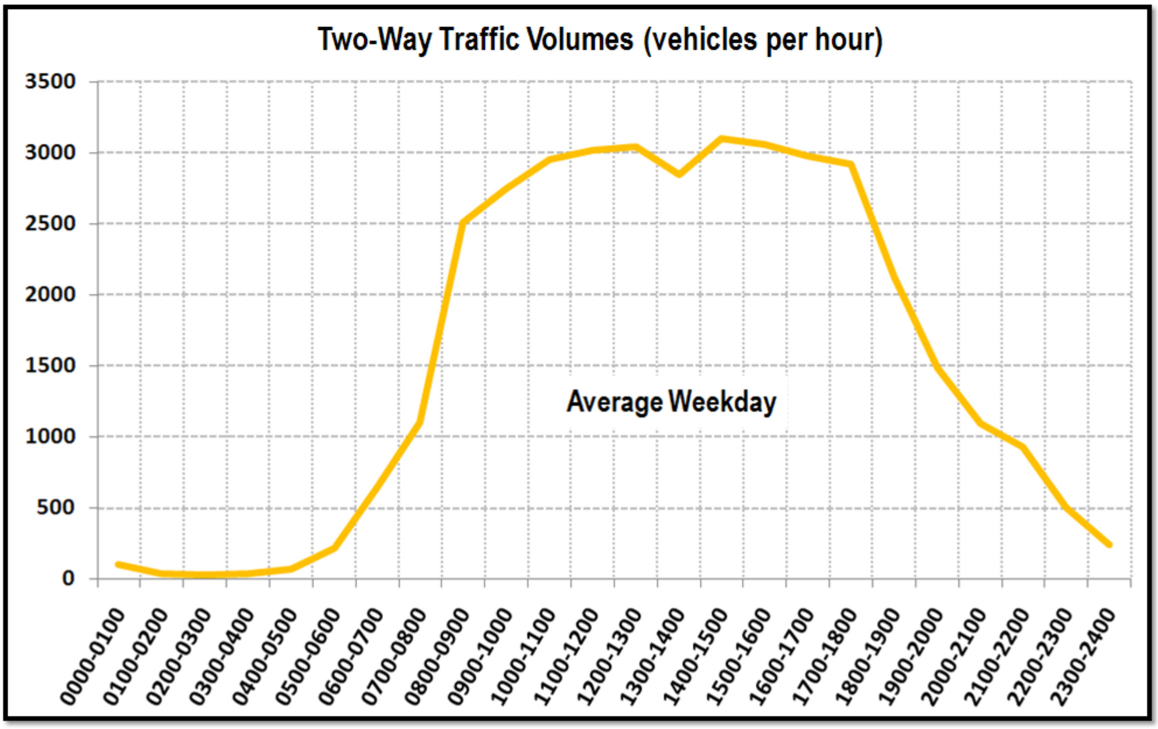


Figure 2.2: Distribution of Traffic Volumes - Average Weekday

The Batemans Bay Town Centre is primarily retail based and hence has higher traffic activity in the midday period compared to a conventional "commuter" morning peak. Also, the afternoon peak period occurs a little earlier than a conventional "commuter" peak which corresponds to a mix of school traffic, personal business traffic and work-related traffic.

2.3 MODEL PERIODS

Based on the distribution shown above, it was decided that the most appropriate periods to be modelled for determination of future traffic infrastructure requirements are:

- Midday Peak: 11.00am – 1.00pm; and
- Afternoon Peak: 3.00pm – 5.00pm.

It is recognised that the typical weekday period being modelled will not be the most congested period with weekends and holiday periods representing "worst case" conditions. However, given that the modelling is being used for defining future intersection upgrade requirements, it should be highlighted that designing for a significantly higher holiday peak would not be cost-effective in terms of typical usage of this infrastructure for most of the year.

2.4 TRAFFIC SURVEY

2.4.1 Survey Types

Traffic Data and Control (TDC) collected additional data specifically for the purpose of the Paramics microsimulation model development. This data was captured on Thursday 18th March 2010 and included:

- numberplate data for determining origin-destination (OD) traffic patterns;
- intersection turning counts (with pedestrians) for the creation of traffic matrices and subsequent model validation; and
- travel time surveys for validation of the performance of the models.

A more detailed description of this survey and results can be found in Appendix A.

2.4.2 Numberplate Survey

TDC recorded numberplates at four sites located on the boundary of the study areas (see yellow circles on Figure 2.1). MetroCount tube counters were also installed by Eurobodalla Shire Council at the same locations to determine the total number of vehicles entering and exiting the study area. These sites correspond to the "external" zones of the simulation model.

The primary purpose of the numberplate survey was to determine the proportion of traffic entering the study area that is through traffic, and the proportion that has an origin or destination within the study area.

Figure 2.3 shows the number of vehicles entering and exiting the study area in each peak period. The volumes shown correspond to the average number of vehicles per hour during the survey periods.

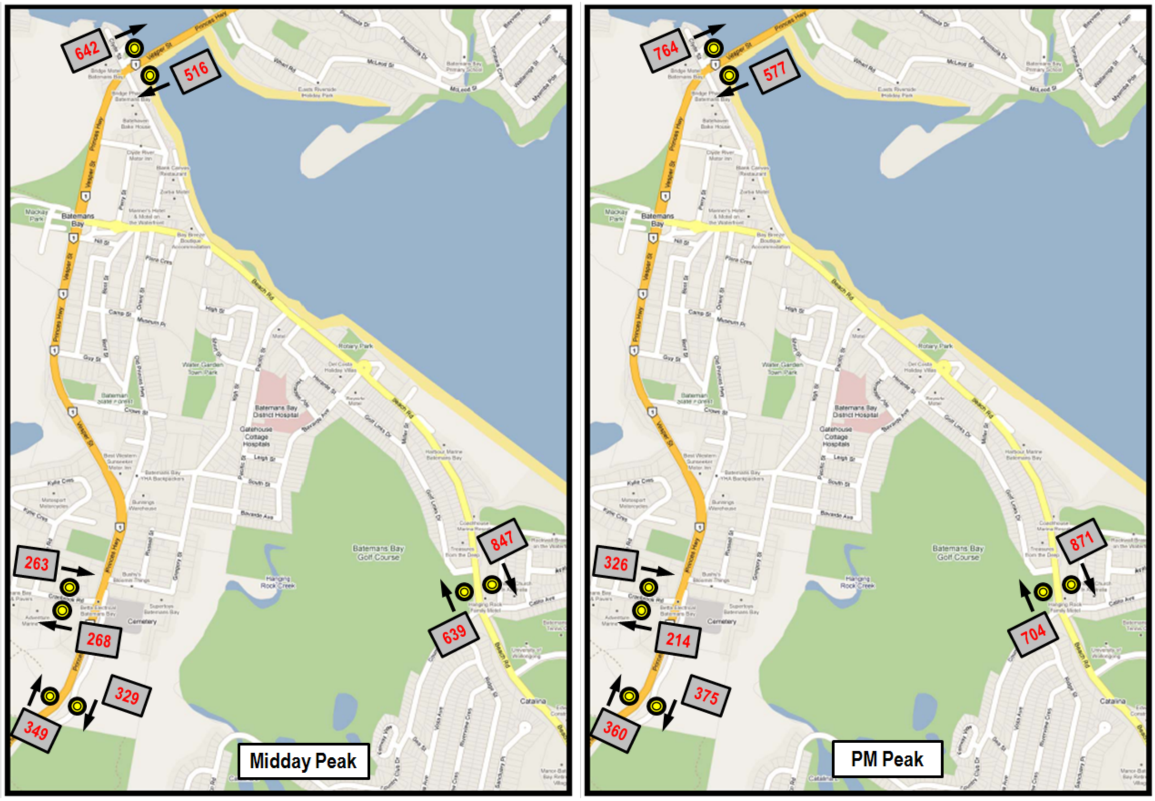


Figure 2.3: Midday and PM Peak Cordon Volumes (average vehicles per hour)

The numberplate data also allowed for OD matrices to be produced based on the selected entry and exit points of the study area. Tables 2.1 and 2.2 show the midday and PM matrices respectively.

The data indicates that in the midday peak approximately 20% of the observed traffic entering the study area is "through traffic" and that in the PM peak this percentage increases to 27%. All other recorded trips have their respective origin and/or destination within the study area.

Other relevant findings provided by the numberplate data are as follows:

- approximately 60% of the traffic entering the study area via the Clyde River Bridge has its destination within the study area;
- of the traffic entering the study area via the Clyde River Bridge, twice as many vehicles exit the study area via Beach Road than via the Princes Highway; and
- about half of the northbound vehicles that enter the study area via the Princes Highway (south) have their destination within the study area with the remaining half exiting the study area via the Clyde River Bridge.

Table 2.1: Midday Peak (11.00 am – 1.00pm) Origin/Destination Traffic Demands

From \ To	Princes Hwy (South)	Crambrook Road	Princes Hwy (North)	Beach Road	Internal	Total
Princes Hwy (South)	0	29	138	41	141	**349**
Crambrook Road	11	0	47	62	143	**263**
Princes Hwy (North)	55	20	0	109	332	**516**
Beach Road	24	34	65	0	516	**639**
Internal	239	185	392	635	N/A	**1451**
Total	**329**	**268**	**642**	**847**	**1132**	

Table 2.2: PM Peak (3.00pm – 5.00pm) Origin/Destination Traffic Demands

From \ To	Princes Hwy (South)	Crambrook Road	Princes Hwy (North)	Beach Road	Internal	Total
Princes Hwy (South)	0	18	146	49	147	**360**
Crambrook Road	22	0	71	75	158	**326**
Princes Hwy (North)	74	14	0	167	322	**577**
Beach Road	33	29	184	0	458	**704**
Internal	246	153	363	580	N/A	**1342**
Total	**375**	**214**	**764**	**871**	**1085**	

2.4.3 Intersection Counts

TDC undertook intersection counts at 14 locations within the study area. Pedestrian volumes were also captured at three signalised intersections where the majority of pedestrian movements occur, namely:

- Flora Crescent/Beach Road;
- Orient Street/Beach Road; and
- Princes Highway/Beach Road.

Figure 2.4 illustrates in which intersections the traffic counts were conducted and provides an indication of the total "throughput traffic volumes" for each location and each peak period. The detailed volumes by movement can be found in Appendix A.

The data indicates that the intersections with higher throughput volumes are:

- Beach Road/Bavarde Avenue (roundabout);
- Beach Road/Orient Street (signalised intersection); and
- Beach Road/Perry Street (roundabout).

All other intersections located along the Beach Road or Princes Highway corridors also show throughput volumes greater than 1000 vehicles per hour in both peaks, whereas the other sites have total volumes less than 700 vehicles per hour.

The volumes observed in the PM peak are generally 10% to 20% higher than those observed during the midday peak period.

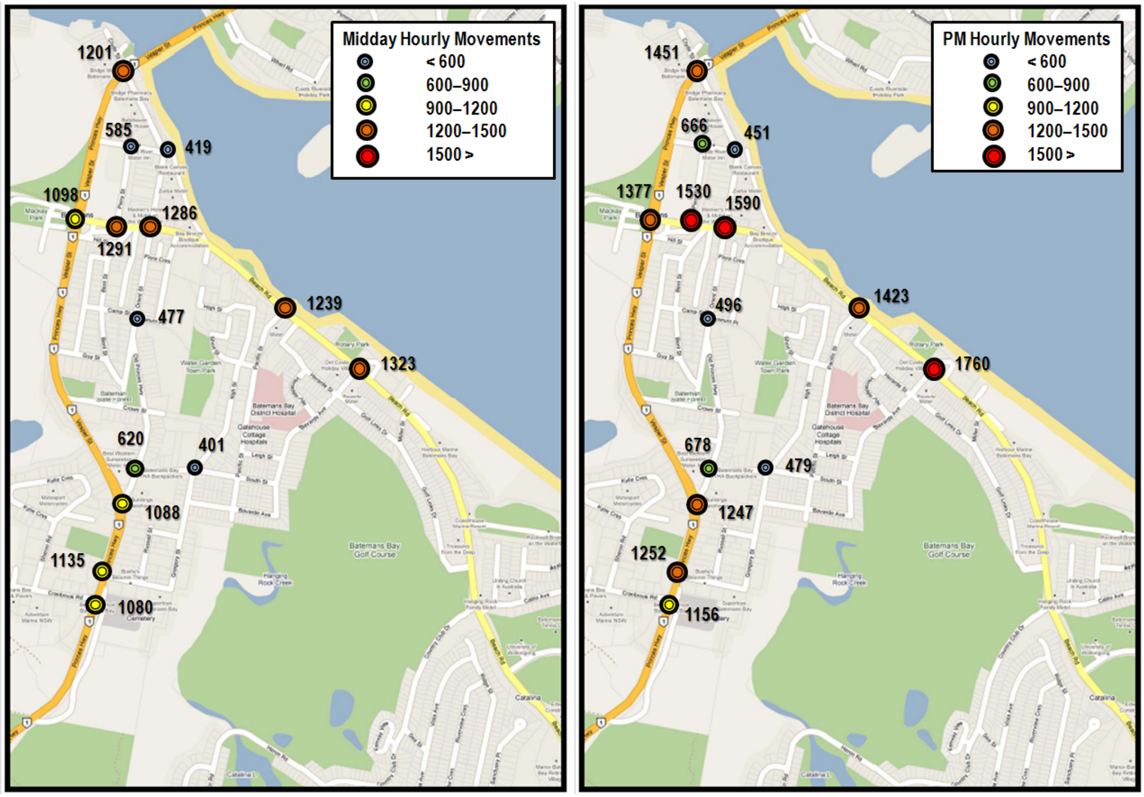


Figure 2.4: Intersection Count Locations and "Hourly Throughput Volumes"

The traffic data was recorded in 15 minute intervals, allowing for the distribution across each peak period to be identified and subsequently used in the models. Figure 2.5 illustrates these distributions.

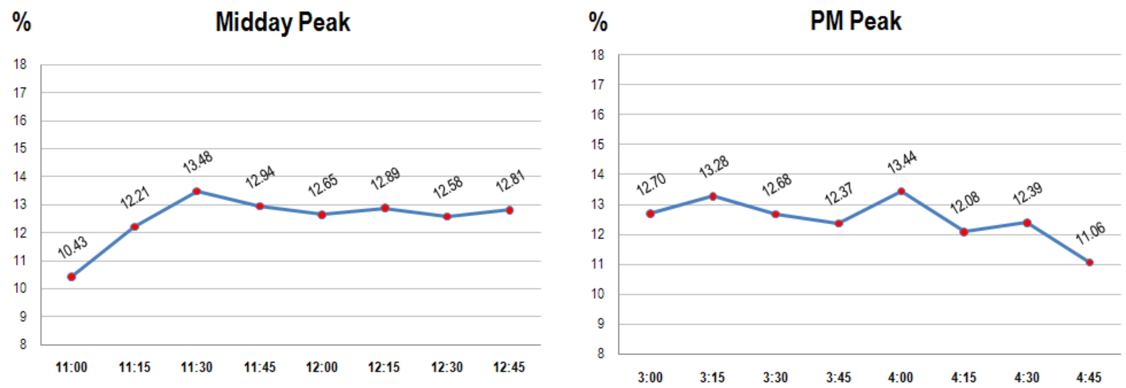


Figure 2.5: Traffic Distribution across the Peak Periods

2.4.4 Travel Time Data

TDC undertook travel time runs along three routes to identify travel times for comparison to modelled travel times and hence for checking the model's validity. The routes included in this survey are as follows:

- Princes Highway;
- Old Princes Highway (via Clyde Street and Orient Street); and
- Beach Road and Perry Street (North Street to Golf Links Drive).

GPS units were used to capture the vehicle position during the survey, thus creating a detailed profile of speed and delays experienced in every section of the surveyed corridors. Figure 2.6 illustrates the average speeds obtained for all the street sections included in the survey.

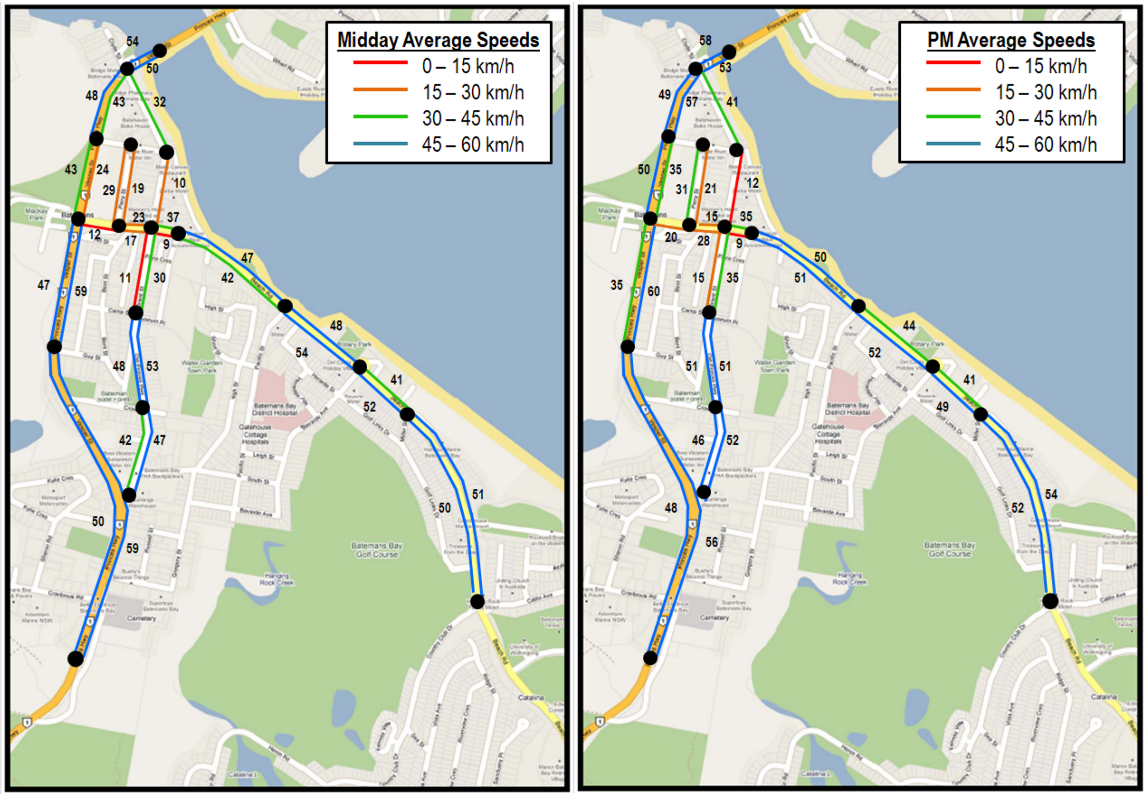


Figure 2.6: Travel Time Routes and Average Speeds

As shown in Figure 2.6, the majority of the average speeds are higher than 30km/h. Generally, the segments showing lower speeds incorporate approaches to signalised intersections and therefore take into account the time which the vehicles are stopped at the signals. However, it must be noted that some road segments in the CBD are not adjacent to traffic signals and still show quite low average speeds, such as in Perry Street. This is related to a number of reasons such as the existence of roundabouts, the number of conflicting movements, the land uses/turning movements adjacent to these streets or the actual road configuration/speed environment.

2.5 Signal Timing Data

The study area incorporates five signalised intersections, namely:

- Princes Highway/North Street;
- Princes Highway/Beach Road;
- Orient Street/Beach Road;
- Flora Crescent/Beach Road; and
- Princes Highway/Cranbrook Road.

The signal phasing configurations for all the above intersections were sourced from RTA and subsequently added to the traffic model in order to accurately replicate their operation. This data included cycle times, phasing sequence and green times.

2.6 Bus Routes and Stops

The study area is currently serviced by three bus routes operated by "Priors Bus Services", namely:

- Route 760: Batemans Bay to Moruya;
- Route 761: Batemans Bay to Catalina; and
- Route 757/761: Batemans Bay to Long Beach.

Figure 2.7 shows the existing bus routes and stops servicing the study area.

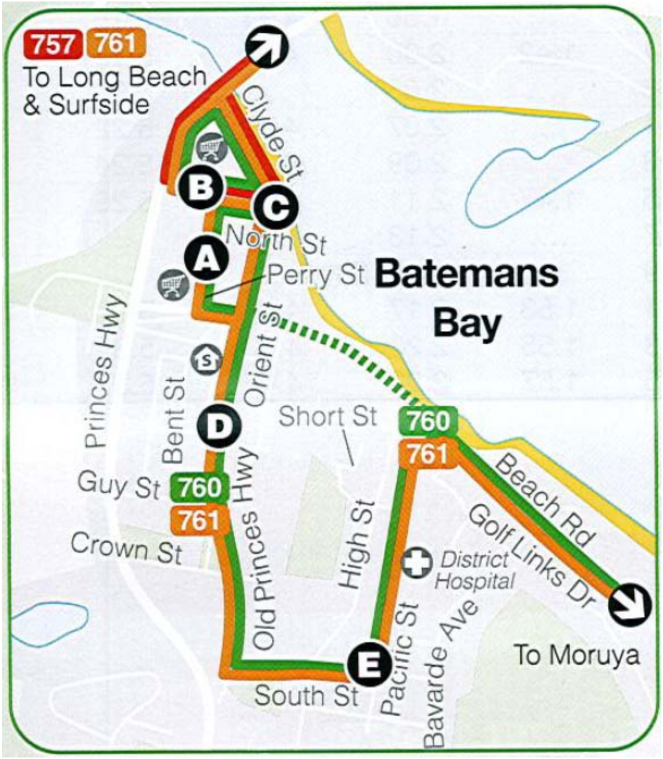


Figure 2.7: Bus Routes and Stops

In general, public transport for access to the Batemans Bay Town Centre has limited patronage, and routes and stops are relatively sparse. The frequencies are generally less than one bus per hour during the week with even fewer services available during the weekends.

This level of bus service would be highly unlikely to attract patronage for those where an alternative mode/option is available and hence is expected to be highly orientated towards the "captive" user market.

These services and respective frequencies were added to the traffic models, replicating current public transport operations in the study area.

3. TRAFFIC MODEL DEVELOPMENT

3.1 MODEL DEVELOPMENT PROCESS

The development of the traffic simulation model involved the following process.

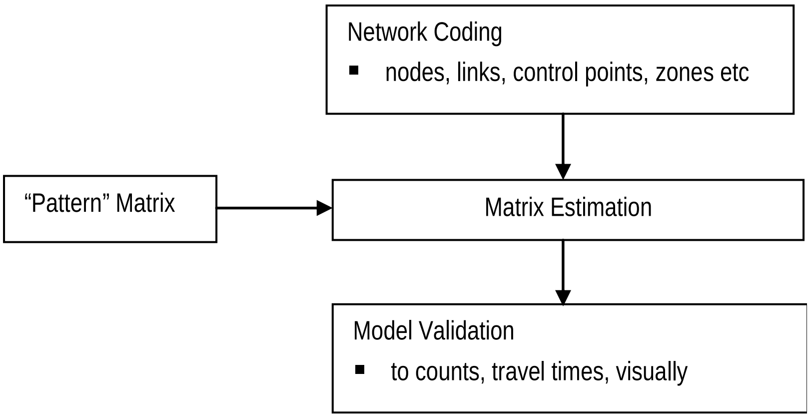


Figure 3.1: Model Development Process

3.2 NETWORK CODING

The model network coding was based on recent aerial photography data provided by the Eurobodalla Shire Council and verified through site inspections. Various road network attributes were added to the model such as the number of lanes, posted speed, signal phasing configurations, priorities, etc.

The extent of the network is shown in Figure 3.2. Most of the area was covered by recent, higher quality aerial photography but part of the southern area was based on older, lower quality photography, as evidenced in Figure 3.2.

Figure 3.2: Model Network

The modelled base network included all through links in the study area as at March 2010. Short link "stubs" were also coded to represent locations where zones access the road network. In some locations zone connectors may represent a single site but in lower density residential areas one zone connector may be representative of a number of driveways.

3.3 ZONING SYSTEM

When developing the zoning system it is important to trade-off having a sufficient number of zones to make the model locally sensitive but not too many zones that the model calibration/validation is unrealistic based on the level of count data available for validation.

A total of 45 zones were added to the base model and Figure 3.3 illustrates how they were distributed across the study area.

Zones have typically been created to represent key sites or blocks and consideration has been given to the location of future development sites in establishing the base year zoning system.

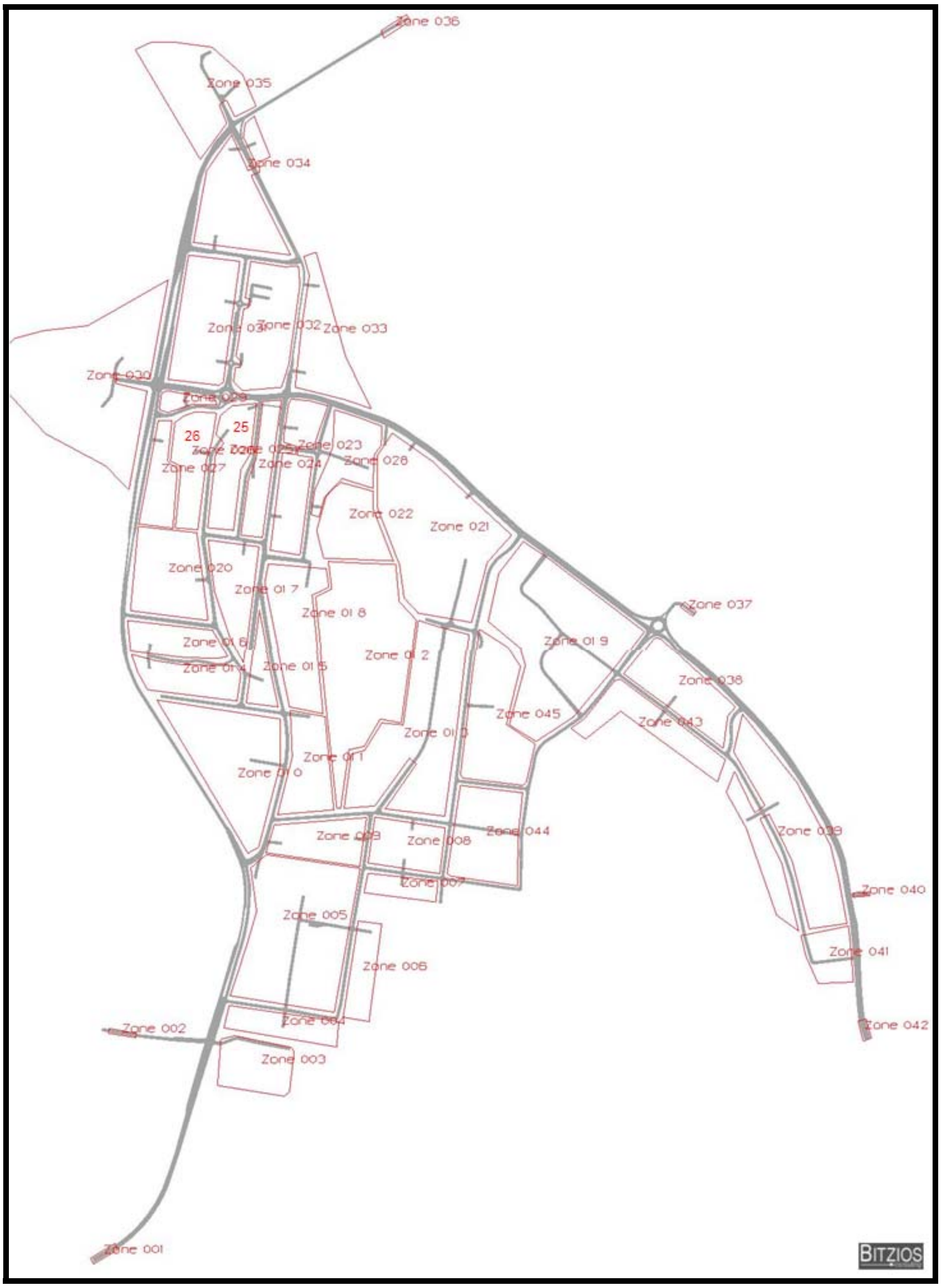


Figure 3.3: Zoning System

3.4 MATRIX ESTIMATION

3.4.1 Zonal Traffic Generation Estimates

The matrix estimation process started by estimating the trips generated in each peak period by each of the zones included in the model. The trips generated by the "external zones" correspond to the volumes provided by the traffic survey data as shown in Figure 2.3. The numberplate survey doesn't provide any information in terms of the trip generation or distribution of the zones internal to the study area. Internal trip generation was therefore estimated using the rates in the "RTA Guide to Traffic Generating Developments".

