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TRAFFIC REPORT

on

PROPOSED BREAKWATER DEVELOPMENT

at

ENTERTAINMENT DRIVE, TOWNSVILLE

for

CITY PACIFIC

11th OCTOBER 2007

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ATTACHMENTS:

1. INTRODUCTION

This report presents an assessment of the traffic-related issues associated with the proposed Townsville Ocean Terminal project (the Breakwater project).

The site is located at the seaward end of the peninsula served by Sir Leslie Thiess Drive on which the Townsville casino, the Magnetic Island ferry terminal, a major boat launching ramp and the Entertainment and Convention Centre are presently situated.

The Breakwater development which is the subject of this report comprises:

- a cruise ship terminal
- 200 detached house lots
- 500 apartments
- 1500 sq m retail floor space
- 360 marina berths (of which 148 will be in the same ownership as adjoining houses/apartments)
- a new parking area containing about 500 parking spaces to serve both the Entertainment Centre and the cruise ship terminal

The site relies wholly for land-based transport on access via Entertainment Drive and Sir Leslie Thiess Drive.

The development does not involve any relocation of the existing Magnetic Island ferry terminal.

Although not strictly correct, the convention adopted in this report is that The Strand and Denham Streets have an east-west orientation and Sir Leslie Thiess Drive has a north-south orientation.

2. THE EXISTING ROAD NETWORK

2.1 Entertainment Drive:

Entertainment Drive provides for one traffic lane in each direction, plus parking lanes.

Its intersection with Sir Leslie Thiess Drive is a priority-controlled T-junction with Entertainment Drive being the minor terminating leg.

A separate right turn lane is provided in Sir Leslie Thiess Drive for traffic turning right into Entertainment Drive.

On a normal day, traffic flows in Entertainment Drive are negligible.

2.2 Sir Leslie Thiess Drive:

Sir Leslie Thiess Drive extends from the Casino to The Strand, terminating at The Strand at a priority-controlled T-junction with traffic flows moving between Sir Leslie Thiess Drive and The Strand (north) having priority: that is, through movements on The Strand at that point face Give-way conditions.

In general, Sir Leslie Thiess Drive is a 4-lane 2-way road, though with an additional lane for right turning vehicles at major access points.

Sir Leslie Thiess Drive is subject to very high traffic demands during major events (principally basketball games) at the Entertainment and Convention Centre. At the conclusion of such events, continuous queues form at the intersection of Flinders Street East and Denham Street and extend back along Flinders Street East, King Street and Sir Leslie Thiess Drive reaching back into the car parks serving the Convention Centre and the Casino. This is primarily due to the inability of the Flinders Street East and Denham Street intersection to cope with the intensive traffic demands experienced at such times.

As part of this investigation, traffic surveys were conducted in Sir Leslie Thiess Drive during the pre-Christmas period 3rd December 2006 to 16th December 2006. Major events, basketball games, were held at the Entertainment Centre during that time, on the evenings of Friday 8th December and Saturday 16th December. Significant findings of the survey were as follows:

(i) On an average (non event) weekday, total traffic flows along Sir Leslie Thiess Drive were 6000 vehicles per day, with peak hour flows of about 400 vehicles per hour in morning peak conditions and about 600 vehicles per hour during evening peak hour conditions;

(ii) On the Friday evening of the observed basketball game, peak northbound traffic flows of 1068 vehicles per hour occurred between 7.00 to 8.00pm and peak southbound traffic flows of 1483 vehicles per hour occurred in the 10.00pm to 11.00pm period;

(iii) Corresponding traffic flows during the observed Saturday basketball game were 994 vehicles per hour northbound and 1474 vehicles per hour southbound; and

(iv) Peak weekend traffic flows, other than associated with basketball games, occurred on Saturday between 7.00pm and 8.00pm, when northbound traffic flows of 362 vehicles per hour were observed and between 3.00pm and 4.00pm on Sunday, when southbound traffic flows of 283 vehicles per hour were observed.

The 4-lane Sir Leslie Thiess Drive carriageway has capacity to handle traffic flows well in excess of those observed outside basketball games: the capacity of a single traffic lane in urban conditions such as those that prevail in Sir Leslie Thiess Drive is about 1200 vehicles per hour, so the 4-lane Sir Leslie Thiess Drive carriageway has a nominal capacity of about 2400 vehicles per hour (one-way) and could accommodate two-way daily flows of up to 40 000 vehicles per day.

Viewed another way, the ability of Sir Leslie Thiess Drive to accommodate the observed peak Entertainment Centre generated traffic flows clearly demonstrates its ability to handle very significant increases in traffic flows under non-peak-event conditions.

2.3 The Strand:

Virtually the whole length of The Strand has recently been reconstructed with a series of traffic calming devices and street beautification measures such as speed humps, zebra crossings and roundabouts. Angle parking spaces have been provided along significant sections of the route: those parking spaces are accessed directly from the through carriageway.

At its southern end, The Strand terminates at Ross Creek, about 70m east of the Sir Leslie Thiess Drive intersection.

It is a long established feature of The Strand that it operates one-way in an eastbound direction between King and Wickham Street. As a result, traffic in Sir Leslie Thiess Drive which wishes to travel in a westerly direction along The Strand must travel via King Street, Flinders Street East and Wickham Street before rejoining The Strand to the west. It is understood the intention of this scheme when it was implemented was to minimise usage of The Strand by traffic from the area served by Sir Leslie Thiess Drive.

2.4 Flinders Street East:

Significant traffic calming measures have recently been introduced into Flinders Street East in order to increase its "pedestrian friendliness". These measures include new zebra crossings and speed humps which reduce traffic operating speeds and transfer priority from motor vehicles to pedestrians.

Apart from the congestion outlined above in relation to major events at the Entertainment Centre, the existing road system in the vicinity of the site is relatively lightly trafficked, particularly taking into account its proximity to the Townsville Central Business District. The only significant exception to this is the intersection of Flinders Street East with Denham Street, which has been identified in previous studies as a critical node in the local street network.

As part of this investigation, peak period traffic surveys were conducted at that intersection, the results of which, together with the above traffic surveys in Sir Leslie Thiess drive, provides the existing weekday peak hour traffic flows depicted at Attachment A.

Analysis of the intersection of Flinders Street East and Denham Street under these flows, using the widely accepted Sidra package (Version aaSidra 2.0), indicates it is presently operating at a satisfactory level, as follows:

	Cycle Time	Performance Index / veh	Prop. Stopped	Degree of Saturation	Delay (secs)	Level of Service
Morning Peak:	59	0.030/veh	62%	61%	16.3	B
Evening Peak:	60	0.030/veh	64%	49%	17.4	B

This analysis was undertaken using standard settings. A commercial vehicle content of 3% was assumed for all movements, with a basic saturation flow of 1950 through car units per lane. Traffic signal co-ordination was assumed on the Denham Street approaches.

The meanings of the items in the table are as follow:

Cycle time: The time in seconds for one complete sequence of the traffic signal displays.

Performance Index per Vehicle: A compilation of a number of different performance measures, including travel time, delays, the number of stops each vehicle will experience at the intersection and a measure of queue lengths. The lower the value the better. It is the writer's experience that a value of 0.05 per vehicle and above indicates poor operating conditions, a value less than that indicates the intersection is probably operating in a satisfactory manner.

Proportion Stopped: This is a measure of the proportion of all vehicles entering the intersection which will need to stop at least once.

Degree of Saturation:	The Main Roads' publication "Guidelines for Assessment of Road Impacts of Development Proposals" specifies that the degree of saturation should not exceed the following limits: priority junction: 80% roundabout: 85% signalised intersection: 90%
Delay:	The delay in seconds is the average delay experienced by all vehicles using the intersection in the design period. For signalised intersections, an average delay approaching the cycle length for example would suggest that most vehicles would miss the first "green signal" they observed.
Level of Service:	There are six levels of service, designated from A to F, with Level of Service A representing the best operating condition and Level of Service F the worst. Typically, at Level of Service A, a vehicle arriving at an unsignalised intersection or roundabout would not need to queue behind another vehicle before entering the intersection. Level of Service F at such intersection would mean continuous queues would occur.

2.5 Pedestrian and Cyclist Facilities:

Excellent pedestrian and cyclist pathways exist along the foreshore at The Strand and along Sir Leslie Thiess Drive.

2.6 Administrative Control:

Roads in the vicinity of the site forming part of the state-controlled road system under the control of Main Roads are depicted at Attachment B. Note that the Denham Street - Bundock Street route forms part of that State-controlled road system.

Lennon Drive (being the seaward extension of Ross Street) and Benwell Road (being the seaward extension of Boundary Street) are under the jurisdiction of the Townsville Port Authority.

All other roads in the general vicinity of the site are Council controlled roads.

3. PLANNING OF FUTURE ROAD PROJECTS

A number of traffic studies of relevance to the Townsville Ocean Terminal project have already been undertaken, including:

3.1 The SKM Study: Council commissioned a study of Flinders Street East in relation to the then current proposal to "traffic calm" Flinders Street East taking into account the development potential of the Breakwater Precinct. That study led to the report by SKM entitled "Flinders Street East Traffic Study, January 2003".

Significant findings of that study were:

- the roads in the study area are generally well within their capacity;
- Flinders Street East would be operating very close to its capacity if narrowed to one traffic calmed lane in each direction;
- the Denham Street/Flinders Street East intersection is close to its practical capacity; and
- taking into account the proposed restriction on traffic flows along Flinders Street East, no satisfactory means was identified of accommodating traffic from the proposed Breakwater development without extension of The Strand across Ross Creek (Council's Ross Creek Bridge Scheme).

The new crossing was proposed to connect The Strand (on the northern side of the creek) to Dean Street via McIlwraith Street (on the southern side of the creek).

Works associated with Council's Ross Creek Bridge Scheme included realigning Sir Leslie Thiess Drive and King Street to form a continuous route, and conversion of the currently one-way section of the Strand between King and Wickham Streets to 2-way operation.

3.2 The Horman Report: Subsequent to the SKM study, Council commissioned C & G Horman to undertake a transport and road hierarchy study for South Townsville taking into account:

- Council's Ross Creek Bridge Scheme, involving a 4-lane bridge over Ross Creek connecting The Strand to South Townsville;
- the emerging Breakwater development;
- the proposed Port Eastern Access Corridor; and
- the possible Rocky Springs development.

The subsequent report, dated February 2006, also examined possible intersection options for The Strand, King Street and Sir Leslie Thiess Drive. Similarly to the SKM report, it suggested conversion of the currently one-way section of the Strand between King and Wickham Streets to 2-way operation.

The report does not identify the impact of the Ross Creek Bridge scheme on operation of the Flinders Street East- Denham Street intersection.

3.3 Council's Breakwater Road Network Headworks Policy: On 4th July 2006, Council adopted the Breakwater Road Network Headworks Policy which requires developments (Material Change of Use or Reconfiguring of a Lot development) in the Breakwater Area (as defined in that policy) to contribute to the cost of proposed Ross Creek bridge. That scheme comprises:

- a Ross Creek bascule bridge;
- intersection works in The Strand at King and Wickham Streets;
- realignment of Sir Leslie Thiess Drive; and
- upgrading of McIlwraith Street and its intersection with Dean Street including traffic signals.

3.4 The Eastern Port Access Corridor:

A major new access road to the Port of Townsville from the south is proposed.

Boundary Road presently forms the principal (designated and signed) access road to the port. Notwithstanding the proposed new access road, Boundary Road will always perform an important function in that regard. It must be anticipated that during the whole period of construction of the subject development, Boundary Road will continue its present function of operating as the primary access road to the port.

3.5 The Veitch Lister Study: As part of the investigations of the Townsville Ocean Terminal project, Veitch Lister (a well known and recognised firm of traffic modelling specialists) was commissioned to undertake transport modelling and analysis of the impacts of the project: their report dated August 2007 is at Attachment C.

Existing base year (2005) traffic flows on the road system in the vicinity of the site as modelled in that study are depicted at Figure 5.2 of that report.

Planned major upgradings of the road network are described in Table 2.1 of the Veitch Lister report.

4. OTHER DEVELOPMENTS IN THE AREA

4.1 Residential Development:

The area served by Mariners Drive is intended to be developed with a further 175 apartments and 20 detached houses.

About 26 detached houses are proposed along the northern waters edge of the existing Breakwater Marina.

The area currently used as an informal car parking area east of the Casino is intended to be developed for about 650 apartments and about 1500 sq m of cafe, restaurant, bar, convenience store and boutique shops.

It is understood these developments are all either approved or are Code Assessable.

4.2 The Boat Launching Ramp:

The Townsville City/Port Strategic Plan envisages relocation of the boat launching facilities which presently adjoins Sir Leslie Thiess Drive, immediately downstream of the Magnetic Island ferry terminal, to a new location in South Townsville.

5. RELEVANT TRAFFIC STUDIES AND OBSERVATIONS

5.1 Study of Existing Cruise Ship Terminals

5.1.1 The Brisbane Terminal: The recently constructed Brisbane cruise ship terminal was observed during the berthing of the Oriana at about 8.00am, 19th February 2007. The Oriana carried about 2000 transit passengers with a further 250 having Brisbane as their base port.

About 70 meeters and greeters were present at the site at that time.

When the passengers began to disembark, there were 8 full size coaches on the site and 9 parked external to the site on the adjacent road system. One was a shuttle bus, presumably to ferry passengers into the city.

There were virtually no taxis: the taxi supervisor advised that most cabs were busy elsewhere (eg the airport). There was a maximum queue of about 15 people awaiting cabs.

There was a separate waiting area for limousines (2 were observed on the site).

There were 143 cars parked in the public basement parking area at about 9.00am, not all of which would have been associated with the berthing activity. The car par was resurveyed at 9.30am on Tuesday 25th September 2007 when no ship was berthed at the wharf. A total of 68 vehicles were parked on the site at that time. By deduction, it would appear the ship and ship berthing activities generated a parking demand of 75 parked cars.

5.1.2 The Cairns Terminal: The Cairns cruise ship terminal was observed during the berthing of the Pacific Star at about 9.30am, 23rd January 2007. The Pacific Star carried about 1500 passengers and 600 crew.

The rate at which passengers dis-embarked appeared to be controlled by the gangplank capacity: the observed passenger flow was about 600 persons disembarking in 20 minutes.

There were only 20-30 meeters and greeters.

When the passengers began to disembark, there were 2 full size coaches (53 seat capacity) and 3 20 seaters (ie a total capacity of 170 persons) at the terminal.

An additional full size coach arrived after the first two had left.

There were virtually no taxis.

All the remaining passengers walked off the wharf toward the CBD or downstream toward the reef cruise terminal.

Another "en masse" coach departure from the site was scheduled for 1.30pm.

The Port's Operation Manager advised that in other cases, with more international passengers, there could be up to 10 coaches. At Cairns, there is only space for three coaches to be loaded at any one time, so the others are held in a remote reservoir and called up when required.

5.1.3 Implications for the Breakwater Project:

Road traffic flows associated with cruise ship operations will be minimal and of no consequence in terms of the road network.

It is likely that:

- provision for pedestrian movement to/from the site requires consideration:
- more taxi usage would be expected than at Cairns in view of the greater distance to the Townsville CBD;
- there is minimal parking demand associated with the ship (presumably only a limited number for wharf staff);

- a holding area for coaches is required plus a need to load a number of coaches simultaneously, perhaps five in total.

5.1.4 Relevant Observations: In order that adequate parking facilities are available, it will be necessary to ensure functions at the Cruise Ship terminal, berthing of ships and significant events such as basketball games at the entertainment centre do not co-incide.

5.2 Marinas

Traffic flows on Mariners Drive adjacent to The Strand were surveyed over the 2-week period 3rd December to 16th December 2006. Those surveys indicated peak hour flows as follows:

weekday morning peak:	100 vehicle per hour
weekday afternoon peak:	139 vehicles per hour

By deduction, taking into account the above surveys of the apartments in Mariners Drive, the existing 240 berth marina generates peak hour flows as follows:

weekday morning peak:	70 vehicle per hour
weekday afternoon peak:	120 vehicles per hour

These flows indicate a peak weekday traffic generation rate of 0.5 vehicles per hour per berth.

However, it is understood the berths in the proposed marina will be operated by the management of the existing Breakwater marina, operating from the existing land-based facilities at Mariners Drive. The subject project will contain no specific boat-oriented facilities. That is, traffic flows associated with the proposed marina berths will be minimal.

5.3 Special Events

5.3.1 Existing Parking Demands:

Parking surveys were undertaken in the area on the evening of Saturday 18th November, when the Townsville basketball team was playing at the Entertainment Centre (beginning at 8.00pm), while the basketball game was proceeding . The results were as follow:

Free car park at north-western end of Sir Leslie Thiess Drive cul-de-sac:	511 cars
Casino Car park south-west of Sir Leslie Thiess Drive:	422 cars (basketball patrons not permitted)
Casino "Platinum" parking area (south-east of Casino):	127 cars
Small self-contained car park at Sir Leslie Thiess Dr - Entertainment Dr intersection:	27 cars
Entertainment Centre "sponsors" car park:	107 cars
Entertainment Drive:	22 cars
Boat launching ramp car park ($5.00 fee):	265 cars
Magnetic Island Ferry car park (*):	127 cars
The Pier restaurant carpark:	15 cars
Enterprise House car park (*):	121 cars
Breakwater Road:	105 cars
The Strand and nearby streets:	250-300 cars (estimated)

(*) Not all these vehicles were necessarily associated with the basketball game.

Total basketball-related parked cars using Sir Leslie Thiess Drive for access:	1180 cars
Total basketball-related parked cars not using Sir Leslie Thiess Drive for access:	350-400 cars
Total parked cars using Sir Leslie Thiess Drive for access:	1744 cars
Total basketball-related parked cars:	1530-1580 cars

Note that at the same time, a school formal dance was held at the Casino.

5.3.2 Public Transport

Shuttle buses are operated to serve the Entertainment Centre before and after special events.

They are subject to the same (long) delays as general road traffic due to the absence any bus priority measures.

5.3.3 Traffic Control

It would appear the severe congestion in the area at the conclusion of major events at the Entertainment Centre is due almost entirely to the inability of the traffic signals at the Flinders Street East - Denham Street intersection to handle the peak traffic demands (in Flinders Street East) placed on them at such times. This situation could be significantly improved by use of trained police control in Flinders Street East, and particularly at the Flinders Street East and Denham Street intersection.

Alternatively, a more demand-responsive traffic signal system could be used, which could automatically adjust itself to the unusual traffic demands placed on the intersection at such times.

6. GENERATED TRAFFIC FLOWS

Insofar as the proposed development is concerned, the detached houses and apartments within the proposed development are considered likely to be atypical in terms of generally accepted traffic generation rates and accordingly, separate traffic generation studies of similar forms of development were conducted as part of this investigation.

Apartments: Traffic surveys indicated that the existing 50 apartments/townhouses abutting Sir Leslie Thiess Drive generate 0.58 vehicle trips per hour per unit in morning peak conditions (79/21 directional split) and 0.44 vehicle trips per hour per unit in evening peak conditions (32/68 directional split).

The 71 apartments in the Mariners North development generate 0.44 vehicle trips per hour per unit in morning peak conditions (87/13 directional split) and 0.28 vehicle trips per hour per unit in evening peak conditions (30/70 directional split).

Detached Dwellings: A canal development at Rosebank Way, Hope Island was selected by City Pacific as being representative of the form of development envisaged on the subject land. Surveys of the 262 dwellings at Rosebank Way indicated a daily traffic generation rate of 6.22 vehicles per day per dwelling, with 0.53 vehicle trips per hour per dwelling in morning peak conditions and 0.49 vehicle trips per hour per dwelling in evening peak conditions.

These residential traffic generation rates were adopted for the subject development in the Veitch Lister work.

7. IMPACT OF DEVELOPMENT ON SIR LESLIE THIESS DRIVE

As already outlined, on an average day, during peak conditions, Sir Leslie Thiess Drive carries 600 vehicles per hour (about 50% in each direction).

Developments other than the subject development yet to be constructed which will rely on Sir Leslie Thiess Drive for access will generate about 540 vehicles per hour.

It is assumed the proposed retail facilities will mainly comprise leisure-oriented facilities such as restaurants etc, and that any convenience retail facility would be patronised, at least during commuter peak periods, almost exclusively by persons already residing or staying on the peninsula.

On that basis, the subject development will generate peak period traffic flows, external to the site, as follows:

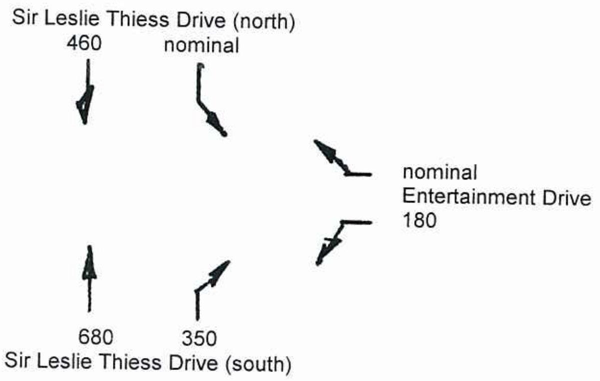
- cruise ship terminal (nominal): 20 vehicles per hour
- 200 detached house lots @ 0.53 vehicles per hour per lot: 106 vehicles per hour
- 500 apartments @ 0.58 vehicles per hour per apartment: 290 vehicles per hour
- 1500 sq m retail floor space lots @ 2 vehicles per hour per 100 sq m: 30 vehicles per hour
- marina berths (nominal): 50 vehicles per hour
- 500 space parking area: 20 vehicles per hour

TOTAL (say): 516 vehicles per hour

Accordingly, on completion of the subject development and other developments in the area, Sir Leslie Thiess Drive will carry peak hour traffic flows of about 1650 vehicles per hour, which corresponds to daily traffic flows of about 17 000 vehicles per day.

Such traffic flows could almost be accommodated in a satisfactory manner by a 2-lane, 2-way road: the four lanes available in Sir Leslie Thiess Drive would be able to accommodate them with ease.

Peak hour traffic flows during the critical evening commuter period at the intersection of Sir Leslie Thiess Drive and Entertainment Drive on completion of the subject development and other developments in the area would be as follows:



Analysis of the existing intersection under these flows, using the widely accepted Sidra package (Version aaSidra 2.0), indicates it would operate at a satisfactory level, as follows:

Performance Index / veh	Prop. Stopped	Degree of Saturation	Delay (secs)	Level of Service
0.013/veh	26%	38%	3.8	A

This analysis was undertaken using standard settings. A commercial vehicle content of 3% was assumed for all movements.

On the basis of the criteria outlined earlier in this report, it can be seen that this level of intersection operation is very good.

8. IMPACT OF DEVELOPMENT ON OVERALL ROAD NETWORK

8.1 The Overall Road Network: The requirements of the Queensland Department of Main Roads in relation to the traffic impact of development proposals are set out in that Department's publication "Guidelines for Assessment of Road Impacts of Development". Section 1.4 (Principle 3) of those guidelines states that Main Roads considers a development's road impacts to be insignificant if the development generates an increase in traffic on State-controlled roads of not more than 5% of existing levels.

Without the Ross Creek bridge, the impact of the Breakwater development (as defined in Section 1 above) on the existing road system will be mainly evident in Flinders Street East, and then primarily at the intersection of Flinders Street East and Denham Street, the intersection identified as the critical network node in the SKM study. Traffic flows on Flinders Street East, and even more so on The Strand, are trivial in a traffic capacity sense both with and without the development.

As part of their investigation, Veitch Lister modelled conditions likely to occur in both 2011 (about the time when dwellings within the subject development will first be occupied) and in 2025 (when the subject development would be completed).

The analysis showed that in 2011, assuming the Ross Creek Bridge was NOT constructed at that time, traffic flows in the critical Flinders Street East -Denham Street area would be as follows:

Street	Without Breakwater (Figure 5.3)	With Breakwater (Figure 5.5)	Increase due to Breakwater
Flinders Street East:	12 705 vpd	13 298 vpd	593 vpd
Denham St west of Flinders Street East:	12 561 vpd	12 780 vpd	219 vpd
Denham St east of Flinders Street East:	19 471 vpd	19 787 vpd	316 vpd

The analysis of 2025 conditions, again assuming the Ross Creek Bridge was NOT constructed at that time, indicated that traffic flows in the critical Flinders Street East -Denham Street area would be as follows:

Street	Without Breakwater (Figure 5.7)	With Breakwater (Figure 5.9)	
Flinders Street East:	14 289 vpd	14 992 vpd	703 vpd
Denham St west of Flinders Street East:	15 668 vpd	16 035 vpd	367 vpd
Denham St east of Flinders Street East:	22 217 vpd	22 756 vpd	539 vpd

It can be seen that in neither case do increases in traffic flows attributable to the development exceed 5% of the background traffic flows which would occur if the Breakwater development did not proceed.

That is, insofar as the critical Flinders Street East - Denham Street intersection is concerned, the traffic flows generated by the development in both 2011 and 2025 will be less than 5% of the 2011 or 2025 background traffic flows and hence, according to the test advocated by the State, will not have a significant traffic impact.

8.2 Relevant Findings of Veitch Lister Study Pertaining to Ross Creek Bridge: Future traffic flows proceed by Veitch Lister on the road system in the vicinity of the site, with and without the proposed development, and with and without the proposed Ross Creek bridge, for 2011 and 2015 are depicted at Figures 5.3 through to 5.10 of that report.

In 2025, the Veitch Lister modelling indicates that the Ross Creek Bridge, if it was in place at that time, would carry 12 784 vehicles per day (see Figure 5.10) , of which 1470 vehicles per day (11.5%) would be attributable to the Breakwater development. This suggests that:

- a 2-lane bridge would be more than adequate (Brisbane's 2-lane Indooroopilly Bridge carries 30 000 vehicles per day); and
- traffic flows associated with the Breakwater development will constitute 11.5% of the total traffic flows on the bridge.

9. CONDITIONS DURING MAJOR EVENTS

Subsequent to completion of the subject development, and other developments in the Breakwater Precinct, parking availability for major events at the Entertainment Centre will be somewhat less than currently exists. This is because of the loss of a large unofficial parking area west of the casino site, and diminution of the car parking area south of the casino. The proposed new 500 space car park north of the casino will not fully compensate for that loss.

In any event, from a residential amenity viewpoint, public kerbside parking will need to be curtailed in the residential culs-de sac forming part of the subject development.

Access to the subject development will be slightly but not unacceptably congested prior to major events, since traffic loadings at such times are not particularly concentrated, but egress from the development immediately subsequent to major events will be subject to severe congestion, as at present.

It may be possible to alleviate the parking situation by allowing entertainment centre parking within the cruise ship terminal area.

10. EMERGENCY ACCESS

The general configuration the subject site, and the existing development in the Breakwater Precinct, was established many years ago when the precinct was first established in law. It is a feature of the precinct that it relies on a single roadway (Sir Leslie Thiess Drive) for access.

This situation already exists, and is perpetuated, by the Casino itself, by the Entertainment Centre, by the Code Assessable development proposed to the north of the casino, and the (presumed) community desire to retain the existing marina.

Within these constraints, provision of alternative access to the overall site in order to provide alternative means of road-based emergency access is not practicable.

Further, it would be unreasonable to accept access only via Sir Leslie Thiess Drive for the casino and entertainment centre (with their combined potential for thousands of public attendees), plus Code Assessable development for hundreds of apartments to the north of the casino, whilst attempting to penalise the subject development on the same grounds.

The possibility of emergency access or evacuation by helicopter, private boat or ferry is considered to be a realistic safety valve in the prevailing circumstances .

11. PROVISION FOR PUBLIC TRANSPORT

The site layout incorporates provision for conventional (full size) passenger buses to access the site and to terminate via a turn-around facility at the northern end of the site.

Although bus priority measures could usefully be implemented at such times, such measures are not reasonably related to the subject development.

12. PROVISION FOR PEDESTRIANS/CYCLISTS

The site layout incorporates provision for pedestrian and cyclist access by the public via a combined bikeway/footpath facility from the existing end of Entertainment Drive to the northern limit of the development.

13. CRUISE SHIP TERMINAL REQUIREMENTS

Based on observation of actual operating conditions at both the Brisbane and Cairns cruise ship terminals, the provisions shown on the plans for bus and car parking, for bus loading, and for service vehicles is capable of being massaged at the detailed design stage to a very workable and satisfactory solution.

