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Nowra CBD (East) Road Network Strategy Review

Prepared for Shoalhaven City Council

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1.0 INTRODUCTION

Determining a preferred road network strategy and traffic arrangements for the Nowra CBD has been the subject of detailed analysis and a series of reports since 2002/03. These have been developed in light of a number of proposed development scenarios on land to the east of the Princes Highway – Nowra CBD (East).

The conditional rezoning of land to allow further development east of the Princes Highway on land referred to as Nowra CBD (East) was made effective via amendment No. 202 to S.L.E.P. 1985 gazetted 2 April 2002.

A major review of Nowra's traffic, pedestrian, cycling and public transport arrangements was undertaken with the completion of the Nowra CBD Strategy by Eppell Olsen & Partners (now Cardno Eppell Olsen – CEO) in December 2003. This was prompted by proposals by AMP Henderson, then owner of Nowra Fair (the current Stockland Nowra shopping centre).

The key feature of the Strategy was the development of the concept of a new bypass road link between Princes Highway (at North Street and Junction Street) and Greenwell Point Road (in vicinity of Old Southern Road), known as the East Nowra Sub-Arterial (ENSA).

The strategic modelling undertaken concluded that ENSA was required to achieve satisfactory network operation in the assessment year 2016. It was therefore concluded to be required by 2016.

The AMP Henderson proposals were not proceeded with, and the centre was sold to Stockland.

A subsequent development proposal by Stockland in 2004 on Council owned land east of the existing Stockland Nowra site (east of the existing shopping centre, formerly known as Nowra Fair) was received by Council.

This proposal was for a staged shopping centre development that was significantly larger than was assumed in the earlier strategy, on a different parcel of land and with different proposed access arrangements. It would also require a greater degree of analysis to determine appropriate staged road construction to accommodate the proposed staged development.

This prompted a revision of the strategy. The review, known as the "Nowra CBD (East) Expansion Traffic Modelling Study", was undertaken by Eppell Olsen and Partners. It was substantially completed in August 2005, with the final report including concept designs completed in February 2006.

The Stockland proposal for the Council owned land was not proceeded with and following the work on the revised strategy in 2005, Council entered into an agreement with LEDA Holdings who proposed to develop a shopping centre on the same Council owned land east of Stockland Nowra (Fair). This was subject to development approval.

LEDA Holdings lodged a DA at the end of August, 2005 – DA05/3342. The development proposal by LEDA was not proposed to be staged, was larger again than the 2004 Stockland Stage 1 and 2 proposal combined, and incorporated design principles that were not consistent with the 2005 preferred road network strategy, including position of the link to ENSA, car park layout, and a new proposed link to Plunkett Street.

This prompted the need for further additional analysis to determine what revision of the strategy might be required to accommodate the LEDA proposal. Eppell Olsen and Partners was again engaged to undertake the LEDA Traffic Impact study. A draft report was completed in July 2006, which investigated the isolated impacts of the LEDA development proposal.

The lodgement of the DA by LEDA Holdings prompted Stockland to lodge a DA for expansion of the existing Stockland Nowra site. This was lodged on 3 March 2006 – DA06/1317. This latest development application by Stockland proposed to approximately double in size the existing Stockland Nowra Shopping centre (formerly known as Nowra Fair) on the same land as the existing Stockland Nowra (Fair) shopping centre.

The Stockland proposal also featured design principles that were not consistent with the 2005 preferred road network strategy, including:

- no direct links to ENSA (to mitigate impacts of Nowra CBD East development);
- increased use of the existing direct access / egress points on Princes Highway;
- increased use of Junction Street access points and therefore increased traffic volumes on Junction Street between Princes Highway and Stockland Nowra access;
- as well as increased traffic friction (conflicts) at the future proposed intersection of Junction Street/Brereton Street/Stockland Nowra access (Nowra CBD strategy).

This prompted concerns that this level of development on the Stockland Nowra (Fair) site would lead to unacceptable impacts of the development on the Princes Highway and Junction Street. The proposal also had no direct link to Plunkett Street which the LEDA impact study indicated would offer network benefits, albeit with negative environmental consequences on local roads.

Accordingly, the Stockland proposal prompted a need for additional analysis again to determine whether the proposal could be accommodated, within the existing strategy, and if not, whether a revision of the strategy could be determined to enable its accommodation. Cardno Eppell Olsen was engaged to undertake the Stockland Traffic Modelling study. A draft of this study was completed in August 2006; however the final study (including study review and additional modelling works reported at Appendix A) has been completed in April 2007.

Both the 2006 Stockland proposal for expansion of the existing Stockland Nowra site and the LEDA proposal for the site immediately to the east of the existing Stockland Nowra have been subject to separate independent isolated impact assessments, with only the previous 2004 Stockland staged proposal to the east of Stockland Nowra being included in any holistic assessment of the impacts of Nowra CBD East expansion (i.e. as per 2005 study – finalised February 2006).

It was considered that (in the longer term) the likelihood of both LEDA and Stockland proposals proceeding was a 'possibility' under the 2004 S.L.E.P. amendment (subject to detailed assessment and approval) and accordingly it was determined that this 'ultimate development' scenario had to be assessed in holistic view under the context of the Nowra CBD Strategy to determine whether that level of development could be accommodated or whether a revision of the strategy could be determined that could enable its accommodation.

It was determined to be required (holistic revision of the strategy) primarily as a result of and instigated by the 2006 Stockland development proposal (DA06/1317) and the potential additional level of development that proposal could create to the east of Princes Highway, which (when combined with the LEDA development proposal and Stockland Junction North development proposal) could create a significant increased level of development to the east of Princes Highway Nowra not previously envisaged by Council. In fact, equating to approximately 50% higher than previously envisaged in the 2005 strategy (February 2006 report) from Stockland and LEDA developments alone.

That is, if Stockland DA06/1317 was determined by the courts and approved (on the existing Stockland Nowra site), the likely potential commercial floor area in Nowra CBD (East) would be increased from the 2005 strategy assumptions from:

- 43,141sq.m envisaged south of Junction Street (2004 Staged Stockland proposal subject of 2005 strategy revision – February 2006 report);
- 5,000sq.m envisaged for Junction north development (assumed by Council 2005 strategy revision – February 2006 report);
- a total 48,141sq.m envisaged Stockland developments (2005 strategy revision – February 2006 report).

To:

- 62,380sq.m proposed 2006 Stockland + 2005 LEDA DA's south of Junction Street (2007 strategy revision – this report);
- 9,330sq.m proposed by Stockland in 2006 for Junction North development (2007 strategy revision – this report);
- a total 71,710sq.m proposed by Stockland and LEDA developments alone (2007 strategy revision – this report)

This represents a total increase of 23,569sq.m or 48.96% (approximately 50%) since the 2005 strategy revision i.e. considering the 2006 Stockland and 2005 LEDA proposed developments alone (2007 strategy revision – this report).

Accordingly, this significant change prompted the need for further detailed analysis of the impacts of this greater commercial expansion of Nowra CBD East.

It is acknowledged that the LEDA and Stockland developments are unlikely to both occur in the short term. However the proposals have presented to Council a development scenario that is possible under the new zone changes and quite likely in scale in the longer term. It is therefore considered important that any short term decisions made in conjunction with either the LEDA or Stockland developments are consistent with a longer term road network strategy that can accommodate increased development on the eastern side of the Princes Highway without operational difficulties.

Cardno Eppell Olsen have been engaged by Council to undertake traffic modelling analysis to test the impacts of these land use changes, including the 2006 Stockland and LEDA proposals, as well as to recommend the necessary revisions to the Nowra CBD Strategy (2005 road network strategy) in order to accommodate the now increased scale of development proposed to the east of the Princes Highway, Nowra.

This is a report of that review. It provides:

- a context by explaining the motivations behind Nowra's transport strategies;
- a brief history of the 2003 Strategy and the 2005 strategy revision;
- an outline of the potential development to the east of the Princes Highway, with emphasis on features of the Stockland and Leda proposals, in order to explain the assumptions behind the traffic modelling;
- a brief summary of other studies and analysis undertaken since 2003 of relevance to the Nowra CBD strategy and subsequent strategy revision;
- the results of the traffic modelling, including recommendations stemming from the modelling; and conclusions.

This report does NOT attempt to supersede the December 2003 traffic and transport study. It is intended to update the 2005 road network strategy with more confidence following incorporation of the latest development proposals, to refine and produce a road network concept design that will have satisfactory traffic operation and pedestrian safety, once development has occurred to a scale envisaged under the Nowra Bomaderry Structure Plan (2016 land use projections) and to a scale likely in the future on commercially zoned land east of Princes Highway Nowra CBD (noting current proposals by LEDA and Stockland with reference respectively to DA05/3342 and DA06/1317).

The traffic modelling that underpins the review has assumed a planned date of 2016, that is ten years out. The traffic demands for 2016 have been derived from Council's TRACKS modelling system which contains the latest Nowra/Bomaderry Structure Plan population and employment projections.

2.0 STRATEGIC OBJECTIVES OF TRAFFIC MANAGEMENT

This section explains the strategic objectives of the RTA and the Shoalhaven Council in relation to traffic in the CBD. The key reality is that the RTA is responsible for the Princes Highway, which passes through Nowra. The current alignment of the Princes Highway through Nowra (East Street) was developed between 1979 and 1981, replacing the previous Princes Highway alignment along Bridge Road, North Street, and Kinghorne Street. At that stage the new alignment formed the eastern boundary of the CBD. However, subsequent development to the east of the CBD, particularly the Nowra Fair shopping centre (approved in 1983) has increased east-west traffic and pedestrian movements across the highway.

The NSW Roads and Traffic Authority (RTA) are responsible for road safety and the efficient and safe movement of traffic on the Princes Highway. It is concerned that growth to the east of the Princes Highway will compromise safety and the road's efficiency as a transport corridor.

The construction of Jane Street as a grade separated means of accessing the Nowra Fair shopping centre for traffic and pedestrian movements was a condition of approval of the centre in order to mitigate the impacts of the centre on the Princes Highway.

The limitations with the present design of Jane Street from a pedestrian perspective, including poor pedestrian accessibility, poor pedestrian integration (lack of safe efficient connections from Jane Street to Nowra CBD and to Stockland), in conjunction with the current location of direct access points from the Stockland development to/from the Highway (more convenient for pedestrians than the present grade separated option), have contributed to a circumstance where the approved (present) design has not been effective in discouraging significant numbers of at-grade pedestrian crossings of the Princes Highway.

Limited direct access to the Highway was approved, and traffic signal phasing favours vehicles on the Highway at the expense of vehicles crossing or gaining access to the Highway.

RTA have been consistent in maintaining that this will continue along the Princes Highway (traffic signal adjustments favouring the Princes Highway) irrespective of the increasing demand for access to/from the Princes Highway to ensure the Highway is optimised as an efficient transport corridor.

Sophisticated traffic modelling software has been used in the 2003 strategy and its revision in order to balance the competing needs of the Princes Highway; that is local accessibility and safety versus through travel efficiency. In addition to ENSA, two broad approaches have been taken to management of the highway and of streets intersecting with it.

1. A feature of both the original and revised strategy has been the identification of bans on turning movements that could improve efficiency of the Princes Highway without causing operational problems on local streets. Maximising grade separated pedestrian opportunity for pedestrians with enhanced integration is also a feature aimed at optimising operational efficiency and safety of the Princes Highway, whilst promoting safe pedestrian integration between east and west.
2. A second response has been to increase the number of lanes on the east west roads at the intersection with the Highway, so that the maximum number of vehicles can make use of the relatively limited (and decreasing proportional) traffic signal cycle time available. Increasing the number of lanes is also considered necessary in view of the relatively short blocks between the Highway and adjacent parallel streets; that is, to contain queuing back from the Princes Highway to within the adjacent blocks to avoid operational difficulties and/or grid lock on local streets in the critical peak periods.

Both these strategies have enabled minimal green time for local movements, thereby promoting through movement on Princes Highway, and thereby protecting its integrity as a through transport corridor.

Shoalhaven Council is concerned to see that the Nowra CBD is readily accessible without accessibility being of detriment to major traffic corridors, and that traffic movement within the CBD is safe and efficient. However it also recognizes the CBD as a key pedestrian zone and wishes to minimize increases in traffic capacity that may threaten the amenity and safety of pedestrians in the town centre. A strategic objective is therefore to limit CBD streets to one lane in each direction where possible. The Council is also concerned to see that developments are designed to ensure access to the development by pedestrians is both safe and convenient, and that developers consider the likely desire lines and volume of pedestrians in the design of appropriate and adequate pedestrian treatments.

Both the Council and the RTA are concerned that pedestrian movements between the retail development to the east and the west of the Princes Highway are undertaken in a safe manner, at controlled crossing points and without unduly impacting on the integrity of the Princes Highway as an efficient transport corridor.

The strategy is aimed at addressing this issue by providing safe and efficient pedestrian crossing of the highway through signalisation of intersections and optimising grade separated pedestrian crossing opportunities to give pedestrians safe efficient alternatives aimed at minimising grade crossings and encouraging alternative modes of travel.

The strategy recognises that at-grade crossings will continue to occur and that traffic signals (including new proposed signals at Junction Street) will make those movements safer.

However the strategy aims to encourage new and improved grade separated options that are attractive to pedestrians (e.g. upgrading Jane Street to improve accessibility and integration, and identifying other opportunities for grade separated pedestrian access across Princes Highway and other major traffic roads as developments occur).

An improved Jane Street pedestrian connection is intended to reduce the number of at-grade crossings of the Princes Highway in the vicinity of Stockland Nowra so as to protect the integrity of the Princes Highway as an efficient transport corridor and reduce the likelihood of midblock pedestrian/vehicle conflicts, which are currently of concern and expected to be exacerbated by enhanced development on both sides of the Highway, but particularly the Nowra CBD East expansion if no improvements are made.

3.0 PREVIOUS STRATEGIES AND DEVELOPMENT PROPOSALS

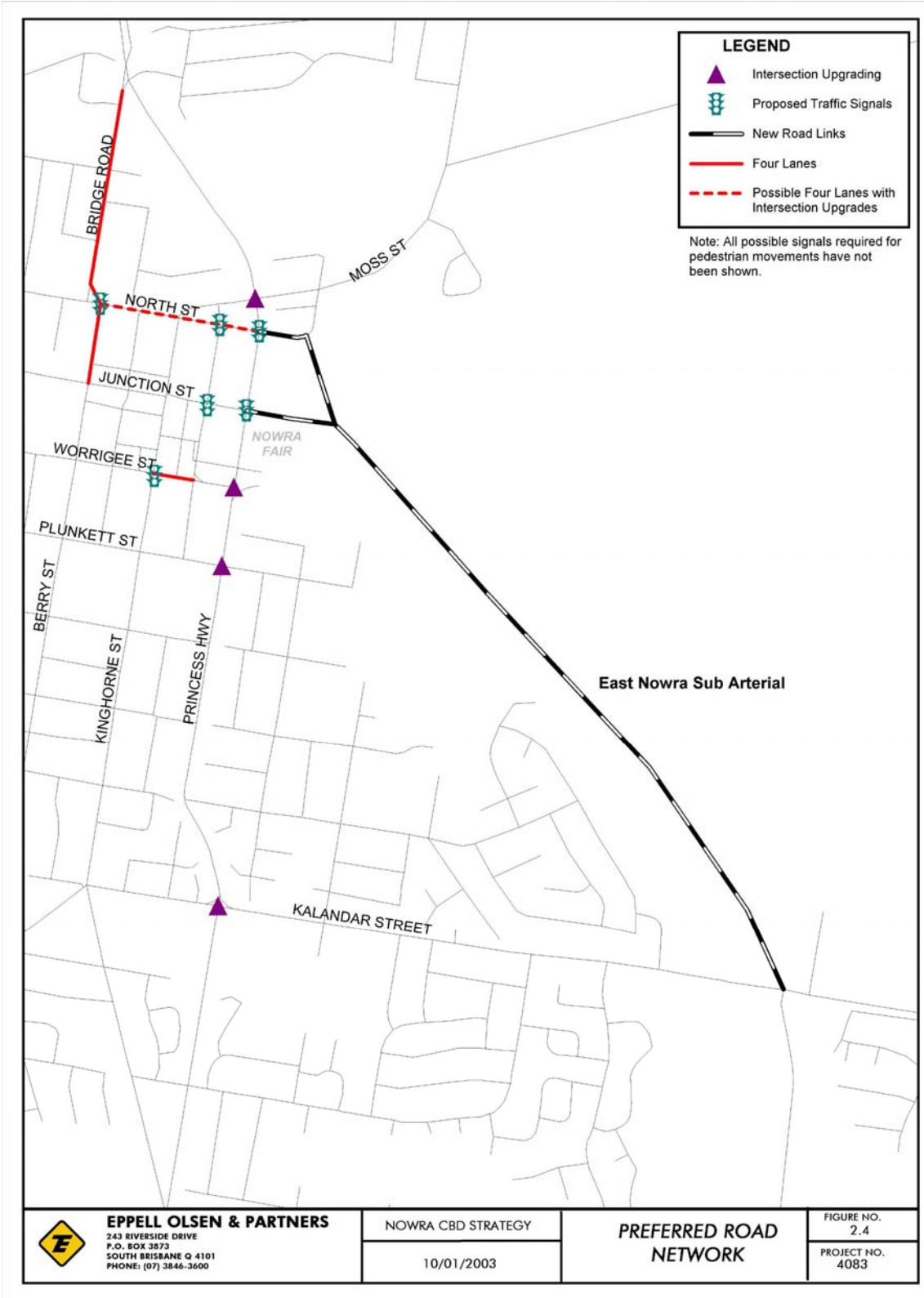
3.1 Nowra CBD Strategy (Traffic & Transport, Parking) – December 2003

The 2003 Strategy was developed from a strategic traffic modelling exercise that took into consideration the population and employment projections from the Nowra/Bomaderry Structure Plan. It essentially identified the measures necessary to cope with predicted traffic volumes before augmentation of existing capacity across the Shoalhaven River, which was not expected before 2016. Figure 3.1 is drawn from the December 2003 report. It indicates one of the key measures proposed in the 2003 strategy, the East Nowra Sub-Arterial (ENSA).

As proposed in the 2003 strategy, ENSA would be a major new road to the east of the Princes Highway and the Nowra CBD (East) commercial area. ENSA would run from the Princes Highway at North Street to Greenwell Point Road near Old Southern Road. There would be secondary access between ENSA and the Princes Highway via Junction Street to alleviate traffic congestion at North Street and to provide direct accessibility between ENSA and the Nowra CBD (East) commercial area, thereby improving accessibility and minimising the impact of the CBD (East) commercial expansion on the Princes Highway.

ENSA is designed to relieve pressure on both Kalandar Street and on the Princes Highway between Kalandar Street and North Street (that is, through Nowra CBD) by enabling traffic from the existing and expanding suburbs and townships to the east of Nowra to travel to Nowra CBD and to points north of the Shoalhaven Bridge without using Kalandar Street or the Princes Highway through the Nowra CBD itself. ENSA thereby also provides a marked improvement to local accessibility by allowing traffic from the existing and expanding suburbs and townships to the east of Princes Highway, Nowra an opportunity of accessing the Nowra CBD (both east and west) of the Highway without using the Princes Highway. The CBD (east) would be accessed via a link to Junction Street. The CBD (west) would be accessed via Junction Street and North Street.

Figure 3.1 ***2003 Nowra CBD Strategy***



Other features of the 2003 Nowra CBD Strategy were:

- promotion of east west links between the east and west portions of the CBD (all modes, including pedestrian) by opening the Princes Highway median at Junction Street, thereby providing a four way intersection catering for all movements. This would also feature a left turn lane for traffic movements north to east bound on the Princes Highway, and right turn lane for traffic movements south to east bound on the Princes Highway;
- dual right turn lanes into Worrigee Street from the Highway (north to west) and upgrading of lane capacity in Worrigee Street (between Highway and Nowra Lane) to improve capacity for traffic from the western part of the CBD to access the Princes Highway;
- dual right turn lanes into Moss Street from the Highway (north to west) and upgrading of lane capacity in Moss Street and North Streets to improve capacity to satisfy demand for access to/from Princes Highway and to accommodate ENSA;
- Plunkett Street and Kalandar Street would have additional lanes to enable access to the Highway;
- enhanced arrangements for public transport, pedestrians, cyclists and service vehicles, both for accessing those parts of the CBD to the east of the Princes Highway as well as integrating these with the western portion of the CBD;
- an extension of Brereton Street to Junction Street, as a necessary means of improving the accessibility and operation of the proposed Nowra CBD (East) road network;
- identification of future parking needs in the CBD.

The 2003 report noted a number of other items where additional detailed analysis was recommended. These included:

- detailed assessment of the North Street corridor between Bridge Road and Brereton Street (completed in November 2004);
- analysis of the impacts on the Princes Highway upgrading requirements (with/without ENSA) between Kalandar Street and North Street, that is, through the Nowra CBD; (the South Nowra Traffic Study was completed February 2006);
- a refinement of the road network strategy to accommodate the Nowra CBD (East) commercial expansion, taking into consideration the changing development proposals for those lands. Additional studies undertaken since that time include the Nowra CBD East Expansion Traffic Modelling Study (February 2006), LEDA Traffic Impact Study (Draft July 2006), Stockland Traffic Modelling Study (April 2007) and now the Nowra CBD (East) Road Network Strategy Review (June 2007).

3.2 Revision of 2003 Strategy in response to AMP proposal – December 2003

The 2003 'base' strategy assumed the AMP Henderson owned 'Nowra Fair' development (16,041sq.m existing shopping centre) being retained with no expansion. This was an important first step in the analysis in terms of understanding the base road network requirements to cater for growth in the Nowra CBD with no change to the existing CBD (East) shopping centre precinct. Importantly, this would determine the base road network requirements for then testing the AMP Henderson Nowra Fair expansion proposal.

The 2003 strategy then further assessed the impact on the 'base' strategy of an AMP Henderson proposal to expand the existing Nowra Fair shopping centre, allowing for retail expansion to the north of the existing shopping centre (proposed across Junction Street at that time) including some additional 12,000sq.m retail floor area. The aim being to determine what additional road network requirements would be necessary solely to accommodate the proposal to expand Nowra Fair.

The modelling for the 2003 strategy developed three scenarios for Junction Street to test the impacts of the AMP Henderson proposal:

- scenario A would use Junction Street as a secondary link between ENSA and the Princes Highway and provide direct accessibility between the Nowra CBD (east) commercial area and ENSA (i.e. as per the base strategy recommendation);
- scenario B was the closure of Junction Street as a through road. That is, Junction Street east of the Princes Highway would provide access to the AMP development only. This was a feature of the AMP proposal;
- scenario C also involved closing Junction Street to through traffic as per Scenario B, but with efficient road links between the CBD (East) commercial area and ENSA. It was assumed that this would be a direct link from the shopping centre to ENSA, with efficient integration between all car parks (in the model) to allow efficient access to ENSA for all traffic desiring to use it.

The study identified that Scenario C could provide acceptable levels of operation, but not to the same degree as Scenario A. There was also some doubt however as to whether it would be physically possible to design the shopping centre to meet the theoretical modelling requirements of Scenario C.

Eppell Olsen & Partners recommended the retention of Junction Street as an important link in the CBD (East) network primarily to avoid operational difficulties associated with Scenarios B and C.

In 2003, AMP Henderson sold the existing Nowra Fair shopping Centre to Stockland and the site was renamed Stockland Nowra.

The 2003 strategy documentation (including the assessment of the AMP Henderson proposal to expand Nowra Fair) was finalised in December 2003. This documentation became important background information for land use planning and for all further studies. It was incorporated into Local Environmental Studies (L.E.S.) documentation submitted to the Department of Planning in support of rezoning of land to the east of the Princes Highway. Nowra lands referred to in this document are as Nowra CBD (East). On 2 April 2004, Amendment # 202 to Shoalhaven Local Environment Plan (1985) was gazetted. The current zoning of the subject lands can be seen on Figure 4.1.

3.3 Revision of 2003 Strategy in response to Stockland proposal – February 2006

Soon after the rezoning was gazetted in 2004, Stockland approached Council with a different development concept that involved development of land to the rear (east) of the existing Stockland Nowra shopping Centre, lands owned by Shoalhaven City Council.

The Stockland development proposed a staged expansion of the existing shopping centre on land to the east of the existing 16,041sq.m Stockland Nowra Shopping Centre site. Stage 1 would involve a 12,010sq.m expansion by 2011 making total development area 28,051sq.m. Stage 2 would add a further 15,090sq.m by 2016. That is the total expansion proposed of 27,100sq.m would bring the combined Stockland shopping centre to 43,141sq.m by 2016.

The 27,100sq.m Stockland expansion proposal was a much larger development than previously envisaged, and initiated an immediate revision of the strategy to test the impact of the proposal under various staging assumptions. The revision was necessary to determine whether the key aspects of the strategy would need to be refined to accommodate the proposal, such as optimal staging of network and access arrangements, optimum location of the link to ENSA from Junction Street, the form of Junction Street required to accommodate the link from ENSA and the retail expansion proposed, and staged upgrade requirements along the Highway.

This revision of the strategy (to test the 27,100sq.m Stockland Stage 1 and 2 expansion proposal to the east of the existing Stockland Nowra) was Cardno Eppell Olsen's *Nowra CBD (East) Expansion Traffic Modelling Study*. It was substantially completed by August 2005, and ultimately completed in February 2006 following refinement to reporting and preparation of concept designs.

The *Nowra CBD (East) Expansion Traffic Modelling Study* developed a 2004 base Paramics model network for the Nowra CBD (East) area that included the Princes Highway between Moss Street and Plunkett Street, and Nowra CBD Streets west to Kinghorne Street, except North Street, which was extended to Bridge Rd as part of the detailed North Street corridor study.

Traffic count data recorded in September 2004 was used for the study. (This was later determined to be equivalent to an annual average weekday following review of annual 2004 traffic data.)

2007, 2011, and 2016 traffic models were also developed for the study. 2007 was factored up from 2004. Later travel demands were derived from Council's Nowra Bomaderry Structure Plan TRACKS models for the years 2011 and 2016.

The study recommended a number of measures in addition to ENSA. Most of these were designed to enable the Princes Highway to cope with higher volumes of traffic. Appendix A indicates the features of the strategy, as provided in the final February 2006 report.

An important feature of the 2005 revision was the detail associated with the connection between Junction Street and ENSA, with signals proposed at the intersection of this link with Junction Street (to align with the main centre access to form direct efficient link to ENSA), a roundabout at the intersection of this link with ENSA (on ENSA), and an assessment of the required lane capacity for all road links.

It was suggested in the 2005 report that adequate capacity for the Stage 1 Centre expansion (i.e. 12,010sq.m expansion making total development 28,051sq.m) at 2011 could be provided without ENSA. However it recommended that either Brereton Street or 1st Stage ENSA (northern part of the ENSA network including link to Junction Street) should be constructed to alleviate substantial queuing along Junction Street.

The 2005 report suggested that full ENSA would be required by 2012 if Stage 1 were developed by Stockland (that is, total development of 28,051sq.m) and by 2009 hypothetically if Stages 1 and 2 were developed by Stockland (that is, hypothetically total development of 43,141sq.m as single stage).

Note: Although the 2005 study indicated that full ENSA would be required to avoid operational difficulties along the Princes Highway, the costs of delivering the full ENSA in conjunction with development activity was not considered to be a realistic outcome, and since that time it has been commonly accepted by Council and RTA that ENSA be built in stages, with the northern component of the works being brought forward at the earliest possible time to address additional traffic generated by the expansion of the Nowra CBD (East) commercial area, and the remaining works (to complete ENSA) to be completed at the earliest practicable time subject to government funding assistance to make the project a reality with consideration of the significant relief the ENSA project would provide to Princes Highway. Consideration should also be given to staged works at southern end of ENSA to provide short to medium term road safety improvements at Greenwell Point Road/Old Southern Road intersection.

Other features of the 2005 study included:

- Junction Street/Princes Highway traffic signals, including new left turn slip lane into Junction Street (for north to east movements) and new right turn bay on the Highway (for south to east movements);
- Junction Street/Nowra Lane traffic signals;
- dual right turn lanes from Princes Highway into Moss Street (north to west);
- dual right turn lanes from Princes Highway into Worrigee Street (north to west);
- banned right turns (north to west) at North Street and Junction Street;
- Moss Street upgraded to four lanes between North Street and Brereton Street;
- North Street upgraded to four lanes between Bridge Road and Kinghorne Street, five lanes between Kinghorne Street and Princes Highway, six lanes between Princes Highway and Brereton Street, and five lanes east of Brereton Street;
- Brereton Street constructed between North Street and Junction Street with traffic signals on Brereton Street at Junction Street, North Street and Moss Street;
- left turn slip lane entry into Stockland Nowra (south of Junction Street) and left turn slip lane exit from Stockland Nowra (south of Worrigee Street) confirmed as acceptable to retain in the network, but with traffic signals required at the southern exit. Note this is subject to further detailed analysis and subsequently RTA has raised concerns about this concept. Refer Stockland Traffic Modelling Study (April 2007) in particular Appendix A (Appendix P to this report).

3.4 LEDA Traffic Modelling Study (Assessment of DA05/3342) – July 2006

On 31 August 2005, Leda Holdings P/L submitted a development application (DA05/3342) for a 31,126sq.m shopping centre on the land to the east of the existing Stockland Nowra site.

Refer Schematic at Appendix D (schematic available at time of issue of deferred commencement consent on 10 August 2006).

This is the same parcel of land that was subject of the 2005 strategy revision (February 2006 CEO *Nowra CBD (East) Expansion Traffic Modelling Study*) that reviewed the 2004 Stockland proposed Staged expansion proposal. Supporting documentation, including Traffic Impact Statement, was not provided by LEDA until 23 December 2005.

Whilst the LEDA development was proposed for the same land (east of the existing Stockland Nowra site) subject of assessment in the 2005 Traffic Modelling study, the following were noted as some of the key differences between the LEDA development proposal and that previous Stockland staged proposal:

- the LEDA development was almost 15% larger than the 2004 Staged Stockland expansion proposal (up from 27,100sq.m to 31,126sq.m);

- Unlike the 2004 Stockland proposal, the LEDA development was not a staged proposal, that is, all 31,126sq.m is proposed to be developed up front;
- the LEDA development provided its main access at a location on Junction Street that would not provide ready access to ENSA along the alignment recommended by Council without likely operational problems in the network;
- the LEDA development provided no opportunities for vehicle or pedestrian integration between the LEDA site and the existing Stockland Nowra shopping centre site, and therefore could not benefit from the enhanced accessibility that integration would provide (including likely reduced traffic generation and broader distribution of traffic and pedestrian impacts);
- the LEDA development proposed a southern access to Morton Parade to mitigate the impacts of their development on Princes Highway and Junction Street.

As a result of these key differences, Council and RTA recommended that additional traffic modelling was necessary to test the traffic impacts of the LEDA proposal. This was expected to provide Council and RTA with an appreciation of the development's impacts on the road network both at opening (assumed 2007) and at 2011 and 2016 to determine staged road works required as a result of the proposal.

Cardno Eppell Olsen was commissioned to undertake the traffic modelling (LEDA Traffic Modelling Study) and a draft report was completed (dated 18 July 2006). (See Appendices D and F).

In addition to the road works proposed by LEDA, other requirements determined by CEO to be needed include:

By 2011

- roundabout treatment at Plunkett Street/Journal Street intersection in conjunction with diverted shared pathway around the perimeter of the LEDA development site (extending from the LEDA eastern boundary direct to Wallace Street to reconnect with existing pathway infrastructure at Douglas Street intersection);
- additional lane capacity on Junction Street (3 approach lanes recommended)
- signalisation of Junction Street/Nowra Lane intersection;
- interim pedestrian refuges on Junction Street immediately east of Stockland Nowra access and immediately east of LEDA access on Junction Street.

By 2016

- stage 1 ENSA, including traffic signals at Princes Highway/North Street;
- traffic signals at Brereton Street/North Street intersection;
- additional lane capacity on Plunkett Street (3 approach lanes recommended);

- re-configuration of the internal car park and access arrangements to maximise use of ENSA.

The LEDA Traffic Modelling Study considered the impacts of the LEDA development in isolation. In accordance with the Nowra CBD Strategy, additional works (traffic signals) would be required at the intersection of Junction Street/Brereton Street if development were to also occur north of Junction Street, or if Brereton Street were extended.

Conditions of approval of developments have been framed based on approvals and applications to hand. Timing of developments will influence components of work attached to projects.

Further, LATM adjustments/improvements to local Nowra East road network are required to mitigate the impacts of LEDA's southern connection to Morton Parade.

The incorporation of LATM treatments in conjunction with capacity improvements on Plunkett Street (as conditioned on LEDA) and provision of ENSA, should ensure adequate protection of Nowra East local road network.

The proposed extension of Wallace Street to Junction Street (not currently supported by Council) could also be expected to mitigate traffic impacts on Journal Street if supported by Council in the future. The extension of Wallace Street could not be completed prior to provision of ENSA due to likely adverse traffic conditions. For further details, refer Appendix F (LATM report by LEDA) and K of this report (Traffic Loading on Nowra East Local Road Network).

3.5 Stockland Traffic Modelling Study (Assessment of DA06/1317) – April 2007

On 3 March 2006, Stockland submitted a development application (DA06/1317) for expansion of the existing 16,041sq.m Stockland Nowra (Fair) shopping centre by an extra 15,213sq.m (total 31,254sq.m). This time, the expansion proposal was to be contained on the same land as the existing shopping centre site. Refer Schematic at Appendix C.

This was a different proposal again from the staged expansion proposed by Stockland in 2004, and was approximately 27% larger than the 2004 Stockland Stage 1 expansion proposal.

The supporting documentation submitted with the DA included a Traffic Impact Statement, which argued that the Stockland proposal was similar to the 2004 Stockland proposal modelled by Council in the earlier revision of the CBD Strategy (February 2006 CEO *Nowra CBD (East) Expansion Traffic Modelling Study*).

This position by Stockland was not correct or agreed to by Council or RTA, as there were significant departures from the Strategy to the 2006 Stockland proposal that were of concern to Council and RTA.

The key causes of concern prompted by the 2006 Stockland development proposal include:

- current traffic generation rates at the existing 16,041sq.m Stockland Nowra (Fair) shopping centre are in the order of 7.5 trips/100sq.m in the Thursday PM peak period. Relevant studies to date (including CBD East Expansion Traffic Modelling Study February 2006, and Draft LEDA Traffic Impact Study July 2006) have all assumed a reasonable reduction in trip generation at the existing Stockland Nowra site on the basis of effective increased centre size, a principle relationship found in many surveys and consistent with RTA guidelines. The reductions adopted have been between 5 trips/100sq.m. to 7.5 trips/100sq.m, consistent with the rate used for the shopping centre expansion area. This equates to approximately 35% reduction in traffic generation to/from the existing Stockland Nowra site, and despite this reduction, studies to date have still determined that Junction Street (between Princes Highway and Stockland Nowra access) is a critical link in the network with high demand and very limited queue storage capacity;
- the latest Stockland expansion proposal, from 16,041sq.m to 31,254sq.m, approximately doubles in size the existing Stockland Nowra shopping centre, and is almost 27% larger in scale than the previous Stockland Stage 1 expansion proposal (which would have added 12,010sq.m, however to the east of the existing Stockland Nowra Fair shopping centre). Expanding on those comments above, increasing traffic volumes on Junction Street (between the Princes Highway and the Stockland Nowra access) by increasing development intensity and traffic generation beyond the levels previously assumed in the 2005 strategy , would be expected to pose particular problems for Junction Street, especially given the relatively short distance between the Princes Highway and the Junction Street access to the shopping centre, and the constraints observed with the previous strategy modelling (limited queue storage and high demand on Junction Street between Highway and Stockland Nowra access);

- the proposal would result in increased use of the existing direct access points to/from the Princes Highway which have also been raised previously as a concern by RTA (during development of the strategy) based on existing traffic usage at Stockland Nowra (no expansion). Further, the existing access (access in off Highway south of Junction Street) is currently only available for use by light vehicle traffic, where as the proposal seeks to modify this access to introduce heavy vehicle use (by service and public transport vehicles);
- the proposal affects a different parcel of land from the proposal of 2004: it is proposed for the existing Stockland Nowra (Fair) Shopping centre site rather than land to the east of the existing site, which was the subject of the 2004 proposal. Given that there is no internal access between the Stockland and LEDA sites, and that there is no additional external access proposed with the Stockland 2006 proposal, it is unlikely that the impacts of the proposed expansion development on Junction Street and Princes Highway would be marginal. As such, any consideration of the latest 2006 Stockland proposal would need to consider the future increased traffic friction on Junction Street as a result of the proposal (i.e. increased friction between Stockland and LEDA traffic, as well as other strategic traffic movements on Junction Street i.e. between Nowra CBD and ENSA and between Princes Highway and ENSA);
- reinforcing the above point, the previous Strategy modelling (CBD East Expansion Traffic Modelling Study based on the Stockland 2004 proposal, i.e. the February 2006 report) envisaged 43,141sq.m total commercial floor area east of Princes Highway (south of Junction Street). This current 2006 proposal by Stockland would result in an increase of commercial floor area east of Princes Highway (south of Junction Street) to 62,380sq.m, i.e. a significant increase of almost 45%. This is a substantial additional increase in commercial floor area potential east of Princes Highway Nowra CBD and as such requires the assessment of the proposal to be considered not just in isolation but also in the context of the Nowra CBD Strategy review (holistic approach to traffic impact assessment);

- the configuration of car parks and their relative accessibility to/from major approach directions was also significantly different. Unlike the previous Stockland (2004) proposal or the 2005 LEDA proposal, the 2006 Stockland expansion development proposal provided no opportunities for vehicle access to the south (access to Morton Parade) to reduce the impact on Junction Street and Princes Highway, nor does the Stockland development proposal provide means of direct efficient access to ENSA to enhance accessibility and mitigate the impacts on Junction Street and Princes Highway. Further development of the Stockland Nowra site (as proposed DA06/1317) is of concern from this point of view (i.e. reduced ability to mitigate traffic impacts by virtue of the location of the Stockland Nowra site in relation to ENSA). This aspect of the development may be in contravention to the S.L.E.P which requires development of lands to the east of Princes Highway Nowra to provide efficient accessible links to ENSA to mitigate impacts of development on the Princes Highway.

As a result of these key concerns, Council and RTA recommended that additional traffic modelling was necessary to test the traffic impacts of the Stockland proposal, both in isolation and together with the LEDA proposal (i.e. holistic view of CBD East expansion considering all current potential envisaged development in the CBD East expansion area). The isolated impact assessment would be expected to provide Council and RTA with an appreciation of the development's impacts on the road network both at opening (assumed 2007) and at 2011 and 2016, to determine staged road works required as a result only of the Stockland proposal.

Whilst it is important to understand the isolated impacts, the isolated impact assessment does not provide an indication of the extent of works required to accommodate all current potential envisaged development in the CBD East expansion area (i.e. the isolated assessment does not test the integrity of the CBD road network strategy) , nor does it indicate whether all current potential envisaged development (including both Stockland and LEDA DA's) can actually all be accommodated without unacceptable impacts on the local road network or Princes Highway. This is a vitally important test to ensure the integrity of the Princes Highway and Nowra CBD strategy. That combined impact assessment is subject of this report.

At a progress meeting on 24 August 2006 to discuss the preliminary Stockland modelling results and draft report, RTA indicated that they would be unlikely to support the proposed traffic signals at the southern exit from the Stockland Nowra site and requested that additional modelling be undertaken to test an access from the Stockland site to Morton Parade (that is, similar to the proposal recently endorsed by Council and RTA for the LEDA development).

Despite concerns raised in relation to expected high volumes of traffic on the local road network, RTA advised that in their opinion in the context of DA impact assessment, similar access arrangements (i.e. via Morton Parade giving access to Plunkett and Journal Streets) should apply to either site, and one site should not be unfairly advantaged over another.

Only the LEDA site has been analysed with access to Morton Parade. Stockland have not approached Council seeking access to Morton Parade for their development and to some extent Stockland have been awaiting the outcome of the Stockland Traffic Modelling Study to identify whether such works (connection to Morton Parade) would be required or whether such works would be supported by Council.

In response to RTA comments, and to ensure all works associated with the Nowra CBD Strategy review are complete in all respects with no outstanding issues left untested, Shoalhaven City Council directed that CEO undertake the modelling of the Stockland Nowra expansion DA06/1317 with access to Morton Parade including in conjunction with all current envisaged potential growth in the CBD East expansion (i.e. including both Stockland and LEDA proposals). Refer to Stockland Nowra Modelling Study (April 2007).

The outcomes of testing alternative egress options from Stockland Nowra site have also been included as Appendix P of this report (Appendix A of the Stockland Nowra Traffic Modelling Study April 2007).

Stockland Traffic Modelling Study April 2007 – Report Conclusions:

Substantial growth is anticipated in the system to 2016 being broadly 30% additional movements. Works at Worrigee Street, Plunkett Street, and Moss Street intersections with the Princes Highway are required irrespective of the Stockland development proposal.

Modelling indicates resolution of southern egress (of Stockland) to the Princes Highway is also required by 2016 irrespective of the Stockland development proposal however this issue should be resolved in conjunction with any further development of the Stockland site.

Addition of the Stockland Nowra (Fair) development expansion proposal and Stockland (Junction North) development proposal requires the staged upgrading of the existing network to function adequately.

The developer has proposed:

- signalising the Junction Street/Princes Highway intersection.

Additional works beyond these Stockland road works proposals are required to accommodate the proposed development traffic in the context of system growth to 2016 and/or provide satisfactory (safe) pedestrian crossing opportunity. These comprise:

Expansion of Nowra Fair proposal :

- In accordance with Nowra CBD Strategy - upgrade of Junction Street (to Brereton Street) including upgrade of Junction Street / Brereton Street intersection;
- upgrade of Moss Street/Princes Highway intersection, in accordance with the Nowra CBD Strategy;
- signalise North Street/Kinghorne Street intersection;
- signalise Junction Street/Nowra Lane intersection;
- provision for double right turn north to west at Worrigee Street/Princes Highway intersection;
- signalise Worrigee Street/Kinghorne Street intersection;
- signalise Plunkett Street/Haigh Avenue intersection;
- extension of Brereton Street from North Street to Junction Street;
- signalise Junction Street/Brereton Street and Brereton Street/Moss Street and undertaken interim safety improvements at Brereton Street/North Street.

Additional works as a result of adding Junction North development proposal:

- signalise Moss Street/North Street intersection;
- signalise Brereton Street/North Street
- provision for double right turn north to west at Plunkett Street/Princes Highway;

Additional works as a result of adding ENSA:

- extension of Junction Street to ENSA roundabout;
- upgrade and signalise Princes Highway / North Street intersection;
- upgrading of North Street to four lanes and signalising intersections between Kinghorne Street and and Brereton Street;
- upgrade capacity of Brereton Street/North Street signals.

The addition of ENSA provides considerable improvements to traffic operations throughout the network, particularly notable along the Princes Highway through Nowra CBD and in Nowra CBD south.

The signalisation of Junction Street/Brereton Street, North Street/Brereton Street and Moss Street/Brereton Street are included primarily from a pedestrian safety perspective. The remained of the works are required from a traffic management perspective in order to provide adequate performance of the road network.

This latest modelling indicates that the network will be able to operate at 2016 without ENSA, however model operations are observed to be constrained with high levels of congestion (low levels of service) and accordingly ENSA is recommended to be provided at or soon after 2016 in any case to improve system operations.

This is a different outcome to previous modelling studies of Nowra CBD (East) commercial expansion (using previous versions of Paramics) however the following factors may have influenced different result:

- use of latest advancements in Paramics modelling software able to optimise performance of the models;
- Stockland expansion development represents only approximately 15,000 sqm increase (similar in scale as the previous 2004 Stockland Stage 1 expansion proposal) which similarly was found to bring forward the need for 1st Stage ENSA (or Brereton Street extension) in conjunction with the 1st Stage development to mitigate impacts, however found that ENSA was required by 2016;
- Unlike the 2004 Stockland expansion proposal and LEDA proposal - the 2006 Stockland expansion proposal does have attenuation benefits of existing access points (Jane Street and Princes Highway access points) to assist distribute additional traffic loads from additional development.

Note despite the modelling differences in relation to full ENSA – model performance still suggests ENSA is required to be provided at or soon after 2016 to improve system operations.

That said it is acknowledged that commercial development will bring forward the need for ENSA (and in particular first stage ENSA or Brereton Street and associated works) to alleviate traffic congestion on Junction Street and at Junction Street / SH1 intersection as a result of commercial development in Nowra CBD (East). This allows more broader distribution of the increased traffic load by expansion of the Nowra CBD (East) road grid.

The modelling analysis suggested that the impact of these developments alone do not 'trigger' the need for full ENSA, nor do they bring forward the need for full ENSA substantially, however they undoubtedly contribute to the need for full ENSA.

Some of the network upgrades required by introducing the expanded Nowra Fair Shopping Centre serve a similar function to the proposed first stage of ENSA, in particular linking traffic from Junction Street to the Princes Highway north through the use of Moss Street, North Street and the Brereton Street extension. Unlike the LEDA assessment - 1st Stage ENSA would not be of benefit to the Stockland developments by virtue of the Stockland development locations, however Brereton Street provides relief equivalent to 1st Stage ENSA prior to full ENSA being provided.

Both Brereton Street and 1st Stage ENSA are required to accommodate commercial development in Nowra CBD (East) if both the Stockland and LEDA developments proceed (refer Nowra CBD Strategy).

Concerns had been raised by RTA at the possibility of introducing another set of signals at the southern egress of the Stockland site (south of Worrigee Street) as proposed in the Stockland DA and previously considered as part of Nowra CBD Strategy (February 2006 report). As a result - additional modelling work has been undertaken to assess alternative southern egress options from the Stockland Nowra site - further details of this assessment are provided at Appendix A (Appendix P of the June 2007 Nowra CBD (East) Road Network Strategy review report).

4.0 POTENTIAL LAND USE DEVELOPMENT FOR REVIEW OF STRATEGY

The combined size of the 2006 Stockland and 2005 LEDA proposed shopping centres (combined DA's) is approximately 62,380sq.m (south of Junction Street only). As previously mentioned this is up almost 45% from the originally envisaged 43,141sq.m (south of Junction Street). Together, the proposed commercial area south of Junction Street alone would provide about the same shopping area (in terms of retail floor area) as the Nowra CBD to the west of Princes Highway.

For comparison purposes, the current floor area statistics for the Nowra CBD (west of Princes Highway) for all commercially zoned land in Nowra CBD includes total floor area of 102,005sq.m of which almost 64% (or 65,012sq.m) is retail floor area whilst 36% (or 36,993sq.m) can be generally categorised in this report as "other" commercial floor area.

At the time of model development, another Stockland proposal (at that stage DA not lodged) on land to the north of Junction Street (between Princes Highway and the proposed Brereton Street extension) was proposed to be approximately 9,330sq.m which was accordingly the development scale tested in this CBD Strategy review.

Subsequently Stockland have lodged DA06/3065 on 14 November 2006 on that same parcel of land north of Junction Street, a development equating to some 9,670sq.m so not that dissimilar to the scale previously assumed and modelled in CBD Strategy review (the current proposal being approximately some 3% to 4 % greater in scale).

The key elements of the current proposal in terms of access are graphically indicated in Appendix E. It is noted that this schematic relates to DA06/3065, however for all intents and purposes is similar in terms of access and car park integration to the original 9,330sq.m proposal incorporated into the modelling.

It is noted that the previous CBD Strategy modelling (CBD East expansion Traffic Modelling Study February 2006) assumed only 5,000sq.m of commercial floor area for this same parcel of Stockland land, so the current proposal is approximately double in size the development proposal originally envisaged on this parcel of land and included in the previous CBD Strategy modelling (report February 2006).

This means that when combined with the LEDA expansion proposal DA05/3342 and the Stockland expansion proposal DA06/1317, the combined commercial floor area increase proposed east of Princes Highway Nowra is almost 50% higher than that originally envisaged by Council in the 2005 strategy (February 2006 report).

The current Stockland and LEDA developments have significantly altered the assumptions on which the previous modelling was based and so require that the strategy be tested to ensure firstly that it is possible to accommodate the scale of development proposed, and secondly that a road network strategy can be engineered to have sufficient capacity to accommodate that scale of development.

In order to avoid the need for further incremental revisions of the strategy, the current revision has taken the approach of assuming (for the purpose of testing the integrity of the road network strategy against further development variation) that all sites are developed to the potential provided in the current LEP i.e. including both current Stockland proposals plus the LEDA proposal and making allowance for additional traffic generation on other lands east of Princes Highway that may impact or influence road network capacity equation in the future.

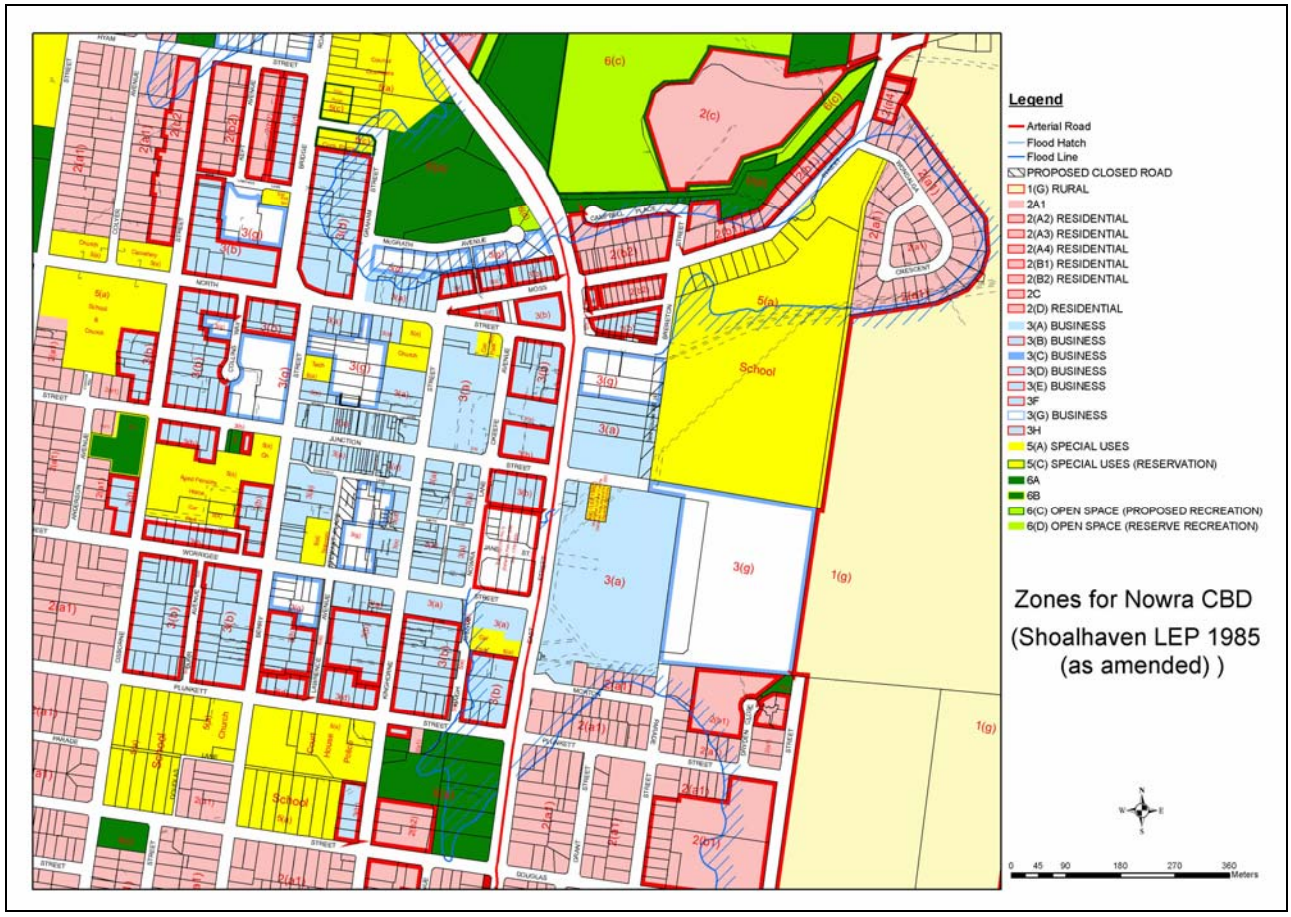
This additional traffic generation includes additional commercially zoned land between Highway and Brereton Street north of Stockland land (immediately south of North Street), commercially zoned land between Highway and Brereton Street (between Moss Street and North Street i.e. Corban site), and residual lands between ENSA and Junction Street (east of Brereton Street) currently zoned Special Use (School).

The future use of these residual lands (between ENSA and Junction Street) is yet to be determined however the following assumptions have been made to ensure robustness of the Nowra CBD Strategy Review:

- to protect future options and to ensure inadequate capacity of the road network will not restrict future uses to be considered for these lands, It has been assumed (in the CBD Strategy Review modelling) that the residual lands would generate traffic volumes at the same rate as the adjacent shopping centre complexes as a worst case scenario;
- the extent of these residual lands is dependent on the location of link to ENSA and it has been assumed the link to ENSA would be the eastern boundary of any future traffic generating activity. This varies the extent of these lands dependent on the location of link to ENSA as can be seen at Appendix C.

The provisions of Shoalhaven Local Environmental Plan (LEP) as amended 2 April 2004 (Amendment # 202 to Shoalhaven LEP 1985) are presented here in order to explain the potential land uses envisaged for the CBD to the east of the Princes Highway. Figure 4.1 indicates zonings for the CBD east of the Princes Highway. The land use and traffic generation assumptions are shown at Appendix B.

Figure 4.1 ***Current Nowra CBD Zone Map***



In terms of development there are three key zones:

- 3(a) Business "A" (retail): standard retail, commercial and business activities;
- 3(b) Business "B" (transitional): "to provide for forms of business activities normally located on the fringe of the central business district which require large sites, including bulky goods retailing";
- 3(g) Business "G" (development area): to provide for additional retail opportunities and other compatible uses to enhance the commercial and social role of Nowra as a subregional centre. Large scale development is envisaged.

There are no development control plans directly limiting the scale of development in these areas, although buildings over a certain height must be referred to the State government.

As noted above, this report is designed to avoid the need for further incremental revisions by assuming that all sites are developed to the potential provided in the current LEP. Appendix B identifies the potential developments envisaged at the time the brief was issued. This includes the combined impacts of the proposed Stockland and LEDA developments. While it is not envisaged that this extent of development will be required for some time, it is acknowledged that it is possible under the current zoning for that extent of development to occur, and accordingly the revision of the strategy is aimed at ensuring sufficient road network capacity will exist to accommodate that scale of development without foreseen operational difficulties. The base strategy traffic modelling has assumed the potential developments identified at Appendix B will occur.