Table 3.1 provides indicative traffic generation volumes for each zone and for each peak period.

Table 3.1: Indicative Trip Generation Volumes

Zone	Trip Distribution			
	Midday to the Zone	Midday from the Zone	PM to the Zone	PM from the Zone
1	external			
2	external			
3	5	5	10	10
4	19	19	19	19
5	76	78	78	76
6	17	17	17	17
7	2	6	6	2
8	3	14	14	3
9	11	15	15	11
10	21	52	52	21
11	2	9	9	2
12	0	0	0	0
13	10	40	40	10
14	4	17	17	4
15	5	5	10	10
16	1	5	5	1
17	3	12	12	3
18	50	55	55	50
19	34	62	62	34
20	1	5	5	1
21	12	40	40	13
22	0	0	0	0
23	80	80	80	80
24	100	100	100	100
25	4	18	18	4
26	2	10	10	2
27	11	15	15	11
28	99	99	99	99
29	5	5	5	5
30	50	30	100	110

Zone	Trip Distribution			
	Midday to the Zone	Midday from the Zone	PM to the Zone	PM from the Zone
31	401	401	401	401
32	171	171	171	171
33	222	222	222	222
34	235	235	235	235
35	45	54	54	45
36	external			
37	0	0	0	0
38	15	29	29	15
39	20	64	64	20
40	0	0	0	0
41	62	62	62	62
42	external			
43	4	14	14	4
44	6	23	23	6
45	36	44	44	36
TOTAL	1845	2132	2355	1918

As shown in Table 3.1, the “Village Centre” shopping centre (Zone 31) is the major trip attractor/generator within the study area, with a retail area of approximately 23,000m2.

3.4.2 Pattern Matrix Development

Matrix estimation in Paramics requires the user to provide a starting “pattern” matrix which the package uses, along with traffic counts, to redistribute trips and achieve a best fit between OD movements and intersection turning movements.

A process of matrix “furnessing” or two dimensional balancing was used to create the pattern matrix for input into Paramics Estimator.

The pattern matrix was developed based on a combination of the data provided by the traffic survey (particularly the numberplate/origin-destination survey) and the trip generation calculations described above.

3.4.3 Estimation Process

The matrix estimation process was conducted using the “Estimator” tool included in the Paramics suite of software. A separate estimation was completed for each peak period and the inputs used in this process are as follows:

- traffic count data for 14 intersections;
- “cordon volumes” (number of trips entering and exiting the study area at each external point); and
- the pattern matrix.

The estimation process consists on a number of iterations in which the software continuously modifies the demands and route choice (initially corresponding to the pattern matrix) in an attempt to reduce the GEH statistic to a minimum. The GEH statistic is a modified chi-square statistic that incorporates both relative and absolute differences in comparing modelled and observed traffic volumes. It is represented by the equation below:

$$GEH = \sqrt{\frac{(M-O)^2}{0 \cdot 5 * (M+O)}}$$

Where:

M: simulated flows; and

O: observed flows.

In this case, the observed flows are the individual turning movements at each of the 14 locations surveyed, as well as the tube count locations at the boundary of the study area.

A demands matrix is generally considered a "good fit" when the average GEH value (i.e. across all turning movements) is less than 5.0. Both the midday and PM peak matrices produced GEH statistics of approximately 4.0.

3.5 Model Calibration and Validation

Effective calibration and validation is very important to the confidence placed in using a traffic model for assessment of future conditions. The criteria applied in the validation process, consistent with RTA and Austroads guidelines are:

- achieve average GEH value of 5.0 or less in the overall network;
- achieve GEH value of 5.0 or less for at least 85% of all turning movements considered;
- verify that no turning movement flow had a GEH value greater than 10.0; and
- ensure that the absolute difference between modelled and observed travel times is one minute or less for all routes.

These criteria incorporate the requirements typically used by the RTA which correspond to those outlined in the *Design Manual for Roads and Bridges Vol 12 – Traffic Appraisal of Road Schemes (DMRB12)*.

The process of calibrating the model included a series of minor modifications to network attributes such as link attributes, route choice definitions or adjustment of some specific OD demands.

This series of modifications and adjustments to the models resulted in the final midday and PM base models. The validation statistics are shown in Tables 3.2 and 3.3.

Table 3.2: GEH Statistic Summary

	Midday Peak	PM Peak
Average GEH	2.69	2.31
% Turn Movements with GEH < 5	90	92
% Turn Movements with GEH < 10	100	100

Table 3.3: Modelled and Surveyed Travel Time Comparison

Route	Midday Peak		PM Peak	
	Survey TT (min)	Modelled TT (min)	Survey TT (min)	Modelled TT (min)
Beach Road NB	3.62	3.31	3.34	3.28
Beach Road SB	3.2	2.85	3.36	2.88
Old Princes Highway NB	6.24	5.48	4.92	4.71
Old Princes Highway SB	4.56	3.85	4.14	3.58
Princes Highway NB	2.88	3.33	3.05	3.4
Princes Highway SB	2.91	3.22	2.65	3.15

As shown in Tables 3.1 and 3.2 all the validation criteria described above have been verified and therefore the models can be considered to be an accurate representation of the current traffic conditions in the study area during the selected periods.

3.6 LEVEL OF SERVICE OUTPUTS

A good way to evaluate how the traffic operates throughout the study area is to investigate levels of service (LOS) of the most relevant intersections and where queuing/delays are experienced.

Figures 3.4 and 3.5 illustrate the LOS of 18 intersections throughout the study area for both peak periods. The locations where queuing occurs are also shown in yellow.

The LOS is based on the LOS delay-bands used by the RTA, namely:

LOS	Average Delay Range (secs)
A	0 - 10
B	10 – 20
C	20 – 35
D	35 – 55
E	55 – 80
F	>80

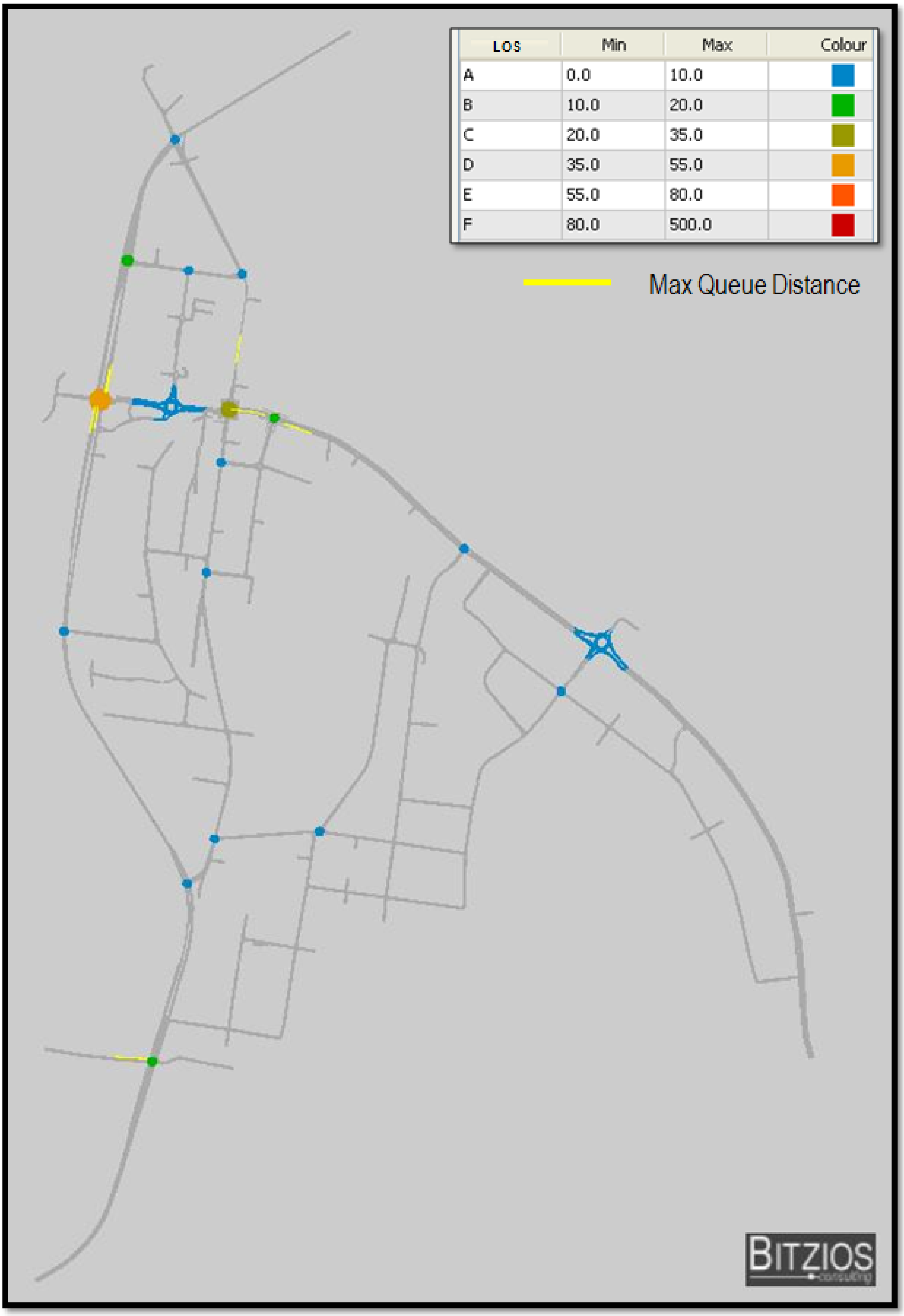


Figure 3.4: Midday Peak Level of Service Outputs

As shown by these outputs, the majority of intersections operate with minimal delays (LOS A or B). Some signalised intersections such as Beach Road/Princes Highway and Beach Road/Orient Street show levels of service C or D, but these results should be interpreted with caution considering the use of delay-based LOS statistics as part of this delay is waiting at a red light. The results do, however, highlight key intersections where issues are emerging and likely to generate congestion with increased traffic growth. It is important to note that both site and model observations revealed that vehicles stopped at any of the signalised intersections are able to clear within a single cycle of the traffic signal.

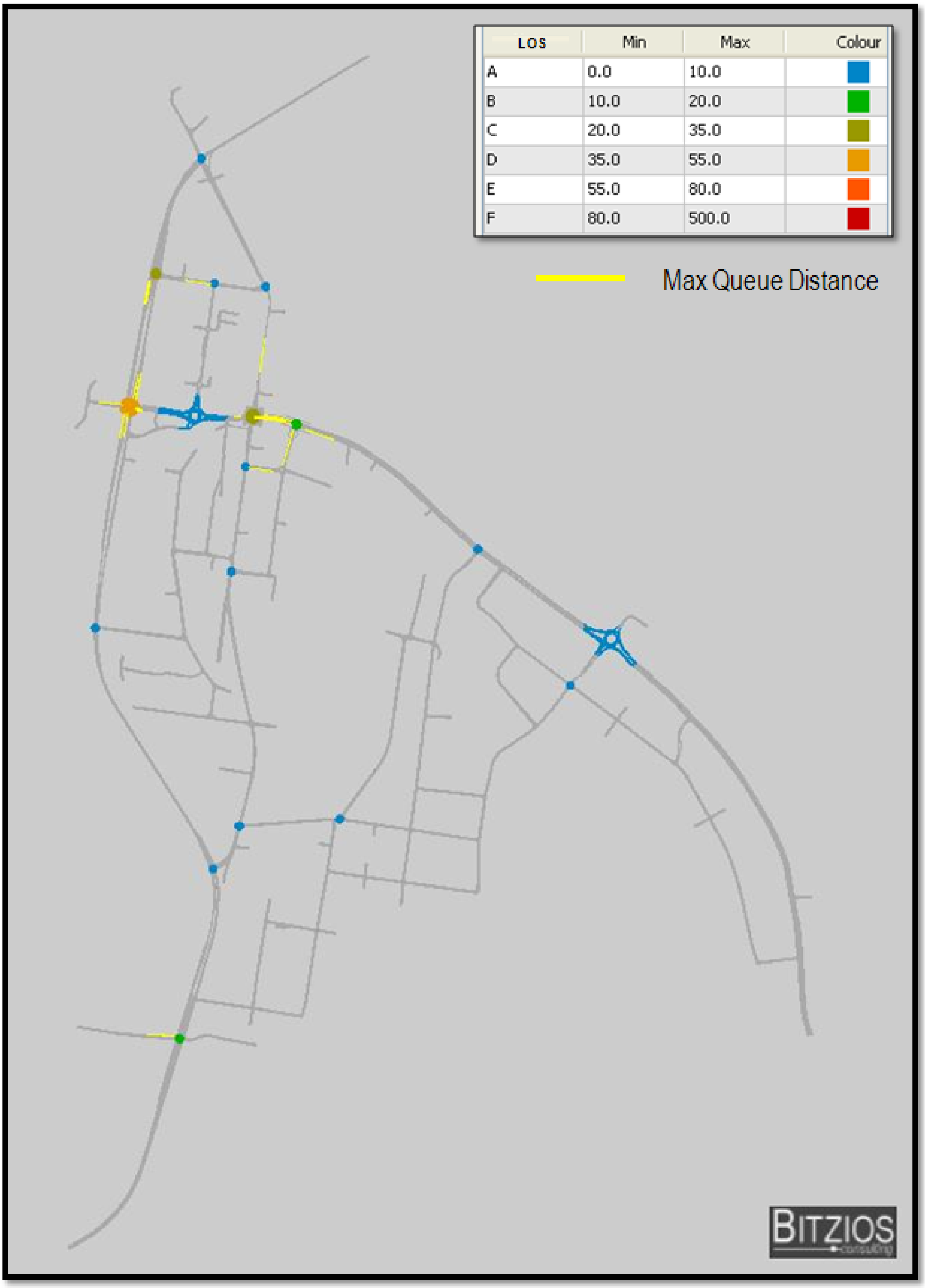


Figure 3.5: PM Peak Level of Service Outputs

4. CURRENT SITUATION ASSESSMENT

4.1 EXISTING TRAFFIC PATTERNS AND PINCH POINTS

The modelling results indicate that while no heavy delays or congestion levels are currently experienced within the study area (in typical week-day periods), the combination of traffic patterns and network configuration results in some queuing occurring mostly in the northern part of the study area.

It is important to note that the section of Beach Road between Princes Highway and Flora Crescent incorporates three signalised intersections, a two-lane roundabout and access to other secondary streets/lanes or car parks. This results in a series of conflicting movements that occasionally lead to some delays.

The survey results indicated that a large proportion of the traffic travelling along Beach Road is vehicles entering the study area via the southern end of Beach Road and then travelling north towards the CBD and the Clyde River Bridge (and vice-versa). The majority of these trips are generated in the suburbs located to the south of the study area such as Catalina, Batehaven, Sunshine Bay, Denhams Beach or Surf Beach.

Figure 4.1 illustrates how the through and local traffic volumes conflict in the CBD.

Figure 4.1: Local versus Through Traffic on Beach Road

Figure 4.2: Queues at the Intersection of Beach Road/Orient Street

While the southern end of the study area provides two main entry/exit points, the northern part of the area converges to a single link – the Clyde River Bridge which comprises a single lane in each direction.

Figure 4.3 illustrates how local and through-northbound trips converge at the Clyde River Bridge.

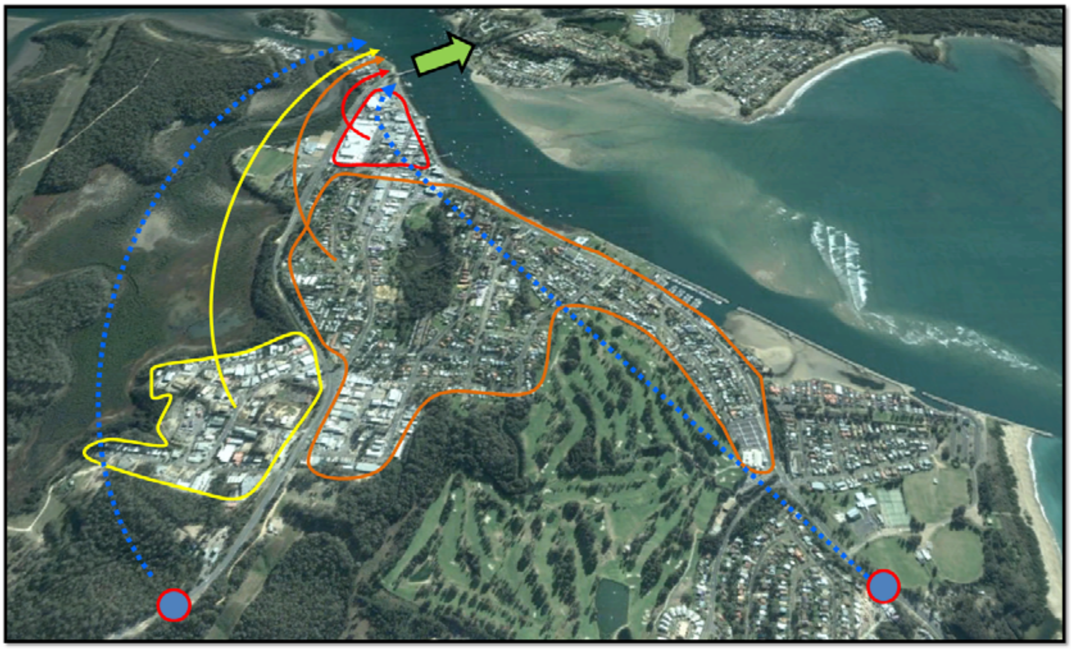


Figure 4.3: Northbound Trips Converging on the Clyde River Bridge

It is important to note that the Clyde River Bridge is "lifted" approximately 1,000 times per year to allow for vessels to pass beneath. This causes the only access to and from the CBD from the north to be occasionally closed. Whilst this has significant short term impacts, outside of tourist seasons disrupted traffic does return back to normal patterns within a few minutes of the bridge being closed.

4.2 PARKING INVENTORY AND ISSUES

The study area is currently serviced by approximately 2,300 off-street parking bays. Approximately 40% of these spaces are provided at "The Village Centre" which provides undercover facilities. There is also on-street parking provided throughout the town centre with some time regulations implemented in the town centre core, where the majority of commercial and retail areas are located.

Batemans Bay is a popular tourist destination on weekends and in typical holiday periods which means that the parking occupancy profiles are highly variable and quite similar to the seasonal nature of traffic demands. However, during a normal weekday, the parking supply and regulations appear to be generally adequate to meet typical weekday demands.

The on-street bays provided along the Clyde Street/Orient Street corridor (between Princes Highway and Flora Crescent) tend to be those with higher occupancy levels and faster turn-over.

As explained above, the Village Centre is the largest trip attractor/generator in the study area and therefore the operation of its off-street car park and respective access points is critical to the traffic operations in the surrounding area.

4.3 PUBLIC TRANSPORT FACILITIES

The public transport routes servicing the study area are quite infrequent and the patronage is also relatively low. There are currently three bus stops located at the northern end of the CBD (close to major trip generators such as the retail areas and restaurants) and two other stops south-west of Beach Road as shown in Figure 2.7. The overall operation of bus services and required manoeuvres to access the bus stops does not conflict with general traffic flows and the incidence of these movements is very low.

The taxi operation in the town centre is also quite minimal and no major traffic capacity issues associated with taxi operations have been identified.

4.4 WALKING AND CYCLING FACILITIES

There are two main types of pedestrian movements in the town centre:

- recreational pedestrian movements – occurring mostly along the corridor comprising Clyde Street, Mara Mia Walkway and Beach Road; and
- shopping/commercial related pedestrian movements – occurring mostly in the northern end of the town centre, particularly on Beach Road, Orient Street, Perry Street and North Street and often to/from parking areas.

Figure 4.4 illustrates these routes.

Figure 4.4: Major Pedestrian Movements in the Study Area

There are generally adequate pedestrian and cycling facilities provided across the study area. More specifically, there are four signalised intersections and a number of identified crossing points provided within the northern end of the town centre, where the majority of the above mentioned pedestrian trips occur.

However, it is important to highlight that there are two locations where cycling and pedestrian movements involve some safety concerns. The first location is the Perry Street/Beach Road intersection, which is controlled by a two lane roundabout that caters for high volumes of traffic during the peak periods. Refuge islands are provided within the approach splitter islands in each leg of this roundabout, however these refuge islands are less user friendly than signals. In fact, the safest alternative for pedestrians to cross Beach Road is to use one of the signalised intersections adjacent to the Beach Road/Perry Street roundabout.

The other location is the area surrounding the Perry Street/North Street intersection. There is a considerable volume of pedestrians attempting to cross the road in the vicinity of this intersection (give-way controlled) but there is no crossing facility provided. There is a strong desire line between parking areas in/near Perry Street and destinations surrounding North Street. It must be noted that more pedestrians cross the road at this location compared to the Beach Road/Perry Street junction and that less safe crossing points exist around the North Street area.

Pedestrians were observed attempting to pre-empt traffic turning movements at this location so as to select appropriate gaps in which to cross, of which there are relatively few in peak times.

5. FUTURE DEVELOPMENTS AND TRAFFIC GROWTH

5.1 DRAFT LEP

The Draft Eurobodalla Shire Council Local Environmental Plan (LEP) was used to estimate future internal trip generation within the study area to model future year traffic growth. This process involved using the draft LEP map of floor space ratios and multiplying these ratios by the corresponding model-zone areas to get approximate areas of land use. Using the land use areas from the draft LEP, traffic generation was calculated using standard rates from the “RTA Guide to Traffic Generating Developments”. We understand that the draft LEP represents maximum allowable floor areas not what is actually likely to be constructed however this approach represents a “worst case” scenario for determining future traffic infrastructure needs.

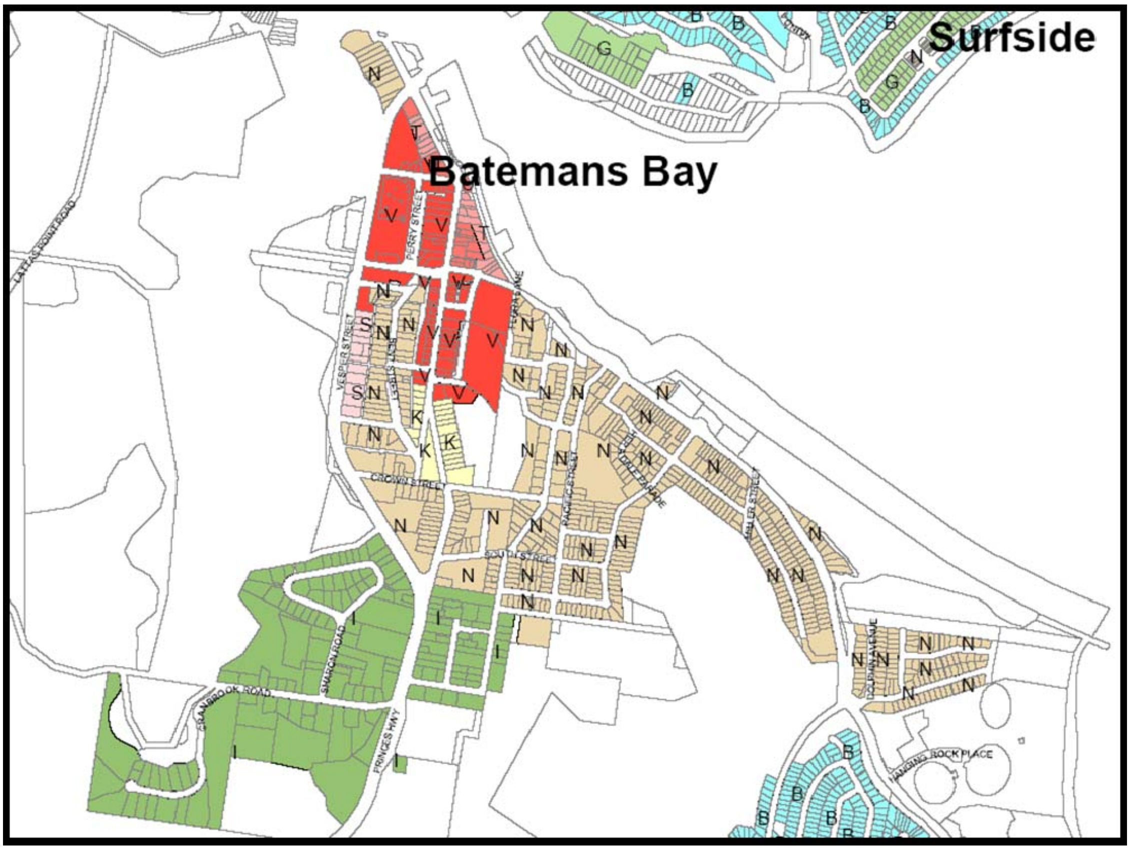


Figure 5.1: Eurobodalla Shire Council Draft LEP 2009

The future zonal traffic generation was then split into in/out trips using the corresponding ratios from the 2010 modelling. The following table lists the “full development” zonal in/out movements based of the draft LEP traffic demands and the 2010 in/out splits. For further information about the Paramics Zones refer to Figure 3.3 (Zoning System).

Table 5.1: Full Development Internal Zone Trip Generation based on draft LEP and Land Use

Paramics Zone	Total Trip Generation (In + Out) Value	Midday LEP				PM LEP			
		In		Out		In		Out	
		Value	%	Value	%	Value	%	Value	%
1	external	-	54%	-	46%	-	50%	-	50%
2	881	438	50%	443	50%	353	40%	528	60%
3	0	0	0%	0	0%	0	0%	0	0%
4	41	27	66%	14	34%	21	51%	20	49%
5	213	104	49%	109	51%	83	39%	130	61%

Paramics Zone	Total Trip Generation (In + Out) Value	Midday LEP				PM LEP			
		In		Out		In		Out	
		Value	%	Value	%	Value	%	Value	%
6	43	15	35%	28	65%	22	51%	21	49%
7	6	4	66%	2	34%	4	65%	2	35%
8	16	6	38%	10	62%	15	91%	1	9%
9	18	9	52%	9	48%	9	50%	9	50%
10	49	16	31%	34	69%	19	39%	30	61%
11	19	2	8%	18	92%	5	28%	14	72%
12	0	0	0%	0	0%	0	0%	0	0%
13	55	8	15%	47	85%	27	49%	28	51%
14	18	14	81%	3	19%	18	100%	0	0%
15	9	1	6%	8	94%	6	66%	3	34%
16	16	14	88%	2	12%	16	99%	0	1%
17	25	15	62%	10	38%	3	14%	22	86%
18	177	78	44%	99	56%	105	59%	72	41%
19	82	22	27%	60	73%	49	59%	33	41%
20	374	374	100%	0	0%	94	25%	281	75%
21	69	51	73%	19	27%	47	68%	22	32%
22	411	0	0	0%	0	0%	0	0%	0
23	519	301	58%	218	42%	170	33%	349	67%
24	290	182	63%	108	37%	129	44%	162	56%
25	19	8	40%	11	60%	17	89%	2	11%
26	20	15	75%	5	25%	0	0%	20	100%
27	458	127	28%	330	72%	153	33%	305	67%
28	381	234	61%	147	39%	160	42%	220	58%
29	83	0	0%	83	100%	10	12%	74	88%
30	0	0	64%	0	36%	0	46%	0	54%
31	689	299	43%	390	56%	306	44%	383	56%
32	678	381	56%	296	44%	336	50%	342	50%
33	591	262	44%	329	56%	250	42%	340	58%
34	630	314	50%	317	50%	263	42%	367	58%
35	26	8	31%	18	69%	11	41%	15	59%
36	external	-	50%	-	50%	-	59%	-	41%
37	0	0	61%	0	39%	0	100%	0	0%
38	25	6	24%	19	76%	15	59%	10	41%
39	65	12	18%	53	82%	43	66%	22	34%
40	0	0	62%	0	38%	0	18%	0	82%
41	9	4	46%	5	54%	4	44%	5	46%
42	External	-	56%	-	44%	-	54%	-	46%
43	21	7	33%	14	67%	21	100%	0	0%
44	28	12	42%	17	58%	26	91%	3	9%
45	38	17	44%	21	56%	21	55%	17	45%

5.2 KEY DEVELOPMENT SITES

There are four key proposed development sites within the study area. More detailed information on development details for these areas was available and hence more detailed trip generation calculations were used to give better input into the future year modelling. These development sites are detailed below.

5.2.1 Bridge Plaza

Figure 5.2 shows the location of the proposed Bridge Plaza development.