14. CODE COMPLIANCE

Compliance of the development with Council's Parking and Access Code (copy at Attachment D) has been assessed as follows:

Specific Outcome SO1:	Adequate on-site parking provisions will be provided in conjunction with all detached dwellings, multiple dwellings, retail areas and the marina. Appropriate provisions will be identified and complied with at the time planning applications for those uses are lodged.
Specific Outcome SO2:	This outcome is capable of being complied with and can be resolved at the appropriate time, probably when development proposals are being assessed for compliance with the BCA..
Specific Outcome SO3:	This outcome is capable of being complied with at the detailed design stage.
Specific Outcome SO4:	This outcome is capable of being complied with at the detailed design stage.
Specific Outcome SO5:	This outcome is capable of being complied with at the detailed design stage.
Specific Outcome SO6:	This outcome is capable of being complied with at the detailed design stage.
Specific Outcome SO7:	This outcome is capable of being complied with at the detailed design stage.
Specific Outcome SO8:	This outcome is capable of being complied with at the detailed design stage.
Specific Outcome SO9:	This outcome is capable of being complied with at the detailed design stage, although a requirement for a bus stop at the proposed retail facilities is considered superfluous, since those facilities, expected to have a recreational and nautical flavour, will almost certainly not be patronised by persons travelling by bus.
Specific Outcome SO10:	This outcome is capable of being complied with at the detailed design stage.
Specific Outcome SO11:	This outcome is capable of being complied with at the detailed design stage.
Specific Outcome SO12:	This outcome is capable of being complied with at the detailed design stage.
Specific Outcome SO13:	This outcome is capable of being complied with at the detailed design stage.
Specific Outcome SO14:	This outcome is capable of being complied with at the detailed design stage.
Specific Outcome SO15:	This outcome is capable of being complied with at the detailed design stage.
Specific Outcome SO16:	This outcome is capable of being complied with at the detailed design stage.
Specific Outcome SO17:	This outcome is capable of being complied with at the detailed design stage.

15. TRAFFIC IMPACT OF CONSTRUCTION TRAFFIC

The Construction methodology is outlined in detail in the overall EIS.

In summary, insofar as traffic impacts are concerned, the building platforms will be constructed from seabed materials in a balanced cut-fill operation, such that little fill material will need to be imported to or exported from the site. However, the platforms will of necessity need to be rock-faced, with the rock being imported. Retaining wall components and road construction materials will also be imported to the site.

The rock will be sourced from quarries at Roseneath or The Pinnacles, or from Marathon quarry.

Access from each of the above quarries to the major road system will be via their existing approved access routes.

15.1 Haul Route Options:

There are four options (with one sub-option) available for the road haulage of quarry-sourced material to the site, as follows:

Option 1: Option 1, the preferred option, involves the construction of a temporary opening bridge at the southern end of The Strand, with the site then accessed via Sir Leslie Thiess Drive and Entertainment Drive. To the south, the temporary bridge will be accessed via Boundary Street, Archer Street and Ross Street. In turn, Boundary Street would be accessed via Abbott Street from the south, or Woolcock Street from the west.

A sub-option available in this scheme is to substitute a barge crossing of the creek for the proposed temporary opening bridge.

Either option has the same characteristics from a traffic viewpoint.

Option 2: Option 2 involves use of Denham Street through the Central Business District, connecting to The Strand via Oxley Street. The site would then be accessed via the eastern end of The Strand and Sir Leslie Thiess Drive.

Significant works would be involved in upgrading Oxley Street in the vicinity of the adjoining school in order that it could be safely and satisfactorily used by construction vehicles.

Details of required intersection upgradings at each end of Oxley Street is considered a matter capable of resolution at the Operational Works stage: there would be a variety of detailed variations both possible and acceptable in that regard.

Cost and amenity considerations rule out this option.

Option 3: Option 3 involves reliance on Warburton and Bundock Streets, connecting to The Strand via Oxley Street.

Again, significant works would be involved in upgrading Oxley Street in the vicinity of the adjoining school in order that it could be safely and satisfactorily used by construction vehicles.

Details of required intersection upgradings at each end of Oxley Street is considered a matter capable of resolution at the Operational Works stage: there would be a variety of detailed variations both possible and acceptable in that regard.

Warburton and Bundock Streets form part of the State-controlled road network under the control of Main Roads, which Department has expressed strong opposition to such a proposal.

Those views rule out this option.

Option 4: Option 4 involves construction of the proposed Southern Port Access Road.

Cost and likely delays in construction of such a route rule out this option.

15.2 Detailed Consideration of Preferred (Temporary Opening Bridge) Option

Traffic flows during the three stages of construction are set out in the EIS. The maximum truck movements will occur during Stage 2 of the work, when trucks will be accessing the site at a rate of up to 7 loads per hour, or 70 loads per day.

All routes to be used by trucks delivering rock or sand to the site are State-controlled roads under the control of The Queensland Department of Main Roads (Main Roads) with the exception of Sir Leslie Thiess Drive, Entertainment Drive, Archer Street and Ross Street. It would be possible to enter into a maintenance agreement regarding the effect of construction traffic on the pavements of each of these roads (while recognising that both Archer Street and Ross Street are already recognised port access roads).

From the south, the temporary creek crossing will be accessed via Boundary Street, South Townsville, which is the recognised port access route.

Discussions with Main Roads officers indicate that in their view, Boundary Street in general is adequate to perform this function, since its riding surface has been recently upgraded in order to reduce concerns regarding both noise and vibration.

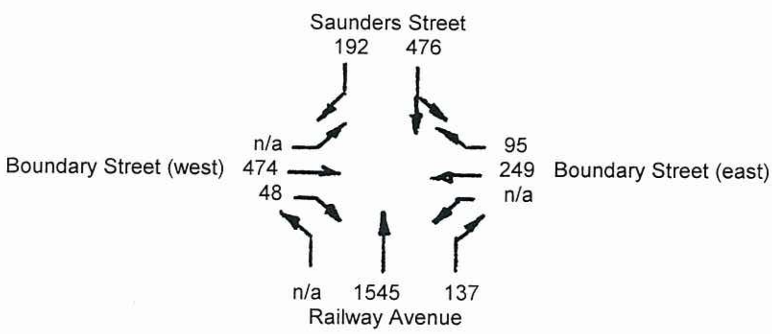
It carries traffic flows of about 5600 vehicles per day: the increase of about 140 vehicles per day associated with the development would represent an increase in total traffic flows of only 2.5%, a negligible increase.

Railway Avenue carries peak flows of about 2400 vehicles per hour and Boundary Street (west of Railway Avenue) carries about 1300 vehicles per hour.

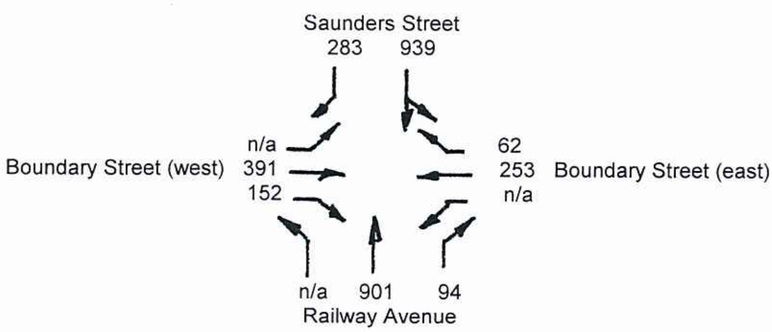
Possible increases in those flows due to the proposed haulage activities would be less than 1% of existing flows, a negligible increase.

According to July 2007 traffic count data suppled by Main Roads, peak hour traffic flows at the intersection of Boundary Street - Railway Avenue - Saunders Street are as follow:

Morning Peak Hour:



Evening Peak Hour:



Taking into account the traffic signal phasing at the intersection, whereby all right turns have their own "right turn green arrow", It can be seen that the controlling critical traffic flows at the intersection are as follow:

Morning peak hour:

- south to north through movement
- north to west right turning movement
- east to north right turning movement
- west to east through movement

Evening peak hour:

- south to north through movement
- north to west right turning movement
- west to south right turning movement
- east to west through movement

Depending on which quarry is utilised, truck movements through this intersection accessing the temporary bridge will be not more than 7 trucks per hour in each direction, in either an east-west direction or a south-east direction.

If in an east-west direction, the increase in movements during the critical peak hour conditions will be less than 3% of current flows, a negligible increase.

If in a south-east direction, left turning movements from east to south will have no impact on intersection operations, taking into account the existing free left turn slip lane available for such turning movements. The south to east right turning movement is not a critical or controlling movement in the overall traffic signal system, hence will have no impact on overall intersection operation. The right turn lane on the southern Railway Avenue approach is 110m long: that length is more than sufficient to accommodate the existing right turning traffic flows which at peak periods are of the order of 140 vehicles per hour. A likely traffic signal cycle time of 120 seconds would result in an average of 4 vehicles per cycle performing that right turn manoeuvre. The existing 100m long lane is more than adequate: in such circumstances, no lengthening of the existing right turn lane is considered necessary or appropriate in connection with the construction of the subject development.

Traffic flows in both Archer Street and Ross Street are currently so low that there is no possible traffic-related issues in that regard.

In view of the prevailing low traffic flows on Sir Leslie Thiess Drive, the introduction of up to 14 trucks per hour in each direction will have a negligible effect on general traffic operations and safety in Sir Leslie Thiess Drive.

B-doubles will be involved in the haulage process. the availability of Archer Street to accommodate B-doubles remains uncertain. Approvals will be required before B-doubles can be directed along Sir Leslie Thiess Drive and Entertainment Drive.

A temporary single lane opening bridge across Ross Creek requires the creation of a holding area on both sides of the bridge within which trucks can store while the bridge is carrying traffic in the opposite direction or while it is open to boats.

It is anticipated that the maximum length of closure of the bridge to either direction of travel will be about 20 minutes. At a flow rate of 10 trucks per hour in each direction, this suggests a queue of up to 4 trucks. A holding area in The Strand capable of accommodating two trucks without queuing on Sir Leslie Thiess Drive or obstructing traffic movements to or from the existing developments abutting The Strand is depicted at Attachment E. This suggests that at times the bridge is about to open to boats, trucks intending to use the temporary bridge should be held within the site and only released when they will have a free passage across the creek.

Queuing on the southern side of the creek is considered not to be an issue: trucks could, in effect, park kerbside in Ross Street awaiting passage across the bridge with no detriment whatsoever to the (low) traffic flows on Ross Street itself.

In conjunction with the temporary opening bridge, from the viewpoint of both safety and minimising delays to loaded trucks, temporary traffic signals should be installed at the intersection of The Strand with Sir Leslie Thiess Drive.

In summary, from a traffic operations viewpoint, and subject to control of trucks departing from the site as outlined, the increases in traffic flows associated with the haulage materials to the site will be negligible.

16. TRAFFIC IMPACT OF BUILDING CONSTRUCTION-ASSOCIATED TRAFFIC

There are no major buildings proposed within the development. Construction traffic associated with the proposed apartment buildings, and the detached dwellings, will be no more significant than traffic flows associated with other Code assessable developments in the immediate vicinity (or elsewhere in the City for that matter).

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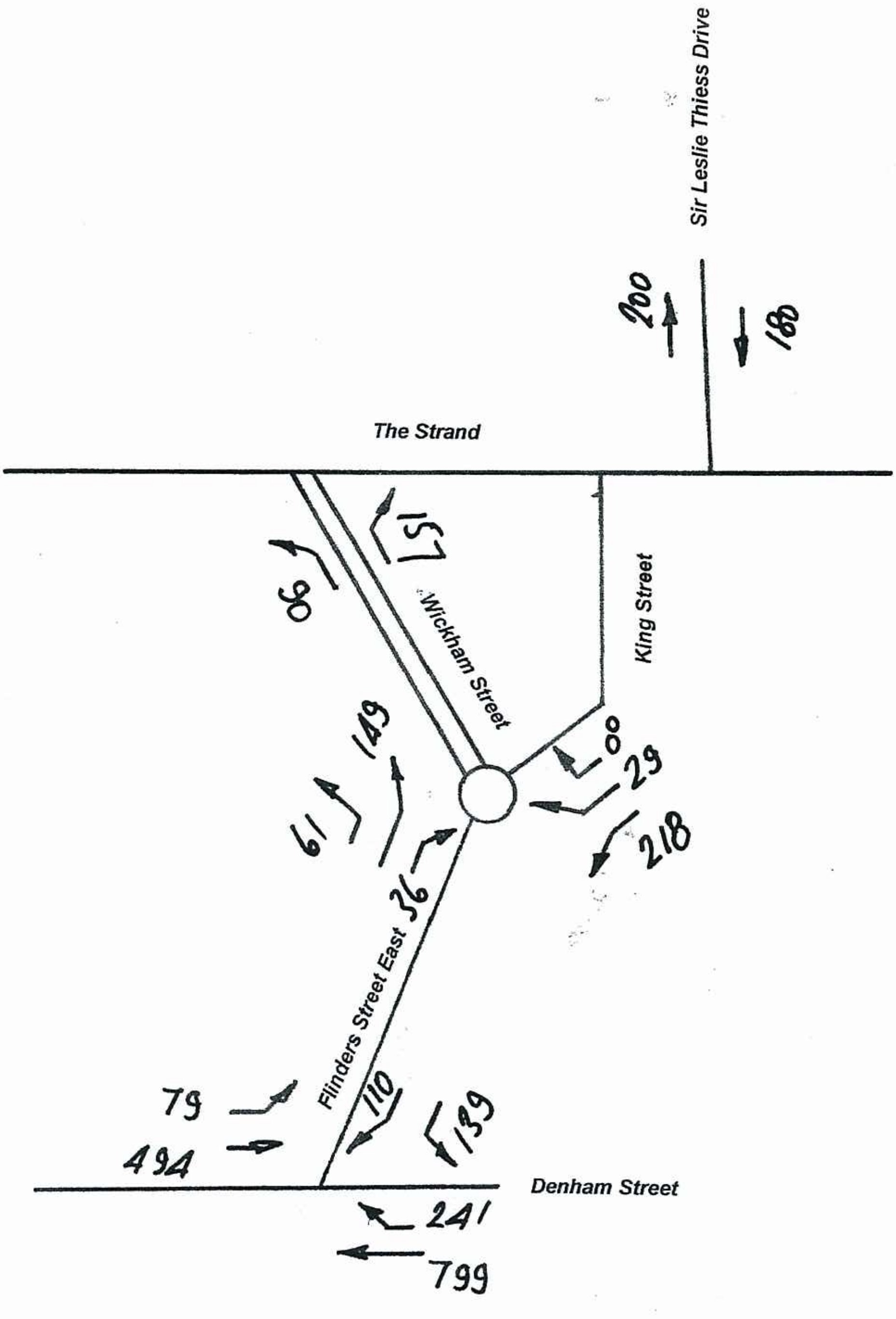
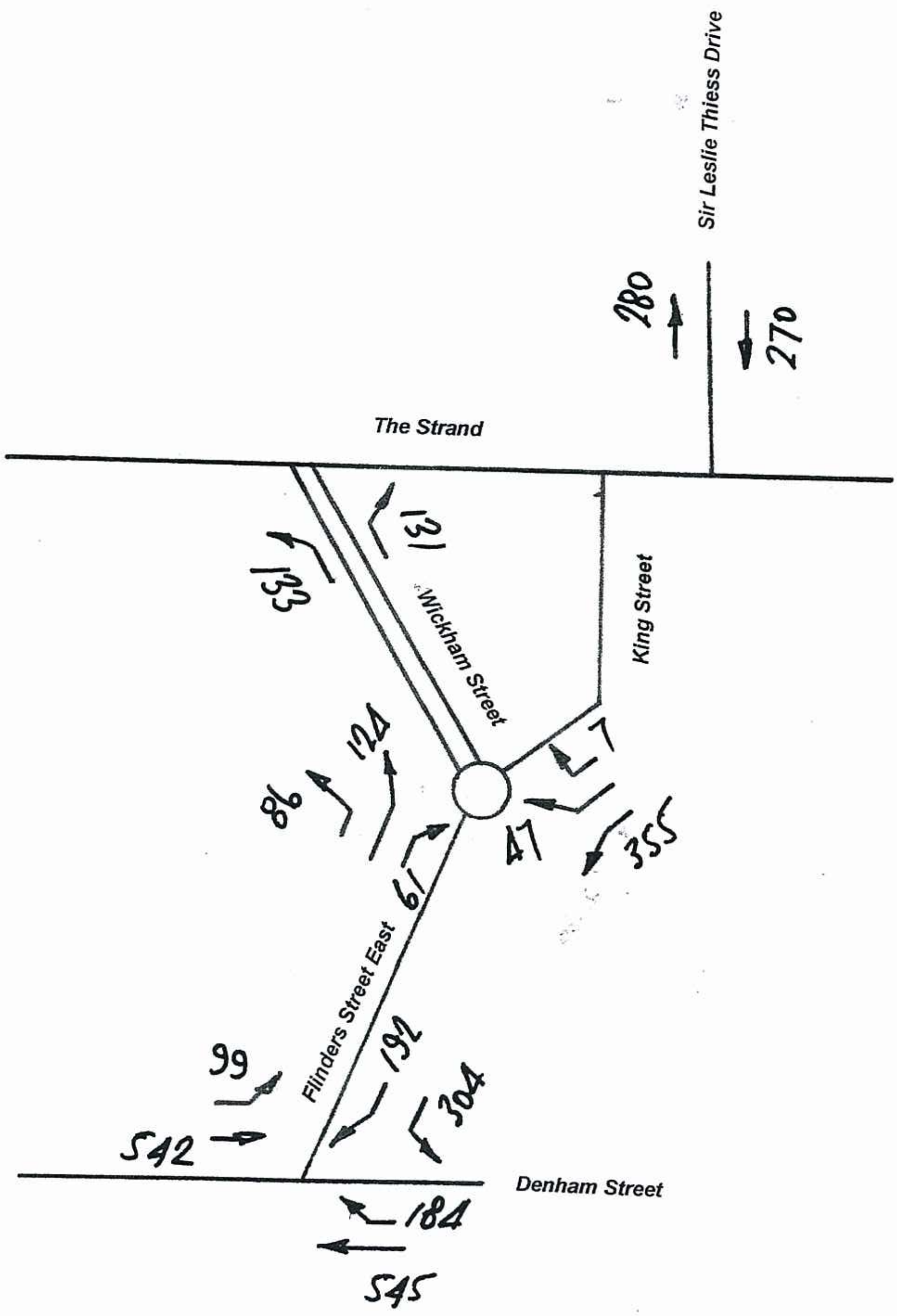
ATTACHMENT A: EXISTING PEAK HOUR TRAFFIC VOLUMES

Morning Peak Hour



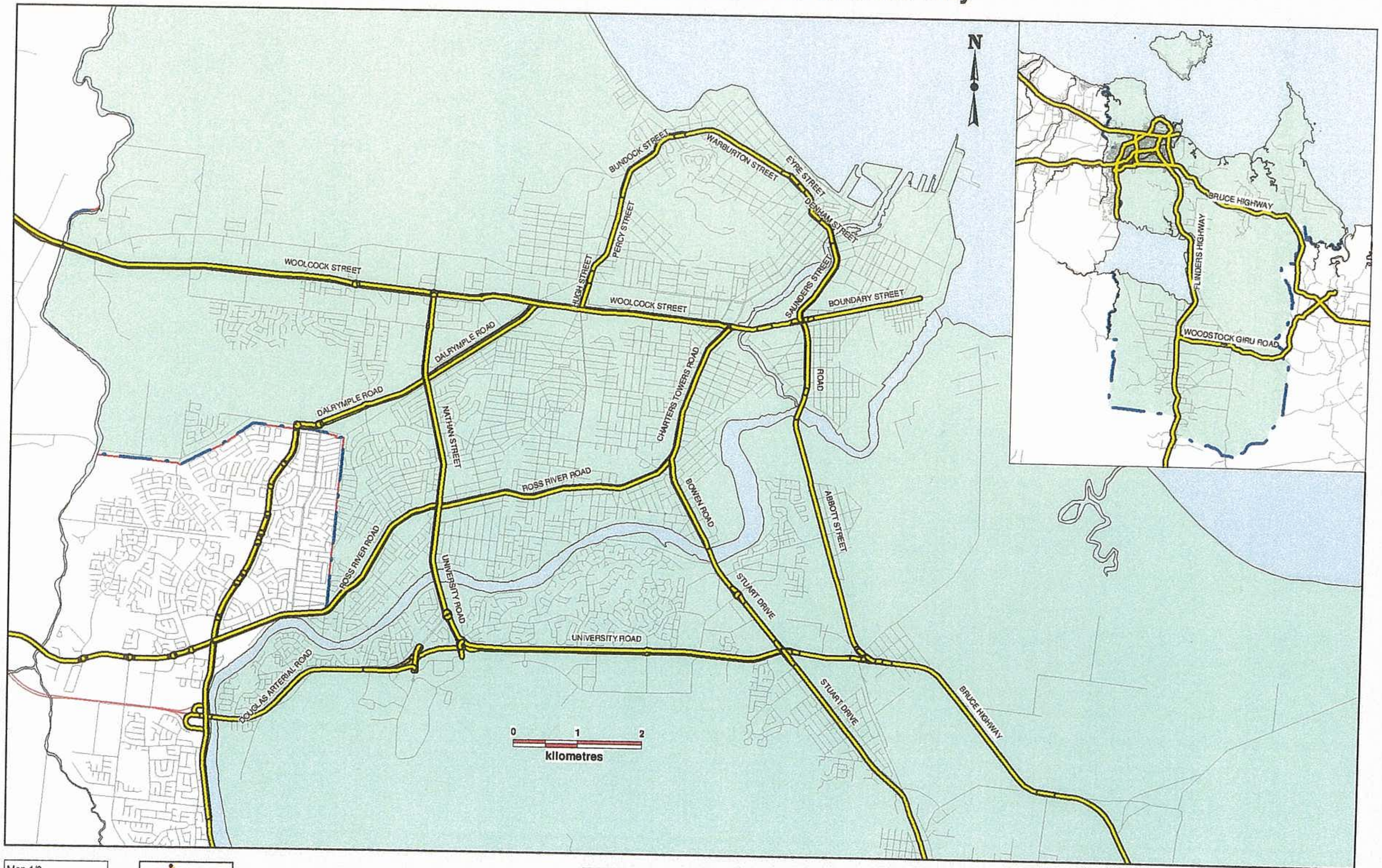
ATTACHMENT A: EXISTING PEAK HOUR TRAFFIC VOLUMES

Evening Peak Hour



ATTACHMENT B: THE RELEVANT STATE-CONTROLLED ROAD SYSTEM

State Controlled Roads within Townsville City



Map 1/8
State controlled Roads within Townsville

Ver 2.0

GDA

LEGEND

- State Controlled Roads
- Ring Road Stages 2 & 3
- Local Roads

Queensland Government
Department of Main Roads
AZA
23/07/2007

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ATTACHMENT C: THE VEITCH LISTER REPORT

August 2007

Draft Final Report

Townsville Ocean Terminal Traffic Modelling

Prepared for
C/- Hyder Consulting
On behalf of
City Pacific Pty Ltd

Veitch Lister Consulting Pty Ltd

Townsville Ocean Terminal

Traffic Modelling Draft Final Report

Project Name	Project No.	Report Name	Date	Version	Completed by
Townsville Ocean Terminal	06-050	Traffic Modelling Draft Final Report	August 2007	V1	MV

Table of Contents

1.0 Introduction

1.1 Background

The Townsville Ocean Terminal Project involves the proposed development of a cruise ship terminal and associated facilities, and an integrated residential waterfront development within the site identified as the 'Future Development Area' in the *Breakwater Island Casino Agreement Act 1984*. City Pacific Limited is undertaking the preparation of an *Environmental Impact Statement* to provide assessment of the potential impacts associated with development of the subject site.

Veitch Lister Consulting (VLC) has been commissioned to undertake transport modelling and analysis of the impacts of the proposed project. This analysis is to include consideration of the need for, and impact of, a proposed Ross Creek Bridge joining the Strand to the South Townsville area.

All the travel forecasting for the project has been undertaken using VLC's Zenith model.

There are essentially three key issues that this report attempts to address. They are as follows:

1. To what extent will traffic growth occur in Townsville for two planning horizons (2011 and 2021) - without the proposed Breakwater Development?

2. For each of the two planning horizons (2011 and 2021), how much additional traffic will occur as a result of the Breakwater Development proceeding as proposed?

3. For each of the two planning horizons (2011 and 2021), and the two development scenarios (i.e. with and without the Breakwater Development) how will traffic redistribute should a new bridge be built over Ross Creek connecting The Strand with South Townsville.

The adoption of this structured approach to land use/transport scenario testing should result in the clear enunciation of the traffic impacts of proceeding with the Breakwater Development.

The initial chapters of this report describe the transport modelling platform that has been used to produce travel forecasts for this investigation (the Zenith model) - how it was established and calibrated for a 2005 base year, and the land use and transport network assumptions that have enabled travel forecasts to be produced for the Townsville/Thuringowa Region for 2011 and 2025.

The latter chapters of the report present the traffic forecasts for several future land use/transport scenarios that have been tested during this investigation. These scenarios are primarily aimed at clearly identifying the contribution that the subject development will make toward traffic demands, and road investment needs, in its vicinity and more broadly across inner-Townsville.

1.2 Structure of the Report

The balance of the report is presented in the following format:

- **Section 2:** Model Establishment
- **Section 3:** Model Validation
- **Section 4:** Options Analysed
- **Section 5:** Evaluation of Model Runs
- **Section 6:** Summary of Study Results

Supporting material is included in the report as Appendices as described in the body of the text.

2.0 Model Establishment

2.1 The Zenith Modelling Framework

The travel demand forecasts used in this investigation have been produced by VLC's proprietary travel forecasting model (Zenith), operating within the OmniTRANS modelling platform.

The first version of the Zenith model that focused on the Townsville/Thuringowa Region was developed some 10 years ago by VLC for the *Townsville Port Access Study*. This model was purely a traffic model, in the sense that it outputs were simply average weekday car and commercial vehicle traffic flow forecasts.

More recently the range of capabilities of the Townsville/Thuringowa version of the Zenith model have been expanded to include forecasts of public transport usage and walking/cycling demands, as well as how travel demands vary across the day (i.e. peak versus off-peak travel). It is this later multi-modal travel forecasting model that has been used to assess the traffic impact of the Breakwater development.

The Zenith model is an established and mature product. The geographical footprint of the model encompasses 22 local authorities across a significant portion of the Far North Queensland (FNQ) region. The modelled area extends from Johnstone Shire in the north, to Flinders Shire in the west, and Nebo and Aramac Shires in the south.

For the purposes of this study, detailed modelling and assessment has focussed on Townsville and Thuringowa. The entire modelled area is shown in **Figure 2.1** with the primary area of interest to this study highlighted in **Figure 2.2**.

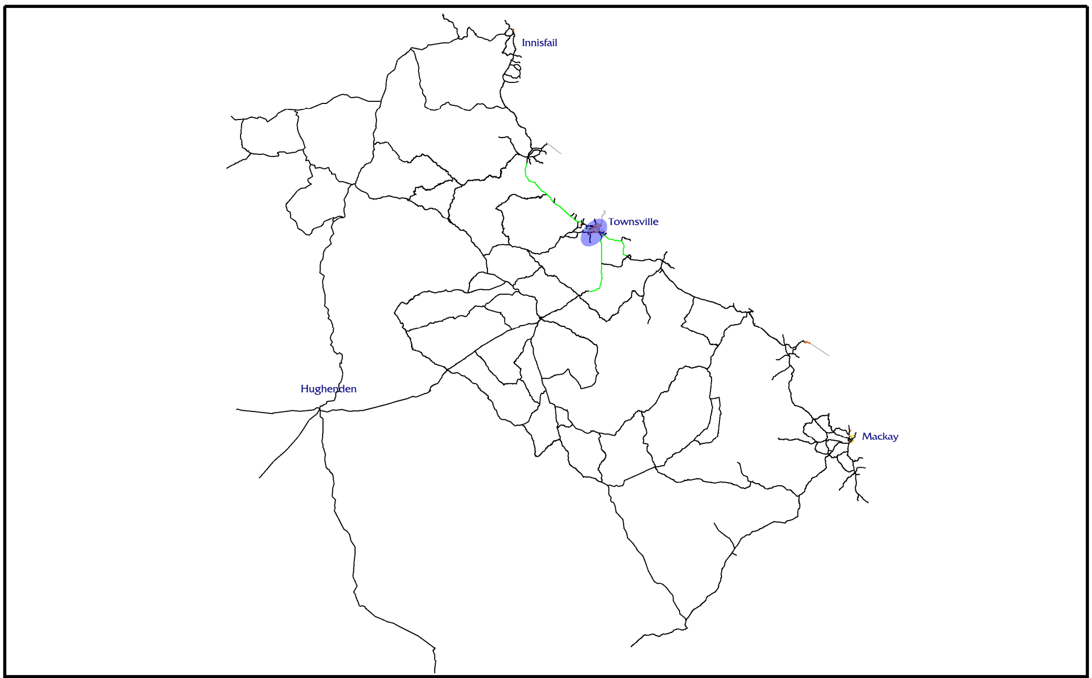
Zenith is a truly multi-modal model. It forecasts travel demands for all transport modes - car travel, bus, train, tram and ferry passenger demands, as well as walking and cycling - for a given land use scenario and transport network. It also predicts the level of commercial vehicle activity across the region.