In order to optimise connections to ENSA (optimise accessibility and thereby reduce impacts on Junction Street and Princes Highway), a number of different links from Junction Street to ENSA were tested using alignments of ENSA similar to either Figure 5.2 or 5.3 of the February 2006 CEO *Nowra CBD (East) Expansion Traffic Modelling Study*. Each of these passed through land currently owned by the Nowra High School. How far east the link was would determine (a) how attractive ENSA would be for shopping centre traffic and (b) (assuming that land to the west of the link would be available for development) how much developable land would be available (affect traffic generation potential on residual school land)

Model tests that included an ENSA link similar to Figure 5.2 (the western most alignment of the ENSA link) made allowance for a reduction in residual school land available for development. Land potential was reduced back to that assumed in the earlier strategy traffic modelling (the 2005 study, finalised in February 2006).

The alignment of ENSA link used as a base for the current study can be seen at Appendix B (i.e. the alignment of ENSA link proposed by LEDA). Four options were tested for the 2007 CBD strategy revision, as discussed in Section 4.2 and summarised in Appendix G. See also Figure 4.2 (excerpt from Appendix H) which shows the recommended option for linking Junction Street to ENSA following testing of the four (4) scenarios.

As can be seen on Figure 4.2, the recommended optimum ENSA link is similar in alignment to the previous concept adopted in the 2005 strategy (February 2006 report) in that the link from ENSA has been determined again to be best located as a direct link between ENSA and Junction Street aligning as direct connection to the main shopping centre access. This alignment has been shown again in the 2007 strategy revision modelling to optimise network operations by allowing a direct efficient link to ENSA from the LEDA shopping centre and as such, mitigate the impacts of development on Junction Street and Princes Highway.

The Council's consent conditions for LEDA appropriately recommend alterations to LEDA car park and access arrangements to benefit from the revised location for link to ENSA pursuant to revised Nowra CBD strategy (relocate and upgrade main car park access to align with ENSA including making provision for future traffic signals), and for alterations to the other car park access points to provide improved accessibility and efficient options for motorists and as such this should ensure that the main access to LEDA shopping centre at Junction Street (location of link to ENSA) is not congested and is able to function as an efficient link between Junction Street and ENSA and between LEDA and ENSA.

4.1 Features of the 2006 Stockland Development Proposal (DA06/1317)

The features of the Stockland proposal assumed in the modelling are those contained in the development application DA06/1317 lodged on 3 March 2006.

The key elements of the proposal in terms of access are graphically indicated at Appendix C.

The proposal includes a 15,213sq.m expansion of the existing Stockland Nowra shopping centre, bringing the total lease able floor space to 31,254sq.m.

In isolation, it is assumed that a development of this scale (31,254sq.m) would generate traffic at a rate of approximately five trips per 100sq.m or 1,563 trips per hour. However when considered in conjunction with the LEDA development, it is considered that similar developments of this combined magnitude would generate traffic at a marginally lower rate per square metre of approximately 4.6 trips per 100sq.m or 1,438 trips per hour for the Stockland part of the combined proposals.

Notwithstanding the key differences noted in section 3.5, the proposal has several features in common with the 2005 revision of the strategy. This is limited to upgrade of Junction Street, provision of traffic signals at the Junction Street/Princes Highway intersection, retention of access and exit points on Junction Street, Jane Street and the Princes Highway.

*** Note: The Stockland expansion proposal DA06/1317 was later withdrawn by Stockland.*

4.2 Features of the 2005 LEDA Development Proposal (DA05/3342)

The features of the LEDA proposal are those contained in the development application DA05/3342 lodged 31 August 2005; that is, as revised following discussions with the council and RTA, following independent assessment of the proposal lodged 23 December 2005, and the Draft Traffic Impact Study by CEO dated July 2006.

The key elements of the proposal in terms of access are graphically indicated at Appendix D.

The proposal includes 31,126sq.m development on Council owned land immediately to the east of the existing Stockland Nowra shopping centre.

In isolation, it is assumed that a development of this scale would generate traffic at a rate of approximately five trips per 100sq.m, or 1,557 trips per hour. When considered in conjunction with the Stockland development, it is considered that combined similar developments of this magnitude would generate traffic at a marginally lower rate of approximately 4.6 trips per 100sq.m, or 1,432 trips per hour for the LEDA part of the combined proposals.

In terms of traffic arrangements, the proposal is consistent with the 2005 strategy with respect of leaving Junction Street open to through traffic. But as noted above in Section 3.4, in many other respects the LEDA proposal is different from the 2005 strategy.

While the LEDA proposal was amended throughout the assessment process, the base layout adopted for testing in the strategy model included four vehicular access points. Three of these access points are from Junction Street (two access points from Junction Street to the basement car park including one via a south west leg of the roundabout, and one to the upper deck car park via a south leg of the same roundabout). The fourth access point is via the southern boundary as an extension of Journal Street (Morton Parade).

The layout of the LEDA development proposed a change to the location where ENSA would link on to Junction Street. The 2005 strategy allowed for ENSA to link onto Junction Street at the location of the main Stockland proposed centre access. This was determined to be the optimum network arrangement based on the assumptions of the 2005 strategy analysis.

The extracts from the draft report for the Leda Traffic Report, July 2006 are at Appendix F.

The 2005 strategy determined that the access point from the expanded shopping centre to/from ENSA must be directly to/from the main development access, in order to provide maximum practical opportunity for shopping centre traffic to utilise ENSA and this would optimise accessibility and thereby mitigate the impacts of the development on the Junction Street and Princes Highway by providing traffic with origin/destination to the east or south east an attractive efficient alternative than Junction Street and Princes Highway.

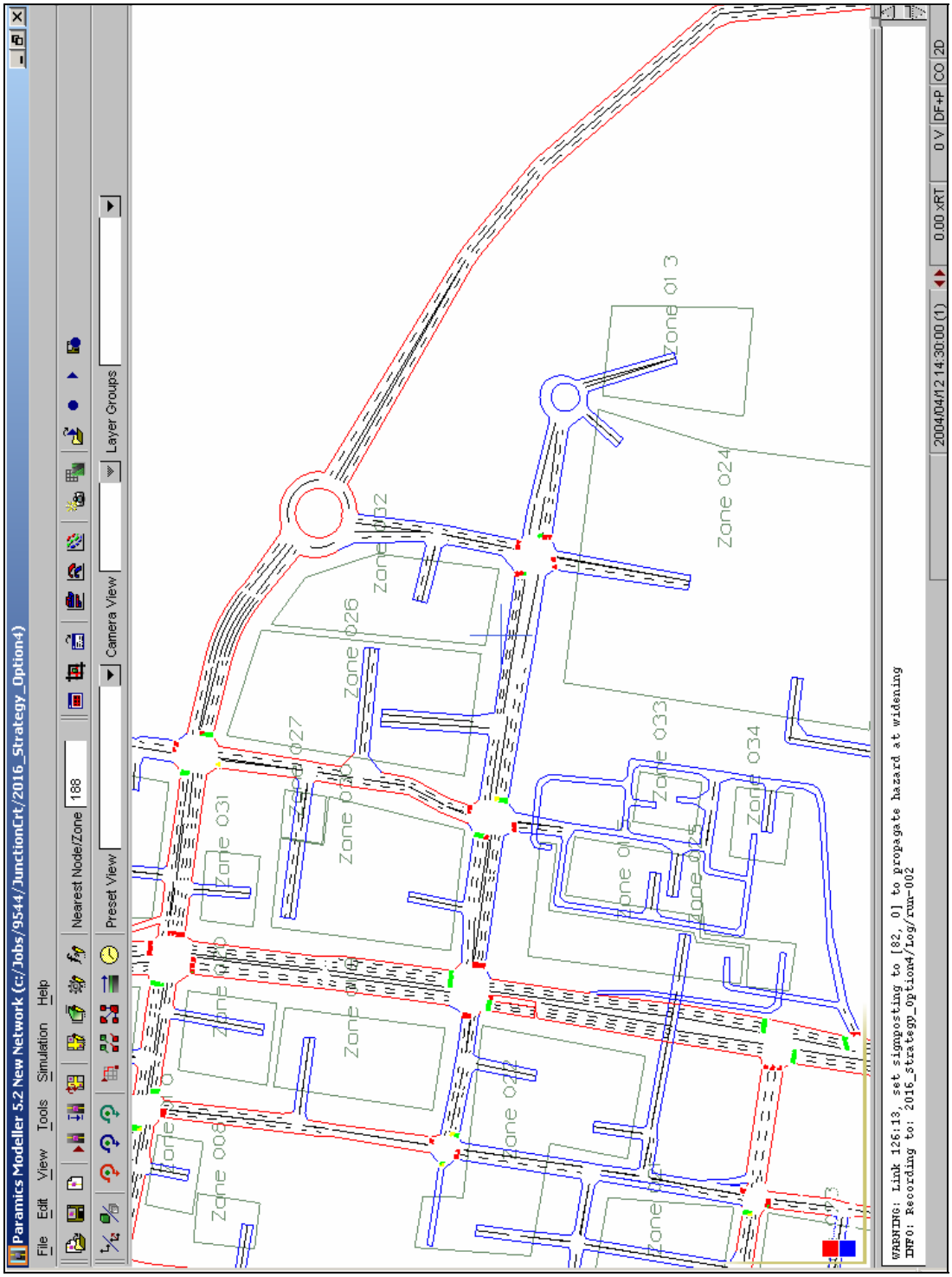
The layout of the Leda Development, with different access points than the previous 2004 Stockland shopping centre proposal for the same site, required a revised analysis of the appropriate link between Junction Street and ENSA.

A Design Note from Cardno Eppell Olsen dated 31 August, 2006 (reproduced here at Appendix G) explains the four scenarios tested. The assessment concluded that Scenario 4 should be adopted for optimum access arrangement. This provides for a direct link between ENSA and the main access to the Leda basement car park via signalised intersection at Junction Street/LEDA main access. The revised concept design of the link can be seen on Figure 4.2, which is an excerpt from Appendix G below.

*** Note: Deferred Commencement Consent was issued to LEDA Holdings for the LEDA development proposal (DA05/3342) on 10th August 2006, subject to outstanding issues to be resolved by the applicant prior to issue of operational consent. A considerable number of those outstanding issues related to traffic.*

Operational Consent was issued to LEDA Holdings for the LEDA development proposal (DA05/3342) on 15th January 2007. Council was satisfied that the remaining outstanding issues as at 15th January 2007 could be resolved at detailed design stage (prior to issue of construction certificate).

Figure 4.2 Recommended Concept Design of Link to ENSA from Junction St



4.3 Other Land Use Developments

As explained above, the revised strategy modelling assessment assumes that all available commercially zoned land east of the Princes Highway, Nowra is developed to its full potential as shown at Appendix B. These sites and assumed traffic generation rates (used in the modelling) can be summarised as follows:

- Stockland Development south of Junction Street (as per DA06/1317 as described above) total 31,254sq.m @ 4.6 trips/100sq.m adopted for strategy modelling assessment;
- Stockland Development north of Junction Street (as described above) total 9,330sq.m @ 4 trips/100sq.m adopted for strategy modelling assessment;
- LEDA Development south of Junction Street (as per DA05/3342 as described above) total 31,126sq.m @ 4.6 trips/100sq.m modelling assessment;
- south east corner of the intersection of the Princes Highway and North Street: It is assumed that this site of approximately 535sq.m could be developed. Possible development scenario is assumed to be 185sq.m fast food café assumed to generate 109 trips per hour in the peak hour. (Note that this is an indicative concept for strategy modelling only);
- land to the east of the Princes Highway, between Moss Street and North Street. This has already been approved for a 185sq.m fast food café and retail units, which are assumed to generate 132 trips per hour in the strategy modelling;

- land to the north of Junction Street and east of the proposed extension of Brereton Street (bordered by ENSA to the north and the link from Junction Street to ENSA to the east). This is currently owned by Nowra High School. As discussed in Section 4.0 above, as an indicative concept for strategy modelling only, this land is assumed to generate traffic at the same rate as the adjacent shopping centres as a worse case scenario; that is, 4.6 trips/100sq.m retail floor area. Given that the task was to ensure adequate spare capacity in the system at 2016 and ensure that a road network strategy could cater for worst case development to the east of the Princes Highway Nowra (as envisaged at the time of the strategy revision modelling – as seen in Appendix B), this is considered a reasonable assumption for inclusion in the Nowra CBD strategy review modelling assessment. Possible future uses could include short to medium term overflow parking, or medium to longer term potential rezoning as additional commercial land. In any event the purpose of the Nowra CBD Strategy review modelling was to allow for a worst case scenario to ensure operational difficulties would not arise in future as a result of increased traffic generation on these residual Nowra High School lands south of ENSA (irrespective of future land use activity). Accordingly, as a worst case scenario was assumed, these uses were assumed to generate similar demands as would be expected to be generated from the current proposed commercial developments. The amount of land available to test is dependent on the location of the link to ENSA, with land availability varying between 10,800sq.m up to 14,953sq.m. Using scenario 4, it is assumed that 10,800sq.m will be available for traffic generating development.

5.0 MODELLING RESULTS AND RECOMMENDATIONS

5.1 Summary – Model Building

Technical details of the modelling have been provided in a separate design note by Cardno Eppell Olsen dated 31 August 2006 and included here at Appendix G. See also Appendix I and Appendix J. The following summary is drawn from Appendix G. The design note builds on the documentation of the adopted traffic modelling process as contained within the previous strategy documents undertaken since 2003.

The modelling of the 2016 traffic network has used the base Thursday 23 September 2004 PM Peak traffic counts for base model validation and has incorporated background travel demand growth derived from the Nowra Bomaderry Structure Plan TRACKS demands for 2016 (modelled with ENSA). This included additional growth in the Nowra CBD west of the Princes Highway, and commercial expansion to the east of Princes Highway Nowra – Nowra CBD (East).

It is acknowledged that the Nowra/Bomaderry Structure Plan land use projections may be conservative; that is, they may produce relatively higher traffic flows (as a result of relatively high input land use projections) than may actually be experienced within the 2016 projection year. This is a result of actual growth rates reviewed for the period 2001 > 2006. That said, the traffic projections have been adopted in light of the original traffic data recordings and validation parameters, and TRACKS demands being equivalent to typical annual average weekday traffic flow scenarios (generated from input land use projections).

That is, a conservative approach to average weekday traffic flows is considered to be warranted given the highly seasonal flows in Nowra, where traffic levels during holidays are known to be much higher than average not just on Princes Highway, but on side road flows as well, particularly access to major shopping centres (including Stockland Nowra).

The detailed LEDA traffic impact assessment (with latest Paramics modelling software allowing more sophisticated plug ins and therefore more detailed and realistic traffic assignment) has shown that increasing through traffic flows on the Highway equivalent to the 120 highest annual hourly flows (recommended by AUSTROADS on recreational routes such as Princes Highway) would bring forward the need for 1st Stage ENSA by 2011 with the LEDA shopping centre development alone.

As mentioned above, Council's TRACKS models have been validated based on average weekday traffic flows (typically closer to Wednesday or Thursday average flow conditions in Nowra CBD).

Fridays are not typically used in Nowra for strategic network analysis because whilst Princes Highway traffic flows may be higher on typical Fridays (particularly during the warmer months, but very seasonally dependent) movements on side roads into/out of the Nowra CBD (and Stockland Nowra shopping centre) are typically higher on Thursdays than Fridays, and certainly more predictable on Thursdays when compared to Fridays.

Whilst there is evidence of seasonal influence on side roads into/out of Nowra CBD, this is quite varied and not to the same extent as the impact of seasonal fluctuations on the Princes Highway with a higher proportion of seasonal demand component being through traffic on Princes Highway.

Higher seasonal demands are also more prevalent for traffic flows into/out of Stockland Nowra when compared to general movements into/out of Nowra CBD (west) and accordingly inconsistencies can arise when trying to determine 'typical' traffic patterns if Fridays are adopted as opposed to Thursdays. This is due to the convenience and accessibility of Stockland Nowra being directly accessible to/from Princes Highway, particularly when the highest proportion of seasonal influence on Fridays are southbound traffic movements which enjoy direct access to/from Princes Highway.

For similar reasons, Saturdays are also not typically used for broad network traffic study particularly of traffic turning movements of Nowra CBD traffic conditions. This is primarily because, whilst typically Saturdays have consistently recorded the highest traffic flow conditions of the typical week into/out of Stockland Nowra shopping centre, typically Saturdays are lower on the Princes Highway and generally lower on Nowra CBD (west) side road flows when compared to Thursday or Friday flows. Saturdays are also seasonally influenced and inconsistencies can arise when trying to determine 'typical' traffic patterns.

As such, and due to the relative stable and more predictable conditions throughout the entire study network, Thursdays are considered by Council to be the most appropriate day of the week for any broad network traffic study particularly of traffic turning movements of Nowra CBD traffic conditions.

This does not negate the need for the isolated development impact assessment to consider Thursday, Friday and Saturday peaks in order to determine the scenario that would result in peak traffic impacts of the development, as well as undertake as assessment of seasonal impacts pursuant to RTA and AUSTROADS guidelines.

In order to validate the base Paramics models for the Nowra CBD strategy modelling, a broad traffic turning movement and pedestrian study was undertaken on Wednesday 22 and Thursday 23 September 2004 where counts were undertaken simultaneously at all key intersections in the study area including all Princes Highway intersections between Plunkett Street and Moss Street to determine the broader network peak period, upon which to establish and validate the operation of the traffic model. The Thursday traffic conditions were found to be more critical throughout the study network and were adopted as base traffic flows for validation of the base Paramics models. Upon review of annual traffic conditions, Thursday 23 September 2004 was later determined to be equivalent to annual average daily traffic conditions (within 2% of the equivalent peak period traffic flows).

The 2016 base model has been modified to incorporate the land use changes outlined above in Section 4, (that is, as per Appendix B) including the latest Stockland and LEDA proposals.

The base model was originally developed using the Paramics micro-simulation program, version 4.2. The model has been redeveloped using Paramics Version 5.2 for this study to allow use of latest technology (including sophisticated plug-ins) that allow the modelled network to be optimised.

5.2 Additional traffic measures required

The modelling assessment found that the existing strategy was largely intact, but the road network was delicately balanced; with high demand flows and queuing evident towards the end of the modelled Thursday PM peak period runs.

Further to the strategy requirements (with reference to the Nowra CBD Strategy dated December 2003 and the Nowra CBD East Expansion Traffic Modelling Study (strategy revision) dated February 2006, the following additional recommendations are made to enable the traffic network to cope with the projected 2016 traffic demands as outlined in this report:

- provide a connection from the proposed Leda Development to Journal Street (Morton Parade), as provided in the Leda proposal;
- adopt Scenario 4 (see Figure 4.2) as the Link to ENSA from Junction Street, which aims to provide direct efficient link from the main LEDA car park access to ENSA, thereby optimising accessibility and thereby mitigating the impacts of the LEDA development on Junction Street and Princes Highway, and which is optimised to provide appropriate bus access arrangements and to avoid congestion at the Leda roundabout and on the link to ENSA;
- provide for a signalized intersection of Junction Street with the main Leda car park access/link to ENSA;
- revise the LEDA car park layout and access point to suit Scenario 4 and to accommodate the future traffic signals;

- retain access from the proposed LEDA roundabout to the basement car park as alternative car park access. Council's consent conditions appropriately require this access to be modified from that concept submitted to Council 23 June 2006 to optimise the efficiency and integration of this link into the LEDA basement car park. While providing a minor benefit in the short term, it could play an increasingly important role in the future with any extension of the eastern road network (possible extension of Wallace Street to Junction Street) in the future. (It is noted that the extension of Wallace Street is not currently supported by Council). However modelling has shown important network benefits of this option and it is recommended that the possibility of this extension (of Wallace Street) be protected for future consideration. It is noted further that an extension of Wallace Street could not be considered for implementation prior to ENSA due to an expected high diversion of local traffic. Not withstanding possible future extension of Wallace Street, the additional basement car park access from Junction Street (direct connection to LEDA roundabout, modified as conditioned in the LEDA DA consent to improve efficiency of connection) provides improved levels of service for access to the car park which has been determined would improve daily operations as well as provide additional capacity to assist evacuation if required;
- provide additional lane capacity on Junction Street between Nowra Lane and Princes Highway (see further below);
- provide additional lane capacity on Brereton Street between Junction Street and North Street;
- signalise the Plunkett Street/Haigh Avenue intersection including additional lane capacity on Plunkett Street and Haigh Avenue;
- provide three lanes eastbound on Plunkett Street (between Haigh Street and Princes Highway);
- provide three lanes westbound on Plunkett Street (between Princes Highway and Grant Street) and provide two lanes westbound on Plunkett Street (between Journal Street and Grant Street);
- single lane roundabout with pedestrian measures inclusive at the intersection of Journal Street/Plunkett Street. Note that pedestrian safety at this location is integral with condition of diverting the existing shared pathway around the perimeter of the LEDA site (extending from the LEDA eastern boundary direct to Wallace Street to reconnect with existing pathway infrastructure at Douglas Street intersection) which aims to minimise traffic/pedestrian conflicts at the intersection of Journal Street/Plunkett Street;

- LATM adjustments/improvements to local Nowra East road network. On this matter, an important reference document is the latest LATM Report (October 2006) submitted by LEDA 12 October 2006 pursuant to deferred commencement conditions. That report was accepted as generally satisfactory with the exception of Appendix A of that report which was not accepted on grounds that the concept drawings shown (see Appendix A of that report) were not a reflection of Council conditions or Council advice relating to design of external works. The incorporation of LATM treatments in conjunction with capacity improvements on Plunkett Street (as conditioned on LEDA) and provision of ENSA, should ensure adequate protection of Nowra East local road network. The proposed extension of Wallace Street to Junction Street (not currently supported by Council) could also be expected to mitigate traffic impacts on Journal Street if supported by Council in the future (Note that the extension of Wallace Street could not be completed prior to provision of ENSA due to likely adverse traffic conditions). Refer Appendix F (LATM report by LEDA) and K of this report for further details;
- for details relating to southern egress arrangements from Stockland Nowra (Fair), refer to Stockland Nowra Traffic Modelling Study (April 2007) for discussion of optimum network connections, of which connection to Morton Parade has been determined to provide the best outcome for Princes Highway. Appendix A of that study (included in this report as Appendix P) includes full details of the Stockland Nowra egress option testing.

The additional traffic measures have not proved as dramatic as might have been expected, given the increased scale of potential development when compared with the assumptions of the 2005 modelling.

Lower traffic generation rates have been applied in the revised strategy modelling as noted above (reduced from 5 trips/100sq.m to 4.6 trips/100sq.m), justified on the basis that the RTA's traffic generation surveys and derived rates have indicated that larger shopping centres generate lower peak volumes of traffic per 100sq.m of lease able floor space when compared with smaller centres.

Refer RTA guidelines for indicative relationships (the adopted rate of 4.6 trips/100sq.m equates to RTA guidelines for suggested Thursday PM peak period hourly rate for Shopping Centres greater than 30,000sq.m in size). Cardno Eppell Olsen's February 2006 (CBD East Expansion Traffic Modelling) Study also contains further discussion on this matter.

The new link between the LEDA shopping centre and Journal Street has also improved model network operation, albeit with impacts on the local Nowra East road network. Council has separately considered means to deal with this change and has imposed approval conditions (on LEDA) accordingly. Refer to Appendix K for further discussion on this topic.

The revised road networks are shown at Appendix H. Concept design 'Option A' is recommended. Option B is not recommended (results in reduced network operational performance).

The only difference between design Options A and B (Appendix H) is Option A has additional land acquisition shown to be required at intersections Princes Highway/Moss Street and Princes Highway/Plunkett Street due to the upgrades required at those intersections.

Option A shows the additional land acquisition required and is recommended. Option B does not require land acquisition, and accordingly implementation of Option B would have implications in terms of reduced network performance.

None of the options show the land acquisition required to provide six lanes along the Princes Highway south of Plunkett Street and north of Moss Street, however this additional acquisition must be taken into consideration at an early stage to allow upgrade of the Princes Highway when required in the future.

Until such times as detailed designs are undertaken, it can be assumed that land to allow an additional travel lane will be required on both sides of Princes Highway between Moss Street and Shoalhaven River bridges and between Plunkett Street and the southern extension of South Nowra. Consideration will need to be given to appropriate tapers required at intersections depending on design vehicle turning movements.

Further, additional land acquisitions will be required as a result of intersection upgrades along the Princes Highway between Shoalhaven River bridges and southern extension of South Nowra). Special consideration is required to determine appropriate setbacks.

Based on the modelling runs and assessments undertaken to date, it is still expected that 1st stage ENSA will be required by, or very soon after 2011 and that full ENSA will be required by 2016.

Council has also made an assessment on the traffic loading on to the Nowra east local road network as a result of allowing a connection from LEDA to Morton Parade and considers likely traffic volumes as a result of a range of development scenarios (Refer Appendix K).

5.3 Specific Design Notes

Princes Highway/Junction Street intersection

The performance of the Junction Street/Princes Highway intersection is critical to the traffic network, particularly in terms of access to the enlarged shopping centres east of the highway. A design note dealing with this intersection is attached at Appendix L.

It is accepted that a right turn ban (for movements north to west) is required under all circumstances to optimise Princes Highway through efficiency.

With respect of the Junction Street (west leg), modelling prior to the Leda proposal envisaged maintaining all movements, in order to promote access between the shopping centres on either side of the highway.

If ENSA Stage 1 is not provided in conjunction with the LEDA proposal, extensive queuing along Junction Street would result, and the right turn from east to north is the critical movement. Enabling this would require a right turn ban, from the west to south (Junction Street west leg).

However, with Brereton Street and ENSA in place, even with all commercial land east of the highway fully developed; the critical movement from Junction Street in the model is from east to south. Accordingly, two left turn lanes on the eastern leg have been required to provide adequate capacity in the CBD Strategy review model under this scenario. Under that scenario, maintaining the right turn movement (west to south) on Junction Street west leg would be acceptable. Prior to introduction of ENSA (or 1st Stage ENSA) a different lane allocation would be necessary.

Lane allocation will need to be reviewed over time as development occurs and traffic conditions change.

Lane allocation shown at Appendix H is considered an appropriate allocation for initial construction.

The important detail as determined by the Paramics modelling is the necessary provision of three approach lanes on the east leg to optimise performance of the junction without impacting the integrity of Princes Highway as through transport corridor.

Princes Highway/Moss Street intersection

Previous modelling had indicated that a high entry angle left turn slip lane, north to east, would be necessary at intersection of Princes Highway and Moss Street.
Design Note at Appendix M provides updated discussion following a more detailed review of this intersection in Paramics 5.2.

In summary, current advice is that whilst a high entry angle left slip lane will be expected to improve Princes Highway operations (marginal reduction in southbound queue conditions), its' effect is not so significant to achieve a marked improvement to network operation, and accordingly this additional expense is not considered essential.

Construction of high entry angle left turn slip lane will also have the effect of influencing higher traffic flows on Moss Street and Brereton Street (between Moss and North). This will lead to adverse conditions on these streets and this is not considered to be justified when considering that the network benefits of such a treatment (improvement to Highway operation) is not significant.

Additional land acquisition to allow for construction of the high entry angle left turn slip lane is not therefore considered to be warranted.

Land acquisition however to allow for construction of an additional through lane (to maintain three through lanes when making allowance for the provision of additional right turn lane into Moss Street (for movements north to west) is considered necessary to achieve satisfactory Highway operation.

Two versions of the current strategy (concept design drawings) have been produced. Option A shows the land required to maintain three approach lanes on north leg at SH1/Moss Street and similarly for SH1/Plunkett Street. Option B does not.

Option B is not recommended as it leads to unacceptable operating conditions.

See Appendix H, which provides conceptual drawings of both options within the revised preferred road network. Option A is the recommended revised preferred road network strategy.

South Nowra Highway Study

An assessment of future network options for the Princes Highway between Hillcrest Avenue and Warra Warra Road, South Nowra has also been undertaken by Cardno Eppell Olsen and completed in February 2006. As part of this report, further assessment of the Princes Highway/Kalandar Street intersection and the Princes Highway section between Junction Street and Plunkett Street (through Nowra CBD) were undertaken and the findings included at Appendices N and O respectively.

The study concluded that without ENSA the Princes Highway may require substantial upgrades to meet the predicted 2016 traffic demands depending on the level of development in the surrounding areas. This may require the Princes Highway to be upgraded to a minimum of eight (8) through lanes (four lanes in either direction) for the entire length of the study corridor.

The addition of ENSA to the road network relieves the Princes Highway, such that the Princes Highway does not require upgrading to the same extent as would be required without ENSA, however localised intersection upgrades are still required.

Stockland's Nowra DA Independent Assessment with ENSA – six (6) through lanes are recommended through the study area from Nowra CBD through South Nowra. This analysis also highlights the significant lane capacity deficiencies on the Shoalhaven river bridges north of Nowra CBD.

This assessment analysed the three potential egress arrangements for the Stockland's Nowra Fair development to the Princes Highway (South of Worrigee Street).

Traffic Modelling of Stockland Nowra (Fair) Expansion April 2007 – Appendix A – Stockland Nowra – Southern Egress Option Testing

In response to RTA concerns in relation to the Stockland Nowra proposed signalised egress to Princes Highway south of Worrigee Street (DA06/1317), this assessment was undertaken to analyse three (3) options for southern egress from the Stockland Nowra site.

The three egress options tested were as follows:

- signalised left only slip lane south of the Princes Highway/Worrigee Street intersection (i.e. as per Stockland Nowra DA06/1317 and consistent with the 2005 revision of Nowra CBD Strategy – February 2006 report);
- additional left exit only approach to the Princes Highway/Worrigee Street intersection;
- exit onto Morton Parade for access to Journal Street via Morton Parade and Plunkett Street.

The assessment concluded that of the three egress options tested, the provision of egress onto Plunkett Street is the most advantageous with respect to the operation of the Princes Highway, as this egress option does not introduce additional conflicts onto the Princes Highway or adversely impact on adjacent intersections.

The reduced conflicts near the Princes Highway/Worrigee Street intersection (as a result of closed egress to Highway and connection to Morton Parade), and subsequent increase in operational efficiency afford significant benefits for traffic on the Princes Highway including reduced queuing in the area which aids the operation of adjacent intersections.

It should be noted however that whilst optimising efficiency of the Princes Highway as a through transport corridor, this option would have the effect of adversely impacting traffic and environmental conditions on Nowra East local road network (Refer also Appendix K of June 2007 Nowra CBD (East) Road Network Strategy Review Report) and this would require LATM treatments, upgrade of Plunkett Street (between Journal Street and Highway) and consideration of other measures to mitigate the impacts on Nowra East local road network.

The full assessment is included at Appendix P. Refer also Appendix K in relation to traffic loading on Nowra East local road network.

Nowra CBD Strategy – Junction Court Opening Options and Worrigee Street One Way

Of the three Junction Court opening options, no option caused unacceptable congestion or delays in the Paramics models. This is primarily due to the base 2016 model having no capacity issues. However, the one-way westbound option was found to have slightly better operational performance (lower relative travel times, delays and costs) than the other two options.

The Paramics modelling showed in 2016 approximate volume of 2,500AADT per direction or approximately double that flow (nearer 5,000vpd) for two-way would be expected if the Junction Court was opened to traffic.

This is considerably lower than both 2003 and 2007 TRACKS model analysis, which indicates 2016 approximate volume of 6,000AADT per direction or approximately double that flow (nearer 12,000vpd) for two-way would be expected if the Junction Court was opened to traffic.

The differences in the modelling outputs (TRACKS v Paramics) are most likely related to model operations and study area.

When considering all options by several indicators such as parking, circulation, pedestrians, cost and crime prevention; all options also gave very similar results. The largest variation between options was in the parking and crime prevention indicators. Council has indicated that crime prevention is main driver to open the mall. If this is a key driver in the decision, the two-way option is preferred as it allows for higher volumes in off peak periods when crime prevention is required most.

When considering objectives of pedestrian safety and town centre amenity (retention of maximum open space) the one-way options would be preferred (noting one way westbound would be preferred on basis of Paramics modelling).

On the basis of traffic modelling and network operations, the opening of Junction Court is not recommended for two way flow.

If Council considers it necessary to open Junction Court (for reasons other than traffic) one way westbound flow is the preferred direction of travel to reduce network impacts.

Other than localised impacts which need to be considered, one way westbound flow is unlikely to result in network operational difficulties in the short term, however modelling indicates that by 2016, traffic flows on Junction Court are likely to be in the order of 6,000 vpd (similar to the

existing two-way flows on Junction Street. Accordingly, design will need to consider appropriate traffic calming and pedestrian safety elements.

Opening up Junction Court to traffic will require resolution of an appropriate safety treatment at intersection Junction Street/O'Connell Lane, as well as resolution of any necessary changes to existing shop front parking and existing taxi zone arrangements (dependent on adopted traffic directional arrangements). These will require liaison with affected parties as part of detailed design process.

If one way westbound is adopted by Council (preferred on basis of detailed Paramics modelling), an option may be to introduce one way westbound on Junction court section only, and provide two-way traffic flow between O'Connell Lane and Nowra Lane (to maintain shop front parking and provide opportunity for retention of taxi zone in this location). This will still require resolution of an appropriate safety treatment at intersection Junction Street/O'Connell Lane. Other options may need to be considered to resolve these issues.

For the Worrigee Street one-way eastbound option, the modelling of this option did not cause unacceptable congestion or delays. However, it is considered that the resultant reduction in accessibility is not justified when considering the strategic objectives of the Nowra CBD strategy (maintain accessibility and maximise side road capacity to combat proportional reduction in green time at Highway intersections), and considering that the impacts of this option do lead to increased trip times, delays and costs for the entire network compared to the 2016 base model. Accordingly, this Option is not recommended.

The full design note is included in this report at Appendix R.

5.4. Network performance

Figure 5.1 indicates the level of service for the PM peak hour on individual road links under the revised strategy (Scenario 4). (This figure has been drawn from Appendix G, which contains further evidence of performance.)

Figure 5.1 suggests that worst delays are experienced for southbound traffic on Princes Highway coming from the Shoalhaven river bridges to the intersection of with Moss Street. Some congestion is also experienced at the Plunkett Street and North Street intersections with Princes Highway, and on Brereton Street.

Dynamic performance of the model suggests that traffic will be slowest on Junction Street, North Street and Plunkett Street, as well as on the Princes Highway above Moss Street and Plunkett Street.

The directional peaks that occur in the PM peak period are likely to occur in the reverse direction in the AM Peak period. This is to be considered in determining appropriate network upgrades.

While lengthy queues are experienced approaching the CBD north of Moss Street, ENSA relieves the situation quite dramatically for the rest of the network and other intersections are generally cleared with each phase of the traffic signals. Average speed on the network (from the revised 2016 preferred strategy Paramics model) as a whole is just under 35km/h. This compares to the current average speed on the network of 41km/h (from the calibrated 2004 Paramics Model).
This reduction in average speeds by 2016 when compared with the base 2004 model indicates broad increases in congestion across the network at the end of the PM peak period, however the general performance of the 2016 CBD Strategy Review Paramics models was considered satisfactory subject to road network improvements implemented as recommended in Section 5 of this report and as shown at Appendix H (Option A).

Accordingly, it is recommended that the revised preferred road network strategy (Option A) with the additional measures as described in section 5 of this report and as shown at Appendix H be considered the minimum provision of road network capacity to cater for the input Nowra/Bomaderry Structure Plan demand flows at 2016 and reflective of the level of commercial development described in Section 4 of this report, shown at Appendix B (relating to commercial development in Nowra CBD East – east of Princes Highway Nowra).

Figure 5.1 ***Level of Service under Preferred Strategy***

6.0 PEDESTRIAN ACCESS

As was noted in the Introduction, the 2003 Strategy has not been superseded by this or subsequent revisions of the strategy. These later studies have looked only at the operational traffic impacts of changing development proposals and have not dealt with other modes. The measures regarding public transport, cycling and walking from the 2003 Strategy are still pertinent.

In fact the larger scale of development proposed raises concerns about the adequacy of pedestrian provision, particularly if the upgrading of Jane Street recommended in the 2003 Strategy is not proceeded with.

While Junction Street/Princes Highway traffic signals is an agreed and necessary at grade solution to the pedestrian problem immediately north and south of the Junction Street corridor, the upgrading of grade separated pedestrian facilities at Jane Street (to provide improved access and integration) is considered necessary to attract more grade separated pedestrian movements, in the interests of:

- minimising traffic/pedestrian conflicts on the Princes Highway both at traffic signals and midblock particularly adjacent Stockland Nowra;
- enhance capacity to cater for marked increases in east-west pedestrian movement whilst protecting the integrity of Princes Highway as an efficient transport corridor;
- provision of facilities that encourage integration (east v west) to enhance the viability of the Nowra CBD whilst promoting alternative mode of travel other than via private motor (optimise opportunity for east v west integration with reduced traffic impacts).

The current Stockland Nowra shopping centre generates a lot of pedestrian traffic across the Princes Highway. A substantial amount of this existing pedestrian traffic crosses midblock between Junction Street and Worrigee Street (directly opposite Nowra Fair), encouraged by fence openings at access/egress points that do not align with safe crossing facilities, and poor design of Jane Street with respect to pedestrian access and integration (connections), and this has contributed to road safety concerns.

Refer to Appendix Q which summarises the results of pedestrian survey undertaken Thursday 23 September 2004, the same day as the base traffic generation data was recorded (later found to be equivalent to annual average daily traffic conditions), so a good day for observing existing pedestrian demands). These results:

- emphasise the magnitude of existing pedestrian movements (noting Thursday 23 September 2004 was a typical average weekday) and accordingly higher seasonal pedestrian volumes could be expected to occur particularly over the warmer months and most notably in the lead up to Christmas);
- highlight that the existing grade separated pedestrian facilities at Jane Street do not encourage or optimise grade separated pedestrian movement, and as such;
- highlight the importance of providing improved grade separated pedestrian facilities at Jane Street with:
  - pedestrian facilities on both sides of Jane Street bridge (currently there is only a footpath on the south side of Jane Street and there is currently no footpath at all at the western end of Jane Street). A new pathway on north side of Jane Street is recommended;
  - improved connections at both ends of Jane Street including good efficient integration with existing pedestrian facilities including direct efficient access to Stockland Nowra, and safe connections to footpath facilities in Nowra Lane (including possible upgrade of the Jane Street/Nowra Lane intersection to improve and encourage pedestrian access to Jane Street).

While it has been argued that an isolated LEDA proposal may not generate significant increases to midblock pedestrian crossings between Junction and Worrigee Streets, the same cannot be said for the proposed Stockland expansion, or with any proposal to integrate the two shopping centres due to the frontage of the development to the Princes Highway and strengthened pedestrian desire lines to the south of the proposed Junction Street/Princes Highway traffic signals by virtue of the shopping centre access location, including direct pedestrian access to Princes Highway.

With reference to Section 4.0 in relation to the balance of floor area (east v west) in Nowra CBD, It is important to note that the pedestrian numbers currently crossing the Princes Highway (as recorded 23 September 2004 and summarised at Appendix Q) have been generated whilst the retail floor area at the existing Stockland Nowra represents approximately 20% of the existing total Nowra CBD retail floor area.

With the potential commercial development growth to the east of Princes Highway (as noted in Section 4 and shown at Appendix B), the proportion of retail floor area to the east of the Princes Highway has the potential to grow to be more approximately 50% of the total Nowra CBD retail floor area.

Whilst this may not necessarily mean a doubling of demand for pedestrian movements across the Princes Highway, it can certainly be concluded that there is likely to be a marked increase in pedestrian movements across the Princes Highway and there is a need for the Nowra CBD Strategy to address this issue in the interests of encouraging safe efficient integration east v west for all modes of travel (with emphasis on pedestrian friendly connections that encourage reduced private car travel), ensuring road safety issues on Princes Highway are addressed, and protecting the integrity of Princes Highway as an efficient transport corridor.

It is not believed that grade solutions 'only' are an acceptable sustainable response to these issues and accordingly the upgrading of grade separated pedestrian facilities on Jane Street is an integral component of the Nowra CBD Strategy.

In essence, the Nowra CBD Strategy identifies that the upgrade of Jane Street (and other grade separated pedestrian opportunities as they arise) are necessary if pedestrians are to be encouraged to safely cross the Princes Highway and other major traffic roads while minimising the impact of increased pedestrian demand on traffic efficiency and road safety.

By providing pedestrians with an attractive and efficient alternative to the proposed new Junction Street intersection (and other at grade signalised pedestrian crossings of the Princes Highway in Nowra CBD), delays at critical intersections along the Highway caused by pedestrian movements will be minimized, enabling the Highway intersections to function much more effectively and optimise through travel capacity.

If pedestrian crossing times on Princes Highway are not responsive to marked increases in pedestrian demands (not expected, with emphasis on Highway likely to be on through traffic capacity), increases in midblock pedestrian crossings can be expected irrespective of the signalised crossings and every effort should be made to ensure such movements are deterred or discouraged by provision of safe efficient integrated alternatives.

With respect of pedestrian crossings of Princes Highway in the vicinity of Stockland Nowra, and further to pedestrian improvements proposed for Jane Street, the following measures are also reinforced as integral to the Nowra CBD pedestrian strategy, they being:

- closure of midblock pedestrian facilities (existing gaps in fence) in conjunction with introduction or Princes Highway/Junction Street traffic signals;
- improvements to pedestrian access to Stockland Nowra at Princes Highway/Worrigee Street intersection. Currently there is a pedestrian crossing phase which is under utilised because there is no direct access to Stockland Nowra in the vicinity of the pedestrian facilities at Princes Highway/Worrigee Street. The pedestrian access to Stockland Nowra fronting Princes Highway is currently only via the existing gaps in the fence at locations of traffic access and egress points. By virtue of these locations, this acts to encourage midblock pedestrian movements, and the strong influence of these access points on pedestrian movements has been confirmed in the surveys of pedestrian movements (summarised at Appendix Q). Direct accessibility to Stockland Nowra aligning generally with the pedestrian crossing facility at Princes Highway/Worrigee Street intersection is also an important aspect of the strategy to reduce midblock pedestrian crossing activity.

Finally, any measures to encourage pedestrian rather than vehicular movement between the retail activities on either side of the Princes Highway are:

- in keeping with State government policy to reduce the onus on motor vehicle travel by provision for alternative modes;
- in keeping with the requirements of the L.E.P by providing safe efficient pedestrian links between east and west without adverse impacts on the Princes Highway;
- likely to relieve some of the pressures caused by increased traffic growth associated with expansion of commercial development to the east of the Princes Highway.

7.0 RECOMMENDATIONS

The recommended additional road network improvements required to enable the road network to cope with background traffic growth plus traffic generated from full development of commercial land to the east of Princes Highway are provided in Section 5 and at Appendix H of this report (Option A), and also summarised below.

This report does NOT attempt to supersede the December 2003 Nowra CBD Strategy, more it is intended to update the 2005 revision of the road network strategy (February 2006 report) following incorporation of the latest development proposals, to enable the CBD strategy to be further refined such to provide confidence of development proposals that can be accommodated in Nowra CBD (East) and the corresponding level of works required to ensure satisfactory traffic operation and pedestrian safety.

This section brings together the recommendations of the 2003 strategy and those of the 2005 revision with those stemming from the current modelling. It also includes the recommendations from the North Street, Nowra Traffic Study November, 2004. Other important recommendations are contained in respective design notes (Section 5.3) and in the Appendices provided at the rear of this report.

Recommendations from December 2003 Strategy report

Road network

- A1 Include a functional road hierarchy into the DCP in accordance with designations shown on Figures 2.6 and 2.7 of the 2003 report;
- A2 Adopt and pursue the implementation of the East Nowra sub-arterial with connections to the Princes Highway at North Street and Junction Street together with an access to Nowra Fair (now Stockland Nowra) – requires direct efficient access to expanding commercial area to the east of Princes Highway to mitigate impacts on Junction Street and Princes Highway;
- A3 Provide signalised all movement access at Junction Street and Princes Highway intersection (since revised);
- A4 In association with the East Nowra sub-arterial and east west connections, upgrade the Princes Highway intersections at Moss Street, North Street, Junction Street, Worrigee Street, Plunkett Street and Kalandar Street;
- A5 Maintain and upgrade principal entry points to the CBD including Bridge Road (Princes Highway to North Street) and Worrigee Street (Princes Highway to Kinghorne Street) to include four lanes with intersection upgrades;
- A6 Retain Junction Court to prevent excessive traffic use west of Nowra Lane;

- A7 Prepare an upgrading concept for North Street between Bridge Street and Princes Highway including intersection upgrades, road widening if needed, parking and pedestrian provisions;
- A8 Other intersection upgrading and road widening at locations shown on Figure 2.4 of the report (those within bounds have been incorporated into Appendix H).

Parking

- A9 Retain and protect the quantity of short term parking available at Stewart Place and Egan's Lane, with long term consideration to possible expansion of these locations post 2016;
- A10 A number of on street car parks will be lost with intersection and other upgrades (estimated to be approximately 210) and these spaces will need to be accommodated off street;
- A11 Provide over 1,500 new car parking spaces within the greater Nowra CBD by 2016, based on a net increase required of 1,290 spaces and provision for losses of existing spaces on street. It is estimated that Public car parking will need to supply about 1,000 of those spaces.
- A12 Approximately 800 of the above new public car parking spaces should be allocated to unrestricted car parking stations located throughout the CBD by 2016. Redevelopment and expansion of existing car parking stations together with the development of a new site should be undertaken at the following locations:
  - the precinct of North Street, Nowra Lane, Jane Street overpass and the Princes Highway;
  - Lawrence Avenue car park;
  - Berry Street/Worrigee Street car park;
  - Collins Way car park.
- A13 Section 94 contributions should continue to be levied to the central zones bounded by North Street, Berry Street, Worrigee Street and Nowra Lane/O'Keefe Avenue, and developers should not be allowed to provide their own parking. Exception may be considered where it is necessary to provide high turnover parking, disabled parking, select customer parking etc (depending on the application). However, these should be minimised where possible with Section 94 contributions collected on the short fall;
- A14 Areas outside of the above Central CBD zones should be required to provide all parking on site.

Further Parking comments:

- of the estimated 1,000 public car parking supply recommended in A11, it includes 210 to accommodate loss of on-street car parking. That is a net increase of 790 off street public spaces required. This is an assumption that was based on the balance of private v public off street car parking spaces at the time of assessment, however there are many factors that may cause a change to that ratio in the future;
- car park estimates at A11 are based on the greater Nowra CBD study area bounded by a grid that included Hyam Street in the north (includes Council site), Shoalhaven Street to the west, Douglas Street to the south, and includes Stockland Nowra (Fair) to the east. The extent of the car parking study area as set up in TRACKS can be seen on a plot of the Nowra/Bomaderry TRACKS zone map which includes a sub plot of the Nowra CBD TRACKS zones (the parking zones). Essentially, this included all commercially zoned land in and around Nowra CBD. In the peripheral CBD TRACKS zones (north of North Street, west of Osborne Street, south of Plunkett Street, and east of Princes Highway), car park supply was only provided to satisfy the demand for car parking in those areas, that is for the purpose of establishing a robust car parking strategy for Nowra CBD (West), no on-street car parking in these peripheral areas was allowed to be utilised by central CBD zones and vice versa. This allowed an accurate estimate of CBD (West) car park demand to be determined at 2016 based on the validation parameters and Nowra Bomaderry Structure Plan projections established at 2001/2002/2003;
- if development occurs in accordance with the sec94 plan, the deficit at 2016 is deficit only in the retail core (where sec94 contributions have been paid under the plan in lieu of providing car parking spaces). However a substantial amount of the deficit at 2016 is attributed to the current deficit at 2007, estimated to be approximately 582 spaces (based on DCP18 requirements), or 643 spaces (based on actual average weekday survey at 2007), i.e. that is some 10% higher than DCP18 requirements, west of Princes Highway alone. East of the Princes Highway, there is a current surplus at 2007 in the order of approximately 66 spaces (based on DCP18 requirements), or a deficit of approximately 86 spaces (based on actual average weekday survey at 2007), i.e. that is some 20% higher than DCP18 requirements. Whilst there may be other influencing factors, this data would suggest deficiencies in DCP18 car parking rates, which are currently subject to review as part of separate car parking strategy review process;

- it has been estimated that approximately approximately 180 spaces (in 2001/2002) were recorded as being commuter (all day) cars parked in peripheral CBD streets, that is that they were recorded as being parked all day adjacent to or in residential or peripheral areas around the Nowra CBD. Approximately 90 of these spaces were recorded in peripheral areas to the south and west of Nowra CBD, and approximately 90 of those spaces were recorded to the north of North Street. This figure (180) needs to be considered when assessing the actual deficit of off street car parking, and for determining actual practical target car parking supply levels for Nowra CBD parking strategy. The figure is believed to be closer to 430 vehicles in 2007 (i.e. surveys have shown that peripheral on street car parking around CBD has increased by 250 vehicles, that is at a rate of approximately 50 on street cars each year since 2002). The 2007 survey showed that approximately 190 of these spaces were recorded in peripheral areas to the south and west of Nowra CBD (increase of 100), and approximately 240 of those spaces were recorded to the north of North Street (increase of 150);
- similarly, it has been estimated that approximately 84 spaces (in 2001/2002) were recorded as being commuter (all day) cars parked on private land holdings in commercial zoned areas, west of Princes Highway. This figure was recorded from the six known separate land holdings where such activity was known to occur in 2001/02.2002/03. Some of these commuters were known to be providing a fee to the land owner for the right to park on their property. When development activity occurs on these land holdings, an additional demand is generated (over and above the existing demand for the vacant land) as a result of the new development. This figure needs to also be considered when assessing the actual deficit of off street car parking, and for determining actual practical target car parking supply levels for Nowra CBD parking strategy, as this activity 'masks' actual demand and creates a latent demand when the private land is no longer available (due to development activity or other reason). The figure is believed to be closer to 102 spaces (2005 estimate) based on eight land holdings known to exist at that time, west of Princes Highway;
- east of Princes Highway, on vacant land north of Junction Street (now owned by Stockland) of the total amount of parking recorded on those lands in 2001/2002, approximately 60 of those spaces were recorded that were employees from west of Princes Highway, that parked here and walked back across Princes Highway. The figure is believed to be closer to 80 spaces in 2005. This data indicates deficiency of all day car parking in the employment zone west of Princes Highway in Nowra CBD. This figure (80) was included in the 2007 estimated deficit of 643 spaces in Nowra CBD West;

- car park estimates at A11 are based on the theoretical modelling of all car park demand being supplied within the greater Nowra CBD study area generating the demand (demands calculated by TRACKS based on the base model validation of supply v demand at the year 2001/2002, and on Nowra Bomaderry Structure Plan land use projections to 2016). The TRACKS model was constrained such that no on street car parking sprawl was permitted in surrounding residential streets. This may not reflect reality or be practically achievable, however this assessment was undertaken to set a target off street car park supply figure for Council's consideration in review of the strategy.

The above mentioned figures in A11 and A12 were derived from the 2016 Nowra/Bomaderry Structure Plan CBD Traffic & Parking (TRACKS) model following detailed TRACKS parking analysis (based on 2016 Nowra/Bomaderry Structure Plan projections) in 2003, and based on average weekday conditions. The land use and parking data upon which the base TRACKS model was validated relates to 2001/02.

Section 5.1 of this report identifies that Nowra/Bomaderry Structure Plan land use projections are conservative, although are considered appropriate on the basis of seasonal demand fluctuations.

All subsequent strategy reviews since 2003 have focused on review of road network capacity following changes to development proposals in Nowra CBD East. This process of strategy review has been undertaken using sophisticated micro-simulation traffic modelling software (Paramics) which has been the appropriate tool for undertaking more detailed network capacity analysis to refine the network strategy. However (unlike TRACKS), Paramics does not have inbuilt parking analysis module.

Accordingly, unlike the road network strategy which has been focus of on-going revision keeping up to date with continual development proposal changes, the parking estimates noted in A11 and A12 of the December 2003 Strategy Report have not been subject of similar review by Cardno Eppell Olsen.

More recent investigations are being undertaken by Council and Monaro Consultants Pty Ltd and likely to be completed by June 2007. That will form an important revision to the car parking component of Council's strategy to 2016, and will be subject of a separate report that will supplement the Nowra CBD Strategy (December 2003) and this strategy revision report (June 2007).

Due to time constraints, the Nowra CBD Strategy (Parking Strategy Revision) will no longer be included at Appendix S of this report. It will be a separate report that will accompany the DCP Review process for Nowra CBD (West).

Pedestrians and cyclists

- A14 Adopt PAMP proposed pedestrian facility upgrades and expand plan to include Highway crossings and those outlined below;
- A15 Provide footpath/cycle paths along Junction Street east to East Nowra sub-arterial and proposed skate facilities;
- A16 Plan for footpath and cycle paths along the East Nowra sub-arterial with connections to existing pedestrian/cycle network;
- A17 Provide a pedestrian crossing/s of the East Nowra sub-arterial within the vicinity of the skate facility, sports fields and Nowra Fair;
- A18 Include additional crossing locations within the CBD at the following potential locations:
  - Worrigee Street between Lawrence Avenue and Kinghorne Street;
  - Nowra Lane/Junction Street;
  - Worrigee Street/Berry Street;
  - North Street/Bridge Road/Berry Street;
  - North Street/Egan's Lane/Graham Street.
- A19 Upgrade the Jane Street overpass to provide wider footpaths alongside and better defining connections extending from the overpass into Stockland Nowra (Fair) and west to Kinghorne Street;
- A20 Identify suitable pedestrian links throughout the CBD considering linkages from proposed future car parking locations (e.g. Worrigee St, Lawrence Avenue, Nowra CBD West of Princes Highway – between Worrigee Street and North Street, Egans Lane, Stewart Place, etc) to key destinations within the CBD – later enhanced to include LEP requirement to strengthen pedestrian integration between CBD East and CBD West identifying opportunities for grade separation to mitigate impacts on Princes Highway.

Public transport

- A21 Develop the road network east of the Princes Highway including the East Nowra sub-arterial, the Brereton Street link between Junction Street and North Street, and connections to North Street and Junction Street to allow for the development of a bus ring route;
- A22 Provide all movement access at the intersection of Junction Street and Princes Highway to facilitate the bus ring route (later revised following latest modelling analysis);

- A23 Provide suitable on site bus servicing at Nowra Fair (now Stockland Nowra) consistent with adequate links to the west via either the existing slip lane onto the highway or Junction Street (later revised to include bus and taxi servicing of the CBD East commercial expansion area including separate servicing of Stockland Nowra (Fair), LEDA, and the Stockland Junction North developments with adequate supporting pedestrian facilities);
- A24 Adopt and implement actions proposed in the Shoalhaven Integrated Transport Strategy.

Recommendations from the North Street, Nowra Traffic Study November, 2004

Signalisation of the intersections along the entire length of North Street will be needed to provide adequate traffic capacity and to allow primary pedestrians movements to be achieved safely. Works required are as follows:

- North/Bridge/Berry intersection is highest priority for signalisation and is recommended in two stages. The ultimate form requires land acquisition for road widening and should be planned to follow soon after or in conjunction with the ENSA link to North Street (update: works were completed on the upgrade of North Bridge/Berry intersection to traffic signals by December 2005);
- The O'Keefe Ave roundabout needs to be converted to signals to coordinate with signals at Princes Highway/North Street and Princes Highway/Moss Street, and to facilitate pedestrian movements. This will be needed in conjunction with ENSA link or upgrades to Princes Highway intersections (particularly upgrade to the Princes Highway/Moss Street intersection);
- The Graham Street/Egans Lane intersection signalisation is required primarily to facilitate safe north-south pedestrian movements. It can be achieved as a single intersection controlling staggered T-Junctions;
- The Kinghorne Street signalisation is seen as lowest priority but will be needed prior to 2016.