Figure 5.2: Bridge Plaza Development

The following summary of the Bridge Plaza development shows the land use and the trips generated by this development.

Table 5.2: Bridge Plaza Trip Generation

Land Use	Paramics Zone	Area (m^2)	Apartments	Peak Trips	Midday		PM	
					In	Out	In	Out
Retail	34	9470	N/A	947	474	474	474	474
Residential	34	20680	166	83	17	66	66	17
Total					490	540	540	490

5.2.2 Village Centre

Figure 5.3 shows the location of the proposed Village Centre development.

Figure 5.3: Village Centre Development

The Village Centre development includes additional residential apartments to this zone. The following table is a summary of the additional trips generated by this development that is added to the existing traffic already generated by this area.

Land Use	Paramics Zone	Area (m^2)	Apartments	Peak Trips	Midday		PM	
					In	Out	In	Out
Residential	31	4785	40	20	4	16	16	4

5.2.3 Soldiers Club/Centrelink

Figure 5.4 shows the location of the proposed Soldiers Club/Centrelink development

Figure 5.4: Soldiers Club/Centrelink Development

This development includes Centrelink (already under construction) as well as offices, residential and other land uses. The Centrelink trips are added to the existing Soldiers Club trips as they are located within the same zone in the model. The following table summarises the trips generated by this development.

Table 5.4: Soldiers Club/Centrelink Trip Generation

Land Use	Paramics Zone	Area (m^2)	Apartments	Peak Trips	Midday		PM	
					In	Out	In	Out
Centrelink	28	4510	N/A	216	117	99	99	117
Residential	22	13269	69	35	7	28	28	7
Office	22	15340	N/A	307	153	153	123	184
Other Uses	22	3080	N/A	150	30	30	100	50
Total (Zone 22)					190	211	250	241

Figure 5.5: Woolworths Development

Trips generated by the construction of a Woolworths at this site are estimated in the following table.

Table 5.5: Woolworths Trip Generation

Land Use	Paramics Zone	Area (m^2)	Peak Trips	Midday		PM	
				In	Out	In	Out
Retail	56	6000	600	300	300	300	300

5.3 Summary of Key Growth Areas

Key growth areas have been identified by the projected increase in trips made between the 2010 and 2030 model scenarios. The significant growth areas are highlighted in Figure 5.6 and Table 5.6.

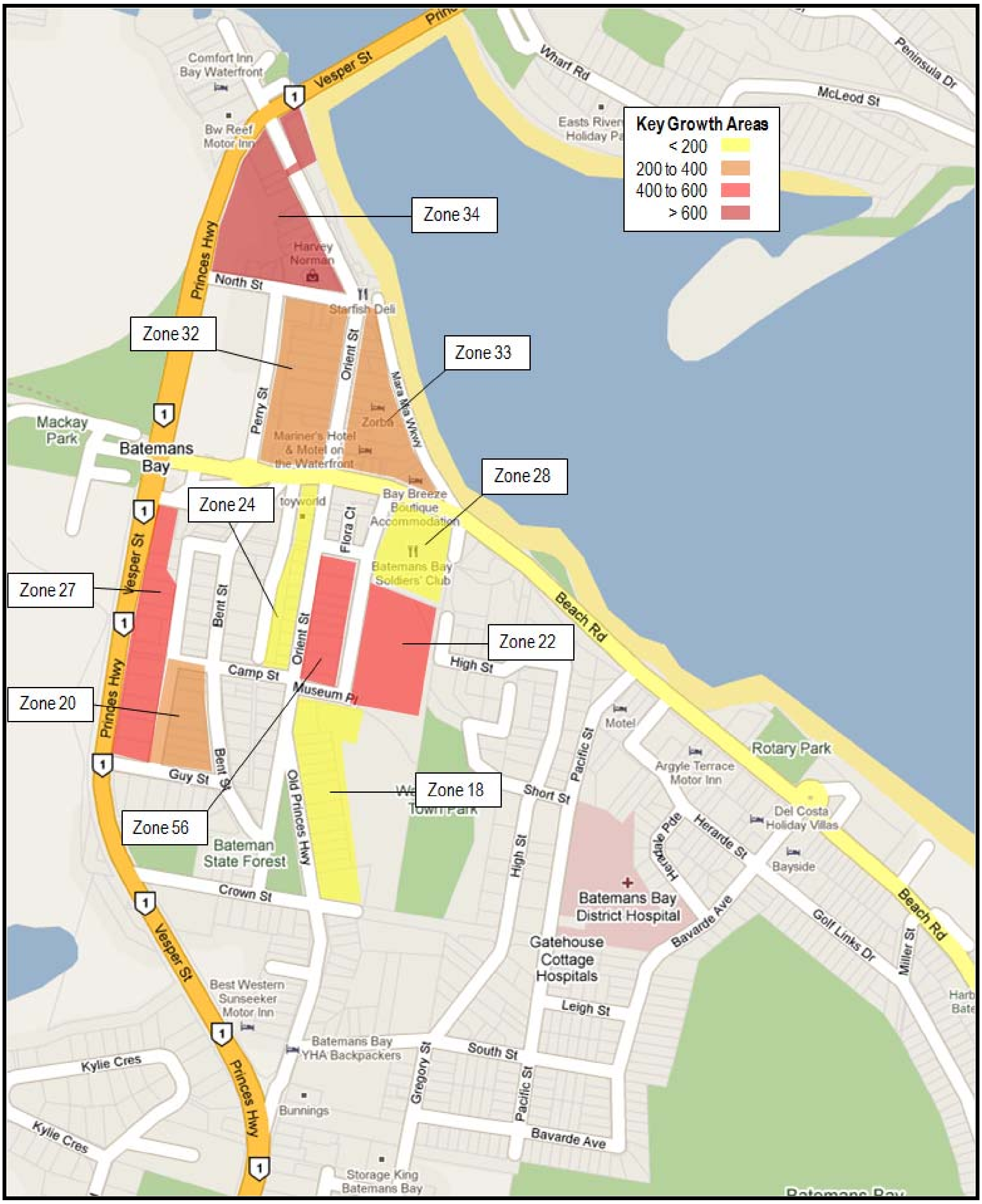


Figure 5.6: Key Growth Areas and Projected Increases in Peak Hour Traffic

Table 5.6: Key Growth Zones

Paramics Zone	MIDDAY Peak Traffic			PM Peak Traffic		
	2010 Model	Full LEP	Volume Increase	2010 Model	Full LEP	Volume Increase
1	763	1053	291	703	970	268
2	452	881	430	516	881	366
5	111	213	102	186	213	27
18	132	177	46	98	177	79
20	24	374	350	8	374	366
22	0	401	401	0	491	491
24	164	290	127	176	290	114
27	54	458	404	15	458	443
28	195	381	186	247	381	134
32	334	678	344	290	678	388
33	356	591	235	335	591	256
34	348	1030	683	369	1030	661
36	1039	1435	396	1389	1918	529
42	1334	1842	508	1594	2201	607
56	0	600	600	0	600	600
TOTAL	53606	10704	5103	5926	11253	5329

5.4 THROUGH TRAFFIC GROWTH

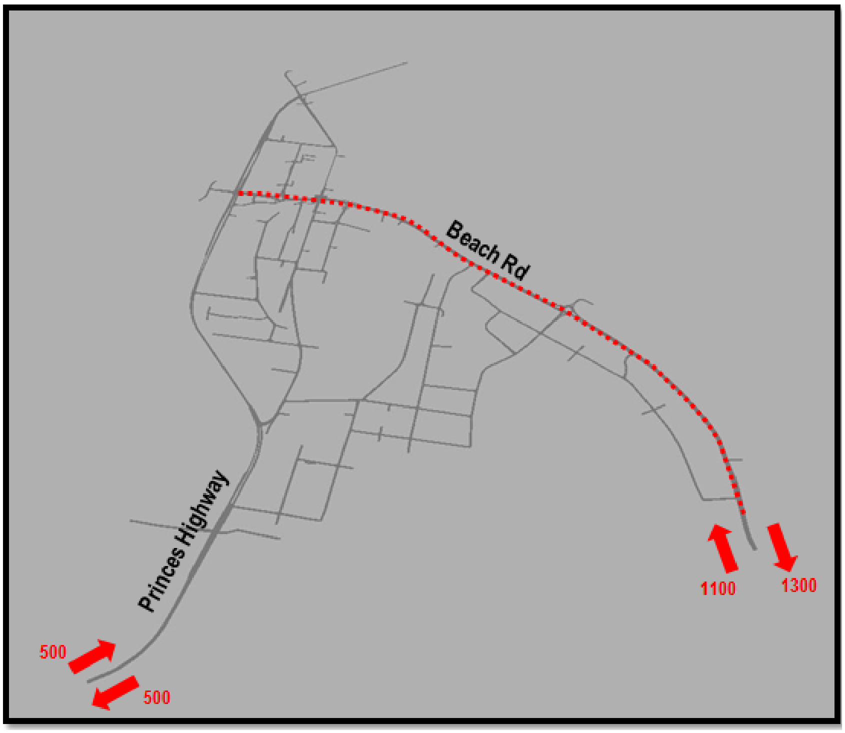
Through traffic growth is an input into calculating “external zone” trip generation for future year modelling. Through traffic growth factors were based on Australian Bureau of Statistics (ABS) population growth forecasts for Batemans Bay – Catalina and Eurobodalla Shire.

Table 5.7: Projected Population Growth

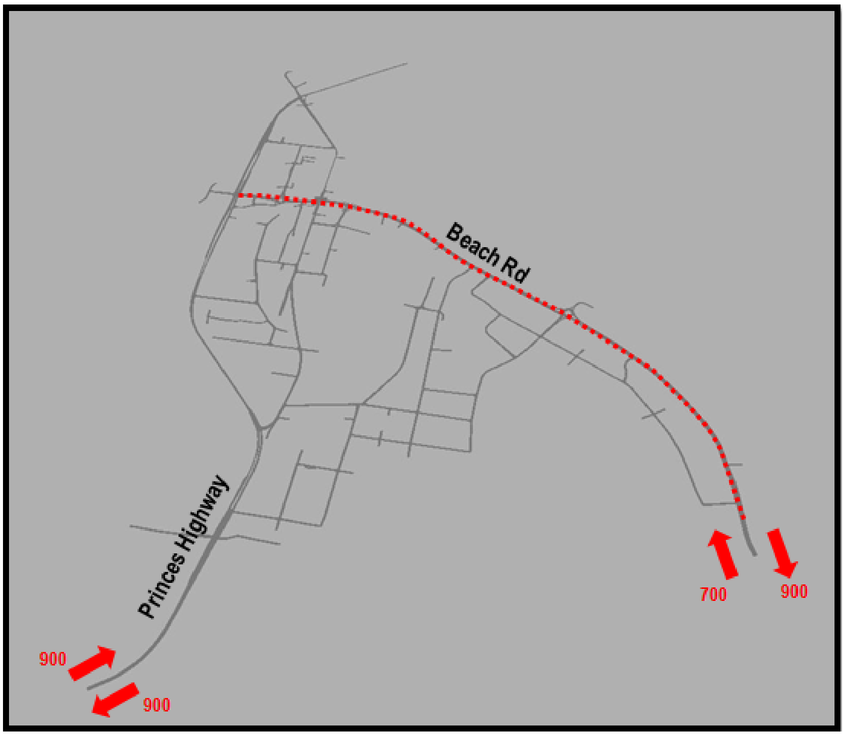
Population Area	Population						Average Annual % Change
	2006	2011	2016	2021	2026	2031	
Batemans Bay - Catalina	1021	4180	4447	4773	5144	5520	1.3
Eurobodalla Shire	36583	38892	41921	44806	47542	50298	1.3

5.5 BATEMANS BAY BYPASS TRAFFIC RE-ROUTING

Traffic demands were also developed to replicate the implementation of the South Batemans Bay Bypass. This scenario consists of approximately 30% (400 trips) of traffic entering the study area via Beach Road to shift to the Princes Highway, as shown in Figure 5.7. This number has been calculated based on a travel time comparison of the two alternative routes between where the bypass is proposed to intersect George Bass Drive and the intersection of Beach Road and Princes Highway in the CBD. It is understood that a strategic TRACKS model is currently being prepared for the entire shire and this model will enable a better estimate of this likely shift to be confirmed once it is established.



Without Bypass



With Bypass

Figure 5.7: Princes Highway/Beach Road Trip Distribution

The assumption of 30% diversion due to the bypass is slightly more ambitious in terms of the number of vehicles using the bypass when compared to ARUP's Study of South Batemans Bay Traffic Management Strategy Options. The 30% assumption can however be partially justified by the spare capacity existing on the Princes Highway and the observed congestion issues experienced on Beach Road.

5.6 SUMMARY OF FUTURE TRAFFIC DEMANDS

Table 5.9 summarises expected traffic demands to, from and within the study area.

Table 5.9: Traffic Demands Summary

Scenario	Vehicle Trips in Study Area	
	Midday Peak	Evening Peak
2010	3,905	4,239
2030	6,446	6,956

Table 5.10 summaries the various components of the 2030 traffic demands.

Table 5.10: 2030 Traffic Demand Sources

Component	Midday Peak	Evening Peak
Through traffic	759	939
“Key Site” traffic	2,051	2,141
Other traffic	3,636	3.,876
Total	6,446	6,956

6. YEAR 2030 NETWORK MODELLING

6.1 OPTIONS AND NETWORK OPTIMISATION PROCESS

Three network scenarios were developed during the study, as follows:

- Do Nothing – essentially no modifications to the year 2010 network;
- Option A – involving a draft set of modifications to overcome identified deficiencies; and
- Option B – based on Option A with modifications to elements of that option plus additional improvements as identified through further modelling and consultation with Eurobodalla Shire Council.

6.2 DO NOTHING

6.2.1 Description

The 2030 Do Nothing network model represents full implementation of the draft LEP plus the development of the key sites but has no modifications to the traffic network. This results in a number of capacity issues mainly in the northern end of the study area. The section of Orient Street between North Street and Beach Road and also westbound on Beach Road endure the majority of the delays. The competing volumes occurring at the intersection of Princes Highway and Beach Road also result in some delays at that location. Figure 6.1 shows the delays experienced by vehicles for the 2030 "Do Nothing" network follows in the midday peak whilst Figure 6.2 shows the evening peak.

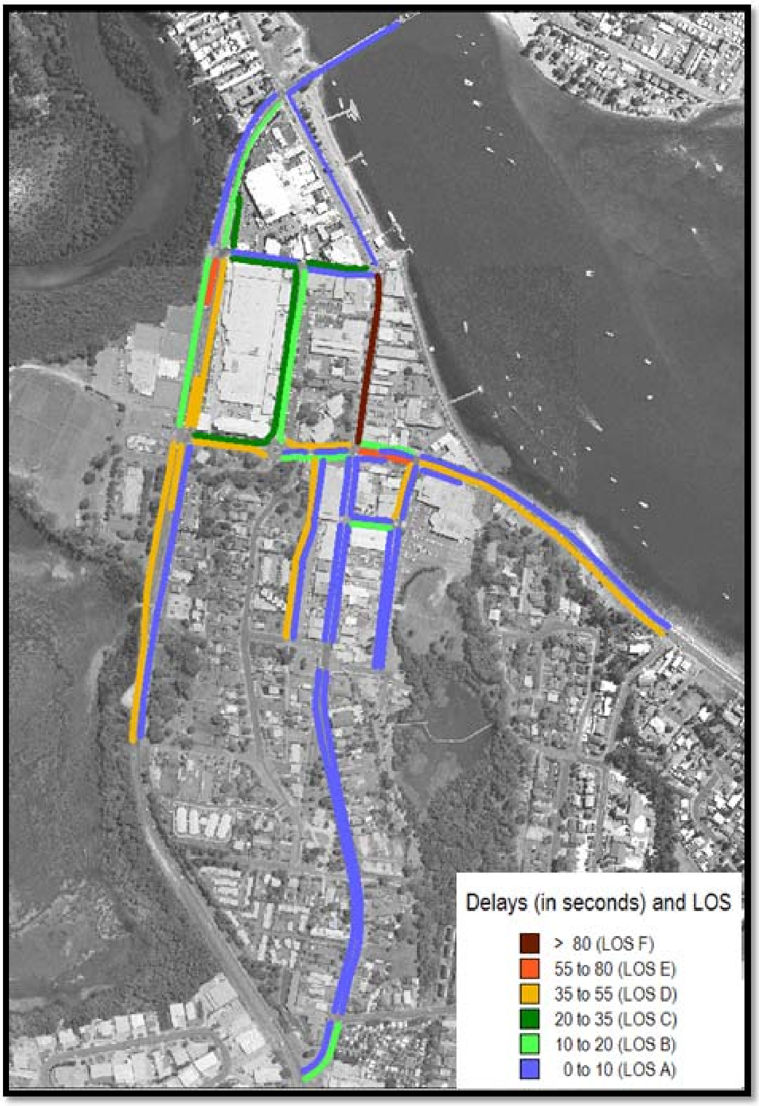


Figure 6.1: Average Delays for 2030 "Do Nothing" without Bypass – Midday Peak

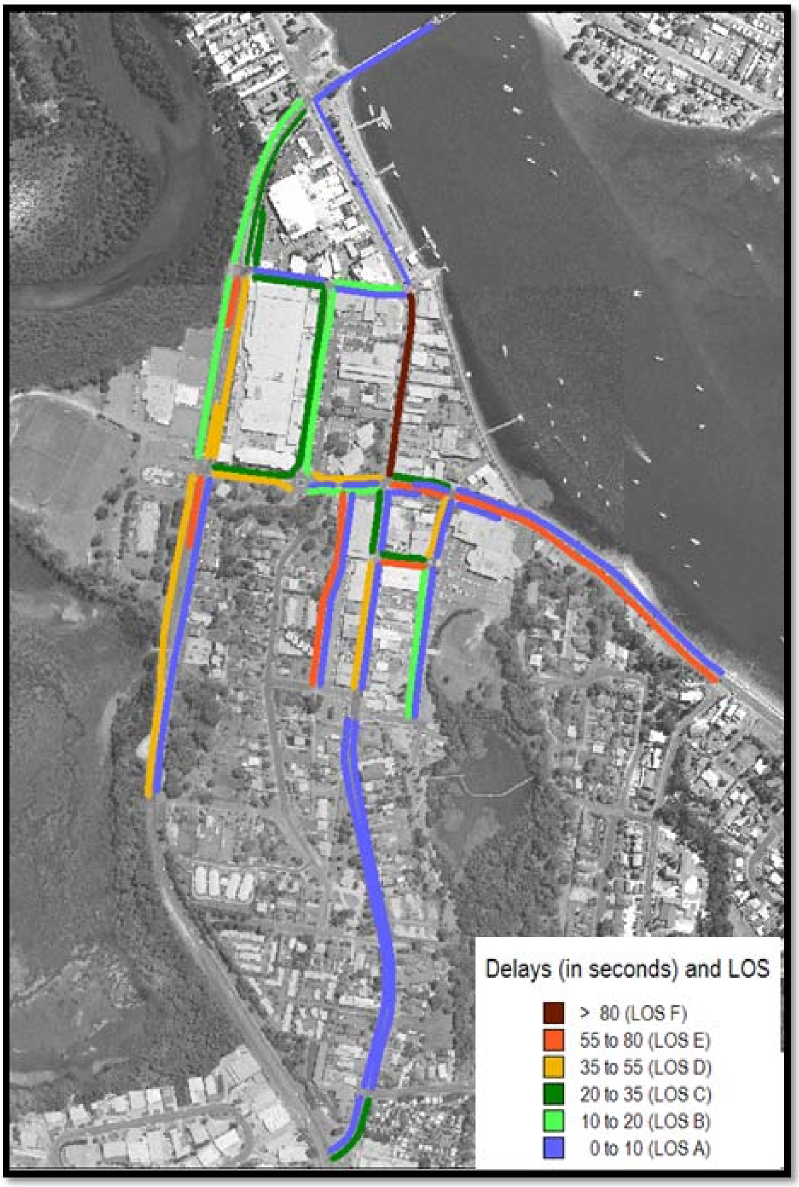


Figure 6.2: Average Delays for 2030 "Do Nothing" without Bypass – Evening Peak

6.2.2 Traffic Capacity Issues

The areas of the 2030 "Do Nothing" network with capacity issues are described below. Increased volumes on Beach Road cause congestion as a result of:

- right turns from Beach Road to Orient Street and Flora Crescent (as shown in Figure 6.3) reducing through traffic to one lane;
- high demand for left turns from Beach Road to Orient Street and Flora Crescent (as shown in Figure 6.4); and
- queuing on Orient Street and Flora Crescent northbound which is a result of an increased volume of traffic and associated congestion on Beach Road as well as local development traffic growth (as shown in Figure 6.5).

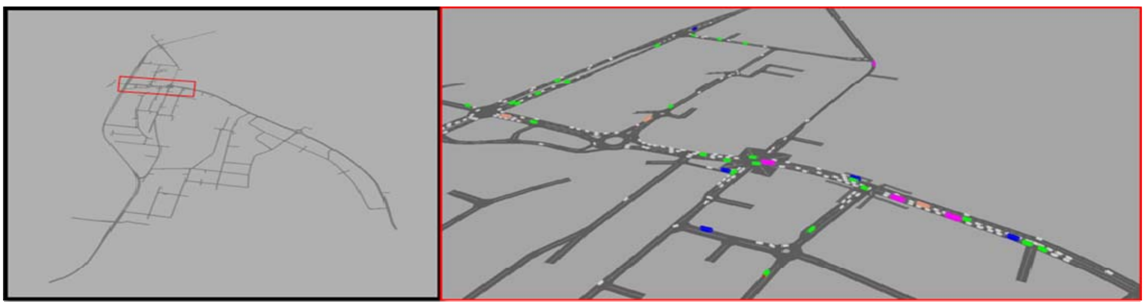


Figure 6.3: Beach Road Congestion

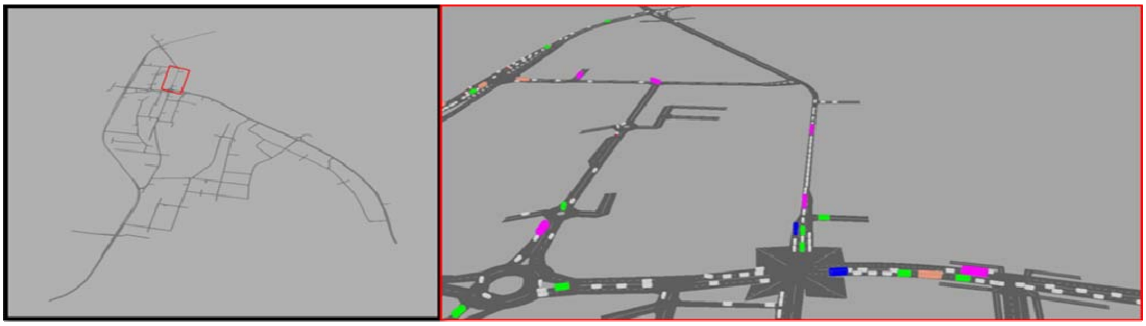


Figure 6.4: Orient Street Southbound Queuing at Beach Road

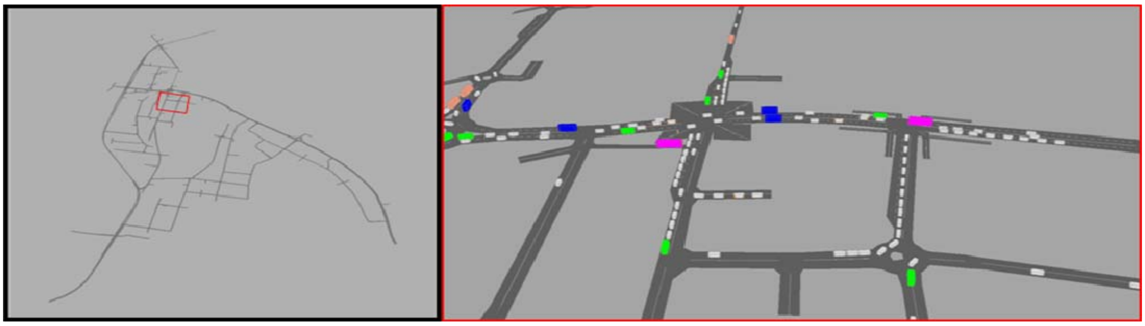


Figure 6.5: Flora Crescent and Orient Street Northbound Queuing at Beach Road

The above issues highlight that the inability of Beach Road to absolve the significant development-related increases in turning traffic, coupled with increased through traffic. Without upgrades along Beach Road, extensive queuing will be created.

6.2.3 Safety/Operational Issues

Safety and operational issues expected in the 2030 "Do Nothing" model are described below.

The main issue at the Princes Highway/Old Princes Highway intersection is that there are insufficient gaps to allow safe right turn movements from the Princes Highway to the Old Princes Highway (see Figure 6.6) or for right turns from the Old Princes Highway to the Princes Highway.

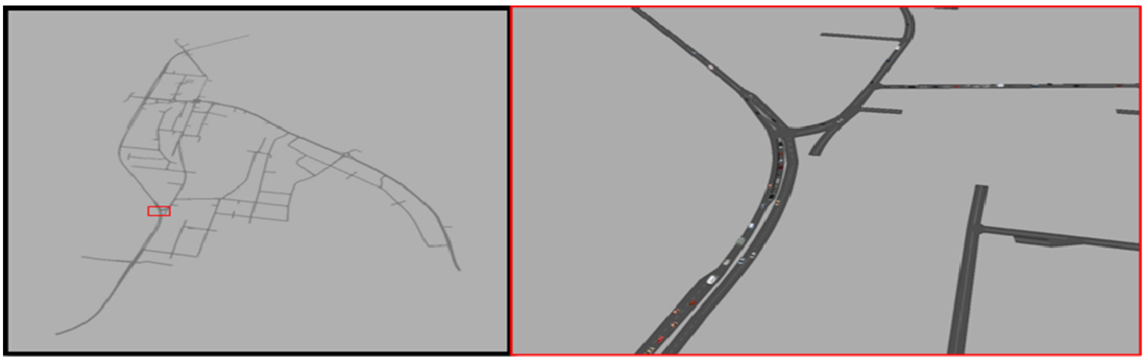


Figure 6.6: Princes Highway/Old Princes Highway Intersection

Also, the increased number of right turns from the Princes Highway into Beach Road and into North Street leads to right turn queues extending past the length of the available turn pockets (see Figure 6.7). This leads to the undesirable situation of stopped vehicles in the through lanes.

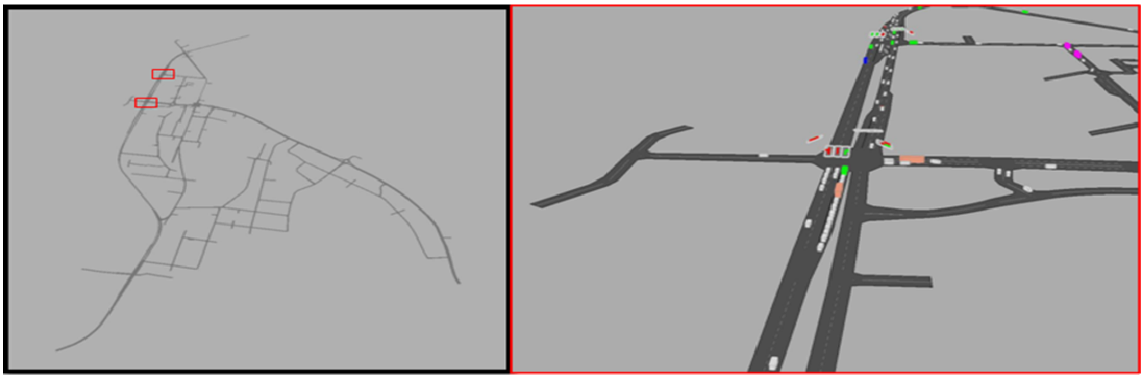


Figure 6.7: Princes Highway Right Turn Pocket Capacity

The intersection of Perry Street/North Street operates under a give-way arrangement. Despite a considerable number of pedestrians using this area and crossing either Perry Street or North Street at this location, no crossing facilities are currently provided. This results in a safety issue (see Figure 6.8) which will be exacerbated as both traffic and pedestrian volumes increase in the area in the future.

Also, the formalisation of pedestrian crossing facilities in this area will improve the perceived integration between the Village Shopping Centre, the redevelopment of Bridge Plaza and pedestrian paths to/from Clyde Street-Orient Street.