Zenith is a network simulation model that includes all freeways, arterial roads and collector roads, and all public transport routes and services that operate within the modelled area.

Travel demands are separately forecast for 15 journey purposes. For example, commuting to work, shopping and personal business trips, travel to and from education institutions, picking up or dropping off a passenger, etc. These travel demands are estimated based on the socio-economic profiles of households in specific areas (travel zones), and the distribution and scale of major trip attractors such as commercial employment areas, shopping centres, industrial areas, schools, universities, hospitals, etc.

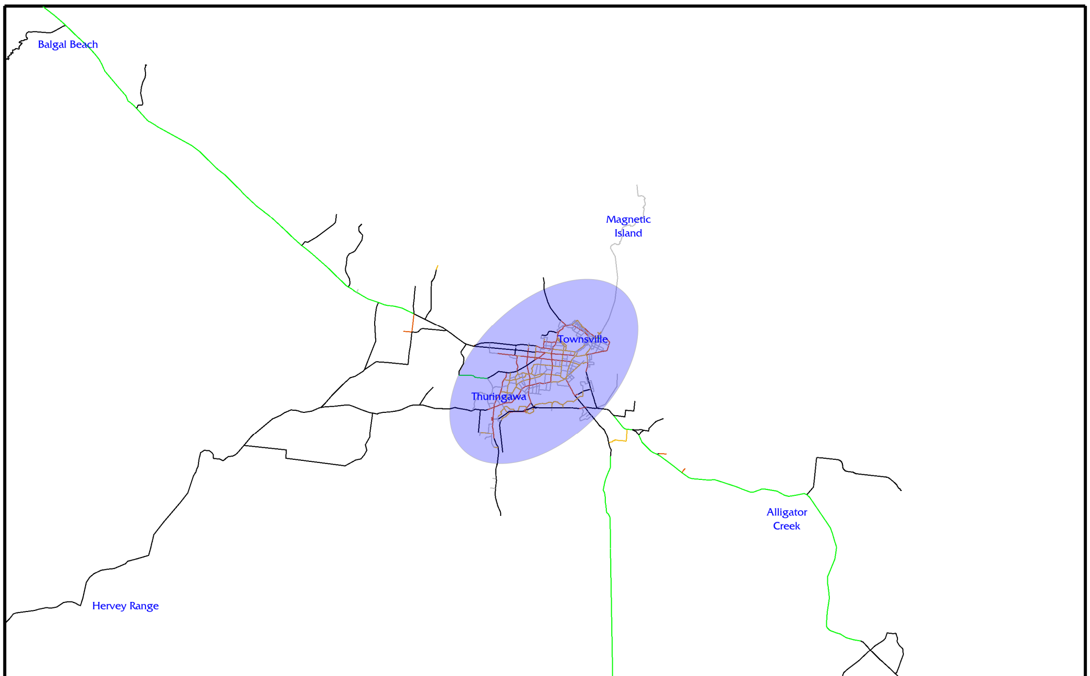
If the specification of either the transport system or the land use input to the model is changed then the travel forecasts will also change. Consequently the model can be used to test a wide array of alternative land use/transport scenarios for a region, including urban growth and development scenarios looking many years into the future.

Figure 2.1: Full Extent of the Zenith Modelled Area



Full Modelled Area

Figure 2.2: Primary Area of Interest (blue shaded area)



Townsville Study Area

For a given land use/transport scenario the model produces traffic estimates by time of day for every road in the modelled network, the number of passengers boarding and alighting at every public transport stop and train station, as well as pedestrian/cycle flows across the transport network.

The model also produces a number of transport network performance indicators that are useful when comparing the economic performance of alternative land use/transport scenarios. These include:

- average trip distance (by mode);
- average trip time (by mode);
- market share (by mode);
- average network speed;
- total travel distance (by mode);
- total travel time (by mode);
- value of time spent travelling (by mode);
- total vehicle operating cost (by mode);
- public transport revenue (by mode);
- crash costs; and
- pollutant emissions.

A more detailed description of the Zenith model is provided in **Appendix A.**

The model is well established in the Townsville/Thuringowa region, having been previously used for traffic assessments for the *Townsville Port Access Study* for the State Government. It has also been used for a Main Roads Department assessment of the traffic implications of major future development at Rocky Springs.

Further customisation to the specific needs of this project have been undertaken. Such customisation extends to:

- refinement/disaggregation of the travel zoning system in Townsville and Thuringowa;
- refinement of the road network descriptions in terms of road link capacities and free-flow speeds (both existing network and future networks);
- confirmation of future public transport network assumptions;
- updating the background land-use assumptions to the adopted base year (2005) with adjustment of pre-existing land-use forecasts (to 2025); and
- the production of interim year (2011) land use forecasts..

The approach adopted to address to the above is the subject of the balance of this section of the report.

2.2 The Adopted Travel Zone System

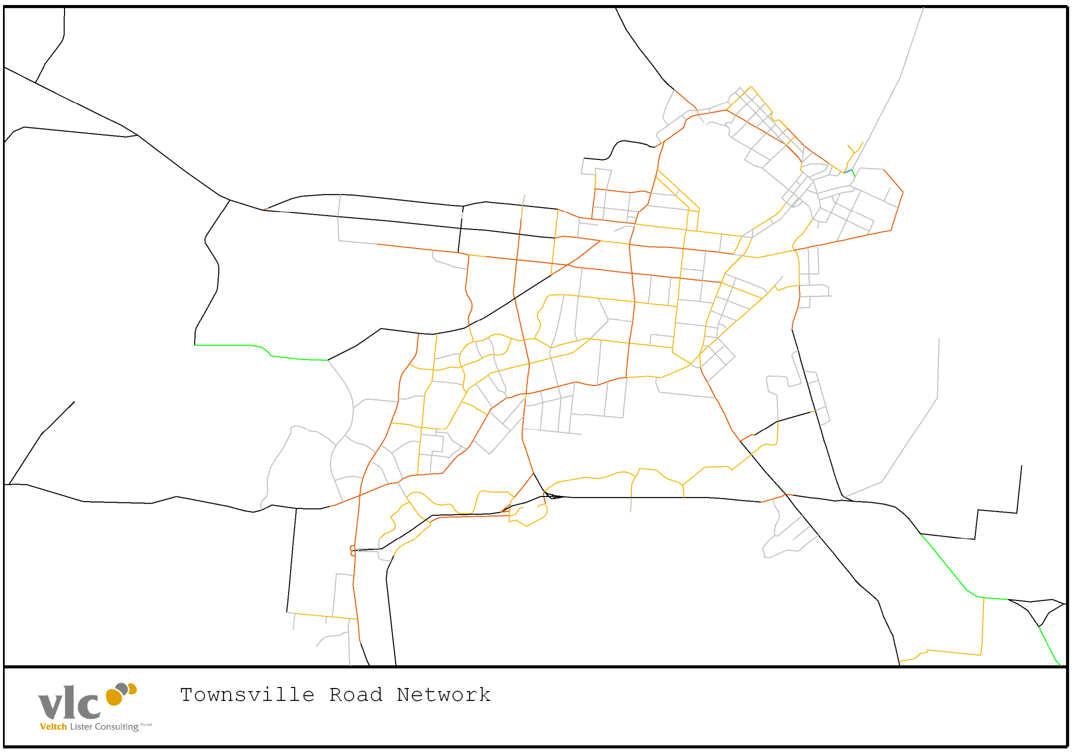
The travel zone system adopted is highly disaggregated within the study area. The standard Zenith zoning system has been split to 2001 census collector district (CCD) level within the broad modelled area, and to sub-CCD level in some developed urban areas (such as the Townsville CBD).

To support the disaggregated zoning system, significant refinement of the local arterial road and street network was also required. The base year (2005) Zenith road network includes all major arterial road, sub-arterial roads and collector level roads within and beyond the immediate study area. The network was also further refined to include critical sub-collector roads and those roads which attract “rat-running”.

The base year road network was also updated in Townsville and Thuringowa, in terms of road capacities and free-flow speeds, following extensive field surveys.

The finally adopted base year transport infrastructure network is presented in **Figure 2.3**.

Figure 2.3: Level of Detail in Base Year Transport Network



2.3 Future Road Network Assumptions

Information as to how the road network in Townsville and Thuringowa is likely to develop in the future was sought from both Councils and Main Roads. VLC also took cognisance was also taken of transport network improvements outlined in the *Townsville Thuringowa Integrated Regional Transport Plan*. Such information is required so that realistic future base case (2011 and 2025) transport networks can be computer coded, against which the impacts of alternative land use/transport scenarios can be gauged.

Table 2.1 below lists the assumed road upgrades for the future base case road networks.

Table 2.1: Assumed Future Year Road Network Upgrades

By 2011
▪ Added Burdell infrastructure ▪ Ring Road connected to Shaws Road ▪ Cross Street upgraded to 4 lanes ▪ Ingham Road, Kings Road to Hugh Street, upgraded to 3 lanes ▪ Mervyn Crossman Drive, Stuart Drive to Murray Lyons Crescent, upgraded to 4 lanes ▪ Mathers Street, Bayswater to Ingham, upgraded to 4 lanes ▪ Hervey Range Road upgraded to 4 lanes, Kern Brothers Drive to Lynam Road ▪ North Ward Road (Hugh, Percy, Bundock, Warburton) upgraded to 4 lanes
2011 to 2025
▪ Ring Road to Bruce Highway - Realignment of Bruce Highway/Ring Road intersection ▪ Weston Street, upgraded to 4 lanes ▪ Greg Jabs Court, Bayswater to Dalrymple, new 2 Lane road ▪ Abbott Street realignment ▪ Fairfield Waters Drive, Stuart Drive to Oonoonba Road ▪ Gulliver Street upgraded to 5 lanes ▪ Walker Street, upgraded to 4 lanes ▪ Oxley Street, Eyre Street, Denham Street - realignment for new roundabout. ▪ Fryer Street, connection to Denham Street closed ▪ McIlwraith Street, upgraded to 4 lanes ▪ Stuart Bypass ▪ Eastern Access Corridor, including a new Ross River Bridge

l

The Ross Creek Bridge project, currently under consideration by Townsville City Council and Main Roads, is a major issue to be addressed in the context of the planned Breakwater Development, and other developments in its vicinity. This project has not been included in either of the two future base networks, but is included in subsequent scenario testing. The scenarios tested by VLC using the Zenith model have included land use/transport scenarios both with and without the Ross Creek Bridge, and with and without the Breakwater development.

2.4 Public Transport System Assumptions

Zenith is a multi-modal model. It is therefore necessary to define likely future base case public transport networks, particularly in instances where public transport initiatives may impact road traffic demand.

VLC has taken a conservative view with respect to the degree to which the public transport system in the modelled area will develop in the future. It has simply been assumed that the existing public transport system will be maintained in the future, and that one additional bus service will be added to the 2011 and 2025 future base case networks running from the Townsville CBD to the Breakwater precinct.

Should the State Government invest heavily in the future in improving the public transport system in the Townsville/Thuringowa Region by expanding route coverage, increasing service frequencies, and extending the hours of operation of bus services, then the traffic forecasts presented in this report are likely to be slightly over-estimated.

2.5 Demographics and Land Use for 2005 Base Case

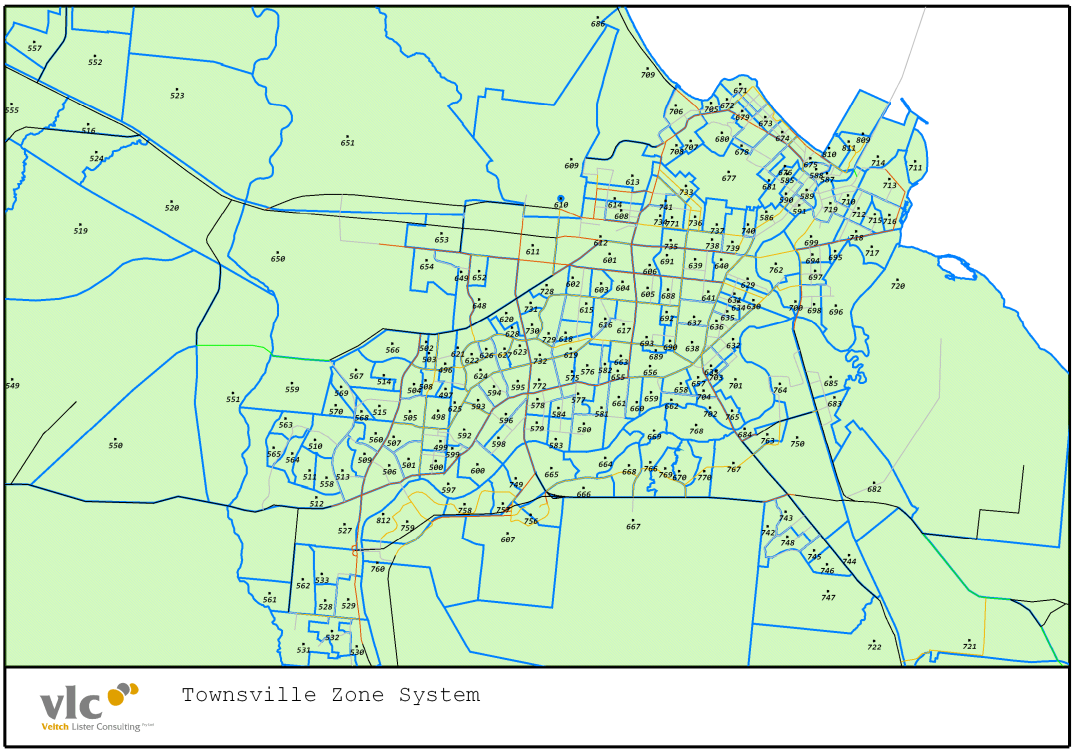
The travel zone system adopted for the updated Zenith model is based on 2001 Census Collector Districts (refer to **Figure 2.4**).

Socio-economic profiles of the population in each travel zone were extracted from the ABS 2001 Census. The population and households in each travel zone were then updated to 2005 using more up-to-date information provided by the Townsville and Thuringowa City Councils.

This information was supplemented by a detailed review of existing residential and commercial development with Council staff, an analysis of recent development approvals, an extensive field survey (including discussions with sales representatives at key residential developments reviewing take up rates), and detailed research into the growth and establishment of educational facilities throughout the two Council areas.

It was considered that an in depth appreciation of recent development trends would provide a more sound basis for reviewing the robustness of future development projections.

Figure 2.4: The Travel Zone System in the Primary Study Area



2.6 Future Population and Employment Projections (2011 and 2025)

This task is invariably problematical but crucial to the modelling task.

Prior to this consulting commission VLC had developed land use/demographic projections for the model footprint (Figure 2.1) at a travel zone level for 2011, 2021 and 2031. These projections were initially developed for the *Townsville Port Access Study,* and subsequently updated for Main Roads road planning investigations associated with Rocky Springs.

For the purpose of this study, future year demographic forecasts were required for 2011 and 2025.

The latest ABS population projections for these two years were taken as the primary basis for deriving updated land use projections across the modelled area. However the abovementioned discussions with the planning staff of the two Councils also focussed on identification of key future development areas, which included Rocky Springs, Bushland Beach, the future intention for development in the Port area, and the Breakwater/Casino area.

A detailed assessment was made of the likely population and employment growth in all travel zones, and has been inclusive of the advent of these major developments.

The assumed Base Year and Future Year population and employment figures are shown in **Table 2.3** by SLA for the two Council areas. By 2025 the populations of the Cities of Townsville and Thuringowa are expected to increase by 25.9% and 62.1% respectively relative to the 2005 base year (or 38.9 percent combined). SLA boundaries within the key area of interest are shown in **Figure 2.5**.

Future year model runs have been undertaken to evaluate traffic scenarios with and without the Breakwater development. Table 2.2 below details the population and employment assumptions used for the development of the Breakwater Precinct.

Table 2.2: Projected Breakwater Development Population and Employment

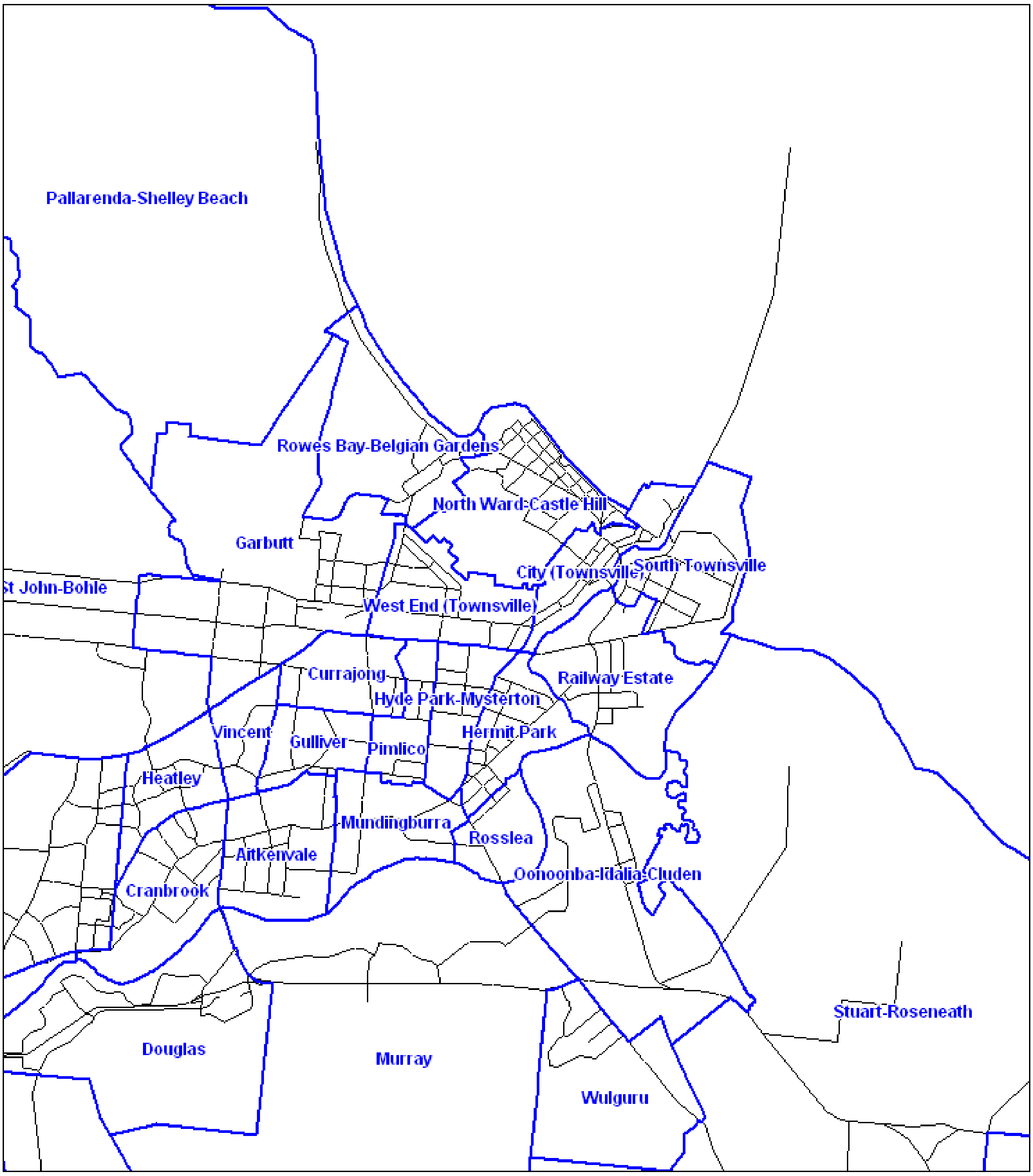
Population		Dwellings		Employment	
2011	**2025**	**2011**	**2025**	**2011**	**2025**
563	1,216	310	664	130	664

Table 2.3: Population and Employment Projections by LGA and SLA

LGA	SLA	Pop 2005	Emp 2005	Pop 2011	Emp 2011	Pop 2025	Emp 2025
Thuringowa (C)	Kelso	8294	360	9750	840	11936	1691
	Kirwan	22747	4274	26045	5234	27397	6450
	Thuringowa (C) - Pt A Bal	18853	1539	27712	2691	45069	6780
	Thuringowa (C) - Pt B	7736	1260	8572	1503	9017	1740
	TOTAL	**57630**	**7432**	**72079**	**10268**	**93419**	**16661**
Townsville (C)	Aitkenvale	5015	3049	5108	3058	5135	3069
	City *	2871	13423	4071	13972	4942	14155
	Cranbrook	6433	1078	6552	1090	6586	1102
	Currajong	2996	1624	3145	2211	3255	2247
	Douglas	6038	3108	6771	3356	7496	3530
	Garbutt	2580	5587	2628	5592	2642	5598
	Gulliver	3070	346	3127	352	3143	357
	Heatley	4403	394	4485	402	4508	409
	Hermit Park	3438	1383	3502	1389	3520	1397
	Hyde Park-Mysterton	2360	1261	2404	1100	2416	1105
	Magnetic Island	3457	550	4024	773	5554	1409
	Mt Louisa-Mt St John-Bohle	5268	2439	6470	2549	6963	2645
	Mundingburra	4051	864	4126	871	4148	879
	Murray	10622	3688	10819	3704	10875	3723
	North Ward-Castle Hill	6802	2515	7246	2665	8151	3029
	Oonoonba-Idalia-Cluden	3261	548	5009	1075	5634	1543
	Pallarenda-Shelley Beach	1027	111	1046	113	1051	115
	Pimlico	2632	1635	2715	1229	2763	1249
	Railway Estate	2782	418	2834	423	2848	429
	Rosslea	2130	239	2170	242	2181	246
	Rowes Bay-Belgian Gardens	2555	623	2602	627	2616	633
	South Townsville	2665	2354	3241	2659	3921	2952
	Stuart-Roseneath	1223	1105	1246	1106	1252	1307
	Vincent	2603	386	2651	390	2665	394
	West End (Townsville)	3910	1997	3983	2004	4003	2016
	Wulguru	5250	374	5487	444	5656	507
	Townsville (C) - Pt B	3585	714	4488	951	15798	5254
	TOTAL	**103027**	**51811**	**111949**	**54350**	**129723**	**61299**

* Townsville City SLA includes development of the Breakwater Precinct

Figure 2.5: SLA Boundaries in the Primary Study Area



3.0 Model Validation

3.1 Model Validation Procedure

A database of recent weekday traffic counts was established for the purposes of validating the base year (2005) Zenith model. The database contains 170 one-way counts supplied by the Main Roads Department and Townsville City Council. The locations of the counts within the primary area of investigation are shown in **Figure 3.1**.

The process of validating the model involved running the 2005 Zenith model, comparing the model's 2005 traffic estimates with the counts, and then examining in detail the specification of the model where major discrepancies were found.

Where major discrepancies were found, the reason for the discrepancy was mainly attributable to one of the following:

1. A "rogue" traffic count - i.e. a particular count is not plausible given the scale of other counts in its vicinity. In some cases this can occur when the traffic counted using a section of road is affected by road works or a major traffic accident. In such instances the "rogue" count was removed from the model validation database.

2. An inappropriate *zone centroid connector* location - i.e. the point in the modelled road network where traffic is allowed to enter and leave a specific traffic zone during traffic assignment of traffic to the road network has been inappropriately specified. Re-specification of the *zone centroid connector* is all that is required to fix up this problem.

3. The model is over-estimating traffic on a section of the road network because a competing lower order road has not been included in the simulation network. This is overcome by adding the competing road to the simulation network which spreads the traffic load.

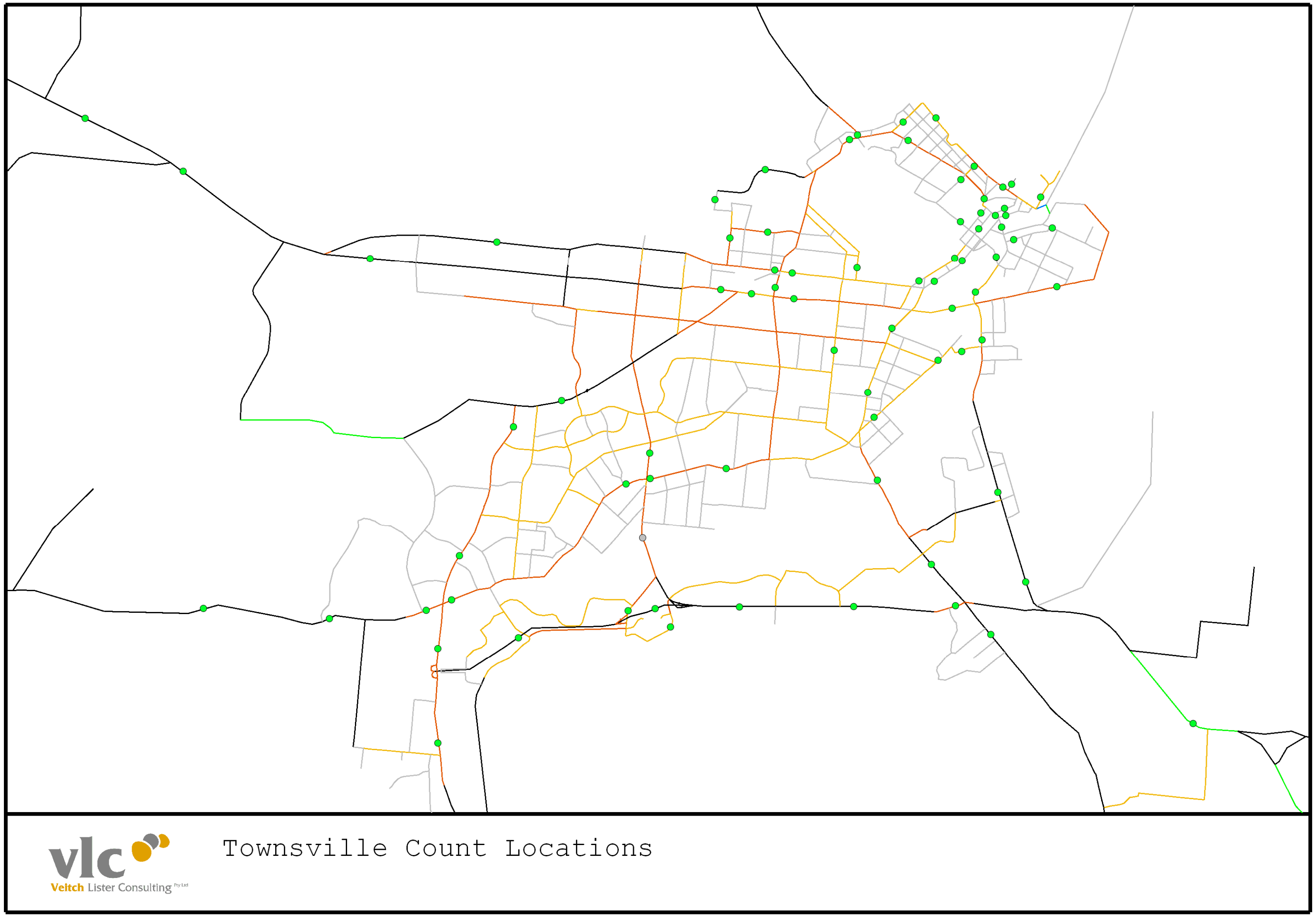
4. The free-flow speed of a section of road has been incorrectly specified (either too high or too low).