Recommendations From Nowra CBD (East) Expansion Traffic Modelling Study (August 2005) – Finalised February 2006

- ENSA link from North Street/Princes Highway intersection to Greenwell Point Road including secondary link to Junction Street aligning with main centre access;
- signalise the North Street/Princes Highway intersection, to connect ENSA to Princes Highway and to provide a direct connection to the CBD west of the Princes Highway. This upgrade will also provide level of immunity for Brereton Street and Moss Street from traffic increases resulting from ENSA and Brereton Street upgrades (in conjunction with increased development in Nowra CBD East);

- upgrade the Moss Street/Princes Highway intersection to allow two right turn lanes into Moss Street (North to West), including works in Moss Street between Princes Highway and North Street;
- upgrade North Street from Brereton Street to Kinghorne Street;
- signalise the Junction Street/Princes Highway intersection to provide access to CBD East commercial expansion and to facilitate pedestrian linkage between the CBD and the CBD East commercial expansion area;
- widen Junction Street to provide adequate network capacity;
- signalise the Junction Street/Brereton Street intersection (access to Stockland Nowra) and Junction Street/ENSA link intersection (access to expanded shopping centre – 2004 Stockland proposal) to resolve vehicle conflicts and to aid pedestrian movements;
- construct Brereton Street extension (link between Junction Street and North Street) and deviate the Brereton Street link at southern end to align with Stockland Nowra car park access;
- signalise the exit from the Stockland centre to Princes Highway south of Worrigee Street (not accepted by RTA as at October 2006). Refer to Stockland Nowra Traffic Modelling Study (April 2007) in particular Appendix A of that report for more discussion on this topic. Closure of existing egress from Stockland Nowra and provision of alternative southern egress to Morton Parade has been determined by later studies to be the optimum arrangements for Princes Highway operations (Refer Appendix P for full details);
- widen Princes Highway to add a 2nd right turn lane into Worrigee Street, and widen Worrigee Street to provide an additional approach lane;
- signalise the Brereton Street/North Street intersection to resolve vehicle conflicts and to aid pedestrian movements;
- ban right turn, North to West at the Princes Highway/North Street and Princes Highway/Junction Street intersections;
- signalise the Moss Street/Brereton Street intersection to resolve vehicle conflicts and to aid pedestrian movements;
- signalise the Junction Street/Nowra Lane intersection to resolve vehicle conflicts and to aid pedestrian movements;
- upgrade the Plunkett Street/Princes Highway intersection to allow two right turn lanes into Plunkett Street (North to West), including works in Plunkett Street to accommodate.

Additional strategy requirements stemming from the current report:

Further to the strategy requirements (with reference to the Nowra CBD Strategy dated December 2003 and the Nowra CBD East Expansion Traffic Modelling Study (strategy revision) dated February 2006, the following additional recommendations are made to enable the traffic network to cope with the projected 2016 traffic demands as outlined in this report:

1. Provide a connection from the proposed Leda Development to Journal Street (Morton Parade), as provided in the Leda proposal.
2. Adopt Scenario 4 (see Figure 4.2 and Appendix H) as the Link to ENSA from Junction Street, which aims to provide direct efficient link from the main LEDA car park access to ENSA, thereby optimising accessibility and thereby mitigating the impacts of the LEDA development on Junction Street and Princes Highway, and which is optimised to provide appropriate bus access arrangements and to avoid congestion at the Leda roundabout and on the link to ENSA.
3. Provide for a signalized intersection of Junction Street with the main Leda car park access/link to ENSA.
4. Revise the LEDA car park layout and access point to suit Scenario 4 and to accommodate the future traffic signals.
5. Retain access from the proposed LEDA roundabout to the basement car park as alternative car park access. While providing a minor benefit in the short term, it could play an increasingly important role in the future with any extension of the eastern road network (possible extension of Wallace Street to Junction Street) in the future. (It is noted that the extension of Wallace Street is not currently supported by Council). However modelling has shown important network benefits of this option and it is recommended that the possibility of this extension (of Wallace Street) be protected for future consideration. It is noted further that an extension of Wallace Street could not be considered for implementation prior to ENSA due to an expected high diversion of local traffic. Not withstanding possible future extension of Wallace Street, the additional basement car park access from Junction Street (direct connection to LEDA roundabout, modified as conditioned in the LEDA DA consent to improve efficiency of connection) provides improved levels of service for access to the car park which has been determined would improve daily operations as well as provide additional capacity to assist evacuation if required.
6. provide additional lane capacity on Junction Street between Nowra Lane and Princes Highway (see further below).
7. Provide additional lane capacity on Brereton Street between Junction Street and North Street.
8. Signalise the Plunkett Street/Haigh Avenue intersection including additional lane capacity on Plunkett Street and Haigh Avenue.

9. Provide three lanes eastbound on Plunkett Street (between Haigh Street and Princes Highway).
10. Provide three lanes westbound on Plunkett Street (between Princes Highway and Grant Street) and provide two lanes westbound on Plunkett Street (between Journal Street and Grant Street).
11. Single lane roundabout with pedestrian measures inclusive at the intersection of Journal Street/Plunkett Street. Note that pedestrian safety at this location is integral with condition of diverting the existing shared pathway around the perimeter of the LEDA site (extending from the LEDA eastern boundary direct to Wallace Street to reconnect with existing pathway infrastructure at Douglas Street intersection) which aims to minimise traffic/pedestrian conflicts at the intersection of Journal Street/Plunkett Street.
12. LATM adjustments/improvements to local Nowra East road network are required to mitigate the impacts of LEDA's southern connection to Morton Parade. On this matter, an important reference document is the latest LATM Report (October 2006) submitted by LEDA 12th October 2006 pursuant to deferred commencement conditions. That version of the LATM report submitted by LEDA was accepted as generally satisfactory with the exception of Appendix A of that report which was not accepted on grounds that the concept drawings shown in that Appendix (A) were not a reflection of Council conditions or Council advice relating to design of external works. The incorporation of LATM treatments in conjunction with capacity improvements on Plunkett Street (as conditioned on LEDA) and provision of ENSA, should ensure adequate protection of Nowra East local road network. The proposed extension of Wallace Street to Junction Street (not currently supported by Council by recommended in the Nowra CBD Strategy revision report) could also be expected to mitigate traffic impacts on Journal Street if supported by Council in the future (Note that the extension of Wallace Street could not be completed prior to provision of ENSA due to likely adverse traffic conditions). For further details, refer Appendix F (LATM report by LEDA) and K of this report (Traffic Loading on Nowra East Local Road Network).
13. Consider southern egress of Stockland Nowra Fair connecting with Morton Parade. Refer additional discussion on this matter in the Stockland Nowra Traffic Modelling Study (April 2007) and in particular Appendix A (Appendix P to this report) "Stockland Nowra – Southern Egress Option Testing".

It is recommended that the revised preferred road network strategy (Option A) with these additional measures (also described in Section 5 of this report) and as shown in Appendix H be considered the minimum provision of road network capacity to cater for the input Nowra/Bomaderry Structure Plan demand flows at 2016 and reflective of the level of development described in Section 4 of this report and shown at Appendix B.

Additionally, section 6 of this report identifies that increased development potential to the east of the Princes Highway creates concern with respect of managing pedestrian demand for crossings of the Princes Highway and re-emphasises those pedestrian improvements integral to the Nowra CBD Strategy and S.L.E.P. aimed at improving pedestrian links between east and west whilst reducing at grade traffic/pedestrian conflicts (by provision of improved grade separated opportunities for pedestrians and identifying new opportunities for grade separation as opportunities arise with development) and thereby protecting the integrity of Princes Highway as an efficient transport corridor. These improvements include:

1. Upgrading grade separated pedestrian facilities on Jane Street including new pathway north side, improved accessibility to Jane Street, improved connections at both ends of Jane Street, and ensuring safe efficient integration (connections) with existing and proposed pedestrian facilities (both in Nowra CBD West and access to Stockland Nowra).
2. Closure of midblock pedestrian facilities (existing gaps in fence) in conjunction with introduction or Princes Highway/Junction Street traffic signals.
3. Improvements to pedestrian access to Stockland Nowra at Princes Highway/Worrigee Street intersection.

While it is acknowledged that the Nowra CBD Strategy Review Traffic modelling has been based on the potential for worst case development scenario of all sites being fully developed at the year 2016 (in reality may not occur strictly within that time frame), the sophisticated modelling techniques employed have provided confidence that the outcomes shown at Appendix B) which does have the potential to occur under the current zoning provisions and accordingly it is recommended that Council now take steps to protect land necessary for future road network improvements as recommended under the strategy.

Given the future potential for development described in Section 4 and Appendix B to occur under the current zoning provisions (that is, subject to detailed assessment and approval, addressing the usual planning regulations and policies, including among many others the S.L.E.P. and the Nowra CBD Strategy revised April 2007), each of these measures as recommended in this report should be undertaken when traffic has risen to a level that requires it.

This should be determined by on-going assessment of traffic conditions on the Princes Highway and Nowra CBD streets, and by ensuring developers undertake detailed traffic impact assessments evaluating the impacts of their development on the surrounding road network.

The objective of such assessments being to demonstrate that a development will not create unacceptable impacts, with objective being maintaining existing or appropriate levels of service (as per RTA guidelines and with reference also to AUSTROADS assessment criteria), or where this is assessed as not being possible with existing levels of infrastructure, adverse effects of development must be identified and corrective measures designed and implemented at the appropriate time to ensure adequate level of service is provided either through appropriate development conditions (79c), section 94 planning, or other means as determined by Council, and or RTA.

It is recommended that any such road network improvements be in accordance/complimentary to this revised strategy to ensure satisfactory levels of network operation and pedestrian safety are provided, and that any interim works do not jeopardise the ability of this strategy to be implemented in cost effective manner.

Appendix A

Preferred Road Network Map from the CBD (East)

Expansion Study, February 2006

CONCEPT ONLY

FOOTBALL

HOCKEY

DESIRABLE ROUNDABOUT GEOMETRY SHOWN. MINIMUM INSCRIBED ROUNDABOUT RADIUS=20M MAY MINIMISE CONSTRUCTION COSTS, LAND REQUIRED AND SCHOOL ISSUES.

ENSA CROSS SECTION AND ALIGNMENT SOUTH TO GREENWALL POINT ROAD TO BE ADDRESSED IN ENSA PROJECT

EASTERN CARPARK 2

EAST ENSA ACCESS

EASTERN CARPARK

ENSA

FUTURE USES
(OVERFLOW CARPARK, COMMUNITY FACILITIES)

COMBINED BUS PICK UP – SET DOWN AREA / SHORT TERM – LONG VEHICLE PARKING.

TRUNCATION MAY BE NEEDED TO SERVE LARGE VEHICLE LEFT TURNS EAST TO SOUTH.

BRERETON STREET

WESTERN CARPARK

MOSS STREET

NORTH STREET

JUNCTION STREET

ASSUMED LOCATION OF OVERPASS PIER

SHOPPING ENTRY

SHOPPING EXIT

MORTON PDE

PRINCES HIGHWAY

OVERPASS

4.0M RESUMPTION

NOTE: IF THE EXISTING 5.0M PATHWAY RESERVE IS TO BE REINSTATED THEN A 6.2M RESUMPTION IS REQUIRED

JANE STREET

WORRIGEE STREET

O'KEEFE AVE

Cardno Eppell Olsen

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Issue	Description	Date	By
A	ISSUE FOR COMMENT	6.02.06	J.M.

PRELIMINARY PRINT
NOT FOR CONSTRUCTION

10 0 10 20 30 40 50 60 70 METRES

SCALE 1 : 750 SHEET SIZE A1

North

Base Information Supplied By: SHOALHAVEN CITY COUNCIL

Design	Drawn	Checked
J.O.	J.M.	J.O.

Certified .....

RPEQ No. .....

Project Title: NOWRA CBD (EAST) EXPANSION ENSA NETWORK

Client: SHOALHAVEN CITY COUNCIL

Drawing Title: PREFERRED 2016 STRATEGY NETWORK

Drawing No. 9504-901

Sheet 1 of 1 | Issue A

Scale AS SHOWN

Project 9504

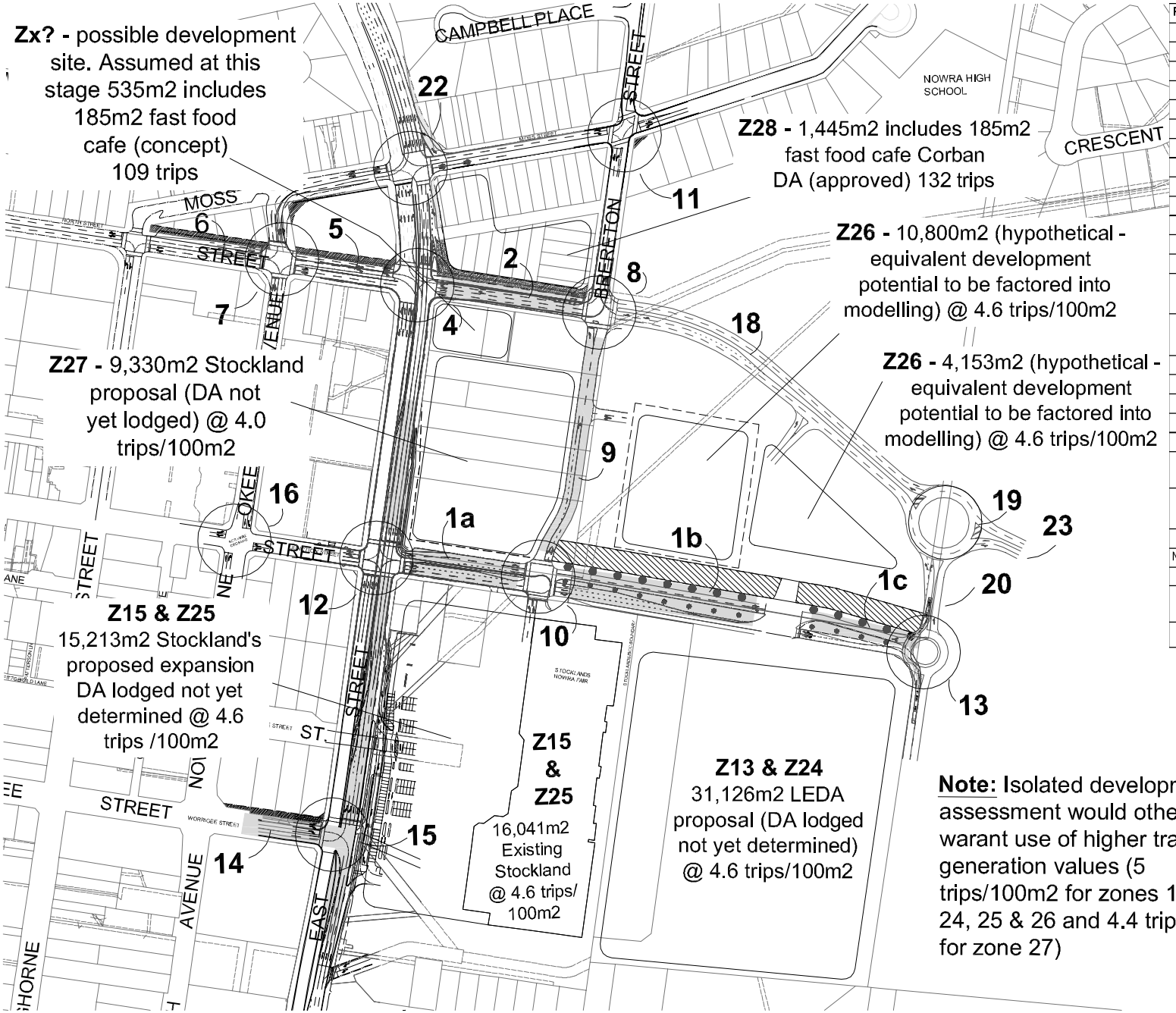
Xref NIL

ACAD file 9504_combined.dwg

Appendix B

Potential land use development (as tested for this study – Nowra CBD Road Network Strategy Review, April 2007)

Appendix B
Nowra CBD East - Strategy Review (2016 & Beyond)



Project No.	Road Network Infrastructure
1a	Upgrade Junction Street between Princes Highway and Brereton Street.
1b	Upgrade Junction Street between Brereton Street and former ENSA Link location.
1c	Upgrade Junction Street east of former ENSA Link location.
2	Upgrade North Street between Princes Highway and Brereton Street.
4	Install traffic signals at North Street/Princes Highway intersection.
5	Upgrade North Street between Princes Highway and O'Keefe Street.
6	Upgrade North Street between O'Keefe Street and Kinghorn Street.
7	Install traffic signals at North Street/O'Keefe Street intersection.
8	Install traffic signals at North Street/Brereton Street intersection.
9	Construct Brereton Street between North Street and Junction Street.
10	Install traffic signals at Junction Street/Brereton Street intersection.
11	Install traffic signals at Moss Street/Brereton Street intersection.
12	Install traffic signals at Junction Street/Princess Highway intersection.
13	Formerly traffic signals at Junction Street/ENSA Link/Stockland access intersection - now two lane roundabout at new ENSA link location.
14	Upgrade Worrigee Street approach to Princes Highway / Worrigee Street intersection.
15	Upgrade Princes Highway - Worrigee Street traffic signals.
16	Install traffic signals at Junction Street/Nowra Lane intersection.
18	Construct ENSA between Brereton Street and roundabout (new location).
19	Construct roundabout at ENSA/Junction Street Link intersection (new location).
20	Construct ENSA-Junction Street Link (new alignment).
22	Upgrade traffic signals at Moss Street/Princes Highway intersection & some widening Moss St from Hwy to O'Keefe/North roundabout.
23	Construct ENSA east of the roundabout to Greenwell Point Road (new indicative alignment).
NOTE:	Projects 3, 17 & 21 have been removed.
3	Was Hwy slip lane into North St east (now incorporated in Project 4).
17	Was install signals at Hwy/Stockland's southern egress (now to be a s79c DA condition if DA approved & subject to RTA concurrence).
21	Was Hwy slip lane into Junction St east (now incorporated in Project 12).

Legend

Road Construction

Signals/Roundabout

Planning Group
Planner : A. Stasiukynas
Drawn by S Gray
Checked by Scott Wells
Date 3rd July 2006
Not To Scale

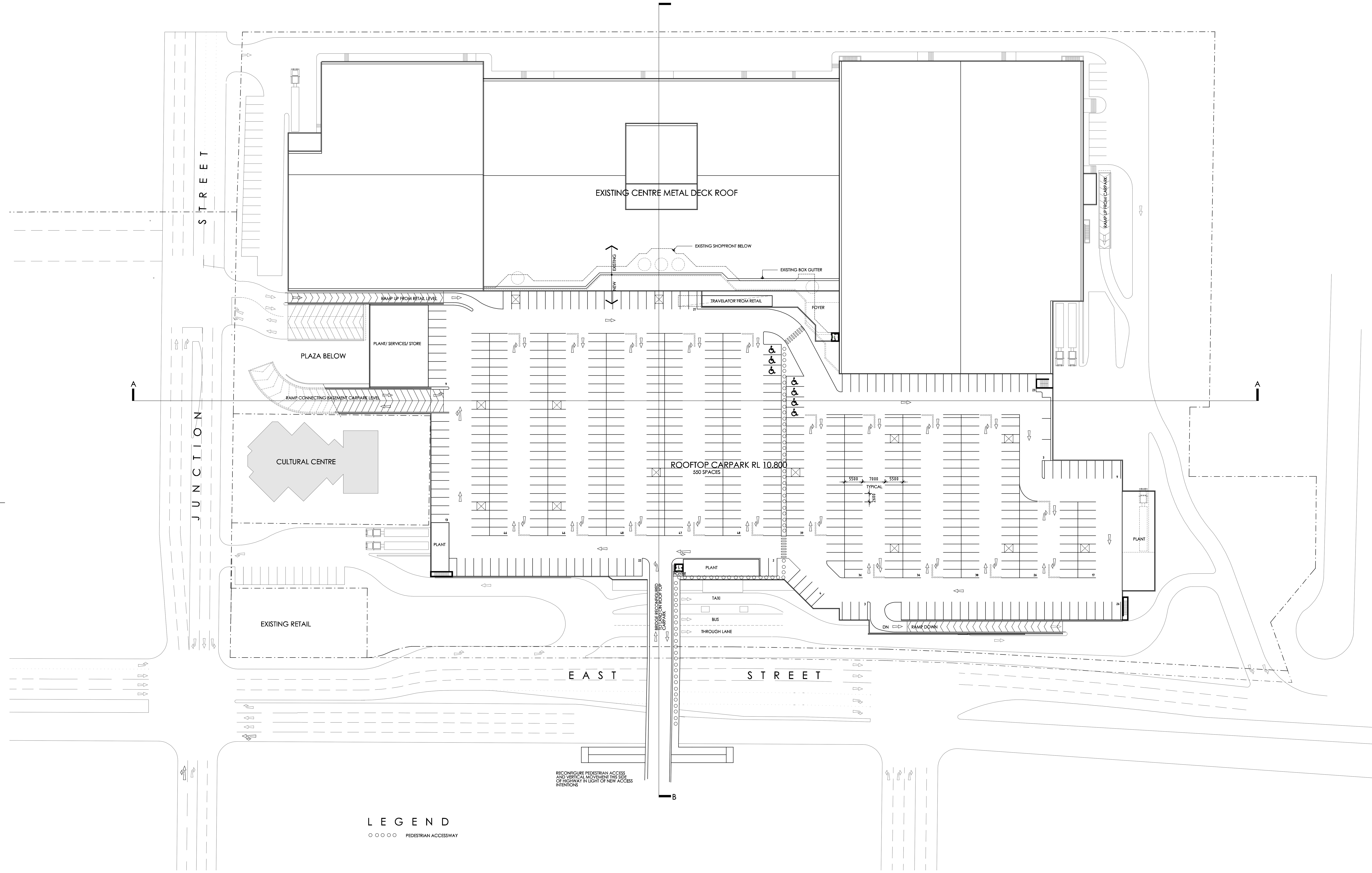
Nowra CBD East Roadworks s94 Plan

ROAD PROJECTS

Appendix C

Schematic – Stockland Proposal (to expand existing site),

DA06/1317 – 3 March 2006


EXISTING CENTRE METAL DECK ROOF
EXISTING SHOPFRONT BELOW
EXISTING BOX GUTTER
RAMP UP FROM RETAIL LEVEL
TRAVELATOR FROM RETAIL
FOYER
PLANT/ SERVICES/ STORE
PLAZA BELOW
RAMP CONNECTING BASEMENT CARPARK LEVEL
CULTURAL CENTRE
ROOFTOP CARPARK RL 10.800
550 SPACES
RAMP UP FROM CARPARK
PLANT
TAXI
BUS
THROUGH LANE
RAMP DOWN
DN
EXISTING RETAIL
STREET
JUNCTION
EAST
STREET
RECONFIGURE PEDESTRIAN ACCESS AND VERTICAL MOVEMENT THIS SIDE OF HIGHWAY IN LIGHT OF NEW ACCESS INTENTIONS
A
A
B
LEGEND
PEDESTRIAN ACCESSWAY

ROOFTOP CARPARK PLAN RL:10.800m

RAIA PRACTICE MEMBER

ISSUE:	DATE:	AMENDMENT:
A	24.02.06	ISSUED FOR DA

STOCKLAND NOWRA
EXTENSIONS & ALTERATIONS, EAST STREET NOWRA

0 5 10 20 30 40 50 SCALE METRES 100

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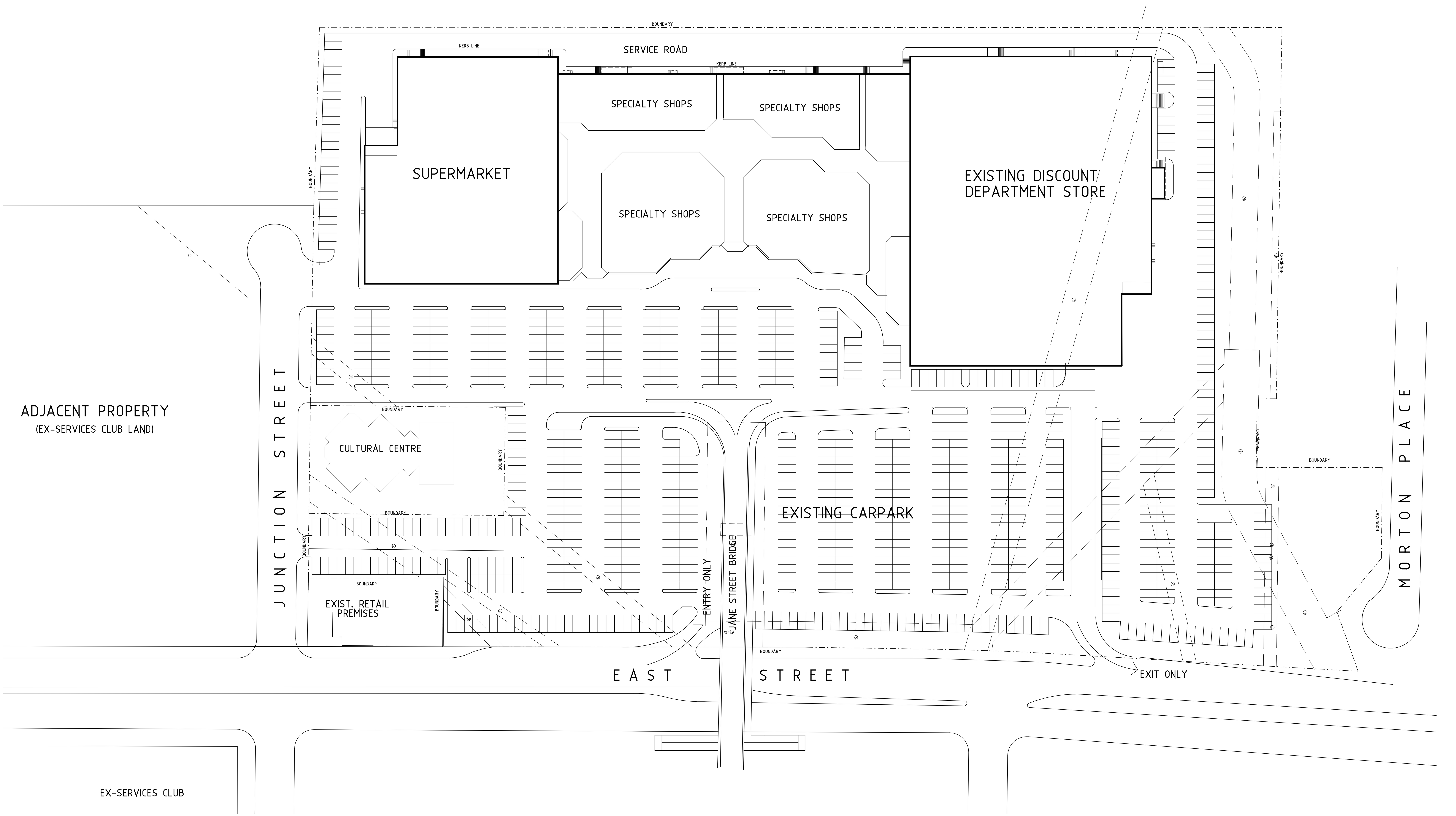
DATE: 3 FEB 2006 DRAWN: LC SCALE: 1:500 B1
PROJECT No:1917 DRAWING No: DA05 ISSUE: A



EXISTING SITE PLAN

RAIA PRACTICE MEMBER

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A	24.02.06	ISSUED FOR DA

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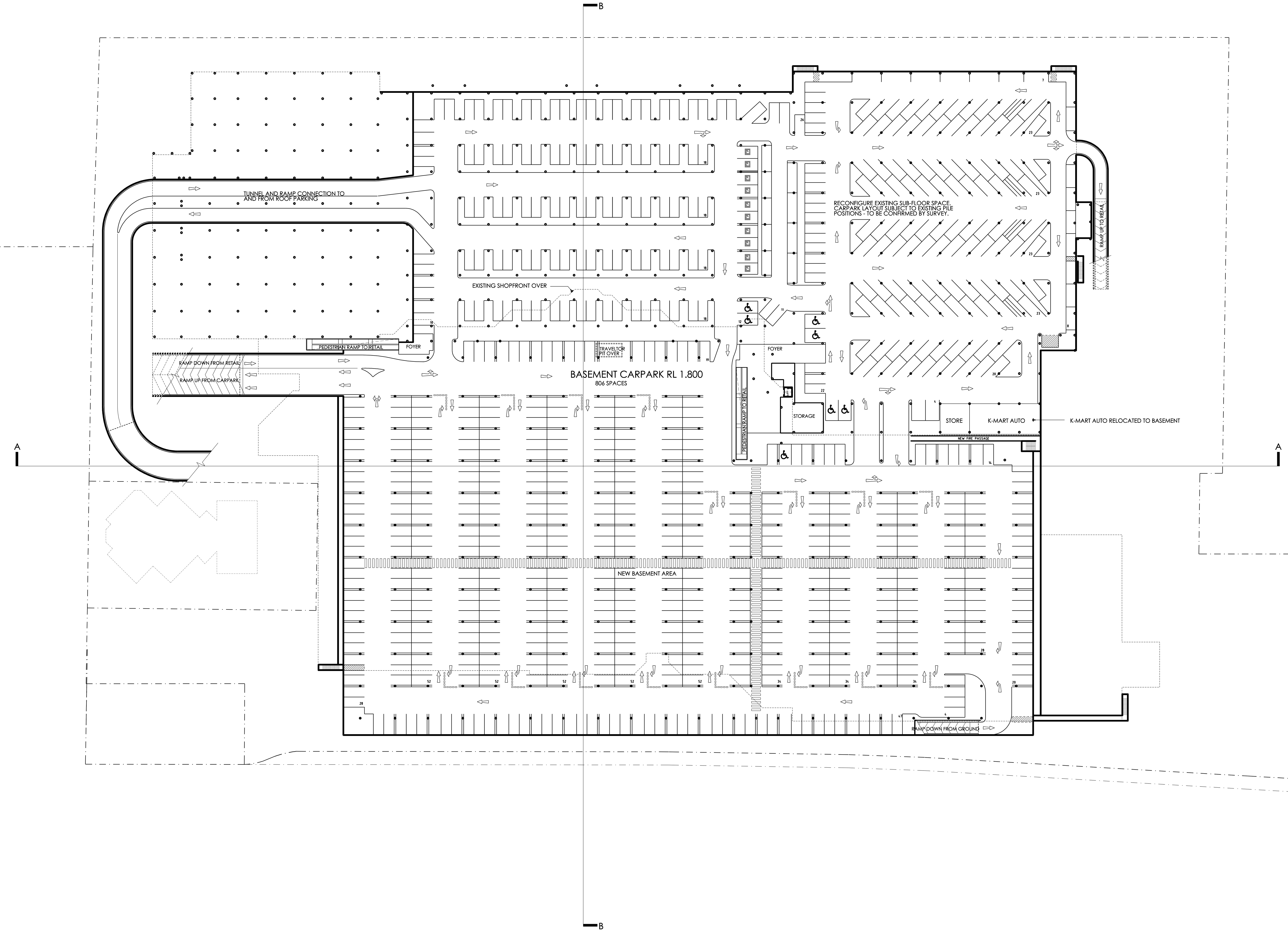

BASEMENT CARPARK RL: 1.800m

RAIA PRACTICE MEMBER

ISSUE:	DATE:	AMENDMENT:
A	24.02.06	ISSUED FOR DA

STOCKLAND NOWRA
EXTENSIONS & ALTERATIONS, EAST STREET NOWRA

0 5 10 20 30 40 50 SCALE METRES 100

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DATE: 3 FEB 2006 DRAWN: LC SCALE: 1:500 B1
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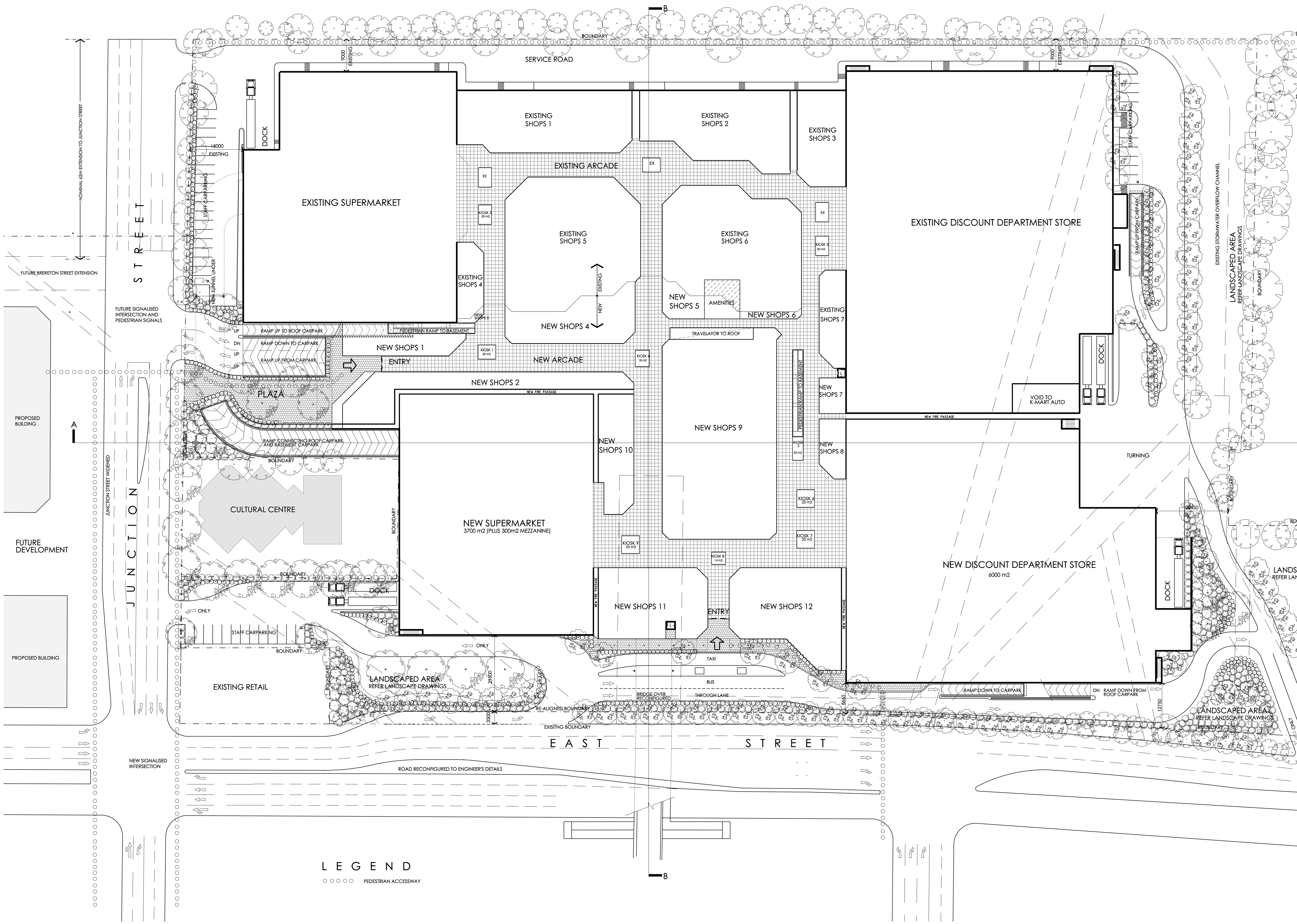


GROSS LETTABLE AREA RETAIL (APPROXIMATE)

SCHEDULE OF EXISTING AREAS (GLA sq m)

Woolworths	4230
K-Mart	7190
Specialty	4516
Lost	(58)
Kiosks	74
TOTAL	**15,952** sq m

SCHEDULE OF NEW AREAS (GLFA sq m)

Supermarket	4000 (includes mezz)
DDS	6000 (includes mezz)
Specialty	5026
Kiosks	187
TOTAL	**15,213** sq m
TOTAL NEW GLA OF CENTRE	**31,165** sq m

NB: casual mall leasing areas have not been included

SCHEDULE OF GROSS FLOOR AREAS

EXISTING CENTRE	17,790
NEW CENTRE	36,164
NETT GFA GAIN	**18,374**

NB: All areas are calculated without consideration of basement risers pending final design of all building services, egress requirements and issue that may have minor influence on the total areas stated.

CARPARKING

Rate of carparking spaces required per metres square of GLA provided as prescribed in Shoalhaven Council document DCP 18

Supermarket	1/19 Gross Leasable Area (GLA)
Specialty Shops	1/24
Designated Storage	1/50

Supermarkets	8,230 sq m GLA = 433 cars
Specialty	9,484 sq m GLA = 395 cars
DDS	13,190 sq m GLA = 549 cars
Kiosks	261 sq m GLA = 11 cars

Total cars required by development is 1388 cars

Provided	Shown	Allow
Roof	568	**550**
Ground	42	**42**
Basement	806	**806**
		1388

Total cars provided for the centre on site is **1388**

NB: the reduced figure has been provided due to future loss of spaces for egress stairs, services installations and shafts and the like and will be used for DA assessment pending final design solutions

RETAIL FLOOR PLAN RL:4.800m

RAIA PRACTICE MEMBER

ISSUE:	DATE:	AMENDMENT:
A	24.02.06	ISSUED FOR DA

STOCKLAND NOWRA
EXTENSIONS & ALTERATIONS, EAST STREET NOWRA

0 5 10 20 30 40 50 SCALE METRES 100

LEFFLER SIMES ARCHITECTS
LEFFLER SIMES PTY. LIMITED. ARCHITECTS
SYDNEY: 7 YOUNG STREET, NEUTRAL BAY NSW 2089 AUSTRALIA
PH: (02) 9909 3344 FAX: (02) 9909 3828
MELBOURNE: FIRST FLOOR, 133 FLINDERS LANE VIC 3000 AUSTRALIA
PH: (03) 9654 6344 FAX: (03) 9654 8244
ACN 001 043 992 ABN 39 001 043 992
WEB: www.leffersimes.com.au EMAIL: lsa@leffersimes.com.au

DATE: 3 FEB 2006 DRAWN: LC SCALE: 1:500 B1
PROJECT No:1917 DRAWING No: DA04 ISSUE: A

Appendix D

Schematic – Leda Development, DA05/3342 (Schematic available at time of issue of deferred commencement consent on 10 August 2006)

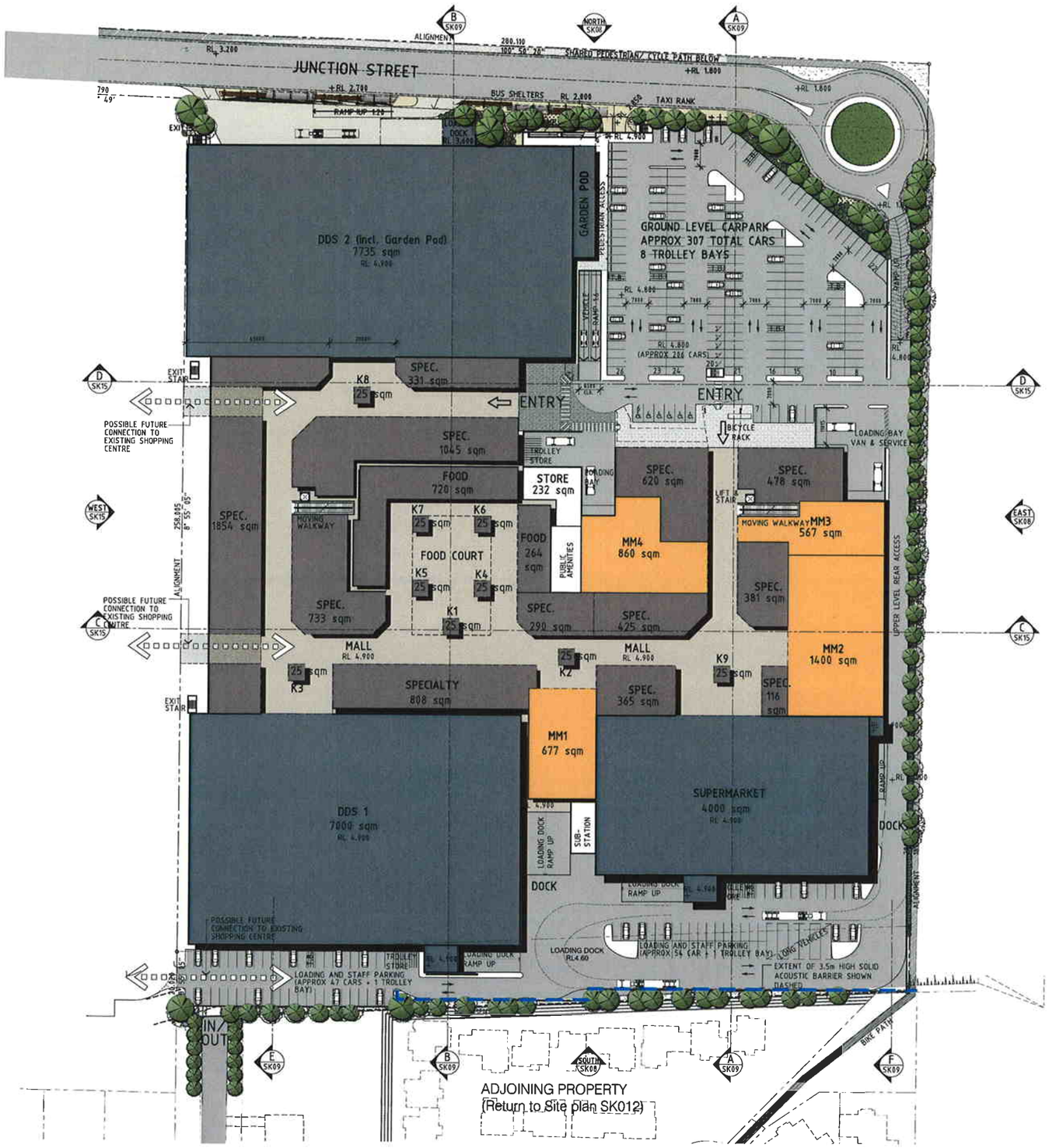
AREA CALCULATIONS

RETAIL AREA BREAK UP	
DDS 1	7,000 sqm
DDS 2	7,735 sqm
MM1	677 sqm
MM2	1,400 sqm
MM3	567 sqm
MM4	860 sqm
Specialty Shops	7,446 sqm
Food Court	984 sqm
Kiosks	225 sqm

AREAS ACCORDING TO USE	
Retail Total	26,894 sqm
Supermarket	4,000 sqm
Storage	232 sqm

TOTAL AREA	31,126 sqm

CAR REQUIRMENT ACCORDING TO USE	
Retail (@ 1/24)	1121
Supermarket (@ 1/19)	211
Storage (@ 1/50)	5
TOTAL REQ'D	1,337
TOTAL PROVIDED	1,405



PROJECT: NOWRA SHOPPING CENTRE
FOR LEDA HOLDINGS

DRAWING DESCRIPTION: GROUND LEVEL PLAN

SCALE 1:500@A0
PROJECT NO. 705099
DATE DECEMBER 2006

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DWN MMD
DWG NO. SK006
ISSUE U

THE BUCHAN GROUP

PROJECT

NOWRA SHOPPING CENTRE

FOR LEDA HOLDINGS

DRAWING DESCRIPTION

UNDERCROFT PLAN

SCALE 1:500@A0

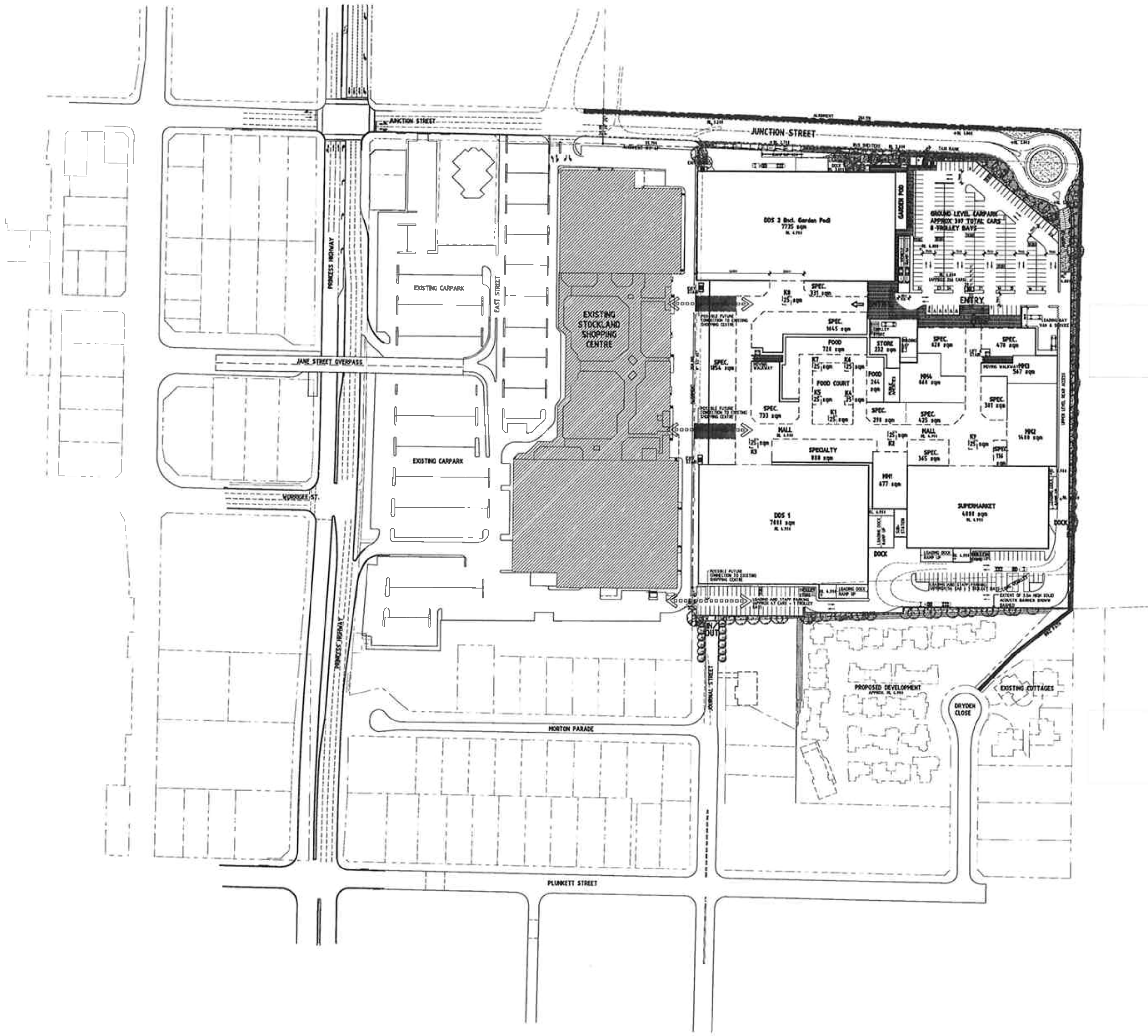
PROJECT NO. 705099

DATE DECEMBER 2005

FILE K:\705099\DWGS\DA\SK007.ccr

DWN	DWG NO.	ISSUE
JW	SK007	V

THE BUCHAN GROUP



E		REVISED DA SUBMISSION
C		DA SUBMISSION
ISSUE DATE	DESCRIPTION	INTS AUTH

PROJECT
NOWRA SHOPPING CENTRE
FOR LEDA HOLDINGS

DRAWING DESCRIPTION
SITE PLAN

SCALE 1:1000@A0
PROJECT NO. 705099
DATE DECEMBER 2005

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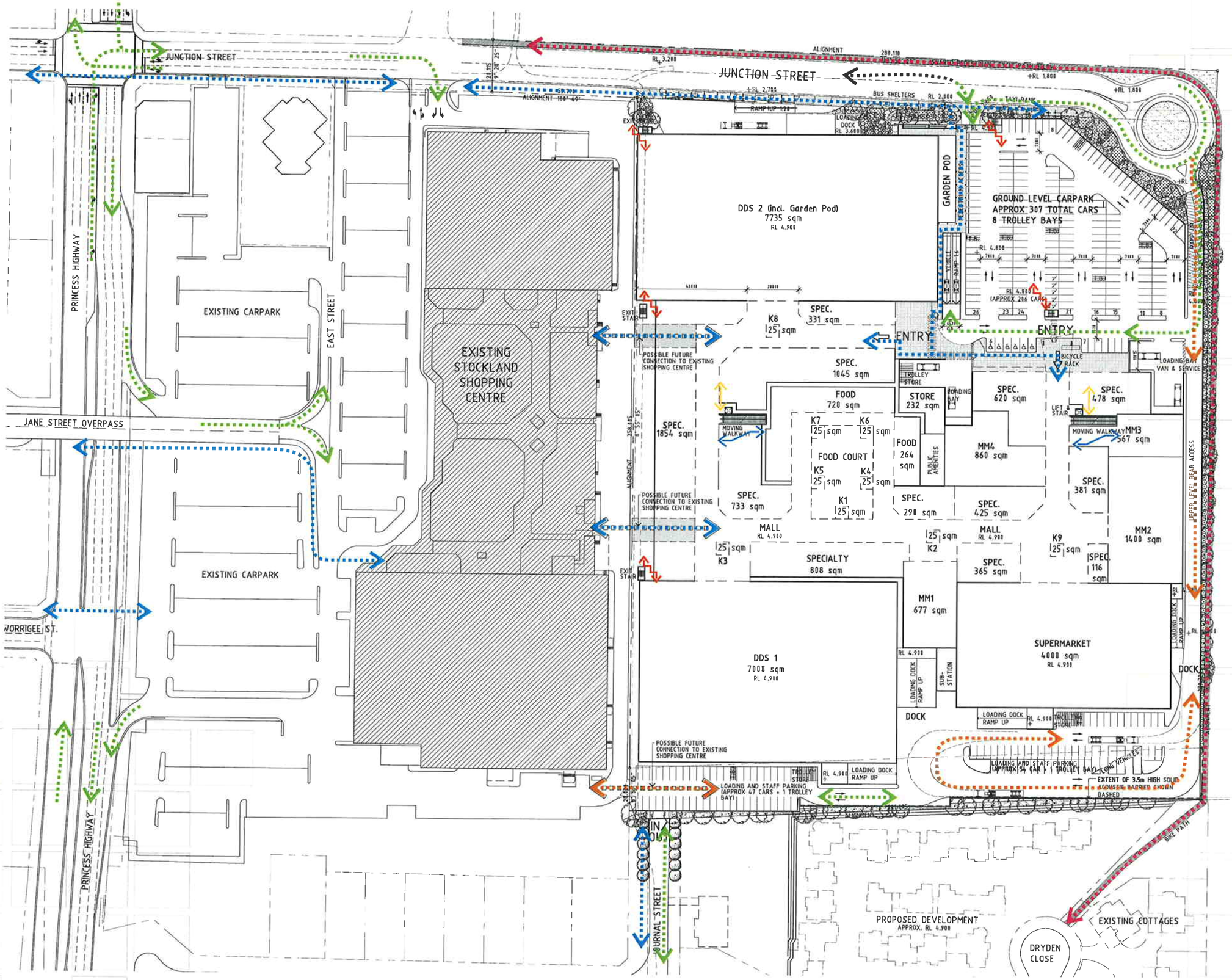
DWN JAW
DWG NO. SK012
ISSUE E

THE BUCHAN GROUP



PROJECT
NOWRA SHOPPING CENTRE
FOR LEDA HOLDINGS

DRAWING DESCRIPTION
CIRCULATION DIAGRAM
GROUND LEVEL PLAN

SCALE 1:500@A0
PROJECT NO. 705099
DATE DECEMBER 2005

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DWN JC
DWG NO. SK016
ISSUE D

THE BUCHAN GROUP

JUNCTION STREET

PRINCESS HIGHWAY

EXISTING CARPARK

EAST STREET

JANE STREET OVERPASS

EXISTING STOCKLAND SHOPPING CENTRE

ALIGNMENT

BUS SHELTERS

CARPARK ENTRY FROM JUNCTION STREET

TAXI STAND

BICYCLE & PEDESTRIAN PATH

FOOTPATH

RAMP UP

LOADING DOCK

EXIT STAIR

UNDERCROFT CARPARKING
APPROX 1098 CARS

MOVING WALKWAY

SHARED PEDESTRIAN CYCLE PATH

VORRIGEE ST.