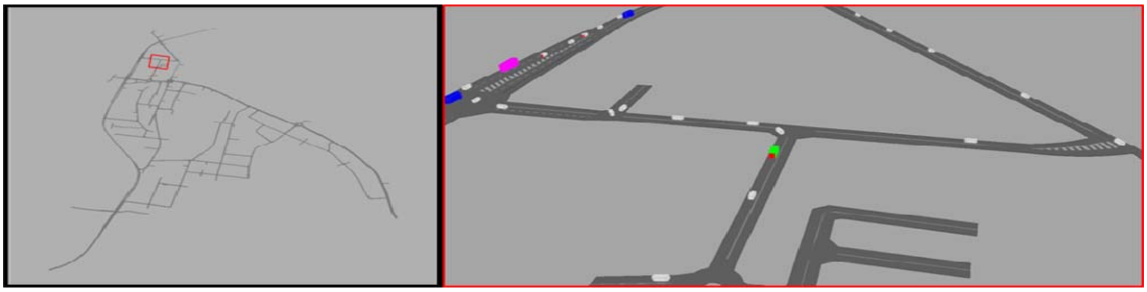


Figure 6.8: North Street/Perry Street Intersection

The alignment of Museum Place and Camp Street results in "staggered T-intersections" with Orient Street, which is not the ideal configuration from safety or efficiency perspectives. Increased traffic growth and nearby development such as the proposed Woolworths Shopping Centre will increase the presence of pedestrians and will introduce additional safety issues at this location (see Figure 6.9).

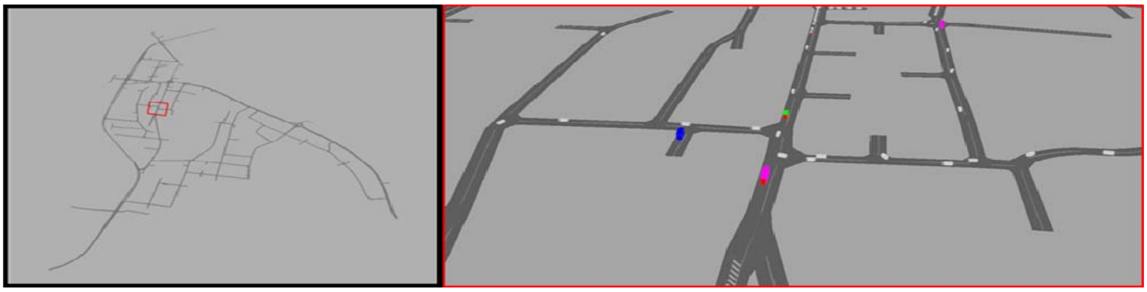


Figure 6.9: Museum Place/Orient Street and Camp Street/Orient Street Intersections

The existing Perry Street/Beach Road roundabout is a safety issue for pedestrians. A roundabout operating at this location is also quite inefficient in the way that "unbalanced" conflicting movements are controlled (see Figure 6.10). While minimal delays may be experienced by a certain movement (such as the right turn from Beach Road to Perry Street) the opposing movements will endure long delays due to insufficient gaps and limited queuing capacity. With increasing traffic and pedestrian volumes, conflicts are expected to increase with significantly reduced gaps available for pedestrians to cross.

Figure 6.10: Beach Road/Perry Street Roundabout

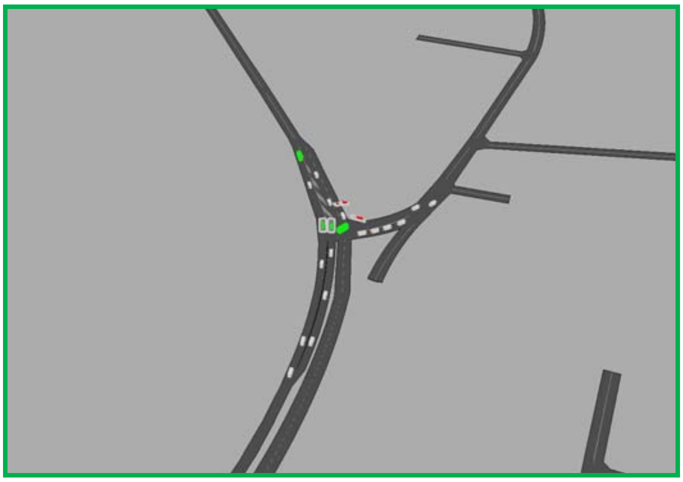
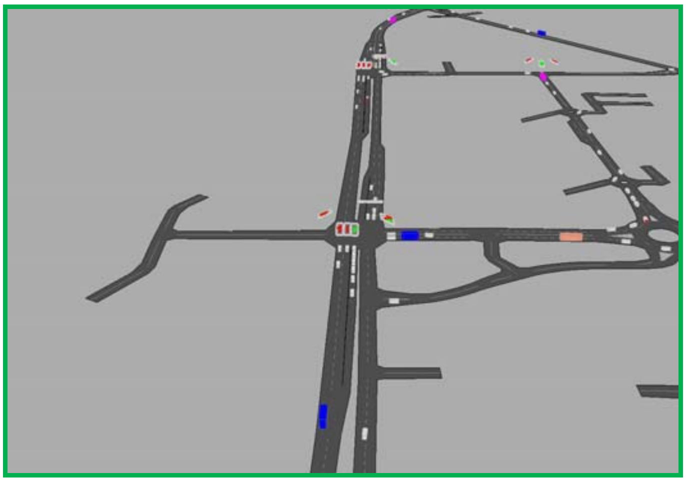
6.3 NETWORK IMPROVEMENTS - OPTION A

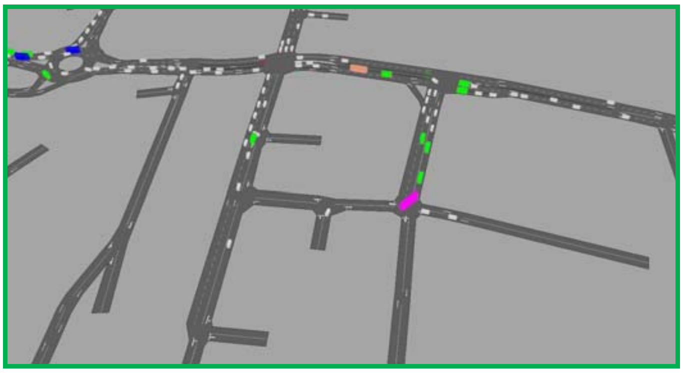
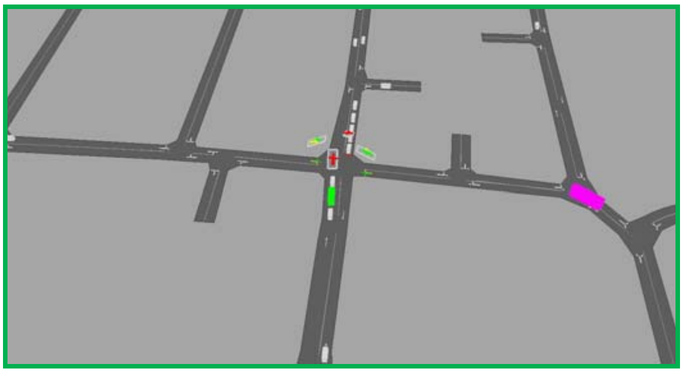
6.3.1 Option Description

The 2030 Option A traffic demands are the same as the "Do Nothing" scenario but the model includes upgrades in some locations as deemed necessary to improve safety, operations and capacity. Figure 6.11 and Table 6.1 describe the upgrades to the network in the Option A models.

Figure 6.11: Option A Upgrades - ID Areas

Table 6.1: Option A Upgrades to the Network

ID	Location Picture	Mitigation Measure
1		Princess Highway/Old Princes Highway Installation of traffic signals. This is to provide gaps for safe movements from the Old Princes Highway to the Princes Highway and vice versa.
2		Princes Highway at Beach Road and North Street Extended right turn bays and optimised phasing arrangements for 2030 traffic conditions. These are required so the queue length of the right turn lanes do not spill out into the through traffic lanes.
3		Beach Road/Commercial Lane to Flora Crescent Provision of a right turn pocket on Beach Road (EB), provision of a left turn lane on Beach Road (WB) and ban right turns to and from Commercial Lane. These measures are implemented to improve capacity and operation of Beach Road through movements.

ID	Location Picture	Mitigation Measure
4		Orient Street north of Beach Road Extended three lane section of the Orient Street (SB) approach to the Beach/Orient intersection and adjusted signal phasing. Decrease the attractiveness of the Clyde Street/Orient Street corridor for use by through traffic by reducing the travelling speed. This could be achieved through a range of measures such as narrower lanes, pedestrian crossings, raised pavement and other forms of traffic calming.
5		Orient Street and Flora Crescent south of Beach Road Left turn slip lane provided on the Flora Crescent approach to Beach Road for increased capacity. Extension of the two lane approach in Orient Street (NB) at Beach Road to increase the queuing capacity. Removal of the roundabout in Flora Crescent at the access to Soldiers Club.
6		North Street/Perry Street Intersection Installation of traffic signals at the Perry Street/North Street intersection. This is to provide for safe pedestrian movements of North and Perry Streets.
7		Camp Street/Museum Place/Orient Street Realign the Camp Street/Museum Place/Orient Street intersection to a standard four-approach signalised intersection. This configuration improves traffic operations and provides a controlled pedestrian crossing opportunity.

6.3.2 Modelling Results without Bypass

The following figure shows average delays output from the 2030 Option A "without Bypass" Paramics models. Figure 6.12 shows the midday peak results whilst Figure 6.13 shown the evening peak results.

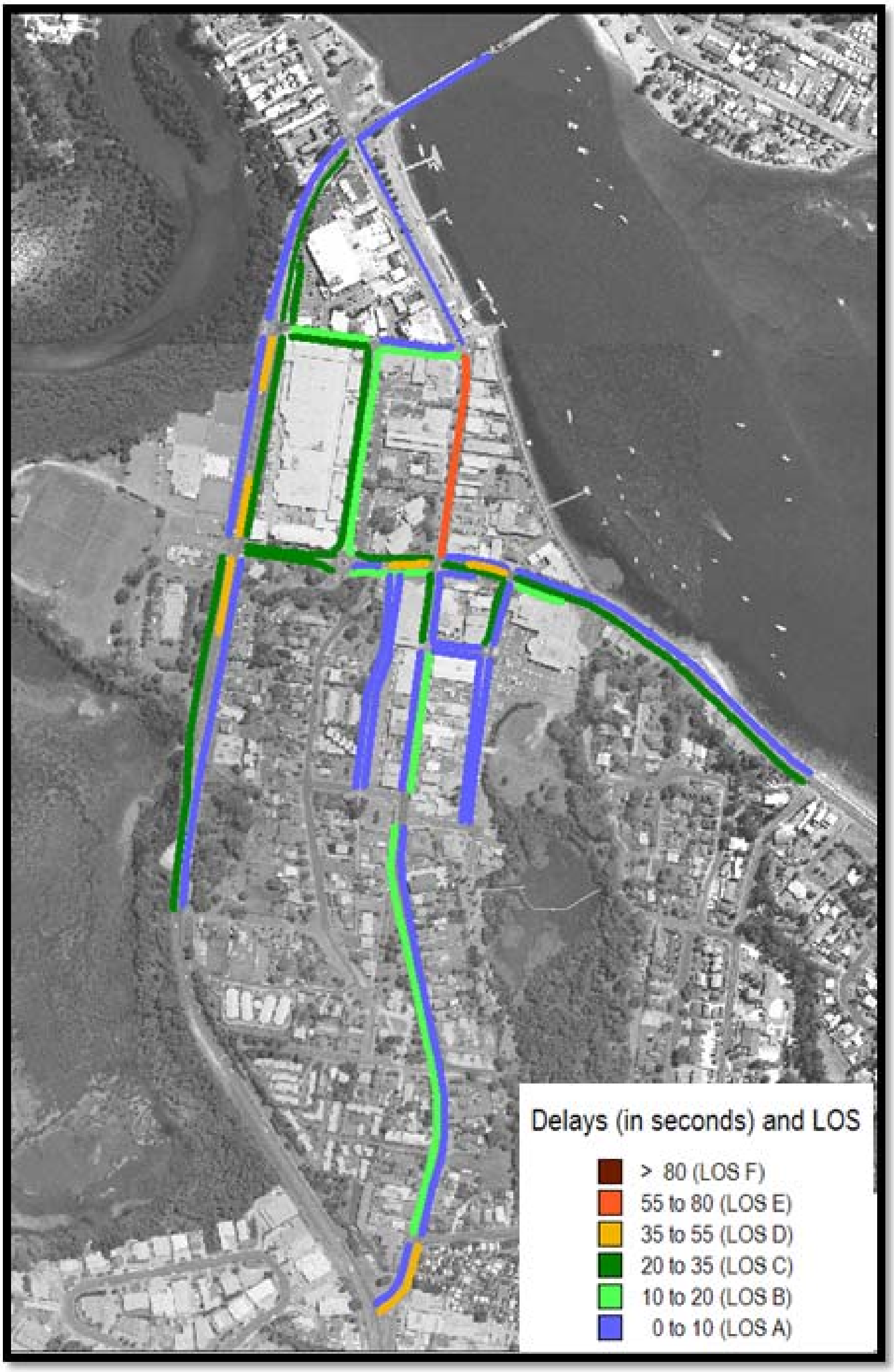


Figure 6.12: Average Delays for 2030 Option A without Bypass – Midday Peak

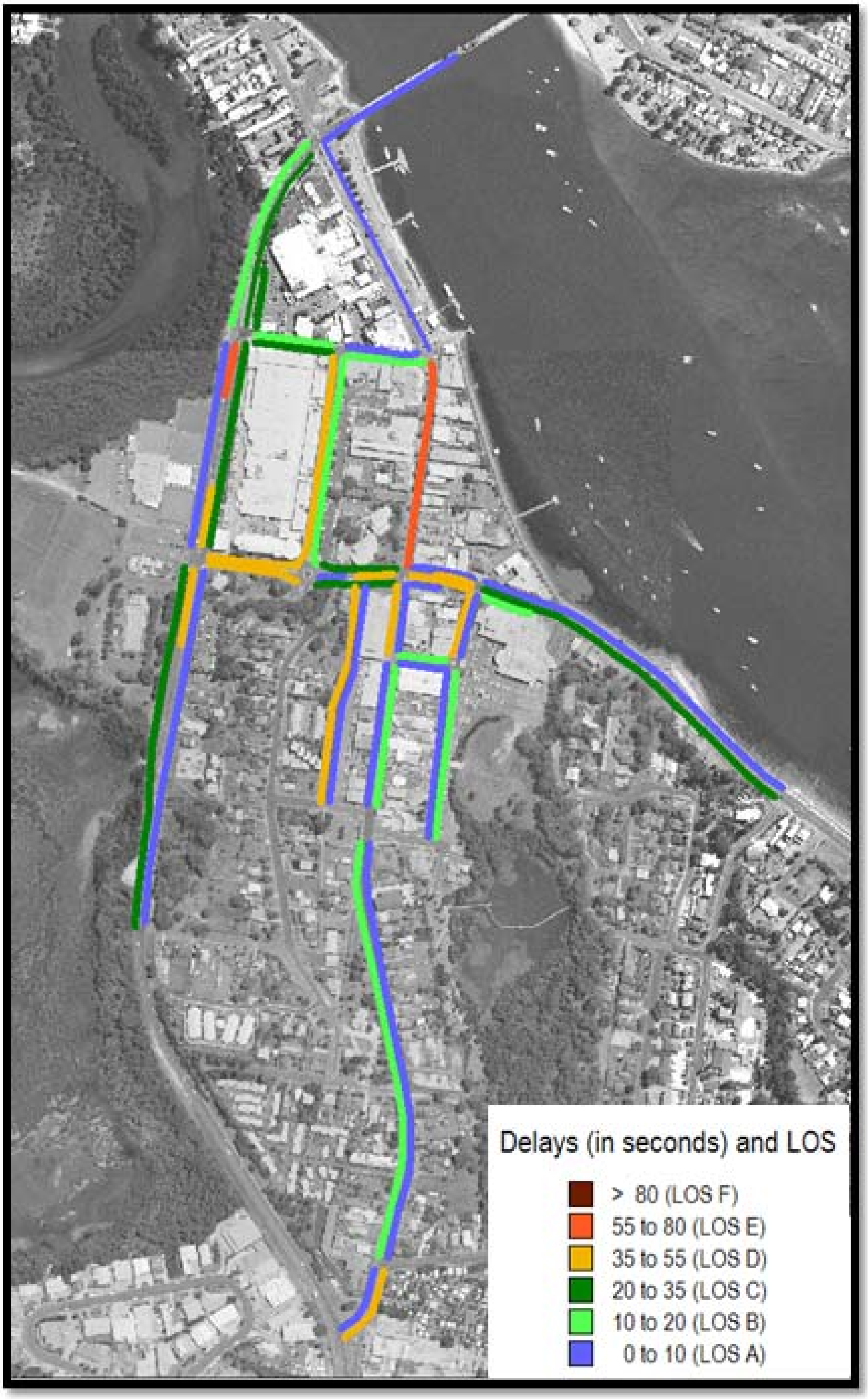


Figure 6.13: Average Delays for 2030 Option A without Bypass – Evening Peak

The results indicate that the traffic operation along Beach Road is significantly improved with the implementation of the upgrades proposed under Option A. While the intended reduced attractiveness of Orient Street results in a reduction in delays observed on its approach to Beach Road, there is still significant queuing occurring at this location. However, the queue lengths and delays are considerably smaller when compared to those observed in the "Do Nothing" scenario. It must be noted that Beach Road traffic must have a more favourable phasing at this intersection to ensure effective operation of the corridor. Delay impacts on the Orient Street approach forces vehicles to seek alternative routes which is seen as a benefit in this pedestrian/parking orientated area, as described above.

While some delays are still observed at the right turn pockets located on the Princes Highway (i.e. at Beach Road and at North Street), these are mainly caused by waiting at red lights however the queues at these locations never extend past the provided pocket length.

6.3.3 Modelling Results - with Bypass

The following figures show the link-delay and LOS results taken from the 2030 Option A with Bypass Paramics models. Figure 6.14 shows midday peak results whilst Figure 6.15 shows evening peak results.

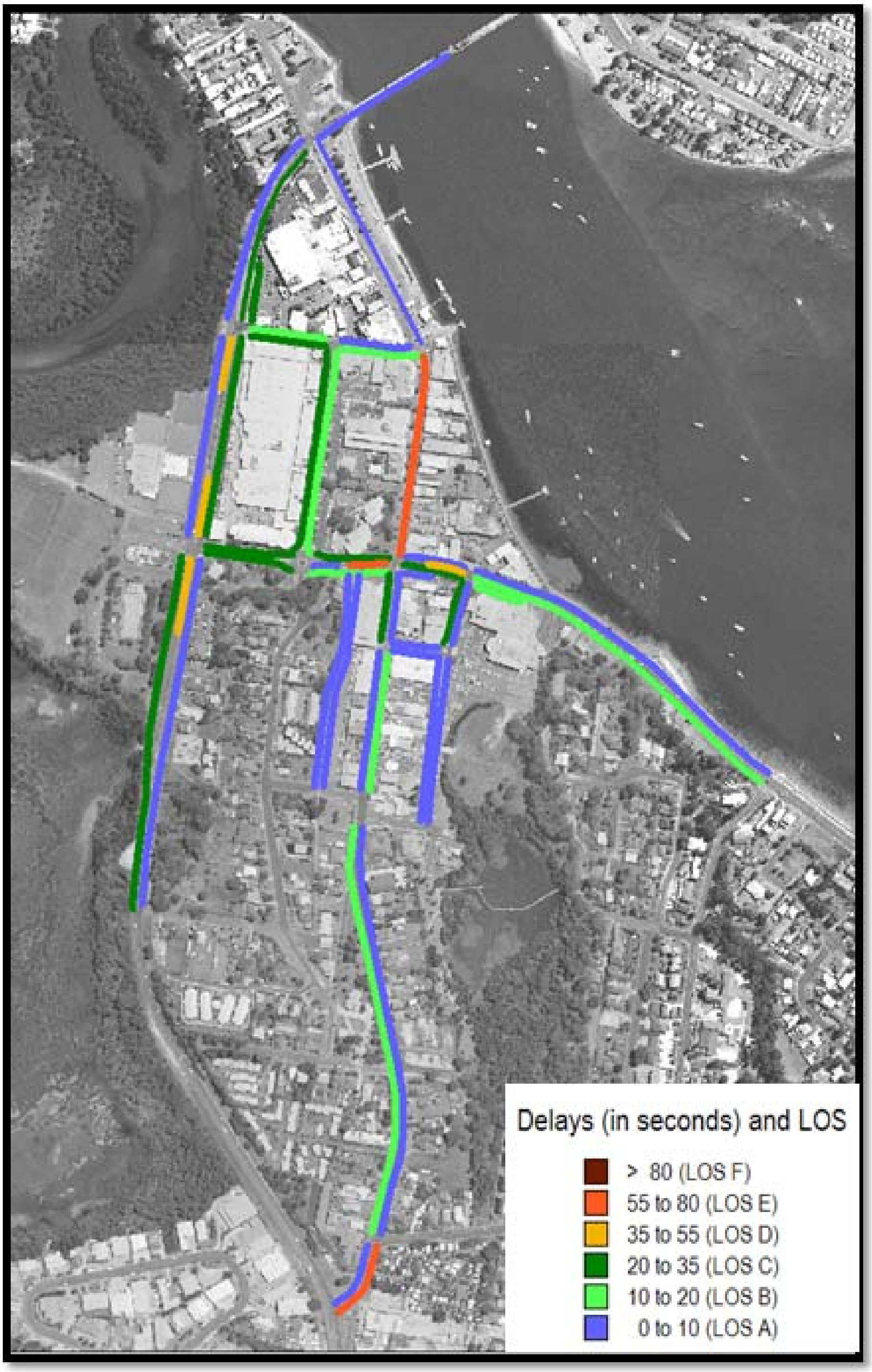


Figure 6.14: Average Delays for 2030 Option A with Bypass – Midday Peak

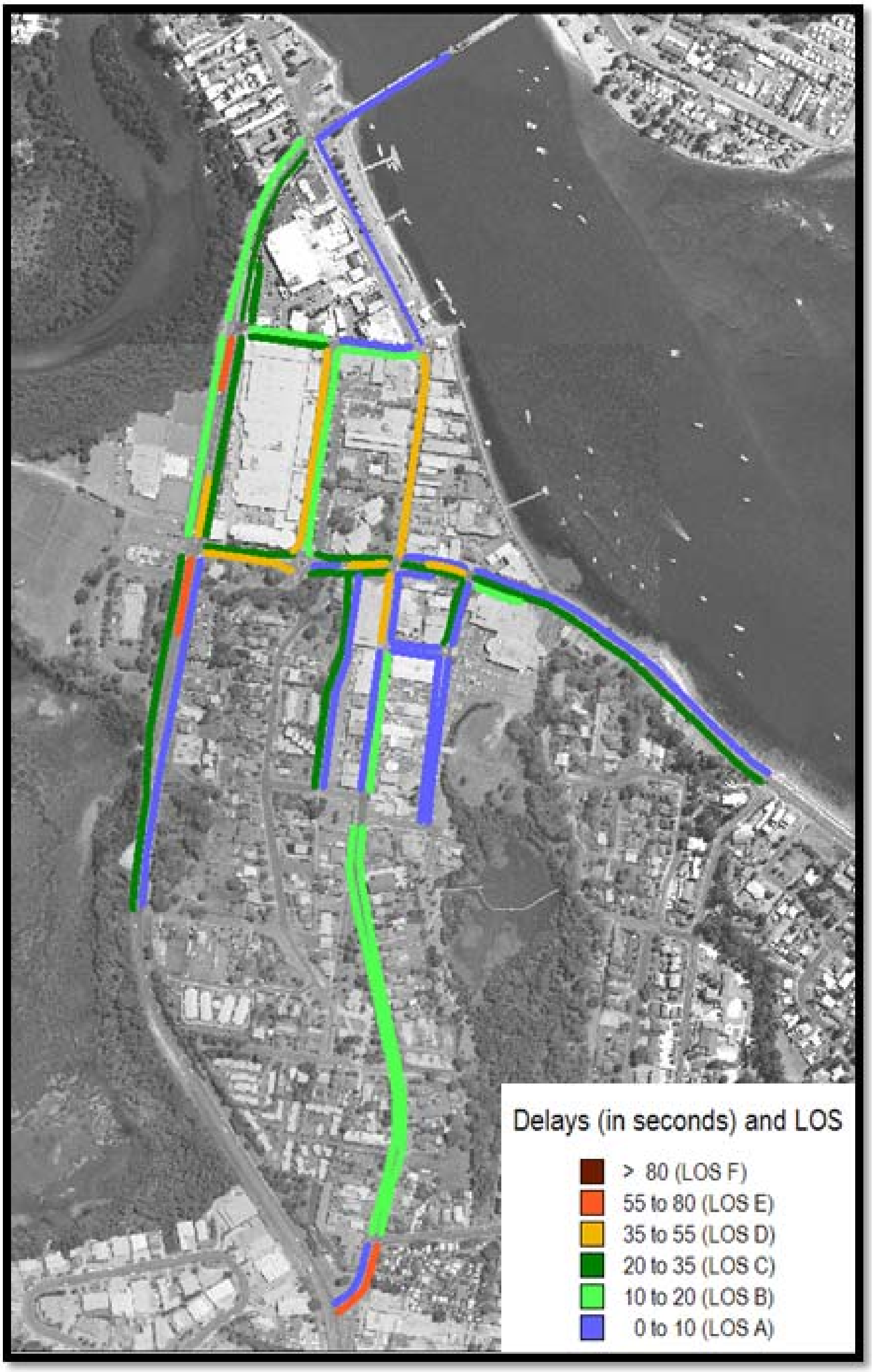


Figure 6.15: Average Delays for 2030 Option A with Bypass – Evening Peak

The results indicate that overall the bypass produces some savings in the travel times across the network, particularly in the evening peak. In general, the LOS observed on the majority of the links remains the same when compared with the scenario without the bypass since the difference in the delay is not significant.

As expected the most considerable benefits of the Bypass occur eastbound in Beach Road, whilst the additional traffic travelling northbound on the Princes Highway does not cause any considerable issues or increased congestion when compared to the "no bypass" situation.

6.3.4 Summary Statistics

To better evaluate the operation of each scenario, a comparison has been of the "vehicle-minutes" statistics extracted from the full run of each model (two hours). Table 6.2 highlights the midday peak statistics, while Table 6.3 shows the evening peak results.

Table 6.2: Midday Peak Statistics (vehicle-minutes)

	2010 Base	2030 Option A (no bypass)	2030 Option A (with bypass)
Vehicle-minutes	21,560	41,172	40,923

	2010 Base	2030 Option A (no bypass)	2030 Option A (with bypass)
Vehicle-minutes	26,318	51,407	49,200

The results shown in Tables 6.2 and 6.3 confirm that the levels of congestion and the number of vehicles observed in the evening peak models are higher than those of the midday peak. In the evening peak, with a higher number of vehicles using the network and more delays experienced throughout the model, the bypass provides a more balanced distribution of the traffic demands and therefore results in more visible travel time savings, as shown in Table 6.3.

6.4 NETWORK IMPROVEMENTS – OPTION B

6.4.1 Option Description

The Option A modelling revealed a number of outstanding capacity, safety and operational efficiency issues that were discussed further with Eurobodalla Shire Council. Following these discussions, further upgrades were included in the models, and these models are referred to as Option B. The additional upgrades in the Option B models are described in Figure 6.16 and Table 6.4.