5. The traffic carrying capacity of a section of road has been incorrectly specified (either too high or too low).

6. A major *trip attractor* has been omitted (or under-estimated) when deriving the zone to zone traffic matrices prior to traffic assignment.

An example of where the latter occurred relates to recreational and leisure visitations to The Strand. In the initial Zenith model runs it was observed that the model's estimates of traffic using the Strand were being significantly under-estimated. So to were to roads immediately feeding to The Strand (eg. Howitt Street and Gregory Street), as well as broader approach routes (i.e. Bundock Street from the north-west and Eyre Street/Oxley Street from the south).

Figure 3.1: Traffic Count Locations for Model Validation

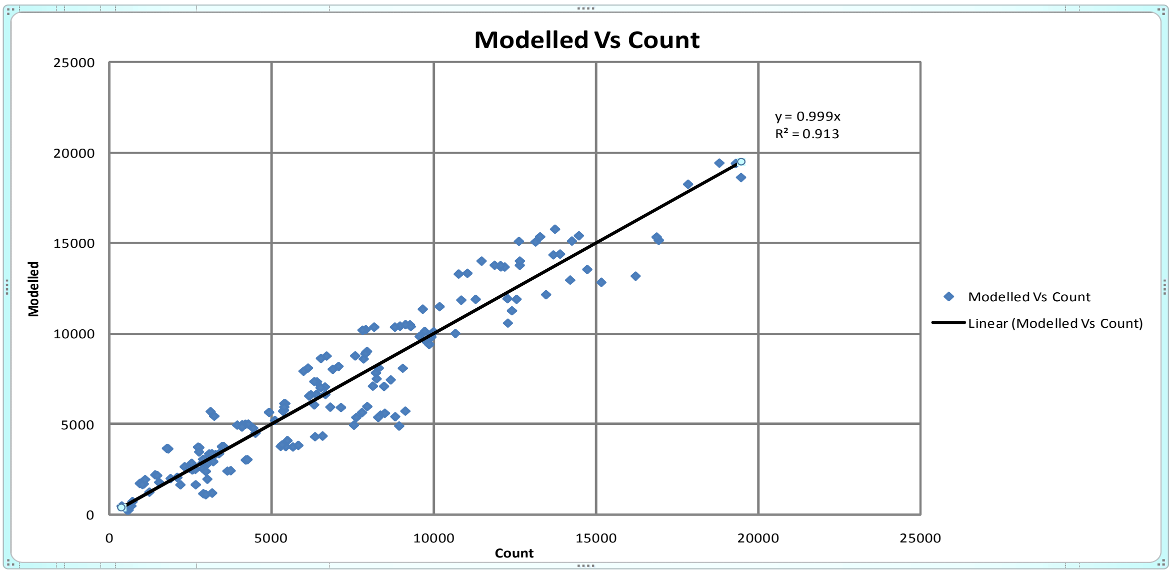


Correction of this traffic under-estimation required that special travel zones be added to the model along The Strand at the major recreation and leisure attractors (eg. The Museum, surf life saving clubs, the public baths, etc.).

3.2 The Model Validation Outcome

Figure 3.2 provides a scatter-plot of modelled 2005 traffic volumes against 170 recent traffic counts supplied by Main Roads and Townsville City Council.. Also shown in the diagram is an R-squared regression line of best fit.

Figure 3.2: Modelled Traffic Volumes versus Traffic Counts (24 hour weekday)



It is immediately apparent from the above figure that there is a close correspondence between the modelled traffic flows on individual roads and the traffic counts in the model validation database. An *R-squared correlation coefficient* of 0.913 has been achieved. This is a good result - an R-squared value in excess of 0.8 is usually regarded as acceptable.

More detail of modelled versus count data for individual road links is presented in tabular form in Appendix B.

Based on the above VLC considers the updated Zenith model to be fit for purpose.

4.0 Scenarios Analysed

A total of 9 Zenith model runs have been performed as part of this commission. The model runs have been undertaken in a structured was so that the extent to which traffic will grow in the future in Townsville under two base case scenarios (i.e. without the Breakwater Development and without a new bridge crossing of Ross Creek for 2011 and 2021) can be gauged, as well as the impacts of the Breakwater Development itself and the proposed bridge.

Table 4.1 summarises the full extent of the model runs undertaken.

Table 4.1: Model Runs Undertaken[1]

Year	Base Case	Without Breakwater	With Breakwater	Without Ross Creek Bridge	With Ross Creek Bridge
Base 2005 (validation) Run 1	X				
2011					
Run 2	X	X		X	
Run 3		X			X
Run 4			X	X	
Run 5			X		X
2026					
Run 6	X	X		X	
Run 7		X			X
Run 8			X	X	
Run 9			X		X

5.0 Assessment of Model Outputs

5.1 Predicted Traffic Growth on the CBD Cordon (2011 and 2025)

Traffic volume plots for the *primary study area* have been prepared for each of the model runs previously listed in **Table 4.1.** The plots are presented in the next sub-section of the report (Section 5.2) in **Figures 5.2 through 5.10**.

In order to gauge the degree to which traffic is predicted to grow in the key central region of Townsville, a table has been prepared that summarises, for each modelled scenario, the traffic demands on a CBD cordon as defined in **Figure 5.1**. The predicted CBD cordon demands are presented in **Table 5.1**.

Figure 5.1: CBD Cordon Crossing Points

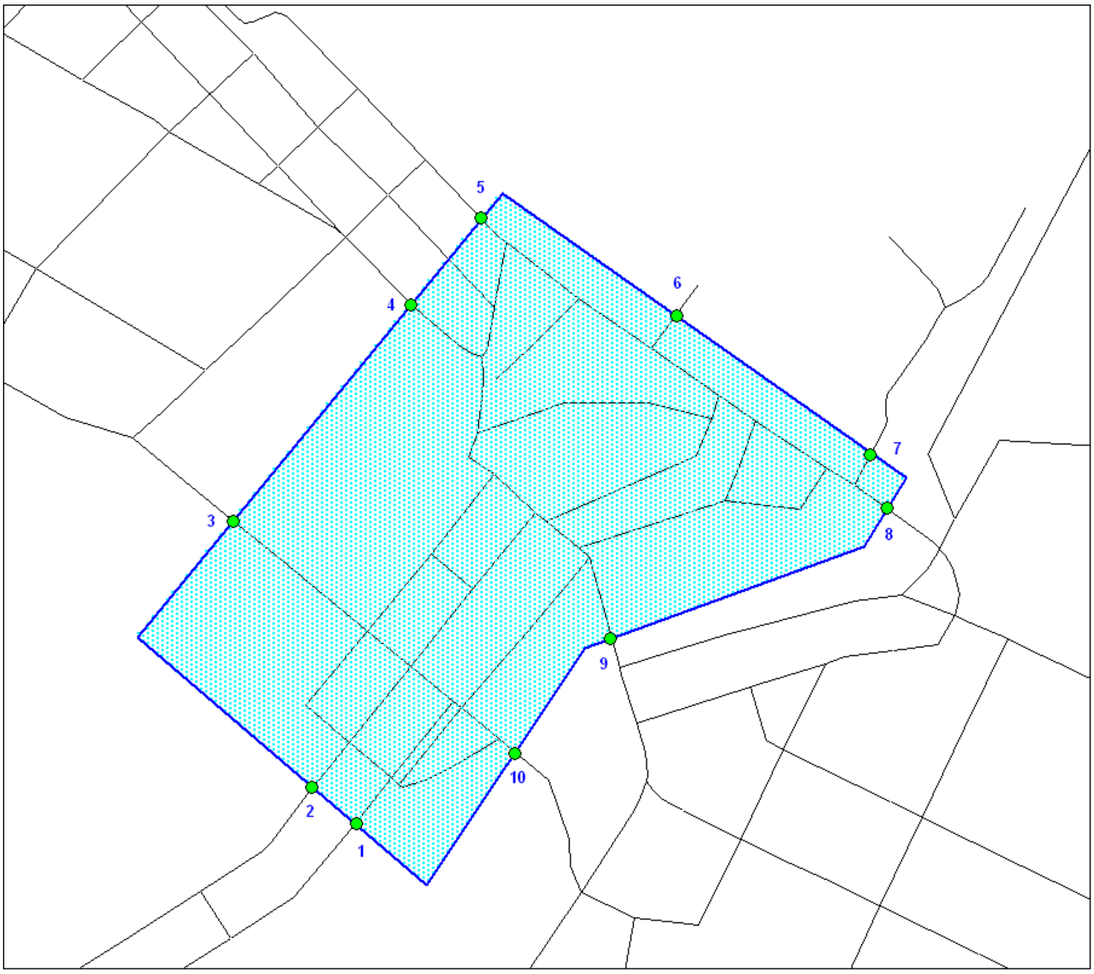


Table 5.1: Predicted Traffic Growth on the Townsville CBD Cordon (modelled 24 hour two-way weekday traffic volumes)

	Modelling Scenario								
	1	2	3	4	5	6	7	8	9
Year	**2005**	**2011**	**2011**	**2011**	**2011**	**2025**	**2025**	**2025**	**2025**
Breakwater Development				**X**	**X**			**X**	**X**
Ross Creek Bridge			**X**		**X**		**X**		**X**
Cordon Crossing Point									
1. Flinders Street	11,365	10,803	10,478	10,935	10,699	12,307	11,852	12,642	11,984
2. Sturt Street	19,830	19,300	18,957	19,464	18,859	22,369	21,242	22,622	21,271
3. Stanley Street	3,851	3,593	3,567	3,573	3,544	4,553	4,086	4,589	4,079
4. Warburton Street	10,989	13,063	12,960	13,014	12,802	12,924	12,507	12,890	12,698
5. The Strand	3,965	5,015	4,882	5,357	5,070	8,701	9,065	9,221	9,232
6. Mariners Drive	1,370	2,399	2,394	2,407	2,401	2,672	2,664	2,683	2,675
6. Sir Leslie Thiess Drive	6,668	9,636	9,517	11,027	10,902	11,775	11,630	14,244	14,090
7. Ross Creek Bridge	**NA**	**NA**	6,588	**NA**	8,686	**NA**	11,732	**NA**	12,784
8. George Roberts Bridge	16,166	19,471	13,988	19,787	12,962	22,217	13,750	22,756	13,842
9. Lowths Bridge	5,703	6,643	6,585	6,611	6,332	9,015	8,698	9,015	8,703
Total Cordon Demand	**79,907**	**89,924**	**89,916**	**92,176**	**92,257**	**106,533**	**107,225**	**110,662**	**111,358**

Referring the **Table 5.1**, the main points to emerge are as follows:

- In 2005 almost 80,000 vehicles crossed the CBD cordon on a typical weekday.

- For the 2011 base case scenario (i.e. without the Breakwater Development and without the Ross Creek Bridge – **Model Run 2**) traffic crossing the cordon is forecasts to increase by 12.5% to almost 90,000 vehicles per day (vpd) - an annual increase of about 2.1%.

- By 2025, for the base case scenario (**Model Run 6**), traffic on the CBD cordon is expected to increase by 33.3 percent relative to 2005 traffic demand (i.e. to about 106,500 vehicles per day (vpd) - an annual increase of approximately 1.7% per annum.

- The quantum of traffic increase predicted for the CBD cordon under the 2011 and 2025 base case scenarios is commensurate with forecasts increases in population and employment within the area, and within the region generally.

- In the base case scenarios the main traffic increases are anticipated to be on:

  - the George Roberts Bridge;
  - Sir Leslie Thiess Drive;
  - The Strand; and
  - Lowths Bridge

- The impact of adding the Ross Creek Bridge to the two base case scenarios (**Model Runs 3 and 7**) does <u>not</u> cause a major redistribution of traffic across the entire CBD cordon. Its traffic impacts are quite specific, as follows:

  - in 2011 the Ross Creek Bridge is predicted to carry some 6,600 vpd, growing to 11,700 vpd in 2025
  - as might be expected, a commensurate traffic reduction occurs on the George Robertson Bridge
  - in both 2011 and 2025 there is fairly negligible change in traffic demand at any of the other cordon crossing points

- The predicted traffic impact of adding the Breakwater Development, but not constructing the Ross Creek Bridge (**Model Runs 4 and 8)**, are as follows:

  - traffic crossing the entire CBD cordon increases by 2.5 percent in 2011, and by 3.9 percent in 2025
  - obviously the largest absolute increase in traffic occurs on Sir Leslie Thiess Drive (an additional 1,400 vpd in 2011 and 2,470 vpd in 2025)
  - the traffic generated by the Breakwater Development disperses fairly evenly across the balance of the CBD cordon, resulting in relatively small traffic increases across most of the cordon

- Under the scenarios that include both the Breakwater Development and the Ross Creek Bridge (**Model Runs 5 and 9**) produces the highest traffic volumes on the new bridge - 8,700 vpd in 2011 and 12,800 vpd in 2025. The main outcome of these scenarios relative to the base case scenarios (**Model Runs 2 and 5**) is to significantly reduce traffic on the George Robertson Bridge. Traffic on Sir Leslie Thiess Drive increases, but there is very little change on the other CBD cordon crossing points.

5.2 Traffic Volumes More Broadly Across the Network

Figures 5.2 though 5.10 show the Zenith model's weekday 24 hour traffic predictions more broadly across the inner road network in Townsville for the 9 modelled land use/transport scenarios.

Close inspection of these Figures shows that the impacts of traffic generated by the Breakwater Development in isolation are largely confined to the inner area of Townsville - in other words the area defined by the CBD cordon in Section 5.1 of the report. As Breakwater traffic dissipates through the network its impact on the network also dissipates quickly.

This is clearly shown in **Figures 5.11** through **5.14**. In these Figures the blue component of the bandwidth is Breakwater generated traffic. The numbers embedded in the bandwidth are the actual breakwater generated daily traffic volumes.

Figure 5.2: Base Year Daily Volumes (Run 1)

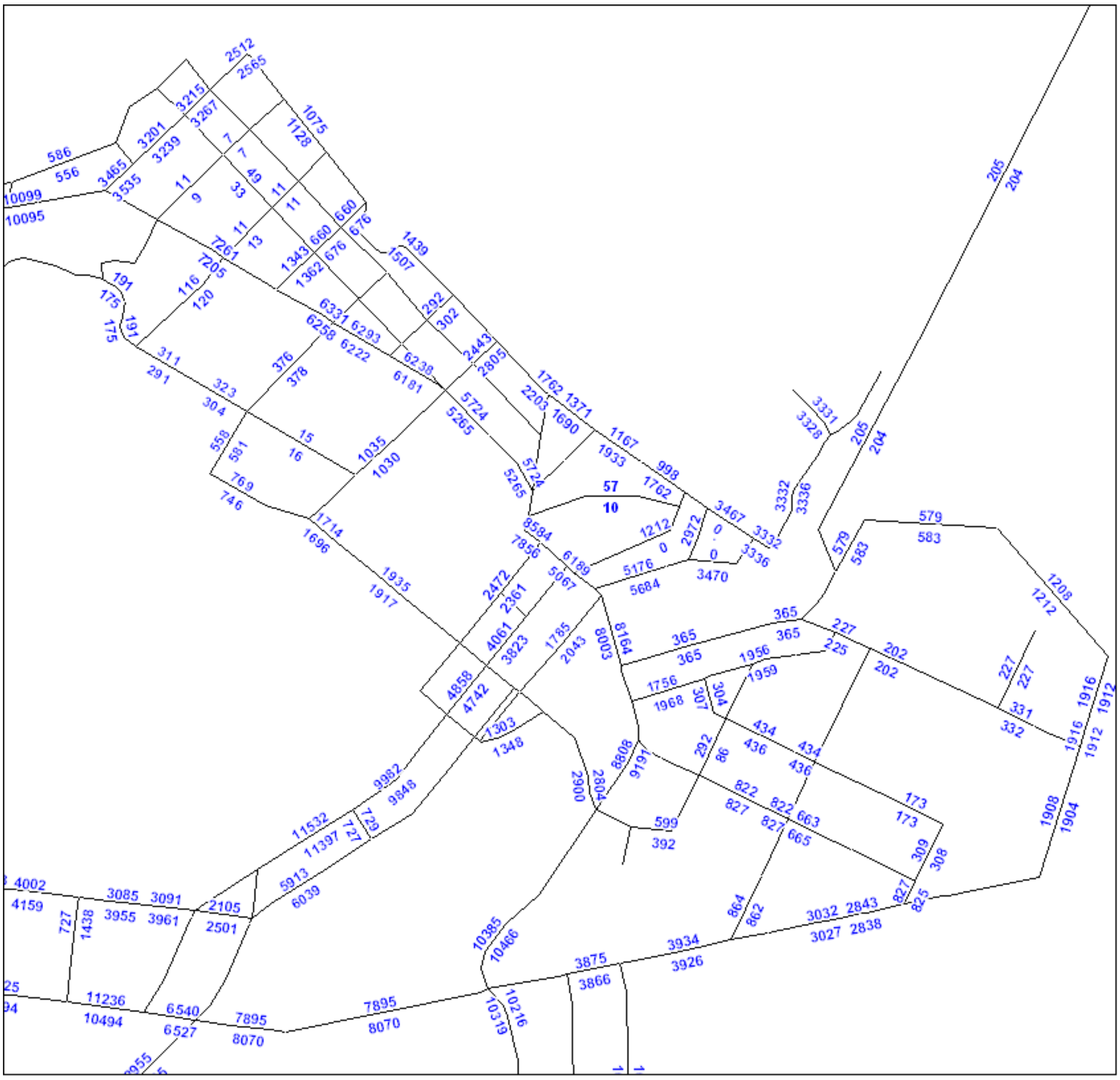


Figure 5.3: 2011 Base Daily Volumes (Run 2) - No Breakwater and No Bridge

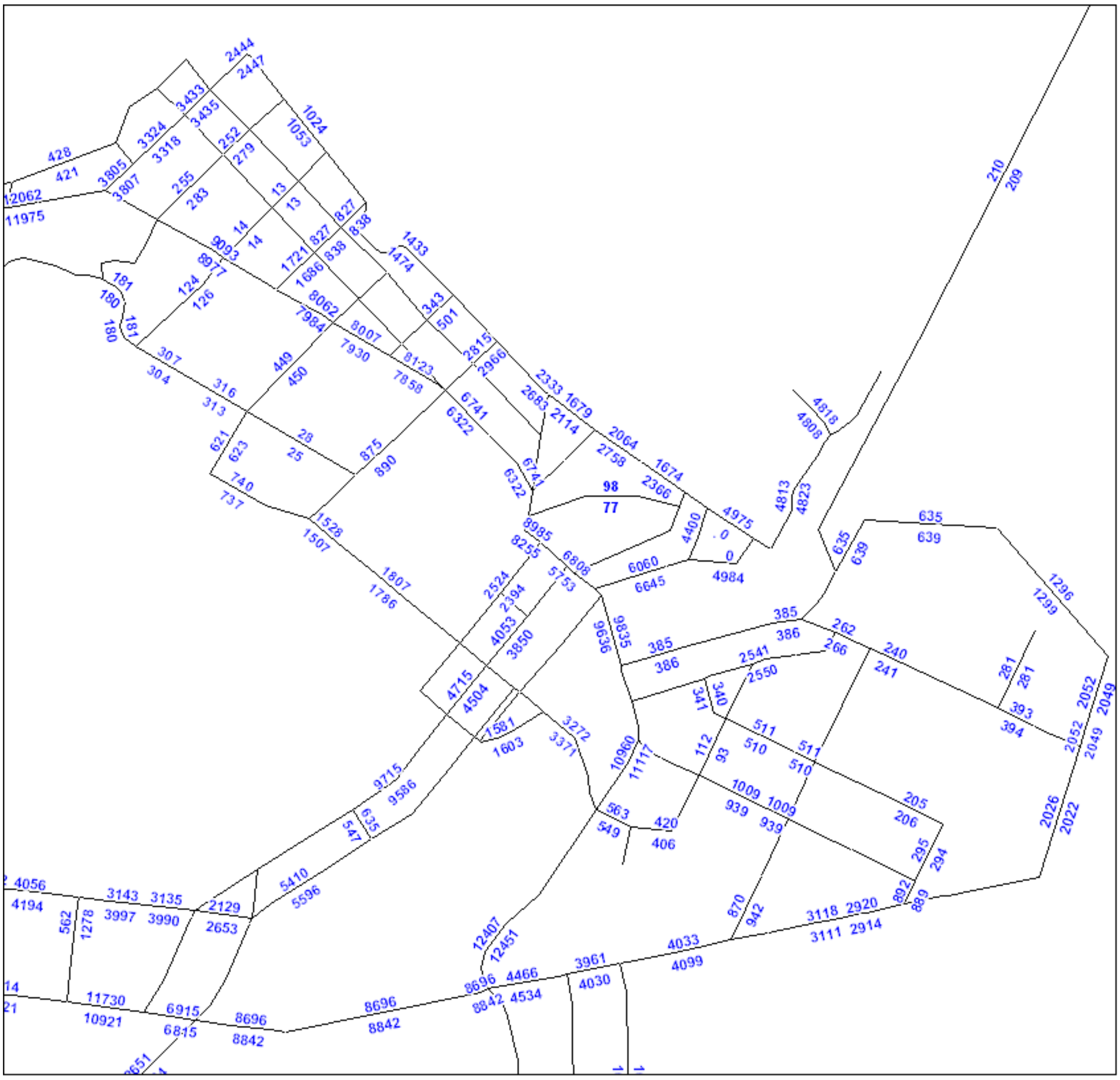


Figure 5.4: 2011 with Bridge and No Breakwater Daily Volumes (Run 3)

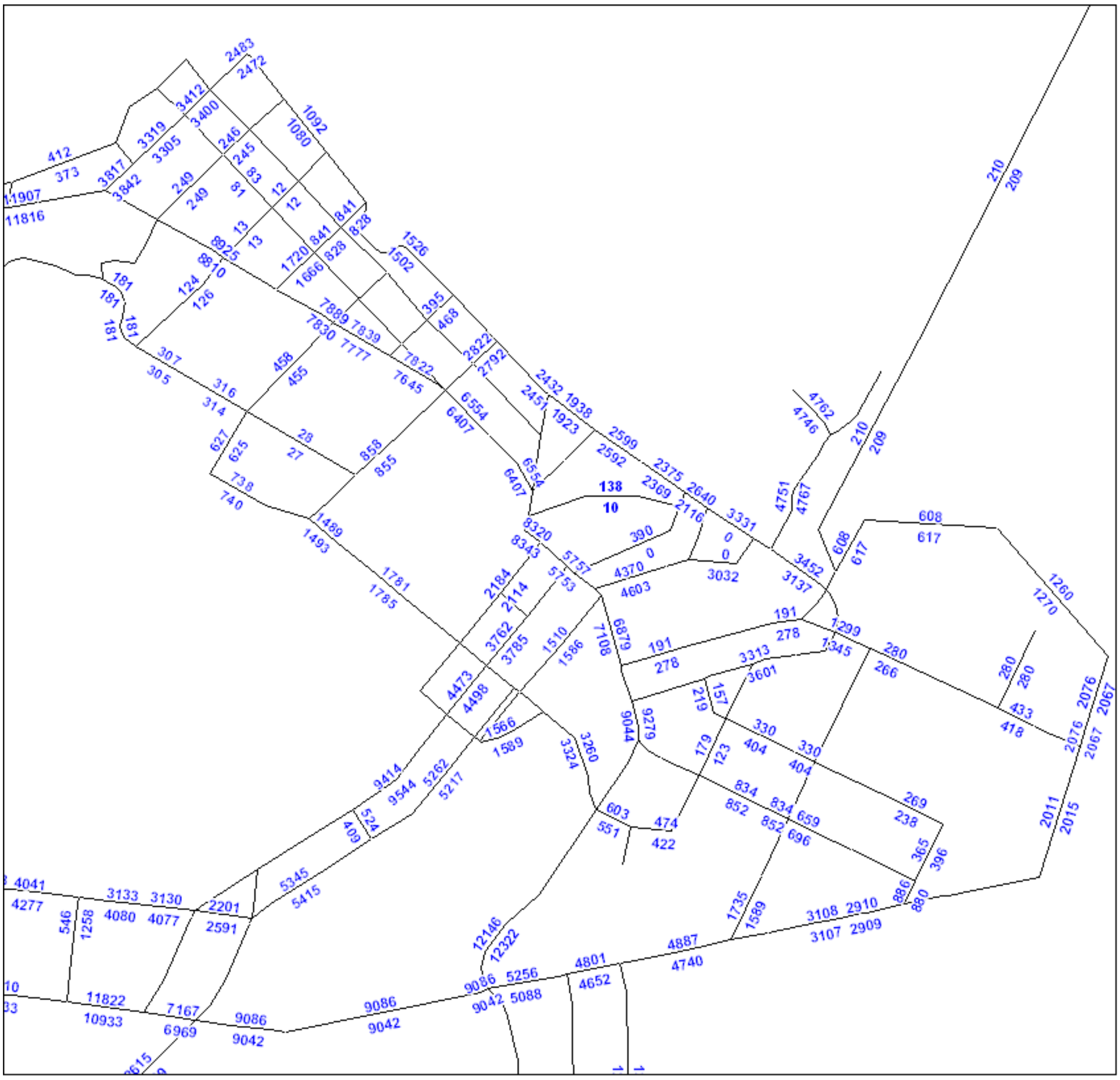


Figure 5.5: 2011 No Bridge with Breakwater Daily Volumes (Run 4)

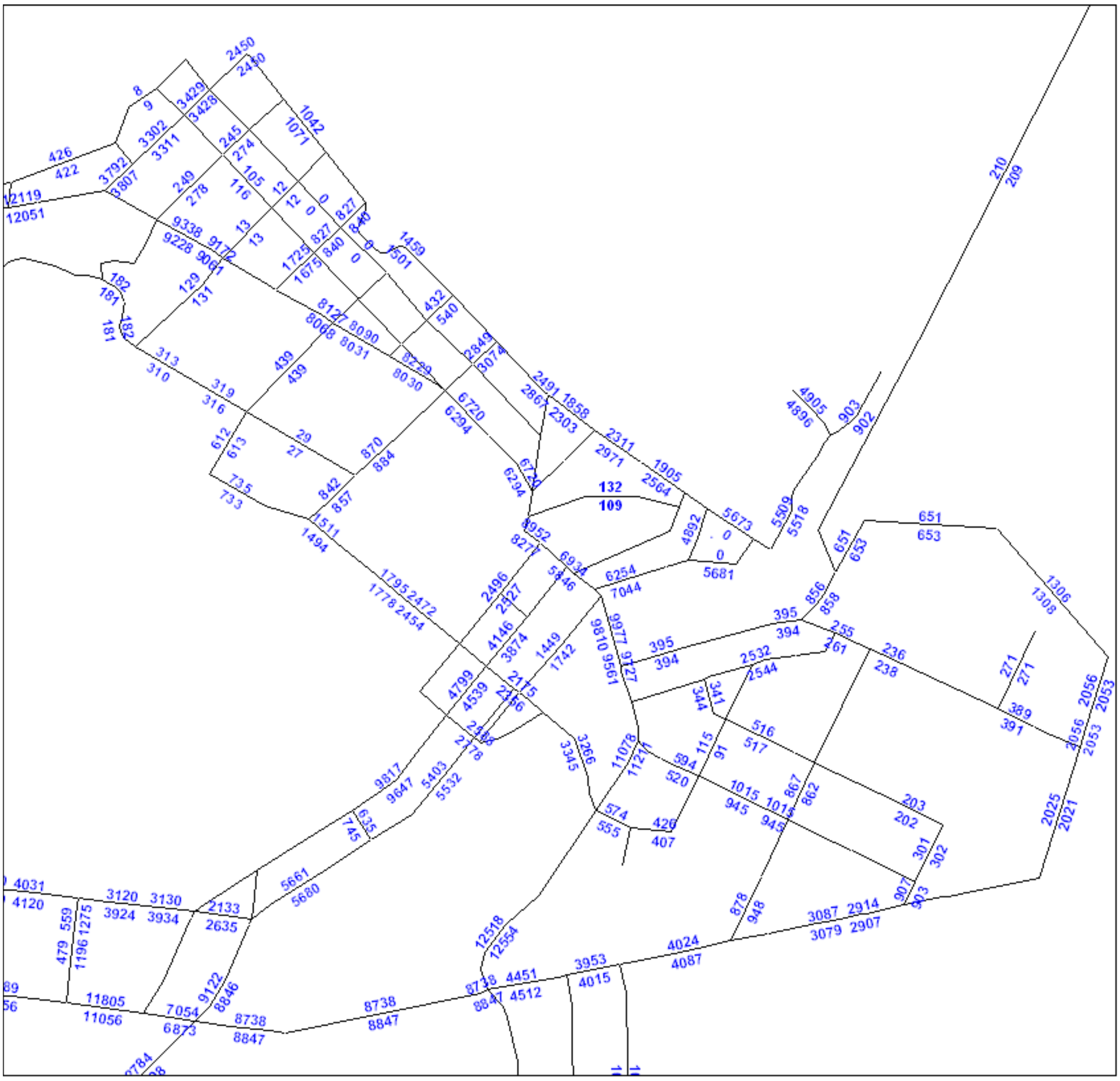


Figure 5.6: 2011 with Bridge and with Breakwater Daily Volumes (Run 5)