PRINCESS HIGHWAY

JOURNAL STREET

PEDESTRIAN FOOTPATH

PROPOSED WATER TREATMENT AREA

LINE OF SECURITY FENCE TO DRAINAGE EASEMENT

CONC. BUND

DRAIN

ROCK PROTECTION

PROPOSED HEADWALL

PROPOSED DRAINAGE EASEMENT
CONCRETE DRAIN

POTENTIAL FUTURE EXTENTION TO CONSTRUCTED WETLA / SEDIMENTATION PO

EXISTING HOUSE

PROPOSED DEVELOPMENT

EXISTING COTTAGES

DRYDEN CLOSE

Stair

Lift

Moving Walk

Pedestrian Circulation

Bicycle & Pedestrian Circulation

Vehicular Circulation

Service Trucks

PROJECT
NOWRA SHOPPING CENTRE
FOR LEDA HOLDINGS

DRAWING DESCRIPTION
CIRCULATION DIAGRAM
UNDERCROFT LEVEL PLAN

SCALE 1:600@A0

PROJECT NO. 705009

DATE DECEMBER 2008

FILE K:\705009\DWGS\DA\SK018.dgn

DWN XL | DWG NO. SK018 | ISSUE D

THE BUCHAN GROUP

:LTERS
CARPARK ENTRY FROM
JUNCTION STREET
TAXI STAND
BICYCLE & PEDESTRIAN PATH
+RL 1.800
RL 1.800
BUS
RL 2.000
RL 2.850
EXIT STAIR
12
RL 1.900
39
39
9
9
5
+RL 1.800
LINE OF BUILDING OVER
15
21
6500
7000
ACCESS FOOTPATH
VEHICLE UP RAMP 1:12.5
UNDERCROFT CARPARKING
APPROX 1074 CARS
24
24
RAMP UP TO LOADING DOCK
35
36
20
23
7000

Appendix E

Schematic – Stockland Proposal (north of Junction),

DA06/3065 – 14 November 2006

AREA SCHEDULE

	AREA (SQM)
LARGE (NE) -TENANCY 2	2360
LARGE (SE) - TENANCIES 5-7	3115
LARGE (NW) - TENANCIES 1, 3 & 4	2530
FRONTING JUNCTION STREET - TENANCIES 8 - 12	780
FAST FOOD 1	225
FAST FOOD 2	260
FAST FOOD 3	400
TOTAL	**8670**
SITE AREA BEFORE RELEASE OF LAND TO COUNCIL	22176 SQM
SITE AREA AFTER LAND RELEASE TO COUNCIL FOR PRINCES HWY, BRERETON & JUNCTION ST	17130 SQM
UNDERCROFT CARPARK AREA (INCL PLENUM)	9100 SQM
GROUND LEVEL CARPARK AREA	2788 SQM

PARKING

PARKING REQUIRED

PARKING FOR SHOPS OF 8785SQM + 885SQM FAST FOOD

SHOPS (8785 SQM)
ASSUME 30% STORAGE AREA TO SHOPS

AREA BREAK-UP
70% SHOP 6150 @ 1/30SQM 256 BAYS
30% STORAGE 2635 @ 1/50SQM 53 BAYS
TOTAL REQUIRED 8785 = 309 BAYS

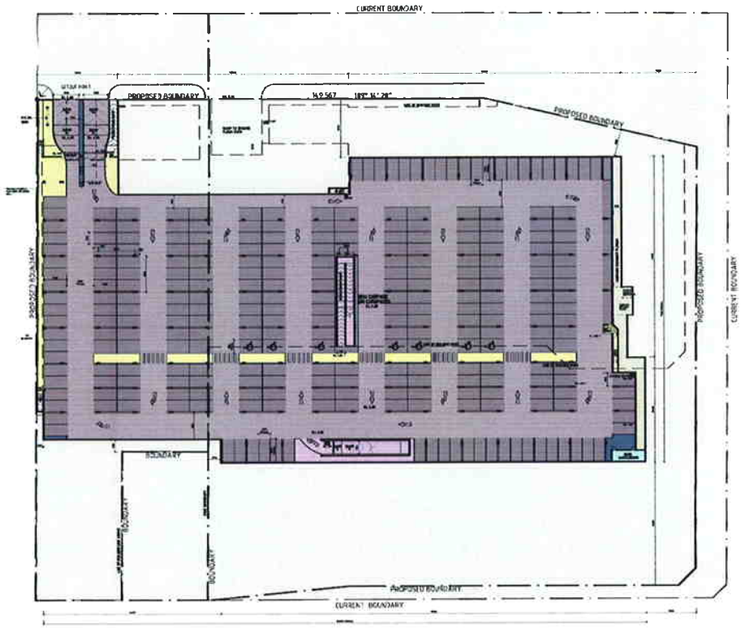
FAST FOOD
FAST FOOD 1 87 SEATS (29 INTERNAL, 58 EXTERNAL) @ 1/3 SEATS =29 BAYS
FAST FOOD 2 ASSUME 60 SEATS (40INTERNAL, 20 EXTERNAL) @1/3 SEATS =20 BAYS
FAST FOOD 3 ASSUME 60 SEATS (40INTERNAL, 20 EXTERNAL) @1/3 SEATS =20 BAYS

TOTAL REQUIRED = 378 BAYS

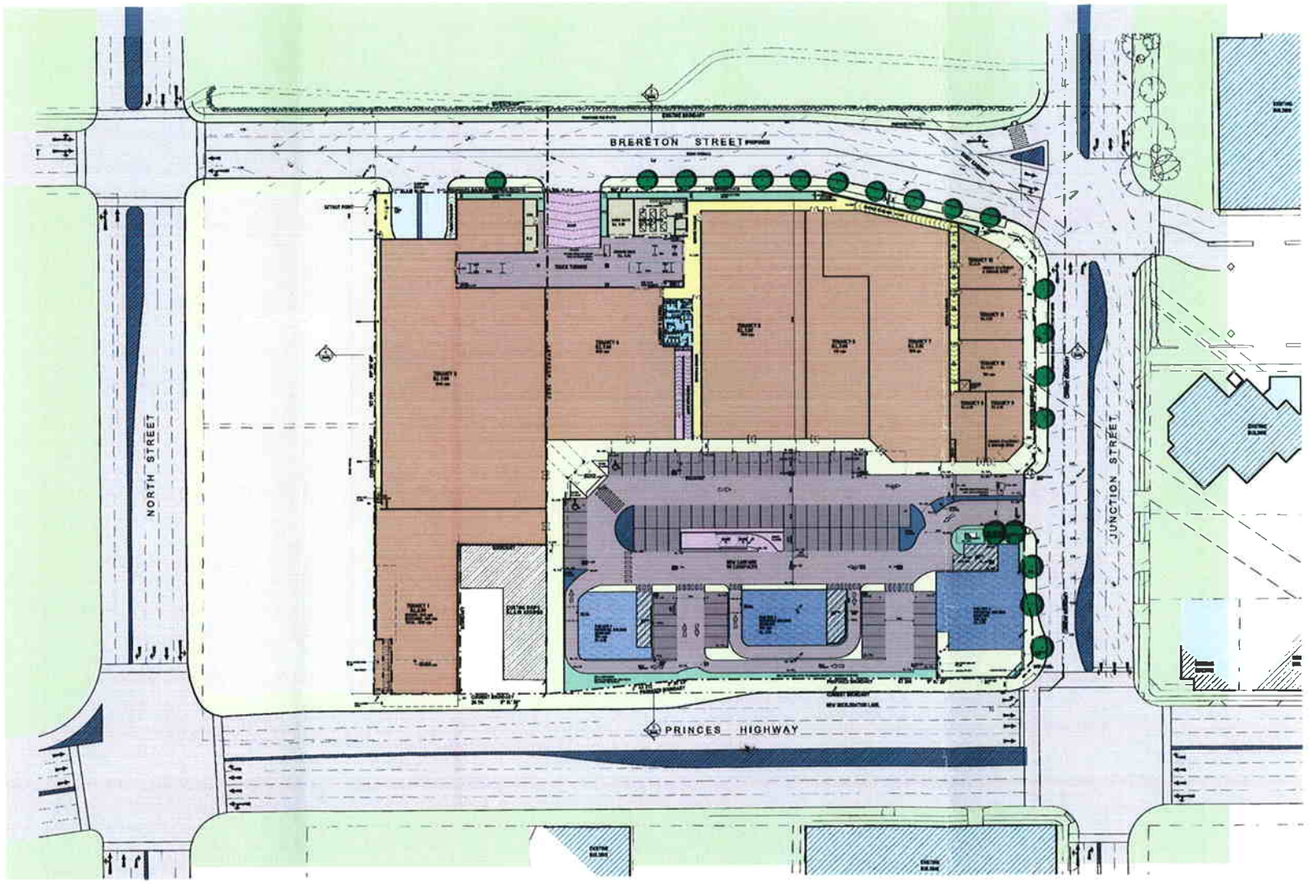
NO APPLICABLE REFER TO TRAFFIC REPORT

PARKING PROVIDED

MAIN CARPARK	90
UNDERCROFT PARKING	288
TOTAL PROVIDED	**378**
DISABLED BAYS	9



BASEMENT CARPARK 1:500



GROUND FLOOR PLAN 1:500

NOWRA JUNCTION LIFESTYLE CENTRE
Sep 2006

Client:
STOCKLAND

Cnr Junction streets &
Princes Highway, NOWRA, NSW

SITE PLAN

Architects
Christiansen O'Brien Pty Ltd
Level 1, 88 Alexander Street, Crows Nest, NSW 2065
P (02) 9439 8622 F (02) 9439 8655

SCALE, 1:500

NORTH

01

AREA SCHEDULE

	AREA (SQM)
LARGE (NE) -TENANCY 2	2360
LARGE (SE) - TENANCIES 5-7	3115
LARGE (NW) - TENANCIES 1, 3 & 4	2530
FRONTING JUNCTION STREET - TENANCIES 8 - 12	780
FAST FOOD 1	225
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FAST FOOD 3	400
TOTAL	**9670**
SITE AREA BEFORE RELEASE OF LAND TO COUNCIL	22176 SQM
SITE AREA AFTER LAND RELEASE TO COUNCIL FOR PRINCES HWY, BRERETON & JUNCTION ST	17130 SQM
UNDERCROFT CARPARK AREA (INCL PLENUM)	9100 SQM
GROUND LEVEL CARPARK AREA	2788 SQM

PARKING

PARKING REQUIRED

PARKING FOR SHOPS OF 8785 SQM + 885 SQM FAST FOOD

SHOPS (8785 SQM)
ASSUME 30% STORAGE AREA TO ALL SHOPS

AREA BREAK-UP

70% SHOP	6150 @ 1/40 SQM	256 BAYS
30% STORAGE	2635 @ 1/40 SQM	53 BAYS
TOTAL REQUIRED	8785	= 309 BAYS

FAST FOOD
FAST FOOD 1 87 SEATS (29 INTERNAL, 58 EXTERNAL) @ 1/3 SEATS =29 BAYS
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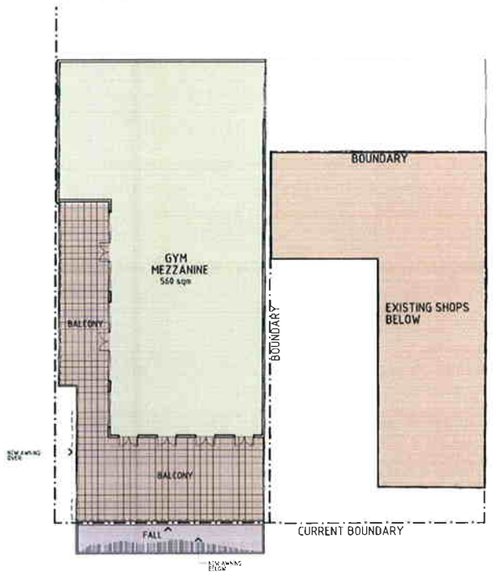
TOTAL REQUIRED = 378 BAYS

PARKING PROVIDED

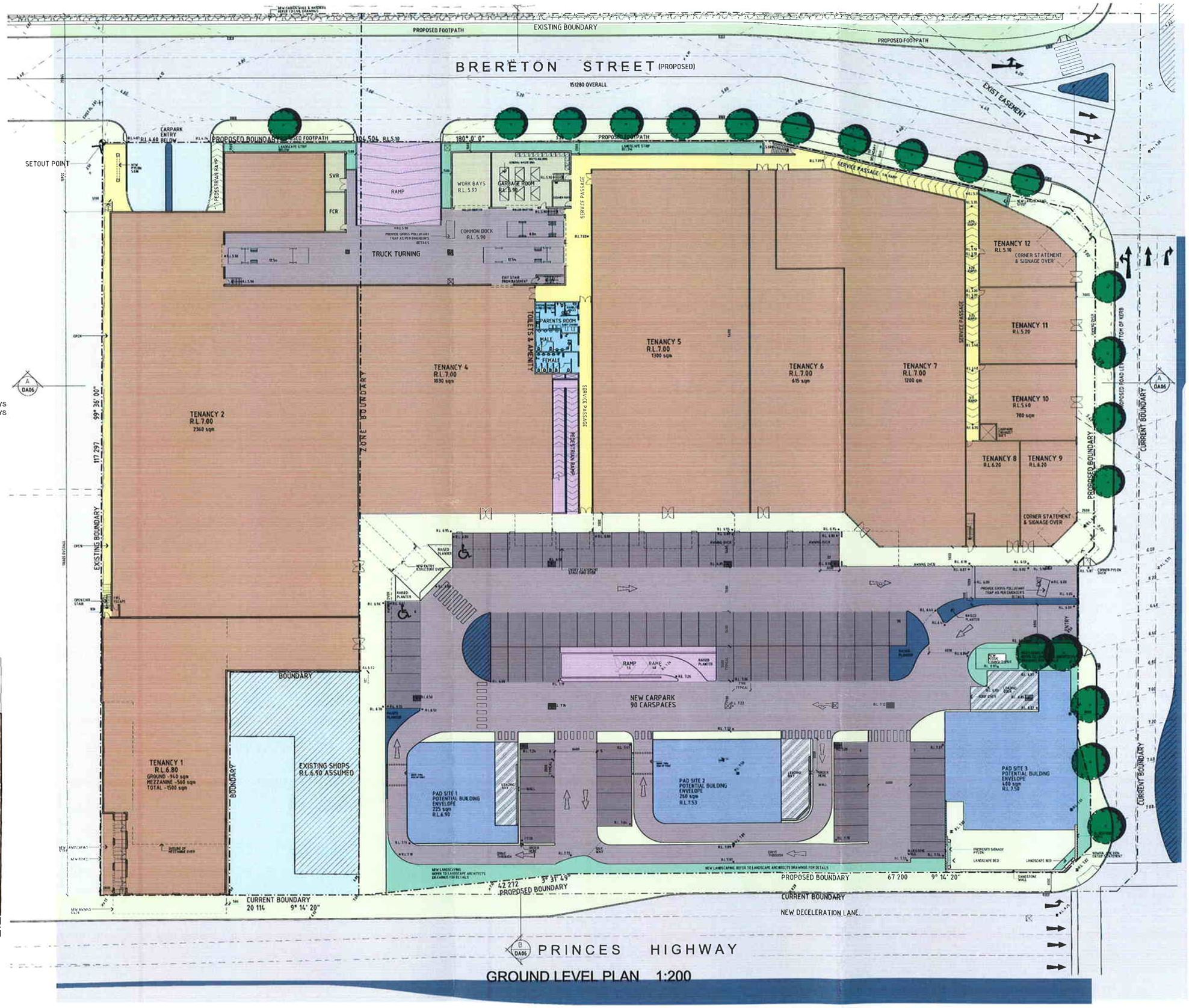
MAIN CARPARK	90
UNDERCROFT PARKING	288
TOTAL PROVIDED	**378**
DISABLED BAYS	9

LEGEND

- PROPOSED SPOT LEVELS
- EXISTING SPOT LEVELS
- PROPOSED GRATED PITS
- PROPOSED NEW ROAD CONTOURS



FIRST FLOOR PLAN 1:200



GROUND LEVEL PLAN 1:200

NOWRA JUNCTION LIFESTYLE CENTRE
Sep 2006

Client:
STOCKLAND

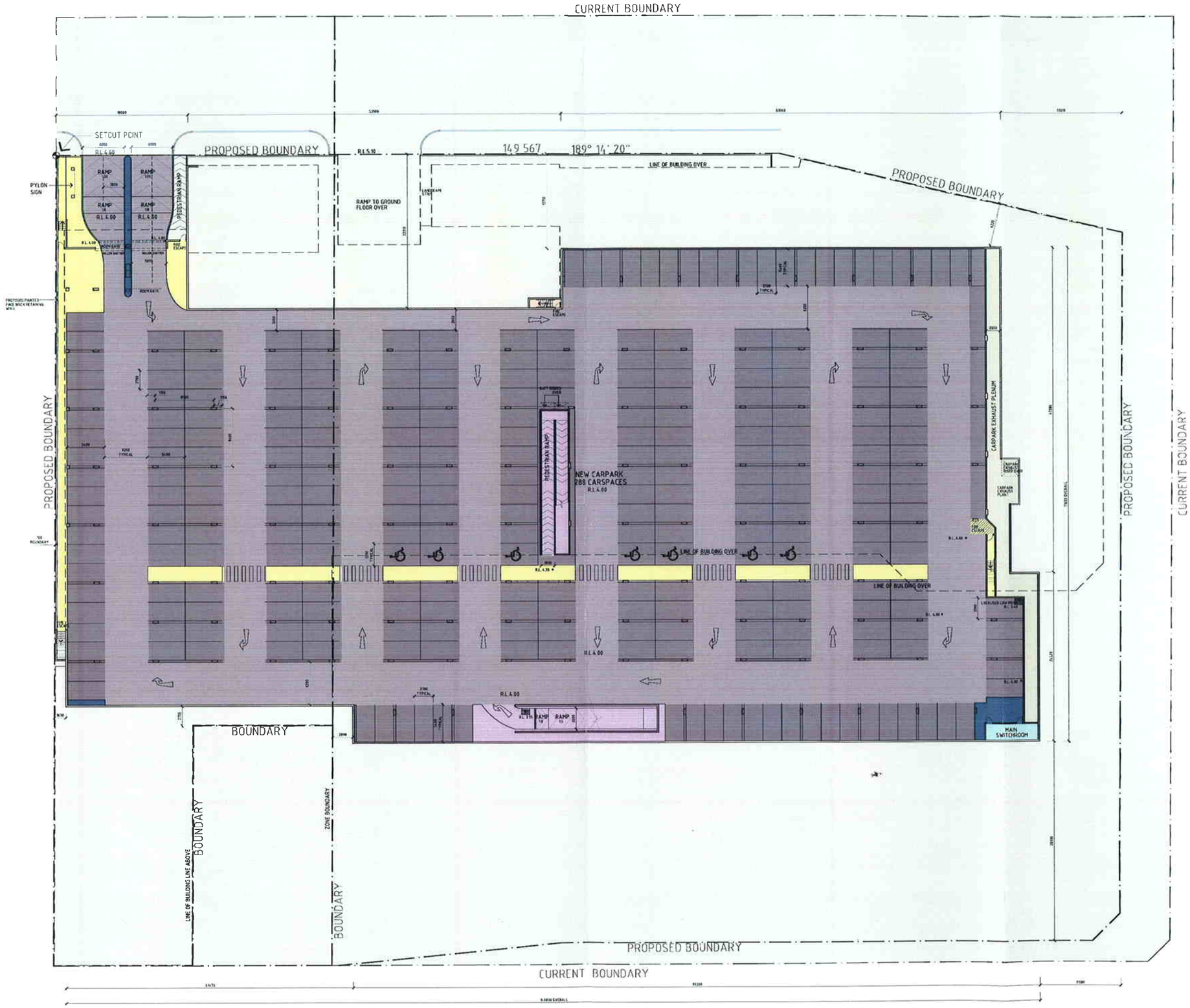
Cnr Junction streets &
Princes Highway, NOWRA, NSW

GROUND LEVEL PLAN

Architects
Christiansen O'Brien Pty Ltd
Level 1, 88 Alexander Street, Crows Nest, NSW 2065
P(02)9439 8622 F(02)9439 8655

NORTH

02



BASEMENT FLOOR PLAN 1:200

NOWRA JUNCTION LIFESTYLE CENTRE
Sep 2006

Client:
STOCKLAND

Cnr Junction streets &
Princes Highway, NOWRA, NSW

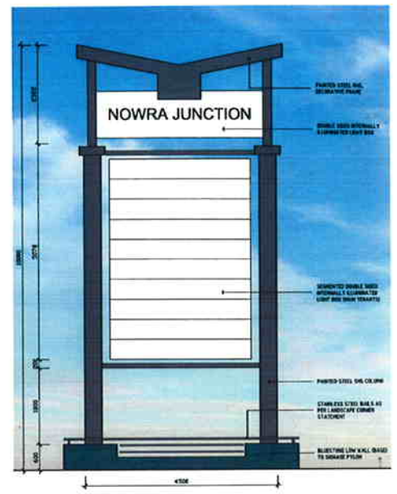
BASEMENT LEVEL PLAN

Architects
Christiansen O'Brien Pty Ltd
Level 1, 88 Alexander Street, Crows Nest, NSW 2065
P(02)9439 8622 F(02)9439 8655

NORTH

03

NORTHERN ELEVATION



PROPOSED SIGNAGE PYLON

EASTERN ELEVATION (BRERETON STREET)

WESTERN ELEVATION (VIEW FROM CARPARK)

SOUTHERN ELEVATION (JUNCTION STREET)

WESTERN ELEVATION (PRINCESS HIGHWAY)

Appendix F

Extracts from LEDA Traffic Studies including; Draft LEDA Traffic Report July 2006, SCATES Sensitivity Analysis submitted 14 August 2006, and LATM report submitted 12 October 2006

8.0 CONCLUSIONS

Substantial growth is anticipated in the system at 2016 being broadly 40% additional movements. Works in North St and dual right turn lanes into Worrigee St from Princes Highway are needed irrespective of the LEDA proposal to cater to growth. Little spare capacity remains in the system at 2016.

Addition of the LEDA development requires upgrading of the existing network to function adequately.

The developer has proposed:

- access to Junction St at 2 locations east of Nowra Fair;
- signalisation of Junction St at Princes Highway;
- left turn lane from Princes Highway (N) to Junction St;
- connection to Journal St leading to access to Princes Highway via Plunkett St.

Additional works beyond these LEDA proposals are required to accommodate the development traffic in the context of system growth to 2016.

These works are:
By 2011

- roundabout or signalisation at Plunkett/Journal intersection (coupled with the diversion of the existing regional shared pathway around the LEDA development site to the intersection of Douglas Street and Wallace Street);
- additional right turn capacity at Junction St approach from development (total of three approach lanes);
- signalisation of the Junction Street/ Nowra Lane intersection to improve pedestrian safety;
- treatment of Junction St/Nowra fair access (interim pedestrian refuge east of Nowra Fair access).

By 2016

- stage 1 of ENSA to connect from the eastern end of Junction St to Princes Highway at North St. This includes signalisation at Princes Highway / North St;
- signalisation of North Street / Brereton Street intersection (predominantly for pedestrian safety);
- provision of three approach lanes on the eastern leg of the Princes Highway/Plunkett Street intersection.

Access arrangements for the proposed development should provide maximum opportunity for vehicles to arrive and depart via ENSA, as a key principle of the CBD East network strategy. This may be achieved by the reconfiguration of the internal layout and site access.

Mitigation of the potential impact as a result of the proposed development on areas to the south of the development site should also be carefully considered. Additional LATM works should be investigated in Nowra East precinct (between Plunkett Street and Kalandar Street) to minimise the impact of the development traffic on local streets. It is recommended that a LATM scheme be designed to comply with minimum standards with the objective of controlling speeds to 40 kph speed environment and improving general road safety (particularly around the school precinct) and ensuring Princes Highway traffic (with destination south) remains on Princes Highway and does not divert down Journal Street / St Annes Street.

Works undertaken as part of the proposal should be consistent with the Nowra CBD East strategy (currently under revision).

This report is currently in draft form and is currently pending further modelling inputs and is subject to change.

Intersection with Princes Hwy		SCATES ANAYSIS – PRINCES HIGHWAY, NOWRA Comparison - Existing against proposed changes with cycle length minimum 120 seconds								
		PM Peak								
		Exist	**2011 + 5% increase in/out of side streets**				**2016+ 5% increase in/out of side streets**			
			prop	**+20%**	**+30%**	**+40%**	**prop**	**+20%**	**+30%**	**+40%**
Moss Street	LOS	B	B	B	B	B	C	D	**F**	**F**
# 2458	DS	0.58	0.66	0.73	0.77	0.81	0.90	1.00	**1.15**	**1.21**
	AVD	24.0	26.5	25.9	25.8	27.2	33.2	56.7	**214.1**	**316**
North Street	LOS	n/a	n/a	n/a	n/a	n/a	B	B	B	B
# 002	DS	n/a	n/a	n/a	n/a	n/a	0.75	0.81	0.86	0.90
	AVD	n/a	n/a	n/a	n/a	n/a	23.1	24.9	25.8	27.7
Junction Street	LOS	n/a	C	C	C	C	B	B	C	C
# 001	DS	n/a	0.79	0.85	0.89	0.89	0.77	0.83	0.89	0.94
	AVD	n/a	31.1	33.2	35.0	36.2	24.8	27.0	29.0	33.0
Worrigee Road	LOS	B	B	B	B	B	B	C	C	C
# 2319	DS	0.58	0.66	0.71	0.74	0.76	0.78	0.85	0.89	0.92
	AVD	21.6	23.0	23.1	23.0	24.0	26.0	29.0	29.9	31.8
Plunkett Street	LOS	B	B	B	B	C	C	C	C	D
# 2637	DS	0.54	0.67	0.73	0.76	0.78	0.83	0.90	0.94	0.99
	AVD	20.2	28.7	28.5	28.7	30.1	29.9	35.5	39.4	48.5
Filename		Princex	PrinPM11	Pr11PM20	Pr11PM30	Pr11PM40	PrinPM16	Pr16PM20	Pr16PM30	Pr16PM40

The following table is the results of duplicating the right turn from Princes Highway (north) into Moss Street west.

2016+ 5% increase in/out of side streets			
prop	**+20%**	**+30%**	**+40%**
B	C	C	**E**
0.81	0.90	0.96	**1.03**
25.2	33.3	36.4	**66.9**

PROPOSED RETAIL CENTRE DEVELOPMENT
JUNCTION STREET, NOWRA

Assessment for LATM Treatment

October 2006

Reference 05260

TRANSPORT AND TRAFFIC PLANNING ASSOCIATES
Transportation, Traffic and Design Consultants
Suite 603, Level 6
282 Victoria Avenue
CHATSWOOD 2067
Telephone (02) 9411 5660
Facsimile (02) 9904 6622
Email: ttpa@ttpa.com.au

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

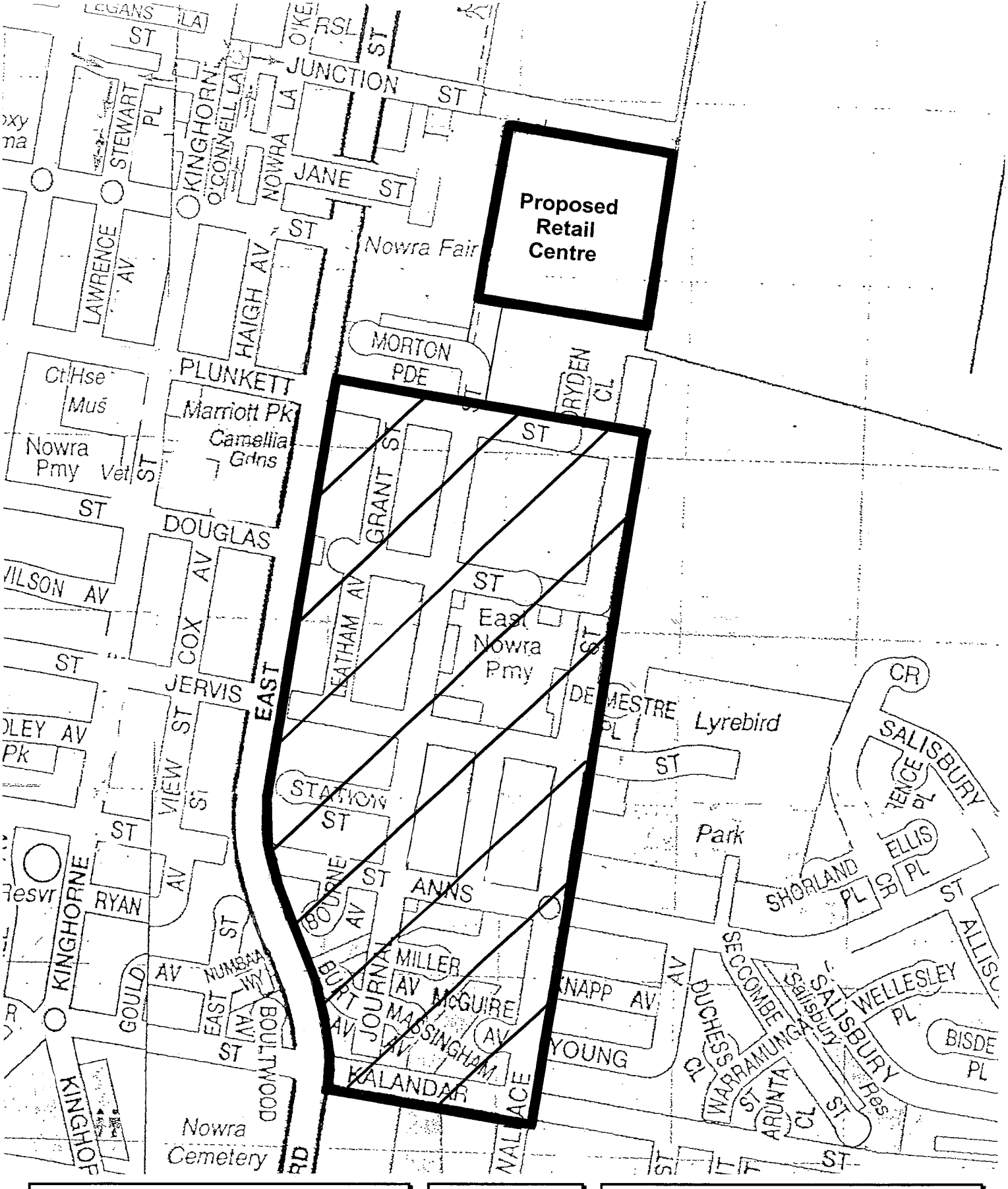
1. INTRODUCTION

Shoalhaven Shire Council has granted a 'Deferred Commencement Consent' to a Development Application for a new retail centre on a site adjacent to the existing Nowra Fair Centre in Junction Street, Nowra.

One condition to that consent requires:

> *"The preparation of detailed plans for the establishment of a Local Area Traffic Management Scheme (LATM) within the residential area immediately to the south of the proposed Shopping Centre bounded by:*
>
> *Princes Highway to the west*
> *Wallace Street to the east*
> *Plunkett Street to the north*
> *Kalandar Street to the south*
>
> *The LATM scheme shall discourage through traffic (other than via Plunkett Street), ensure protection of residential amenity and children's safety. The scheme shall be designed to achieve a 40 kmph safe speed environment as a design objective and be in conformity with AS 1742.13, Austroads Part 13 or as appropriate on RTA Technical Direction".*

The purposed of this report is to provide details of the assessment undertaken and for the LATM scheme as required by Council. Details of the retail centre site and the LATM study area are provided in Figure 1.


Proposed Retail Centre
Nowra Fair
JUNCTION ST
JANE ST
MORTON PDE
PLUNKETT
DOUGLAS
JERVIS
EAST
STATION ST
ANNS
Nowra Cemetery
Lyrebird Park
Marriott Pk
Camellia Gdns
Nowra Pmy Vet
East Nowra Pmy
Ct Hse
Mus
KINGHORNE
HAIGH AV
LAWRENCE AV
GRANT ST
COX AV
VIEW ST
RYAN AV
GOULD AV
BOULTWOOD AV
MILLER AV
McGUIRE AV
MASSINGHAM AV
KALANDAR ACE
KNAPP AV
YOUNG
DUCHESS CL
WARRAMUNGA ST
ARUNTA CL
SECCOMBE
WELLESLEY PL
SALISBURY
SHORLAND PL
ELLIS PL
BISDE PL
LEGEND
N
LOCATION
FIG 1

2. EXISTING ROAD NETWORK AND TRAFFIC MANAGEMENT

The road network within the study area is already subject to significant traffic management. These measures, in part, reflect previous actions to curtail vehicle movement and vehicle speed in the area.

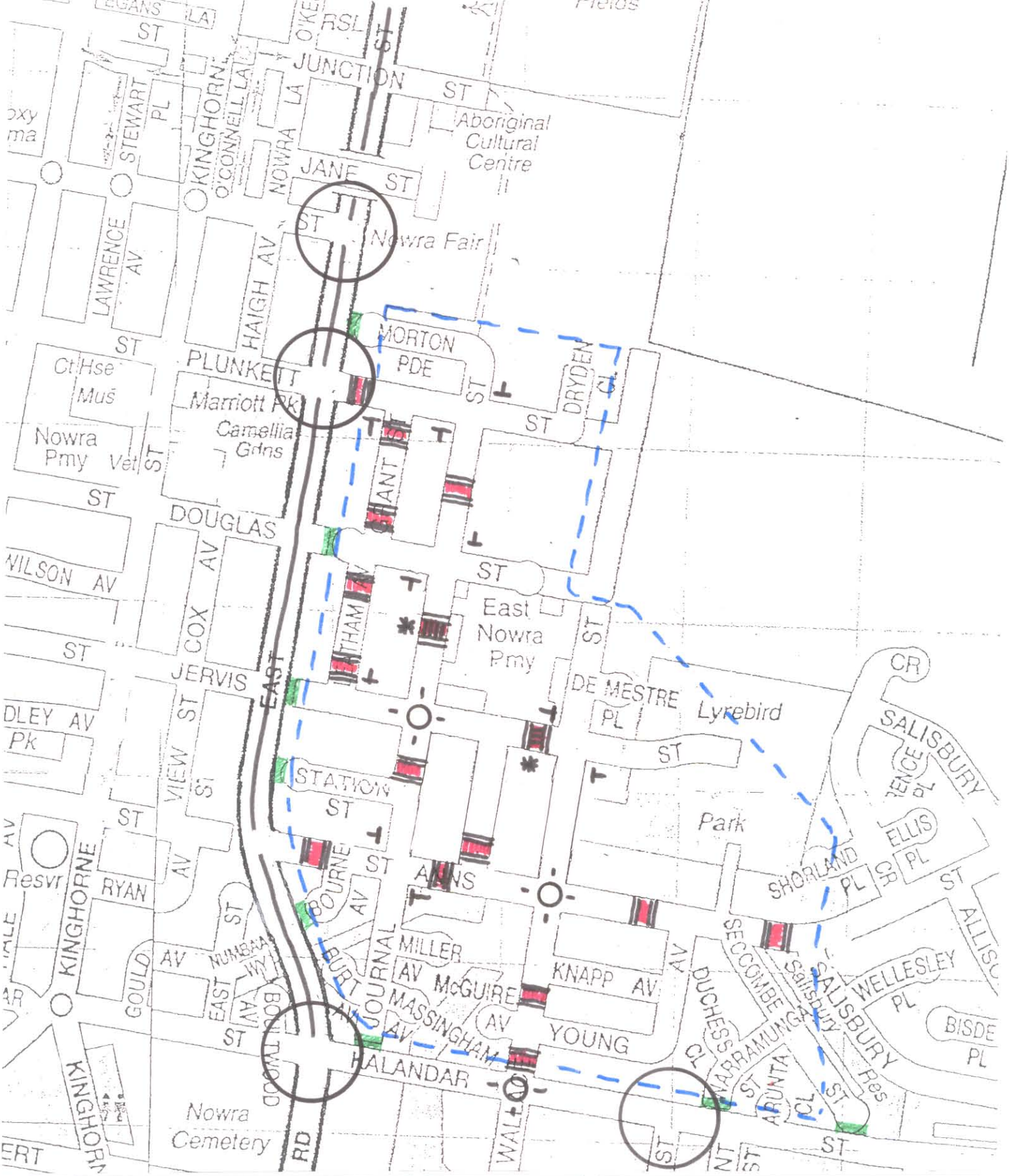
The existing traffic management measures and controls in the area are shown on Figure 2 and are summarised in the following:

* 40 kmph Local Area Speed Restriction (including 40 kmph School Speed Restriction adjacent to East Nowra Primary School)

* Roundabouts:
  - Jervis Street/Journal Street
  - St Anns Street/Wallace Street
  - Kalandar Street/Wallace Street

* Wombat pedestrians crossings:
  - Journal Street at East Nowra Primary School
  - Jervis Street at East Nowra Public School

* Road closures:
  - Morton Parade at Princes Highway
  - Douglas Street at Princes Highway
  - Jervis Street at Princes Highway
  - Station Street at Princes Highway
  - Bourne Avenue at Princes Highway
  - Journal Street at Kalandar Street
  - Warramunga Street at Kalandar Street
  - Seccombe Street at Kalandar Street



LEGEND

- TRAFFIC SIGNALS
- STOP/GIVE WAY SIGN
- ROUNDABOUT
- WOMBAT CROSSING
- RAISED PLATFORM
- 40 KMPH ZONE
- ROAD CLOSURE

N

EXISTING TRAFFIC MANAGEMENT

FIG 2

* STOP/GIVE WAY control:
    - Journal Street at Plunkett Street
    - Journal Street at Douglas Street
    - Jervis Street at Wallace Street
    - St Anns Street at Journal Street

* Raised platforms:
    - Plunkett Street east of Princes Highway
    - Grant Street south of Plunkett Street and north of Douglas Street
    - Leatham Street south of Douglas Street and north of Jervis Street
    - Journal Street south of Plunkett Street and north of Station Street
    - Elizabeth Street north of St Anns Street
    - St Anns Street east of Princes Highway, east of Journal Street, east of Wallace Street and east of Seccombe Street
    - Wallace Street north of Kalandar Street and north of Young Street

* Entry treatment:
    - Wallace Street north of Kalandar Street
    - Plunkett Street east of Princes Highway

3. OFF-SITE ROADWORKS PROPOSED FOR RETAIL CENTRE DEVELOPMENT

The off-site roadworks which are proposed to be undertaken in conjunction with the development relevant to the study area comprise:

* construction of Morton Parade between Plunkett Street and the site boundary

* construction of a roundabout at the Plunkett Street/Journal Street intersection (replacing GIVE WAY control)

* widening of Plunkett Street between Princes Highway and Grant Street (3 lanes westbound and 1 lane eastbound) and between Grant Street and Journal Street (2 lanes westbound and 1 lane eastbound).

Concept design details of these proposals are provided on the plans incorporated in Appendix A and these works will include:

* removal of the existing raised platform in Morton Parade approximately 100 metres north of Plunkett Street

* provision of a raised platform in Journal Street north of Norton Parade

* provision of footways and kerb ramps.

4. ASSESSMENT

It is apparent that the road network in the study area is already subject to significant traffic management and consequently the speed environment is relatively low. Particularly effective in this regard are:

* the 'blanket' 40 kmph speed restriction
* the speed control devices which enforce the speed limit
* the 'consistent' application of measures over the area.

The already proposed 'off-site' roadworks associated with the development will contribute to the consistency of the LATM facilities with:

* the provision of a raised platform in Journal Street just north of Morton Parade
* the provision of a roundabout at the Journal Street/Plunkett Street intersection.

The established criteria (AS 1742.13) for LATM devices specifies that in order to be effective they should be installed:

* within 50 metres of the beginning of travel on a street
* with a maximum spacing of 80 to 120 metres.

Assessment of the existing road network and traffic management measures within the specified Study Area indicates that:

* vehicles travelling to/from the proposed retail centre access connection at the northern end of Journal Street are less likely to travel along Leatham Street, Grant Street or Elizabeth Street because these streets will not form part of any access route. It is conceivable however, that other vehicles could divert onto these streets if any significant delays occur on the access road system

* Journal Street (Douglas Street to Jervis Street) – the distance between the existing wombat facility and Jervis Street is some 140 metres

- Journal Street (Jervis Street to St Anns Street) – the distance between the existing facility and St Anns Street is some 130 metres

- Jervis Street (Journal Street to Wallace Street) – the distance between the existing wombat facility and Journal Street is some 180 metres

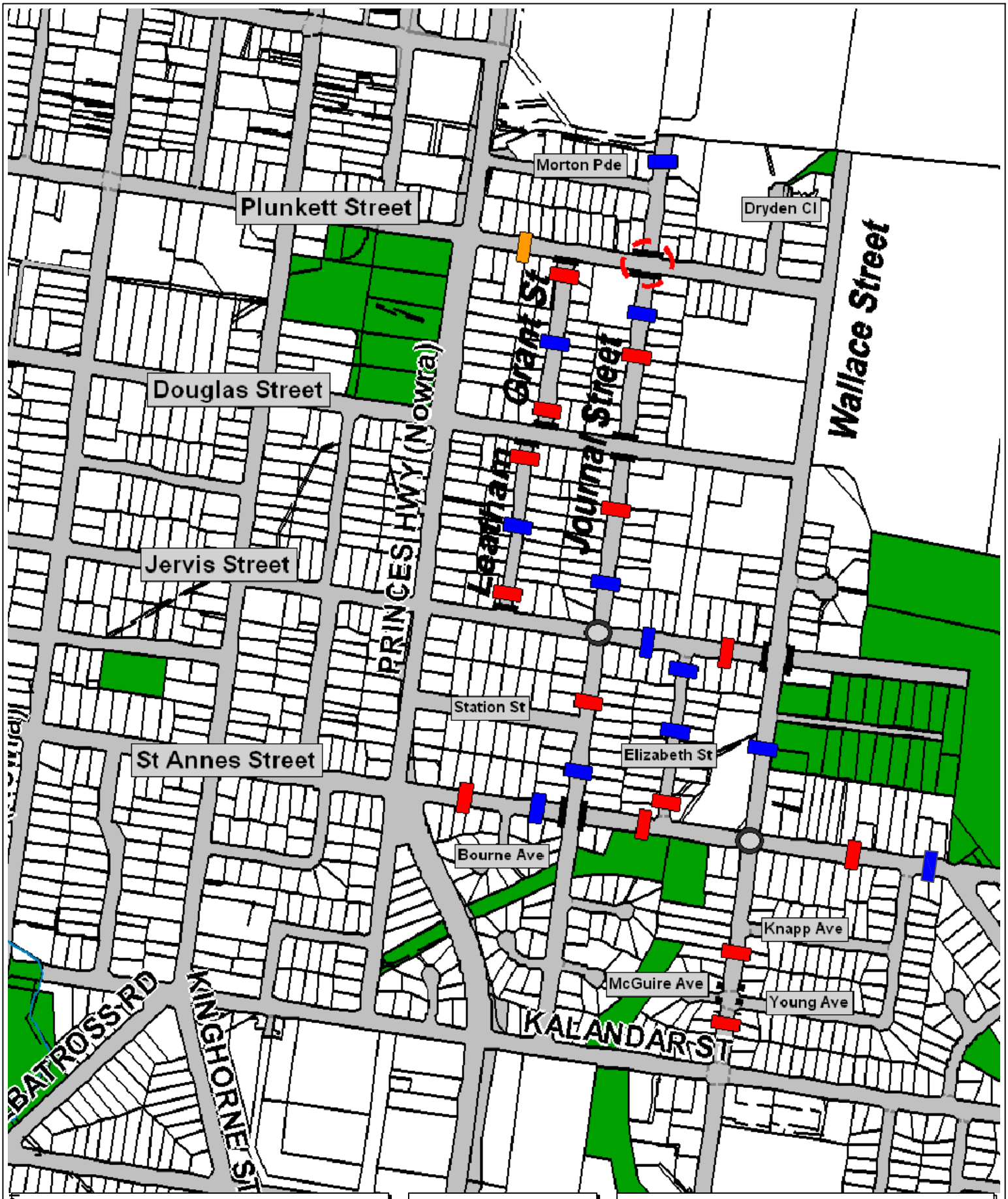
- Wallace Street (Jervis Street to St Anns Street) – the distance between intersections without any facilities is some 200 metres

- St Anns Street (Princes Highway to Journal Street) – the distance between the existing facility and Journal Street is some 150 metres.

In order to exactly comply with the criteria it is apparent that there are a number of locations where additional LATM facilities could be applied. Details of the proposed LATM facilities are indicated on Figure 3 and comprise:

Location	Facility	Status
Plunkett Street east of Princes Highway	Raised platform	Delete
Plunkett Street and Journal Street	Roundabout	Proposed
Morton Parade north of Plunkett Street	Raised platform	Proposed
Journal Street north of Jervis Street	Narrowing nibs	Proposed
Journal Street north of St Anns Street	Narrowing nibs	Proposed
Jervis Street east of Journal Street	Raised platform	Proposed
Wallace Street north of St Anns Street	Raised platform	Proposed
St Anns Street west of Journal Street	Raised platform	Proposed
Journal Street south of Plunkett Street	Narrowing nibs	Proposed
Elizabeth Street south of Jervis Street	Raised platform	Proposed
Grant Street midway Douglas Street and Plunkett St	Narrowing nibs	Proposed
Leatham St midway Douglas Street and Jervis Street	To be determined	Deferred
Elizabeth Street midway Jervis Street and St Anns St	To be determined	Deferred
St Anns Street midway Young Ave and Seacombe St	To be determined	Deferred

A decision as to whether to install the 'deferred' facilities would await realisation of any undue traffic affectation after the opening of the centre. Survey and design will be undertaken to precisely locate the proposed facilities to avoid impact on driveways and services.



LEGEND

Criteria applied : AS1742.13 Local Area Traffic Management.
Devices to be installed within 50m of commencement of street with maximum spacing 80-120m to achieve speed environment.

- Existing Facility
- Proposed Facility
- Remove Facility

N

PROPOSED AND POTENTIAL LATM FACILITIES

FIG 3

F:\WORK\05\05260 NOWRA SHOPPI

5. CONCLUSION

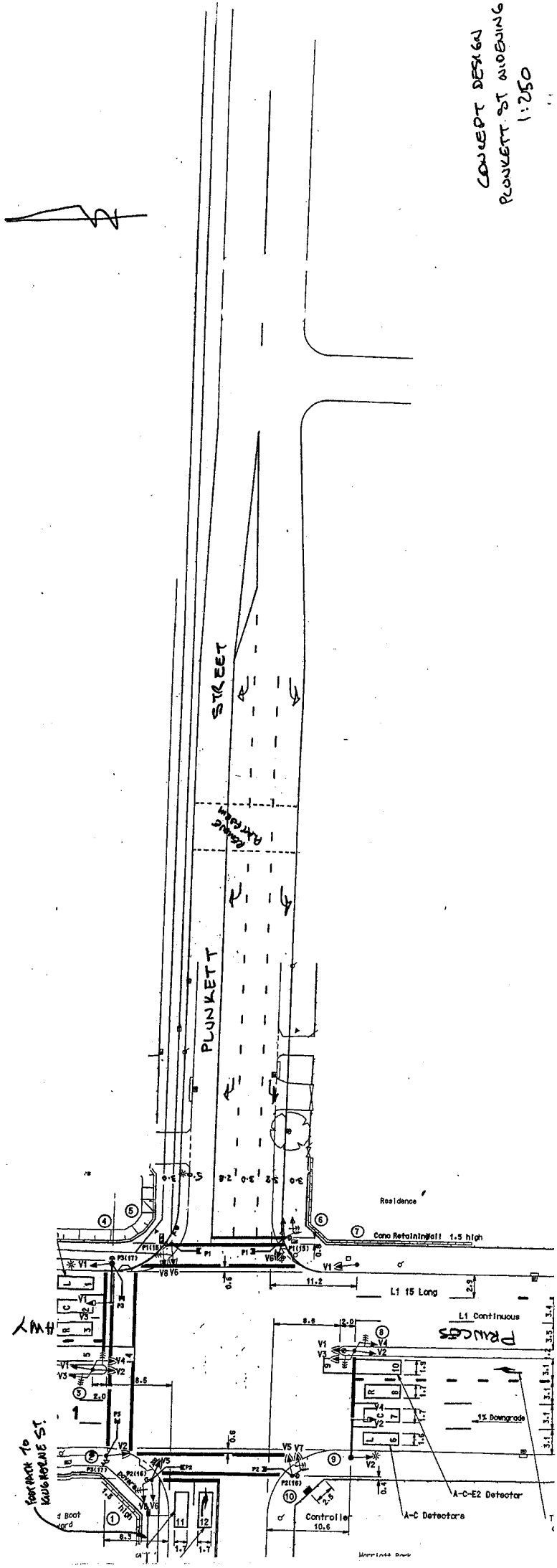
Deferred commencement conditions for the proposed retail centre require the development of a detail LATM scheme for a specified area to the south of the site. There is already in place a very comprehensive system of LATM devices and supplementary controls within the area which act to effectively constrain vehicle speeds and undue volumes.

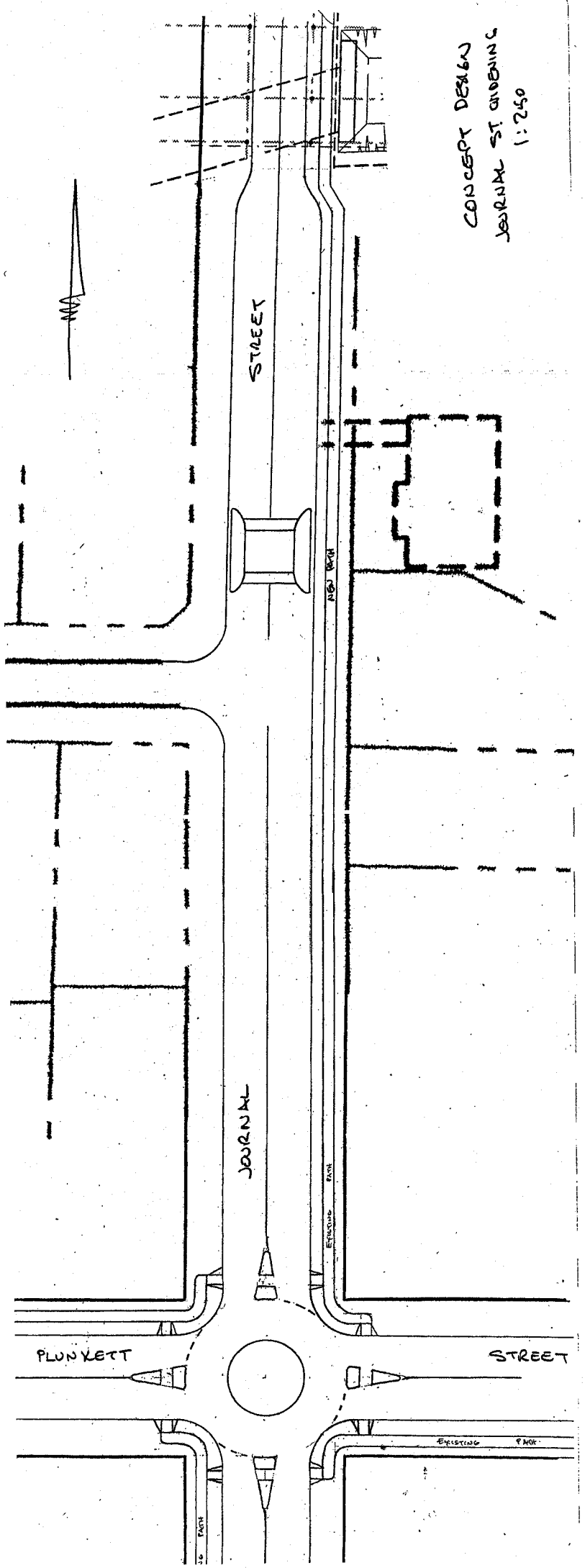
There are already some LATM devices in place, however there are a number of locations where the spacing of devices does not comply with the minimum requirements of AS 1742.13, and accordingly recommendations have been made for provision of additional LATM devices as shown on Figure 3 and listed on Page 6 of this report to offset the impacts of the proposed shopping centre. As listed, some of these devices have been recommended to be deferred for review following opening of the shopping centre.

APPENDIX A

PROPOSED OFF-SITE WORKS

CONCEPT DESIGN
PLUNKETT ST WIDENING
1:250




CONCEPT DESIGN
JOURNAL ST WIDENING
1:250
STREET
JOURNAL
PLUNKETT
STREET
EXISTING PATH

Appendix G

Design Note on modelling (for this study –

Nowra CBD Road Network Strategy Review),

Design Note dated 31 August 2006)

Cardno Eppell Olsen Pty Ltd
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Our Ref: 9544

Date: 31 August 2006

DESIGN NOTE

NOWRA CBD STRATEGY 2016 REVIEW

In response to applications for major developments, Cardno Eppell Olsen was commissioned by Shoalhaven City Council to analyse and report on the future traffic operation within Nowra based on the CBD Strategy which includes ENSA developed by Eppell Olsen and Partners from previous projects. The key question was whether the strategy should be amended to cater to the expanded development expectations for the eastern CBD area.

This design note analyses results for the Princes Highway corridor between Plunkett Street and Moss Street undertaken using Paramics micro-simulation modelling software.

Model

The base 2004 model has recently been re-developed in Paramics version 5.2 and calibrated to the 2004 counts. This base network was then modified as per the developed CBD Strategy

The carpark layouts adopted for the developments have been provided by the applicants' respective traffic engineers. These cover:

- Stockland's expansion of Stocklands Nowra (ex Nowra Fair)
- Leda's proposal for land east of Stocklands Nowra
- Concepts for Junction North bulky goods and convenience foods on former Services club overflow parking.

In addition development of the land to be excised from the school property and lying west of ENSA was assumed as shown in Council's summary Figure.

Additional modifications to the model to improve network performance are as follows:

- New connection from Proposed Leda Development to Journal Street,
- Extended two lane section in Junction Street West at Nowra Lane,
- Signals at Plunkett Street/Haigh Avenue with two stand up lanes southbound in Haigh Avenue,
- Three lane section to Princess Highway in Plunkett Street from east,
- Extended two lane sections in Brereton Street, and
- Extended two lane sections in Kinghorne Street north of Worrigee Street.

OD Demands

Generation rates for all developments are listed on the Council's summary Figure. Essentially a rate of 4.6 vte per 100sq m was adopted for the shopping centres treated in aggregate.

Separate OD Matrices were developed to be able to isolate and analyse each development's traffic generation. The matrices and area are as follows and included in Appendix 1 and as well as figures showing the OD Demands for the Nowra Fair and Leda Developments:

- Matrix 1 – Base background traffic,
- Matrix 2 – Nowra Fair Development (Zones 16,25,33 & 34) 31,000sqm,
- Matrix 3 – Leda Development (Zones 13 & 24) 31,000sqm,
- Matrix 4 – Junction North (Zones 27 & 30) 9,300sqm,
- Matrix 5 – Developments on old school land (Zones 26 & 32) 15,000sqm,
- Matrix 6 – Corban (Zone 29) 1,400sqm, and
- Matrix 7 – Convenience Store (Zone 31) 500sqm.

A preload period was introduced for the first hour from 2:30pm to 3:30pm at 80% of the OD matrices.

Scenarios Tested

As discussed at the review meeting in Wollongong on the Thursday 10th August, the following scenarios were modelled, see Appendix 2 for figures showing all scenarios network configuration:

- Scenario 1:- As per figure 5.3 with all zones fully developed and Leda main access and egress (65 %) from left in and left out at mid block along Junction Street and one lane roundabout at Junction and Wallace Street.
- Scenario 2:- As per figure 5.3 with all zones fully developed with Leda main access and egress (65%) from one lane roundabout at Junction and Wallace Street, and secondary left in and left out at mid block along Junction Street.
- Scenario 3:- As above but two lanes on Junction Street/Wallace Street roundabout and approaches.
- Scenario 4:- As per figure 5.2 with all zones fully developed and Leda main access and egress (75 %) from signals at mid block along Junction Street and one lane roundabout at Junction and Wallace Street.

Appendix 2 shows the north-eastern corner of each scenario modelled.

Scenarios Results

Appendix 3 shows Analyser results for all scenarios including:

- Turn and link flows
- Link Level of Service
- Link Average Queues
- Link Maximum Queues
- Link Delays

Scenarios Operation

The operation of each scenario was observed as follows:

Scenario 1:- Junction Street is heavy with queuing on several occasions extending back and into the main Leda egress. As a result, vehicles divert north along Brereton Street to North Street which blocks egress from zones on both side of Brereton Street. Queues form on ENSA east of Brereton Street but do not block the egress from the resumed school land development.

Due to the high flows on Princess Highway northbound, the model shows a tendency for vehicles to divert to the local network in particular north along Haigh Avenue/ Nowra Lane/O'Keefe Avenue which adds delays to the other minors to the west of Princess Highway.