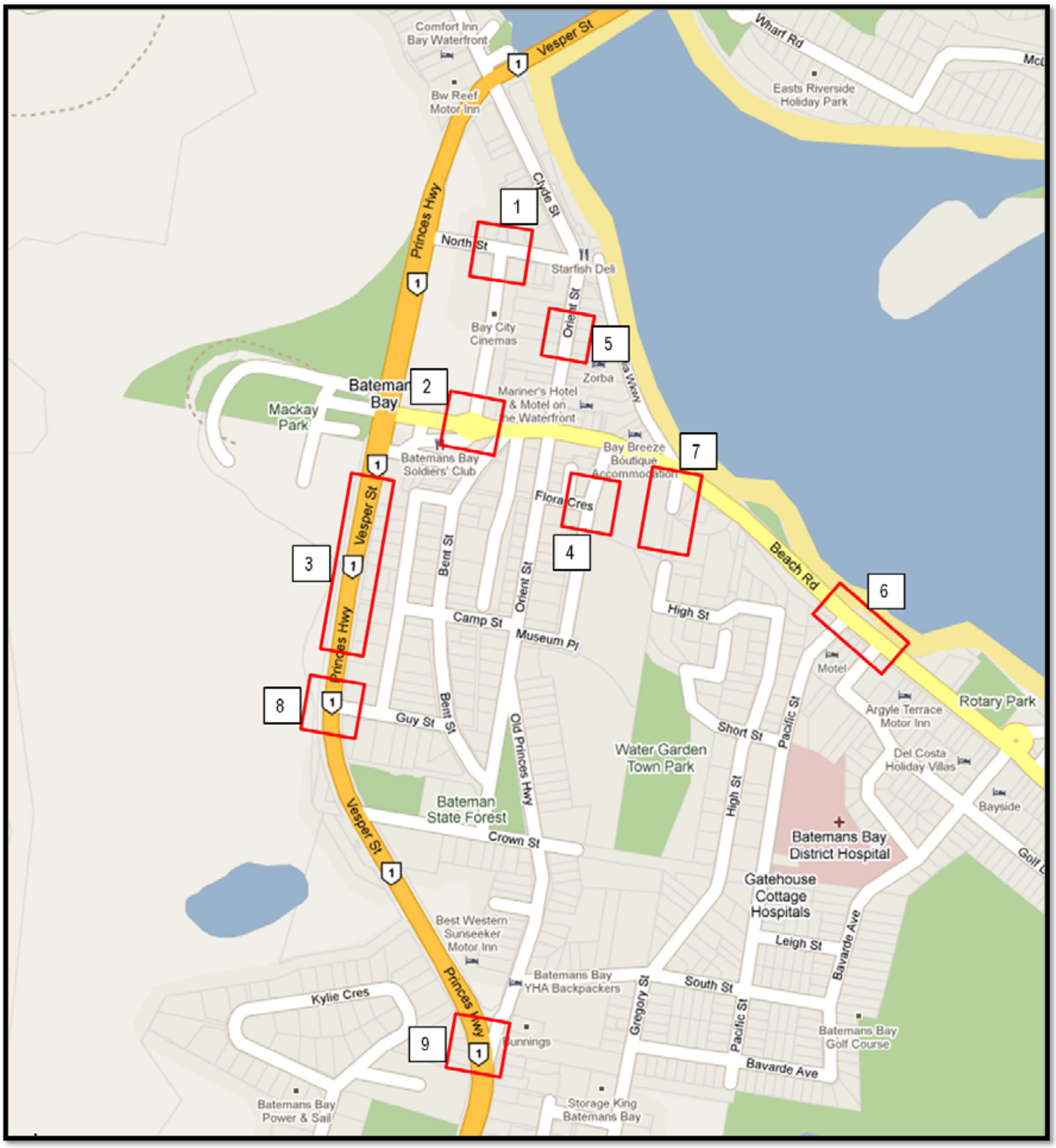
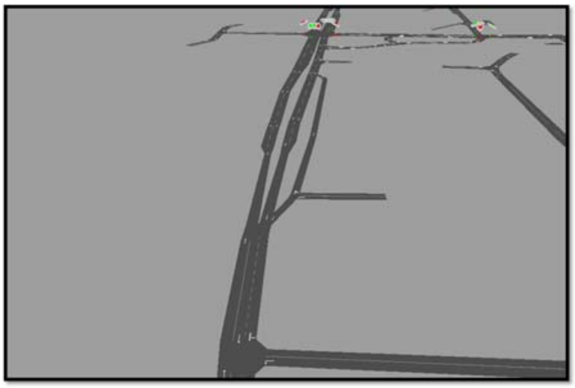
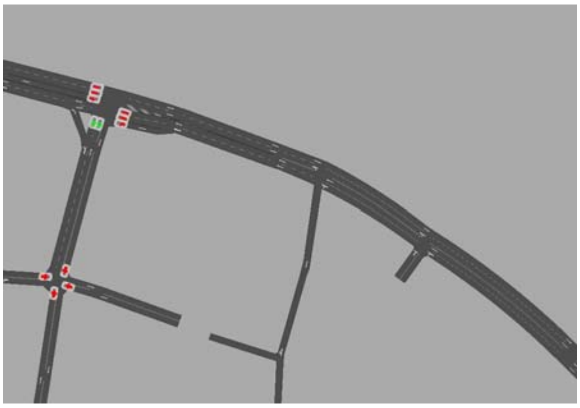
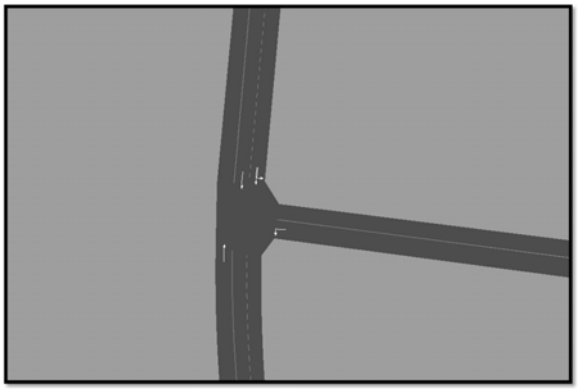


Figure 6.16: Option B Upgrades from Option A - IDs

Table 6.4: Option B Infrastructure Upgrades

ID	Picture	Location/Description
1		Bridge Plaza/Perry Street/North Street Intersection Access to Bridge Plaza is moved to be the fourth leg of the signalised intersection of North Street/Bridge Street. A left turn lane is also provided for turns from Perry Street to North Street. This improvement is proposed to control access to the Bridge Plaza redevelopment (as access to/from the current location would be problematic) and to better cater for pedestrian demands.

ID	Picture	Location/Description
2		Beach Road/Perry Street Intersection Signalisation of the Beach Road/Perry Street intersection to provide safe pedestrian movements. The concept includes left turn only from Perry Street to maximise the signal time able to be provided for the heavy right-turn in movement into Perry Street.
3		Princes Highway Service Lane The proposed Princes Highway service lane has been included for access to commercial properties.
4		Flora Crescent/Soldiers Club rear access Installation of signals at this intersection to cater for traffic from nearby developments as well as to provide for safe pedestrian movements.
5		Soldiers Club Access Link off Beach Road An access to the rear of Soldiers Club from Beach Road has been included as an entry only. This measure provides an alternative access to the development proposed at the rear and taking pressure off the left turn into Flora Crescent from Beach Road.

ID	Picture	Location/Description
6		Guy Street/Princes Highway The right turns in/out of Guy Street have been banned on safety grounds (as required by the RTA). Alternative routes for right in/out movements are available.
7		Princes Highway/Old Princes Highway Intersection Two through lanes northbound on the Princes Highway have been implemented to provide continuity of these lanes from the signals further south and address capacity issues. The two straight ahead lanes will also help to better cater for holiday peaks and to remove the current merge that exists upstream from these proposed signals.

6.4.2 Modelling Results without Bypass

Figures 6.17 and 6.18 show the average delay and LOS results from 2030 Option B without Bypass midday and evening peak Paramics models.

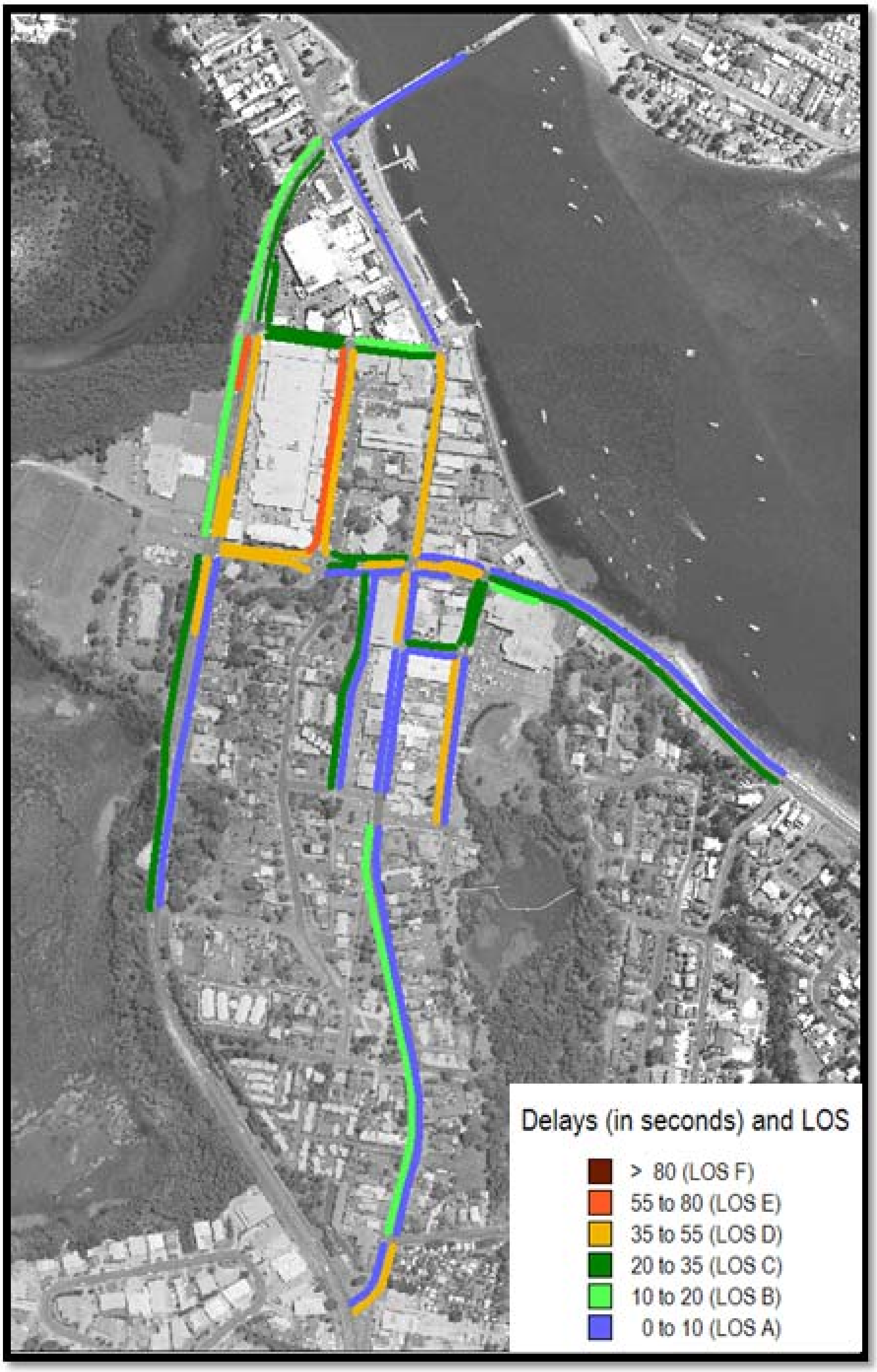


Figure 6.17: Average Delays for 2030 Option B without Bypass – Midday Peak

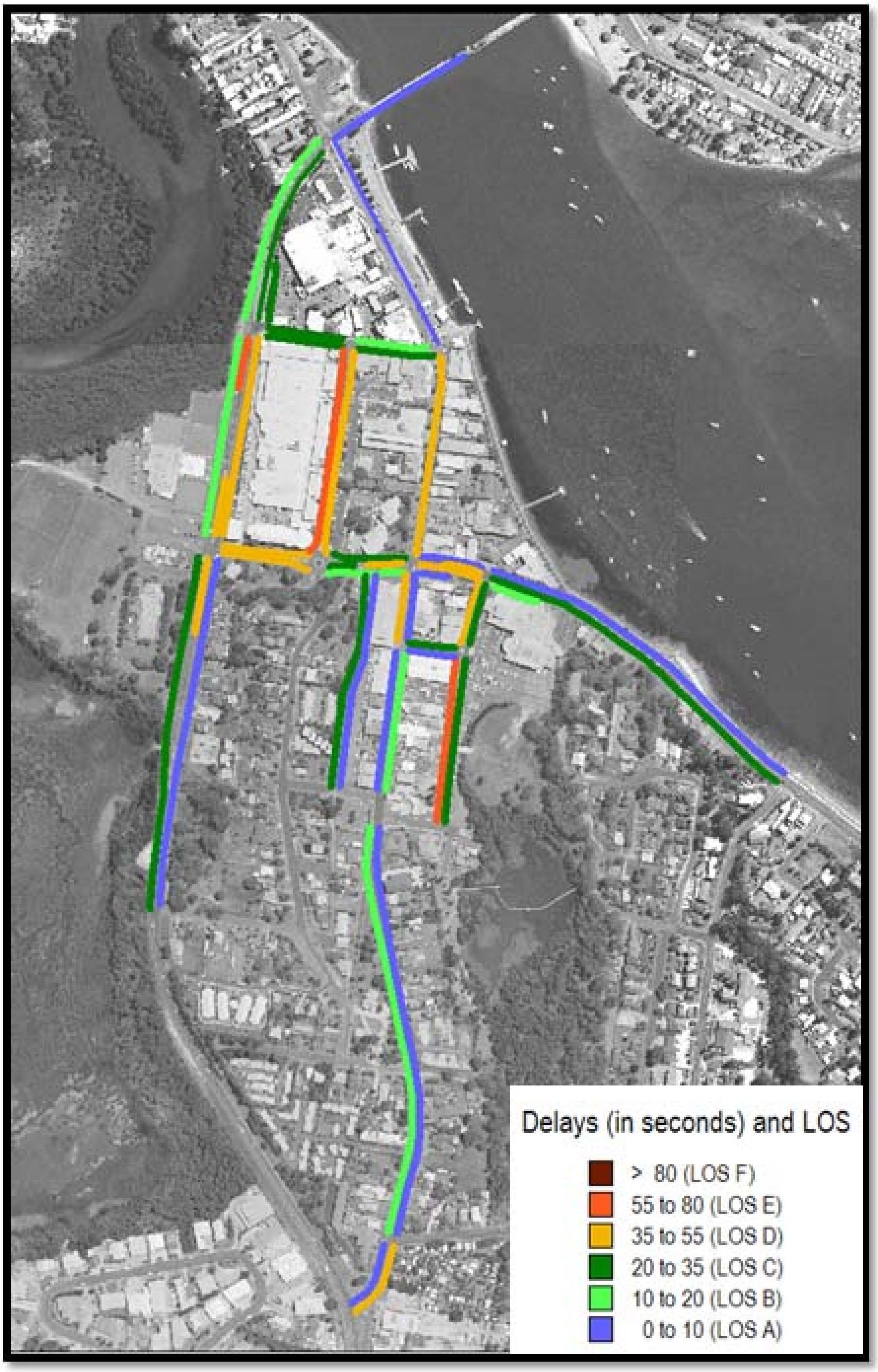


Figure 6.18: Average Delays for 2030 Option B without Bypass – Evening Peak

The majority of the upgrades proposed as part of Option B include the installation of traffic signals or the implementation of other measures that intend to improve safety for both traffic and pedestrians. This results in a reduction on the number of "free flow" movements across the network and therefore a higher level of delays when compared to the Option A scenarios. The evaluation of Option B must therefore be considered in a slightly different way to take the inherent safety improvements into account. The interpretation of the delay results should therefore consider whether the modified network provides sufficient capacity to cater for the anticipated traffic demand or if the proposed upgrades cause excessive delays to traffic.

The results confirm that the delays experienced under the Option B scenario are relatively higher when compared with Option A, but the overall result is a more balanced network operation with no gridlock or excessive congestion issues. It must be noted that the implementation of traffic signals at some key locations (particularly at the intersection of Perry Street / Beach Road) allows for a more controlled network since the phasing can be adjusted as the demands change over time and through different seasonal demands. Apart from the safety improvements, this inherent traffic management flexibility is a key benefit of the additional traffic signals proposed under Option B.

6.4.3 Modelling Results with Bypass

Figures 6.19 and 6.20 show the average delay and LOS results from the 2030 Option B with Bypass midday and evening peak Paramics models.

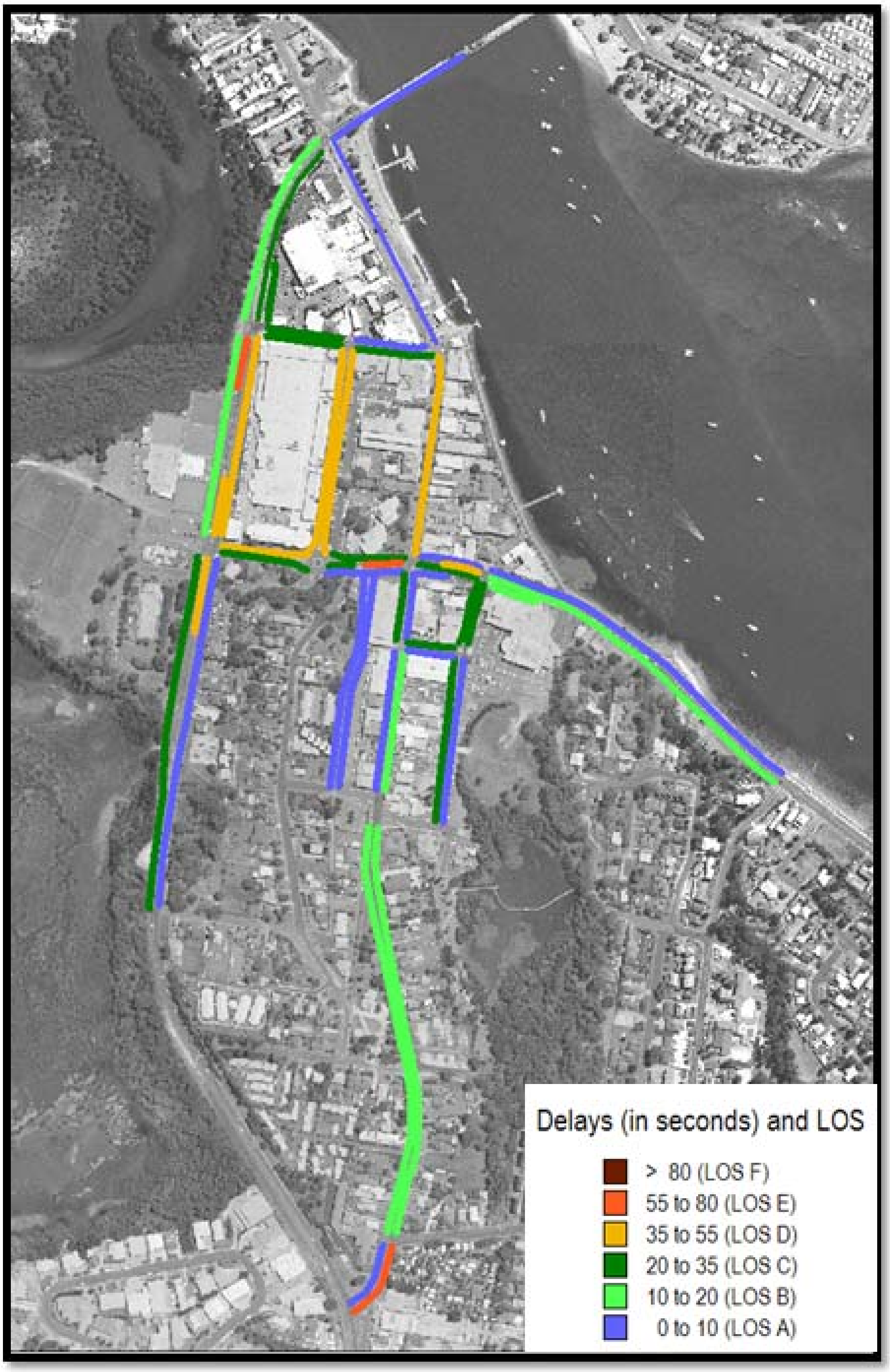


Figure 6.19: Average Delays for 2030 Option B with Bypass – Midday Peak

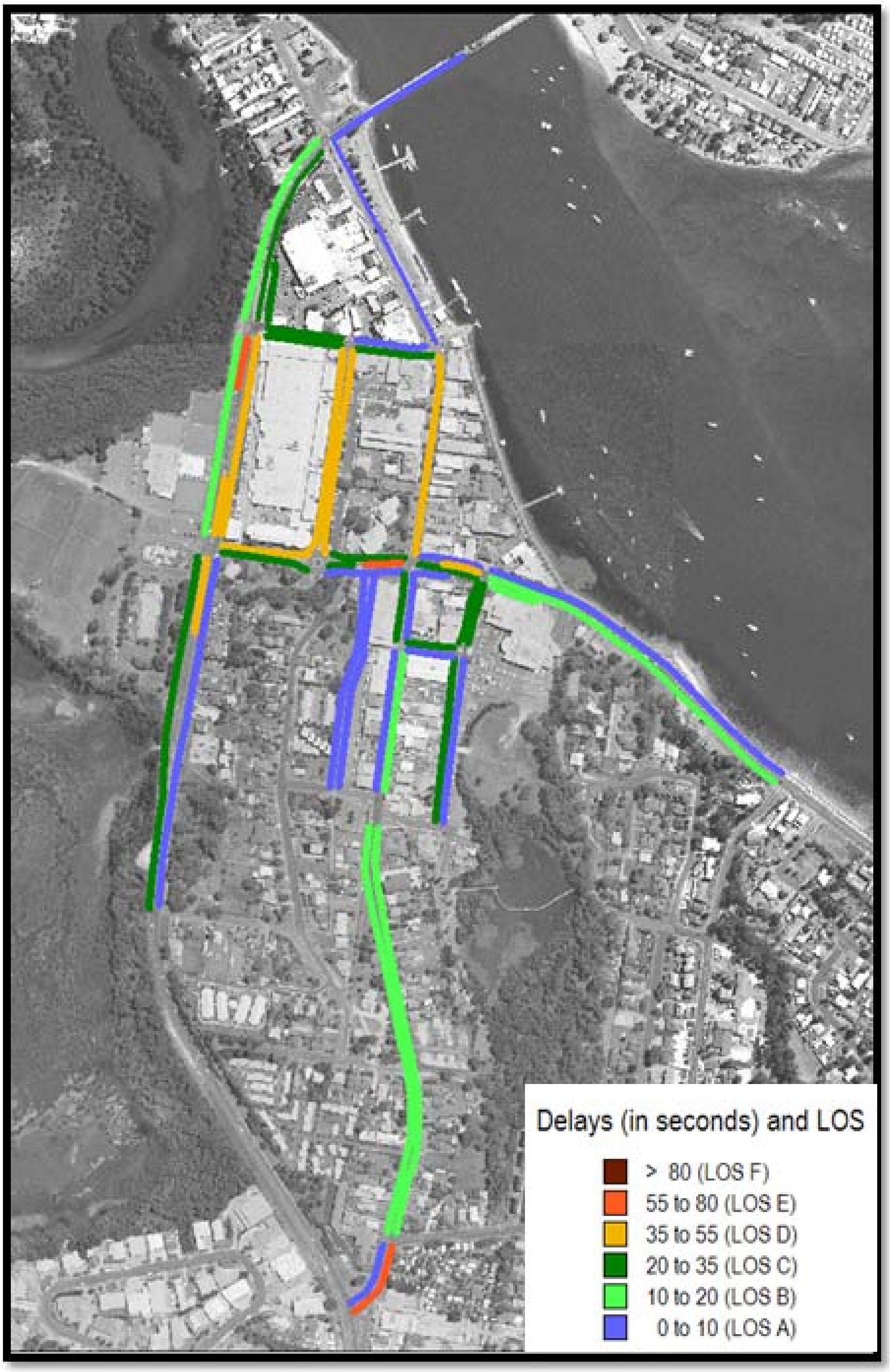


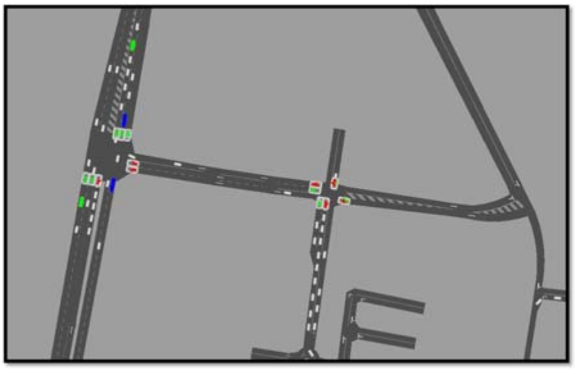
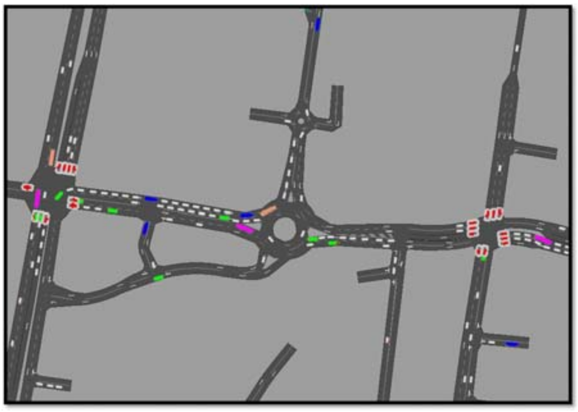
Figure 6.20: Average Delays for 2030 Option B with Bypass – Evening Peak

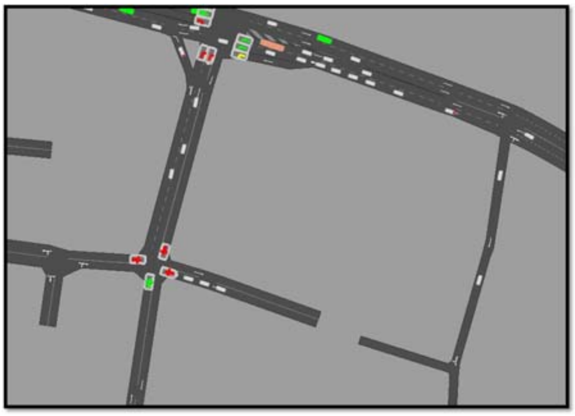
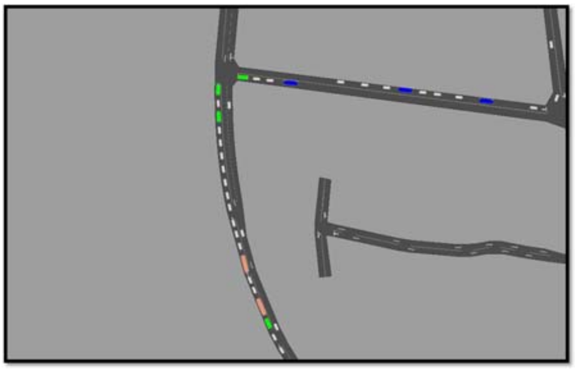
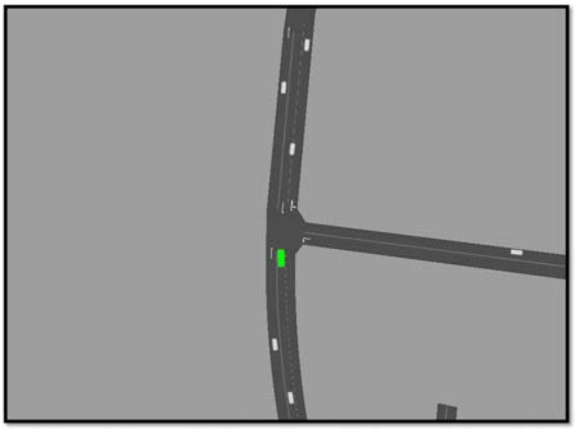
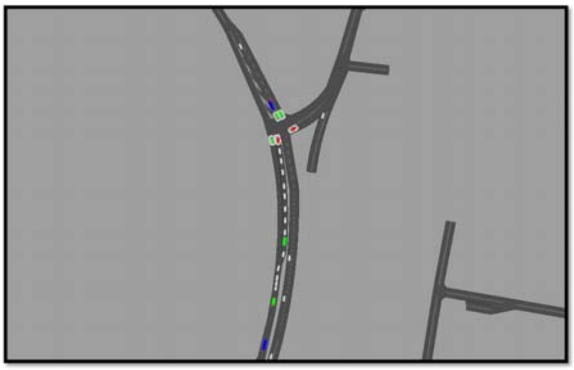
Under Option B, the benefits associated with the construction of the bypass are also more visible in the evening peak model, due to higher levels of congestion throughout the network in this period compared to the midday peak. The traffic operation in the eastbound direction along Beach Road is improved considerably due to the number of vehicles shifting to the Princes Highway. This doesn't significantly affect the Princes Highway corridor, which continues to operate with satisfactory levels of service.