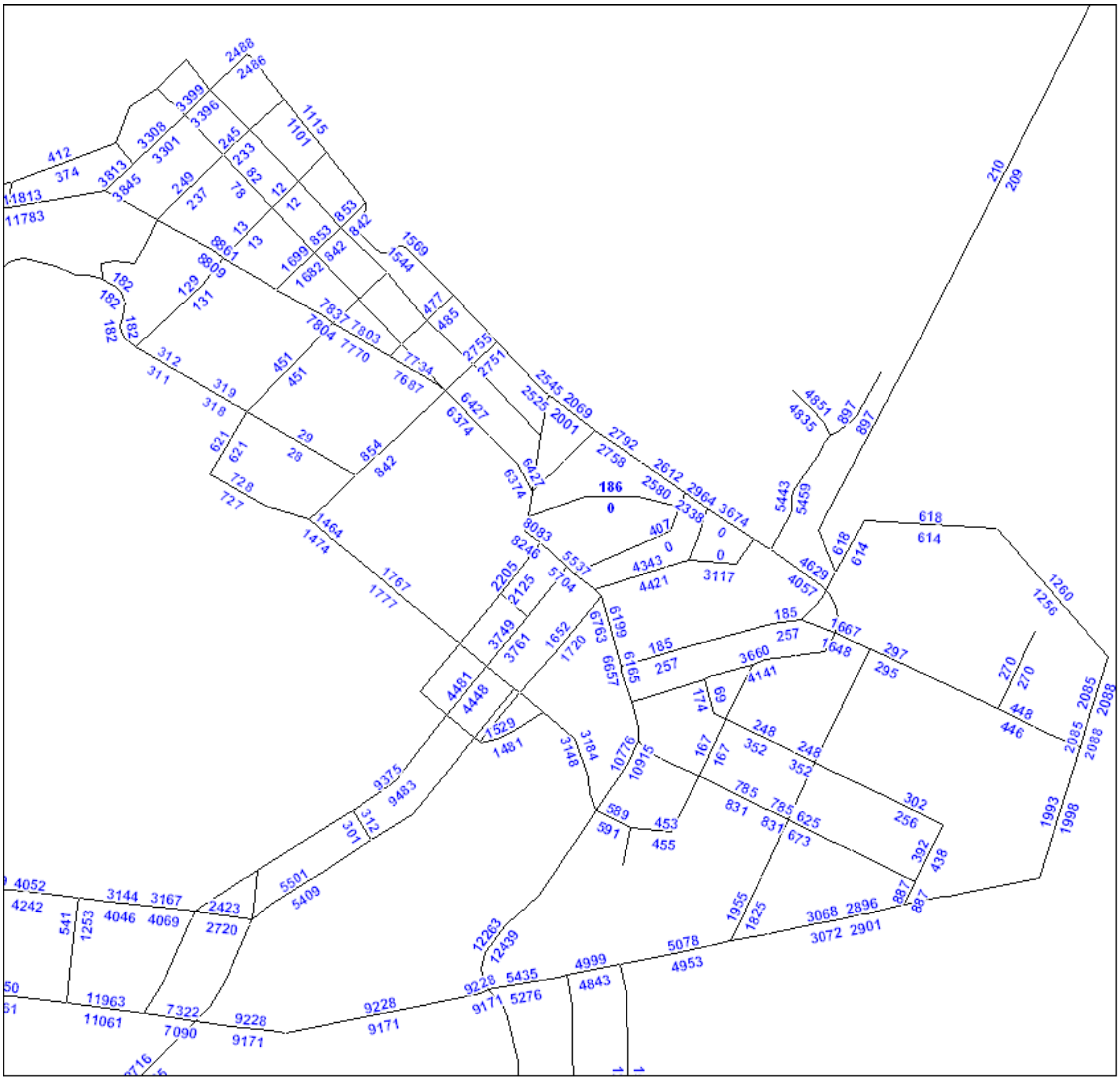


Figure 5.7: 2025 Base Daily Volumes (Run 6) - No Breakwater and No Bridge

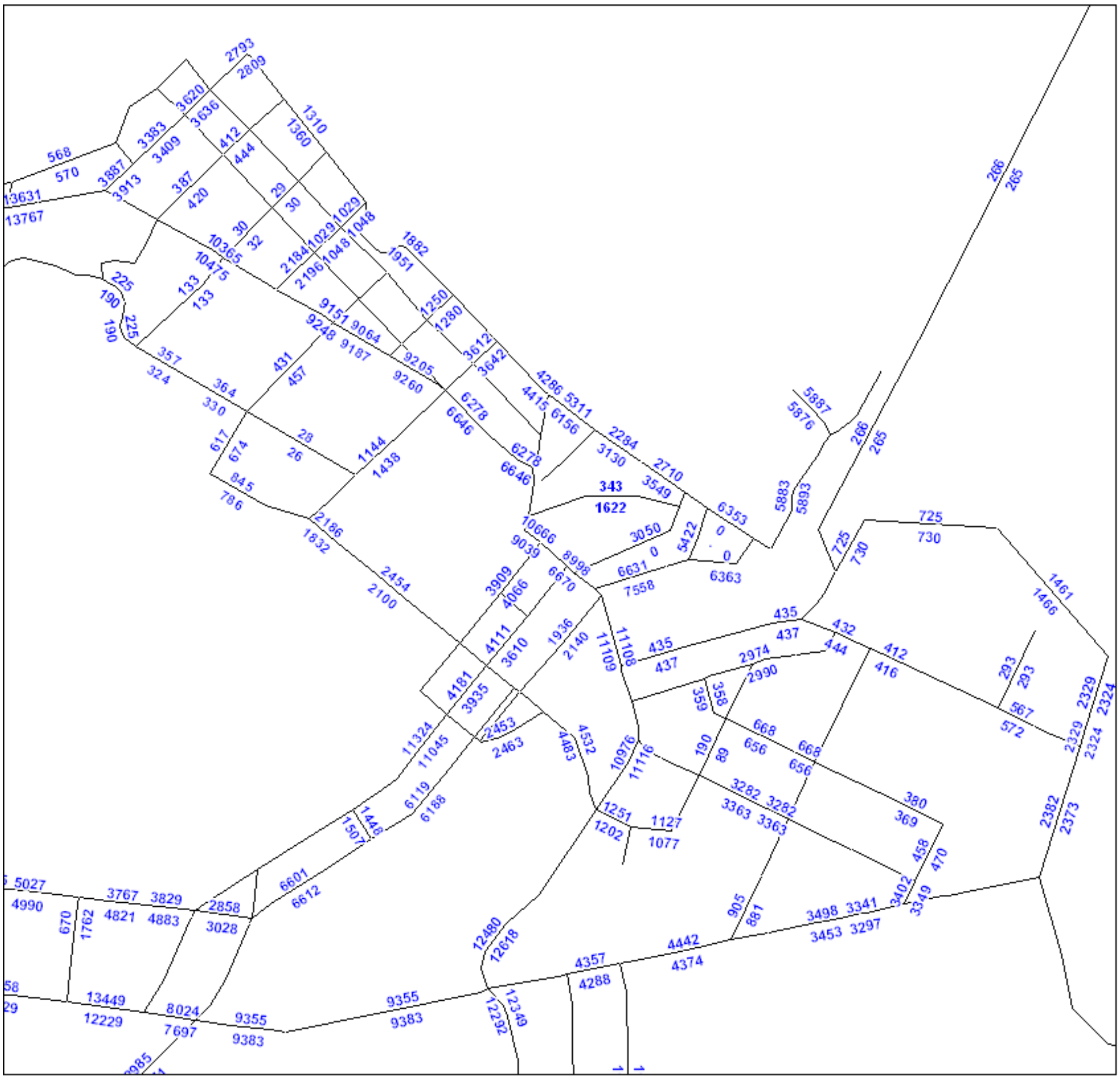


Figure 5.8: 2025 with Bridge and No Breakwater Daily Volumes (Run 7)

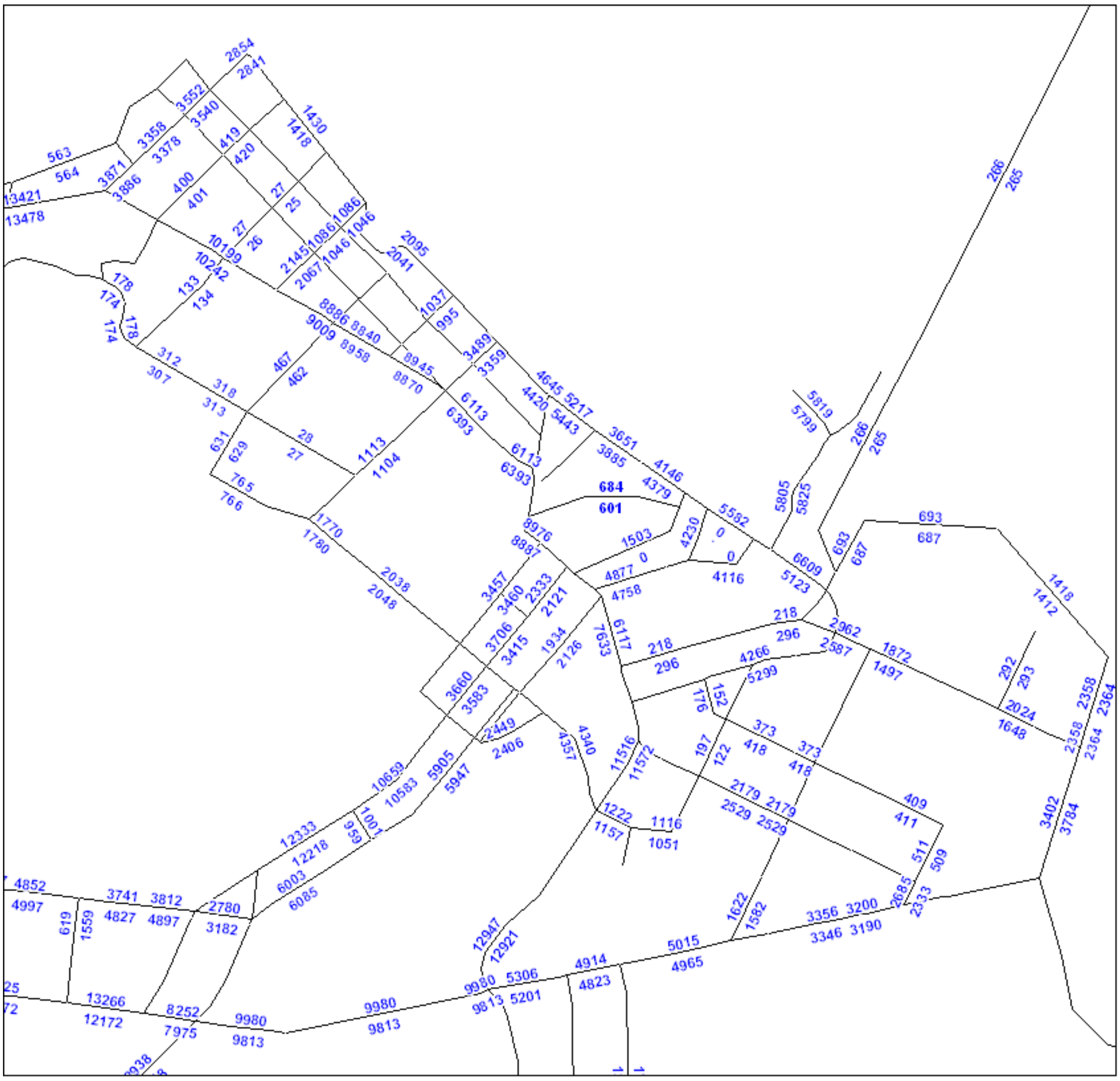


Figure 5.9: 2025 No Bridge with Breakwater Daily Volumes (Run 8)

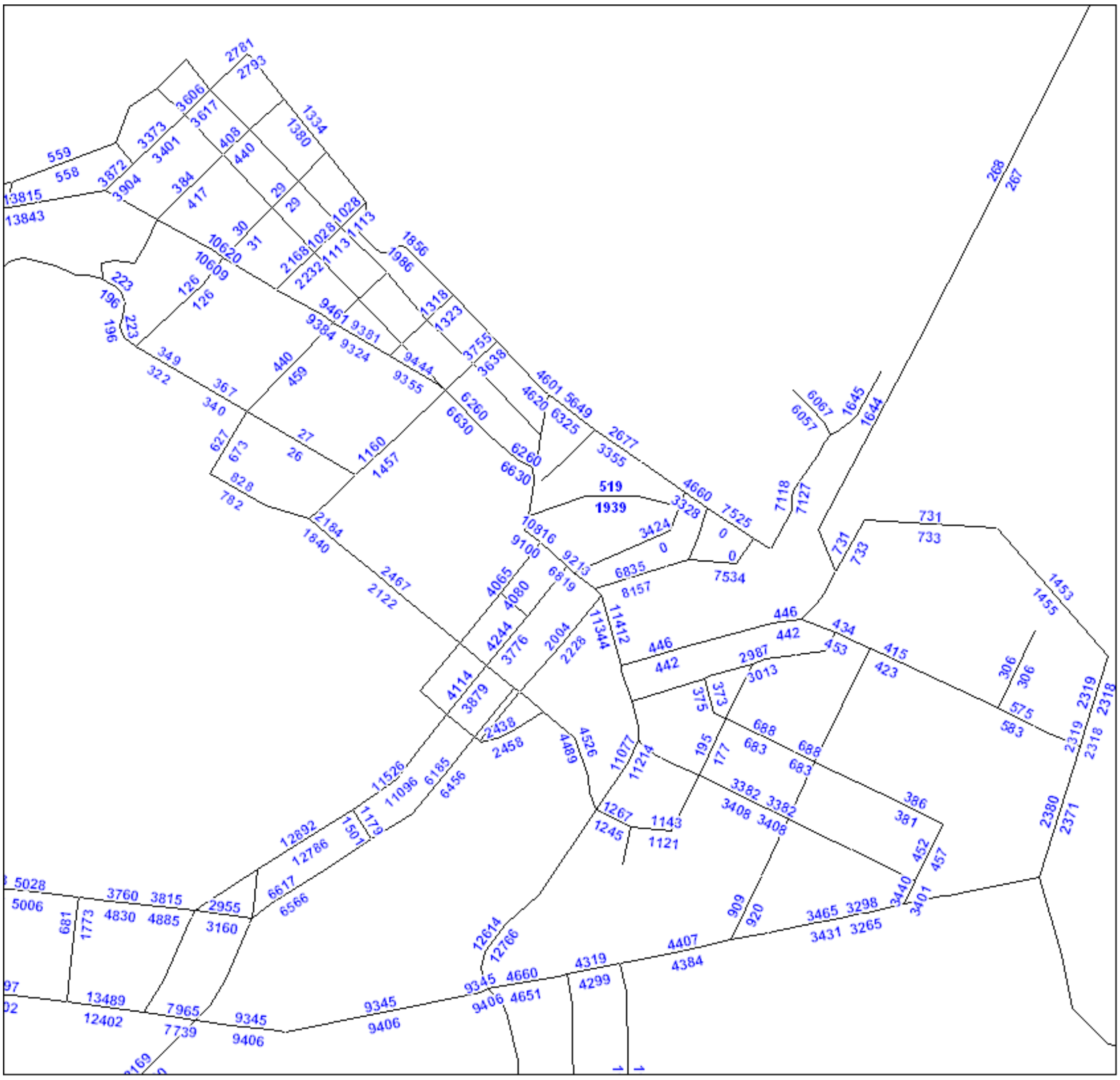


Figure 5.10: 2025 with Bridge and with Breakwater Daily Volumes (Run 9)

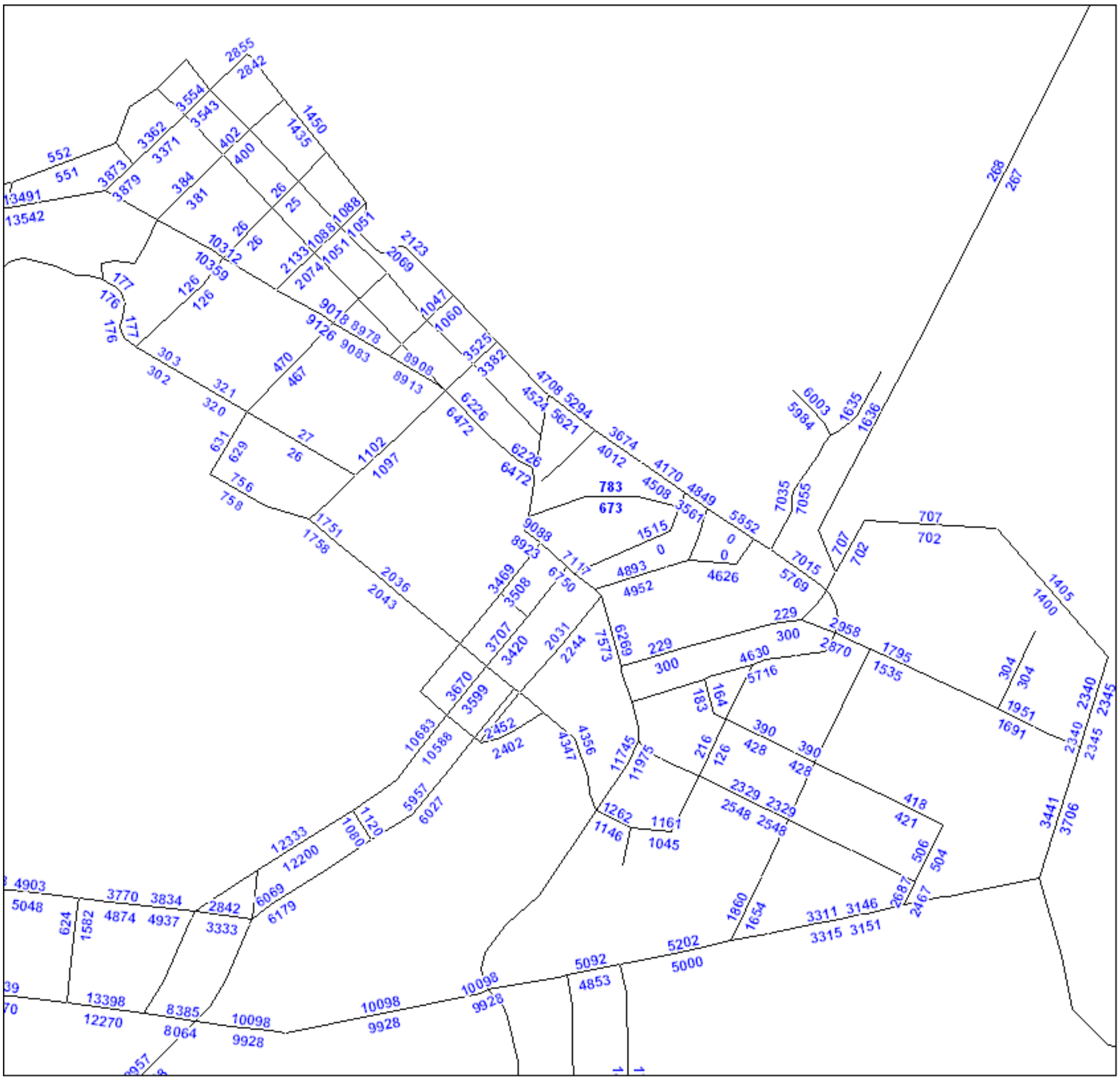


Figure 5.11: 2011 Breakwater Generated Trips No Bridge

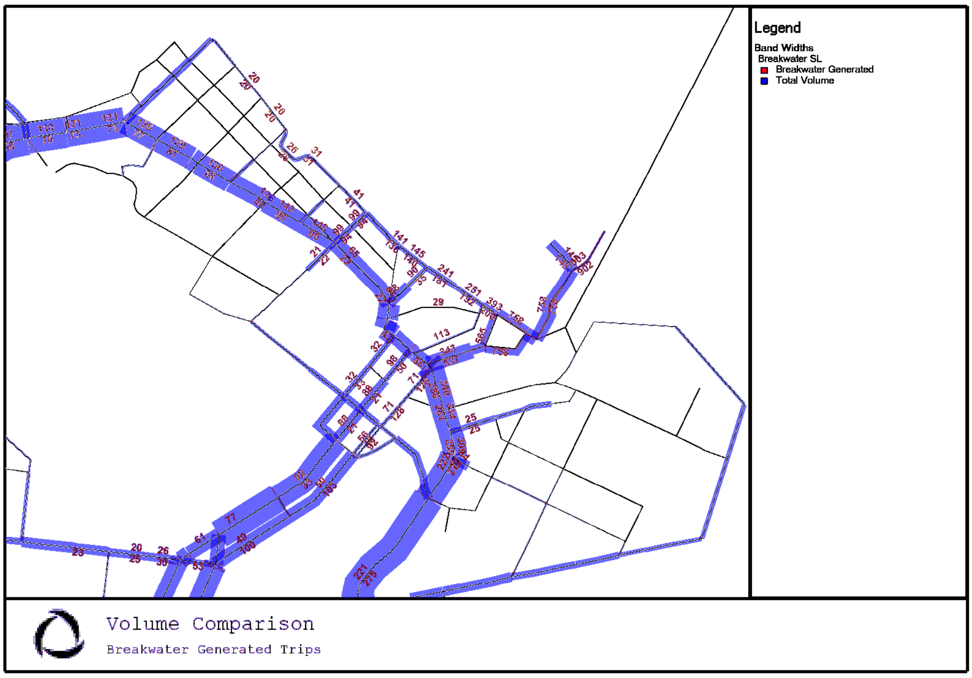


Figure 5.12: 2011 Breakwater Generated Trips With Bridge

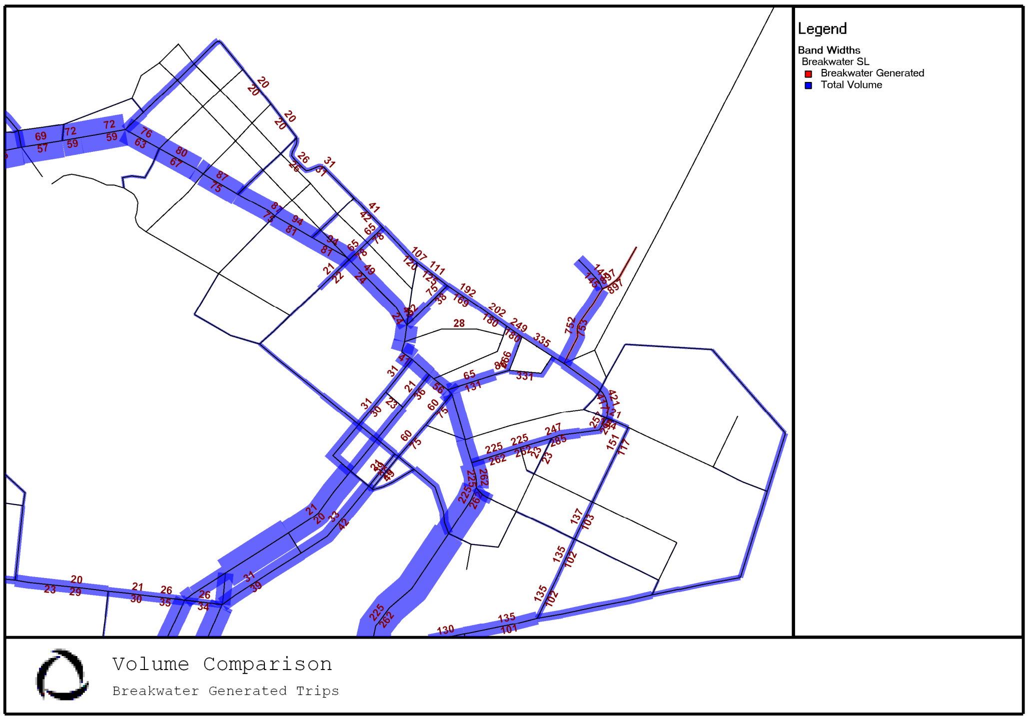


Figure 5.13: 2025 Breakwater Generated Trips No Bridge

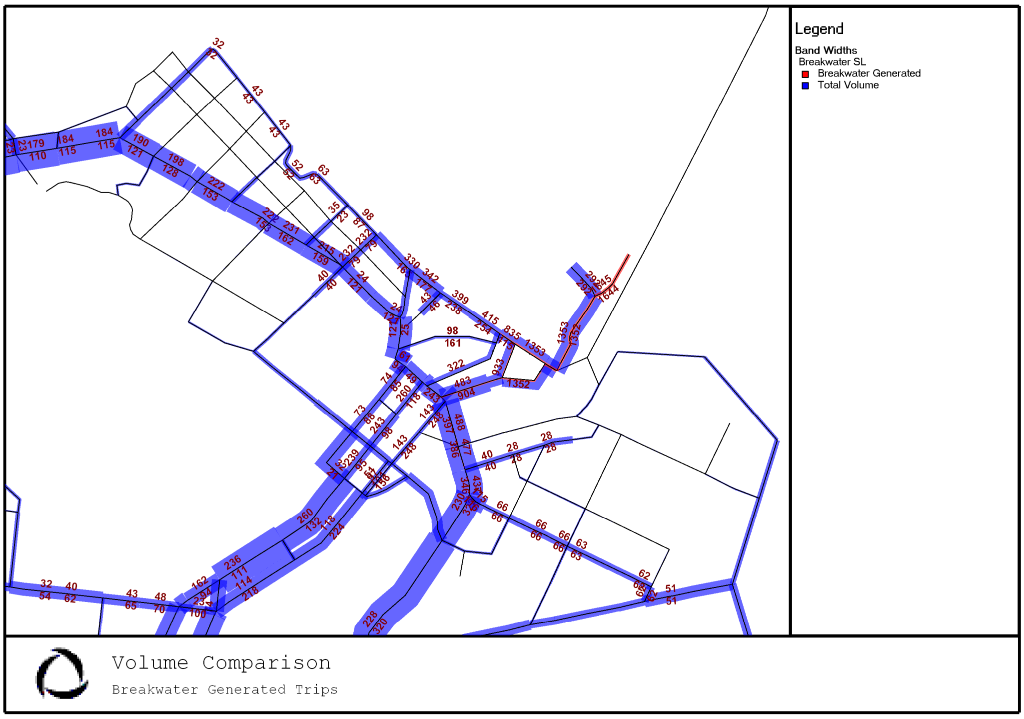
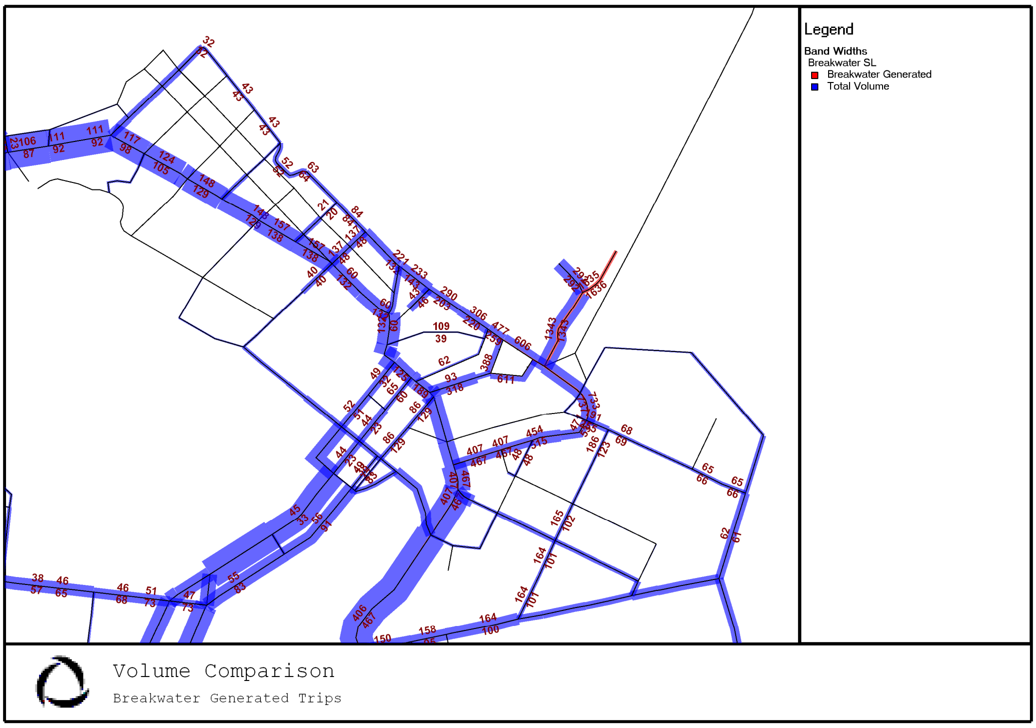


Figure 5.14: 2025 Breakwater Generated Trips With Bridge



Appendix A: Description of Zenith Travel Forecasting Model

The Zenith Travel Demand Forecasting Model

1. Introduction

This article describes the current extent of the Zenith model, its structure and capabilities, as well as the nature of the outputs it can produce.