A sensitivity test was completed on this scenario. The test allowed right turns to and from the Leda development at their proposed access on Junction Street. This improved the operation and performance of the network reducing queues on Brereton Street, allowing free egress from Leda and developments both side of Brereton Street. It also diverted northbound traffic from Princes Highway to the local roads. Whilst this test improved the model network performance, it must be noted that In real terms there would be an additional conflict point on Junction Street, and the additional conflict point arising in close proximity to the roundabout and bus stops would not be desirable from a general traffic safety perspective, nor desirable from a pedestrian safety perspective.

Scenario 2:- The main difference from scenario 1 is that ENSA has higher flows due to the increased accessibility from the Leda Development. This resulted in minor queues on ENSA east of Brereton Street. This higher flow along ENSA blocks Brereton Street traffic but not as much as Scenario 1, there be improving egress from the northern developments on Brereton Street.

Queues form eastbound on Junction Street on approach to Junction Street/Wallace Street roundabout and queues on several occasions fill the short link to the ENSA roundabout but do not block either roundabout.

No excessive queuing was observed and limited diversion to local streets from the Princess Highway.

Scenario 3:- As with scenario 2 the network operates to allowable tolerances with improved circulation at the Junction Street/Wallace Street roundabout.

Scenario 4:- This scenario gave similar results as scenarios 2 and 3 with no excessive queuing observed or diversion to local streets from the Princess Highway. Circulation around Moss Street and North Street between O'Keefe Avenue and Brereton Street seemed to be slightly improved.

Overall Observations

In comparing all scenarios the following observations can be made:

1. There are only small differences between the models in terms of flows, delays, queues and level of service.
2. If the main Leda carpark access and egress is midblock along Junction Street between Brereton Street and Wallace Street the model shows:
    a. slightly more traffic northbound on Brereton Street, and

b. slightly less traffic northbound on ENSA.

3. Occasional queues form back from ENSA roundabout to south. These reach the Junction Street/Wallace Street roundabout but do not restrict either roundabout and queues clear ok.
4. Occasional queues form along ENSA back from North Street/Brereton Street towards the east.
5. Scenario 1 is not preferred as it seems to:
    a. make least use of ENSA, and
    b. load the Nowra Fair/Brereton Street/ Junction intersection more.
6. Scenario 2 with one lane roundabout at Junction Street/Wallace Street shows evidence of some extra queuing due the main access to Leda from the roundabout. The short link between Junction Street/Wallace Street roundabout and ENSA is filled several times in the peak hour, which increases the chance of blocking the ENSA roundabout.
7. Scenario 3 is more stable then scenario 2 but still shows queue at Junction Street/Wallace Street roundabout.
8. Scenario 4 with the signals at the access to Leda controls the release of vehicles such that the model is the most stable and has less queue interference between ENSA.
9. In both Scenarios 3 and 4 there is an increase in use of ENSA. This has some impacts on queues in North Street.

Pedestrian Movement

Scenario 4 offers considerable benefits for safe pedestrian movement when compared with the other scenarios. The benefits are experienced both on Junction Street and within the shopping centre development itself.

With most traffic using a left-in, left-out entrance and egress on Junction Street, scenario 1 does not provide for easy crossing of Junction Street at the main entry point to the shopping centre, which is mid-way between the intersection of Brereton Street and the roundabout. A median will provide some refuge for pedestrians, but there are concerns about the ability of pedestrians to safely cross the southern side of Junction Street adjacent to the main entrance. Pedestrians and cyclists using the shared use path to skirt the roundabout that forms the intersection of Wallace and Junction Streets will also need to cross the access road to ENSA.

The situation is eased somewhat in scenario 2, which has most traffic accessing the car park via the roundabout. However the left-in, left-out access on Junction Street remains and pedestrians will still be crossing Junction Street with no protection apart from the median refuge. In addition, the provision of access from the roundabout (that is, the corner of the basement car park) complicates vehicle movement within the car park itself, with a deleterious effect on the safety of pedestrian movements. The same factors applying in scenario 2 also apply to scenario 3. However the two lane roundabout that features in this scenario is worse for pedestrians.

By providing traffic lights at the main entrance on Junction Street, scenario 4 offers the following advantages:

- there will be a safe means of crossing Junction Street at the point most pedestrians will wish to cross the road - adjacent to the main entrance and beyond the Stockland loading bay that will discourage pedestrian use of the southern side of Junction Street.
- crossing the road link to ENSA will be protected by the use of signals.
- by removing the ENSA link as an arm on the roundabout, those pedestrians and cyclists using the share use path will also be able to skirt the roundabout safely.

- reinstating Junction Street as the main entrance to the basement car park should also enable more straightforward layout of car parking and circulation aisles. (To what extent this advantage is taken up will depend on the exact layout of the car park in the light of an access to the roundabout being retained.)

Recommendations

No scenarios grid locked the network and all gave acceptable levels of queuing and delays. However:

- scenario 1 has northbound vehicles diverting from the Princes Highway to local roads,
- scenarios 1 and 2 resulted in blocking of links and egress from several zones, and
- scenarios 2 and 3 shows queuing at Junction Street/ Wallace Street roundabout which could extend to ENSA due to the short link to ENSA.

Therefore, scenario 4 is recommended with the main connection from Leda to a mid block signalised junction, which would then connect north to a roundabout as per figure 5.2. This scenario has benefits such as:

- being able to control egress from the Leda Development and platooning vehicles allowing co-ordination with other signals,
- reduces the chance of queuing on ENSA,
- allows for the extension of Junction street if required in the future to improve local accessibility and network capacity and/or to meet ENSA to the east of required in the future either directly or via Plunkett Street,
- reduces the resumption of school land, which in turns reduces the development and traffic generation by approximately 200vehs/hr, and
- improves pedestrian safety.

Appendix 1

OD Demands

Matrix 1																																			
from 1	0	0	5	26	23	91	10	72	139	0	156	0	0	189	0	230	40	897	183	0	30	41	0	0	0	0	0	0	0	0	0	0	0	0	##	2132
from 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 3	2	0	0	0	0	100	0	0	1	0	4	0	0	0	0	0	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	113
from 4	9	2	0	0	45	737	0	1	0	0	26	0	0	1	0	1	2	35	7	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	##	867
from 5	5	2	0	36	0	229	9	1	9	0	2	0	0	0	0	0	1	5	5	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	##	305
from 6	1	50	0	183	148	0	50	49	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	483
from 7	32	8	0	182	56	0	0	0	38	0	101	0	0	0	0	0	6	51	28	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	##	505
from 8	46	1	0	0	15	100	100	0	43	0	36	0	0	0	0	1	1	5	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	357
from 9	207	2	1	4	4	2	15	11	0	0	42	0	0	6	0	55	1	13	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	##	367
from 10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 11	0	9	4	19	17	58	76	54	39	0	0	0	0	35	0	0	0	0	23	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	##	338
from 12	0	0	0	0	0	50	0	0	0	0	53	0	0	0	0	0	0	6	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	117
from 13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 14	157	3	0	0	0	0	0	0	14	0	39	0	0	0	0	0	16	325	26	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	##	591
from 15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 16	94	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	25	171	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	292
from 17	93	2	0	2	12	1	7	5	4	0	0	0	0	30	0	55	0	6	5	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	##	224
from 18	939	16	1	7	7	3	29	21	21	0	0	0	0	330	0	80	6	0	33	0	0	18	0	0	0	0	0	0	0	0	0	0	0	0	##	1511
from 19	69	2	1	4	4	22	17	12	6	0	20	0	0	25	0	7	3	49	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	##	243
from 20	0	0	0	0	0	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	40
from 21	42	1	0	1	1	0	3	2	2	0	50	0	0	0	0	0	1	29	8	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	##	149
from 22	34	1	0	1	1	0	3	2	2	0	4	0	0	12	0	3	1	24	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	90
from 23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 28	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	10
from 29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
## total	1730	99	12	465	333	1443	319	230	320	0	534	0	0	628	0	432	103	1622	341	0	30	93	0	0	0	0	0	0	0	0	0	0	0	0	##	8734

Matrix 2																																				
from 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	66	0	0	0	0	0	0	0	0	0	92	0	0	0	0	0	0	0	26	20	##	204
from 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	1	1	##	9	
from 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	2	2	##	17	
from 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	2	2	##	17	
from 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	1	1	##	9	
from 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	2	3	##	20	
from 9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	2	2	##	15	
from 10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0	
from 11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	0	0	0	0	0	0	0	0	0	36	0	0	0	0	0	0	11	8	##	91	
from 12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	2	2	##	17	
from 13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	1	1	##	11	
from 14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	13	0	0	0	0	0	0	4	5	##	39	
from 15	77	0	1	3	3	1	3	1	6	3	22	1	5	29	0	27	22	74	3	0	0	0	0	11	0	5	4	0	2	1	0	2	0	0	##	306
from 16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	7	8	##	60
from 17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	2	2	##	37
from 18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	44	0	0	0	0	0	0	0	0	0	27	0	0	0	0	0	0	0	10	22	##	103
from 19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	1	2	##	13
from 20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	1	1	##	9
from 21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	2	3	##	20
from 22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	3	3	##	27
from 25	92	0	1	3	3	1	3	1	5	3	19	1	4	29	0	26	5	49	3	0	0	0	0	10	0	5	3	0	2	1	0	2	0	0	##	271
from 26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	1	1	##	10	
from 27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	1	##	7	
from 28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	##	2
from 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	##	2
from 31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	##	5
from 33	22	0	0	1	1	0	1	0	2	1	8	0	1	8	0	7	2	23	1	0	0	0	0	3	0	1	1	0	0	0	0	1	0	0	##	84
from 34	19	0	0	1	1	0	1	0	2	1	8	0	1	10	0	9	2	27	1	0	0	0	0	3	0	2	1	0	0	0	0	1	0	0	##	90

## total	210	0	2	8	8	2	8	2	15	8	57	2	11	76	303	69	31	173	8	0	0	0	0	27	268	13	9	0	4	2	0	6	82	91	##	1495
Matrix 3																																				
from 1	0	0	0	0	0	0	0	0	0	0	0	0	70	0	0	0	0	0	0	0	0	0	0	121	0	0	0	0	0	0	0	0	0	0	##	191
from 2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	##	4
from 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 4	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	##	13
from 5	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	##	13
from 6	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	##	4
from 7	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	##	22
from 8	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	##	4
from 9	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	##	9
from 10	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	##	4
from 11	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	40	0	0	0	0	0	0	0	0	0	0	##	57
from 12	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	18	0	0	0	0	0	0	0	0	0	0	##	26
from 13	89	2	2	4	4	2	4	2	4	2	18	8	0	2	5	10	20	76	4	2	6	2	0	0	4	4	3	0	2	1	0	2	1	1	##	286
from 14	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	##	4
from 15	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	##	16
from 16	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	##	17
from 17	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	31	0	0	0	0	0	0	0	0	0	0	##	44
from 18	0	0	0	0	0	0	0	0	0	0	0	0	47	0	0	0	0	0	0	0	0	0	0	66	0	0	0	0	0	0	0	0	0	0	##	113
from 19	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	##	9
from 20	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	##	4
from 21	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	##	22
from 22	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	##	4
from 23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 24	166	5	5	9	9	5	9	5	9	5	41	18	0	5	11	23	46	134	9	5	14	5	0	0	10	9	6	0	2	2	0	4	3	3	##	577
from 25	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	##	14
from 26	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	##	10
from 27	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	##	7
from 28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	##	2
from 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	##	1
from 31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 32	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	##	4

from 33	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	##	4
from 34	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	##	4
## total	255	7	7	13	13	7	13	7	13	7	59	26	212	7	16	33	66	210	13	7	20	7	0	414	14	13	9	0	4	3	0	6	4	4	##	1489
Matrix 4																																				
from 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	38	0	0	9	0	0	0	0	##	47
from 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	##	1
from 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	1	0	0	0	0	##	5
from 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	1	0	0	0	0	##	5
from 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	##	1
from 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	2	0	0	0	0	##	9
from 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	##	1
from 9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	1	0	0	0	0	##	4
from 10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	##	1
from 11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	4	0	0	0	0	##	21
from 12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	2	0	0	0	0	##	10
from 13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	1	0	0	0	0	##	4
from 14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	##	1
from 15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	1	0	0	0	0	##	5
from 16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	1	0	0	0	0	##	6
from 17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	0	0	7	0	0	0	0	##	34
from 19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	1	0	0	0	0	##	4
from 20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	##	1
from 21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	2	0	0	0	0	##	9
from 22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	##	1
from 23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	2	0	0	0	0	##	8
from 25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	1	0	0	0	0	##	4
from 26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	##	2
from 27	57	2	2	4	4	2	4	2	4	2	18	8	2	2	3	10	0	62	4	2	6	2	0	5	2	2	0	0	1	0	0	0	1	1	##	214
from 28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	##	1
from 30	14	0	0	1	1	0	1	0	1	0	4	2	0	0	1	2	0	16	1	0	1	0	0	1	1	0	0	0	0	0	0	2	0	0	##	49

from 31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	##	2
from 33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	##	1
from 34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	##	1
## total	71	2	2	5	5	2	5	2	5	2	22	10	2	2	4	12	0	78	5	2	7	2	0	6	3	2	151	0	1	38	0	2	1	1	##	452
Matrix 5																																					
from 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	53	0	0	0	0	0	23	0	0	##	76
from 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	##	3
from 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	2	0	0	##	8
from 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	2	0	0	##	8
from 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	##	3
from 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	4	0	0	##	13
from 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	##	3
from 9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	2	0	0	##	6
from 10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	##	3
from 11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	0	0	0	0	0	10	0	0	##	34
from 12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0	5	0	0	##	16
from 13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	2	0	0	##	6
from 14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	##	3
from 15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	2	0	0	##	7
from 16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	3	0	0	##	10
from 17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39	0	0	0	0	0	17	0	0	##	56
from 19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	2	0	0	##	6
from 20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	##	3
from 21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	4	0	0	##	13
from 22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	##	3
from 23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	4	0	0	##	13
from 25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	2	0	0	##	7
from 26	80	3	3	6	6	3	6	3	6	3	25	11	3	3	4	14	0	88	6	3	8	3	0	7	4	0	2	0	1	0	0	0	1	1	##	303
from 27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	##	2
from 28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0

from 29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	##	1
from 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	##	2
from 31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 32	34	1	1	2	2	1	2	1	2	1	11	5	1	1	2	6	0	38	2	1	4	1	0	3	2	0	0	0	0	2	0	0	0	1	##	127
from 33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	##	2
from 34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	##	3
## total	114	4	4	8	8	4	8	4	8	4	36	16	4	4	6	20	0	126	8	4	12	4	0	10	6	215	2	0	1	2	0	95	1	2	##	740
Matrix 6																																					
from 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	0	##	15
from 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	##	1
from 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	##	2
from 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	##	2
from 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	##	1
from 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	##	3
from 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	##	1
from 9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	##	1
from 10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	##	1
from 11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	##	7
from 12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	##	3
from 13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	##	2
from 14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	##	1
from 15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	##	2
from 16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	##	2
from 17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0	##	11
from 19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	##	1
from 20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	##	1
from 21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	##	3
from 22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	##	1
from 23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	##	2
from 25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	##	2
from 26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	##	1

from 27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	##	1
from 28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 29	23	1	1	2	2	1	2	1	2	1	7	3	0	1	0	4	0	25	2	1	2	1	0	2	2	1	1	0	0	0	0	0	0	0	##	88
from 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
## total	23	1	1	2	2	1	2	1	2	1	7	3	0	1	0	4	0	25	2	1	2	1	0	2	2	1	1	0	67	0	0	0	0	0	##	155
Matrix 7																																				
from 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	##	13
from 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	##	1
from 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	##	1
from 6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	##	2
from 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	##	1
from 10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	##	6
from 12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	##	3
from 13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	##	2
from 17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	##	9
from 19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	##	1
from 20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	##	2
from 22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0

from 25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 31	19	1	1	1	1	1	1	1	1	1	6	3	0	1	0	3	0	21	1	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	##	67
from 32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
from 34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	##	0
## total	19	1	1	1	1	1	1	1	1	1	6	3	0	1	0	3	0	21	1	1	2	1	0	0	0	0	0	0	0	0	41	0	0	0	##	108

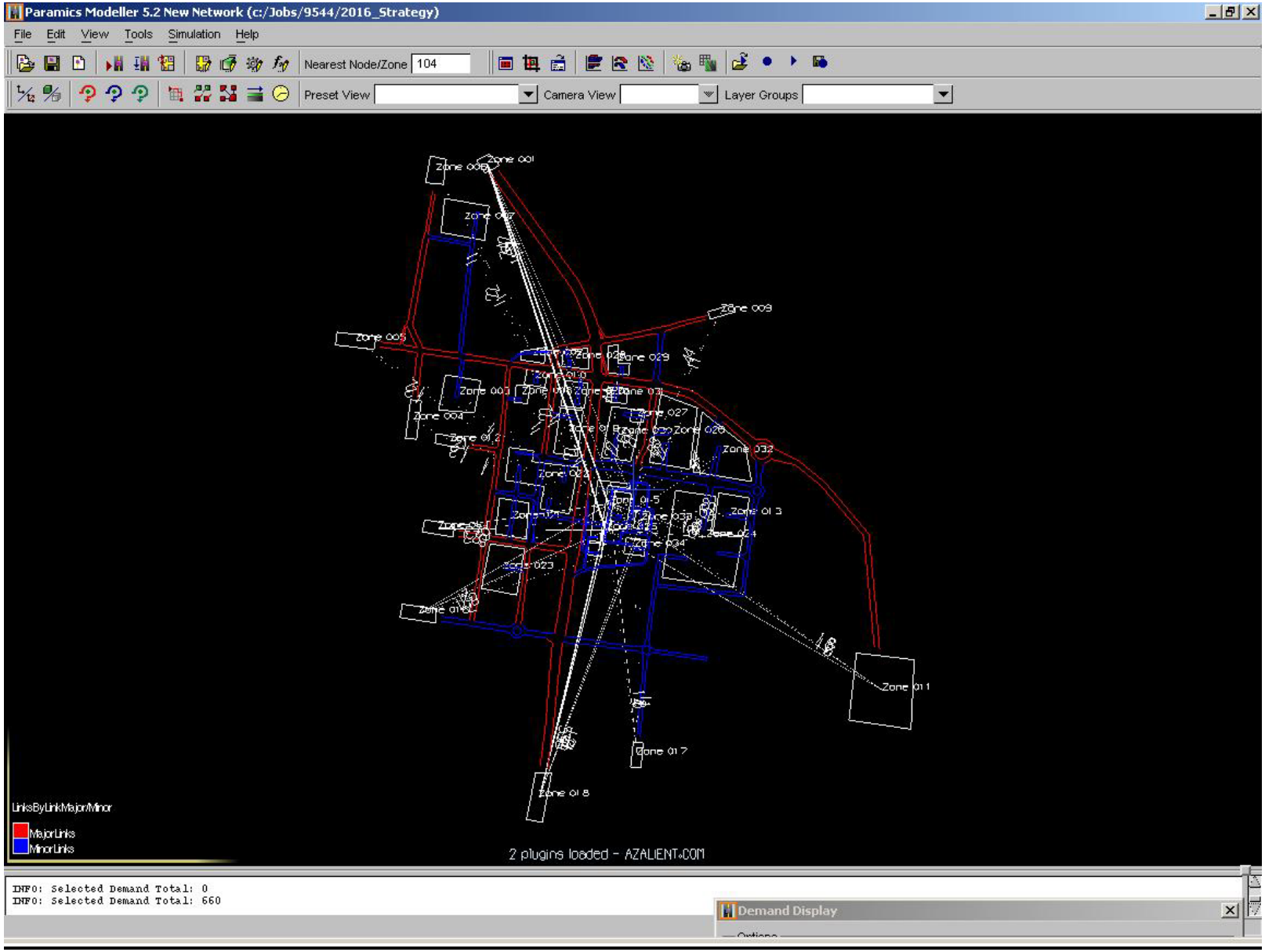


Figure 1 – Nowra Fair OD Demands

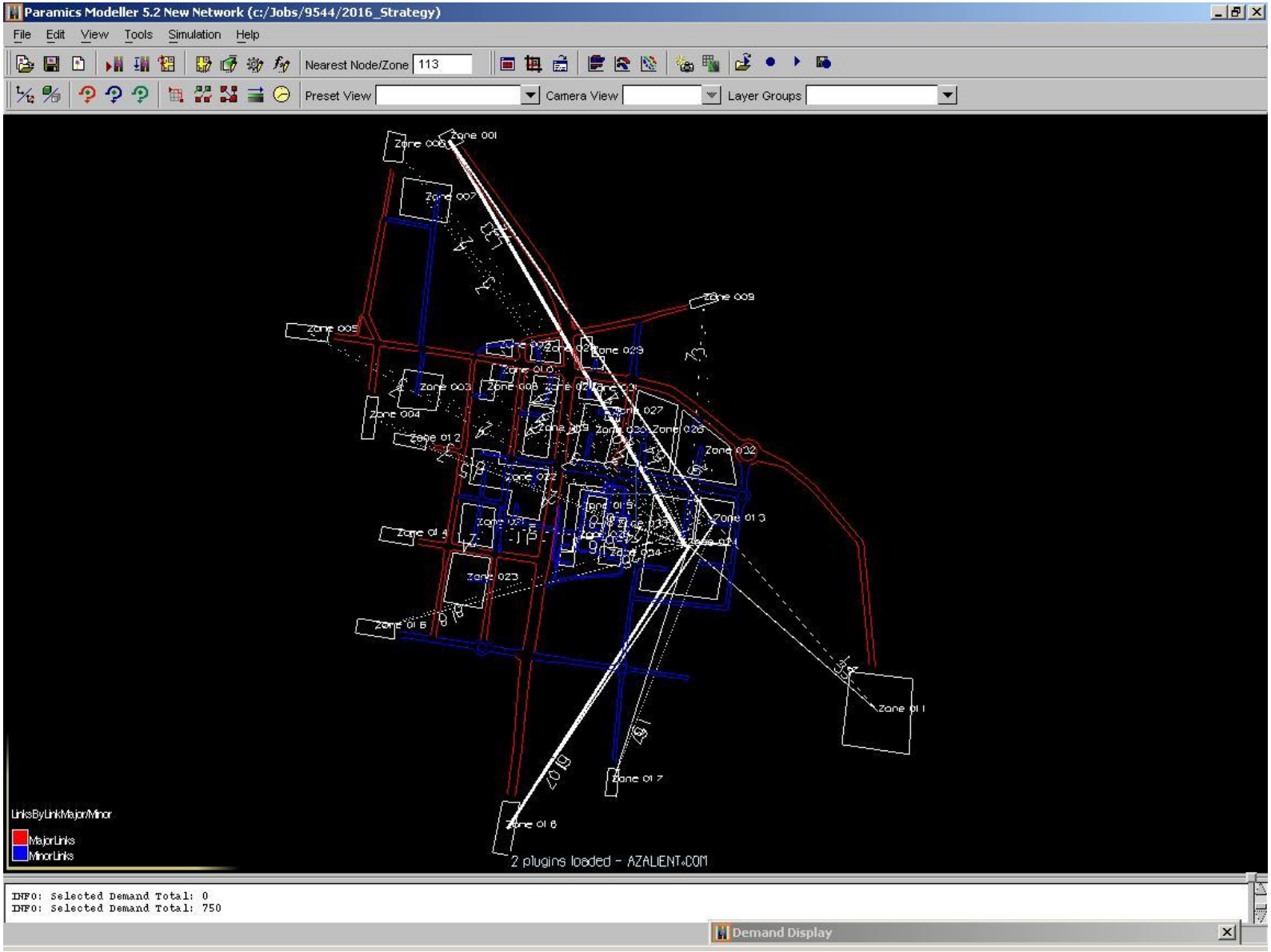


Figure 2 – Leda OD Demand

Appendix 2

Scenarios Modelled

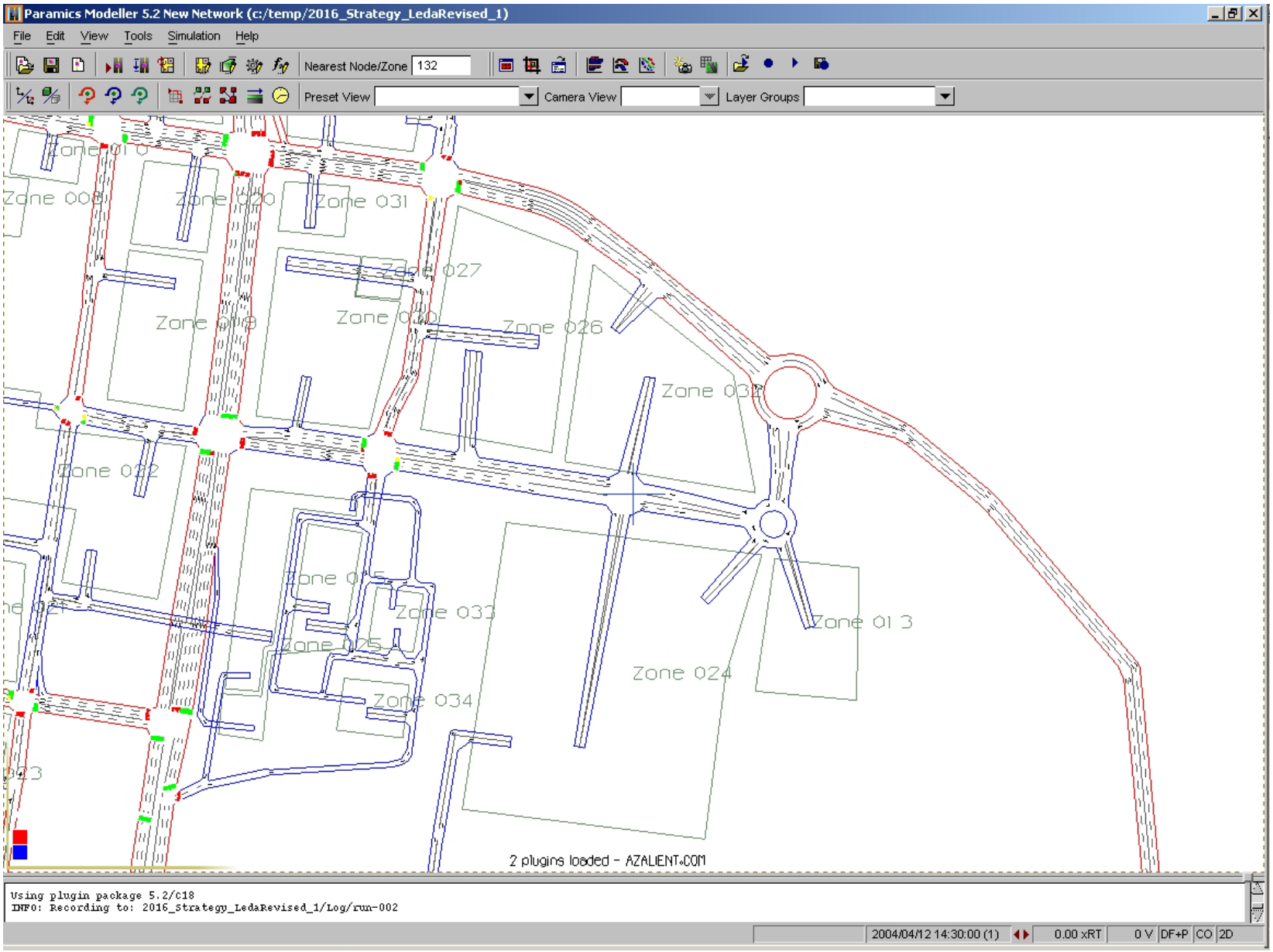


Figure 3 – Scenario 1

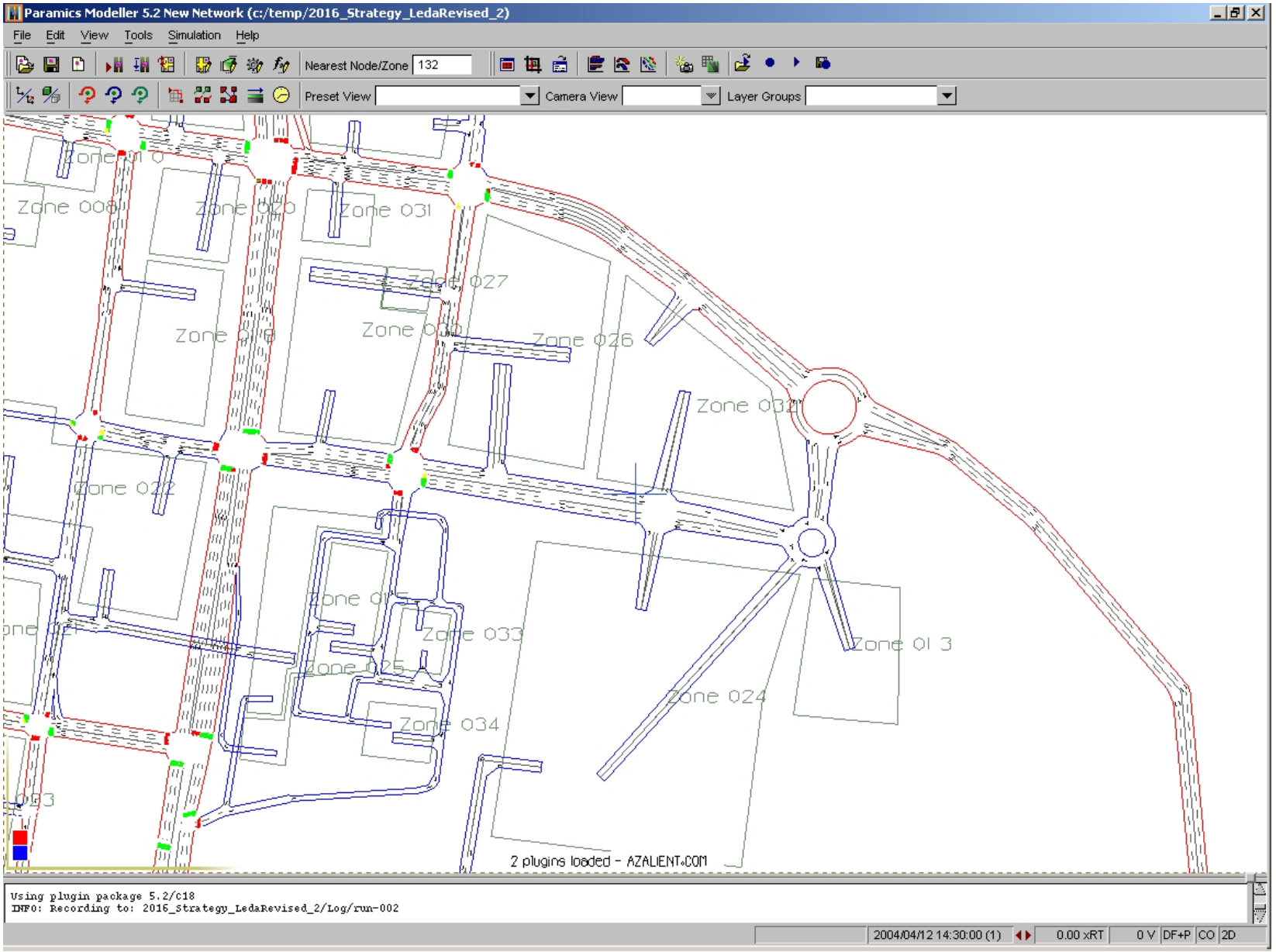


Figure 4 – Scenario 2

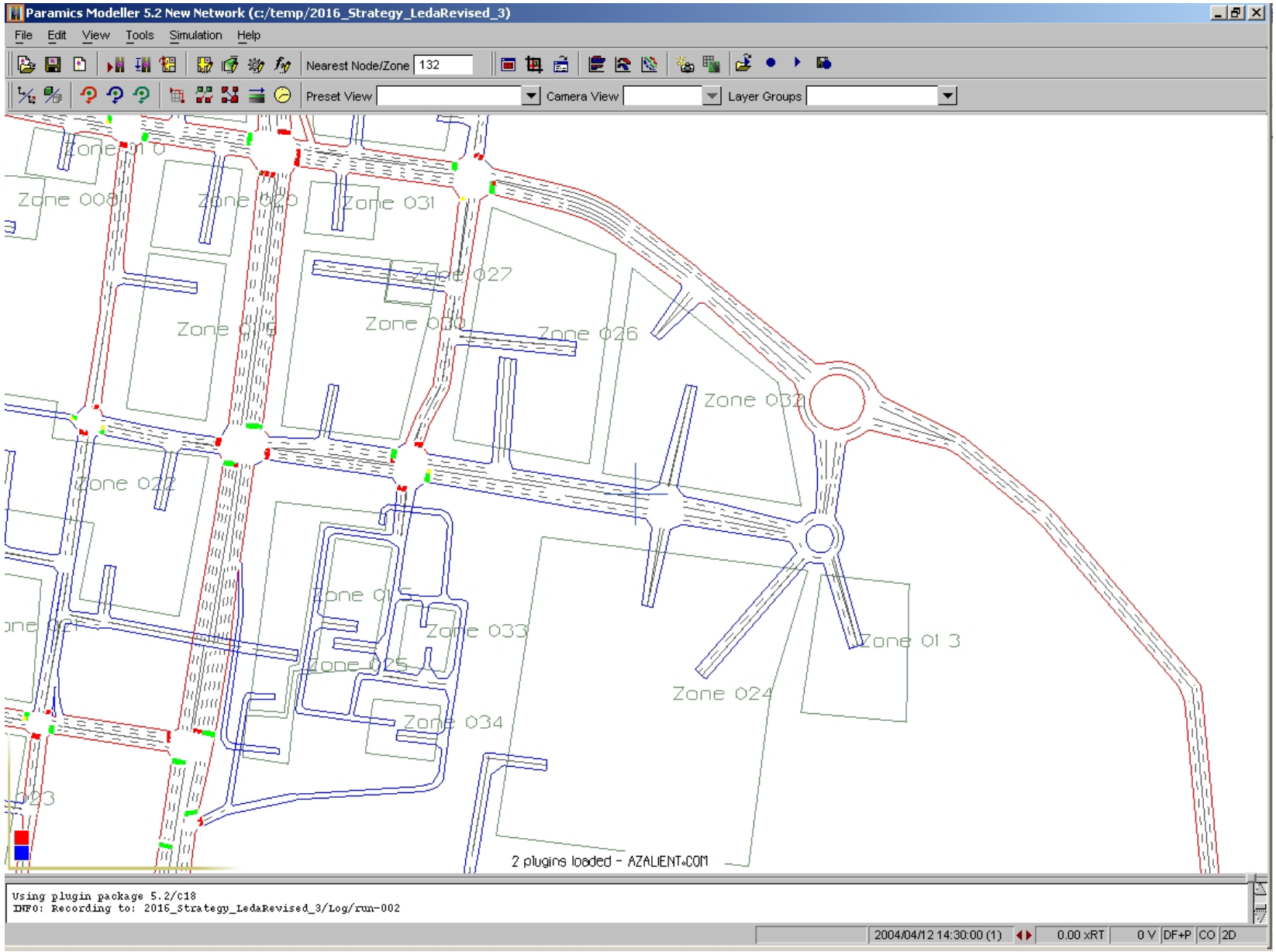


Figure 5 – Scenario 3

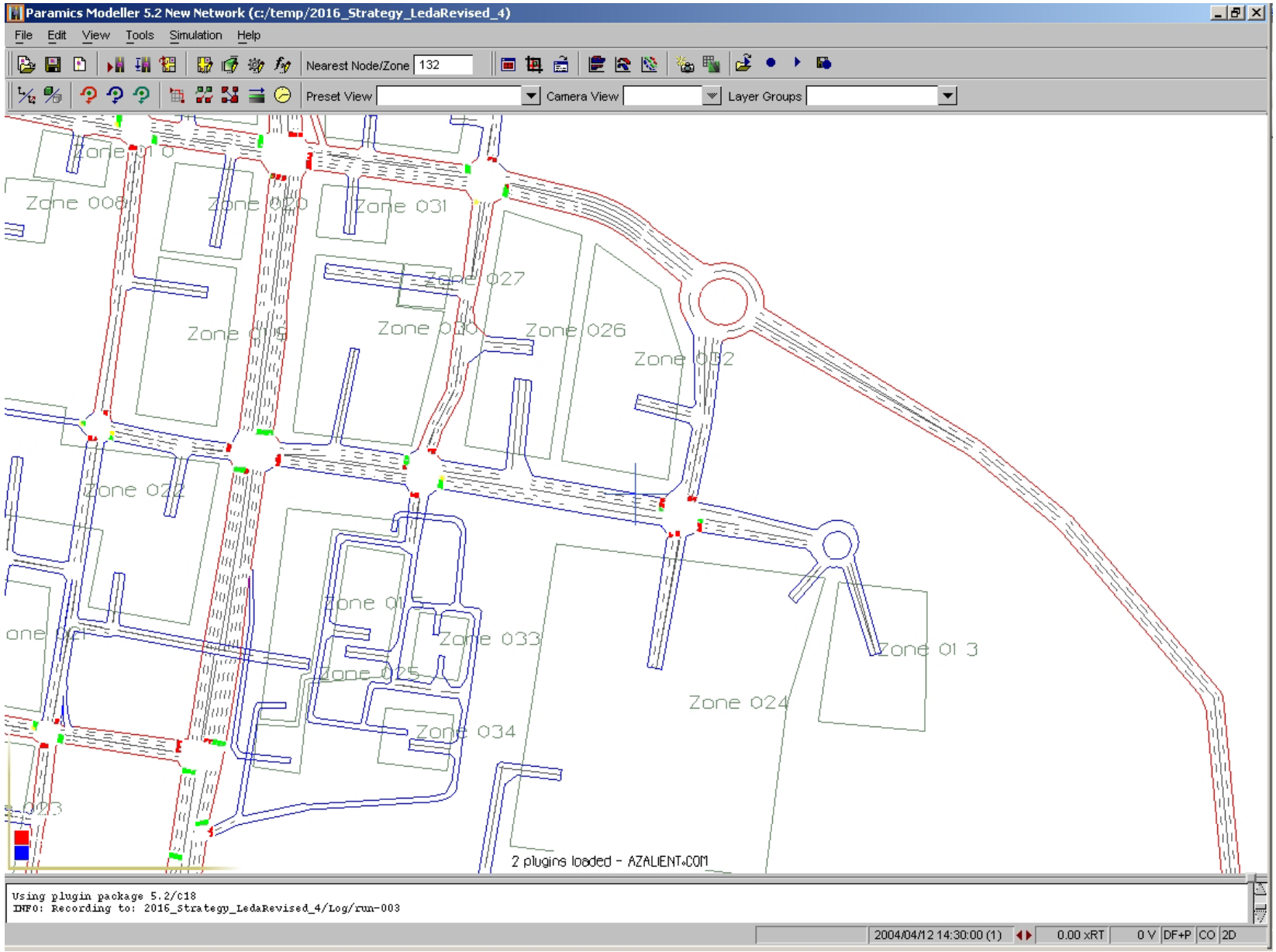


Figure 6 – Scenario 4

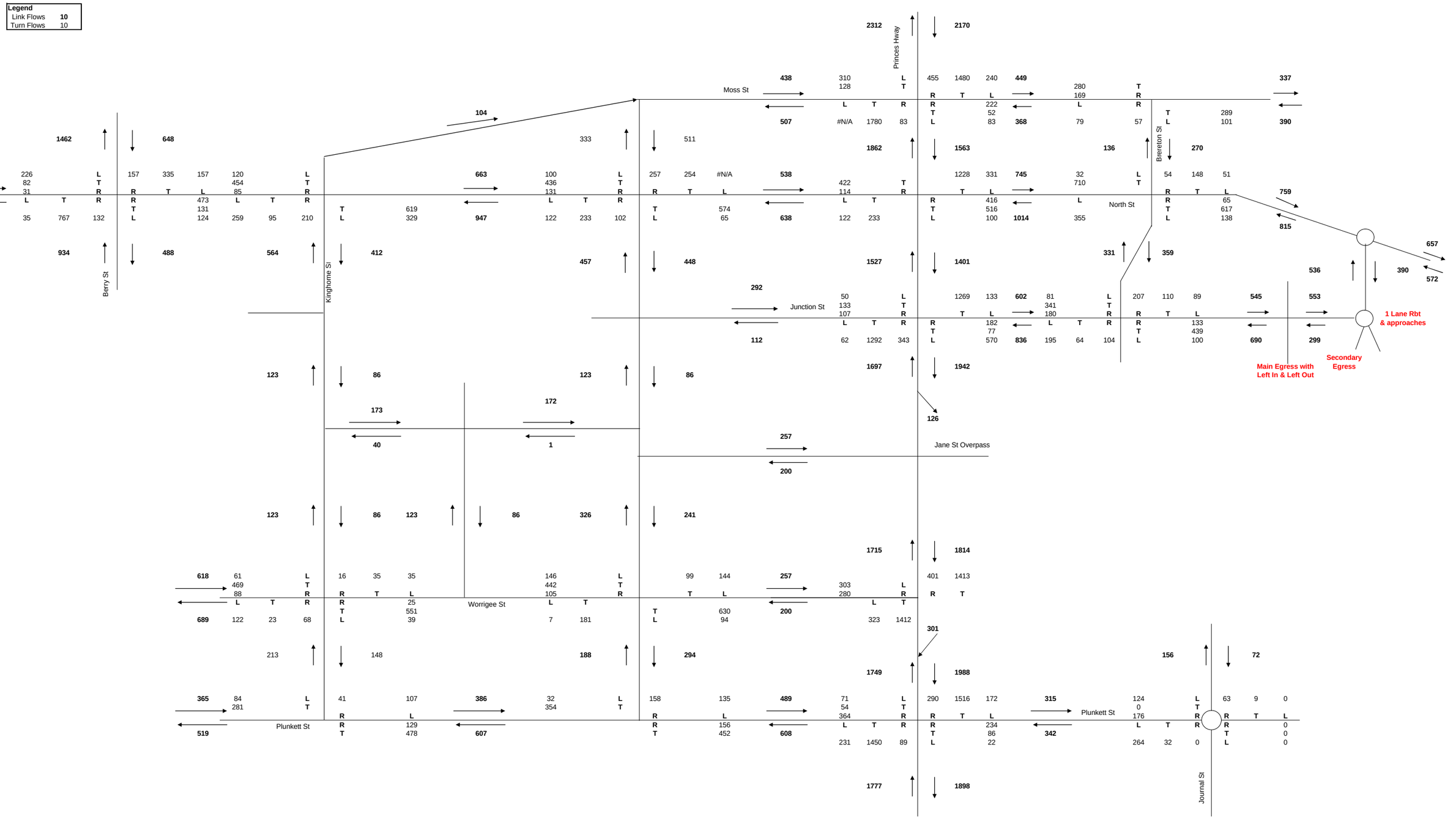
Appendix 3

Scenarios Results

NOWRA CBD STRATEGY 2016 REVIEW

Paramics Model Turn Counts

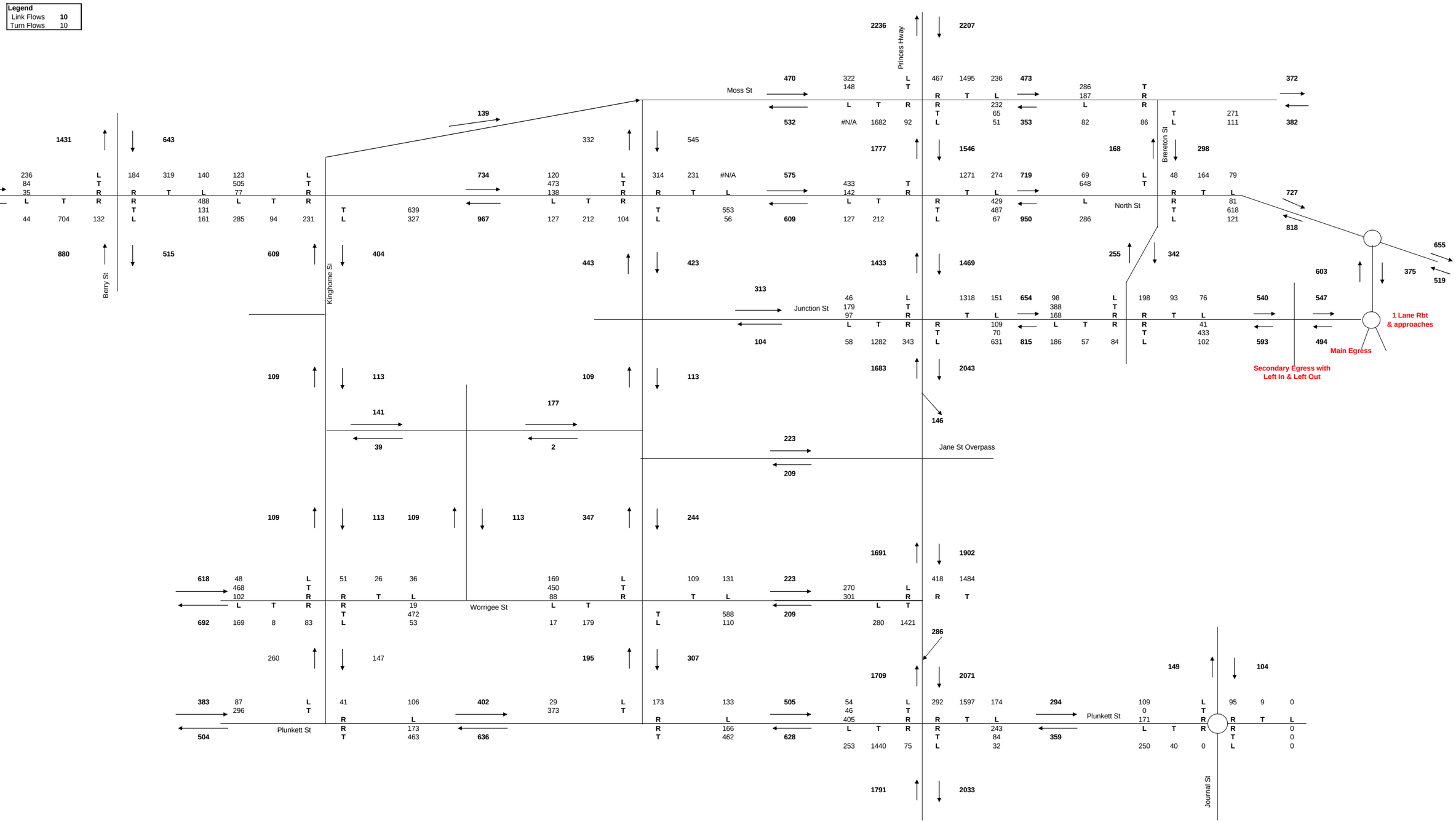
Scenario 1



NOWRA CBD STRATEGY 2016 REVIEW

Paramics Model Turn Counts

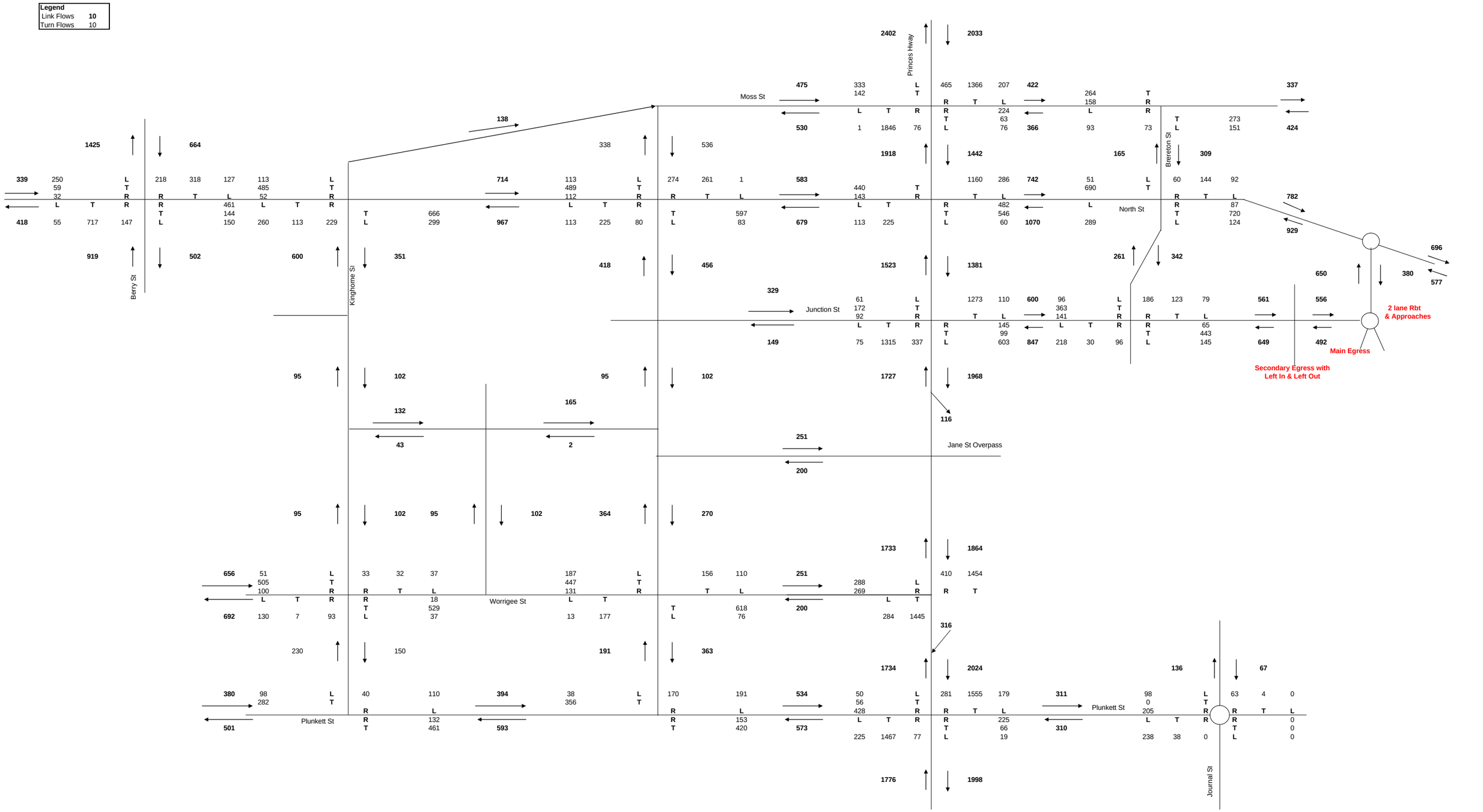
Scenario 2



NOWRA CBD STRATEGY 2016 REVIEW

Paramics Model Turn Counts

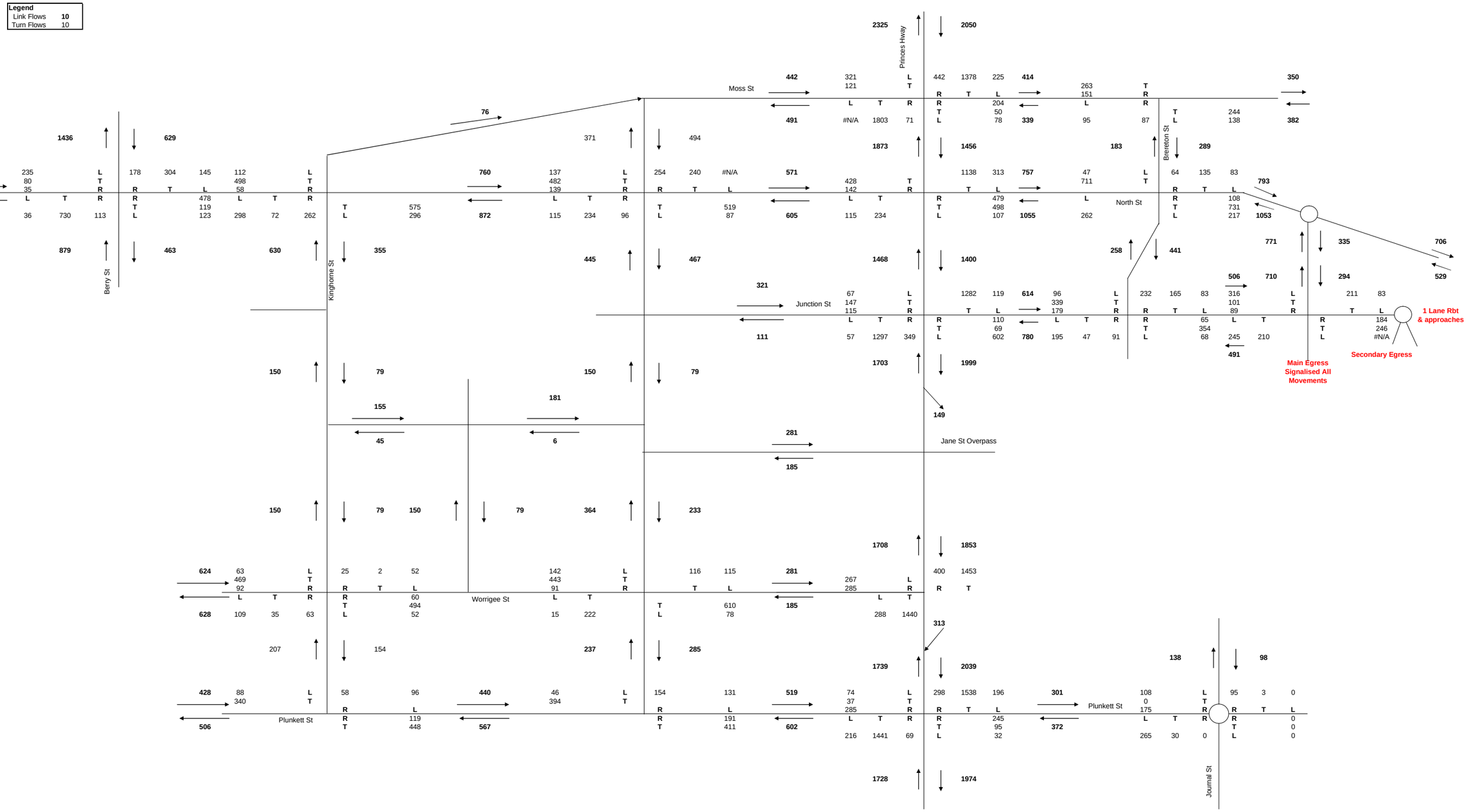
Scenario 3



NOWRA CBD STRATEGY 2016 REVIEW

Paramics Model Turn Counts

Scenario 4



C:\Jobs\9544\Flows_Scenario4.xls on 22/08/2006@ 4:22 PM

NOWRA CBD STRATEGY 2016 REVIEW

Paramics Model Link Flows
Scenario Comparison

Junction	Approach	Scenario 1 1 lane Rbt 65% Midblock	Scenario 2 1 lane Rbt 66% Rbt	Scenario 3 2 lane Rbt 66% Rbt	Scenario 4 Signals 75% Midblock
Princes Hway					
	Junction St W	836	815	**847**	**780**
	Junction St E	602	**654**	**600**	614
	North St W	1014	950	**1070**	1055
	North St E	745	719	742	**757**
	Moss St W	**368**	353	366	339
	Moss St E	449	**473**	422	414
ENSA Rbt					
	Junction St N	**536**	603	650	**771**
	Junction St S	**390**	375	380	**335**
	Brereton Leg N	**815**	818	929	**1053**
	Brereton Leg S	759	**727**	782	**793**
	Southern Leg N	572	**519**	**577**	529
	Southern Leg S	657	**655**	696	**706**
Brereton St between Junction and North					
	Midblock N	**331**	**255**	261	258
	Midblock S	359	**342**	**342**	**441**
Brereton St between North & Moss					
	Midblock N	**136**	168	165	**183**
	Midblock S	**270**	298	**309**	289
Journal St					
	Plunkett St N	**156**	149	**136**	138
	Plunkett St S	72	**104**	**67**	98
Plunkett St					
	Princes Hway W	342	359	**310**	**372**
	Princes Hway E	**315**	**294**	311	301