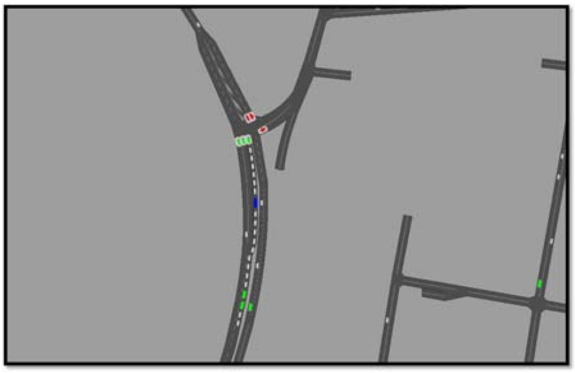
6.5 OPTION B NETWORK IMPROVEMENTS SUMMARY

6.5.1 Improvement Justification Summary

The following figures from the models and the associated test develop the justification for the recommended improvements under Option B.

 	Bridge Plaza/North Street/Perry Street The Option A model has signals at the North Street/Perry Street intersection and has the entry and exit to Bridge Plaza from North Street between Perry Street and the Princes Highway. This figure shows queue lengths on the Perry Street approach to the intersection as far back as the northern-most roundabout access to The Village. The Option B model introduces a left turn lane from Perry Street to North Street separating movements and queues and reducing the impacts back into the roundabout. The entry/exit to Bridge Plaza has been included in the signalised intersection allowing easier access and less interference to North St. The intersection also allows for safe pedestrian movements.
 	Beach Road/Perry Street In the Option A model the existing roundabout at the Beach Road/Perry Street intersection was not modified. The queue lengths from the Beach Road western approach extended back into the Princes Highway intersection. Roundabouts also do not provide for controlled pedestrian movements. The Option B model introduces signals at this intersection, including a right turn pocket for Beach Road turns into Perry Street. The right and through movements from Perry Street have been banned to allow more signal time for the heavy movement from the east and west on Beach Road. The signalised intersection can now also allow safe pedestrian movements.
	Flora Crescent/Soldiers Club Access An un-signalised intersection was included in the Option A model at the Flora Crescent/Soldiers Club access intersection. The Option B model includes access to the Soldiers Club/Centrelink development via a one way entry from Beach Rd. This reduces left turn demand at the Flora Crescent/Beach Road intersection. The Flora Crescent Intersection has been signalised to allow for pedestrian movements and better manages competing

	demands at the intersection.
 	Princes Highway/Guy Street Intersection In the Option A models the Princes Highway/Guy Street intersection allowed right turns from the Princes Highway into Guy Street and from Guy Street to the Princes Highway. Large queues resulted from these movements in 2030 as through volumes increase and the gaps to turn right become fewer (as shown in this figure). These movements were removed in the Option B model to allow safe and efficient flow of the Princes Highway.
	Princes Highway/Old Princes Highway The signalisation of the Princes Highway/Old Princes Highway intersection in the Option model resulted in additional delays and queues in the Princes Highway. In Option B an additional through lane is provided for the Princes Highway northbound to offset any delays to northbound through traffic caused by the introduction of signals.



6.5.2 6.5.2 Summary Statistics

To evaluate the overall operation of each scenario, a comparison of the total "vehicle-minutes" statistics has been extracted from the models for the full period of each model (two hours). Table 6.5 highlights the midday peak statistics for Options A and B compared to the 2010 Base scenario, while Table 6.6 shows the evening peak results.

Table 6.5: Option A and Option B Midday Peak Statistics (vehicle-minutes)

	2010 Base	2030 Option A (no bypass)	2030 Option (with bypass)	2030 Option b (no bypass)	2030 Option B (with bypass)
Vehicle-minutes	21,560	41,172	40,923	44,136	43,629

Table 6.6: Option A and Option B Evening Peak Statistics (vehicle-minutes)

	2010 Base	2030 Option A (no bypass)	2030 Option (with bypass)	2030 Option b (no bypass)	2030 Option B (with bypass)
Vehicle-minutes	26,318	51,407	49,200	55,800	53,161

The results shown in Tables 6.5 and 6.6 confirm that the levels of congestion observed in the evening peak models are higher than those of the morning peak. They suggest that the benefits provided by the construction of the bypass are almost negligible during the morning peak since the upgrades proposed under Option A minimise delays and provide some spare network capacity.

In terms of the comparison between Scenario A and Scenario B, the results confirm that the "vehicle-minutes" travelled under Option B are higher than those in the Option A network. This is due to the inclusion of more traffic signals in Option B compared to Option A. Whilst introducing additional delays to vehicles, intersections are not "over-capacity" and there are significant safety, flexibility and pedestrian accessibility benefits of the traffic signals. The modelling has shown that while the "vehicle-minutes" increase under Option B compared to Option A, the network operation is not affected and no significant queuing or congestion is apparent.

7. UPGRADE STAGING BASED ON 2020 NETWORK MODELLING

7.1 TRAFFIC DEMANDS

The traffic demands for the 2020 scenario models represent 50% of the full implementation of the draft LEP, however they also assume 100% implementation of the "key site" developments. A summary table of the traffic demands used in the year 2020 models is shown in Table 7.1.

Table 7.1: Traffic Demands Summary

Scenario	Origin-Destination	Midday Peak			PM Peak		
		External	Internal	Total	External	Internal	Total
2010 Base	External	694	2208	2902	1208	2087	3295

	Internal	2674	2234	4908	2867	2315	5182
	Total	3368	4442	7810	4075	4402	8477
2030	External	932	3444	4376	1303	3408	4711
	Internal	3689	4826	8515	4502	4698	9200
	Total	4621	8270	12891	5805	8106	13911
2020	External	813	3048	3861	1254	3106	4360
	Internal	3810	4316	8126	4014	4247	8261
	Total	4623	7363	11986	5268	7353	12621

7.2 Do Nothing

The 2020 "Do Nothing" scenario represents no modifications or upgrades to the network. The results show similar issues to that of the 2030 "Do Nothing" modelling with capacity, safety and operational issues in the same areas. The capacity and operational issues are less significant in 2020 than 2030, as expected.

Figures 7.1 and 7.2 show average delays by link/intersection for the midday and evening peaks without the bypass whilst Figures 7.3 and 7.4 show these results with the bypass.

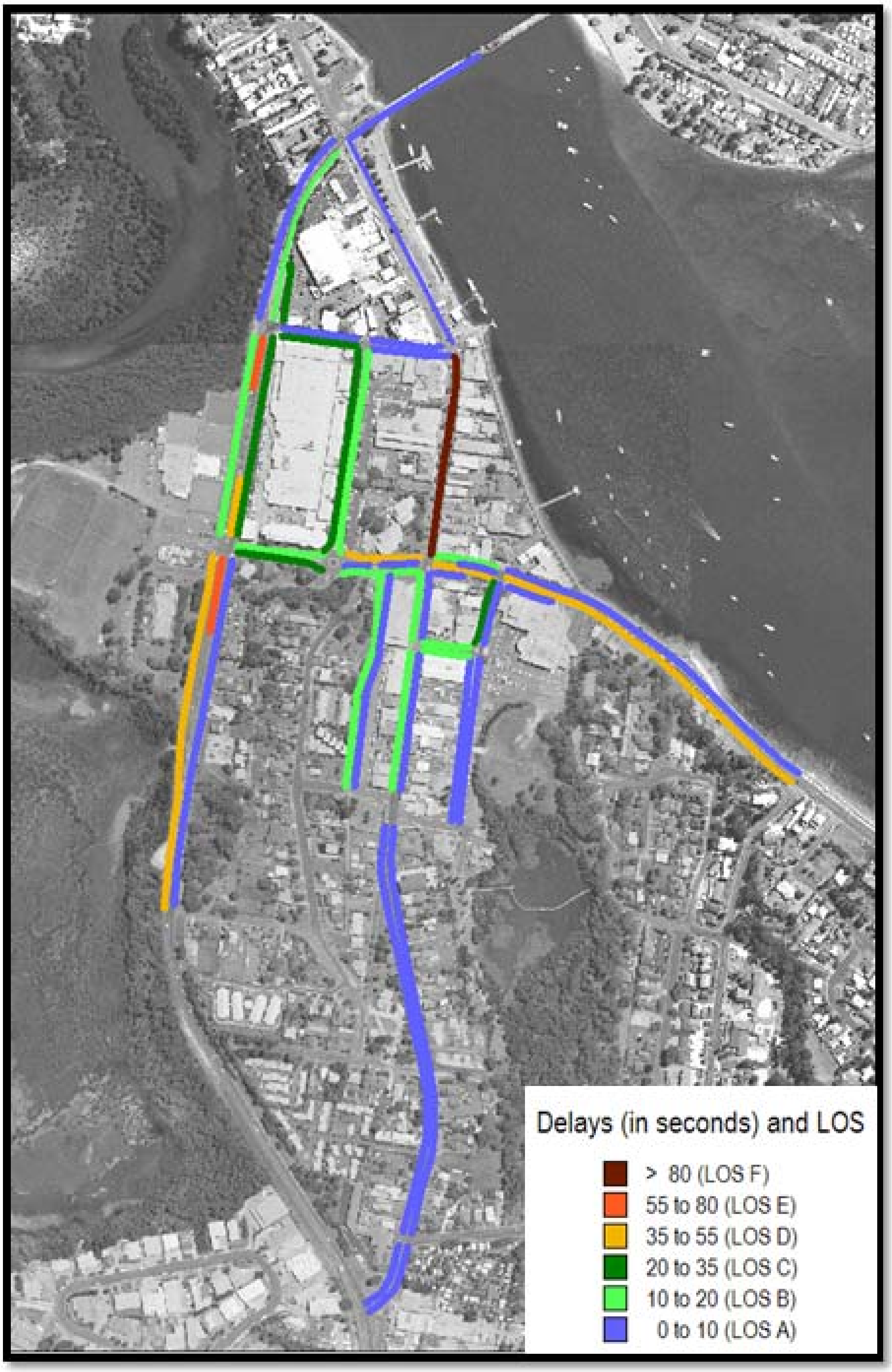


Figure 7.1: Average Delays for 2020 “Do Nothing” without Bypass – Midday Peak

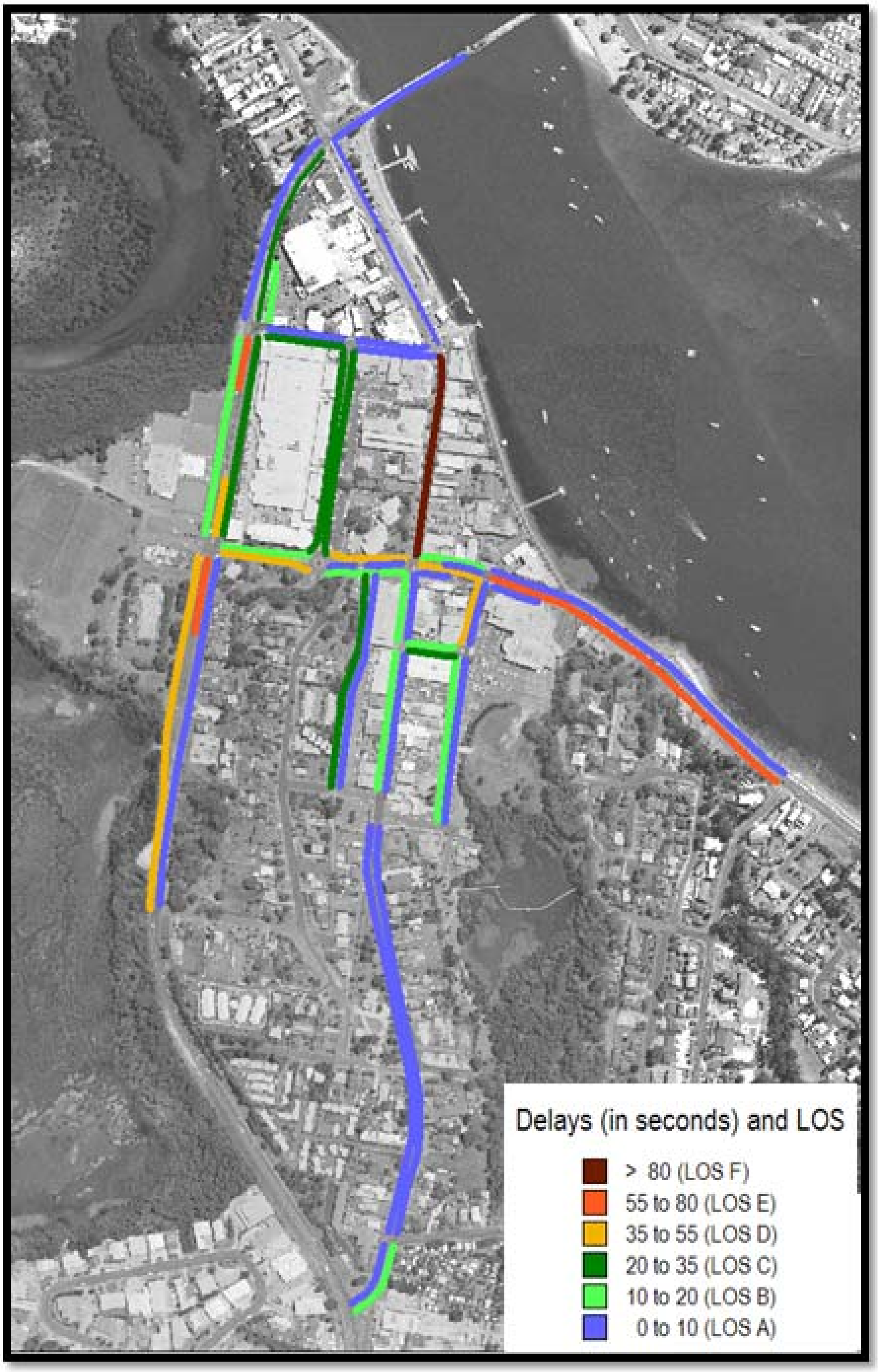


Figure 7.2: Average Delays for 2020 "Do Nothing" without Bypass – Evening Peak

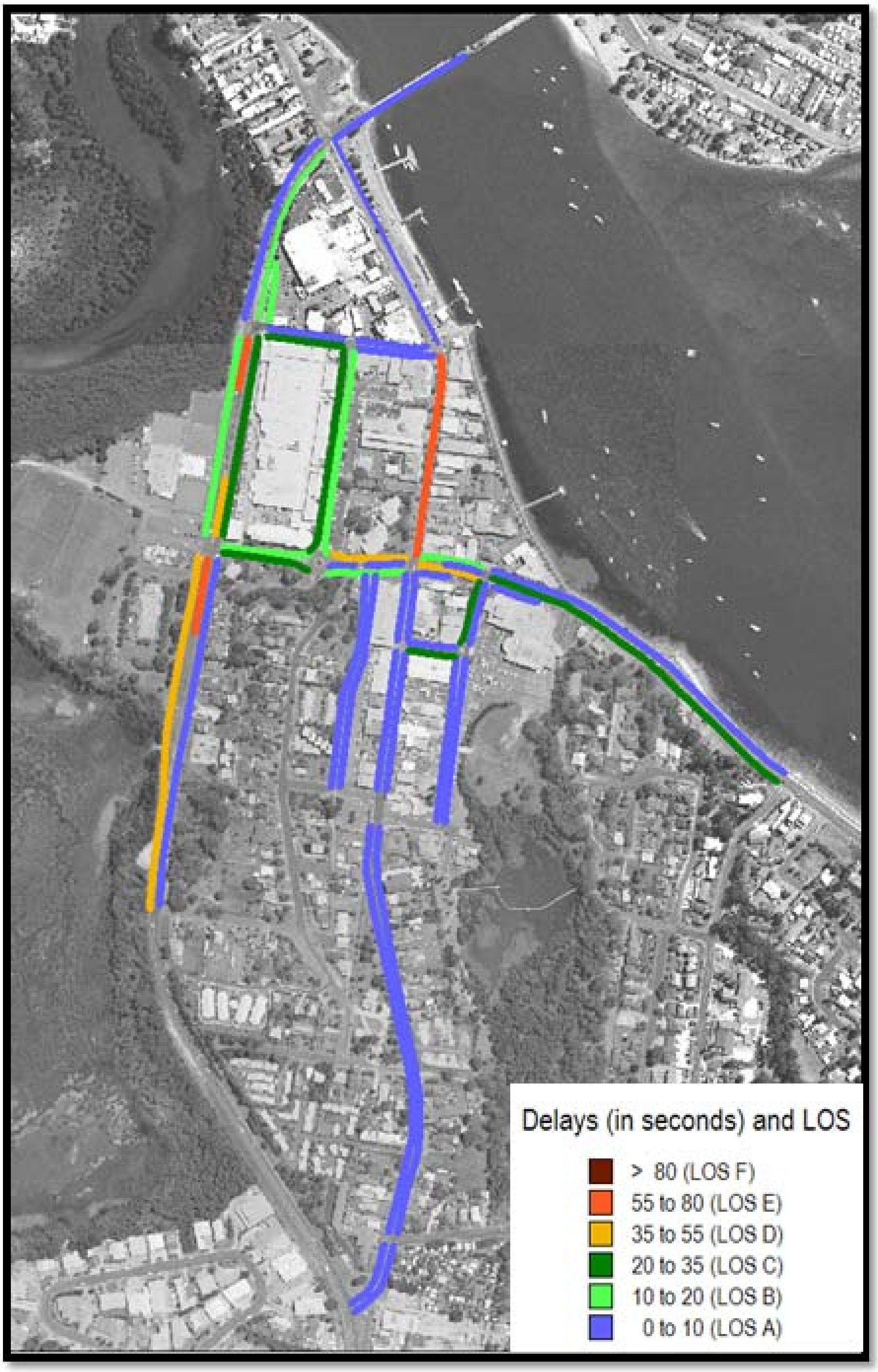


Figure 7.3: Average Delays for 2020 “Do Nothing” with Bypass – Midday Peak

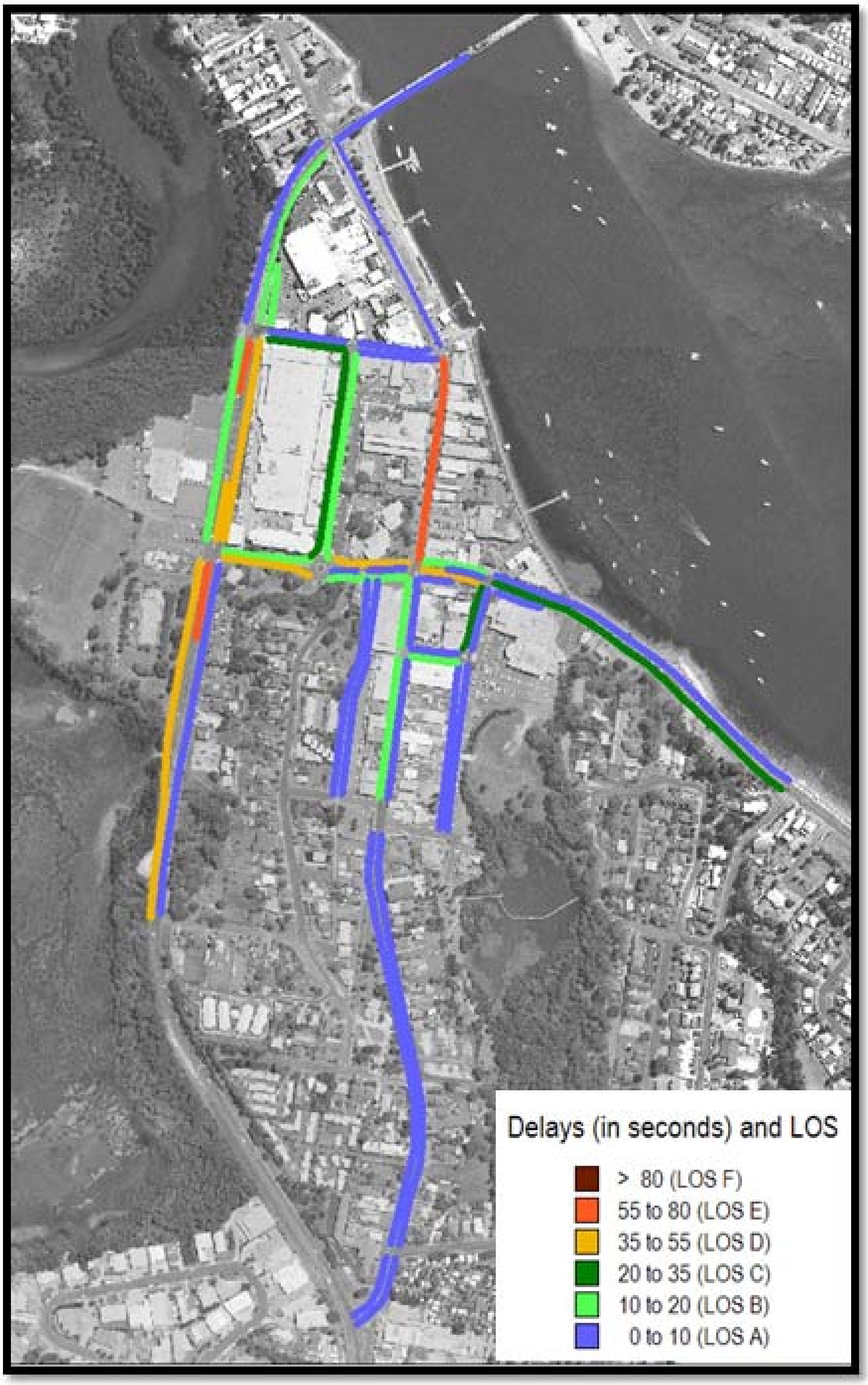


Figure 7.4: Average Delays for 2020 "Do Nothing" with Bypass – Evening Peak

The results shown in Figures 7.1 to 7.4 confirm the evening peak as the period with higher delays. The issues observed in the 2020 horizon generally correspond to an interim stage of those issues described under 2030 traffic conditions.

The westbound traffic along Beach Road and the northern approach to the Orient Street / Beach Road intersection experience the most considerable delays throughout the network. However, the implementation of the bypass and the associated traffic redistribution results in these issues being considerably alleviated, without compromising the levels of service elsewhere in the network.

7.3 Year 2020 Improved Network (Based on Option B)

7.3.1 Description and Process

The 2020 modelling assumed full development of the four "key sites" by 2020 but only 50% implementation of draft LEP demands. Accordingly, the modelling and network optimisation process for 2020 was based on including all of the intersection upgrades identified under 2030 Option B near, or directly associated with, the key site developments. The model results were then reviewed to determine whether any additional upgrades identified in 2030 Option B were also needed to be implemented on traffic capacity grounds.

7.3.2 Modelling Results

The following figures show results taken from the 2020 Option B Paramics models. Figures 7.5 and 7.6 are for without the bypass and Figures 7.7 and 7.8 are with the bypass.