2. Current Extent of the Model

The Zenith Travel Forecasting Model simulates transport networks and travel behaviour throughout South East Queensland. In terms of geographical coverage it comprises of two parts.

1. The core modelled area; and
2. a buffer area.

The core modelled area, essentially the area bounded by Noosa/Cooroy to the north, Toowoomba to the west and Tweed to the south, is modelled in great detail. All arterial, sub-arterial and collector roads are included in the simulation network, as well as every train line, train station, bus route, bus stop, ferry service and inter-city coach service.

Travel patterns are generated at a fine-grained census collector district level. In other words, the model predicts travel demands from each of 3,700 discrete areas of the region (called travel zones) to every other discrete area. These travel patterns are predicted for each journey purpose - i.e. work, education, shopping, recreation, etc.

Within the buffer area, the simulation considers both the land use and the transportation system at a much coarser level. The purpose of the “buffer” is to improve the predictive capability of the model in terms of travel between the core modelled area and adjoining areas.

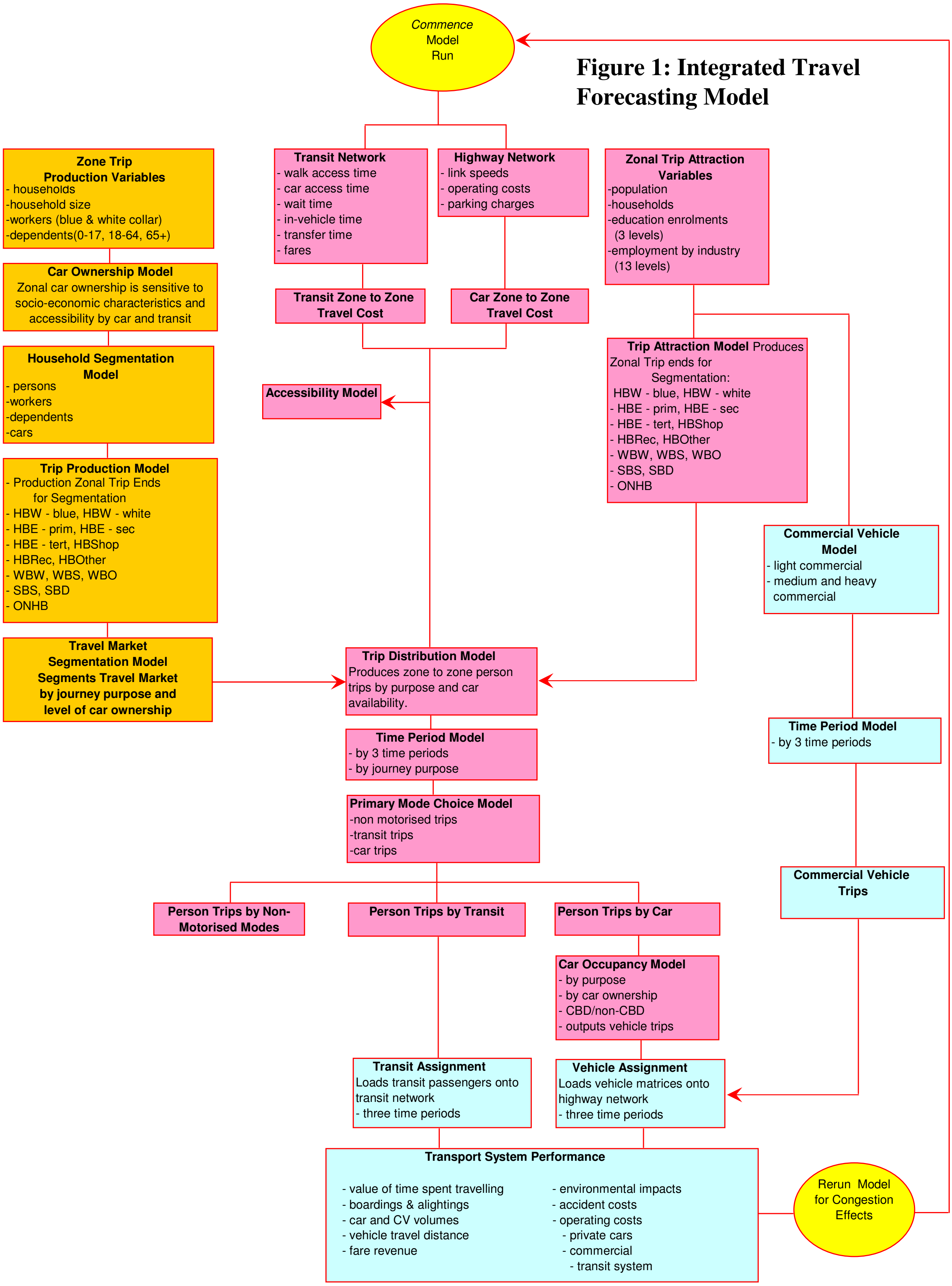
The model is by far the most comprehensive travel simulation system currently being used in Australia, and is at the “leading edge” in terms of world development of such models. It is being used by VLC to produce very detailed travel forecasts for both road and public transport networks for a number of the most significant transport infrastructure investments ever contemplated in Australia.

3. Outline of Model Structure

The basic model structure is depicted in Figure 1. In simple terms, the model has the following basic components:

- Road and rail infrastructure networks (including system capacities and operating speeds);
- Transit service networks (routes) and frequency/fare details;

Figure 1: Integrated Travel Forecasting Model



Details of land uses in discrete areas of the city - called travel zones;

- Travel patterns (expressed as numbers of trips made between origin and destination travel zone pairs by various modes - the tables reflecting these travel desires are called trip matrices);
- Algorithms to interrogate the model's output and produce a range of transport system performance indicators.

The integrated model's outputs are derived by assigning trips to the road and public transport networks based on minimising travel cost (usually expressed in terms of travel time, fares, parking charges and vehicle operating costs). Travel times are adjusted in the model to reflect levels of congestion caused by traffic and the perceived dislike of and walking and waiting when travelling by public transport.

The following section describes how the travel matrices are derived.

4. Production of Travel Matrices (Trip Tables)

The Zenith travel forecasting model simulates people's travel behaviour based on observed travel behaviour. The model incorporates the following components in generating travel matrices:-

- a trip production model (a model of how often households of various types decide to make trips for different purposes);
- a trip attraction model (which produces a measure of how attractive a destination will be in satisfying travel desires);
- a trip distribution model (which uses the outputs of the trip production and attraction models to produce estimates of zone to zone travel for each travel market segment);
- a mode choice model (which estimates whether people will choose to travel by car, transit or non-motorised modes);
- a vehicle occupancy model (which converts person trips made by car into vehicle trips)
- a time period model (which allocates trips to parts of the day).

Each of the above modules is briefly described in the following sub-sections.

4.1 The Trip Production Model

The trip production model estimates the frequency that households of different types make trips for various purposes. The model is run for each travel zone (in this case each Census Collector District or CCD). Because they display very different characteristics, home based and non-home based trips are modelled separately.

Home Based Travel

The home based trip production model derives travel demands in each zone based on the following demographic variables:-

- households in a zone;
- average household size;
- numbers of blue and white collar workers;
- numbers of dependants aged 0-17, 18-64, 65 and over; and
- level of car ownership.

For a 1996 base year these variables can be obtained from the census. When the model is run in "forecast mode", they are predicted by the household segmentation and car ownership models.

The home based trip production model produces separate trip production estimates for the following categories of travel.

- home based work - blue collar;
- home based work - white collar;
- home based education - pre-school and primary;
- home based education – secondary;
- home based education – tertiary;
- home based shopping and personal business;
- home based social and recreation; and
- home based other.

In order to increase the accuracy of the subsequent trip distribution and mode choice models, the above trip purposes are further disaggregated by the level of household car ownership (0, 1, 2, 3+) using a travel market segmentation model.

Non-Home Based Travel

Because of the far more complex relationships that exist for non-home based travel, a more complex array of variables (17 in total) is used to produce measures of zonal trip production. These are:

- zonal population;
- households;
- pre and primary school enrolments;
- secondary enrolments;
- equivalent full time tertiary enrolments; and
- employment in 12 industry categories (retail, manufacturing, public administration, personal services, etc.).

Again the model generates separate zonal trip forecasts for each trip purpose:

- work based work (WBW);
- work based shopping (WBS);
- work based other (WBO);

- shopping based shopping (SBS);
- shopping based other (SBO); and
- other non-home based travel (ONHB).

4.2 The Trip Attraction Model

Once trips have been "produced" there is a need for a model that generates measures as to how attractive each zone is as a potential destination. This is the trip attraction model.

The model uses multiple regression to relate the reported zonal trip attractions to the 17 zonal variables described previously for non-home based trip productions.

4.3 Trip Distribution Model

The next step in the process is to distribute the trips produced in each travel zone across the available destinations. This is performed by the trip distribution model which uses a process that emulates gravity - i.e. as a possible destination becomes more costly to reach, then it is less likely to be chosen as a destination. Similarly, if a shopping centre is expanded then it becomes more attractive as a destination, and will therefore attract more shopping trips.

The trip distribution model is run separately for each travel market segment.

4.4 Mode Choice Model

Once the likely travel patterns have been established by the trip distribution model, a series of mode choice logit curves are used to determine which mode of travel will be chosen - based on the relative attractiveness of each mode in terms of "perceived generalised cost".

Perceived generalised cost comprises of:-

- in car travel time;
- in transit vehicle travel time;
- transit access time (walking or car);
- transit waiting time (which is a function of service frequencies);
- transit transfer times;
- transit fares;
- car operating costs;
- parking charges; and
- modal perceptions.

The mode choice model is run for each travel market segment (i.e. trip purpose and car ownership level), and is applied in an hierarchical sequence as depicted in Figure 1.

The first step in the sequence is to predict motorised and non-motorised (i.e. walk and cycling) modes of travel. Motorised modes are then divided between car and public transport travel. Travel by public transport is then further subdivided into trips that access the system by walking, and those who choose to use a car.

Whether transit travellers choose to use a bus, train or tram is then determined during the transit assignment process.

4.5 Car Occupancy Model

For travel by public transport a person trip is a trip. By car, however, several people may travel in the same car. It is therefore necessary to convert person trips made by car to vehicle trips using the car occupancy model. The occupancy varies by journey purpose, level of household car availability and whether the journey is being made to the CBD or not.

4.6 Time Period Model

The final step in deriving travel matrices is to assign various trips between time periods. Different types of trips are usually made at different times of the day (e.g. journeys to work and school dominate travel demands in the morning peak period whereas shopping trips occur to a greater extent in the inter-peak). This task is performed by the time period model.

The time periods considered by the model are:

- midnight to 7:00am (morning off-peak);
- 7:00am to 9:00am (AM peak);
- 9:00am to 4:00pm (daytime off-peak);
- 4:00pm to 6:00pm (PM peak); and
- 6:00pm to midnight (evening off-peak).

Note that early, daytime off-peak and evening periods are assigned as one.

4.7 Other Model Components

The model structure also includes a sub-model for the prediction of commercial vehicle travel patterns.

5. Features of the Zenith Model

There are several features of the integrated model that distinguish it from other models that have been used in Australia in recent years. The primary objective of the new model is to provide a planning tool that is more relevant to the policy issues that planners and Governments have to address in the nineties and the next century.

Perhaps the most important features of the new model are its comprehensive simulation of public transport system options and the sensitivity of its forecasts to various pricing mechanisms (fares, fuel costs, tolls and parking charges, etc.).

The following sub-sections describe various elements and features of the model, which should provide some insight as to how it is able to overcome some of the structural deficiencies evident in models that were generally used previously.

5.1 Fine-grained Zoning System

VLC believes that simulating access to the public transport system is as important as accurately simulating the system itself. This means that zones must be sufficiently small to allow simulation of walk access/egress as well as car access to the system. For this reason the model simulates travel between much smaller geographic units than have traditionally been used - the travel zones are defined by ABS census collector districts, which results in over 5,000 zones in Melbourne and 3,700 in South East Queensland (previous modelling exercises in Melbourne have been based on 800 – 850 zones, while SEQ models have used about 500 zones).

5.2 Multiple Access Modes to Transit

Walking is no longer the only means of accessing the transit system - in fact at some outer suburban stations people travelling to the system by car (park-and-ride and kiss-and-ride) constitute the largest segment of rail patronage.

For this reason the integrated model is capable of simulating both walk and car access to the transit system.

5.3 Detailed Simulation of the Transport System

The model includes an extremely detailed description of SEQ's public transport system. All bus, tram and train routes are separately specified and all stations and stops are considered as candidate locations for boarding and alighting the system. The model also distinguishes between all stops, limited stop and express services.

As well as accurately simulating where and how people can access the transit system, the integrated model also allows travellers to travel on a bus or a tram to a station and then catch a train. Several interchanges in sequence can be modelled, and the model will also allow people to walk from a stop where they have alighted a service to another stop where they can continue their journey on another service. This capability is critical in assessing the interactions that occur between the various modes (eg bus/rail trips).

5.4 Highly Disaggregated Travel Market Segmentation

It has been found during previous model development that accuracy can be significantly increased by including private vehicle availability within the travel market segmentation. Households with limited private motor vehicle access are likely to display different trip destination and mode choice decision-making behaviour from those with a high level of access to private motor vehicles.

The integrated model recognises this and breaks each home-based journey purpose into 4 household car ownership levels (0, 1, 2, and 3+) to give a total of 32 home based travel market segments and six non-home based segments.

5.5 Sophisticated Modal Choice and Trip Distribution Models

The choice of travel mode and the choice of trip destination are closely linked in the decision-making process. The model takes this into account so that changes in public transport service characteristics, for example, will be reflected in both mode choice and trip distribution.

5.6 Realistic Simulation of Transit Passenger Journey Options

The public transport component of the model incorporates a number of processes which make the simulation of journey options particularly powerful. In essence, these processes:

- provide multiple options for zone access to and from the PT system;
- accurately reflect the range of choices available to a person once they have "entered" the PT system, for example, whether to alight a PT service at a particular stop and, if so, whether to wait for another service or walk to a different stop; and
- account for different decisions being made by people arriving at a given stop at different times.

5.7 Sensitivity to Transport Pricing

Trip distribution, mode choice, and assignment are all influenced by the following pricing issues:

- vehicle operating costs (fuel);
- car parking charges;
- tolls; and
- public transport fares.

5.8 Ability to Test a Wide Range of Transit Options

The model is capable of testing a wide range of transit modes and associated infrastructure and operating strategies.

In its current form the model (and the associated networks) simulates the following modes in detail:

- Trains;
- Scheduled Route Bus Services (BT, private operators, long distance coach services)
- Tram Services
- Ferry Services (Brisbane River and Moreton Bay services)

Services can be disaggregated as required (eg. by operating company, by service type etc). In this context the model is capable of simulating the effects of:

- new infrastructure and associated services;
- route restructuring;
- service frequency changes;
- fare levels;
- integration of services;
- express services; and
- transit lanes and HOV lanes.

5.9 Sensitivity to Congestion Effects

Public transport services that use road links in the network (for example, buses or trams) are affected by congestion on these links.

The Zenith model "feeds back" private vehicle assignment results into the public transport assignment so that congested bus or tram routes take that congestion into full account. Delays due to congestion are therefore incorporated into the trip distribution and mode choice decisions in an iterative process within the model

(unless of course services are insulated from ambient congestion levels – busway, bus priority etc.)

5.10 Sensitivity to Transport Investment Decisions

Generally modelling carried out previously has been based on a fixed trip patterns – in other words a change to the transport system had no effect on where or how people travelled, only the route they took. In the integrated model a major investment in transport infrastructure (either road or transit) will result in:

- change in destination choice; and
- change in mode choice.

6. Standard Model Outputs

The model produces estimates of individual link flows for travel by private and public transport and, for public transport services, boardings and alightings at individual stations or stops. Summary network performance indicators at a regional or sub-regional level are routinely available for:

- average trip distance (by mode);
- average trip time (by mode);
- market share (by mode);
- overall network volume/capacity ratio;
- average network speed;
- total travel distance (by mode);
- total travel time (by mode);
- value of time spent (by mode);
- total operating cost (by mode);
- public transport revenue (by mode);
- cost recovery by public transport mode;
- crash costs; and
- pollutant emissions.

Model outputs can be designed for individual project purposes however, because, as the proprietary owner, VLC has direct access to the software source code.
Typical model outputs and possible presentation formats are illustrated in the following pages:

- **Table 1** summarises network wide performance indicators. These relate to all public transport modes, private vehicle and commercial vehicle travel. The example cited in Table 1 relates to an analysis of future public transport patronage in Melbourne in the context of a variety of network improvements, pricing regimes and policy initiatives.

- **Figure 2** indicates peak period boardings, alightings and resultant line loadings for the Ipswich line in Brisbane.

- **Figure 3** indicates a possible boarding/alighting/loading profile for a possible heavy rail service in the Scoresby Corridor of Melbourne, by time of day.

- **Figure 4** summarises similar data for a possible tram connection between Huntingdale and Rowville in Melbourne's eastern suburbs.

- **Figure 5** shows the destination of walk access/walk egress trips which boarded at Spencer Street Station in 2000.

- **Figure 6** shows the boarding station of rail trips alighting at Spencer Street Station.

- **Figure 7** shows the origins and destinations of private vehicle trips on the Pacific Highway just south of Robina Town Centre. This form of presentation is much clearer than many alternatives and can be produced for any link in the modelled network without the need for additional model runs.

As we noted earlier the form of presentation is easily customised to meet the needs of particular projects and different target audiences.

Table 1: Performance Indicators

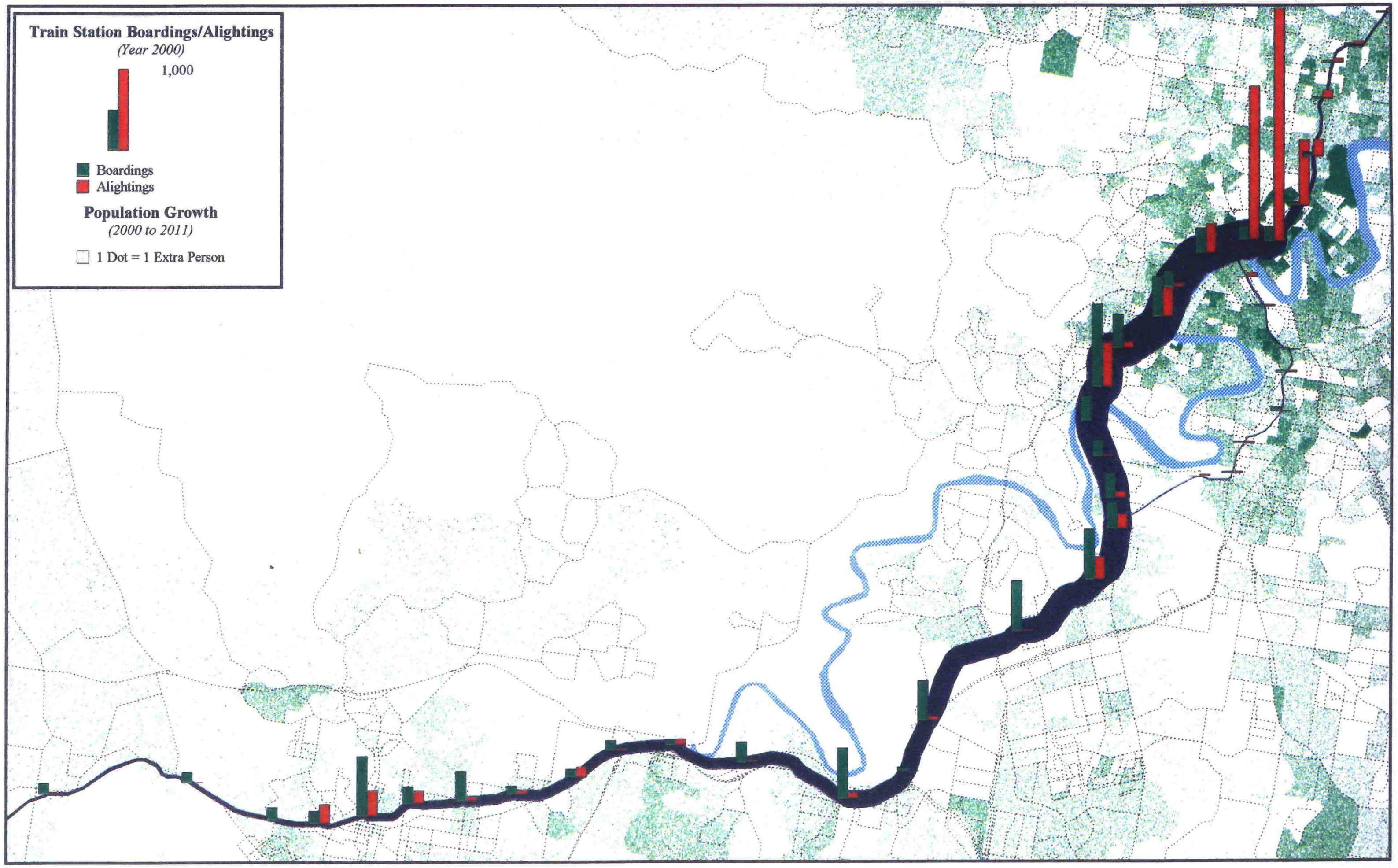
Network Performance Indicators	Year 2000 Run28 MSD Only	Year 2021 BASE 20/2020 MSD Only	Year 2021 Do Something 20/2020 MSD Only	Year 2021 Do Something 20/2020 + Pricing (15c/km) MSD Only	Year 2021 Do Something 20/2020 + Travel Smart MSD Only	20/2020 Do Something + Pricing (15c/km) + Travel Smart MSD Only
Public Transport						
Total Public Transport System Patronage (per day)						
• Tram	412,239	565,700	853,692	914,812	939,199	1,006,805
• Train	402,110	620,658	726,659	826,080	797,705	906,914
• Bus - Metro	254,069	297,526	579,396	641,624	638,784	707,328
• Other	6,872	13,123	13,123	13,123	13,123	13,123
Total	**1,075,290**	**1,497,007**	**2,172,870**	**2,395,639**	**2,388,811**	**2,634,170**
Passenger Kilometres (per day)						
• Tram	1,728,674	2,338,713	3,764,732	4,115,772	4,145,032	4,533,862
• Train	5,293,558	8,557,340	10,854,047	12,750,751	11,914,095	13,997,145
• Bus - Metro	1,675,811	1,879,254	3,723,254	4,285,841	4,111,915	4,728,556
• Other	200,053	394,867	394,867	394,867	394,867	394,867
Total	**8,898,096**	**13,170,173**	**18,736,899**	**21,547,230**	**20,565,909**	**23,654,430**
Passenger Hours (per day)						
• Tram	92,520	130,460	164,402	177,711	180,196	194,884
• Train	138,725	219,172	248,480	290,157	272,698	318,468
• Bus - Metro	55,231	65,322	112,828	126,925	123,745	139,006
• Other	3,832	7,589	7,589	7,589	7,589	7,589
Total	**290,307**	**422,543**	**533,298**	**602,382**	**584,228**	**659,947**
No. of Passenger Interchanges (per day)	312,818	450,933	853,604	965,841	938,834	1,061,388
No. of Passenger Trips (per day)	762,472	1,046,074	1,319,266	1,429,798	1,449,977	1,572,782
Revenue (per day)						
• Tram	$296,188	$405,767	$583,215	$620,075	$641,500	$682,224
• Train	$602,520	$919,068	$953,640	$1,093,144	$1,047,491	$1,200,161
• Bus - Metro	$143,843	$161,609	$274,726	$302,080	$303,098	$333,261
• Other	$2,462	$4,813	$4,813	$4,813	$4,813	$4,813
Total	**$1,045,013**	**$1,491,258**	**$1,816,394**	**$2,020,112**	**$1,996,903**	**$2,220,459**
Increase in Fleet Requirements (AM Peak)						
• Tram	-	32.7%	131.3%	128.6%	129.9%	127.3%
• Train	-	25.9%	128.2%	128.2%	128.2%	128.2%
• Bus - Metro	-	8.8%	113.6%	108.8%	111.1%	106.4%
• Other	-	-	-	-	-	-
Total	**0.0%**	**17.5%**	**120.3%**	**116.6%**	**118.4%**	**114.8%**
<u>Private/Commercial Vehicles</u>						
Person Trips (per day)						
• Private Vehicle **	9,634,200	12,227,469	11,975,167	11,849,280	11,636,820	11,501,130
• Commercial Vehicle **	434,975	564,139	564,139	564,139	564,139	564,139
Vehicle Trips (per day)						
• Private Vehicle **	6,675,080	8,670,970	8,474,420	8,373,658	8,237,027	8,127,423
• Commercial Vehicle **	434,975	564,139	564,139	564,139	564,139	564,139
Person Kilometres (000's per day)						
• Private Vehicle ^	105,892.2	148,181.8	142,599.3	139,389.2	140,957.6	137,030.3
• Commercial Vehicle ^	6,209.7	8,372.7	8,354.3	8,346.4	8,346.7	8,337.1
Vehicle Kilometres (000's per day)						
• Private Vehicle ^	74,581.9	105,391.5	101,552.9	98,772.0	100,014.8	97,096.1
• Commercial Vehicle ^	6,209.7	8,372.7	8,354.3	8,346.4	8,346.7	8,337.1
Person Hours (per day)						
• Private Vehicle ^	2,219,901	3,504,188	3,231,378	3,075,385	3,148,217	2,979,089
• Commercial Vehicle ^	131,425	203,220	195,645	190,936	192,856	188,093
Vehicle Hours (per day)						
• Private Vehicle ^	1,564,835	2,494,877	2,303,356	2,180,200	2,235,161	211,725
• Commercial Vehicle ^	131,425	203,220	195,645	190,936	192,856	188,093
Operating Costs ($000's per day)						
• Private Vehicle ^	$18,510.1	$26,162.3	$25,135.0	$24,409.1	$24,725.7	$23,968.2
• Commercial Vehicle ^	$4,478.4	$6,089.8	$6,038.4	$6,007.3	$6,019.5	$5,987.0
Accident Rate (Crashes per day)						
• Number of Accidents (Total per Day) ^	23.25	31.36	30.2	29.39	29.71	28.87
• Accidents Costs ($ per Day) ^	$3,873,830	$5,275,090	$5,084,158	$4,950,484	$5,005,268	$4,865,094
Fuel Consumption (Litres per Day)						
• Private Vehicle	8,113,435	11,681,911	11,156,471	10,802,245	10,957,794	10,594,569
• Commercial Vehicle	1,825,809	2,547,651	2,512,616	2,494,547	2,499,461	2,481,772
Sub-Total	9,939,244	14,229,562	13,669,087	13,296,792	13,457,255	13,076,341
NO_x (tonnes per Day)						
• Private Vehicle	86.89	125.11	119.49	115.69	117.36	113.47
• Commercial Vehicle	27.77	38.75	38.22	37.94	38.02	37.75
Sub-Total	114.67	163.86	157.70	153.63	155.37	151.22
NMVOC (tonnes per Day)						
• Private Vehicle	40.65	58.53	55.89	54.12	54.90	53.08
• Commercial Vehicle	17.22	24.02	23.69	23.52	23.57	23.40
Sub-Total	57.87	82.55	79.59	77.64	78.47	76.48
SO_x (tonnes per Day)						
• Private Vehicle	2.596	3.738	3.570	3.457	3.506	3.390
• Commercial Vehicle	3.086	4.306	4.246	4.216	4.224	4.194
Sub-Total	5.682	8.044	7.816	7.673	7.731	7.584
CO_2 (tonnes per Day)						
• Private Vehicle	17,581.6	25,314.4	24,175.7	23,408.1	23,745.2	22,958.1
• Commercial Vehicle	4,267.8	5,955.1	5,873.2	5,830.9	5,842.4	5,801.1