Legend
Highest Flow
Lowest Flow
Above/Below Avg Flow

NOWRA CBD STRATEGY 2016 REVIEW

Paramics Model
Network Evaluation Results

		Measured Totals										Estimated Totals					Resultant	Derived Averages (per vehicle)							
		Count				Freeflow	Trip Time	Distance	Stops			Time	Distance	Stops			Total		Trip Time	Distance	Speed	Delay	Stops (per km)		
	Scenario	All	Cars	Light	Heavy	Time (min)	(min)	(km)	Cars	Light	Heavy	(min)	(km)	Cars	Light	Heavy	Cost($)	Cost($)	(min)	(km)	(km/h)	(min)	Cars	Light	Heavy
	Complete	12,187	7,847	3,622	718	14,320	47,657	12,904	38,231	17,096	3,045						10,869	0.89	3.91	1.06	16.25	2.74	4.6	4.46	4.01
	Incomplete	1,057	719	289	49	493	4,486	434	2,494	1,187	152	8,397	1,269	4,752	1,524	155	1,003	0.95	7.94	1.2	9.07	6.77	8.44	10	7.55
1	Total	13,244	8,566	3,911	767	14,813	52,142	13,339	40,725	18,283	3,197	56,054	14,173	42,983	18,620	3,200	11,871								
	Complete	12,286	7,830	3,742	714	14,423	48,086	12,999	37,911	17,889	2,985						11,014	0.9	3.91	1.06	16.22	2.74	4.58	4.52	3.95
	Incomplete	985	687	260	38	474	4,334	416	2,362	947	110	7,843	1,190	4,397	1,258	114	879	0.89	7.96	1.21	9.1	6.79	8.14	8.62	6.85
2	Total	13,271	8,517	4,002	752	14,897	52,420	13,415	40,273	18,836	3,095	55,929	14,189	42,308	19,147	3,099	11,892								
	Complete	12,407	7,901	3,744	762	14,580	48,883	13,179	39,517	18,139	3,264						11,377	0.92	3.94	1.06	16.18	2.76	4.71	4.56	4.03
	Incomplete	902	631	228	43	452	4,735	393	1,781	799	146	8,267	1,123	4,012	1,075	153	823	0.91	9.16	1.24	8.15	7.99	6.48	8.05	7.8
3	Total	13,309	8,532	3,972	805	15,031	53,618	13,572	41,298	18,938	3,410	57,149	14,302	43,529	19,214	3,417	12,200								
	Complete	12,243	7,886	3,648	709	14,286	49,034	12,868	38,033	17,272	3,028						10,878	0.89	4.01	1.05	15.75	2.84	4.59	4.5	4.06
	Incomplete	966	662	260	44	480	4,301	426	2,307	993	149	8,084	1,179	4,466	1,273	155	909	0.94	8.37	1.22	8.75	7.2	7.91	8.67	7.69
4	Total	13,209	8,548	3,908	753	14,767	53,335	13,293	40,340	18,265	3,177	57,118	14,047	42,499	18,545	3,183	11,788								

Normalised to 10,000 vehicles

	Measured Totals										Estimated Totals					Resultant
	Count				Freeflow	Trip Time	Distance	Stops			Time	Distance	Stops			Total
Scenario	All	Cars	Light	Heavy	Time (min)	(min)	(km)	Cars	Light	Heavy	(min)	(km)	Cars	Light	Heavy	Cost($)
1	10,000				11,228						43,043	10,749	31,892	14,324	2,434	9,012
2	10,000				11,261						42,715	10,731	31,425	14,649	2,338	8,995
3	10,000				11,362						44,179	10,822	31,882	14,920	2,605	9,268
4	10,000				11,247						44,542	10,709	31,329	14,415	2,412	8,977

N

2016 Scenario 1
Level Of Service

- A
- B
- C
- D
- E
- F

Cardno Eppell Olsen

PROJECT TITLE:
Nowra CBD Strategy Review

DRAWING TITLE:
2016 Scenario 1

FIGURE NO.
1

PROJECT NO.
9544

DATE DRAWN
22/08/2006

N

2016 Scenario 2

Level Of Service

- A
- B
- C
- D
- E
- F

Cardno Eppell Olsen	PROJECT TITLE: Nowra CBD Strategy Review DRAWING TITLE: *2016 Scenario 2*	FIGURE NO. 1 PROJECT NO. 9544 DATE DRAWN 22/08/2006

N

2016 Scenario 3
Level Of Service
A
B
C
D
E
F

Cardno Eppell Olsen	PROJECT TITLE: Nowra CBD Strategy Review DRAWING TITLE: *2016 Scenario 3*	FIGURE NO. 1 PROJECT NO. 9544 DATE DRAWN 22/08/2006

N

2016 Scenario 4
Level Of Service
A
B
C
D
E
F

Cardno Eppell Olsen

PROJECT TITLE:
Nowra CBD Strategy Review
DRAWING TITLE:
2016 Scenario 4

FIGURE NO.
1
PROJECT NO.
9544
DATE DRAWN
22/08/2006

N

2016 Scenario 1

Link Delay

- 0 to 0.99
- 1 to 4.99
- 5 to 9.9
- 10 to 14.9
- 15 to 19.9
- >= 20

Cardno Eppell Olsen

PROJECT TITLE:
Nowra CBD Strategy Review

DRAWING TITLE:
2016 Scenario 1

FIGURE NO.
2

PROJECT NO.
9544

DATE DRAWN
22/08/2006

N

2016 Scenario 2

Link Delay

- 0 to 0.99
- 1 to 4.99
- 5 to 9.9
- 10 to 14.9
- 15 to 19.9
- >= 20

Cardno Eppell Olsen

PROJECT TITLE:
Nowra CBD Strategy Review

DRAWING TITLE:
2016 Scenario 2

FIGURE NO.
2

PROJECT NO.
9544

DATE DRAWN
22/08/2006

N

2016 Scenario 3

Link Delay

- 0 to 0.99
- 1 to 4.99
- 5 to 9.9
- 10 to 14.9
- 15 to 19.9
- >= 20

Cardno Eppell Olsen

PROJECT TITLE:
Nowra CBD Strategy Review

DRAWING TITLE:
2016 Scenario 3

FIGURE NO.
2

PROJECT NO.
9544

DATE DRAWN
22/08/2006

N

2016 Scenario 4

Link Delay

- 0 to 0.99
- 1 to 4.99
- 5 to 9.9
- 10 to 14.9
- 15 to 19.9
- >= 20

Cardno Eppell Olsen

PROJECT TITLE:
Nowra CBD Strategy Review

DRAWING TITLE:
2016 Scenario 4

FIGURE NO.
2

PROJECT NO.
9544

DATE DRAWN
22/08/2006

N

2016 Scenario 1
Average Queues
0 to 0.24
0.25 to 0.49
0.5 to 0.99
1 to 1.99
2 to 2.49
>= 2.5

Cardno Eppell Olsen

PROJECT TITLE:
Nowra CBD Strategy Review
DRAWING TITLE:
2016 Scenario 1

FIGURE NO.
5
PROJECT NO.
9544
DATE DRAWN
22/08/2006

N

2016 Scenario 2
Average Queues

- 0 to 0.24
- 0.25 to 0.49
- 0.5 to 0.99
- 1 to 1.99
- 2 to 2.49
- >= 2.5

Cardno Eppell Olsen

PROJECT TITLE:
Nowra CBD Strategy Review

DRAWING TITLE:
2016 Scenario 2

FIGURE NO.
5

PROJECT NO.
9544

DATE DRAWN
22/08/2006

N

2016 Scenario 3
Average Queues
0 to 0.24
0.25 to 0.49
0.5 to 0.99
1 to 1.99
2 to 2.49
>= 2.5

Cardno Eppell Olsen

PROJECT TITLE:
Nowra CBD Strategy Review
DRAWING TITLE:
2016 Scenario 3

FIGURE NO.
5
PROJECT NO.
9544
DATE DRAWN
22/08/2006

N

2016 Scenario 4

Average Queues

- 0 to 0.24
- 0.25 to 0.49
- 0.5 to 0.99
- 1 to 1.99
- 2 to 2.49
- >= 2.5

Cardno Eppell Olsen

PROJECT TITLE:
Nowra CBD Strategy Review

DRAWING TITLE:
2016 Scenario 4

FIGURE NO.
5

PROJECT NO.
9544

DATE DRAWN
22/08/2006

N

2016 Scenario 1

Maximum Queues

- 0 to 2
- 2 to 5
- 5 to 10
- 10 to 15
- 15 to 20
- 20 to 25

Cardno Eppell Olsen

PROJECT TITLE:
Nowra CBD Strategy Review

DRAWING TITLE:
2016 Scenario 1

FIGURE NO.
4

PROJECT NO.
9544

DATE DRAWN
22/08/2006

N

2016 Scenario 2

Maximum Queues

- 0 to 2
- 2 to 5
- 5 to 10
- 10 to 15
- 15 to 20
- 20 to 25

Cardno Eppell Olsen

PROJECT TITLE:
Nowra CBD Strategy Review

DRAWING TITLE:
2016 Scenario 2

FIGURE NO.
4

PROJECT NO.
9544

DATE DRAWN
22/08/2006

N

2016 Scenario 3

Maximum Queues

- 0 to 2
- 2 to 5
- 5 to 10
- 10 to 15
- 15 to 20
- 20 to 25

Cardno Eppell Olsen

PROJECT TITLE:
Nowra CBD Strategy Review

DRAWING TITLE:
2016 Scenario 3

FIGURE NO.
4

PROJECT NO.
9544

DATE DRAWN
22/08/2006

N

2016 Scenario 4

Maximum Queues

- 0 to 2
- 2 to 5
- 5 to 10
- 10 to 15
- 15 to 20
- 20 to 25

Cardno Eppell Olsen

PROJECT TITLE:
Nowra CBD Strategy Review

DRAWING TITLE:
2016 Scenario 4

FIGURE NO.
4

PROJECT NO.
9544

DATE DRAWN
22/08/2006

Appendix H

Nowra CBD Road Network Strategy Review

April 2007 – Revised preferred road network

CONCEPT ONLY

NOTE: FUTURE POSSIBLE CONNECTION TO LOCAL ROAD NETWORK AND MONDALGA SPORTS FIELDS

3.0m SHARED PATHWAY OFFSET 6.5M FROM THE ROAD

3.0m SHARED PATHWAY OFFSET 1.0M FROM THE ROAD

EXTENT OF JUNCTION STREET ROAD RESERVE (TOTAL 47M) BASED ON ROAD CONSTRUCTION AT MINIMUM HEIGHT 3.7M AHD

NOTE: PROPOSED APPROXIMATE LOCATION OF NEW RELOCATED FOOTBALL AND HOCKEY FIELDS – ACCESS THROUGH SCHOOL

ENSA CROSS SECTION AND ALIGNMENT SOUTH TO GREENWELL POINT ROAD TO BE ADDRESSED IN ENSA PROJECT

POSSIBLE GRADE SEPARATION TO REMOVE PEDESTRIAN CONFLICT.

LEDA SECONDARY JUNCTION STREET ACCESS TO MAIN CAR PARK

NOTE: TO BE RE-DESIGNED TO LINK DIRECTLY INTO A PROPOSED NEW SECONDARY NORTH-SOUTH INTERNAL ROAD AISLE TO ENSURE EFFICIENT ALTERNATIVE ACCESS TO JUNCTION STREET

130m APPROX. C/L OF LEDA MAIN ACCESS TO EASTERN BOUNDARY (NOTE: AS MEASURED FROM LEDA CONCEPT PLANS – DETAILS TO BE CONFIRMED BY LEDA)

EAST ENSA ACCESS

LEDA MAIN JUNCTION STREET ACCESS TO MAIN CAR PARK

NOTE: CAR PARK LAYOUT TO BE RE-DESIGNED TO ENSURE MAIN NORTH SOUTH INTERNAL ROAD AISLE ALIGNS DIRECTLY TO THIS LOCATION FOR EFFICIENT ACCESS TO JUNCTION STREET AND DIRECT TO ENSA

ENSA

FUTURE USES (UNDETERMINED)

PROPOSED APPROXIMATE LOCATION OF NEW RELOCATED LOWER SCHOOL ACCESS.

TRUNCATION REQUIRED TO SERVE LARGE VEHICLE LEFT TURNS EAST TO SOUTH.

3.0m SHARED PATHWAY OFFSET 1.0M FROM THE ROAD

2.5m SHARED PATHWAY ADJACENT ROAD, 1.1M HAS BEEN ALLOWED FOR RETAINING WALL STRUCTURE.

BRERETON STREET

REMOVE EXISTING BUSTERS

STOCKLAND NOWRA EXISTING JUNCTION STREET ACCESS

NOTE: AMENDED TO SHOW UPGRADE TO ALLOW TWO WAY ACCESS AT THIS LOCATION TO BENEFIT FROM REALIGNMENT OF BRERETON STREET. EXTENT OF CAR PARK CHANGES TO ALLOW SUCH WORKS TO OCCUR TO BE DETERMINED BY STOCKLAND AND SUBJECT TO PROVISION OF REQUIRED CAR PARKING SPACES IN ACCORDANCE WITH COUNCIL POLICY

NOTE : ACQUISITION MAKES NO PROVISION FOR MEDIAN. IF MEDIAN DEEMED REQUIRED TO REGULATE TURNING MOVEMENTS, A 600MM MINIMUM MEDIAN COULD BE PROVIDED BY WAY OF REDUCTION OF LAND WIDTHS OVER THIS SECTION. THIS MAY IMPACT CAPACITY / ROAD SAFETY, AND THE BENEFITS / DISBENEFITS OF SUCH A CHANGE WOULD NEED TO BE EVALUATED AT THE TIME.

MOSS STREET

NORTH STREET

JUNCTION STREET

POSSIBLE FUTURE AMENDMENTS TO CAR PARK ENTRY

NOTE: SUBJECT TO RTA APPROVAL, NOTING RTA CONCERNS IN RELATION TO THE DIRECT ACCESS POINTS TO/FROM PRINCES HIGHWAY

ASSUMED LOCATION OF OVERPASS PIER

NOTE: SUBJECT TO RTA APPROVAL, NOTING RTA CONCERNS IN RELATION TO THIS PROPOSAL. REFER STOCKLAND NOWRA TRAFFIC STUDY (FEBRUARY 2007) FOR MORE DISCUSSION ON THIS MATTER. THAT STUDY INVESTIGATED THREE POSSIBLE ALTERNATIVES FOR SOUTHERN CONNECTION INCLUDING THIS, DIRECT CONNECTION TO SH1 / WORRIGEE STREET INTERSECTION, AND COMPLETE CLOSURE – WITH ALTERNATIVE CONNECTION TO MORTON PARADE – IDENTIFIED AS THE BEST IN TERMS OF OPTIMISING CAPACITY OF THE PRINCES HIGHWAY.

STOCKLAND NOWRA PROPOSED NEW SOUTHERN EGRESS

MORTON PDE

JOURNAL STREET

GRANT STREET

PLUNKETT STREET

ADDITIONAL LAND ACQUISITION WILL BE REQUIRED IF FOOTPATH WIDTHS GREATER THAN 2.6M IS REQUIRED TO BE PROVIDED.

ACQUISITION TAPERS TO 0.0M AT BEGINNING OF ADJOINING PROPERTY BOUNDARY.

NOTE: ACQUISITION MAKES NO PROVISION FOR MEDIAN.

ACQUISITION TAPERS TO 0.0M AT BEGINNING OF ADJOINING PROPERTY BOUNDARY.

PRINCES HIGHWAY

NOTE: PEDESTRIAN FACILITIES ON JANE STREET OVERPASS TO BE UPGRADED, INCLUDING PROVISION OF FOOTPATH ON NORTH SIDE OF JANE STREET WITH SAFE EFFICIENT LINKS TO NOWRA LANE AND STOCKLAND NOWRA, TO ENHANCE PEDESTRIAN ACCESSIBILITY AND INTEGRATION (EAST V WEST) AND TO ATTRACT A HIGHER PROPORTION OF PEDESTRIANS AWAY FROM AT GRADE CROSSINGS OF THE PRINCES HIGHWAY.

JANE STREET OVERPASS

4.0M RESUMPTION

NOTE: IF THE EXISITING 4.6M PATHWAY RESERVE IS TO BE REINSTATED THEN A 5.0M RESUMPTION IS REQUIRED. ALSO NOTE THAT THE ACQUISITION MAKES NO PROVISION FOR MEDIAN.

NOTE: WIDENING OF HIGHWAY NECESSARY TO MAINTAIN THREE THROUGH LANES WILL ABSORB ALL AVAILABLE ROAD SPACE BETWEEN EXISTING CARRIAGEWAY AND BRIDGE PIER. LAND ACQUISITION WILL BE NECESSARY TO RELOCATE SERVICES AND FOOTPATH TO THE EAST SIDE OF BRIDGE PIER ON LAND CURRENTLY OWNED BY STOCKLAND. EXTENT OF ACQUISITION TO BE DETERMINED SUBJECT TO DETAILED DESIGN AND INTEGRATION WITH STOCKLAND CAR PARK.

NOTE: IMPROVEMENTS TO PEDESTRIAN ACCESS TO STOCKLAND NOWRA REQUIRED AT THIS LOCATION. CURRENTLY PEDESTRIAN ACCESS TO THE CENTRE DOES NOT ALIGN WITH THE SIGNALISED CROSSING, LEADING TO UNACCEPTABLE VOLUMES OF MID-BLOCK PEDESTRIAN CROSSINGS.

NOTE: WIDENING OF HIGHWAY NECESSARY TO MAINTAIN THREE THROUGH LANES.

4.2M RESUMPTION

NOTE: ACQUISITION MAKES NO PROVISION FOR MEDIAN.

WORRIGEE STREET

O'KEEFE AVE

NOWRA LANE

HAIGH AVENUE

NOTE: OPTION B DOES NOT REQUIRE LAND ACQUISITION AT MOSS AND PLUNKETT STREET INTERSECTIONS BUT RESULTS IN UNSATISFACTORY INTERSECTION LAYOUT AND SUBSEQUENT UNSATISFACTORY TRAFFIC CONDITIONS.

Cardno Eppell Olsen

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Issue	Description	Date	By
A	ISSUE FOR COMMENT	6.02.06	J.M.
B	REVISED STRATEGY FROM FULLY DEVELOPED MODELLING	19.09.06	P.C.F.
C	AMENDMENTS FROM S.C.C.	17.01.07	J.M.
D	AMENDMENTS FROM S.C.C.	30.01.07	J.M.
E	AMENDMENTS FROM S.C.C.	13.02.07	J.M.

PRELIMINARY PRINT
NOT FOR CONSTRUCTION

25 0 25 50 75 100 125 METRES

SCALE 1 : 1250 SHEET SIZE A1

*.PDF file saved as A1 paper size – print to A1 at 100% or set page scaling to 'None' and not as 'Fit to Printer Margins'

North

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Base Information Supplied By: SHOALHAVEN CITY COUNCIL

Design	Drawn	Checked
J.O.	J.M.	J.O.

Certified .....

RPEQ No. .....

Project Title: NOWRA CBD (EAST) EXPANSION ROAD NETWORK STRATEGY REVIEW - FEB 2007

Client: SHOALHAVEN CITY COUNCIL

Drawing Title: PREFERRED 2016 STRATEGY NETWORK OPTION A

Drawing No. 9504-901A

Sheet 1 of 1 | Issue E

Scale AS SHOWN

Project 9544

Xref NIL

ACAD file 9504-901 Option A.dwg

CONCEPT ONLY

NOTE: FUTURE POSSIBLE CONNECTION TO LOCAL ROAD NETWORK AND NOWRA/GA SPORTS FIELDS

3.0m SHARED PATHWAY OFFSET 6.5M FROM THE ROAD

3.0m SHARED PATHWAY OFFSET 1.0M FROM THE ROAD

EXTENT OF JUNCTION STREET ROAD RESERVE (TOTAL 47M) BASED ON ROAD CONSTRUCTION AT MINIMUM HEIGHT 3.7M AHD

ENSA CROSS SECTION AND ALIGNMENT SOUTH TO GREENWELL POINT ROAD TO BE ADDRESSED IN ENSA PROJECT

NOTE: PROPOSED APPROXIMATE LOCATION OF NEW RELOCATED FOOTBALL AND HOCKEY FIELDS – ACCESS THROUGH SCHOOL

POSSIBLE GRADE SEPARATION TO REMOVE PEDESTRIAN CONFLICT.

LEDA SECONDARY JUNCTION STREET ACCESS TO MAIN CAR PARK

NOTE: TO BE RE-DESIGNED TO LINK DIRECTLY INTO A PROPOSED NEW SECONDARY NORTH-SOUTH INTERNAL ROAD AISLE TO ENSURE EFFICIENT ALTERNATIVE ACCESS TO JUNCTION STREET

130m APPROX. C/L OF LEDA MAIN ACCESS TO EASTERN BOUNDARY

(NOTE: AS MEASURED FROM LEDA CONCEPT PLANS – DETAILS TO BE CONFIRMED BY LEDA)

EAST ENSA ACCESS

LEDA MAIN JUNCTION STREET ACCESS TO MAIN CAR PARK

NOTE: CAR PARK LAYOUT TO BE RE-DESIGNED TO ENSURE MAIN NORTH SOUTH INTERNAL ROAD AISLE ALIGNS DIRECTLY TO THIS LOCATION FOR EFFICIENT ACCESS TO JUNCTION STREET AND DIRECT TO ENSA

ENSA

FUTURE USES (UNDETERMINED)

MORTON PDE

JOURNAL STREET

PROPOSED APPROXIMATE LOCATION OF NEW RELOCATED LOWER SCHOOL ACCESS.

TRUNCATION REQUIRED TO SERVE LARGE VEHICLE LEFT TURNS EAST TO SOUTH.

3.0m SHARED PATHWAY OFFSET 1.0M FROM THE ROAD

2.5m SHARED PATHWAY ADJACENT ROAD, 1.1M HAS BEEN ALLOWED FOR RETAINING WALL STRUCTURE.

BRERETON STREET

STOCKLAND NOWRA EXISTING JUNCTION STREET ACCESS

NOTE: AMENDED TO SHOW UPGRADE TO ALLOW TWO WAY ACCESS AT THIS LOCATION TO BENEFIT FROM REALIGNMENT OF BRERETON STREET. EXTENT OF CAR PARK CHANGES TO ALLOW SUCH WORKS TO OCCUR TO BE DETERMINED BY STOCKLAND AND SUBJECT TO PROVISION OF REQUIRED CAR PARKING SPACES IN ACCORDANCE WITH COUNCIL POLICY

GRANT STREET

REMOVE EXISTING BUSTERS

NOTE : ACQUISITION MAKES NO PROVISION FOR MEDIAN. IF MEDIAN DEEMED REQUIRED TO REGULATE TURNING MOVEMENTS, A 600MM MINIMUM MEDIAN COULD BE PROVIDED BY WAY OF REDUCTION OF LAND WIDTHS OVER THIS SECTION. THIS MAY IMPACT CAPACITY / ROAD SAFETY, AND THE BENEFITS / DISBENEFITS OF SUCH A CHANGE WOULD NEED TO BE EVALUATED AT THE TIME.

MOSS STREET

NORTH STREET

JUNCTION STREET

POSSIBLE FUTURE AMENDMENTS TO CAR PARK ENTRY

NOTE: SUBJECT TO RTA APPROVAL, NOTING RTA CONCERNS IN RELATION TO THE DIRECT ACCESS POINTS TO/FROM PRINCES HIGHWAY

ASSUMED LOCATION OF OVERPASS PIER

NOTE: SUBJECT TO RTA APPROVAL, NOTING RTA CONCERNS IN RELATION TO THIS PROPOSAL. REFER STOCKLAND NOWRA TRAFFIC STUDY (FEBRUARY 2007) FOR MORE DISCUSSION ON THIS MATTER. THAT STUDY INVESTIGATED THREE POSSIBLE ALTERNATIVES FOR SOUTHERN CONNECTION INCLUDING THIS, DIRECT CONNECTION TO SH1 / WORRIGEE STREET INTERSECTION, AND COMPLETE CLOSURE – WITH ALTERNATIVE CONNECTION TO MORTON PARADE – IDENTIFIED AS THE BEST IN TERMS OF OPTIMISING CAPACITY OF THE PRINCES HIGHWAY.

STOCKLAND NOWRA PROPOSED NEW SOUTHERN EGRESS

MORTON PDE

PLUNKETT STREET

ADDITIONAL LAND ACQUISITION WILL BE REQUIRED IF FOOTPATH WIDTHS GREATER THAN 2.6M IS REQUIRED TO BE PROVIDED.

ACQUISITION TAPERS TO 0.0M AT BEGINNING OF ADJOINING PROPERTY BOUNDARY.

NOTE: ACQUISITION MAKES NO PROVISION FOR MEDIAN.

PRINCES HIGHWAY

NOTE: PEDESTRIAN FACILITIES ON JANE STREET OVERPASS TO BE UPGRADED, INCLUDING PROVISION OF FOOTPATH ON NORTH SIDE OF JANE STREET WITH SAFE EFFICIENT LINKS TO NOWRA LANE AND STOCKLAND NOWRA, TO ENHANCE PEDESTRIAN ACCESSIBILITY AND INTEGRATION (EAST V WEST) AND TO ATTRACT A HIGHER PROPORTION OF PEDESTRIANS AWAY FROM AT GRADE CROSSINGS OF THE PRINCES HIGHWAY.

JANE STREET OVERPASS

4.0M RESUMPTION

NOTE: IF THE EXISITING 4.6M PATHWAY RESERVE IS TO BE REINSTATED THEN A 5.0M RESUMPTION IS REQUIRED.

ALSO NOTE THAT THE ACQUISITION MAKES NO PROVISION FOR MEDIAN.

NOTE: WIDENING OF HIGHWAY NECESSARY TO MAINTAIN THREE THROUGH LANES WILL ABSORB ALL AVAILABLE ROAD SPACE BETWEEN EXISTING CARRIAGEWAY AND BRIDGE PIER. LAND ACQUISITION WILL BE NECESSARY TO RELOCATE SERVICES AND FOOTPATH TO THE EAST SIDE OF BRIDGE PIER ON LAND CURRENTLY OWNED BY STOCKLAND. EXTENT OF ACQUISITION TO BE DETERMINED SUBJECT TO DETAILED DESIGN AND INTEGRATION WITH STOCKLAND CAR PARK.

NOTE: IMPROVEMENTS TO PEDESTRIAN ACCESS TO STOCKLAND NOWRA REQUIRED AT THIS LOCATION. CURRENTLY PEDESTRIAN ACCESS TO THE CENTRE DOES NOT ALIGN WITH THE SIGNALISED CROSSING, LEADING TO UNACCEPTABLE VOLUMES OF MID-BLOCK PEDESTRIAN CROSSINGS.

4.2M RESUMPTION

NOTE: ACQUISITION MAKES NO PROVISION FOR MEDIAN.

O'KEEFE AVE

NOWRA LANE

WORRIGEE STREET

HAIGH AVENUE

NOTE: OPTION B DOES NOT REQUIRE LAND ACQUISITION AT MOSS AND PLUNKETT STREET INTERSECTIONS BUT RESULTS IN UNSATISFACTORY INTERSECTION LAYOUT AND SUBSEQUENT UNSATISFACTORY TRAFFIC CONDITIONS.

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Issue	Description	Date	By
A	ISSUE FOR COMMENT	6.02.06	J.M.
B	REVISED STRATEGY FROM FULLY DEVELOPED MODELLING	19.09.06	P.C.F.
C	AMENDMENTS FROM S.C.C.	17.01.07	J.M.
D	AMENDMENTS FROM S.C.C.	30.01.07	J.M.
E	AMENDMENTS FROM S.C.C.	13.02.07	J.M.

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Base Information Supplied By: SHOALHAVEN CITY COUNCIL

Design	Drawn	Checked
J.O.	J.M.	J.O.

Certified .....

RPEQ No. .....

Project Title: NOWRA CBD (EAST) EXPANSION ROAD NETWORK STRATEGY REVIEW - FEB 2007

Client: SHOALHAVEN CITY COUNCIL

Drawing Title: 2016 STRATEGY NETWORK OPTION B

Drawing No. 9504-901B

Sheet 1 of 1 | Issue E

Scale AS SHOWN

Project 9544

Xref NIL

ACAD file 9504-901 Option B.dwg

Appendix I

Design Note, Response by CEO to

sec94 submission re Paramics Modelling

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Date: 18 October 2006

DESIGN NOTE

NOWRA SECTION 94 PLAN

This design note is in response to comments by the Developer Consultant on the Section 94 application in regards to the traffic signal operation in the Paramics Model. In particular "the model is not realistic, nor reliable as it is simplified and does not contain traffic signal operations reflective of the very complex signal operations along the Princes Highway, Nowra".

Paramics Model Build

Firstly, the Paramics network developed extends to a wider area than the Princess Highway intersections. The Nowra Paramics model extends from Plunkett Street in the South to Moss Street to the north and Kinghorne Street in the west to Wallace Street in the East. The model has been extended in the north-western corner along North Street to include Bridge Street.

To build the model the links are coded by speed, and road hierarchy as per the standard RTA category file. Zones are coded to represent either an area with common land use to which traffic generation rates can be applied or external cordons which have known total in and out vehicle trips. A base Origin-Destination matrix is produced which corresponds to the number of vehicle trips being attracted or generated between each zonal pair in the model. The Origin-Destination matrix was based on the TRACKS model. The base model was then calibrated to 2004 count data to ensure the model was realistic and reasonably reflects travel patterns. Any model's capacity to reflect base operations is a major test and allows a project to move on to forecast future operations with reasonable confidence.

This above process produces a model which responses dynamically to congestion as it calculates each vehicles best route between OD pairs based on travel time and cost.

Traffic Signals Operations

In the base Paramics software, traffic signals are modelled with fixed time phasings. In the field, the SCATS controller dynamically allocates signal times. The average phasing times for the peak period were obtained from the RTA for all signals along the Princes Highway and this data was used in the model. Paramics does allow offsets along a corridor to maximize flows as well as complex plans with various phases. Cardno Eppell Olsen spent considerable time and effort in both optimising each individual set of traffic signals and their co-ordination along the Princes Highway.

In the real world drivers make route choices based on their prior experiences on alternative routes and so averaging is part of their choice. When systems are congested the opportunity to re-allocate times is reduced.

SCATES analysis undertaken by Ross Nettle was reviewed by RTA in regards to the 120 second cycle times used in the Paramics models and whether (in RTA opinion) cycle times had to be increased in the Paramics models. RTA advised that in their opinion the 120 second cycle times were appropriate based on their interrogation of Ross Nettles SCATES model / model runs, and in their opinion no additional modelling was therefore necessary (no adjustment to cycle times in Paramics models was necessary). Based on this advice, no additional modelling works was undertaken by CEO.

Section 94 Approach

The basic requirement of cost allocation is a relationship between the roadworks proposed and the levied land uses. Across the state the cost apportionment is done in a variety of ways. What is clear is that this in all probability has never taken account of the SCATS ability to dynamically re-allocate green time in signal systems. Further many would use modelling using less detailed models than Paramics.

The Section 94 Plan was prepared using the most up to date Paramics model then available.

Summary

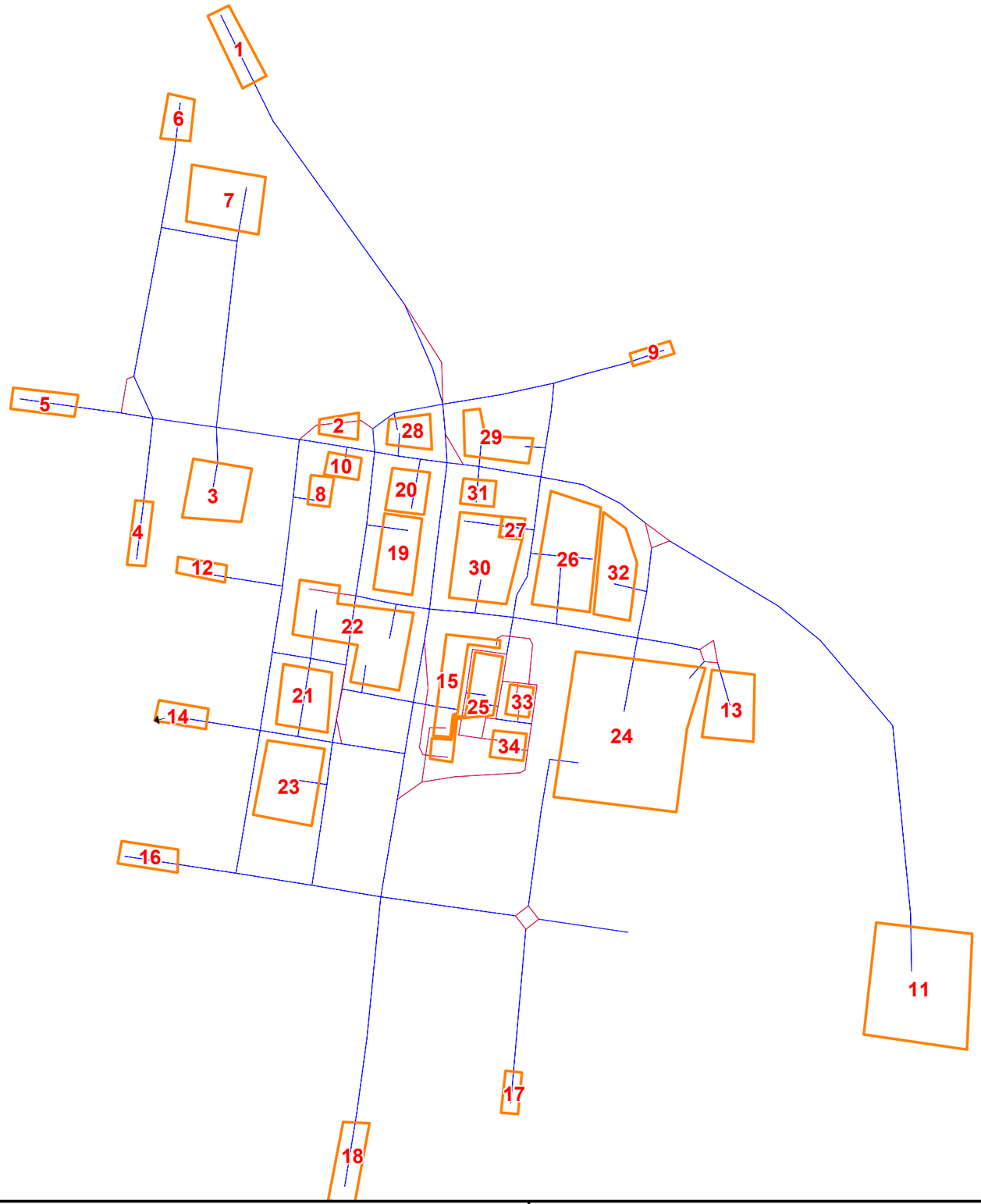
In summary, Cardno Eppell Olsen believes the result is a micro-simulation model which is detailed, realistic and complex. Furthermore and most importantly, the model and software utilised is robust enough and suits the requirements to be able to modify inputs (such as demands) to test future scenarios to achieve a workable network such as the recommended Nowra CDB Strategy.

While the model can be made more complex, it is considered to be a reasonable basis for the allocation of the sharing of project costs to developments based on each project is proportional use of the works.

Appendix J

Nowra CBD Road Network Strategy

Review – Paramics Model zone system



Cardno Eppell Olsen	NOWRA SECTION 94 UPDATE 12/09/2006	*NOWRA CBD STRATEGY & ZONE SYSTEM*	FIGURE NO. 1 PROJECT NO. 491400

Appendix K

Traffic Loading on Nowra

East Local Road Network

Traffic Loading on Nowra East Local Road Network

Based on the modelling runs and assessments undertaken to date, it is expected that 1st stage ENSA will be required by, or very soon after 2011 and that full ENSA will be required by 2016.

Allowing access from the commercial expansion area east of Princes Highway Nowra to Morton Parade will lead to increased traffic volumes on Journal Street and other local streets in the Nowra East local area.

A number of measures are being investigated to mitigate the impacts of commercial expansion on the Nowra East area.

These include:

- ensuring sufficient capacity exists on Plunkett Street ;
- ensuring LATM devices are effective in deterring through traffic (particularly the rat run between Morton Parade and St Annes Street as alternative route to Plunkett Street and Princes Highway);
- ensuring LATM devices are effective in controlling traffic speeds to acceptable levels;
- investigating additional local road network capacity (potential for connection of Junction Street to Wallace Street in the longer term), and ;
- provision of ENSA.

Construction of ENSA is an integral component of the Nowra CBD strategy and would result in a marked shift in traffic off local Nowra East streets.

Prior to full ENSA being constructed however, traffic volume increases will be noticeable on local Nowra East streets particularly traffic routes between Morton Parade and Kalandar Street.

<u>Condition on development - LATM Devices</u>

Traffic volume impacts on local streets can be mitigated immediately (upon opening of new commercial development with access to Morton Parade) through conditioning of appropriate LATM works on the new development.

Refer above to section 5.2 which references LATM planning document submitted 12th October by LEDA pursuant to deferred commencement condition on DA05/3342.

Plan for broader distribution of traffic impacts

Traffic volume impacts on local Nowra East streets can also be mitigated by the planning of additional local road network capacity.

The possible future extension of Wallace Street to Junction Street (not presently supported by Council) is supported by the CEO traffic modelling analysis, and would be expected to alleviate traffic impacts on Journal Street.

Such infrastructure is not recommended to be provided prior to the construction of ENSA due to expected diversion of higher traffic volumes on to local Nowra East streets namely Wallace Street.

The provision of additional local road network capacity post ENSA however could ensure the long terms impacts of the commercial expansion on local Nowra East roads (namely Journal Street) are sufficiently mitigated by way of broader distribution of traffic from the commercial expansion area.

This would also be expected to significantly enhance local accessibility, currently hindered by restricted access to Princes Highway and no access to Stockland Nowra (without first accessing the Princes Highway). It is not considered that such restricted access is an appropriate long term strategy for optimising the integrity of the Princes Highway.

Plan for broader distribution of traffic impacts

The loading of additional traffic on local streets as a result of the southern access to Morton Parade, and the effectiveness of proposed improvements to LATM scheme, should be continually monitored by Council over time, and the local road traffic environment in Nowra East should be the subject of on-going evaluation by Council to determine need and justification for any additional mitigation works (refer above mentioned).

Indicative Traffic Volumes on Journal Street (south of Plunkett Street) under various development scenarios

Indicative traffic volume loading on Nowra East local roads (Journal Street, south of Plunkett Street) for typical off peak Thursday PM peak traffic conditions are estimated as follows:

* Note vph = vehicles per hour (Typical Thursday PM peak hour)

* Note vpd = vehicles per day (Typical Thursday daily traffic flow) using average guide (approximate) peak / daily rate of 10 %

- **Current volumes** of traffic : **270 vph** recorded Thursday 17th February 2005 (code C154) estimated Daily traffic volume 2700 vpd

- **Forecast volumes** of traffic **with LEDA (no ENSA)** : approximate 21% distribution to Journal Street, therefore estimated + 327vph (making total estimated **597 vph**) - estimated Daily traffic volume 5970 vpd

- **Forecast volumes** of traffic **with LEDA + Stockland Existing i.e. No Expansion (no ENSA)** : approximate 21% distribution to Journal Street, therefore estimated + 495vph (making total estimated **765 vph**) - estimated Daily traffic volume 7650 vpd

- **Forecast volumes** of traffic **with LEDA + Stockland Expansion proposal i.e. worst case scenario (no ENSA)** : approximate 21% distribution to Journal Street, therefore estimated + 603vph (making total estimated **873 vph**) - estimated Daily traffic volume 8730 vpd

- **Forecast volumes** of traffic **with LEDA (with ENSA)** : approximate 10% distribution to Journal Street, therefore estimated + 156vph (making total estimated **426 vph**) - estimated Daily traffic volume 4260 vpd

- **Forecast volumes** of traffic **with LEDA + Stockland Existing i.e. No Expansion (with ENSA)** : approximate 10% distribution to Journal Street, therefore estimated + 236vph (making total estimated **506 vph**) - estimated Daily traffic volume 5060 vpd

- **Forecast volumes** of traffic **with LEDA + Stockland Expansion proposal i.e. worst case scenario (with ENSA)** : approximate 10% distribution to Journal Street, therefore estimated + 287vph (making total estimated **557 vph**) - estimated Daily traffic volume 5570 vpd

Note that the Stockland Nowra Traffic Modelling Study is due for completion in June 2007 and considers the traffic modelling analysis in relation to potential for connection of Stockland Nowra to Morton Parade (as recommended to be considered by RTA, following RTA concerns in relation to the signalisation of southern egress from Stockland Nowra to Princes Highway).

The above figures assume no background traffic growth rates on the local road network.

Since the implementation of the initial LATM devices in Nowra East, in the 9 years (1996 to 2005) no growth patterns were observed on local Nowra East roads (traffic volumes were observed and have been recorded to be relatively stable).

Indicative distribution rates have been determined by interrogation of Nowra / Bomaderry Structure Plan TRACKS trip demand matrices, and have been summarised in the LEDA Traffic Modelling Study (refer Draft Report dated July 2006). These are the rates used in the Nowra CBD Strategy review Paramics models.

It is noted that marginally higher traffic volumes may be experienced on typical Saturday (mid-morning / mid-day) peak traffic conditions.

The above figures assume no connection between Junction Street and Wallace Street.

It is noted that lower traffic volumes would be experienced if the impacts of the CBD East expansion area were more broadly distributed across the Nowra East local road network by possible future extension of Wallace Street to Junction Street (not presently supported by Council).

It is further noted that these indicative traffic volumes above assume sufficient LATM devices are in place to deter through traffic and control speeds to acceptable levels (40 kph).

Failure to provide immediate implementation of LATM works (in conjunction with opening of Morton Parade to commercial development) and works to increase capacity of Plunkett Street as recommended in this report, may influence higher volumes of traffic on local roads in East Nowra (particularly rat running between LEDA and Princes Highway via Journal and St Annes Streets).

Indicative Traffic Volumes highlight importance of ENSA

It is noted that the above indicative traffic flow figures highlight the importance of ENSA in the Nowra CBD Strategy in terms of protecting the environmental integrity of Nowra East local streets.

The above indicative traffic flow figures also highlight the importance of protecting the option of extending Wallace Street to connect with Junction Street in the future (post ENSA) – expected to further mitigate impacts on Journal Street by allowing more broader distribution of traffic from the commercial expansion area to the south.

Appendix L

Design Note, Junction Street/Princes

Highway Intersection

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Our Ref: CE009544/jo

Date: Tuesday, 30 January 2007

DESIGN NOTE

JUNCTION STREET/PRINCES HIGHWAY INTERSECTION

Scope

A variety of intersection forms have been discussed over the last few years for this intersection. This note reviews options and sets out the basis of the long term strategy. Comment is also provided on interim forms/development conditions applied to LEDA's DA.

History

Signalisation of the intersection was raised in the July 2002 "Review of Existing CBD Strategy Working Paper". At that time re-opening of Junction Court was also being considered. The report identified advantages from signalisation for CBD access and for pedestrian linkage between Nowra Fair and the CBD. The report supported signalisation but identified the need to address potential increases in use if Junction Court was opened.

Subsequent discussions in relation to the expansion plans for Stocklands Nowra adopted signalisation of Junction Street as a key means of access to the development and as a secondary connection to ENSA.

The February 2006 Report "Nowra CBD (East) Expansion Traffic Mobility Study" reviewed a number of layout and phasing options. The recommended form was shown on Figure 5.2 of that report with:

- banned right turn from north to west;
- three approach lanes in Junction Street from east (left through, right);
- two approach lanes in Junction Street from west (shared through/left, right);
- three through lanes on Princess Highway on each approach;
- auxiliary turn lanes for right turns from south to east and left turns from north to east.

That layout was recommended for 2011 (without ENSA) and for 2016 with ENSA.

Strategy Review

More recently the development potential considered for the CBD (East) has been increased and at the same time the land has fallen into separate ownerships. This latter factor has led to some separation of access arrangements for the two sites. Council has also accepted that the eastern parcel (LEDA) would be permitted egress to the south via Morton Parade to Journal Street and via Morton Parade and Plunkett Street to Princes Highway.

Three separate modelling projects have been undertaken:

(a) modelling of both DA proposals together with allowance for development of adjacent lands to North of Junction Street. This work was undertaken to determine that consideration of both applications was appropriate. The risk was that the level of growth could have generated new road requirements and fundamentally altered the strategy. Alternatively, the review may have determined that the combined impacts of both developments may not have been acceptable in terms of traffic impacts on local roads and Princes Highway operations;
(b) modelling LEDA DA proposal in context of approved development only;
(c) modelling Stockland DA proposal independent of LEDA proposal i.e. in same context as (b) above of only the subject DA and approved development.

The strategy review work has now concluded.

In relation to Junction Street the numbers of lanes needed remains constant – essentially the maximum lanes achievable due to width to the existing development on north west and south east corners.

The LEDA development has been conditioned to signalise Junction Street/Princess Highway on the basis of a ban on the right turns from north to west and also from west to south. This proposal originated from LEDA and was then adopted by RTA and applied as a condition of development. Discussions with RTA in relation to LEDA made clear that RTA's responsibility to maintain acceptable operation on the Princes Highway will limit the green time available for side roads at signalised intersections. The strategy from Councils perspective then has to be to, wherever possible, increase the number of approach lanes to the Princes Highway. This has confirmed the need for three approach lanes from the east at Junction Street and at Plunkett Street.

The LEDA analysis was not undertaken in the context of development of adjacent sites. In that context, introduction of ENSA would be needed just after 2016. Their analysis therefore is for an interim stage. This affects the lane allocation for Junction Street from the east. Without ENSA the right turn from east to north is the critical movement for the LEDA development.

A different scenario exists when ENSA is introduced together with the demands of adjacent development and the expanded Stockland Nowra. In that case, the right turn east to north is reduced by diversion to ENSA and the left turn from east to south becomes the critical movement for the eastern leg. In our Paramics modelling additional capacity is achieved with lane allocation as left, through/left, and right.

On the western leg, the strategy modelling has adopted as a basis the earlier strategy form which allows a right turn from west to south. This increase the overall access capacity from the west.

Our modelling was based on lane allocation on the western approach of shared through/left, and through/right lanes. The phasing of the February 2006 report (see page 16) was retained. This has "split side street" phasing which allows use of shared lanes. The use of shared lanes has operational efficiency advantages over the lane allocation in the February 2006 report. That lane allocation (shared through left through/right) disadvantages through traffic as the left turn could be delayed by pedestrians.

Through traffic from west to east has to deviate northwards through the intersection as the northern kerb alignment to the west cannot be moved north (as can occur with future development on the east). RTA has implicitly accepted the extent of diversion involved by the conditions imposed by LEDA.

It is recommended that the lane allocation from the west be shared lanes through/left and through right.

Appendix M

Design Note, Southbound Left turn at Moss Street/Princes Highway Intersection

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Date: Tuesday, 30 January 2007

DESIGN NOTE

NOWRA CBD STRATEGY 2016 REVIEW

This design note addresses the need for the left turn slip on the south bound approach at Princes Highway/Moss Street Intersection. In the review of the Nowra CBD Strategy with full development i.e. Nowra Fair, Leda and other developments in north-western corner of model; increased delays southbound on Princes Highway resulted in vehicles re-routing and turning left into Moss than right into Brereton to three destinations. They were:

1. east (left) to ENSA instead of continuing along Princes Highway to free left slip at North Street;
2. south (thru) to Brereton Street to Developments instead of continuing along Princes Highway to Junction Street;
3. west (right) at North Street to western zones instead of turning right at Princes Highway/Moss Street and right again at Moss Street/North Street.

Whilst re-routing to destinations 1 and 2 is logical, re-routing to destination 3 is not. In a hierarchy sense it is not really appropriate for vehicles to turn off the major road and use the lesser streets (i.e. Brereton Street) to reach another major road (e.g. ENSA). The net result in allowing these vehicles to re-route in the model was heavy congestion along Moss Street and Brereton Street which adversely affected the dynamics of the whole model. In part this is an issue with the model structure. In life drivers do not all "learn" about delays and best routes at the one time. In the model the feedback is provided to a relatively large group of drivers simultaneously and then only after congested conditions are generated.

Modelling measures to reduce this re-routing would be to increase Moss Street and Brereton Street cost factors and/or decrease speeds but as the model is calibrated with these road characteristics already set, we believed this may have resulted in additional changes to traffic patterns which we did not want to introduce.

During scenario testing, removing the free left turn slip simply reduced the attractiveness enough to reduce the re-routed vehicles to give acceptable levels of service in the model without affecting the dynamics of the model as a whole. Additionally, the 4 minute feedback causes this re-routing to come and go which in real life would be gradual over weeks and months instead of higher flows switching back and forth. Furthermore, the re-routing can be controlled in the real world by the co-ordination, in particular the lack of co-ordination for these movements to make the route less attractive.

In conclusion, the modelling indicates that a workable system could be achieved without the free left turn arrangement but highway operations would benefit from provision of the free left turn, however:

1. the left turn facility would influence a greater volume of traffic onto Moss Street and Brereton Street which may result in adverse local road conditions in the vicinity of the retirement village and Nowra Technology High School;
2. in terms of road hierarchy planning, diverted traffic from an arterial road (Princes Highway) would be more appropriate on North Street (east of Highway) with it's direct connection to ENSA, than on local roads Moss Street and Brereton Street;
3. if the left turn facility was to be further considered by RTA, it would be appropriate that traffic management measures be considered for Moss Street and Brereton Street to dissuade vehicles which could re-route to Brereton Street.

Appendix N

South Nowra Highway Assessment

February 2006 – Appendix A

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APPENDIX A

PRINCES HIGHWAY/KALANDAR ROAD INTERSECTION

Eppell Olsen & Partners has been commissioned by Shoalhaven City Council to conduct an assessment of the Princes Highway/Kalandar Road intersection, South Nowra, under existing and future conditions with and without the East Nowra Sub Arterial (ENSA) connection in place.

This follows network analysis undertaken that indicates congestion and turn restrictions along the Princes Highway in South Nowra leads to increased pressure on the Kalandar Street intersection. Accordingly, this intersection analysis is aimed at reviewing the ability of the subject intersection to cope with such network diversions.

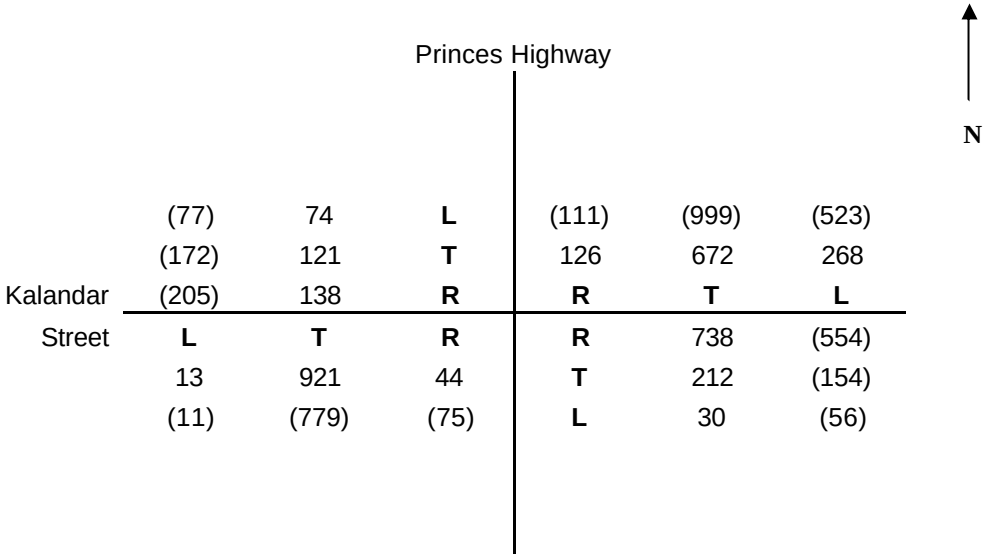
Methodology

Peak hour turning movement counts were conducted at the study intersection on Thursday 24 February 2005. The peak hours were identified as 8:15am – 9:15am and 3:00pm – 4:00pm. Existing peak hour intersection volumes are shown on Figure 1.

Discussions with Shoalhaven City Council have indicated that with the introduction of ENSA, future turning movement volumes (2016) at the intersection will be of similar magnitude as existing volumes. Therefore, traffic volumes for the 2016 "with ENSA" scenario have been estimated adopting no change in turning movements at the intersection and applying an annual background traffic growth of 4-percent to only through movements along the Princes Highway. The 2016 "with ENSA" volumes are summarised on Figure 2.
This is considered a minimum traffic growth scenario at the intersection as there is likely to be some sustained higher growth on the Kalandar Street (west) approach.

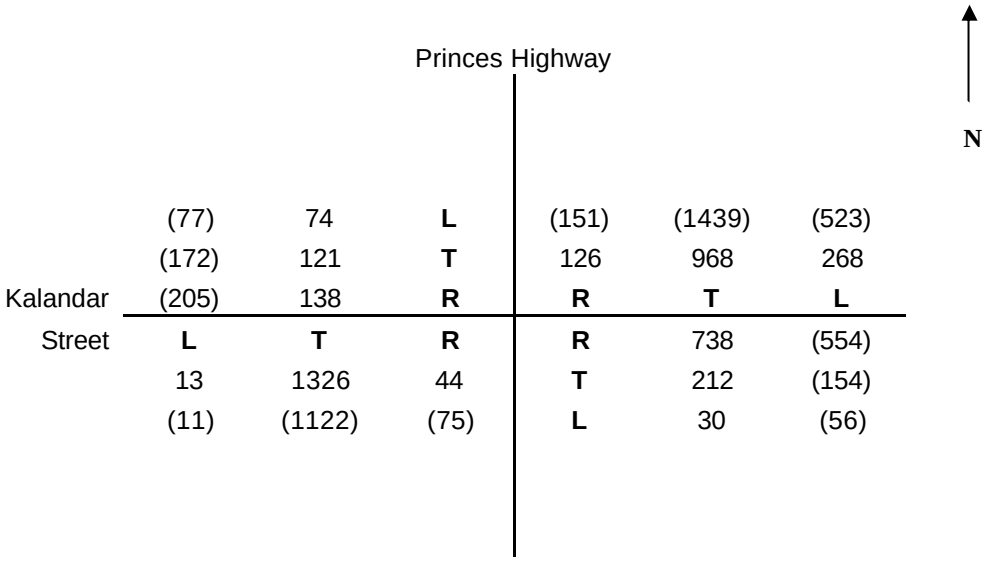
Traffic volumes for the 2016 "Without ENSA" scenario have been calculated by applying a 4% annual background traffic growth to all movements at the subject intersection. Turning movement volumes for this scenario are summarised on Figure 3.