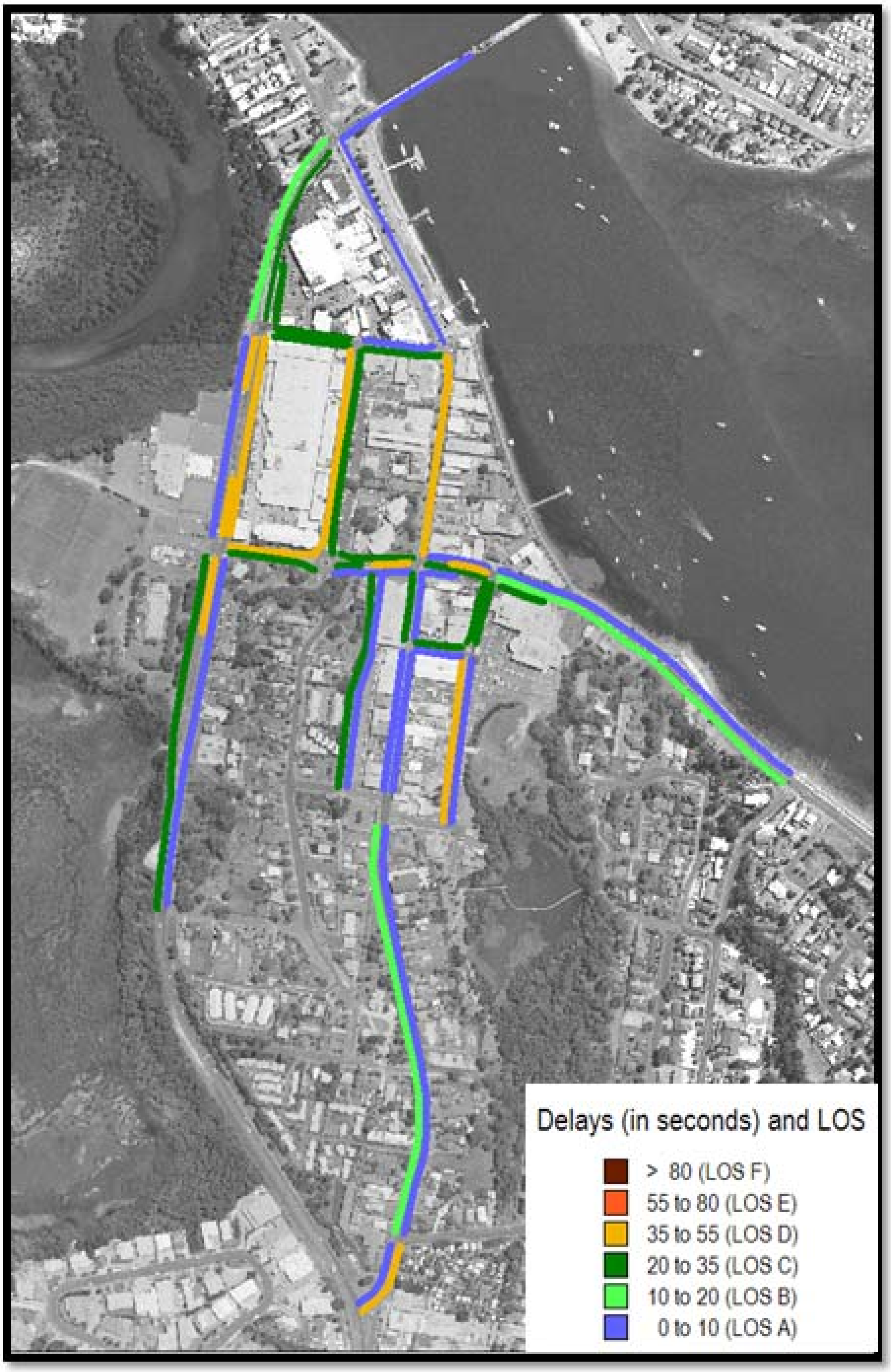


Figure 7.5: Average Delays for 2020 Option B without Bypass – Midday Peak

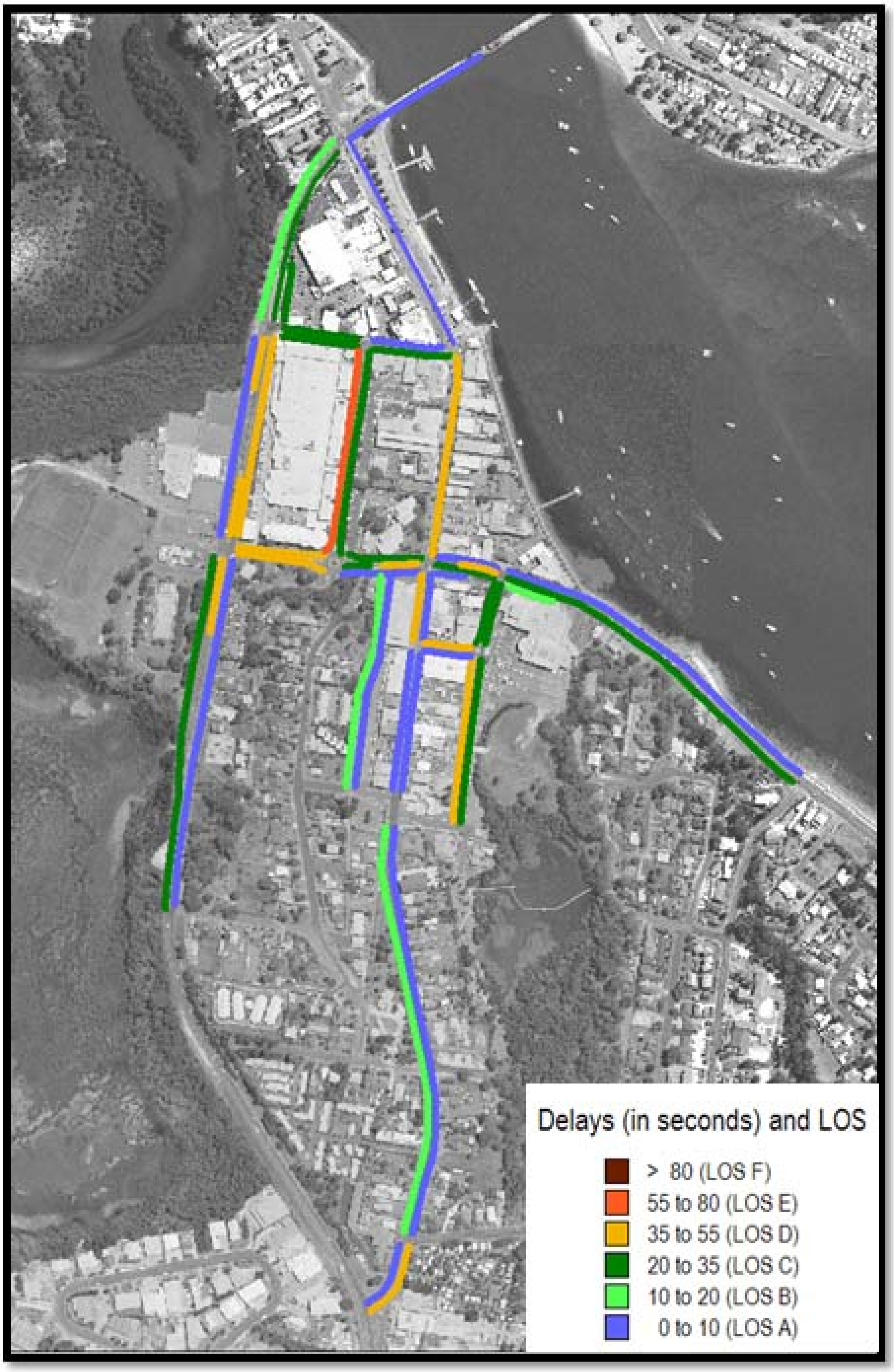


Figure 7.6: Average Delays for 2020 Option B without Bypass – Evening Peak

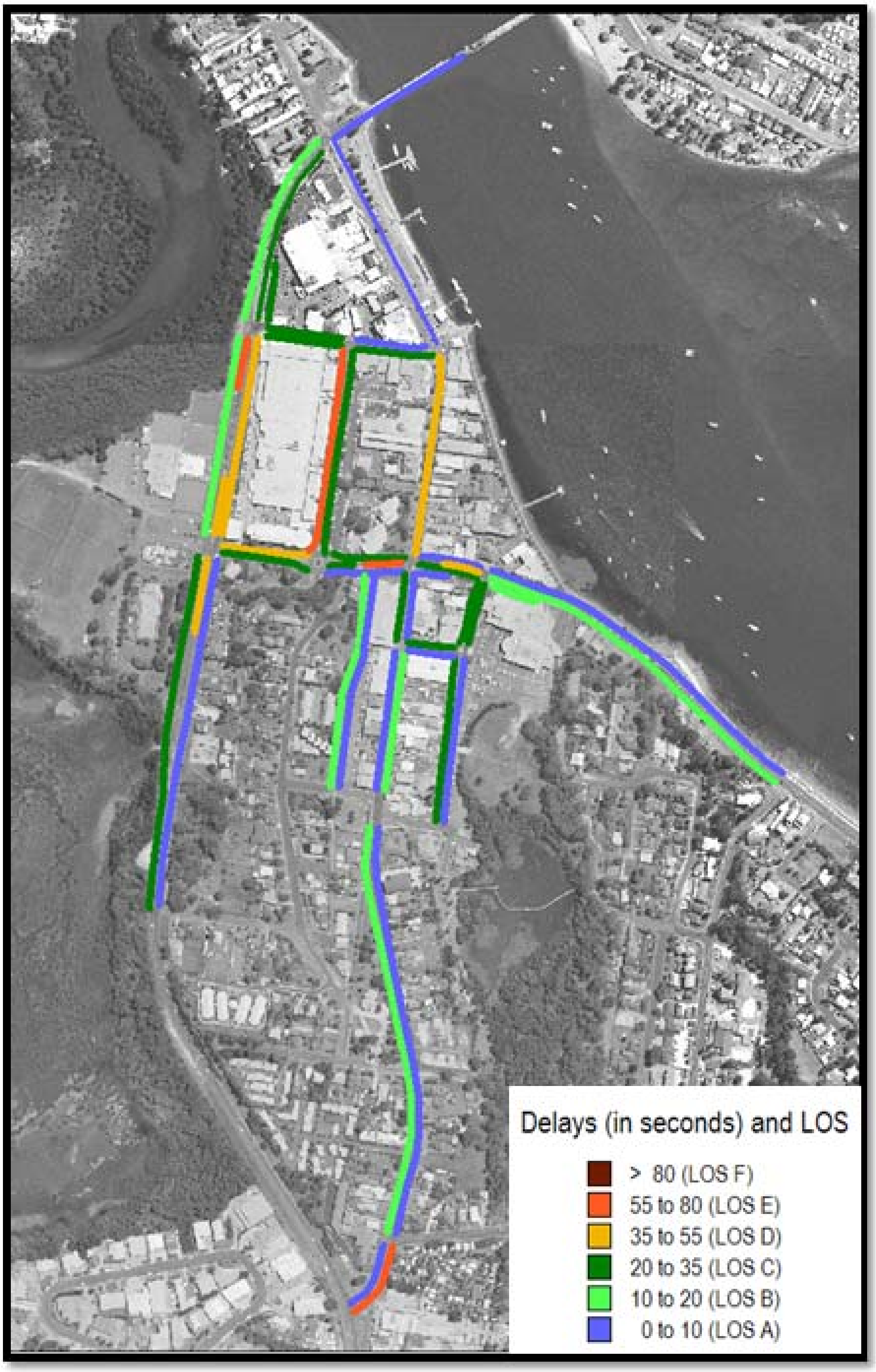


Figure 7.7: Average Delays for 2020 Option B with Bypass – Midday Peak

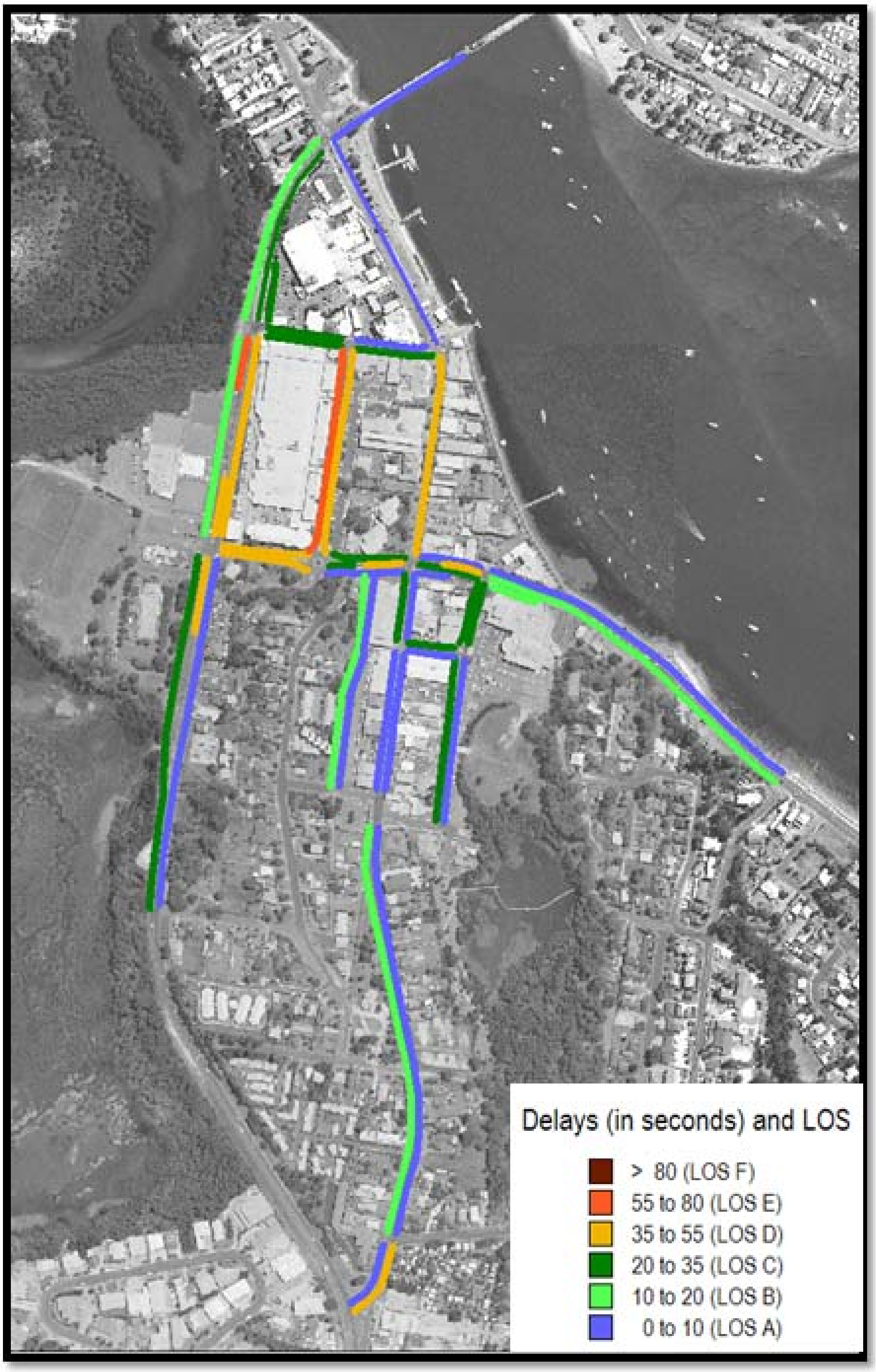


Figure 7.8: Average Delays for 2020 Option B with Bypass – Evening Peak

The results shown in Figures 7.5 to 7.8 show that the majority of the issues observed throughout the network under a "Do nothing" situation in 2020 are eliminated with the implementation of the targeted "Option B" upgrades. This is particularly evident eastbound along Beach Road and in the northern approach to the Orient Street/Beach Road intersection. The benefits provided by the construction of the bypass are not as noticeable as in the 2030 scenarios due to the lower congestion levels evident in 2020.

7.3.3 2020 Suggested Upgrades

The 2020 modelling indicates that some congestion issues are expected to occur at some key points of the network if no modifications of the current configurations are undertaken. More specifically, the northern end of the CBD will experience some pressure caused by conflicting movements and increased traffic volumes due to both background growth and the expected development of the proposed key sites.

The implementation of the bypass alleviates the congestion issues to some extent and provides a more balanced distribution of traffic at the northern end of the CBD. However, assuming that the bypass is fully operational by 2020, it is still recommended that a series of upgrades is constructed by 2020, particularly to cater for the localised issues caused by the key site developments and also to tackle the safety and operational issues described in Section 6.

The list of upgrades recommended to be in place by 2020 is as follows:

- extend right turn bays and optimise phasing arrangements at the intersections of Princes Highway/Beach Road and Princes Highway/North Street;
- provide right turn pockets on Beach Road (eastbound) at its intersections with Orient Street and Flora Crescent;
- extend the three lane section of the Orient Street northern approach to the intersection with Beach Road;
- signalise Beach Road/Perry Street intersection including right turn lane into Perry Street
- extension of the two lane section at Flora Crescent on the approach to the intersection with Beach Road and provide a left turn slip lane;
- install traffic signals at the Perry Street/North Street intersection;
- realign the Camp Street /Museum Place/Orient Street intersection to a standard four approach signalised intersection;
- provide a direct access to the Soldiers Club site via Beach Road; and
- ban the right turns in and out of Guy Street at the intersection with Beach Road.

8. SENSITIVITY TESTS

A number of "sensitivity" tests were undertaken to test alternative concepts at some intersections, or test sensitivities to increased traffic demands. These tests included:

- Sensitivity Test 1 – Double right turn from Princes Highway to Beach Road;
- Sensitivity Test 2 – "Malling" of North Street (Princes Highway to Perry Street);
- Sensitivity Test 3 – Batemans Bay Marina impacts;
- Sensitivity Test 4 – Perry Street left and through movement at Beach Road signals;
- Sensitivity Test 5 – "Pedestrian only" phase at the Beach Road/Orient Street signals; and
- Sensitivity Test 6 – One way only along Flora Crescent.

8.1 SENSITIVITY TEST 1

Sensitivity Test 1 is for a two lane right turn from the Princes Highway into Beach Road. The second pocket would be of similar length to the current single pocket. This option/test was run in the 2030 model with the bypass. Comparisons between the 2030 with bypass Option B model and the same model with the double right turn included are shown in the following tables.

Table 8.1: Sensitivity Test 1 - Screenshots and Comments

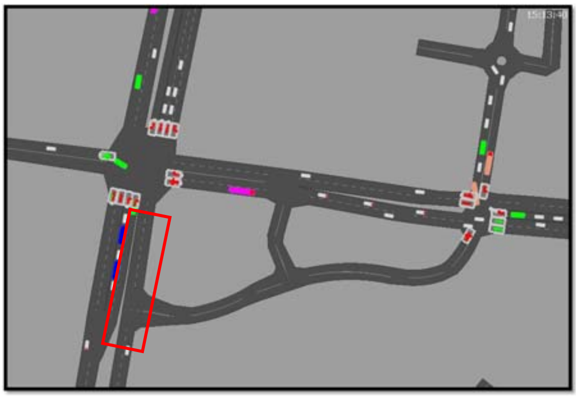
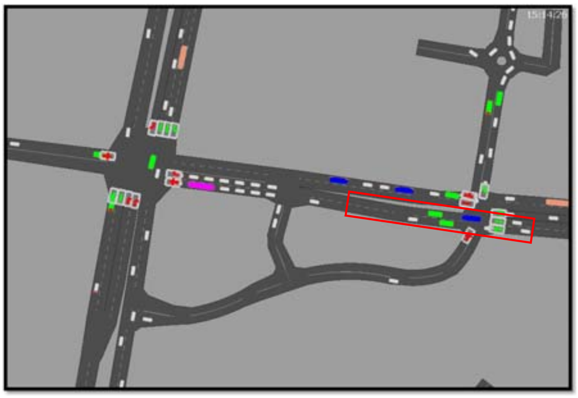
Sensitivity Test 1 Model Screenshot	Comments
	The modelling has shown that a large proportion of traffic using the double right turn pockets is, in fact, intending to turn left into Perry Street. This has two effects: under-utilisation of the right-most turn pocket and weaving issues in Beach Road on the eastbound approach to Perry Street. The modelling suggests that a longer single turn pocket is better than two shorter right turn pockets. The single turn pocket requires a longer right turn phase at the signals, which results in approximately 22sec of additional delay for southbound traffic (compared to the double right turn scenario)
	

Table 8.2: Sensitivity Test 1 - Delay Comparison

Description	Option B with Bypass (seconds)	Sensitivity Test 1 (seconds)	Difference (seconds)
NBD along Princes Highway to Princes Highway/Beach Road intersection (right turn)	48.3	40.9	-7.4
NBD along Vesper Rd to Princes Highway/Beach Road intersection (through)	26.4	25.4	-1.0

EBD along Beach Road to Beach Road/Perry Street intersection	47.9	55.0	7.1
Total Northern Area Delays	1177	1239	62

In general, the provision of the double right turn (instead of the single right turn) from Princes Highway into Beach Road reduces travel times on approach to this intersection. The weaving in Beach Road, however, introduces delays in this area with the net effect being that the double right turn is less efficient (and potentially less safe) than the longer single right turn lane.

8.2 SENSITIVITY TEST 2

This Sensitivity Test was to test the implementation of a mall on North Street between the Princes Highway and Perry Street. The results of this test are shown in the tables below.

Table 8.3: Sensitivity Test 2 - Screenshots and Comments

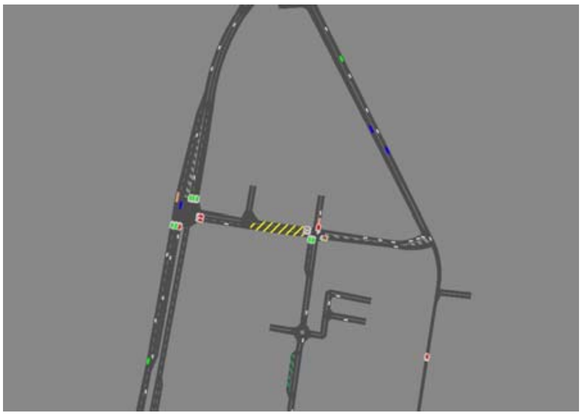
Sensitivity Test 2 Model Screenshot	Comments
	This figure shows the implementation of the mall by closing North Street between the Princes Highway and Perry Street.
	One outcome of this closure congestion on North Street eastbound and Perry Street southbound as traffic leaving "The Village" and "Bridge Plaza" has limited routes to access Beach Road and the Princes Highway. Increased volumes are experienced on Perry Street southbound, Orient Street southbound, Princes Highway northbound and the right turn from Beach Road to Perry Street, back to Flora Crescent.
	As vehicles can't turn right at North Street some of these vehicles now make this turn at Beach Road as well. Consequently there are very long delays and excessive queuing in this right turn pocket. The right turn from the Princes Highway to Beach Road has increased in volume and is over capaci ty.

Table 8.4: Sensitivity Test 2 - Delay Comparison

Description	Option B with Bypass (seconds)	Sensitivity Test 2 (seconds)	Difference (seconds)
SBD along Princes Highway to Princes Highway/North Street intersection	22.1	11.3	-10.8
NBD along Princes Highway to Clyde Street intersection	15.9	18.9	3.0
EBD along North Street to Clyde Street/Orient Street/North Street intersection	10.2	31.7	21.5
SBD along Orient St to Beach Road/Orient Street intersection	40.7	75.9	35.2
SBD along Perry St to Beach Road/Perry Street intersection	35.4	46.5	11.1
EBD along Beach Rd to Beach Road/Perry Street intersection	47.9	68.6	20.7
NBD along Vesper Road to Vesper Road/Beach Road intersection (right turn)	48.3	54.1	5.8
WBD along Beach Road to Beach Road/Orient Street intersection	25.2	27.0	1.8
NBD along Orient Street to Beach Road/Orient Street intersection	34.8	69.4	34.6
NBD along Commercial Lane to Beach Road	15.9	56.3	40.4
Total Northern Area Delays	1177.1	1468.1	291.0

Table 8.4 shows significant increases in travel times across the CBD with the malling of North Street. The results show that even though there is a reduced delay along the Princes Highway southbound due to the removal of the North Street intersection, this has actually increased the delay northbound because of the increased volume turning at Clyde Street.

The modelling highlights the issue with the limited number of locations that traffic has available to leave the CBD and enter the Princes Highway. Removing one of these locations (i.e. at North Street) whilst increasing traffic at Bridge Plaza and at the Soldiers Club/Woolworths sites, has significant effects on congestion in the area.

8.3 SENSITIVITY TEST 3

Sensitivity Test 3 includes the proposed development of the Batemans Bay Marina. This test was conducted on the 2020 Option B without the Bypass and on the 2030 Option B with the Bypass models. Without the Bypass implemented, there remains a large volume of traffic using Beach Road.

Traffic generation for the Marina was calculated based on the data shown in the Batemans Bay Marina Transport Impact Study, prepared by AECOM and dated 25th June 2010. The results from these tests are in the following figures and table.

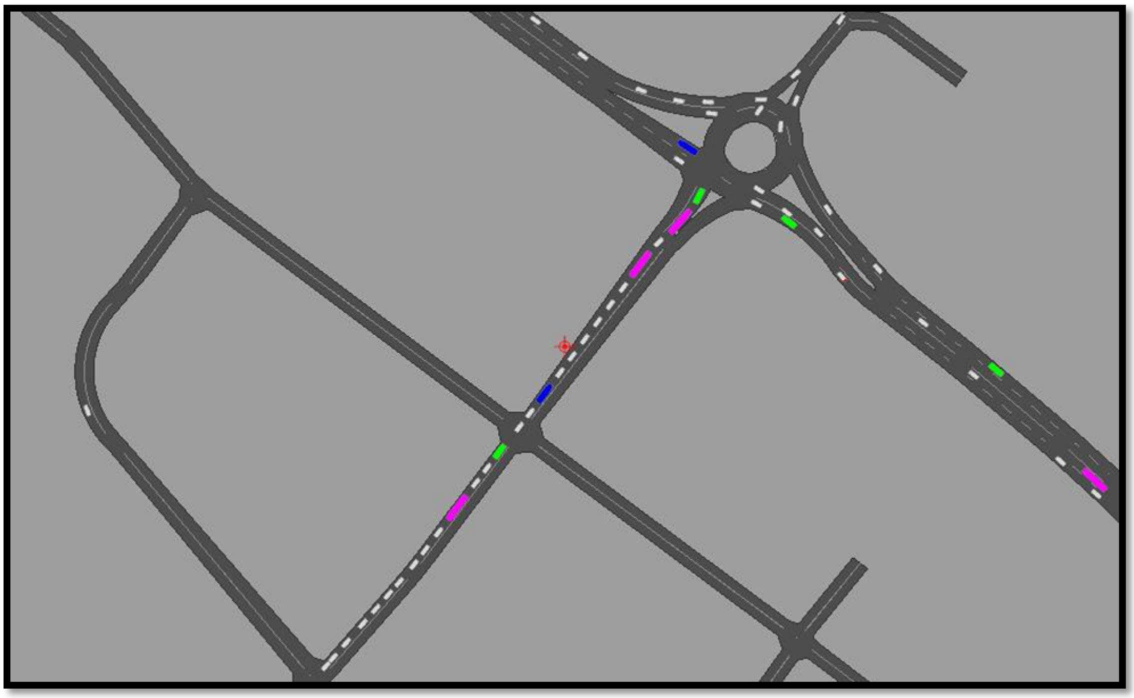


Figure 8.1: 2020 Sensitivity Test 3 - Beach Road/Bavarde Avenue Roundabout Typical Queues

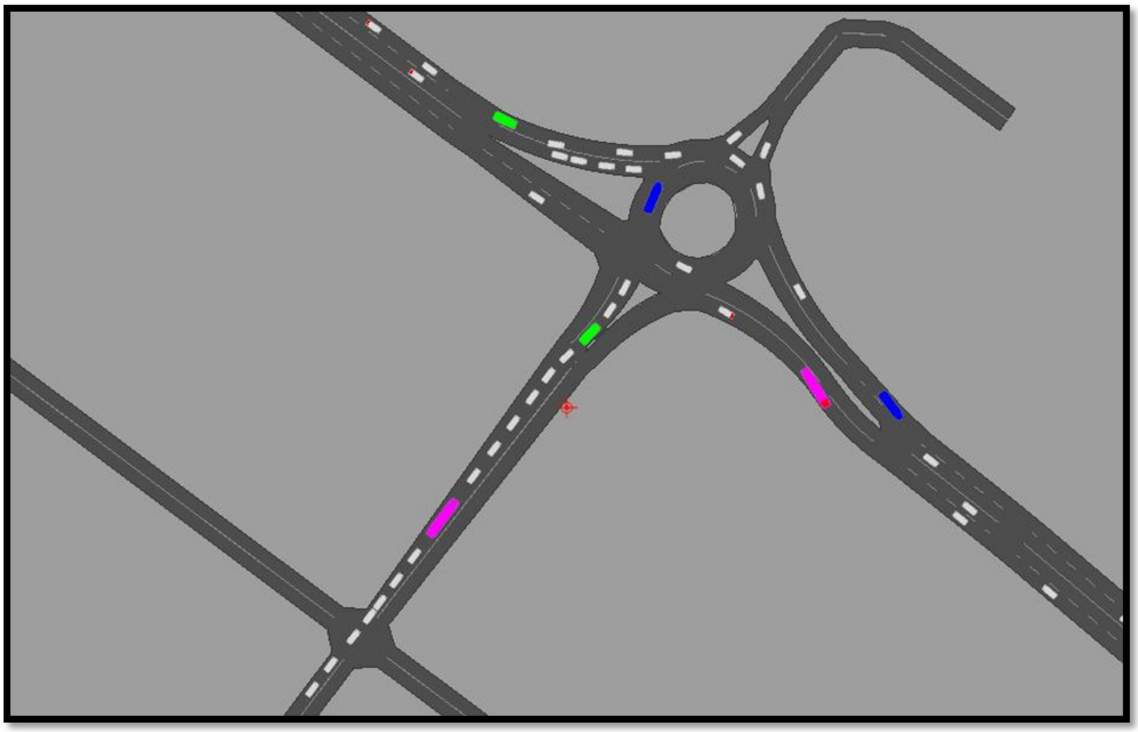


Figure 8.2: 2030 Sensitivity Test 3 - Beach Road/Bavarde Avenue Roundabout Typical Queues

Figure 8.1 and Figure 8.2 show the queuing on the Bavarde Avenue approach to the roundabout. The queues in both scenarios are significantly worse than without the Marina development. Right turns out of the Marina, in effect, reduce the gaps available for traffic from Bavarde Avenue to enter the roundabout, resulting in extensive queues. The average delays experienced by vehicles are summarised in the following table. The results confirm the significant impact of the Marina development on the network and also show that without the bypass implemented there is a much greater impact on the delays for this intersection.

Table 8.5: Sensitivity Test 3 - Delay Comparison

Description	2020 Option B (without bypass)		2030 Option B (with bypass)	
	Original	Sensitivity Test 3	Original	Sensitivity Test 3
SBD along Beach Road to the Beach Road/Bavarde Avenue Roundabout	4.8	8.9	4.1	5.4
WBD from the Marina to the Beach Road/Bavarde Avenue Roundabout	n/a	4.0	n/a	3.9
NBD along Beach Road to the Beach Road/Bavarde Avenue Roundabout	4	8.6	3.3	4.5
EBD along Bavarde Avenue to the Beach Road/Bavarde Avenue Roundabout	28.5	104.8	8.9	27.5

The 2020 model without the bypass implemented results in an unacceptable LOS of F for the Bavarde Avenue approach to the intersection. It is clear from the modelling that without the bypass implemented, this intersection needs to be signalised in order to manage the additional volume generated by the Marina Development. Even with the bypass in place, there is some noticeable queuing in Bavarde Avenue. This congestion coupled with the need to cater for increased pedestrian movements in this area suggests that signalisation should be considered regardless of whether the bypass is in place or not.

8.4 SENSITIVITY TEST 4

This sensitivity test introduces a through lane at the Perry Street approach to Beach Road signalised intersection configuration proposed under Option B. This provides an opportunity for traffic leaving Perry Street to turn left onto the Princes Highway via the through movement at the signals and then a left turn near the McDonalds site. Figure 8.3 shows this arrangement.

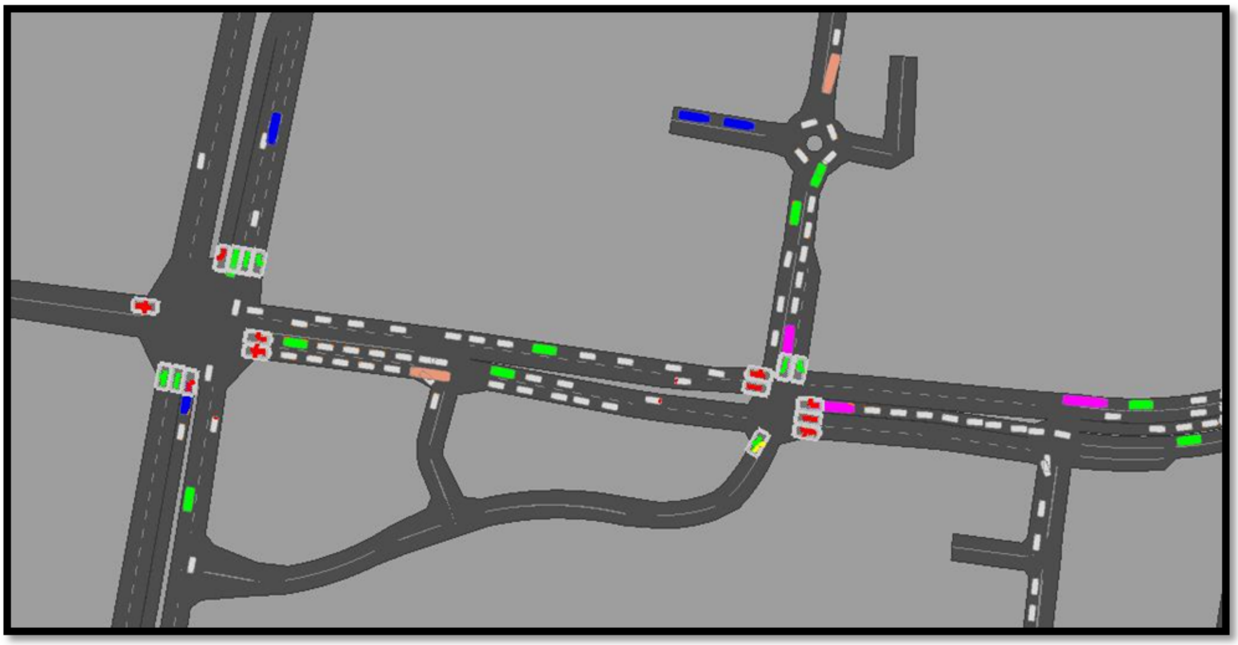


Figure 8.3: Sensitivity Test 4 – Perry Street Through Lane

Table 8.6 provides the comparative delay results for this option.