Table 1: Performance Indicators *(continued)*

Sub-Total	21,849.3	31,269.4	30,048.9	29,239.1	29,587.6	28,759.2
Network Performance Indicators	**Year 2000 Run28**	**Year 2021 BASE 20/2020**	**Year 2021 Do Something 20/2020**	**Year 2021 Do Something 20/2020 + Pricing (15c/km)**	**Year 2021 Do Something 20/2020 + Travel Smart**	**20/2020 Do Something + Pricing (15c/km) + Travel Smart**
	MSD Only	**MSD Only**	**MSD Only**	**MSD Only**	**MSD Only**	**MSD Only**
CH_4 (tonnes per Day)						
• Private Vehicle	6.491	9.346	8.925	8.642	8.766	8.476
• Commercial Vehicle	0.931	1.299	1.281	1.272	1.275	1.266
Sub-Total	7.422	10.645	10.207	9.914	10.041	9.741
N_2O (tonnes per Day)						
• Private Vehicle	1.623	2.336	2.231	2.160	2.192	2.119
• Commercial Vehicle	0.164	0.229	0.226	0.225	0.225	0.223
Sub-Total	1.787	2.566	2.457	2.385	2.417	2.342
CO (tonnes per Day)						
• Private Vehicle	591.23	851.26	812.97	787.16	798.49	772.03
• Commercial Vehicle	164.71	229.82	226.66	225.03	225.48	223.88
Sub-Total	755.93	1,081.08	1,039.64	1,012.19	1,023.97	995.91
Particulate Emissions (tonnes per Day)						
• Private Vehicle	3.729	5.270	5.078	4.939	5.001	4.855
• Commercial Vehicle	0.717	0.974	0.966	0.961	0.963	0.958
Sub-Total	4.446	6.244	6.044	5.900	5.964	5.813
Person Trip Statistics						
PT Passenger Trips (per day)						
• AM Peak **	196,649	270,775	326,287	347,247	353,665	381,970
• Off-Peak **	417,772	559,821	717,776	775,618	790,066	853,183
• PM Peak **	148,051	215,478	275,203	306,933	306,246	337,629
Total Vehicle Trips (per day) **	7,110,055	9,235,109	9,038,559	8,937,797	8,801,166	8,691,562
Passenger Trips Categorised (per day)						
• Total Persons in Cars **	9,634,200	12,227,469	11,975,167	11,849,280	11,636,820	11,501,130
• Total Persons in Comm. Vehicles **	434,975	564,139	564,139	564,139	564,139	564,139
• Total Persons on PT **	762,472	1,046,074	1,319,266	1,429,798	1,449,977	1,572,782
• Total Persons Walking/Cycling **	1,770,577	2,099,145	2,078,258	2,093,811	2,286,088	2,303,190
Total	**12,602,224**	**15,936,827**	**15,936,830**	**15,937,028**	**15,937,024**	**15,941,241**
Mode Splits (per day)						
• Total Persons in Cars **	79.18%	79.54%	77.90%	77.08%	75.70%	74.79%
Total Persons in CV **	-	-	-	-	-	-
• Total Persons on PT **	6.27%	6.80%	8.58%	9.30%	9.43%	10.23%
Total Persons Walk/Cycle **	14.55%	13.66%	13.52%	13.62%	14.87%	14.98%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

Note : ** - Values contain Intrazonal Trips
^ - Values do NOT contain Intrazonal Trips

Figure 2: Ipswich Corridor Boardings, Alightings, Population Growth and Line Loadings (AM – 2000)



Nergal\01-011\Graphics\2000 Ipswich Board, Alight, Pop Growth and Line Load.wor

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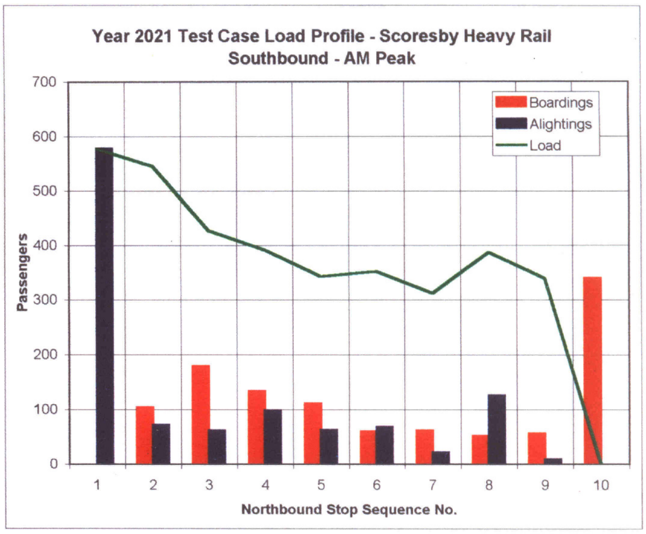
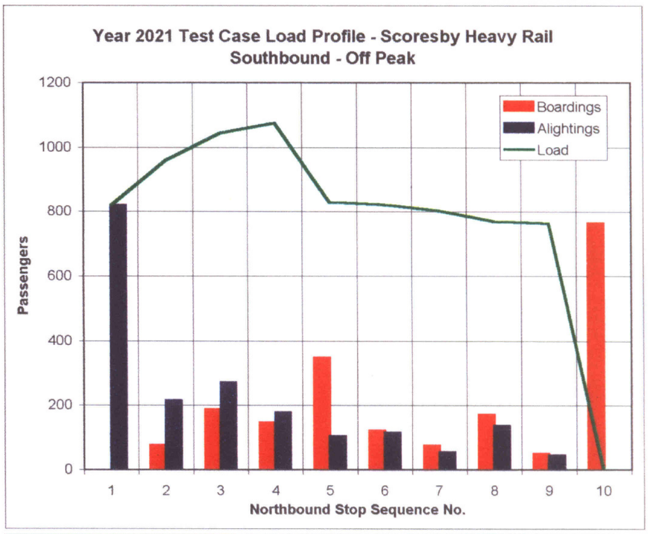
Figure 3: Year 2021 Test 2 Load Profiles – ScorRail_SB

NB Stop Sequ.	Stop Name	Node_ID
1	Dandenong Stn	14263
2	Yarraman Stn	14069
3	Princes Highway Station	19349
4	Police Road Station	19350
5	Wellington Road Station	19351
6	Ferntree Gully Road Station	19352
7	High Street Road Station	19353
8	Burwood Hwy Station	19354
9	Canterbury Road Station	19355
10	Heatherdale Stn	14292





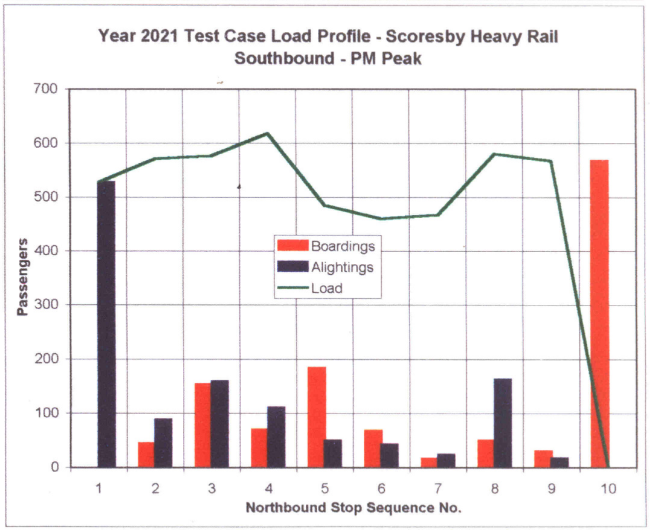


Figure 4: Year 2021 Test 2 Load Profiles – Hunt_Row_EB

Stop Sequence	Stop Name	Node_ID
1	Monash (C)	19336
2	Monash (C)	19337
3	Monash (C)	19338
4	Monash (C)	19339
5	Monash (C)	19340
6	Monash (C)	19341
7	Monash (C)	16557
8	Monash (C)	19342
9	Monash (C)	19343
10	Monash (C)	19344
11	Monash (C)	19345
12	Monash (C)	19346
13	Knox (C)	19347
14	Knox (C)	16637
15	Knox (C)	16641
16	Knox (C)	16532

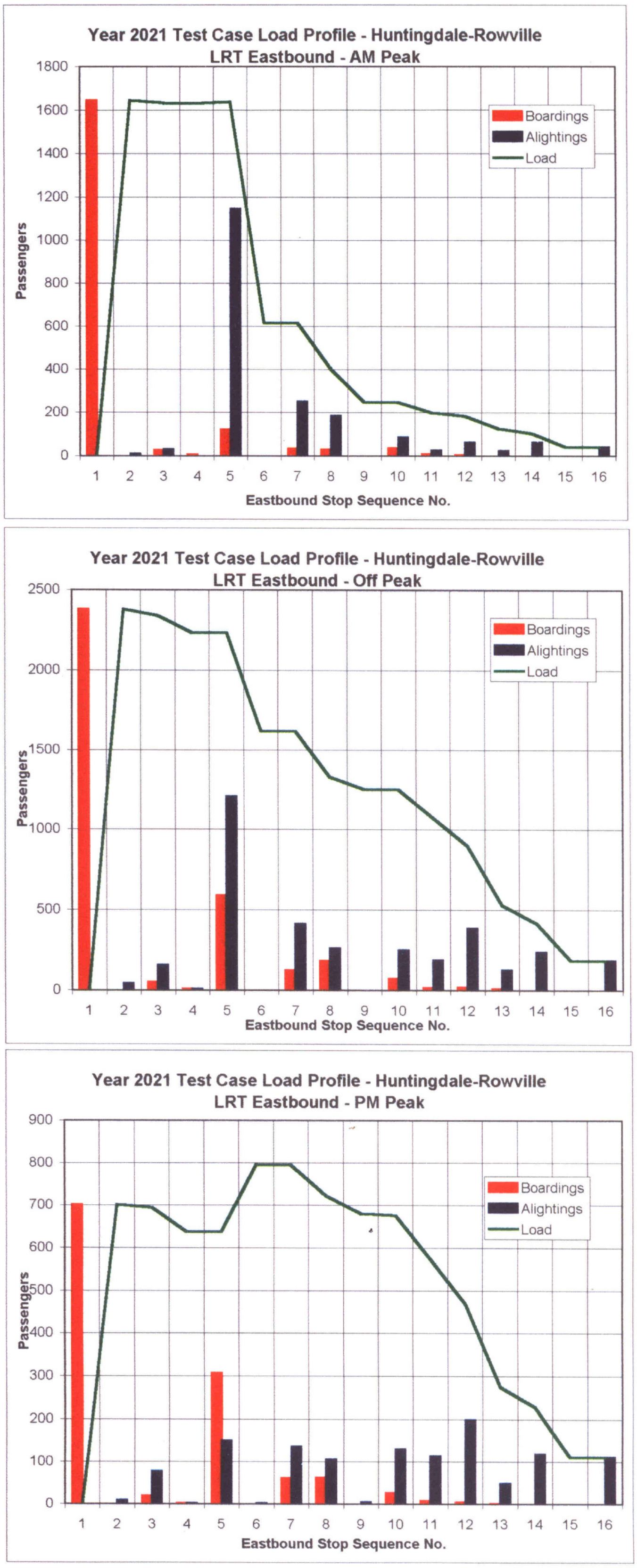


Figure 5: Destination of Walk Access – Walk Egress Trips Boarding at Spencer Street Station in the Year 2000

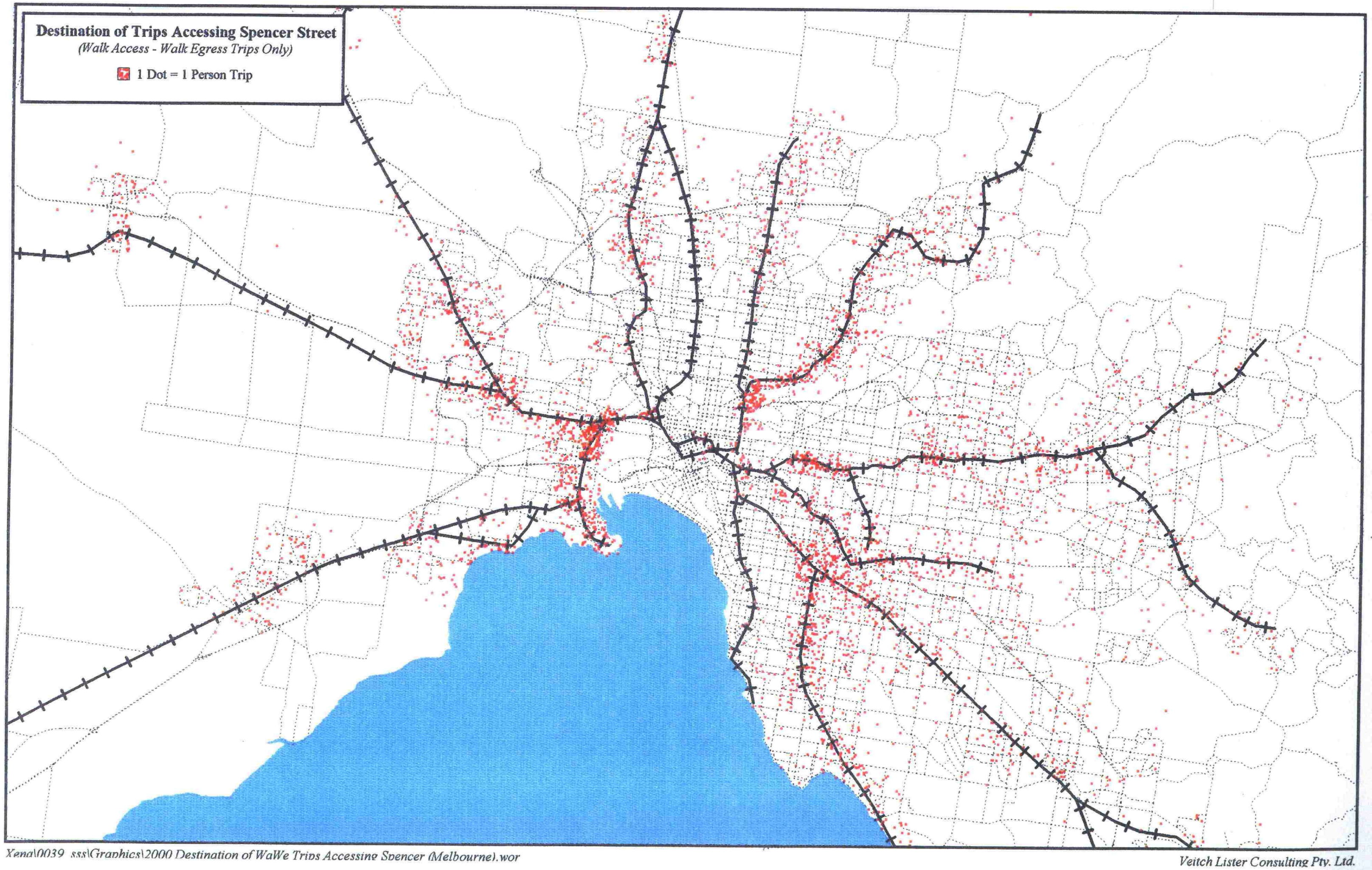
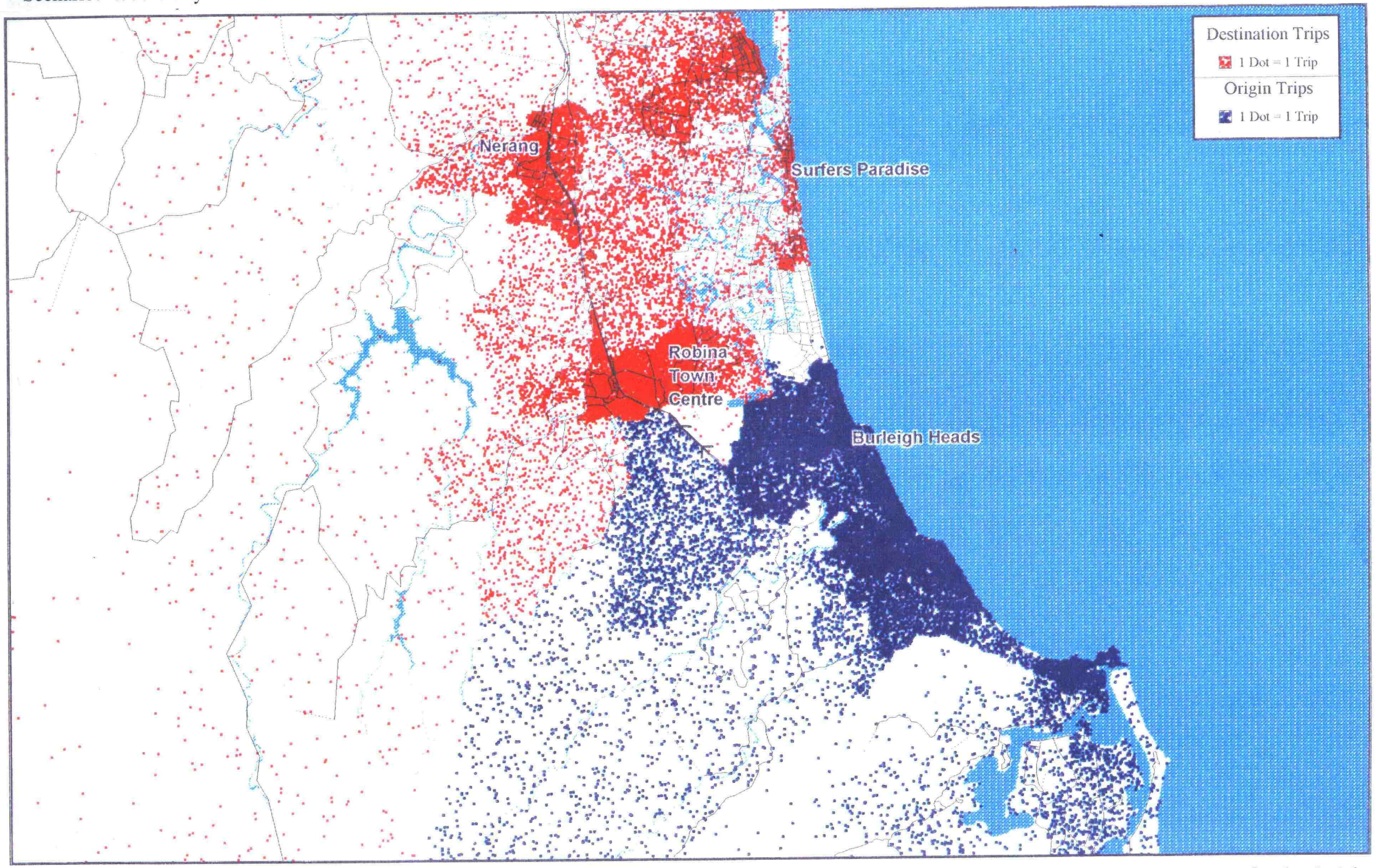


Figure 6: Rail Station Boardings Destined to Spencer Street Station in the Year 2000

Figure 7: VLC Zenith Model
Origin & Destination of Trips on the Pacific Highway (Northbound)

Scenario: 1999 Daily



Appendix B: Modelled Volumes versus Counts

Count Nr	Location	Modelled	Count	Difference	% Difference
181	Abbott St 500m N of Oonoonba Rd (Northbound)	8,730	6,704	2,026	30%
180	Abbott St 500m N of Oonoonba Rd (Southbound)	8,604	6,530	2,074	32%
179	Abbott St 750m N of Bruce Hwy (Northbound)	4,964	4,201	763	18%
178	Abbott St 750m N of Bruce Hwy (Southbound)	4,918	3,950	968	25%
159	Angus Smith Drive 100m S of Rside Blvd (Eastbound)	5,610	7,798	-2,188	-28%
158	Angus Smith Drive 100m S of Rside Blvd (Westbound)	5,343	7,621	-2,278	-30%
54	Archer St, At Railway X'ing, E	227	595	-368	-62%
55	Archer St, At Railway X'ing, W	225	548	-323	-59%
112	Boundary St 100m W of Samphire Cr (Eastbound)	2,843	2,876	-33	-1%
111	Boundary St 100m W of Samphire Cres (Westbound)	2,838	2,890	-52	-2%
116	Boundary St Adj Civic Ctr (Eastbound)	7,895	5,992	1,903	32%
115	Boundary St Adj Civic Ctr (Westbound)	8,070	6,131	1,939	32%
133	Bruce Hwy 150m Nth of Veals Rd (Eastbound)	6,613	6,667	-54	-1%
132	Bruce Hwy 150m Nth of Veals Rd (Westbound)	6,615	6,390	225	4%
184	Bruce Hwy 1km W of Hunter St (Northbound)	6,110	5,431	679	13%
183	Bruce Hwy 1km W of Hunter St (Southbound)	6,108	5,396	712	13%
135	Bruce Hwy 300m Sth of Greenvale Rlwy O'Pass (Eastb	4,479	4,514	-35	-1%
134	Bruce Hwy 300m Sth of Greenvale Rlwy O'Pass (Westb	4,478	4,505	-27	-1%
131	Bruce Hwy 300m Sth Of Mt Low Pkwy (Eastbound)	10,068	10,005	63	1%
130	Bruce Hwy 300m Sth Of Mt Low Pkwy (Westbound)	10,097	9,730	367	4%
185	Bruce Hwy 700m N of Allendale Rd (Northbound)	3,734	3,478	256	7%
186	Bruce Hwy 700m N of Allendale Rd (Southbound)	3,735	3,530	205	6%
126	Bruce Hwy @ Ingham Rd City Side (Eastbound)	8,985	7,954	1,031	13%
127	Bruce Hwy @ Ingham Rd City Side (Westbound)	8,933	7,923	1,010	13%
81	Bundock St, @ St James Dr, EBND	11,901	12,286	-385	-3%
80	Bundock St, @ St James Dr, WBND	11,869	12,566	-697	-6%
176	C Towers Rd 50m N of Townsend St (Northbound)	11,237	12,421	-1,184	-10%
177	C Towers Rd 50m N of Townsend St (Southbound)	10,551	12,299	-1,748	-14%
119	C Towers Rd Adj Hermit Park Hotel (Northbound)	13,265	10,778	2,487	23%
120	C Towers Rd Adj Hermit Park Hotel (Southbound)	13,305	11,047	2,258	20%
69	Dean St, George Roberts Bridge, N	8,003	6,895	1,108	16%
68	Dean St, George Roberts Bridge, S	8,164	7,071	1,093	15%
198	Dearness St, Ebnd	1,697	946	751	79%
197	Dearness St, Wbnd	1,663	1,065	598	56%
79	Denham St, Btwn Flinders & Sturt St, Ebnd	5,384	8,824	-3,440	-39%
78	Denham St, Btwn Flinders & Sturt St, Wbnd	5,473	8,369	-2,896	-35%
212	Discovery Dve Conn Rd (Eastbound)	5,410	3,239	2,171	67%
211	Discovery Dve Conn Rd (Westbound)	5,666	3,124	2,542	81%
163	Douglas Arterial @ Angus Smith O'Pass (Eastbound)	4,972	4,291	681	16%
162	Douglas Arterial @ Angus Smith O'Pass (Westbound)	4,937	4,102	835	20%
155	Douglas Arterial @ Ross River (Eastbound)	10,194	7,916	2,278	29%
156	Douglas Arterial @ Ross River (Westbound)	10,160	7,813	2,347	30%
213	Echlin St, Ingham Rd to Humphrey St, Nbnd	1,641	1,020	621	61%
214	Echlin St, Ingham Rd to Humphrey St, Sbnd	1,910	1,107	803	73%
56	Filnders St, Btwn Denham St & Wickham St, E	5,176	5,108	68	1%
103	Flinders St, Aplin St to Blackwood St, Nbnd	5,745	5,388	357	7%
104	Flinders St, Aplin St to Blackwood St, Nbnd	5,620	4,931	689	14%
57	Flinders St, Btwn Denham St & Wickham St, W	5,684	5,364	320	6%
105	Flinders St, Morris St to Knapp St, Ebnd	5,913	5,398	515	10%

Count Nr	Location	Modelled	Count	Difference	% Difference
106	Flinders St, Morris St to Knapp St, Wbnd	6,039	6,322	-283	-4%
239	Gregory St, Clifton St to Murray St, Ebnd	1,622	2,668	-1,046	-39%
240	Gregory St, Clifton St to Murray St, Wbnd	1,617	2,194	-577	-26%
218	Gregory St,Mitchell St to the Strand, Ebnd	2,443	2,562	-119	-5%
217	Gregory St,Mitchell St to the Strand, Wbnd	2,805	2,541	264	10%
195	Halifax St, Airport to Meenan St, Ebnd	3,298	3,279	19	1%
196	Halifax St, Airport to Meenan St, Ebnd	3,335	3,386	-51	-1%
110	Heatley St, Bundock St to Primrose St, Nbnd	3,034	2,975	59	2%
109	Heatley St, Bundock St to Primrose St, Sbnd	3,029	2,893	136	5%
145	Hervey Range Rd E of Golf Links Drive (Eastbound)	3,708	5,668	-1,960	-35%
146	Hervey Range Rd E of Golf Links Drive (Westbound)	3,738	5,445	-1,707	-31%
154	Hervey Range Rd E of GumlowRd (Eastbound)	3,679	2,779	900	32%
153	Hervey Range Rd E of GumlowRd (Westbound)	3,701	2,738	963	35%
141	Hervey Range Rd E of Kern Br Drive (Eastbound)	8,855	7,900	955	12%
142	Hervey Range Rd E of Kern Br Drive (Westbound)	8,744	7,586	1,158	15%
149	Hervey Range Rd W of Blk Rvr Rd (Eastbound)	439	389	50	13%
150	Hervey Range Rd W of Blk Rvr Rd (Westbound)	440	383	57	15%
147	Hervey Range Rd W of Rupertswood Drive (Eastbound)	453	682	-229	-34%
148	Hervey Range Rd W of Rupertswood Drive (Westbound)	474	654	-180	-28%
151	Hervey Range Rd W of West Rd (Eastbound)	3,609	1,820	1,789	98%
152	Hervey Range Rd W of West Rd (Westbound)	3,631	1,779	1,852	104%
209	Howitt St, Cook St to Eyre St, Nbnd	3,201	3,127	74	2%
210	Howitt St, Cook St to Eyre St, Sbnd	3,239	3,110	129	4%
207	Hugh St @ TCC Depot, Nbnd	11,867	11,302	565	5%
208	Hugh St @ TCC Depot, Sbnd	11,824	10,860	964	9%
201	Ingham Rd, E of Hugh ST, Ebnd	3,793	5,834	-2,041	-35%
202	Ingham Rd, E of Hugh ST, Wbnd	3,744	5,288	-1,544	-29%
204	Ingham Rd, W of Hugh ST, Ebnd	4,871	8,943	-4,072	-46%
203	Ingham Rd, W of Hugh ST, Wbnd	4,915	7,549	-2,634	-35%
205	Ingham Rd, W of Mather ST, Ebnd	4,272	6,348	-2,076	-33%
206	Ingham Rd, W of Mather ST, Wbnd	4,312	6,581	-2,269	-34%
193	John Melton Black Dr, Ebnd	2,169	1,417	752	53%
194	John Melton Black Dr, Wbnd	2,132	1,479	653	44%
222	Kings Rd, Bayswater Rd to View St, Nbnd	5,569	8,501	-2,932	-34%
221	Kings Rd, Bayswater Rd to View St, Sbnd	5,346	8,298	-2,952	-36%
108	Lowth's Bridge, Ebnd	2,804	3,046	-242	-8%
107	Lowth's Bridge, Wbnd	2,900	3,207	-307	-10%
31	Main Dalrymple Rd, E of Banfield Dr, SW	15,065	12,636	2,429	19%
32	Main Dalrymple Rd, E of Banfield Rd, NE	15,039	13,151	1,888	14%
29	Main Dalrymple Rd, E of Nathan St, NE	14,323	13,702	621	5%
28	Main Dalrymple Rd, E of Nathan St, SW	14,367	13,905	462	3%
190	Mariners Dr, Nbnd	684	716	-32	-4%
189	Mariners Dr, Sbnd	685	714	-29	-4%
58	McIlwraith St, Btwn Dean St & Plume St, E	1,756	1,537	219	14%
59	McIlwraith, Btwn Dean St & Plume St, W	1,968	1,890	78	4%
200	Meenan St, Lonerganne St to Chandler St, Nbnd	4,814	4,093	721	18%
199	Meenan St, Lonerganne St to Chandler St, Sbnd	4,743	4,442	301	7%
86	Melton Tce, North of Denham	1,212	1,236	-24	-2%
165	Nathan St 150m Sth of Ross River (Northbound)	19,395	18,820	575	3%