Figure 1 ***Princes Highway/Kalandar Street***
2005 Existing Turning Movement Volumes



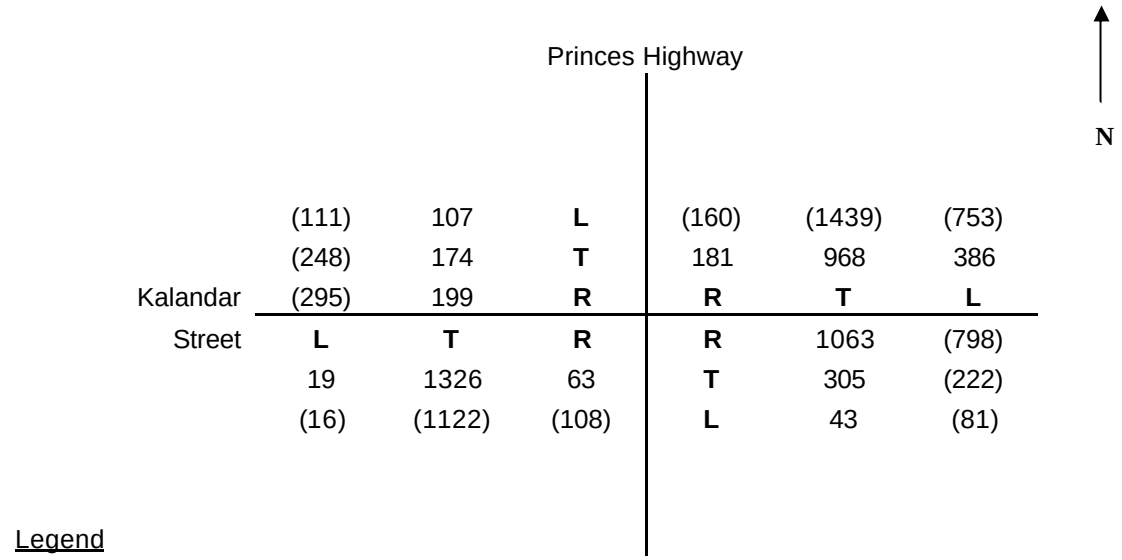
Legend
AM Peak Volume (vph)
(##) PM Peak Volume (vph)

Figure 2 ***Princes Highway/Kalandar Street***
2016 "with ENSA" Turning Movement Volumes



Legend
AM Peak Volume (vph)
(##) PM Peak Volume (vph)

Figure 3 ***Princes Highway/Kalandar Street***
2016 "without ENSA" Turning Movement Volumes



Legend

##	AM Peak Volume (vph)
(##)	PM Peak Volume (vph)

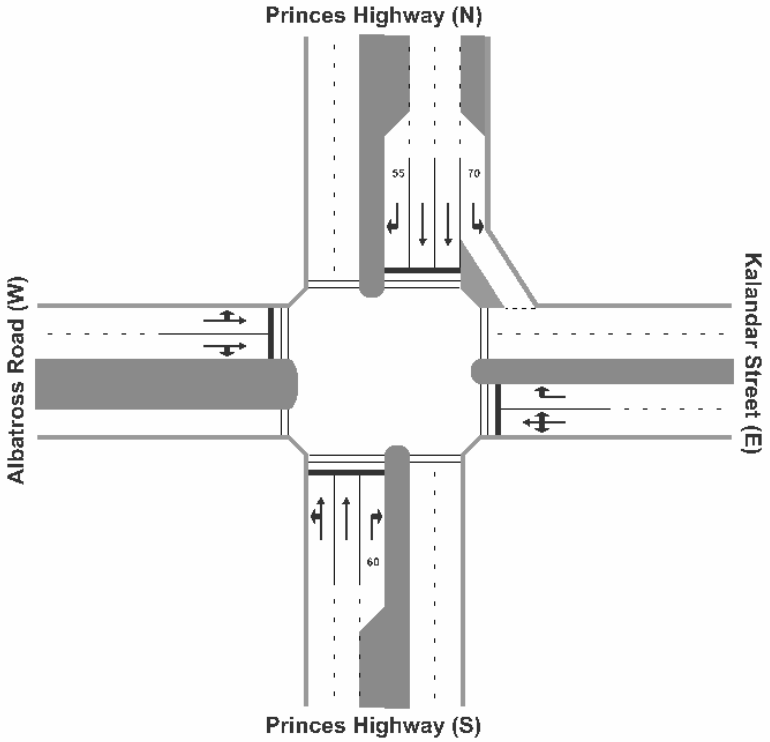
Analysis Results

The intersection has been analysed for both the existing and future scenarios using the aaSIDRA analysis software. A degree of saturation (DOS) of less than 1.0 indicates the intersection is operating within theoretical capacity, however the maximum desirable DOS for a signalised intersection is 0.90. A greater DOS indicates that the intersection is nearing its operational capacity and identifies potential constraints that may impact traffic operations.

The existing phasing and cycle time was adopted for this analysis unless otherwise noted.

2005 Existing
The existing form of the Princes Highway/Kalandar Street intersection is summarised on Figure 4.

Figure 4 ***Princes Highway/Kalandar Street Existing Intersection Geometry***



Analysis of the existing intersection form assuming full-pedestrian movements on all approaches has been conducted. A four-phase operation and a 120-second cycle length have also been adopted. Results of the intersection analysis are as follows:

- AM Peak: DOS = 0.98, Max Queue = 295m (southern approach);
- PM Peak: DOS = 0.88, Max Queue = 233m (northern approach).

Currently, the intersection operates beyond desirable capacity limits (DOS = 0.90) during the AM peak. Queue lengths during both the AM and PM peak hour are significantly long. This is consistent with site observations.

The following sensitivity analyses have been conducted to determine critical factors influencing intersection operation:

- staged pedestrian crossing on the northern approach;
- no pedestrians;
- revised phasing (however still maintaining four-phase operation).

Including a staged pedestrian crossing on the northern approach of the intersection has the effect of reducing intersection degree of saturation to within desirable capacity limits, however queue lengths are still significantly long. Operations under this layout are as follows:

- AM Peak: DOS = 0.89, Max Queue = 235m (eastern approach);
- PM Peak: DOS = 0.87, Max Queue = 222m (northern approach).

During both peak hours, the removal of pedestrians from all approaches replicated conditions with the staged pedestrian crossing on the northern approach. This shows that intersection operations are not dictated by the pedestrian phases during the peak hour (with the exception of the northern approach).

No improvement in operations was delivered with alternative four-phase arrangements at the intersection.

Under the “best case scenario”, that is, a staged pedestrian crossing is provided on the northern approach to the intersection (or very few pedestrians use the signals to cross during the peak hours), the intersection will operate within, but near desirable capacity limits under existing traffic volumes. It is expected that this intersection will reach capacity in the near future. This analysis reinforces the need to substantially bring forward the construction of ENSA, as identified in the Nowra CBD Strategy.

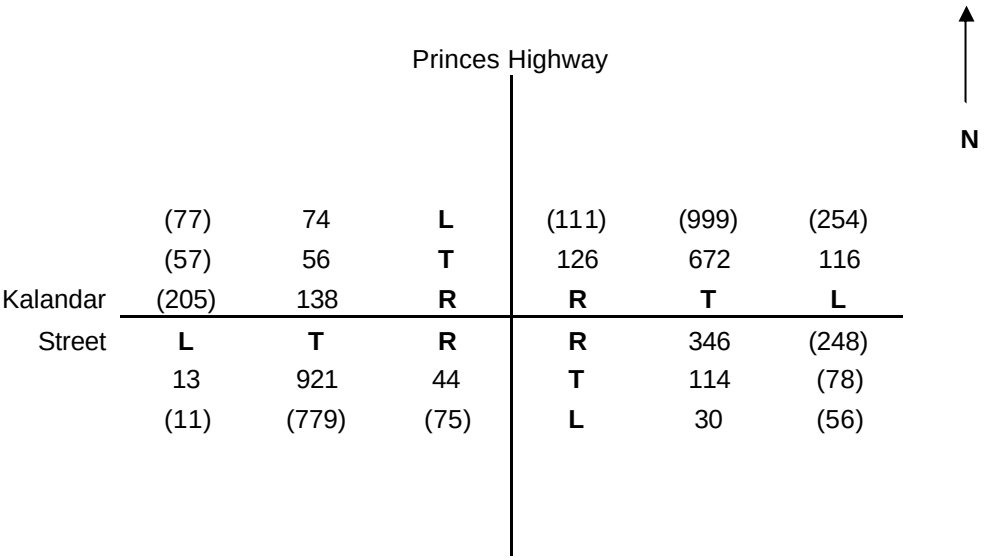
2005 'With ENSA'

A 2005 'with ENSA' scenario has been assessed adopting the following assumptions:

- volumes on Kalandar Street (east) represent 50% of existing volumes: this has been derived from discussions with Shoalhaven City Council and considering that 2016 volumes are similar on Kalandar Street (east) as existing volumes on the same link (without ENSA) and that volumes on ENSA are similar to those on Kalandar Street (east) in 2016;
- left-turn out/right-turn into Kalandar Street (east) volumes remain the same;
- through and right-turn out/left-turn into Kalandar Street (east) volumes reduced in proportion to existing volumes.

Turning movements for the 2005 'with ENSA' scenario are summarised on Figure 5.

Figure 5 ***Princes Highway/Kalandar Street***
2005 'With ENSA' Turning Movement Volumes



Legend

##	AM Peak Volume (vph)
(##)	PM Peak Volume (vph)

Results of the intersection analysis are as follows:

- AM Peak: DOS = 0.70, Max Queue = 171m (southern approach);
- PM Peak: DOS = 0.73, Max Queue = 184m (northern approach).

The introduction of ENSA at 2005 would provide considerable improvement to intersection operations at the Princes Highway/Kalandar Street intersection and increase the life of the existing intersection form.

2016 'With ENSA'

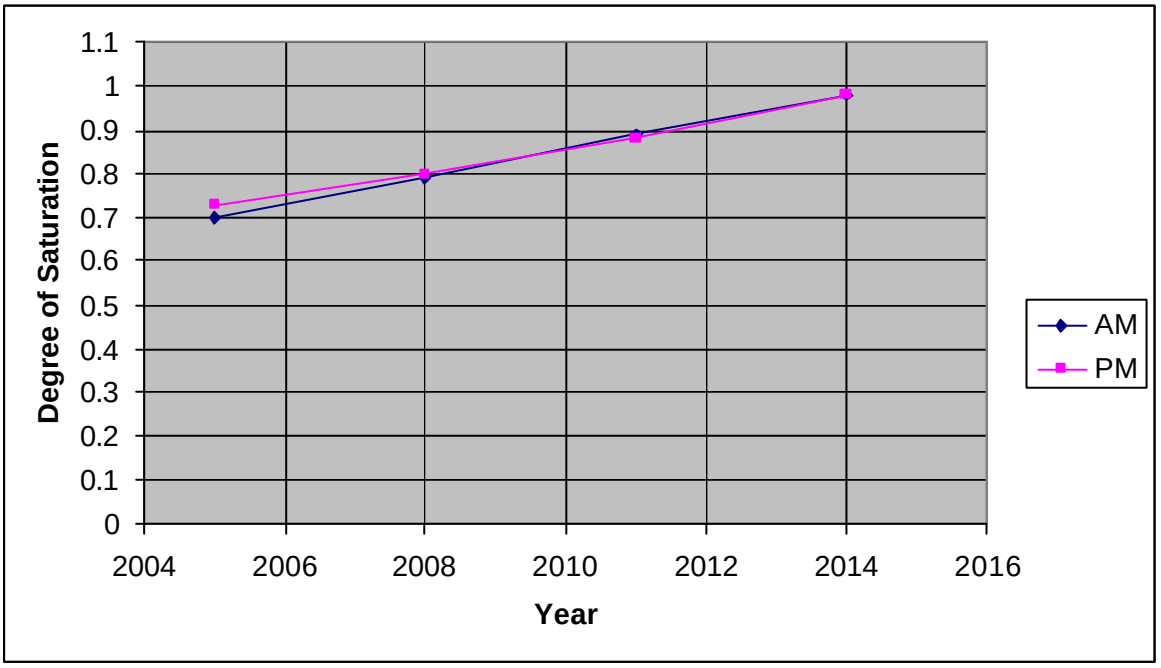
Future volumes at the intersection (2016) with the inclusion of the ENSA connection, as shown on Figure 2, have been assessed with the existing layout and phasing, and including a staged pedestrian crossing on the northern approach. The results of this analysis are as follows:

- AM Peak: DOS >1.0;
- PM Peak: DOS >1.0.

Background traffic growth on the Princes Highway will be such that the intersection operates beyond desirable capacity limits (DOS = 0.90) and theoretical capacity limits (DOS = 1.0) and increases vehicle queues substantially at the intersection.

A sensitivity test has been conducted to determine at what year, the existing form of the Princes Highway/Kalandar Street intersection will exceed desirable capacity limits (DOS = 0.90) with ENSA in place. Assuming a linear growth of "with ENSA" traffic volumes between 2005 and 2016, the intersection will exceed desirable capacity at 2011/2012 as shown on Figure 5.

Figure 5 ***Princes Highway/Kalandar Street Intersection Operation "With ENSA"***

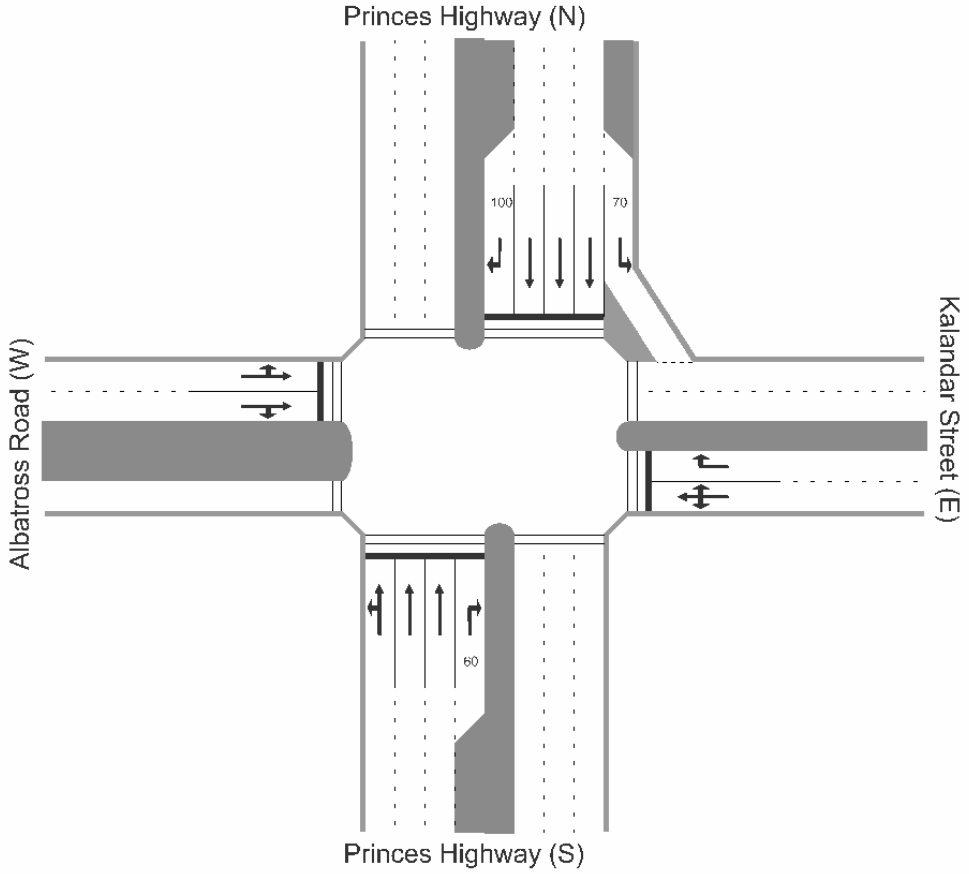


It is likely in reality that traffic will divert around the congested Princes Highway/Kalandar Street intersection where possible, taking up capacity on the local road system. This is likely to affect Albatross Road, Kinghorne Street, and Berry Streets on the west side of Highway , and Old Southern Road, Millbank Road, Jindy Andy Lane, and Moss Street on the east side of Highway. To minimise large traffic diversions onto Old Southern Road (once connected to the Princes Highway via Warra Warra Road), it is advised that this connection (extension of Old Southern Road) should be restricted physically until such time as capacity is improved along the full Highway corridor through South Nowra and Nowra.

The above analysis shows that in order to obtain acceptable operation of the Princes Highway/Kalandar Street intersection, the provision of six lanes along the Highway is required at (or prior to) 2012.

The required intersection form for the 2016 'With ENSA' scenario is shown on Figure 7 and comprises of three dedicated though lanes, a 100m long right turn lane and 70m left turn slip lane on the northern approach, with the southern approach comprising of three though lanes with the leftmost lane shared with the left turn movement and 60m long right turn lane. The east and west approaches both consist of two lanes, with the western leg comprising of a shared through and left lane, and shared through and right lane. The eastern approach comprises of one combined shared left, though and right turn lane and one dedicated right turn lane.

Figure 7 ***Princes Highway/Kalandar Street Intersection Geometry 2016 PM Peak With ENSA***



Note: Staged Pedestrian Crossing On Northern Approach

Alternative options requiring fewer capital works were also investigated, and although were able to reduce the subject intersection's DOS, the changes resulted in unacceptably long vehicle queues and greater delays in travel time. Providing six lanes along the highway allows delay and queue length to be maintained at an acceptable level.

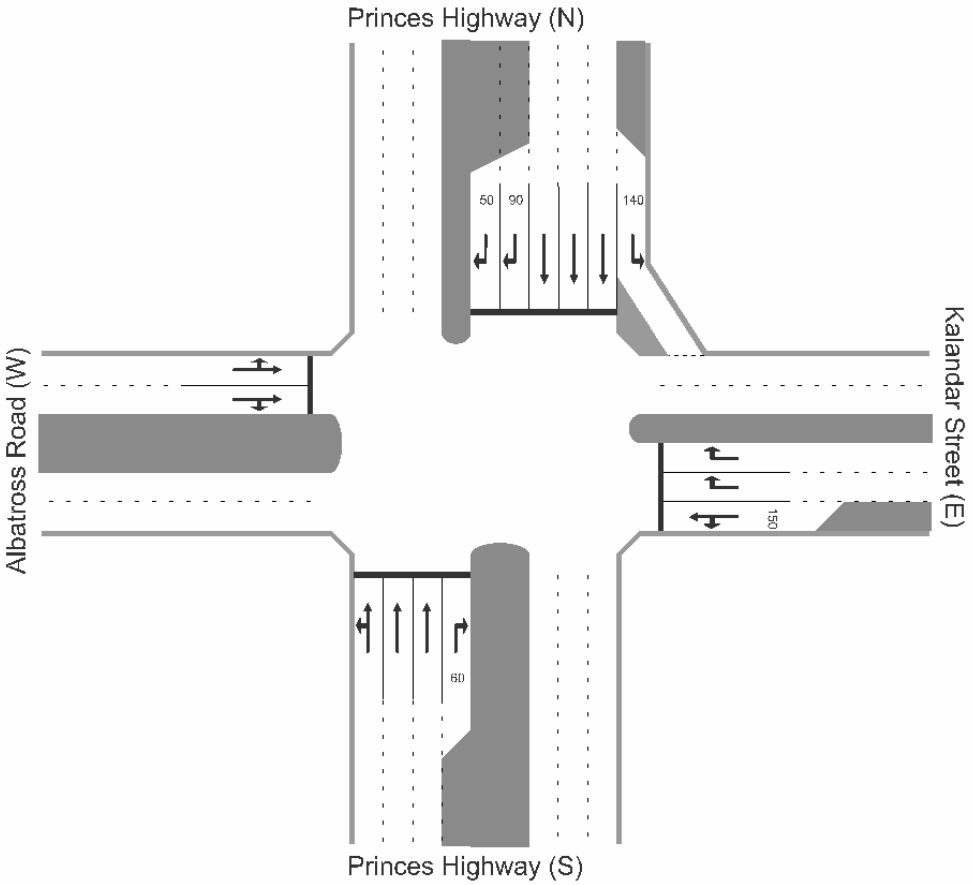
2016 'Without ENSA'

Future volumes at the intersection (2016) without the inclusion of the ENSA connection, as shown on Figure 3, have been assessed with the existing layout and phasing. The results of this analysis have shown that the existing intersection form operates beyond theoretical capacity at this scenario and that substantial upgrades in excess of the upgrades required under the 'with ENSA' scenario will need to be

constructed in order to meet acceptable DOS, delay and queue length criteria. The required intersection form is shown on Figure 8.

The approach lanes of the northern leg will need to comprise of two right turn lanes (50 and 90 meters long), three full length through lanes and a 140m long left turn slip lane. The eastern approach will require the creation of a 150m long left turn and through lane with two full length right turn lanes, with the southern leg comprising of a 60m long right turn lane, two full length through lanes and one full length shared through and left turn lane.

Figure 8 ***Princes Highway/Kalandar Street Intersection Geometry 2016 PM Peak Without ENSA***



Note: Staged Pedestrian Crossing On Northern Approach

The geometry shown on Figure 8 will allow the intersection to operate close to the desirable capacity limit of DOS = 0.90 (assuming very few or no pedestrian crossing calls). Should pedestrian crossing calls become more frequent, the geometry above will be insufficient, with the intersection DOS exceeding the theoretical DOS of 1.0.

Conclusion

Under existing volumes, the intersection operates above capacity during the AM peak hour and near capacity during the PM peak hour. Queue lengths during both peak periods are considerable. The introduction of a staged pedestrian crossing on the northern approach may allow the intersection to operate within desirable capacity limits. It is noted that pedestrian movements at the intersection are relatively low and hence, actual intersection operation is likely just within desirable capacity limits.

The introduction of ENSA at 2005 would provide significant benefits to intersection operation below desirable capacity limits.

Whilst the ENSA provides substantial relief to the SH1/Kalandar Street intersection; at 2016, with the construction of ENSA, turning movements at the intersection are expected to be approximately the same as existing volumes on the Kalandar Street (east) leg. Background traffic growth for the through movements along the Princes Highway is expected to be in the order of 4% per year – a reflection of strong sustained population and economic growth in the Shoalhaven. Accordingly (even with the ENSA in place) at 2016, the intersection will operate beyond desirable and theoretical capacity limits in its existing form. Assuming linear growth of traffic volumes between the 2005 and 2016 'with ENSA' scenarios, the intersection would exceed desirable capacity limits in its existing form at approximately 2011/2012.

Additionally, at 2016 an upgrade of the Princes Highway/Kalandar Street intersection will be necessary even with ENSA in place however not to the same extent as would otherwise be required without ENSA. These differences are summarised in Table 1. Provision of adequate capacity along the Princes Highway (South Nowra) will accordingly assist in preventing a subsequent worsening of conditions at the Princes Highway/Kalandar Street intersection and along other areas of the local road network.

Table 1 ***Princes Highway/Kalandar Street Intersection Required 2016 Intersection Forms***

Approach	With ENSA	Without ENSA
South	3 through lanes (1 shared left/through lane) 1 right turn lane (60m)	3 through lanes (1 shared left/through lane) 1 right turn lane (60m)
East	1 shared left/through/right lane 1 right turn lane	1 shared left/through lane (150m) 2 right turn lanes
North	1 free left lane (70m) 3 through lanes 1 right turn lanes (100m)	1 free left lane (140m) 3 through lanes 2 right turn lanes (90m & 50m)
West	1 shared left/through lane 1 shared through/right lane	1 shared left/through lane 1 shared through/right lane

The "without ENSA" scenario causes major traffic congestion along the Princes Highway between Kalandar Street and North Street (through the Nowra CBD). This is assessed at Appendix B.

The findings of Appendix B indicate that without the construction of ENSA, a six-lane form of the Princes Highway is required between Plunkett Street and Junction Street with some localised widening to eight-lanes at Worrigee Street. Significant upgrades to the intersection forms in this section are also required. With the construction of ENSA, a six-lane form, as well as some intersection upgrading is required to achieve acceptable operation.

The findings of Appendix B and the requirement for a six-lane form of the Princes Highway at the Kalandar Street intersection suggests that the Highway, between Kalandar Street and Junction Street should be upgraded to at least a six-lane form (with a localised eight-lane section at Worrigee Street under the 'without ENSA' scenario) prior to 2016.

Appendix O

South Nowra Highway Assessment

February 2006 – Appendix B

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APPENDIX B

SOUTH NOWRA HIGHWAY STUDY KALANDAR STREET TO JUNCTION STREET

Eppell Olsen & Partners have been commissioned by Shoalhaven City Council to undertake further analysis of the Princes Highway through South Nowra, and in particular the section between Kalandar Street and Junction Street and, assess the operation of its intersections with Plunkett Street, Worrigee Street, and Junction Street. Analysis has been undertaken to determine the effects on highway and intersection geometry with and without the construction of the East Nowra Sub Arterial (ENSA). A design horizon of 2016 has been adopted for this analysis.

This assessment combines analysis results for the Princes Highway corridor between Plunkett Street and Junction Street undertaken as part of the *Nowra CBD (East) Expansion Traffic Modelling Study (2005)* using the Paramics micro-simulation modelling software and additional intersection analysis undertaken using aaSIDRA.

The aaSIDRA computer package has been used to identify intersection performance characteristics, in the form of Degree of Saturation (DOS). A DOS of less than 1.0 indicates the intersection is operating within theoretical capacity, however, the maximum DOS typically desired for signalised intersections is 0.90. A DOS above this indicates that the intersection is nearing its operational capacity and identifies potential constraints that may impact traffic operations.

Volumes used in the analysis of subject intersections have taken into account the "northern roundabout option" as defined in the *Nowra CBD (East) Expansion Traffic Modelling Study (2005)* as being the preferred 2016 strategy network for the expansion of the CBD to the east including connections onto ENSA.

Princes Highway Geometry

The results of analysis undertaken at the study intersections as part of the *Nowra CBD (East) Expansion Traffic Modelling Study* (2005) found that the existing six-lane form of the Princes Highway between Junction Street and Plunkett Street is insufficient to meet demand and performance criteria at the 2016 design horizon without the construction of ENSA.

The operation of the Paramics model for the "without ENSA" scenario was such that demand traffic volumes exceeded the network capacity causing substantial network congestion. As a result, this scenario has been considered using a manual traffic distribution method that diverted expected traffic volumes on the future ENSA connection back onto the Princes Highway. Ultimate intersection forms, and upgrade staging has been considered for this scenario.

With the construction of ENSA, additional works at the study intersections would also be required to allow the six-lane form of the Princes Highway to meet demand and performance criteria at the 2016 design horizon. These works have been summarised herein and are also included in the Eppell Olsen & Partners report titled *Nowra CBD (East) Expansion Traffic Modelling Study,* 2005.

'With ENSA' Scenario

Princes Highway/Plunkett Street

The 2016 volumes extracted from the Paramics model and used for the analysis of the Princes Highway/Plunkett Street intersection are shown on Figure 1 and assume the construction of ENSA.

The required geometry at the intersection is shown on Figure 2 and would comprise of:

- right-turn ban for Princes Highway (south) - Plunkett Street (east) movement;
- two right turn lanes for the Princes Highway (north) - Plunkett Street (west) movement;
- dedicated right turn lane and a shared left/through/right-turn lane on the eastern leg of the intersection;
- a dedicated left turn lane, a shared through/right-turn lane, and a dedicated right turn lane on the western leg of the intersection.

Figure 1 ***Princes Highway/Plunkett Street PM Peak Hour Volumes***

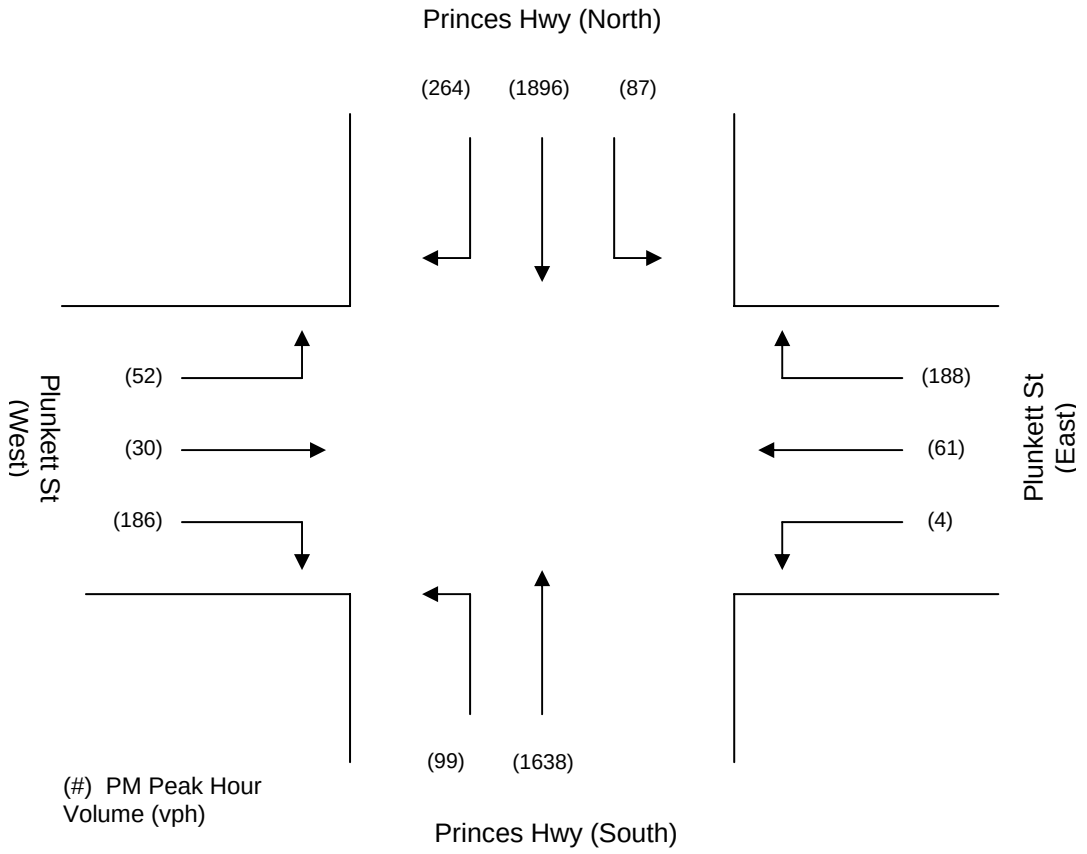
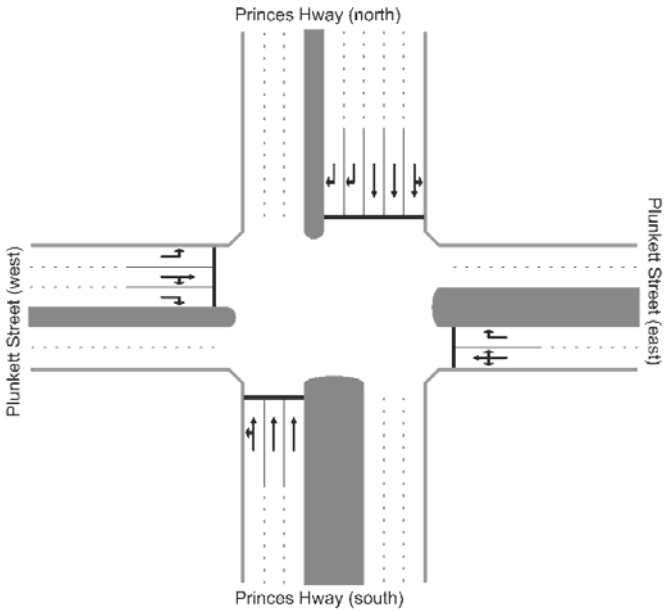


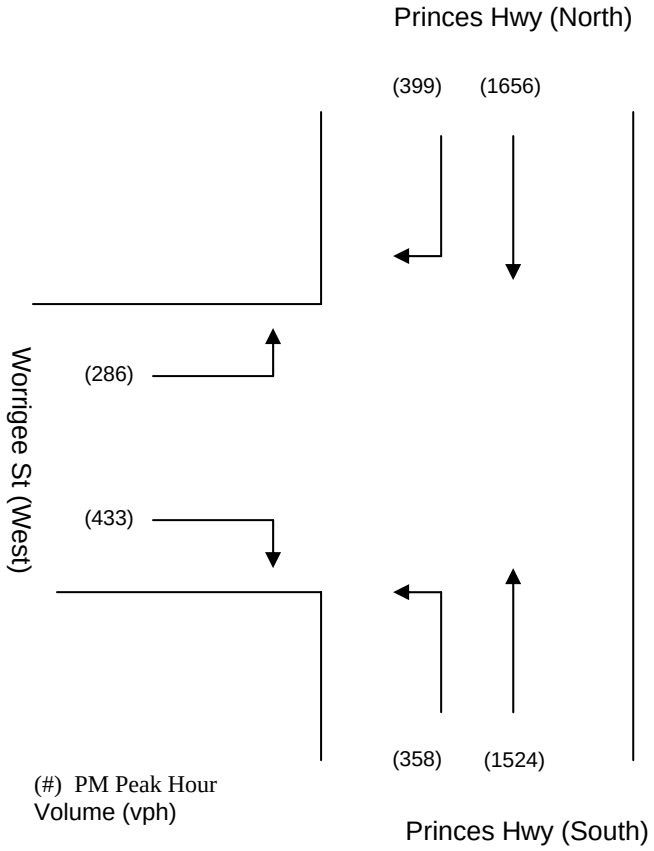
Figure 2 ***Princes Highway/Plunkett Street Intersection Geometry 2016 PM Peak With ENSA***



Princes Highway/Worrigee Street

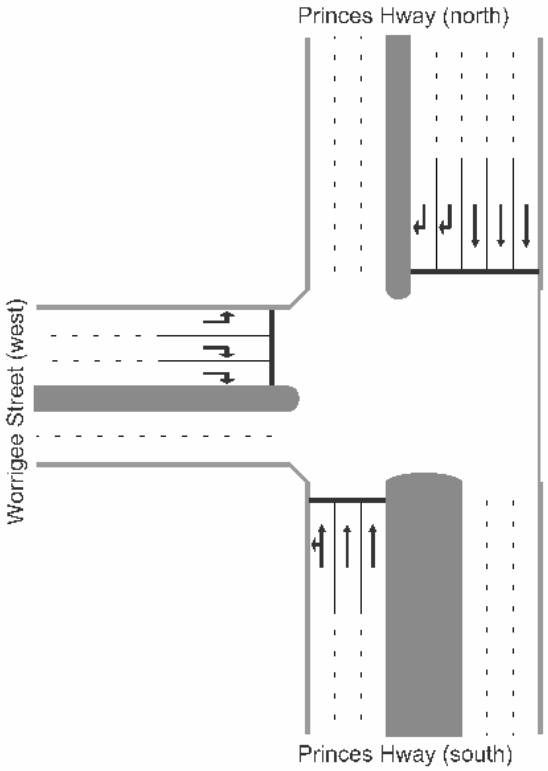
The 2016 volumes extracted from the Paramics model and used for the analysis of the Princes Highway/Worrigee Street intersection are shown on Figure 3 and assume the construction of ENSA.

Figure 3 ***Princes Highway/Worrigee Street PM Peak Hour Volumes***



The required geometry at the intersection at 2016 is shown on Figure 4 and would require the widening of Princes Highway to accommodate construction of dual right-turn lanes on the northern approach of the intersection, and a dedicated left-turn and dual right-turn lanes in Worrigee Street.

Figure 4 ***Princes Highway/Worrigee Street Intersection Geometry 2016 PM Peak With ENSA***



Princes Highway/Junction Street

The 2016 volumes extracted from the Paramics model and used for the analysis of the Princes Highway/Junction Street intersection are shown on Figure 5 and assume the construction of ENSA.

The required geometry at the intersection is shown on Figure 6 and would require the following upgrades:

- right-turn ban for the north - west movement;
- construction of a left-turn lane on the northern approach;
- a right-turn lane constructed on the southern approach;
- eastern approach constructed as separate left, through, and right-turn lanes;
- western approach constructed as a shared left/through lane, and a separate right-turn lane.

Figure 5 ***Princes Highway/Junction Street PM Peak Hour Volumes***

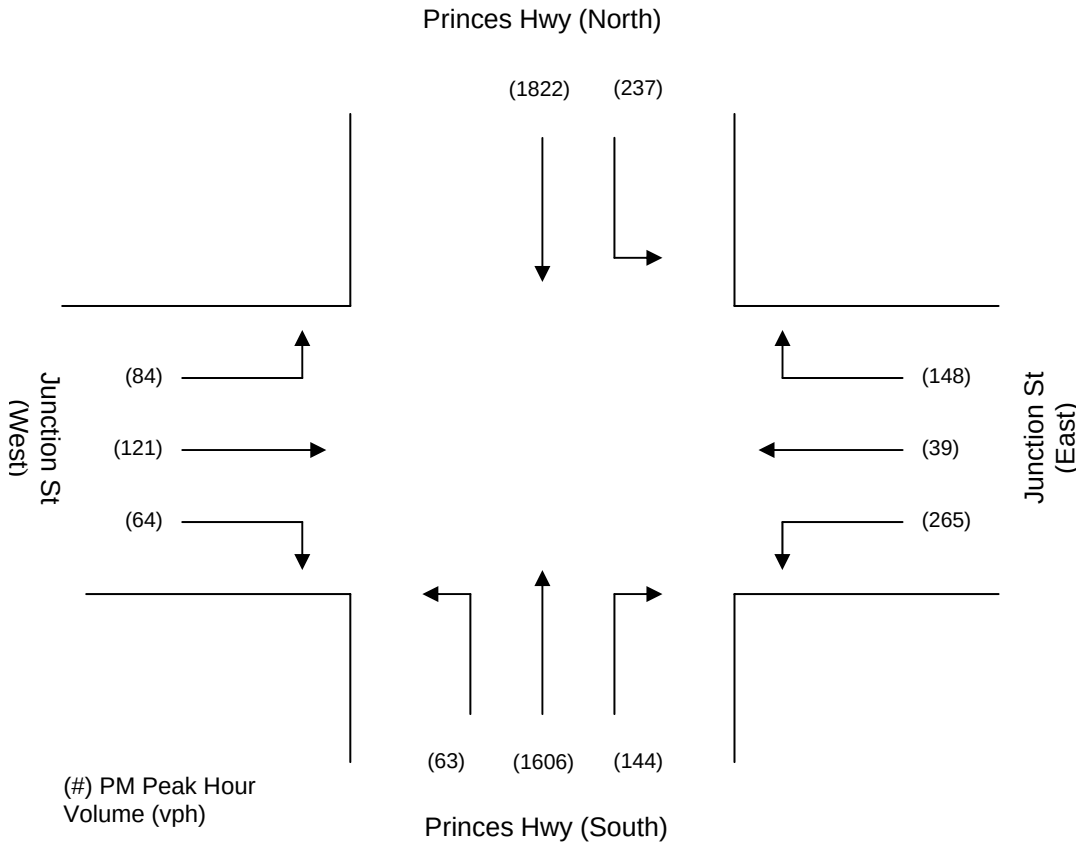
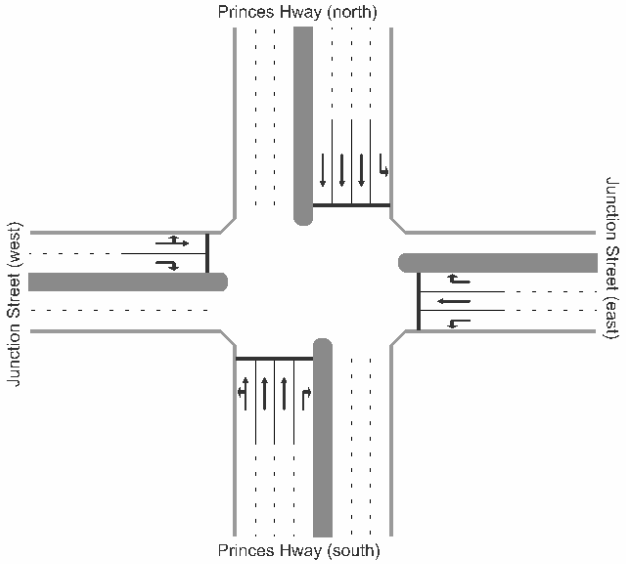


Figure 6 ***Princes Highway/Junction Street Intersection Geometry 2016 PM Peak With ENSA***



'Without ENSA' Scenario

Turning Movement Volumes

Traffic volumes for the 2016 'Without ENSA' scenario have been calculated using the following methodology:

- 2004 'without ENSA' turning movements extracted from Paramics modelling;
- 2016 'with ENSA' turning movements extracted from Paramics modelling;
- 2016 'without ENSA' turning movements estimated by adding 1,500vph to the 2016 'with ENSA' volumes along the Princes Highway to represent potential traffic. The traffic split will be proportioned accordingly north and south consistent with the projected traffic patterns. Plunkett Street directional split of 54% north/46% south (i.e. 54% of 1,500vph is added to the northbound through movement of the 2016 'with ENSA' scenario). Worrigee Street directional split of 52% north/48% south and the Junction Street directional split of 53% north/47% south. All other turning movements have identical volumes for the 'with ENSA' and 'without ENSA' scenarios. The amount of through traffic to be added to Princes Highway at 2016 has been determined from the TRACKS assignment . At 2016 the traffic on ENSA is around 15,000vpd which translates to 1500vph 2 way flow in the peak. However the TRACKS analysis shows that the level of congestion on Princes Highway leads to the diversion of traffic to Kinghorne and Berry Streets west of the highway to reduce the modelled increase on Princes Highway. It is inappropriate for these local streets to be sharing the demands with Princes Highway to any significant extent. As a result the analysis has been undertaken on the basis that the load would not be redistributed to Kinghorne and Berry Streets;
- intermediate study years of 2007, 2010, and 2013 have also been assessed to determine upgrade timing requirements without the construction of ENSA. Turning movements for these scenarios have been linearly interpolated between the 2004 and 2016 'without ENSA' scenarios;
- for the 2018 With ENSA all movements on the eastern and western approaches and the turn movements on the southern and northern approaches were assumed to have identical volumes to that of the 2016 With ENSA scenario. However the through movements on Princes Highway witnessed a 4% growth on the With ENSA scenario and then the proportion of the 1,500vph was added to obtain the values for the Without ENSA.

Princes Highway/Plunkett Street

The existing form of the Princes Highway/Plunkett Street intersection has been assessed using the aaSIDRA package under a number of interim-year 'without ENSA' scenarios to identify an intersection upgrade timeline to 2016. This is summarised in Table 1.

Table 1 ***Princes Highway/Plunkett Street Intersection Upgrade Requirements and Timing (without ENSA)***

Scenario	Intersection Form	Degree of Saturation
2004 Without ENSA	Existing	0.59
2007 Without ENSA	Existing	0.68
2010 Without ENSA	Existing Modified[1]	0.92 0.86
2013 Without ENSA	Modified[1] Ultimate[2]	0.93 0.83
2016 Without ENSA	Ultimate[2]	0.89

[1] Alter lane assignment on east and west approaches to shared left/through/right lane and separate right-turn lane

[2] Create ultimate intersection form. Works include: ban right-turn on southern approach; add 2nd right-turn lane on northern approach; add left-turn lane on western approach.

Note that the three intersection layouts assessed (Existing, Modified and Ultimate) are shown in Figures 7, 8 and 9 respectively.

Figure 7 ***Princes Highway/Plunkett Street Intersection Existing Intersection Form***

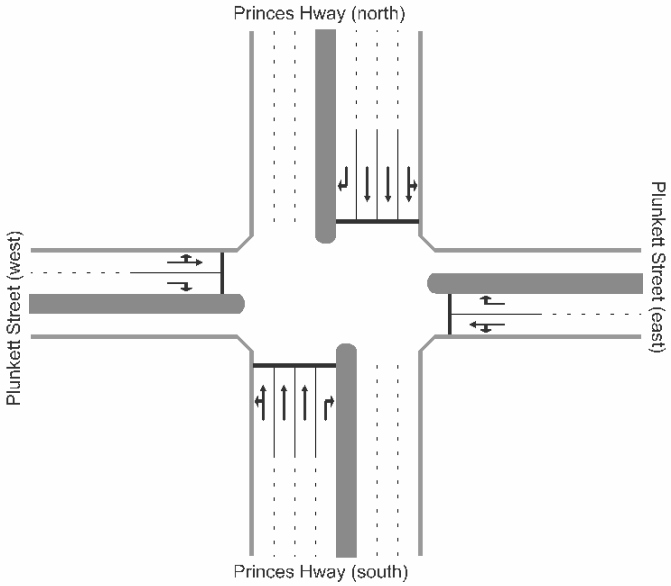


Figure 8 ***Princess Highway/Plunkett Street Intersection***
Modified Intersection Form

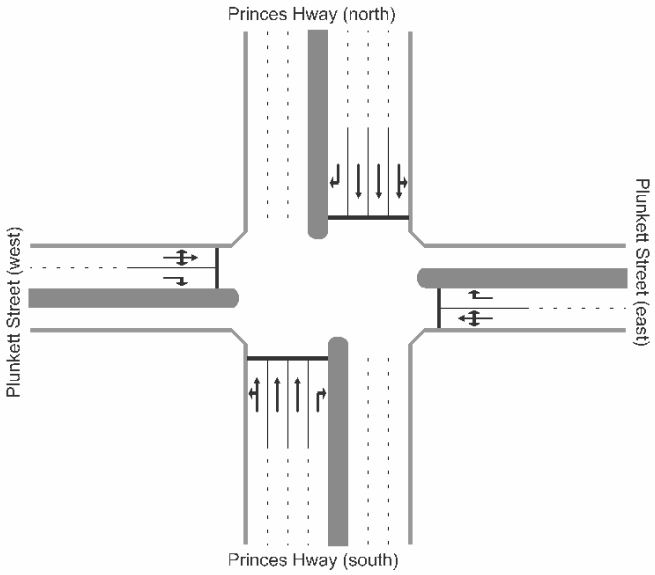


Figure 9 ***Princes Highway/Plunkett Street Intersection***
Ultimate Intersection Form

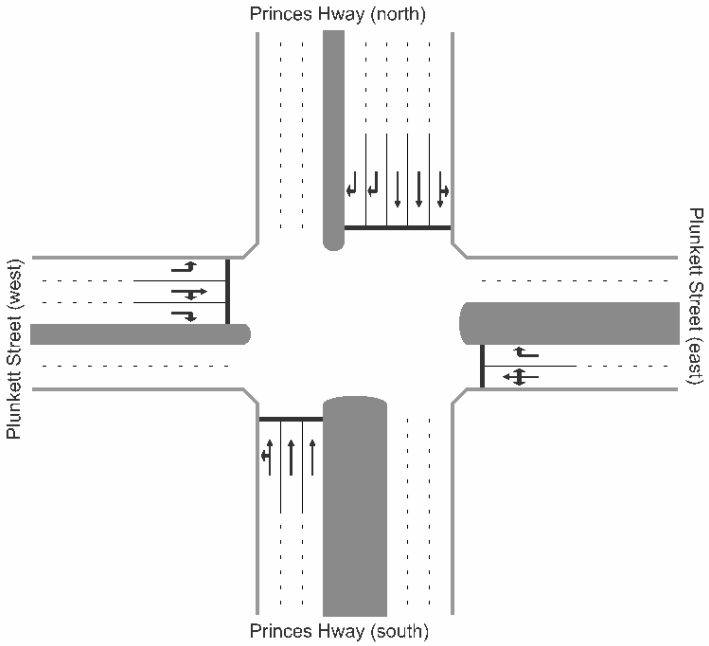


Table 1 shows that the existing intersection form will operate within desirable capacity limits (DOS = 0.90) to approximately 2009/2010. An altered lane assignment to provide a shared left/through/right lane and a separate right-turn lane on both the east and west approaches to the intersection will allow desirable capacity limits to be achieved to approximately 2012/2013.

Beyond 2013, the ultimate form of the intersection, including a right-turn ban on the southern approach, the construction of a second right-turn lane on the northern approach and the construction of a left-turn lane on the western approach will be required. Even with the described "ultimate form", the intersection is operating just under desirable capacity limits at 2016 and accordingly it is likely that by 2017/18 additional lane capacity would be required south of Plunkett Street (ie minimum 8 lane form) for the "without ENSA" scenario

Table 2 presents the intersection degree of saturation for the "with ENSA" scenario.

Table 2 ***Princes Highway/Plunkett Street Intersection Upgrade Requirements and Timing (with ENSA)***

Scenario	Intersection Form	Degree of Saturation
2004 (Without ENSA)*	Existing	0.59
2007 (Without ENSA)*	Existing	0.68
2010 With ENSA	Existing	0.75
2013 With ENSA	Existing	0.82
2016 With ENSA	Existing	0.87
2018 With ENSA	Existing	0.94
	Modified[1]	0.85
	Ultimate[2]	0.73

[1] Alter lane assignment on east and west approaches to shared left/through/right lane and separate right-turn lane

[2] Create ultimate intersection form. Works include: ban right-turn on southern approach; add 2nd right-turn lane on northern approach; add left-turn lane on western approach.

* 2004 and 2007 results reported herein do not have ENSA constructed as it would be impractical to have results for this scenario.

Comparison of Tables 1 & 2 indicate that the construction of ENSA could defer the need for a minor upgrade of the Plunkett Street intersection by approximately eight years and defer the need for a major upgrade of the Plunkett Street intersection by about 9 years to 2022. The comparison of results between Table 1 and Table 2 suggests that the impact of constructing the ENSA is that eight lanes on Princes Highway is deferred well beyond the 2016 timeframe examined compared to around 2013 without ENSA..

Princes Highway/Worrigee Street

The existing form of the Princes Highway/Worrigee Street intersection has been assessed using the aaSIDRA package under a number of interim-year 'without ENSA' scenarios to identify an intersection upgrade timeline to 2016. This is summarised in Table 3.

Table 3 ***Princes Highway/Worrigee Street Intersection Upgrade Requirements and Timing (without ENSA)***

Scenario	Intersection Form	Degree of Saturation
2004 Model	Existing	0.68
2007 Without ENSA	Existing	0.77
2010 Without ENSA	Existing	1.13
	Modified[1]	0.99
	Modified[2]	0.99
	Ultimate[3]	0.74
2013 Without ENSA	Ultimate[3]	0.77
2016 Without ENSA	Ultimate[3]	0.80

[1] Construct left-turn lane on southern approach

[2] Construct 2nd right-turn lane on northern approach and departure lane on western approach.

[3] Construct 4th through lane on southern approach.

Table 3 shows that the existing intersection form will operate within desirable capacity limits (DOS = 0.90) to approximately 2008/2009. The construction of a left-turn lane on the southern approach will not achieve desirable capacity neither will the construction of a 2nd right turn lane on the northern approach (and associated departure lane on the western approach at 2010.

Beyond 2010, the ultimate form of the intersection, including the construction of a fourth through lane on the southern approach will be required to achieve desirable capacity limits. Although not assessed it is likely (considering existing travel patterns) that the construction of a fourth southbound lane would also be required to provide reasonable operating conditions for the morning peak scenario.

Table 4 below provides a summary of the intersection degree of saturation for the "with ENSA" scenario. Note that results for 2004 and 2007 reported herein are provided for "without ENSA" as it would not be possible to have ENSA open at these time horizons.

Table 4 ***Princes Highway/Worrigee Street Intersection Upgrade Requirements and Timing (with ENSA)***

Scenario	Intersection Form	Degree of Saturation
2004 Without ENSA	Existing	0.68
2007 Without ENSA	Existing	0.77
2010 With ENSA	Existing	0.88
	Modified[1]	0.88
	Modified[2]	0.65
	Ultimate[3]	0.49
2013 With ENSA	Modified[2]	0.69
	Ultimate[3]	0.52
2016 With ENSA	Modified[2]	0.73
	Ultimate[3]	0.55

[1] Construct left-turn lane on southern approach

[2] Construct 2nd right-turn lane on northern approach and departure lane on western approach.

[3] Construct 4th through lane on southern approach.

The comparison of results between Table 3 and Table 4 suggests that the impact of constructing the ENSA is that eight lanes on Princes Highway is deferred well beyond the 2016 timeframe examined compared to around 2010 without ENSA.

Princes Highway/Junction Street

The Princes Highway/Junction Street intersection is currently a left-in/left-out intersection with six-lanes along the Princes Highway. An upgrade timeline has therefore not been prepared for the intersection, however the required form of the intersection has been assessed to 2016 as summarised in Table 5. Figures 10 and 11 are referenced in this regard.