Table 8.6: Sensitivity Test 4 – Delay Comparison

Description	2030 Option B (with bypass)	Sensitivity Test 4 (seconds)	Difference (seconds)
SBD Perry Street to Perry Street/Beach Road intersection	35.4	60.1	24.7
EBD Beach Road to Perry Street/Beach Road intersection	47.9	55.2	7.3
WBD Beach Road to Perry Street/Beach Road intersection	44.6	49.4	4.8
EBD along Beach Road to Beach Road/Orient Street intersection	22.9	22.8	-0.1
WBD along Beach Rd to Beach Rd / Perry St intersection	8.0	9.3	1.3
NBD along Vesper Rd to Vesper Rd / Beach Rd intersection	26.4	27.2	0.8
NBD along Vesper Rd to Vesper Rd / Beach Rd intersection (right turn)	48.3	53.6	5.3
WBD along Beach Rd to Beach Rd / Orient St intersection	25.2	30.4	5.2
Total Northern Area Delays	1177	1255	78

Overall the additional of a through movement from Perry Street at the proposed Beach Road signals results in delays to the broader network. The delays on Perry Street southbound affect the roundabouts on Perry Street creating delays for vehicles entering Perry Street. Delays are also experienced on Beach Road and on the Princes Highway. Eastbound vehicles on Beach Road experience slight reductions in delay due to less vehicles exiting from Perry Street in this traffic stream.

8.5 SENSITIVITY TEST 5

Sensitivity Test 5 is for a pedestrian only phase to be implemented at the Beach Road/Orient Street signals. The pedestrian phase must run for approximately 30seconds to allow the pedestrians to cross the wider sections of the junction (both the Beach Road approaches). This option/test was run in the 2030 model with the bypass. Comparisons between the 2030 with bypass Option B model and the same model with the "pedestrian only phase" included are shown in the following tables.

Table 8.7: Sensitivity Test 5 - Screenshots and Comments

Sensitivity Test 2 Model Screenshot	Comments
	The modelling shows that the modified phasing arrangement at the Beach Road/Orient Street intersection result in additional delays on all approaches to the roundabout. The queues occasionally extend as far as the adjacent intersections, affecting the traffic flow at those locations.

Table 8.8 provides the comparative delay results for this option.

Table 8.8: Sensitivity Test 5 - Delay Comparison

Description	2030 Option B (with bypass)	Sensitivity Test 5 (seconds)	Difference (seconds)
SBD along Orient St to Beach Rd / Orient St intersection	41.6	92.9	51.3
WBD along Beach Rd to Beach Rd / Flora Cres intersection	54.5	47.5	-7.0
EBD along Beach Rd to Beach Rd / Flora Cres intersection	36.4	39.5	3.1
EBD along Beach Rd to Beach Rd / Orient St intersection	33.4	73.0	39.6
NBD along Flora Cres to Beach Rd / Flora Cres intersection	37.7	74.9	37.2
NBD along Orient St to Beach Rd / Orient St intersection	35.3	56.0	20.7
SBD along Orient St to Flora Cres / Orient St intersection	4.3	4.4	0.1
EBD along Beach Rd to Beach Rd / Perry St intersection	9.6	8.1	-1.5
WBD along Beach Rd to Beach Rd / Perry St intersection	51.2	52.0	0.8
WBD along Beach Rd to Beach Rd / Orient St intersection	25.7	32.5	6.8
Total Northern Area Delays	1177	1422	245

In general, the provision of the "pedestrian only" phase increases the congestion levels on all approaches to the Beach Road/Orient Street intersection with queues occasionally affecting the operation of adjacent intersections.

The volume of pedestrians using this intersection (both current volumes and estimated future year volumes) appear to be insufficient to justify this measure and the consequent impact on the traffic operation on the adjacent links.

8.6 SENSITIVITY TEST 6

Sensitivity Test 6 intends to evaluate the option of converting Flora Crescent to one-way circulation. Two alternatives were tested as part of this sensitivity test, as follows:

- Sensitivity Test 6.1: circulation on Flora Crescent restricted to eastbound and northbound (anti-clockwise only); and
- Sensitivity Test 6.2: circulation on Flora Crescent restricted to southbound and westbound (clockwise only).

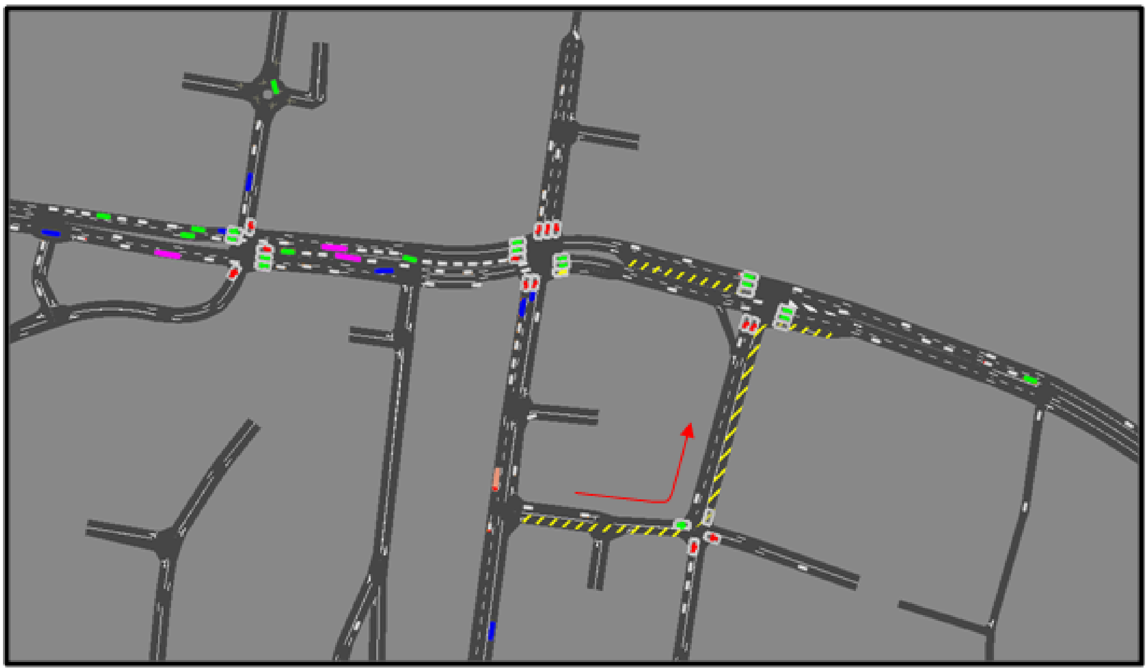


Figure 8.4: Sensitivity Test 6.1 – Anti-Clockwise Circulation Only on Flora Crescent

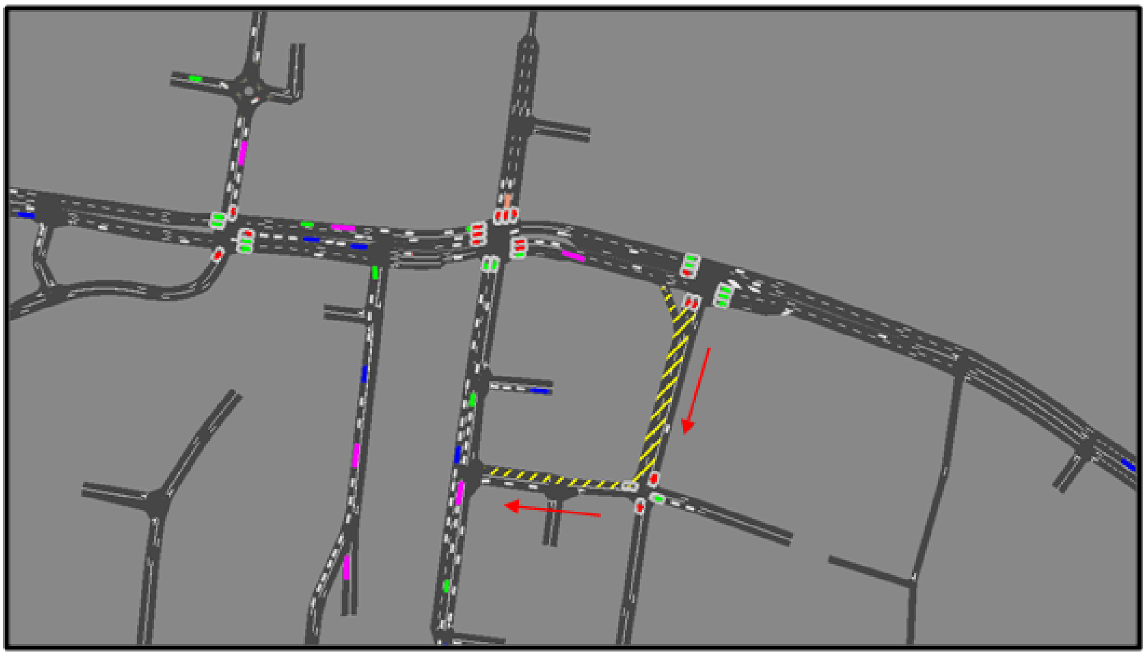


Figure 8.5: Sensitivity Test 6.2 – Clockwise Circulation Only on Flora Crescent

Both these options allow a reduction on the number of movements (and consequently on the number of signal phases) at the intersection of Flora Crescent/Beach Road. However, the restriction of certain turns and movements has an impact on adjacent intersections, especially at the Beach Road / Orient Street signals.

These options were assessed using the 2030 model with the bypass. Comparisons between the 2030 with bypass Option B model and the same model with the "one-way" segments included are shown in the following tables.

Table 8.9: Sensitivity Test 6 - Delay Comparison

Description	Option B (with bypass) (seconds)	Sensitivity Test 6.1 (seconds)	Sensitivity Test 6.2 (seconds)
NBD along Vesper St to Vesper St/Princes Highway/Clyde St intersection	22.0317	27.4604	30.466
EBD along North St to North St/Perry St intersection	31.2731	30.9704	34.3431
NBD along Vesper Highway to Vesper St/Princes Highway/North St intersection	11.2635	19.6867	16.6401
SBD along Vesper Rd to Vesper Rd/Beach Rd intersection	46.7248	49.6437	47.7055
SBD along Orient St to Beach Rd/Orient St intersection	45.4563	50.0346	46.6031
EBD along Beach Rd to Beach Rd/Orient St intersection	25.7093	30.2008	24.702
EBD along Beach Rd to Beach Rd/Orient St intersection (right turn)	63.4703	75.0955	47.6552
EBD along Beach Rd to Beach Rd/Flora Cres intersection	7.02321	26.8118	3.93224
EBD along Beach Rd to Beach Rd/Flora Cres intersection (right turn)	47.4897		15.3846
WBD along Beach Rd to Beach Rd/Orient St intersection	30.539	64.5937	36.9328
WBD along Beach Rd to Beach Rd/Orient St intersection (left turn)	2.88935	3.52226	3.72851
WBD along Beach Rd to Beach Rd/Flora Cres intersection	19.2761	23.9794	11.7113
WBD along Beach Rd to Beach Rd/Flora Cres intersection (left turn)	17.5366		12.297
NBD along Vesper Rd to Vesper Rd/Beach Rd intersection	27.3826	28.37	28.8659
NBD along Orient St to Beach Rd/Orient St intersection	39.885	41.9703	53.7528
SBD along Orient St to Orient St/Flora St intersection	4.3319	3.8873	4.79134
NBD along Flora Cres to Beach Rd/Flora Cres intersection	28.0198	44.6699	
SBD along Flora Cres to Beach Rd/Flora Cres intersection	25.0393		20.4177
NBD along Orient St to Orient St/Flora St intersection	4.62165	5.11037	8.83294
SBD along Orient St to Orient St/Museum Pl intersection	11.1935	9.50061	25.0256
NBD along Flora Cres to Flora Cres intersection	53.1094	23.8028	47.5522
SBD along Flora Cres to Flora Cres/Museum Pl intersection	7.48996	15.6533	58.772
NBD along Orient St to Orient St/Museum Pl intersection	13.9016	14.5802	16.7455
EBD along Flora Cres to Flora Cres intersection	36.0034	15.4666	
WBD along Flora Cres to Orient St/Flora St intersection	2.88592	27.4604	7.05544
Total Northern Area Delays	1177	1277	1317

The results indicate that while the potential implementation of the one-way scheme on Flora Crescent provides some localised benefits (particularly at the intersection of Flora Crescent/Beach Road) some additional delays occur elsewhere on the network. Both options result in a traffic redistribution which puts additional pressure on other parts of the network and overall, none of the schemes is considered to be beneficial.

9. PUBLIC TRANSPORT NEEDS

9.1 POTENTIAL SERVICES GROWTH

The demand for public transport services has been assumed to grow at the same rate and in the same areas as traffic growth between 2010 and 2030.

The bus service-growth rates were calculated based on three main areas:

- External North – this represent trips in and out of the network to the north via the Princes Highway.
- External South – this represents the trips in and out of the network to the south. Over time, it is expected that all of the southern services will move to Beach Road and service have been assumed to be re-routed accordingly.

Trips made from an internal zone to another internal zone are not included as the trip length is considered to be too short to generate a significant volume of trips. These trips have therefore been excluded from the public transport demands. The trips forecast to be generated by public transport are shown in the following table.

Table 9.1: Public Transport Person Trips

From \ To	External North	External South	Internal	Total
External North	n/a	20	43	63
External South	26	n/a	94	120
Internal	65	116	n/a	181
Total	92	136	137	364

The trips between the zones have been manually assigned to the bus routes southbound and northbound. The person trips relating to bus routes are summarised in the following table.

Table 9.2: 2030 Bus Route Demand (PM Peak)

Bus Route	Enter Network	In Network		Exit Network
		Off	On	
North to South	65	44	116	137
South to North	121	94	66	93

The number of buses required for these routes is determined based on a capacity of 40 passengers per bus. The number of buses required per hour and the frequency of the services can then be calculated. The results are shown in the table below.

Table 9.3: Buses and Frequency Required

Bus Route	Enter Network	Exit Network	Total Buses Required (buses/hour)	Frequency (minutes)
North to South	2	4	4	15
South to North	4	3	4	15

The projected number of buses required and the frequency of these services appears reasonable based on the size of the CBD in 2030. More detailed analysis would be required in the future to determine the best routes for buses, including determining if the routes are to go through the study area or terminate within it.

The above is a broad assessment of public transport needs and a detailed public transport strategy for the shire would provide a more detailed set of location-specific recommendations.

10. PEDESTRIAN AND CYCLING INFRASTRUCTURE

10.1 KEY GENERATORS AND DESIRE LINES (2030)

The key generators of pedestrian and cycling movements are the CBD's retail areas and all waterfront areas. Desire lines are displayed in Figure 10.1 below and relate primarily to future demands likely to be generated by key development sites.

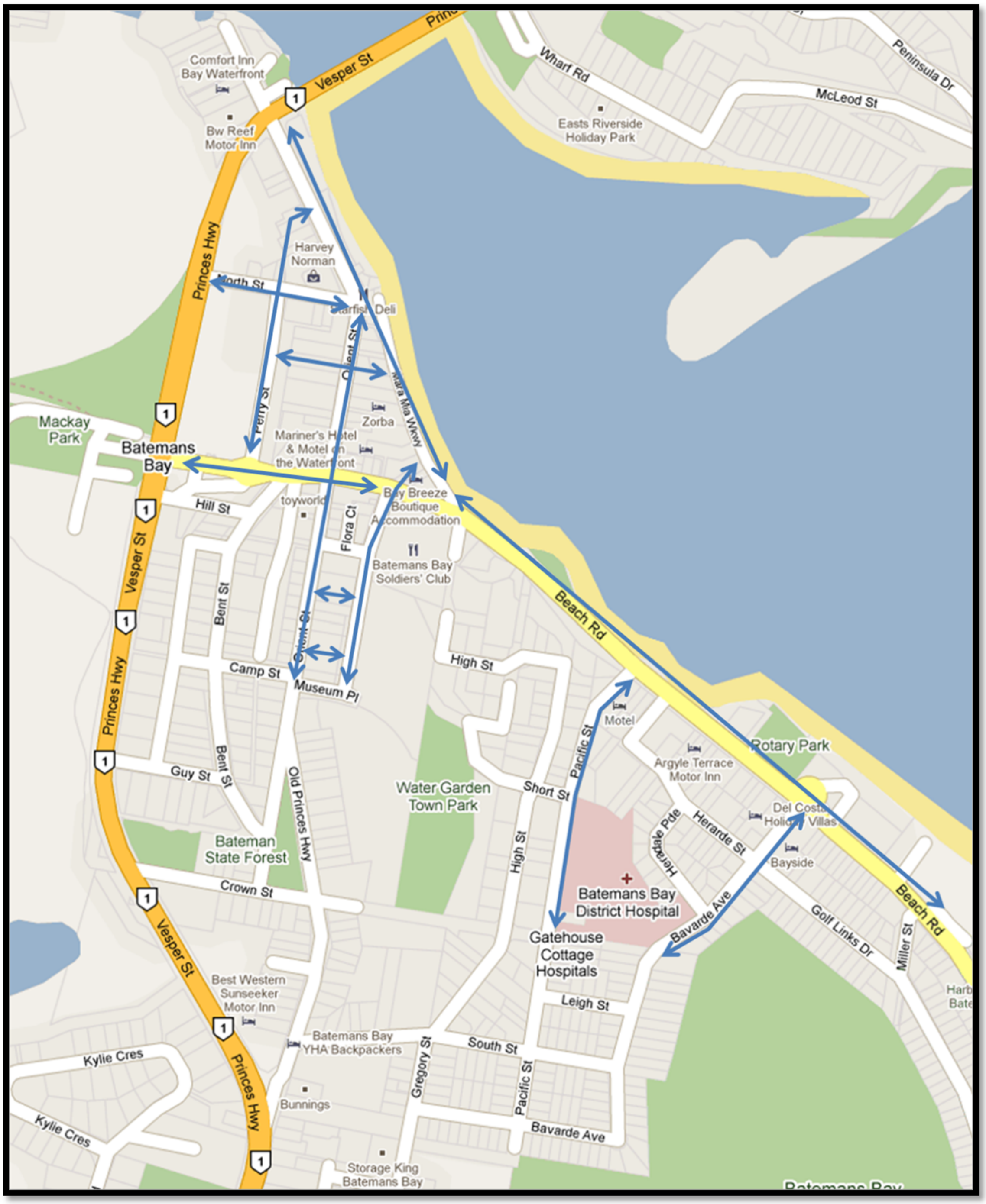


Figure 10.1: Key Pedestrian/Cycling Desire Lines in 2030

10.2 PEDESTRIAN AND CYCLING FACILITIES

The determination of pedestrian and cycling facilities was based on the desire lines and what upgrades or additional infrastructure is needed based on what is currently available. Figure 10.2 and Table 10.1 summarises the suggested pedestrian and cycling upgrade suggestions.

Figure 10.2: Pedestrian and Cycling Suggestions

Table 10.1: Pedestrian and Cycling Improvement Suggestions

ID	Suggestions Description
1	North Street and Perry Street Intersection – signalisation to cater for future heavy demands by pedestrians.
2	Flora Crescent Intersection – this current roundabout has been signalised to incorporate pedestrian movements as this will be an intersection heavily used by pedestrians, following the implementation of nearby developments.
3	Beach Road and Perry Street – this intersection was originally a roundabout offering no safe pedestrian crossings. Signalisation will provide for the expected increases in pedestrian demands.
4	There are significant accessibility benefits for the Bridge Plaza development including pedestrian access through the site between Clyde Street and the Perry Street.
5	Access from Flora Crescent to the foreshore.
6	Consideration be given to cyclists along Beach Road between the Soldiers Club and the Princes Highway.
7	Allow for footpaths along Flora Crescent as development access.
8	Construction of a footpath along Pacific Street particularly near the hospital.
9	Construction of a footpath along Bavarde Avenue to access Beach Road and the foreshore.

11. TRAFFIC AND TRANSPORT INFRASTRUCTURE AND FUNDING

11.1 SUMMARY OF NEEDS

The traffic-upgrade infrastructure needs are summarised in Table 11.1. Further details on the infrastructure items can be found in Table 6.1 and Table 6.2. An approximation has been calculated for the cost of each item and the apportionment of responsibility of these costs has been suggested based on the generators of the need for these items (i.e. site specific or the CBD as a whole).

Table 11.1: Traffic Infrastructure Needs and Responsibilities

ID	Item	Responsibility	%	Indicative Cost
1	Increase length of right turn lane on Princes Highway northbound at Beach Road	General	100	$75,000
2	Increase length of right turn lanes on Princes Highway northbound at North Street	General	100	$75,000
3	Signalise North Street/Perry Street intersection including left turning lane from Perry Street and access to Bridge Plaza development	Bridge Plaza Development	50	$1,500,000
		General	50	$2,000,000
4	Signalise Beach Road/Perry Street intersection including right turn lane into Perry Street	General	100	
5	Beach Road/Orient Street intersection upgrades	General		$1,600,000
6	Beach Road/Flora Crescent intersection upgrades	General	37.5	$1,600,000
		Soldiers Club Development	37.5	
		Woolworths Development	25	
7	Signalise the Flora Crescent/Soldiers Club access intersection	Soldiers Club Development	60	
		Woolworths Development	40	$1,000,000
8	Access road from Beach Road to Soldiers Club, Centrelink and additional proposed development	Soldiers Club Development	100	n/a
9	Signalise and realign Camp Street and Museum Place with Orient Street	Woolworths Development	40	$1,500,000
		Soldiers Club Development	60	
10	Signalise Princes Highway/Old Princes Highway intersection including turning lane changes and additional through lane on the Princes Highway northbound	General	100	$1,500,000
11	Clyde Street and Orient Street Traffic Management Scheme	General	100	$250,000
Total		General		$6,850,000
Totals		Bridge Plaza Development		$750,000
		Woolworths Development		$1,400,000
		Soldiers Club Development		$2,100,000
Grand Totals				$11,100,000

The above indicative costs are subject to further design and detailed estimation. The contribution makeup between each developer and "general" is subject to DA conditions when the individual developments are lodged. They are meant as a guide only.

Pedestrian and cycling related infrastructure items are summarised in Table 11.2.

Table 11.2: Pedestrian/Cycling Infrastructure Needs and Responsibilities

ID	Item	Responsibility	%	Cost
12	Footpath – Pacific Street	General	100	$200,000
13	Footpath – Bavarde Avenue	General	100	$100,000
14	Walkway from Flora Crescent connecting to the foreshore.	General	100	$30,000
15	Improvements for cyclists on Beach Road between the Soldiers Club and the Princes Highway.	General	100	$400,000
16	Allow for pedestrian walkways along Flora Crescent.	Soldiers Club Development	60	$120,000
		Woolworths Development	40	
Total		General		$730,000
Total		Soldiers Club		$72,000
		Woolworths Development		$48,000
Grand Total				$850,000

The above indicative costs are subject to further design and detailed estimation. The contribution makeup between each developer and "general" is subject to DA conditions when the individual developments are lodged. They are meant as a guide only.

11.2 SCHEDULE

A schedule for the required infrastructure items follows. The schedule has been developed based on the Paramics modelling results.

Table 11.3: Infrastructure Implementation Schedule

Item	Implementation Year
Increase length of right turn lanes on Princes Highway northbound at Beach Road	2020
Increase length of right turn lanes on Princes Highway northbound at North Street	2020
Signalise Beach Road/Perry Street intersection including right turn lane into Perry Street	2020
Beach Road/Orient Street intersection upgrades	2020
Beach Road/Flora Crescent intersection upgrades	2020 (if Woolworths/Soldiers Club sites developed)
Signalise Princes Highway/Old Princes Highway intersection including turning lane changes and additional through lane on the Princes Highway northbound	2030
Clyde Street and Orient Street Traffic Management Scheme	2030
Signalise North Street/Perry Street intersection including left turning lane from Perry Street and access to Bridge Plaza development	3-way junction can be signalised in 2020 and the fouth leg (on the northern side) added at the same time as Bridge Plaza Development

Item	Implementation Year
Signalise the Flora Crescent/Soldiers Club access intersection	Same time as the Woolworths and Soldiers Club Development
Access Road from Beach Road to Soldiers Club, Centrelink and additional proposed development	Same time as the Soldiers Club Development
Signalise and realign Camp Street and Museum Place with Orient Street Same time as the Woolworths and Soldiers Club Development	Same time as the Woolworths and Soldiers Club Development
Allow for pedestrian walkways along Flora Crescent.	Same time as the Woolworths and Soldiers Club Development
Footpath – Pacific Street	As funding is available
Footpath – Bavarde Avenue	As funding is available
Walkway from the Flora Crescent connecting to the Mara Mia Walkway.	As funding is available

12. CONCLUSIONS

The key conclusions are as follows:

- the models created are a valid representation of current traffic operations in the Batemans Bay CBD and are suitable to be used for the assessment of future year scenarios;
- no significant traffic delays currently occur within the study area on typical weekdays, with most queues associated with traffic signals. These queues generally clear within one signal cycle;
- the section of Beach Road between Princes Highway and Flora Crescent endures a considerable number of conflicting movements, including traffic, pedestrians and cyclists and this leads to occasional delays and potential safety considerations;
- approximately 60% of the traffic entering the study area via the Clyde River Bridge has its destination within the study area. By comparison, locally-destined traffic is 50% of the vehicles entering the study area via the southern end of Princes Highway;
- the PM peak traffic volumes are generally 10% to 20% higher than those observed during the midday peak period;
- the busiest intersections are Beach Road/Bavarde Avenue, Beach Road/Orient Street and Beach Road/Perry Street, with total throughput volumes between 1250 and 1800 vehicles per hour;
- of the traffic entering the study area at its boundaries, the proportion of through traffic is 20% in the midday peak period and 27% in the PM peak period;
- the number of public transport services (buses and taxis) provided in the area are minimal and no particular operational issues are currently experienced by these transport modes;
- the on-street parking areas generally show higher occupancy and turnover figures but overall, the current parking capacity appears to be sufficient to cater for the average weekday demand;
- the key developments proposed to be constructed represent approximately 30% of the total traffic estimated to use the network in 2030;
- a number of capacity and safety issues have been identified in the 2030 models under a "do nothing" approach. Overall, the network operates very poorly with excessive congestion levels and delays, particularly in the northern end of the CBD;
- a series of upgrades is required to tackle the issues observed. A list of mitigation measures has been tested (Option B) and it proved to be adequate to cater for 2030 traffic volumes from both capacity and safety perspectives;
- the construction of the "Southern Batemans Bay Bypass" provides considerable benefits in the 2030 evening peak period for CBD traffic. More specifically, it results in a more balanced distribution of traffic flows along the Princes Highway (northbound) and Beach Road (westbound). The benefits are not as noticeable during the midday peak;
- the analysis of the 2020 scenarios indicated that a staged upgrade implementation is possible however much of the timing depends on when each of the key sites is developed;
- the proposed key site developments and background traffic growth will result in significant pressure being placed on both on-street and off-street parking. Some multi-level parking is likely to be required and the increased demand will need to be managed through appropriate pricing and/or regulation, subject to the findings of a more detailed parking strategy which is expected to follow this study;
- more frequent bus services are recommended to be implemented as the demand grows and key sites are developed;
- a number of pedestrian and cycling improvements have been identified based on current and estimated future desire lines. Most of these projects form part of the integrated upgrade strategy also proposed to cater for traffic issues; and
- an approximation of the responsibilities attributable to both background growth and proposed developments have been calculated for all the infrastructure needs identified. It is likely that over $10M in traffic and pedestrian/cyclist infrastructure upgrades will be required in the CBD by 2030.