Count Nr	Location	Modelled	Count	Difference	% Difference
164	Nathan St 150m Sth of Ross River (Southbound)	19,376	19,328	48	0%
167	Nathan St 50m Nth of Raynor St (Northbound)	13,517	14,746	-1,229	-8%
166	Nathan St 50m Nth of Raynor St (Southbound)	13,749	12,662	1,087	9%
223	Oxley St, Fronting Cathedral, Nbnd	7,799	8,227	-428	-5%
224	Oxley St, Fronting Cathedral, Sbnd	8,575	7,847	728	9%
225	Queens Rd, Ackerst St to Armstrong St, Nbnd	2,990	4,213	-1,223	-29%
226	Queens Rd, Ackerst St to Armstrong St, Sbnd	3,014	4,262	-1,248	-29%
227	Queens Rd, Jameson St to Hirst St, Nbnd	2,619	2,326	293	13%
228	Queens Rd, Jameson St to Hirst St, Nbnd	3,436	2,770	666	24%
229	Queens Rd, Third Ave to Railway Ave, Ebnd	2,378	3,644	-1,266	-35%
230	Queens Rd, Third Ave to Railway Ave, Wbnd	2,394	3,749	-1,355	-36%
113	Railway Ave 30m Nth of Queens Rd (Northbound)	10,454	9,277	1,177	13%
114	Railway Ave 30m Nth of Queens Rd (Southbound)	10,359	9,302	1,057	11%
82	Ross River Rd, Between Nathan St & Elizabeth St, E	15,741	13,751	1,990	14%
83	Ross River Rd, Between Nathan St & Elizabeth St, W	15,381	14,487	894	6%
84	Ross River Rd, Cathedral School, EB	15,321	13,290	2,031	15%
85	Ross River Rd, Cathedral School, WB	15,087	14,272	815	6%
235	Ross Rvier Rd @ St Ignatius College (Eastbound)	13,661	12,078	1,583	13%
236	Ross Rvier Rd @ St Ignatius College (Westbound)	13,654	12,197	1,457	12%
137	Ross Rvier Rd @ Weir School (Eastbound)	9,488	9,804	-316	-3%
138	Ross Rvier Rd @ Weir School (Westbound)	9,376	9,870	-494	-5%
241	Saunders Ck 300m E of Geaney La (Eastbound)	13,737	12,070	1,667	14%
242	Saunders Ck 300m E of Geaney La (Westbound)	13,753	11,888	1,865	16%
117	Saunders St Rail O'Pass (Northbound)	10,385	8,967	1,418	16%
118	Saunders St Rail O'Pass (Southbound)	10,466	9,140	1,326	15%
188	Sir Leslie Theiss Dr, North of the Strand, Nbnd	3,332	3,080	252	8%
187	Sir Leslie Theiss Dr, North of the Strand, Sbnd	3,336	3,163	173	5%
231	Stanley St,Wills St to Hale St, Nbnd	2,529	2,477	52	2%
232	Stanley St,Wills St to Hale St, Nbnd	2,511	2,890	-379	-13%
50	Stuart Dr, S of Edison St, NW	7,030	6,656	374	6%
49	Stuart Dr, S of Edison St, SE	6,988	6,520	468	7%
53	Stuart Dr, S of Mt Stuart Dr, N	2,025	2,094	-69	-3%
52	Stuart Dr, S of Mt Stuart Rd, S	2,025	2,100	-75	-4%
174	Stuart Drive 200m N of Love Lane (Northbound)	9,785	9,937	-152	-2%
175	Stuart Drive 200m N of Love Lane (Southbound)	9,811	9,571	240	3%
173	Stuart Drive 400m from Uni Rd Int (Northbound)	5,892	7,147	-1,255	-18%
172	Stuart Drive 400m from Uni Rd Int (Southbound)	5,913	6,818	-905	-13%
99	Sturt St, Aplin St to Blackwood St, Nbnd	9,982	10,677	-695	-7%
100	Sturt St, Aplin St to Blackwood St, Sbnd	9,848	9,928	-80	-1%
97	Sturt St, Greenslade St to Morris St, Nbnd	5,944	7,958	-2,014	-25%
98	Sturt St, Greenslade St to Morris St, Sbnd	5,687	9,135	-3,448	-38%
101	Sturt St, Stokes St to Stanley St, Nbnd	4,061	5,497	-1,436	-26%
102	Sturt St, Stokes St to Stanley St, Sbnd	3,823	5,330	-1,507	-28%
89	The Strand, Btwn Fryer St & Wickham St, E	1,167	3,172	-2,005	-63%
90	The Strand, Btwn Fryer St & Wickham St, W	1,933	3,027	-1,094	-36%
234	The Strand, Landsborough St to Mckinley St, Nbnd	1,128	2,903	-1,775	-61%
233	The Strand, Landsborough St to Mckinley St, Sbnd	1,075	2,979	-1,904	-64%
143	Thuringowa Dr @ Kirwan State School (Northbound)	12,807	15,182	-2,375	-16%
144	Thuringowa Dr @ Kirwan State School (Southbound)	12,930	14,218	-1,288	-9%

Count Nr	Location	Modelled	Count	Difference	% Difference
35	Thuringowa Dr, S of Dalrymple Rd, N	10,330	8,811	1,519	17%
34	Thuringowa Dr, S of Dalrymple Rd, S	10,331	8,172	2,159	26%
169	University Rd 200m E of Mark Reid Dr (Eastbound)	13,980	12,665	1,315	10%
168	University Rd 200m E of Mark Reid Dr (Westbound)	13,983	11,486	2,497	22%
170	University Rd 200m W of Cluden Racecourse (Eastbou	7,312	6,409	903	14%
171	University Rd 200m W of Cluden Racecourse (Westbou	7,321	6,328	993	16%
46	University Rd, E of Lachlan Wilson Dr, E	7,069	8,134	-1,065	-13%
47	University Rd, E of Lachlan Wilson Dr, W	7,056	8,478	-1,422	-17%
44	Upper Ross River Rd, Btwn Allambie Ln & Shops, N	8,057	9,054	-997	-11%
43	Upper Ross River Rd, Btwn Allambie Ln & Shops, S	8,066	8,310	-244	-3%
40	Upper Ross River Rd, N of Gollogly Ln, N	11,322	9,671	1,651	17%
41	Upper Ross River Rd, N of Gollogly, S	11,465	10,189	1,276	13%
71	Upper Ross River Rd, N of Ring Rd, N	15,124	16,950	-1,826	-11%
72	Upper Ross River Rd, N of Ring Rd, S	15,307	16,885	-1,578	-9%
95	Walker St, Denham to Stokes St, Nbnd	2,472	2,656	-184	-7%
96	Walker St, Denham to Stokes St, Sbnd	2,361	2,979	-618	-21%
77	Warburton St, Btwn Styx St & Howitt St, NW	7,419	8,684	-1,265	-15%
76	Warburton St, Btwn Styx St & Howitt St, SE	7,474	8,252	-778	-9%
22	Woolcock St, Btwn Dalrymple Rd & Hugh St, E	18,223	17,857	366	2%
23	Woolcock St, Btwn Dalrymple Rd & Hugh St, W	18,599	19,490	-891	-5%
191	Woolcock St, E of Hugh St, E	12,125	13,476	-1,351	-10%
192	Woolcock St, E of Hugh St, W	13,151	16,238	-3,087	-19%
19	Woolcock St, W of Dalrymple Rd, E	6,593	6,222	371	6%
20	Woolcock St, W of Dalrymple Rd, W	6,528	6,169	359	6%

ATTACHMENT D: COUNCIL'S PARKING AND ACCESS CODE

6.24 PARKING AND ACCESS CODE

OVERALL OUTCOMES

The purpose of this code is to achieve the following outcomes:

(a) Sufficient and convenient parking which accommodates the volume and type of vehicle traffic expected to be generated by the use.

(b) Car parking layouts are designed to be operationally safe, functional and self-draining and are of a standard suitable to the expected lifespan of the development.

(c) On-site vehicle parking does not detract from the streetscape character or amenity of an area.

(d) Management of access to premises achieves safe and effective operating conditions on the road network.

(e) Adequate public transport, pedestrian and cycling facilities are provided.

SPECIFIC OUTCOMES AND PROBABLE SOLUTIONS

(1) VEHICLE PARKING

SPECIFIC OUTCOMES	PROBABLE SOLUTIONS
SO1 Adequate on-site parking is provided for the needs of the users and visitors.	**PS1.1** On-site parking spaces are provided in accordance with Appendix 1 of this code – Parking Provision.[314] **OR** **PS1.2** Where it is impracticable or unreasonable to provide on-site carparking (in part or in full) a cash contribution is paid in accordance with the rates set out in the relevant Planning Scheme Policy.

The following is a non-statutory inclusion for information purposes only and does not form part of the City Plan.

[314] As a result of the high level of pedestrian activity on Magnetic Island compared to the mainland, a lesser amount of car parking may be acceptable.

SPECIFIC OUTCOMES		PROBABLE SOLUTIONS	
SO2	A reasonable portion of the total number of car parking spaces are wheelchair accessible spaces and these are identified and reserved for such access.	**PS2.1**	The proportion of total parking spaces provided for people with disabilities is in accordance with AS2890.1 – Parking Facilities: Off-Street Car Parking, Table 1.1.
		AND	
		PS2.2	Access to spaces for people with disabilities is provided in accordance with AS1428.1 – Design for access and mobility: General Requirements for Access: New Building Work and AS2890.1- Off-Street Car Parking.
SO3	All car parks are kerbed or provided with other similar treatments that surround and positively constrain vehicles within the trafficked area for parking purposes only.	**PS3.1**	The location and type of physical barriers are in accordance with AS2890.1 – Parking Facilities: Off-Street Car Parking, Section 2.4.4.
SO4	The car park pavement is constructed to an appropriate standard.	**PS4.1**	Pavement design is in accordance with the provisions of Aus-spec Development Design Specification D2 – Pavement.
SO5	Trolley bays and pedestrian walkways are located to ensure safe access and storage of trolleys.	**PS5.1**	Trolley bays and pedestrian walkways are located in accordance with AS2890.1 - Parking Facilities: Off-Street Car Parking, Section 4.
SO6	Short-term visitor parking is provided in obvious and easily accessible locations.	**PS6.1**	Visitor parking required under Appendix 1 is provided at the front or on the main approach side of the site, with easy access to the building entry, other than where an alternative location is nominated in another code.
SO7	Where car parking areas are located adjacent to residential uses or land in a residential precinct, adequate provision is made to minimise noise levels.	No probable solution provided.	
SO8	Access to the car park is safe for all road users both within and external to the site.	**PS8.1**	Sight distances at car park exits are in accordance with AS2890.1 – Parking Facilities: Off-Street Car Parking.
		AND	

SPECIFIC OUTCOMES	PROBABLE SOLUTIONS
	PS8.2 Queuing space is provided both within the street for safe entry into the site and within the car park access driveway for safe egress of the site in accordance with AS2890.1 – Parking Facilities: Off-Street Car Parking. **AND** **PS8.3** All driveway crossovers servicing the premises are constructed in accordance with Aus-Spec D1 – Road Geometry, Standard Drawing 46399 and comply with the standards set out in Schedule 2.[315]
SO9 Public transport parking spaces are provided for all activities that generate a high demand for the use of buses and/or taxis.	**PS9.1** At least one bus parking space with a minimum width of 4m, minimum length of 20m and a minimum clear height of 4.6m, and one taxi parking space are provided where the development is for the purposes of: • accommodation building; • hotel; • motel having at least 20 units; • retirement village; • educational establishment; • shopping complex; • an indoor recreation; • outdoor recreation facility; or any other use of a similar type and scale.
SO10 Bicycle parking spaces are provided for all activities that generate a demand for the use of bicycles.	**PS10.1** Parking and end of trip facilities for bicycles are provided in accordance with AS2890.3 – Bicycle Parking Facilities and with the AUSTROADS Guide to Traffic Engineering Practice Part 14 – Bicycles (Chapter 10).

The following is a non-statutory inclusion for information purposes only and does not form part of the City Plan.

[315] Applicants should note that where a development proposes access to a State controlled road, the Department of Main Roads will require the access to be in accordance with its "Planning and Design Manual".

SPECIFIC OUTCOMES	PROBABLE SOLUTIONS
SO11 Vehicle parking spaces have adequate dimensions to meet user requirements.	**PS11.1** Car parking spaces are at least 2.7m wide. **AND** **PS11.2** Service vehicle loading areas are designed in accordance with AS2890.2 - Off Street Parking – Commercial Vehicle Facilities.
SO12 Parking areas are kept accessible and available for use as a car park at all times during the normal business hours of the activity.	**PS12.1** Signage is erected indicating the location of the entry and exits to the car park, specific use bays (eg. disabled, bus, taxi, bicycle, loading), as well as regulatory signs controlling movement within the car park. **AND** **PS12.2** Signage is in accordance with AS2890.1 – Parking Facilities – Off-Street Parking, the Manual of Uniform Traffic Control Devices (AS1742).
SO13 Car park areas have appropriate lighting for activities that operate at night.	**PS13.1** Lighting is provided in accordance with AS1158 – Road Lighting and AS1158 – Public Lighting Code.
SO14 Car washing areas are provided to minimise environmental impacts in development for the purposes of: • Accommodation building; • Multiple dwelling; **AND** • Retirement village.	**PS14.1** A dedicated car washing bay (additional to visitor and tenant parking spaces) is provided for the washing of motor vehicles when using detergents, polishes, waxes or other car cleaning preparations. Such bays are designed and constructed including the following: • Imperviously paved; • Provided with a hose cock; • Graded to a central drain incorporating a silt trap. **AND** **PS14.2** Car washing bays are fitted with a diversion valve which allows contaminated run-off to pass to a sewer. **OR** **PS14.3** Car washing bays are fitted with a roof or automatic control device that prevents the ingress of stormwater to sewers.

(2) ON-SITE VEHICLE MOVEMENT

SPECIFIC OUTCOMES	PROBABLE SOLUTIONS
SO15 Vehicle manoeuvring areas are designed to be safe and functional.	**PS15.1** Aisles within car parks are designed in accordance with AS2890.1 – Parking Facilities – Off-Street Parking. **AND** **PS15.2** Turning circles are designed in accordance with AS HB 72 (AUSTROADS 1995) – Design Vehicles and Turning Path Templates. **AND** **PS15.3** All vehicles expected to use the site are able to drive on and off the site in forward gear when the car park is full.

(3) DESIGN FOR SAFETY

SPECIFIC OUTCOMES	PROBABLE SOLUTIONS
SO16 All car parking areas, including enclosed and multi-level car parks, are sited and designed to maximise opportunities for surveillance.	**PS16.1** Car parks are located where they can be monitored by passers-by or the users of a site. **AND** **PS16.2** Walls are finished with light coloured materials which reflect light.
SO17 Where car parks are not required at night, entry to the car parking area is physically restricted.	No probable solution provided.

(4) ADDITIONAL REQUIREMENS FOR RESIDENTIAL DEVELOPMENT

SPECIFIC OUTCOMES	PROBABLE SOLUTIONS
SO18 Visitor parking remains accessible and useable to visitors at all times.	**PS18.1** Visitor car parking bays are not allocated to individual dwelling units. **AND** **PS18.2** Visitor car parking is not gated or located behind security doors/gates.

SPECIFIC OUTCOMES	PROBABLE SOLUTIONS
	AND **PS18.3** Visitor car parking is visible from the street frontage, clearly signed and delineated. **AND** **PS18.4** Visitor car parking bays are not provided in a tandem arrangement (other than in a dual occupancy). **AND** **PS18.5** Visitor car parking bays are not located in front of private storage rooms allocated to individual units. **AND** **PS18.6** Visitor car parking bays are not provided in parallel formation along a driveway.
SO19 The car park pavement is finished to an appropriate standard.	**PS19.1** Paths and driveways are finished with exposed aggregate, stenciled concrete or other aesthetic finish (Other than bare or painted concrete).

APPENDIX 1 – PARKING PROVISION

USE	MINIMUM CAR PARKING PROVISION
Accommodation building	1 space for every 2 beds provided, 1 for every 4 employees, **AND** an additional 1 covered space for a resident manager, **AND** a dedicated car washing bay (additional to visitor and tenant parking spaces).
Bed and breakfast	As per detached house.
Car washing station	2 spaces, **AND** queuing space within the site for 4 vehicles using or awaiting use of each washing bay.
Caravan park	1 space per van, relocatable home **AND** cabin site (to be located adjacent to such site), 1 visitor space per 10 such sites, 1 space for each 2 staff members, **AND** 1 space for a resident manager.
Caretaker's residence	1 covered space.
Catering shop	1 space per 15m^2 of total retail gross floor area **AND** 1 space for each 100m^2 of total storage gross floor area.
Child care centre	1 space for every 6 children able to be accommodated.
Commercial animal keeping	1 per 10 animals for which accommodation is provided on the premises **OR** 3, whichever is the greater.

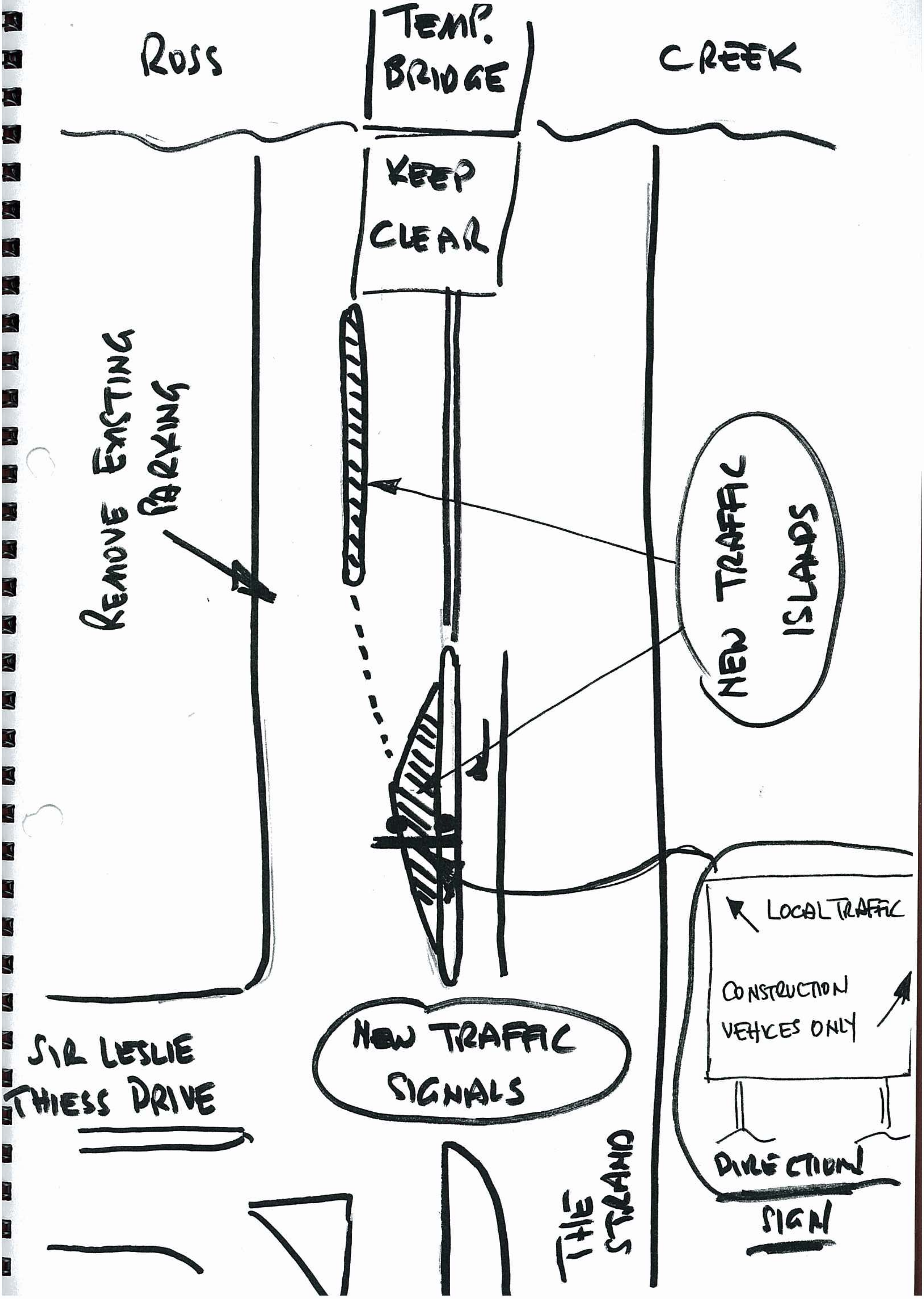
USE	MINIMUM CAR PARKING PROVISION
Community residence	2 spaces, which may be provided in tandem.
Cultural Facility	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Detached house	2 spaces, which may be provided in tandem.
Display home	2 spaces, which may be provided in tandem, one of which is to be covered.
Dual occupancy	Where located in a cul-de-sac or on an irregular shaped block, 2 on site carparking spaces (1 covered and integrated into the building) are provided for each dwelling unit which may be in a tandem arrangement. **OR** 2 covered spaces (1 per dwelling unit and integrated into the building) and 1 visitor car space (unless on Magnetic Island where the visitor car space is not required).
Educational Establishment	1 for each 2 employees, **AND** 1 per $50m^2$ of gross floor area of any room intended for use for public assembly.
Extractive industry	1 for each $100m^2$ of total use area.
Fast food outlet	1 space per $10m^2$ of gross floor area available to the public, 1 per $50m^2$ of gross floor area for food preparation, **AND** 1 per $100m^2$ of gross floor area used for storage.
Funeral director's premises	1 space per employee, 1 per hearse, **AND** 1 per 4 persons capable of being seated in any chapel or accommodated in a function area with a minimum of 10 spaces for such public use areas.
Garden centre	1 space per $100m^2$ of total use area, but not less than 5 spaces.
General industry	1 space per $100m^2$ of gross floor area.
Hospital	1 for each 4 beds, 2 for each 3 employees, **AND** 1 for each doctor.
Hotel	1 space per $2m^2$ of bar area, 1 space per $5m^2$ of the lounge and beer garden area, 1 space for each guest suite, **AND** 1 space for a resident manger or caretaker, **AND** for any drive-through facility, queuing space within the site for 10 vehicles being served or awaiting service.

USE	MINIMUM CAR PARKING PROVISION
Indoor recreation	
• **squash or other court game**	4 spaces per court.
• **indoor cricket, soccer or other "field" game**	20 spaces per "field".
• **swimming**	15 spaces, plus 1 space per 100m^2 of gross floor area.
• **gymnasium**	1 space per 10m^2 gross floor area.
• **licensed club**	1 space per 15m^2 for the first 1,500m^2 of gross floor area, then 1 space per 25m^2 of gross floor area thereafter.
• **other**	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Institutional residence	1 space per 6 dormitory type beds; 1 space per 4 hostel type units; 1 space per self-contained unit; 1 space for ambulance vehicle pick-up and set down; **AND** visitor parking equal to 50% of the resident parking requirement.
Intensive animal husbandry	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Landscape supplies	1 space per 100m^2 of total use area, but not less than 5 spaces.
Market	1 space per 15m^2 of gross floor area or total use area.
Medical centre	1 space per 20m^2 of gross floor area, **OR** 4 spaces per medical practitioner **AND** for each 2 other employees, whichever is the greater; **AND** 1 space for ambulance vehicle pick-up and set down.
Motel	1 space for each guest suite, 1 space for a restaurant manager or caretaker, **AND** 1 space for each 10m^2 of gross floor area available to the public **AND** 1 space per 50m^2 of gross floor area of kitchen and preparation areas.
Multiple dwelling	1 covered space per dwelling unit, **AND** 1 visitor car space for every 2 dwelling units (except on Magnetic Island where the visitor car space is not required), **AND** a dedicated car washing bay (additional to visitor and tenant parking spaces).
Office	
• **Banks, Post Offices**	3 spaces per 50m^2 of gross floor area.
• **Other**	1 space per 30m^2 of gross floor area.

USE	MINIMUM CAR PARKING PROVISION
Outdoor recreation	
• **tennis or other court game**	6 spaces per court.
• **cricket or football**	30 spaces per pitch or field, plus 1 space per 5 people able to be seated in stands.
• **lawn bowls**	30 spaces per green.
• **swimming**	15 spaces, plus 1 space per $100m^2$ of site area.
• **boat ramps**	Minimum number of car trailer units (CTU): 10-15 ctu spaces for one boat lane, 45 CTU spaces for 3 boat lanes and 90 CTU spaces for 4 boat lanes.
• **other**	sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Place of worship	1 space per 6 seats.
Restaurant	1 space per $10m^2$ of gross floor area available to the public **AND** 1 space per $50m^2$ of gross floor area of kitchen and preparation areas.
Retirement village	1 space per 6 nursing home beds; 1 space per 4 hostel type units; 1 space per self-contained unit; 1 space for ambulance vehicle pick-up and set down; **AND** visitor parking equal to 50% of the resident parking requirement, **AND** a dedicated car washing bay (additional to visitor and tenant parking spaces).
Roadside stall	Queuing space for 4 vehicles being served or awaiting service clear of through traffic lanes.
Rural service industry	2 spaces per lot or tenancy, **AND** 1 space per $100m^2$ of gross floor area.
Sales or hire yard	2 spaces, **AND** 1 space per $150m^2$ of total use area.
Service industry	1 space per $100m^2$ of gross floor area.
Service station	5 for the first lubricating or service bay and 4 for each additional lubricating or service bay, **AND** 1 per $15m^2$ of retail gross floor area.
Shop	1 space per $15m^2$ of total retail area **AND** 1 space for each $100m^2$ of total storage gross floor area.
Shopping complex	1 per $20m^2$ of total retail gross floor area **AND** 1 space for each $100m^2$ of total storage gross floor area.
Showroom	1 space per $40m^2$ of total use area.
Storage or contractor's yard	2 spaces, **AND** 1 space per $150m^2$ of total use area.

USE	MINIMUM CAR PARKING PROVISION
Transport depot	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Vehicle repair workshop	1 per $30m^2$ of total use area.
Warehouse	1 space per $100m^2$ of total use area.
Any other use	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.

ATTACHMENT E: POSSIBLE HOLDING AREA FOR CONSTRUCTION VEHICLES IN THE STRAND



ROSS
TEMP. BRIDGE
CREEK
KEEP CLEAR
REMOVE EXISTING PARKING
NEW TRAFFIC ISLANDS
LOCAL TRAFFIC
CONSTRUCTION VEHICES ONLY
DIRECTION SIGN
NEW TRAFFIC SIGNALS
SIR LESLIE THIESS DRIVE
THE STRAND