Table 5 ***Princes Highway/Junction Street Intersection Ultimate Intersection Geometry***

Scenario	Intersection Geometry	Degree of Saturation
2016 Without ENSA	As per existing geometry (left in left out) with signalisation for pedestrian mobility/safety (see Figure 10)	1.12
2016 Without ENSA	As per '2016 preferred strategy network' (see Figure 11) i.e. including Left-turn lane on northern approach Junction Street (west) assigned to a shared left/through lane and separate right turn lane Junction Street (east) would be constructed to have three stand-up lanes, left, through, and right, plus an additional lane for eastbound traffic on Junction Street New right turn lane (south to east) on Princes Highway No right turn (north to west) from Princes Highway	1.10
2016 With ENSA	As per '2016 preferred strategy network' described above (see Figure 11)	0.83

Figure 10 ***Princes Highway/Junction Street Intersection***
Existing Intersection Form

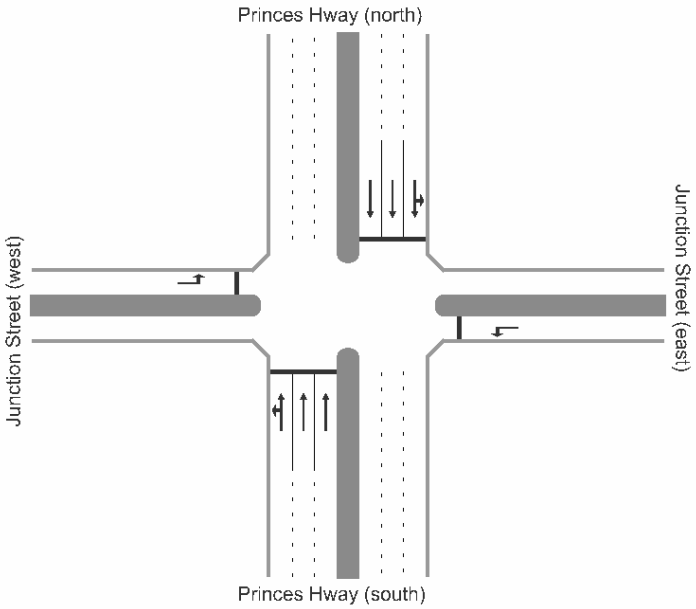
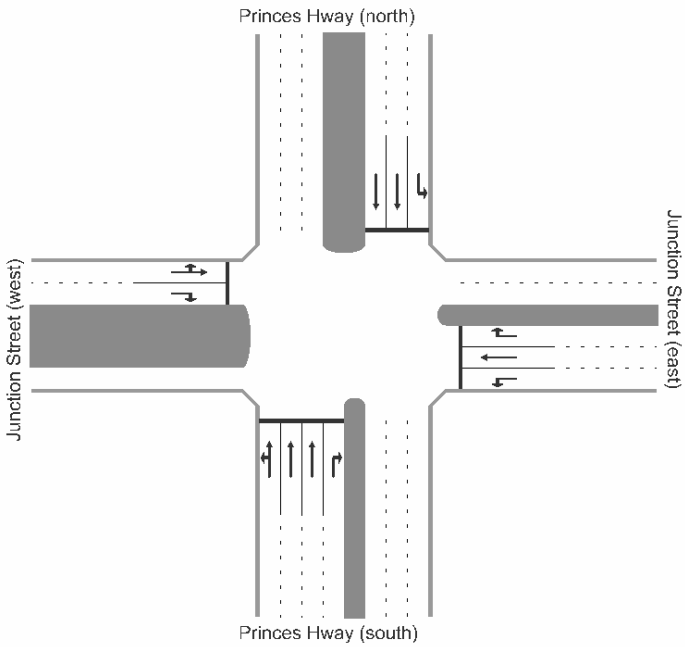


Figure 11 ***Princes Highway/Junction Street Intersection***
Ultimate Intersection Form



It should be noted that using the existing geometry (left in/left out) would place higher demands on turning movements at other intersections in the network which would result in heavy congestion. Junction Street is an integral link in the road network to provide for growth and the possible development east of the Princes Highway adjacent to the existing Nowra Fair shopping centre. Whilst the need for signalised pedestrian crossing at Junction Street is not debated and considered integral to the CBD strategy, improvements to grade separation (pedestrian crossings) of the Princes Highway could improve the capacity of Junction Street signalised intersection by reducing the demand for activation of pedestrian phase and would provide a safer crossing opportunity with less delay when compared to the signalised pedestrian crossing.

Consideration

This aaSIDRA analysis considers the intersections in isolation whereas previous analysis of the network was undertaken using a combination of Paramics and aaSIDRA. The use of
Paramics in this analysis was able to provide a tool to assess the operation of the entire road network in comparison to the output from aaSIDRA which only considers isolated intersections. Further the traffic the traffic volumes are derived from manual re-assignment of "with ENSA" analysis reported in the main body of this report.

The Paramics analysis makes provision for efficiency losses through coordination, effects of adjacent intersections and short term perturbations in demand. Thus while the 2016 aaSIDRA data shows operation without ENSA at capacity, these other factors lead to the conclusion that at 2016 the "ultimate" form of Plunkett Street/Princes Highway will not operate satisfactorily. The "with ENSA" analysis drawn from the main body of the report shows adequate operation at 2016.

Conclusion

Analysis conducted using the Paramics modelling software as part of the *Nowra CBD (East) Expansion Traffic Modelling Study (2005)* study has shown that the existing six-lane form of Princes Highway can not cater to growth without the construction of ENSA. Studying each of the intersections in isolation under the 'without ENSA' scenario herein shows that intersection forms employing six-lanes along the Princes Highway are achievable with some localised widening. The operation of the 'without ENSA' Paramics model suggested that the effect of queue build-up on adjacent intersections may also warrant eight-lanes along the Highway.
It should also be noted that the analysis herein has been undertaken for the Thursday evening peak period only as this is typical of the maximum peak during the week and corresponds with late night shopping. It is possible that during the typical morning peaks that additional lanes in the opposite direction to that of the evening peak may be required at intersections to satisfactorily manage the vehicle demands. This may particularly be the case at Worrigee Street where it has been shown that various works are required for satisfactory intersection operation in the evening peak.

Without ENSA the Princes Highway may require substantial upgrades to meet the predicted traffic demands depending on the level of development in the surrounding areas. This may require the Princes Highway to be upgraded to a minimum of eight (8) through lanes (four lanes in either direction) for the entire length of the study corridor. The addition of ENSA to the road network relieves the Princes Highway, such that the Princes Highway does not require complete upgrading, however localised intersection upgrades are still required.

Scenarios tested without ENSA, have limited connectivity between the CBD and the existing Nowra Fair site. Vehicle demands for trips with these origins/destinations, are shifted around the road network and result in longer trips than necessary and may cause congestion beyond the scope of the study area. There is also limited connectivity between the two areas for non-vehicle (pedestrian/cycle) trips. The inclusion of ENSA to the road network will also promote future growth in the area.

With the construction of ENSA and the upgrade works described in Table 6, the existing six-lane form of the Princes Highway can operate adequately throughout the design horizon of 2016. Additional upgrade works required for the operation of the 'without ENSA' scenario (on top of works required for the 'with ENSA' scenario) are summarised in Table 7. Further documentation of the required intersection forms and timings are found in the *Nowra CBD (East) Expansion Traffic Modelling Study (2005)* report. That report also includes commentary on the effects of various levels of development and the required infrastructure needed as a result.

Table 6 Lane and Intersection Upgrade Requirements (2016) with ENSA

Intersection	Upgrade Requirements with Construction of ENSA
Princes Highway/Plunkett Street	Right-turn ban (south – east) Dual right-turn lanes on northern approach Remark lanes on eastern approach to include a shared left/through/right and separate right turn lane Construct left turn lane and remark existing lanes to include a shared through/right lane and a separate right turn lane on the western approach
Princes Highway/Worrigee Street	Construct second right-turn lane on northern approach Construct Worrigee Street as separate left and dual right turn lanes
Princes Highway/Junction Street	Right-turn ban (north-west) Construct left turn lane on northern approach Construct right turn lane on southern approach Construct eastern approach as separate left, through, and right turn lanes Construct western approach as shared left/through lane, and right turn lane
Princes Highway	Six through lanes (three in each direction) for study corridor

Table 7 Additional Lane and Intersection Upgrade Requirements (2016) without ENSA

Intersection	Upgrade Requirements without Construction of ENSA
Princes Highway/Plunkett Street	As per with ENSA scenario (Table 6)[1]
Princes Highway/Worrigee Street	As per with ENSA scenario (Table 6), plus… Construct left turn lane on southern approach[2] Construct 4th through lane on southern approach[2]
Princes Highway/Junction Street	As per with ENSA scenario (Table 6)
Princes Highway	Eight through lanes (four in each direction) for study corridor[2]

[1] ENSA defers the need for minor upgrade of the intersection by approximately 8 years and defers the need for major upgrade of the intersection well beyond the 2016 analysis period.

[2] Upgrade requirements are not considered to be practical, nor cost effective solutions, when compared to the reduced level of infrastructure upgrading required along the Highway corridor and broader community benefits of constructing ENSA.

Appendix P

Traffic Modelling of Stockland Nowra (Fair) Expansion

April 2007 – Appendix A – Stockland Nowra –

Southern Egress Option Testing

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Date: 02 July 2007

DESIGN NOTE

STOCKLAND NOWRA DA06/1317 - SOUTHERN EGRESS OPTION TESTING

This design note documents the assessment of three southern egress option arrangements - egress from the Stocklands Nowra (Fair) site to the Princes Highway.

This additional modelling analysis work was agreed to be undertaken by Council following a meeting of the Stockland Development Proposal (DA06/1317) Traffic Modelling working party at RTA 24 August, 2006.

RTA raised concerns at that meeting in relation to the proposed signalisation of Stockland southern egress (intersection with Princes Highway) as proposed by Stockland in their DA.

Whilst the Stockland proposal was consistent at the time with the Nowra CBD Strategy (refer February 2006 report) following earlier modelling work by CEO - RTA were not satisfied that Council had thoroughly investigated alternative options and subsequently requested additional analysis be undertaken to compare the performance of this proposal with other alternative proposals including direct connection to SH1/Worrigee Street intersection or direct connection to Morton Parade (i.e. consistent with consent conditions for the LEDA development).

RTA were concerned that the signalisation of southern egress was not the best option in terms of maximising capacity of the Princes Highway.

The three egress options agreed to be tested using Paramics 5.1 are as follows:

- signalised left only slip lane south of the Princes Highway/Worrigee Street intersection (i.e. as per the February 2006 CBD Strategy);
- additional left only approach to the Princes Highway/Worrigee Street intersection;
- exit onto Journal and Plunkett Streets via Morton Parade (i.e. as per approved LEDA connection).

The egress options have been tested using the 2016 PM Nowra CBD “Preferred” Road Network Strategy model as the base model.

This model includes all development scenarios as per the Nowra CBD (East) Strategy (Revision - April 2007) including the proposed Stockland Nowra Fair expansion, the proposed LEDA development to the east of Nowra Fair, the proposed Stockland Lifestyle Centre development (Junction North), traffic generation on residual Nowra High School lands south of ENSA (west of link between Junction Street and ENSA), and includes the East Nowra Sub-Arterial (ENSA).

Signalised left only slip lane south of Princes Highway/Worrigee Street intersection

This egress option formed part of the original egress plans for the original Stockland Stage 1/Stage 2 development on lands to the east of Nowra Fair (now subject of LEDA development proposal), and provides for two left turn approach lanes to the Princes Highway (movements east to South only ie same as existing egress movements from the Stockland Nowra Fair site) approximately 100m south of the Worrigee Street intersection.

In the 2016 model - the Princes Highway/Worrigee Street intersection runs three phases, with a 120 second cycle time and includes the following lane configurations:

- Northern Approach: Three though lanes and turn pocket with two right turn lanes;
- Western Approach: Two right turn lanes and one left turn lane;
- Southern Approach: Shared left and through lane and two dedicated though movement lanes.

With the egress option and intersection configurations as listed above, the network operates adequately, with vehicles able to exit the development, although there are potential issues concerning traffic turning towards the south from Worrigee Street on to Princes Highway, as the egress of vehicles from the development may adversely affect the movement of traffic from Worrigee Street. The vast majority of the vehicles exiting the development were observed to be able to enter onto the Princes Highway each cycle.

Addition of left turn only eastern approach at the Princes Highway/Worrigee Street intersection

This egress option involves the addition of an approach only eastern leg to the Princes Highway/Worrigee Street intersection, which is comprised of two left turn exit only lanes.

The resulting model intersection configuration is then as follows

- Northern Approach: Three though lanes and turn pocket with two right turn lanes;
- Eastern Approach: Two left turn only lanes;
- Western Approach: Two right turn lanes and one left turn lane;
- Southern Approach: Shared left and through lane and two dedicated though movement lanes.

The addition of the east approach requires the provision of an additional phase (for a total of four phases) to allow for traffic to exit the development, due to the provision of dual right turn lanes on the western leg of the intersection.

The addition of the additional phase (and subsequent reduction in time for other phases to maintain a consistent 120 second cycle time with adjacent intersections) adversely affects the performance of the western approach of the intersection causing queuing on this approach.

Egress of development traffic onto Journal Street and Plunkett Street via Morton Parade

This option involves the provision of southern egress from the Stockland development onto Morton Parade instead of directly onto the Princes Highway.

Vehicles leaving the southern aspect of the site and bound for the south would access the Princes Highway via Morton Parade and Plunkett Street and then head south from the eastern leg of the Princes Highway/Plunkett Street intersection. Alternatively, some traffic would be expected to travel south and east via Journal Street, and accordingly LATM measures and capacity improvements to Plunkett Street are required to mitigate this impact and ensure sufficient capacity is provided in Plunkett Street.

There have been no additional changes to the intersection configuration at the Princes Highway/Plunkett Street intersection over the configuration recommended in the Nowra CBD Strategy network including works conditioned on LEDA DA. The intersection operates five phases with diamond right turns on all approaches.

The intersection is able to operate acceptably, with the additional development traffic on the eastern approach of the intersection not significantly adversely affecting the operation of this approach, subject to full upgrade of east approach as per LEDA consent conditions (in accordance with Nowra CBD Strategy "Preferred" Road Network April 2007).

It is noted that whilst optimising efficiency of the Princes Highway as a through transport corridor (compared with the alternative egress options) , this option would have the effect of adversely impacting traffic and environmental conditions on Nowra East local road network (Refer also Appendix K of Nowra CBD Strategy Report April 2007).

Effects of Removing ENSA

As requested by Council, all of the above scenarios were tested with the ENSA link removed from the three alternatives tested above.

The modelled volume of traffic coming to and from ENSA previously coming from or going to the ENSA link external zone is a total of 1255 which have subsequently been redirected to the southern Princes Highway external zone and Journal Street external zone in accordance with previously determined traffic distributions from TRACKS (Refer distributions documented in the February 2006 CBD East Expansion Traffic Modelling Study Report as well as the LEDA Traffic Modelling Study July 2006).

To summarise - 13% of traffic from the Nowra East commercial expansion area arrived via ENSA and 9% departed via ENSA. With ENSA in place*, there was still approximately 10% traffic (arrivals / departures) entering the shopping centre expansion area (LEDA) via Morton Parade as a result of allowing the southern connection. Without ENSA, all traffic at the ENSA external are able to be re-distributed to the Princes Highway (South external) with exception of the 13% (arrivals) and 9% (departures) that are re-distributed to Morton Parade as a result of the new permitted access. Without ENSA, it is therefore expected that approximately 23% traffic (arrivals) and 19% traffic (departures) will utilise Journal Street if no ENSA. This is in addition to traffic that would utilise Morton Parade / Plunkett Street for access to Highway (some east-west movements and southern destinations along the Princes Highway).*

As these rates have been determined for the Nowra East expansion area, the same rates are applicable to Stockland and have been utilised in this assessment. Refer also Appendix K of the Nowra CBD Strategy Report April 2007.

The result of removing ENSA is that the network gridlocks during the 2016 PM peak model run. It is likely that similar levels of congestion would occur for the AM peak period It is envisaged that substantial improvements to the network would be required to achieve a reasonable level of operation should ENSA not be in place. Refer also Appendices N and O of the Nowra CBD Strategy Revision Report (April 2007) relating to the South Nowra Traffic Modelling Study (February 2006).

The model shows significant issues relating to right turn movements from the Princes Highway to intersecting streets, as turn pockets overflow frequently therefore obstructing the adjacent movements. The model shows initially, significantly increased queuing as a result of the higher southbound volumes on the northern approach of the Princes Highway/Plunkett Street intersection. This queue extends back to the Worrigee Street intersection with the Princes Highway and adversely impacts the operation of the western approach of the intersection. Vehicles on the western approach are thereby limited in their ability to proceed south resulting in significant queues along the western approach of the Princes Highway/Worrigee Street intersection which interferes with other upstream intersections in Nowra CBD.

Significant queuing is also present on the northern approach of the Princes Highway/Junction Street intersection, due to the large volumes of southbound traffic. Similar to the issue at Plunkett Street the

queue extends back to the upstream intersection (North Street) which adversely impacts on vehicles on the western approach of the North Street intersection. The inability of vehicles progress through the intersection on the western approach of the North Street intersection with the Princes Highway results in extensive queuing which adversely affects upstream intersections in Nowra CBD.

The significant queuing at many approaches to intersections within the network results in blockage of other upstream intersections with the effect of queue distribution throughout the network causing the network to gridlock.

The Princes Highway simply does not have the capacity (through Nowra CBD) as a 6 lane corridor to accommodate the volumes of traffic predicted at 2016 without ENSA, and would require substantial upgrade to provide the additional lane capacity required for Princes Highway.

Conclusion

Of the three egress options tested, the provision of egress to Morton Parade and Plunkett Street is the most advantageous with respect to the operation of the Princes Highway, as this egress option does not introduce additional conflicts onto the Princes Highway or adversely impact on adjacent intersections.

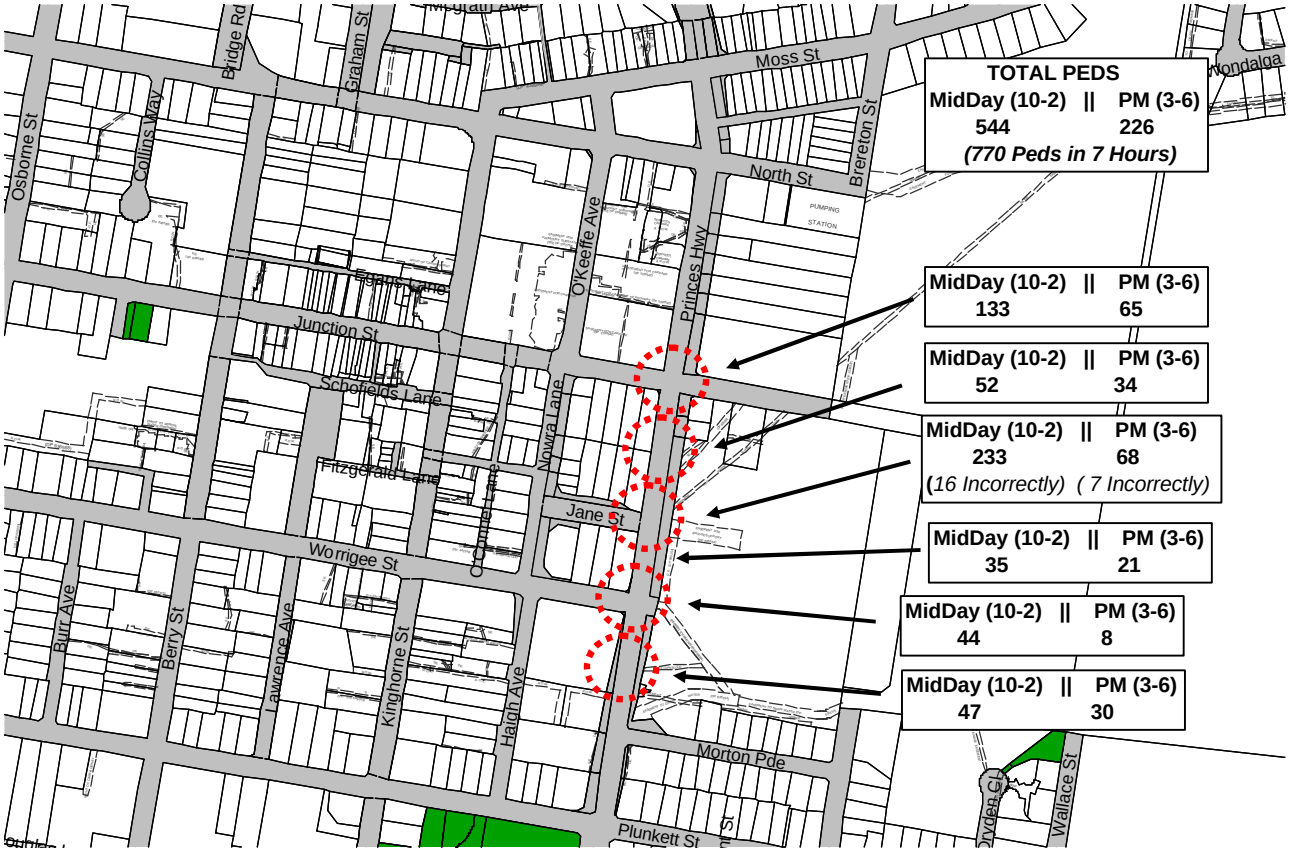
The reduced conflicts near the Princes Highway/Worrigee Street intersection (as a result of closed egress to Highway and connection to Morton Parade), and subsequent increase in operational efficiency afford significant benefits for traffic on the Princes Highway including reduced queuing in the area which aids the operation of adjacent intersections.

It should be noted however that whilst optimising efficiency of the Princes Highway as a through transport corridor, this option would have the effect of adversely impacting traffic and environmental conditions on Nowra East local road network (Refer also Appendix K of June 2007 Nowra CBD (East) Road Network Strategy Review Report) and this would require LATM treatments, upgrade of Plunkett Street (between Journal Street and Highway) and consideration of other measures to mitigate the impacts on Nowra East local road network.

This latest assessment has further reinforced the need for planning of provision of full ENSA by 2016 if growth occurs in the order of magnitude as determined in Council's Nowra/Bomaderry Structure Planning.

Appendix Q

Summary – Pedestrian Survey Results (Survey undertaken Thursday 23 September 2004)



Note : Only 36% of Pedestrians Crossing the Highway between North of Junction Street and South of Worrigee Street use Jane Street correctly. Proposed upgrade to the northern side of Jane Street to provide improved grade-separated access across the Highway with enhanced connections and improved integration is likely to increase correct usage of Jane St by up to 60% (ie raising the % of pedestrians crossing SH1 that correctly use Jane St to approximately 58%).

The remaining volumes of pedestrians crossing the Highway in the vicinity of Junction Street and Worrigee Street are likely to significantly benefit from proposed improvements to crossing opportunities at those locations. That includes the proposed installation of traffic signals at Junction Street and the proposed improvements to pedestrian connections between Worrigee Street traffic signals and Nowra Fair main pedestrian access. These volumes support the recommendations of the Nowra CBD Traffic and Parking Strategy (2003) reinforced in the Nowra CBD Strategy Revision (2007).

Appendix R

Nowra CBD Strategy – Junction Court Opening Options and Worrigee Street One Way

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Date: 30 July 2007

DESIGN NOTE

NOWRA CBD STRATEGY – JUNCTION COURT OPENING OPTIONS AND WORRIGEE STREET ONE WAY

Introduction

Preliminary analysis undertaken in 2003 (using Council's TRACKS model) identified that opening of Junction Court to traffic would lead to unacceptably high traffic volumes on Junction Street. These tests were carried out at the same time strategic traffic modelling assessment was being undertaken to determine the most appropriate location for link to ENSA. The modelling analysis determined that traffic volumes would be very high on Junction Street if the existing mall were removed irrespective of the location of link to ENSA - either direct to Junction Street or to North Street (preferred) with secondary link to Junction Street.

In response to on-going concerns from the Nowra CBD business community in relation to Junction Court, Council have engaged Cardno Eppell Olsen (CEO) to review Junction Court opening options from a traffic operational perspective, using the 2016 Nowra CBD Strategy Paramics model developed as refined following the 2007 strategy revision.

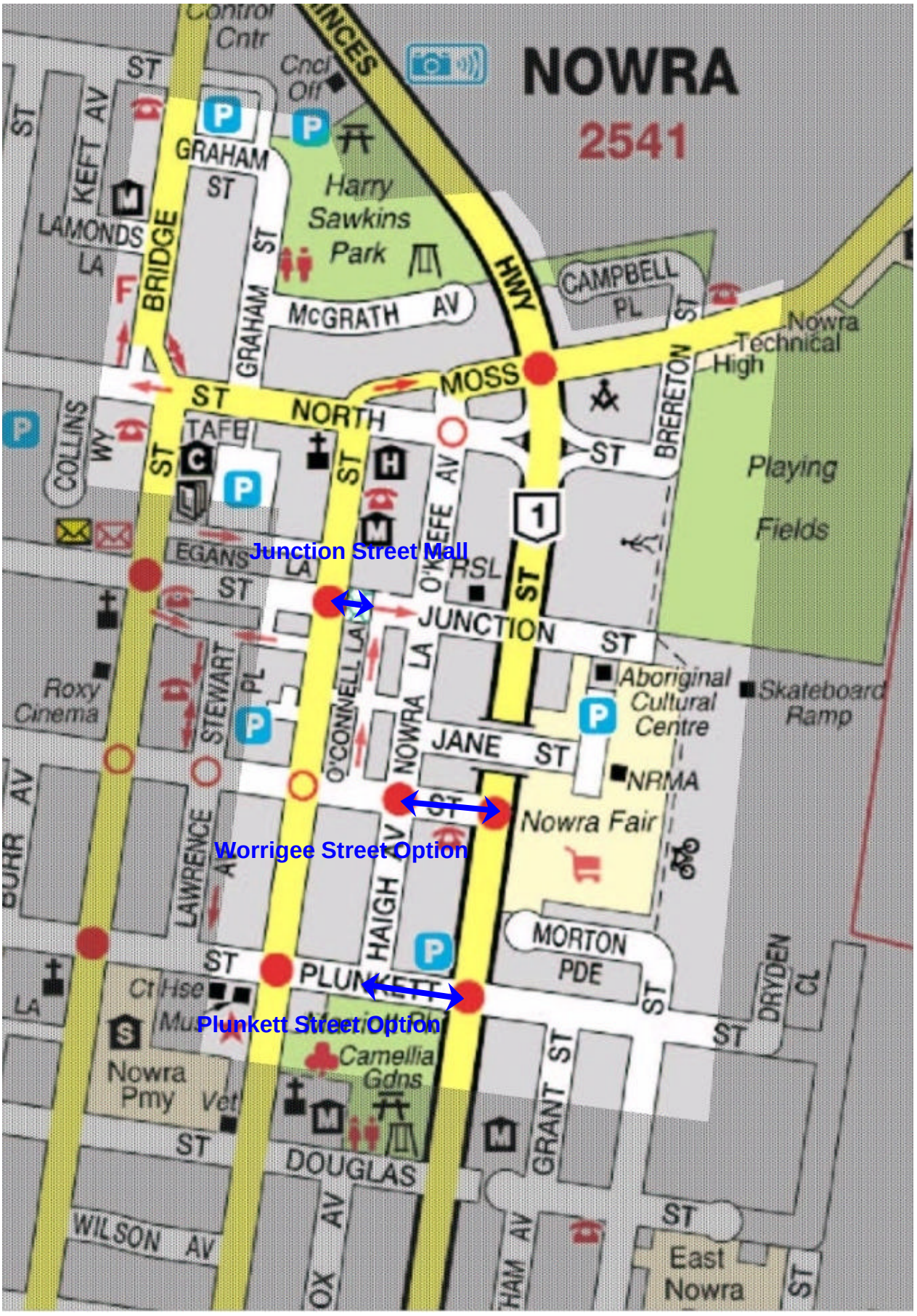
Further - In response to sec94 submission in relation to the proposed upgrade of Worrigee Street in accordance with Nowra CBD Strategy, Council have further engaged CEO to test an Option of making Worrigee Street one way (eastbound) between Nowra Lane and Princes Highway, also using the revised 2016 Nowra CBD Strategy Paramics model.

This design note is the review and analysis of three (3) options modelled for the opening of Junction Court (the existing mall between Kinghorne Street and O'Connell Lane), and an option to make Worrigee Street between Princes Highway and Haigh Avenue one-way eastbound. Additionally, a second option to make Plunkett Street between Princes Highway and Haigh Avenue one-way westbound to be modelled if required. This is to assist Shoalhaven City Council to appreciate the operational impacts of these changes to the Nowra CBD network.

Figure 1 shows the location of the Junction Street mall and Worrigee Street options within the extents of the Nowra CBD Strategy Paramics model.

Cardno Eppell Olsen

Figure 1 ***Locations of Options Tested***



Options Tested

The three options modelled of Junction Court included:

- Open Junction Court (two-way);
- Open Junction Court (one-way Eastbound);
- Open Junction Court (one-way Westbound).

The base Paramics model used for comparison of the above options has Junction Court closed to traffic.

The option modelled of Worrigee Street included:

- Worrigee Street one-way eastbound from Princess Highway to Haigh Avenue.

Council also wished that a second option to make Plunkett Street between Princes Highway and Haigh Avenue one-way westbound be modelled if the above option has poor traffic circulation that leads to unacceptable congestion or total grid lock.

Previous Modelling

An extensive number of road network options were completed in TRACKS by Eppell Olsen during the development of the Nowra CBD Strategy. One of the options tested was the opening of Junction Court to two-way traffic movements, and this was modelled under a number of scenarios involving different connections of ENSA. The assessment identified traffic volumes on Junction Court would generally be high - in the range 14,000 vpd – 18,000 vpd (2016 flow estimates).

In order to interpret the 2003 TRACKS assessment of Junction Court opening, a number of factors need to be considered which would have influence on likely traffic volumes if Junction Court were re-opened to traffic:

- Nowra Bomaderry Structure Plan projections have been updated since 2003, and remodelling with the latest projections should be considered (i.e. with land use changes that reflect current Nowra Bomaderry Structure Plan projections including impacts of Stockland and LEDA developments on Nowra CBD West);
- Forest Road upgrade is likely to be an influence on 2016 traffic volumes on ENSA, although this is unlikely to change longer term projections (which had already taken Forest Road upgrade into consideration);
- Significantly less commercial development was expected in Nowra CBD (East) in 2003 compared to 2007 and remodelling with the latest known scale of development should be considered. In 2003, only 28,041sq.m was envisaged with AMP Henderson proposal to expand Nowra Fair. In 2007, the combined scale of LEDA and Stockland developments is in the order of 72,050sq.m (i.e. greater than 2½ times the scale of commercial development originally envisaged east of the Princes Highway, Nowra);
- 24hr strategic TRACKS model likely to under-estimate delays at intersections and this could lead to higher traffic volumes on Junction Court than may actually be experienced in reality (not likely to occur in Paramics model, which accordingly could return lower traffic demands for Junction Court, however Paramics model study area is limited compared with the Nowra Bomaderry TRACKS model);
- Nowra CBD (East) Road network strategy has now been confirmed with the 2007 revision of Nowra CBD Strategy with ENSA connected direct to North Street with secondary connection to Junction Street, which is likely to result in lower volumes on Junction Court, than if ENSA were connected direct to Junction Street only (trend found in the earlier strategy modelling).

Irrespective of the above influential factors, the TRACKS models predicted strong demand for Junction Street in 2016 with Junction Court removed. This makes sense given the direct connection this option would provide for the linking of Nowra CBD with Princes Highway and ENSA, and the expanding commercial precinct to the east of Princes Highway, Nowra.

It is known from surveys and observed traffic patterns that approximately 30% of existing traffic at Stockland Nowra also has origin or destination in Nowra CBD (west) after discounting trips that utilised CBD (West) road network to access the Princes Highway.

If this pattern were to continue when Nowra CBD (East) is developed to the full potential now envisaged in 2007, the demand for Junction Street could be expected to be in excess of that level previously modelled in TRACKS.

The previously high traffic volumes modelled on Junction Street (when test Junction Court as two-way traffic flow in TRACKS) was determined to be of significant enough concern due to the likely impacts on pedestrian safety and town centre amenity to dismiss opening of Junction Court as a viable option for inclusion in the Nowra CBD Strategy.

Accordingly, until now no further work has been done between 2003 and 2007 (investigating the removal of Junction Court) from a traffic analysis perspective. Additional TRACKS modelling has since been undertaken to complete this review of Junction Court (refer later section of this design note for outcomes and discussion).

Paramics Models

For the base models and all options, five RTA standard seeds have been used for the analysis. The tables presented below are the average of these five RTA standard seeds. Appendix A shows the trip summary table for all seeds and the average for the base models and all options.

Base Paramics Model

The base Paramics model used for the coding of options was the 2016 Nowra CBD Strategy model (an average weekday PM peak period model – validated on Thursday flow conditions) as refined following the 2007 Nowra CBD strategy revision.

The model includes all future land use developments as envisaged in the Nowra CBD Strategy i.e. Stockland Nowra (Fair) expansion proposal, LEDA development proposal, Stockland Lifestyle development proposal (Junction North), assumed traffic generating development on residual Nowra High School land between Junction Street and ENSA, etc. and includes all road network improvements in accordance with Nowra CBD Strategy (as revised in 2007) i.e. including latest recommendations for ENSA, upgrades of Princes Highway intersections, and upgrades of local road network, etc.

The 2016 base Paramics model OD Matrix traffic distribution was taken from the Nowra TRACKS Model (which did not have the Junction Street Mall opened). As a result wider shifts in traffic are not incorporated. The base 2016 model was however modified to allow re routing of traffic from Berry Street to Junction Street with the mall opening, however again - wider shifts in traffic beyond Berry Street are not likely to have been incorporated.

The following changes were made to the base 2016 Model which formed the base for comparison of the Junction Court opening options i.e. 1 to 3 inclusive:

- the network was extended along both Junction Street to the west and Berry Street to the South;
- a new four-way signalised intersection at Junction Street/Berry Street with a simple two phase operation;
- the two external Paramics model Zones 12 and 4, Junction Street and Berry Street respectively, were shifted;

- the two external Paramics model Zones 12 and 4, Junction Street and Berry Street respectively, trip ends were modified to represent 2016 flows at Junction Street/Berry Street Intersection. The total trip ends percentage difference to the base 2016 model was than distributed to each zones OD pairs.

Survey count data for Junction Street/Berry Street Intersection and 2016 volumes are included at Appendix B. Note: Council provided advice that a two (2) percent linear annual growth rate in traffic volumes would be appropriate to apply to old traffic count data for the purpose of the assessment (relevant to Junction Street/Berry Street Intersection and Junction Street/Kinghorne Street Intersection)

The 2016 models have spare capacity in the network and traffic is generally in free flow, subject to road network improvements in accordance with Nowra CBD Strategy (2007 revision). A summary of the 2016 base and 2016 base modified model operational performances are shown in Table 1. The turning counts and link flows for the 2016 base and 2016 modified base networks are included at Appendix C.

Table 1 ***2016 Base Model Operational Performance***

Performance Criteria	2016 Base Performance Value	2016 Base Modified Performance Value
Network Normalised Totals		
Freeflow Time (min)	14,694	15,111
Trip Time (mins)	37,248	40,882
Distance (km)	13,708	14,060
Cost ($)	10,485	11,372
Derived Averages (per vehicle)		
Cost ($)	0.82	0.89
Trip Time (mins)	2.87	3.14
Distance (km)	1.06	1.09
Speed (km/h)	35.0	33.6
Delay (mins)	1.70	1.93

Limitations of the Paramics Model

The Nowra Paramics models were originally developed to undertake modelling assessment of Nowra CBD (East) road network and accordingly extensive validation effort focused on the Princes Highway.

During validation - the model was extended west to Kinghorne Street to ensure re-routing of traffic was possible during peak period conditions (as occurs in reality west of Princes Highway) however this was primarily focused at validation of traffic patterns at Princes Highway intersections and the section of network between Nowra Lane and Princes Highway.

The model was later extended along North Street as part of the detailed North Street traffic study (November 2004) however focus was on appropriate validation of traffic volumes and patterns along North Street.

That is to say – that the Paramics models were never developed or appropriately validated to undertake an assessment of CBD streets further west of Nowra Lane (such as the Junction Court opening options), even though that section of the network is within the peripheral bounds of the modelled network.

However, primarily because the model existed, Council engaged CEO to determine the results of Paramics modelling for the Junction Court opening options (due to the recent resurgence of community pressure for removal of Junction Court), in the lead up to the Nowra CBD Strategy Councillor briefing on Tuesday 3 April 2007.

The model does have limitations for such an exercise, and some of these are summarised below:

- the Paramics models were never developed or appropriately validated to undertake an assessment of CBD streets further west of Nowra Lane (as discussed above);
- the Paramics models did not extend west of Kinghorne Street (as discussed above);
- the 2016 base Paramics model OD Matrix traffic distribution was taken from the Nowra TRACKS Model which did not have the Junction Street Mall opened (as discussed above).

Not withstanding these limitations, prior to the modelling exercise, it was considered that seeing as though the 2016 Paramics models did contain the full scale of development in CBD (East) as envisaged with the 2007 revision of the strategy, that the models may be appropriate to give some general indication of demand for Junction Street with Junction Court removed.

It was found however that the Paramics modelling did not replicate the high demand for Junction Court as found with the earlier TRACKS modelling.

This was of concern as it is not known at this time whether this was due to limitations of the Paramics models or limitations of the TRACKS models.

It was accordingly recommended that TRACKS modelling assessment be revisited to determine strategic demands for the Junction Court link – with the models updated with the latest 2016 Nowra Bomaderry Structure Plan projections, the latest scale of commercial development now envisaged in the Nowra CBD Strategy for CBD (East), the latest revised CBD road network as recommended in the 2007 CBD Strategy revision, and incorporating each of the Junction Court options (1 - 4), prior to further consideration.

Review of Options (Paramics Modelling)

All options gave similar result in terms of operational performance of the network. No option caused unacceptable congestion or delays. Detailed analysis of each option is discussed herein.

Junction Court Options

Option 1 – Open Junction Court (Two-way)

The changes to the 2016 base modified model to effect this Option (Option 1) were as follows:

- one lane 40km/h link of category 74 added from Junction Street/Kinghorne Street Intersection (node 8) to end of Junction Mall (node 68);
- one lane 40km/h links of category 74 added from Junction Street/O'Keefe Street Intersection (node 20) to end of Junction Mall (node 68);
- two lane 40km/h link of category 75 added from end of Junction Mall (node 68) to Junction Street/Kinghorne Street Intersection (node 8);
- links from end of Junction Mall (node 68) to Junction Street/ O'Keefe Street Intersection (node 20) changed from 20km/h (category 77) links to 40km/h links (category 74) to reflect this section as a normal through street;
- phasing at Junction Street/Kinghorne Street Intersection and Junction Street/O'Keefe Street modified to include new two-way movements along Junction Street.

The lane configuration and phasing for Option 1 are included at Appendix D.

The volume of traffic expected to use the new two-way links are as follows:

- eastbound: 266vph;
- westbound: 310vph;
- TOTAL: 576vph.

Of the eastbound traffic, approximately 50% are travelling to the retail zones east of the Princes Highway from the western and south-western external zones i.e. Junction Street, Worrigee Street and Plunkett Street. Another 16% of the eastbound traffic is also travelling to the retail zones east of the Princes Highway from the north-western zones or other internal zones. The remaining traffic is made up as follows:

- 7% to ENSA;
- 15% to other external zones;
- 12% local circulating traffic to other internal zones.

In the westbound direction there is a similar pattern but in reverse of approximately 53% of vehicles are travelling from retail zones east of the Princes Highway to the western and south-western external zones. The majority of the remaining traffic is local circulating traffic.

This option does not produce any grid-locking or excessive congestion in the network. It has moderately higher trip times and slightly higher cost for the entire network compared to the 2016 modified base. A summary of the Option 1 operational performance with comparison to the base model is shown in Table 2.

Table 2 Option 1 Junction Court Open (two-way traffic) v Base Model Operational Performance

Performance Criteria	Performance Value	Variation from 2016 Base Modified
Network Normalised Totals		
Freeflow Time (min)	15,025	-0.6%
Trip Time (mins)	39,914	-2.4%
Distance (km)	13,954	-0.8%
Cost ($)	10,990	-3.4%
Derived Averages (per vehicle)		
Cost ($)	0.86	-3.6%
Trip Time (mins)	3.07	-2.2%
Distance (km)	1.08	-1.1%
Speed (km/h)	34.0	1.3%
Delay (mins)	1.87	-3.0%

A summary of the turning counts and link flows for Option 1 are shown in Table 3 and full turning counts and link flows are included at Appendix D.

Table 3 Option 1 Junction Court Open (two-way traffic) v Base Model Flows

Section	Option 1 Flows	2016 Base Modified Flows	Variation from 2016 Base Modified Flow
Junction St West of Kinghorne St			
Eastbound	208	139	50%
Westbound	396	281	41%
Junction St East of O'Keefe Av			
Eastbound	344	295	17%
Westbound	357	137	161%
Kinghorne St north of Junction St			
Northbound	166	129	29%
Southbound	263	251	5%
Kinghorne St south of Junction St			
Northbound	141	150	-6%
Southbound	88	123	-28%
O'Keefe Av north of Junction St			
Northbound	448	409	10%
Southbound	427	446	-4%

Section	Option 1 Flows	2016 Base Modified Flows	Variation from 2016 Base Modified Flow
O'Keefe Av south of Junction St			
Northbound	419	466	-10%
Southbound	272	239	14%

As expected there is significantly higher traffic volumes on Junction Street east and west of Junction Court. On O'Keefe Avenue there is minor volume changes, however on Kinghorne Street north of Junction Court has moderately increased traffic due to vehicles now travelling further west before heading north and has moderately decreased traffic south of Junction Court due to previously left turning vehicles now travelling further east before heading south.

Option 2 – Open Junction Court (One-way Eastbound)

The changes to the 2016 base modified model for Option 2 were as follows:

- one lane 40km/h link of category 74 added from Junction Street/Kinghorne Street Intersection (node 8) to end of Junction Mall (node 68);
- links from end of Junction Mall (node 68) to Junction Street/O'Keefe Street Intersection (node 20) changed from 20km/h links (category 77) to 40km/h links (category 74) to reflect this section as a normal through street;
- phasing at Junction Street/Kinghorne Street Intersection modified to include new one-way eastbound movements along Junction Street.

The lane configuration and phasing for Option 3 are included at Appendix E.

The volume of traffic expected to use the new one-way eastbound link is as follows:

- eastbound: 265vph.

The traffic pattern of vehicles travelling eastbound though the mall is similar to Option 1.

This option does not produce any grid-locking or excessive congestion in the network. It has moderately higher trip times and slightly higher cost for the entire network compared to the 2016 modified base. It has higher trip times, delays and costs compared with the Junction Court (two-way) option. A summary of the option 2 operational performance with comparison to the 2016 base modified model is shown in Table 4.

Table 4 Option 2 Junction Court Open (one-way E/B) v Base Model Operational Performance

Performance Criteria	Performance Value	Variation from 2016 Base Modified
Network Normalised Totals		
Freeflow Time (min)	15,017	-0.6%
Trip Time (mins)	40,141	-1.8%
Distance (km)	14,015	-0.3%
Cost ($)	11,125	-2.2%
Derived Averages (per vehicle)		
Cost ($)	0.87	-2.5%
Trip Time (mins)	3.08	-1.9%
Distance (km)	1.09	-0.4%
Speed (km/h)	33.6	0.1%
Delay (mins)	1.88	-2.9%

A summary of the turning counts and link flows for Option 2 are shown in Table 5 and full turning counts and link flows are included at Appendix E.

Table 5 ***Option 2 Junction Court Open (one-way E/B) v Base Model Flows***

Section	Option 2 Flows	2016 Base Modified Flows	Variation from 2016 Base Modified Flow
Junction St West of Kinghorne St			
Eastbound	212	139	53%
Westbound	219	281	-22%
Junction St East of O'Keefe Av			
Eastbound	350	295	19%
Westbound	112	137	-18%
Kinghorne St north of Junction St			
Northbound	132	129	2%
Southbound	241	251	-4%
Kinghorne St south of Junction St			
Northbound	210	150	40%
Southbound	47	123	-62%
O'Keefe Av north of Junction St			
Northbound	454	409	11%
Southbound	422	446	-5%
O'Keefe Av south of Junction St			
Northbound	409	466	-12%
Southbound	307	239	28%

Similarly as options 1, there is significantly higher traffic volumes on Junction Street east and west of Junction Court but only in the eastbound direction. Kinghorne Street south of Junction Court has moderately increased traffic northbound due to vehicles now turning right into Junction Court and has significantly decreased traffic southbound due to previously left turning vehicles now travelling further east before heading south.

Option 3 – Open Junction Court (One-way Westbound)

The changes to the 2016 base modified model for Option 3 were as follows:

- one lane 40km/h links of category 74 added from Junction Street/O'Keefe Street Intersection (node 20) to end of Junction Mall (node 68);
- two lane 40km/h link of category 75 added from end of Junction Mall (node 68) to Junction Street/Kinghorne Street Intersection (node 8);
- links removed from end of Junction Street Mall (node 68) to Junction Street/O'Keefe Street Intersection (node 20);
- phasing at Junction Street/Kinghorne Street Intersection and to Junction Street/O'Keefe Street Intersection modified to include new one-way westbound movements along Junction Street;
- phasing at Junction Street/O'Keefe Street Intersection modified to remove existing one-way eastbound movements.

The lane configuration and phasing for Option 3 are included at Appendix F.

The volume of traffic expected to use the new one-way westbound link is as follows:

- westbound: 253vph.

The traffic pattern of vehicles travelling westbound though the mall is similar to Option 1.

This option does not produce any grid-locking or excessive congestion in the network. It has moderately higher trip times and minimal increase to delays and costs for the entire network compared to the 2016 modified base. It has the least impact on trip times, delays and costs when compared to the other Junction Court opening options. A summary of Option 3 operational performance with comparison to the 2016 base modified model is shown in Table 6.

Irrespective of the actual traffic volume demand for the Junction Court link, the Paramics modelling undertaken has shown comparative advantages and disadvantages between the junction Court opening options – of which Option 3 - Open Junction Court (One-way Westbound) has been found to have the least impact of all the Junction Court opening options.

Table 6 Option 3 Junction Court Open (one-way W/B) v Base Model Operational Performance

Performance Criteria	Performance Value	Variation from 2016 Base Modified
Network Normalised Totals		
Freeflow Time (min)	15,041	-0.5%
Trip Time (mins)	38,839	-5.0%
Distance (km)	13,977	-0.6%
Cost ($)	10,956	-3.7%
Derived Averages (per vehicle)		
Cost ($)	0.85	-4.0%
Trip Time (mins)	2.99	-4.8%
Distance (km)	1.08	-0.7%
Speed (km/h)	34.2	2.0%
Delay (mins)	1.79	-7.6%

A summary of the turning counts and link flows for Option 3 are shown in Table 7 and full turning counts and link flows are included at Appendix F.

Table 7 Option 3 Junction Court Open (one-way W/B) v Base Model Flows

Section	Option 3 Flows	2016 Base Modified Flows	Variation from 2016 Base Modified Flow
Junction St West of Kinghorne St			
Eastbound	119	139	-14%
Westbound	390	281	39%
Junction St East of O'Keefe Av			
Eastbound	280	295	-5%
Westbound	303	137	121%
Kinghorne St north of Junction St			
Northbound	148	129	15%
Southbound	254	251	1%
Kinghorne St south of Junction St			
Northbound	62	150	-59%
Southbound	146	123	19%
O'Keefe Av north of Junction St			
Northbound	386	409	-6%
Southbound	486	446	9%
O'Keefe Av south of Junction St			
Northbound	526	466	13%
Southbound	240	239	0%

Similarly as options 1, there is significantly higher traffic volumes on Junction Street east and west of Junction Court but only in the westbound direction. Kinghorne Street south of Junction Court has significantly decreased traffic northbound due to vehicles now able to using Nowra Lane northbound and left into Junction Court. On O'Keefe Avenue there is minor volume changes.

Worrigee Street Options

Option 1 – Worrigee Street One-way Eastbound

The changes to the 2016 base model to effect this Option were as follows:

- westbound links removed from Princes Highway (node 38) to Haigh Avenue (node 24);
- right turn lanes on Princes Highway southbound removed;
- phasing at Princes Highway/Worrigee Street Intersection and Worrigee Street/Haigh Avenue Intersection modified to remove westbound movements on Worrigee Street between Haigh Avenue and Princes Highway.

The lane configuration and phasing for Option 4 are included at Appendix G.

This option was modelled with no other changes to the Nowra CBD Strategy, that is – Junction Court is closed to traffic in this option, as per the current Nowra CBD strategy recommendations.

The 2016 base model shows a flow of approximately 710vph westbound on Worrigee Street between Princes Highway and Haigh Avenue.

70% of this traffic is travelling to the external zone at the end of Worrigee Street (west of Kinghorne Street). Of this 70% of traffic, approximately 40% is from Princes Highway northern external zone, 40% is from Princes Highway southern external zone and the remaining 20% is split between other external zones and retail zones east of the Princes Highway.

The remaining 30% of westbound traffic is split between vehicles to the external on Plunkett Street and other internal zones west of Princes Highway.

With the westbound section of Worrigee Street closed in this option, the 710vph are re-routed at the following three major locations and use the following routes:

- approximately 33% at Princes Highway/Moss Street from Princes Highway southbound turn right at Moss Street and either continue straight through or turn right and than left at Kinghorne Street;
- approximately 15% at Princes Highway/Junction Street from retail zones east of Princes Highway continue straight at Junction Street, left at Nowra Lane and than right at Worrigee Street;
- approximately 25% at Princes Highway/Plunkett Street traffic from Princes Highway northbound turn left at Plunkett Street and either turn right at Haigh Avenue or Kinghorne Street.

The balance (27%) distribute between Junction Street, North Street, and Plunkett Street via various zones.

To allow for the shift in the traffic pattern, phase times were modified to reflect increased turning movements at several intersections as follows:

- Princes Highway/Moss Street for southbound right turns to Moss Street;
- Moss Street/North Street for southbound through and right turns;
- Princes Highway/Plunkett Street for northbound left turns to Plunkett Street;
- Plunkett Street/Haigh Avenue for northbound right turns to Haigh Avenue;
- Plunkett Street/Kinghorne Street for northbound right turns to Kinghorne Street.

This option does not produce any grid-locking or excessive congestion in the network. It has moderately higher trip times, delays and costs for the entire network compared to the 2016 base model.

A summary of operational performance with comparison to the 2016 base model is shown in Table 8.

The turning counts and link flows for Option 4 are included at Appendix G.

Table 8 Option 4 Worrigee (one-way E/B) Haigh to SH1 v Base Model Operational Performance

Performance Criteria	Performance Value	Variation from 2016 Base
Network Normalised Totals		
Freeflow Time (min)	14,697	0.0%
Trip Time (mins)	40,176	7.9%
Distance (km)	13,688	-0.1%
Cost ($)	11,087	5.7%
Derived Averages (per vehicle)		
Cost ($)	0.86	5.4%
Trip Time (mins)	3.06	6.7%
Distance (km)	1.06	-0.4%
Speed (km/h)	33.4	-4.4%
Delay (mins)	1.89	11.3%

Nowra CBD Accessibility is an important issue that can not be directly measured by the Paramics models. The need to maintain accessibility is an important strategic objective of the Nowra CBD Strategy. This is particularly important when considering the need to optimise Princes Highway through flows in future, and accordingly Nowra CBD side roads will need to be upgraded (not downgraded) to optimise side road capacity in future (to combat proportional reductions in green time).

It is considered that the reduction in accessibility is not justified when considering that the impacts of this option lead to increased trip times, delays and costs for the entire network compared to the 2016 base model. Accordingly, this Option is not recommended.

Review of Options (2007 TRACKS modelling)

Additional TRACKS modelling has since been undertaken to incorporate the 2007 revised Nowra CBD Strategy assumptions including land use changes that reflect current Nowra Bomaderry Structure Plan projections including impacts of Stockland and LEDA developments on Nowra CBD West.

The base 2016 TRACKS volumes are included at Appendix H.

Junction Court Options

Results of latest TRACKS modelling analysis for the Junction Court Options are shown in Table 9 and included at Appendix I.

Table 9 TRACKS Junction Court Options Results

Speed	Option		
	One Way EB	One Way WB	Two Way
30kmh	5,700vpd	7,970vpd	16,630vpd
40kmh	6,420vpd	8,280vpd	15,770vpd
50kmh	6,790vpd	8,400vpd	16,230vpd

The trend in comparing the TRACKS vs. Paramics traffic modelling estimates of traffic flow on Junction Court have been found to be similar. That is, the estimates of traffic volume are still much greater in TRACKS than predicted by the Paramics Model. This is most likely due to differences in model operations and study area as mentioned in the section “Limitation of Paramics Model“ above.

The minor reductions in TRACKS traffic flow estimates on Junction Court (2003 compared to 2007) is most likely related to an assumed reduction in retail growth for CBD west assumed (in consideration of

likely impacts of Stockland and LEDA developments) again mentioned in the section “Limitation of Paramics Model“ above.

It is noted that the Paramics model predicted traffic flows on Junction Court when opened to two-way traffic (576vph) is approximately equivalent to existing traffic flows on Junction Street west of Kinghorne Street (between Berry Street and Kinghorne Street).

In order to understand the relative differences between TRACKS and Paramics modelling outcomes, the assessment has also considered the likely traffic flows from first principles basis.

Considering that some 30 - 35 % of traffic from Nowra on CBD (East) will also have origin or destination in Nowra CBD (West), the following can be estimated as being likely minimum traffic demand levels from first principles:

- commercial floor space east of Princes Highway Nowra:
  - with an envisaged total commercial floor space of 88,643sq.m east of Princes Highway Nowra CBD estimated trips are: 88,643sq.m x 4.7 trips (average for all land uses) per 100 sq.m x 35% = 1,460vph;
  - these trips are apportioned across North Street, Junction Street, Worrigee Street, and Plunkett Street. At least 50% could be expected to use Junction Street if available as a direct two-way link into Nowra CBD (West) and if capacity allows;
  - therefore the estimated trips on Junction Court are: 1,460vph x 50% = 730vph.
- ENSA:
  - approximately 30% of ENSA trips could use Junction Street for access to CBD: 1,500vph x 30% = 450vph;
- peak to daily factor:
  - reviewing count data for Jane Street and Junction Street servicing Stockland Nowra Fair the average of 3 counts on Jane Street and 2 counts on Junction Street for the 3:30-4:30pm PM period on Thursdays was 8.532 % - i.e. peak to daily factor is 11.72;
- total demand:
  - therefore, the total estimated trips on Junction Court are: 450vph (ENSA component) + 730vph (commercial component) = approx 1,180vph
  - therefore, the total estimated daily trips = 1,180vph * 11.72 = 13,830vpd.

This estimate from first principles is 2 x the magnitude of that demand estimated by the 2016 strategy Paramics model, and is more comparable to the traffic demands predicted by 2016 TRACKS model.

On first principles, it seems like a reasonable traffic demand estimate for ‘minimum; expected likely traffic flows.

On these same principles, and assuming approx 50/50 directional split – one-way link flows for Junction Court could be (from first principles) expected to be at least 590vph – i.e. the same magnitude as estimated by the 2016 Paramics model for two way modelled scenario.

In considering strategy for Junction Court, Council must consider the potential for Junction Court to reach traffic volumes in the order predicted by the 2016 TRACKS models for that year of assessment, if opened to traffic.

On the basis of the modelling undertaken, it is considered that there is no justification on traffic grounds for Junction Court to be opened to traffic.

However, if Council considers that it is necessary for Junction Court to be opened to traffic for reasons (other than traffic management), then it is recommended on the basis of modelling outcomes that one way “westbound” be adopted as the preferred management approach to reduce network impacts (mitigate the adverse impacts of opening Junction Court to traffic), with designs to address issues relating to amenity, pedestrian safety, intersection safety (Junction / O’Connell and Junction / Nowra Lane), access, taxi and parking requirements, etc.

Worrigee Street Options

Results of latest TRACKS modelling analysis for the Worrigee Street options are shown in Table 10 and included at Appendix J.

Table 10 ***TRACKS Worrigee Street Options Results***

Section	Base	Option1 – Worrigee Street One-way Eastbound		Option1 plus Plunkett Street One-way Westbound	
	vpd	vpd	% diff	vpd	% diff
Moss Street Eastbound	2,350	2,354	0.2%	2,373	1.0%
Moss Street Westbound	1,590	1,760	10.7%	1,745	9.7%
North Street Eastbound	5,809	5,764	-0.8%	5,831	0.4%
North Street Westbound	7,789	8,958	15.0%	9,338	19.9%
Junction Street Eastbound	896	857	-4.4%	914	2.0%
Junction Street Westbound	400	400	0.0%	400	0.0%
Worrigee Street Eastbound	6,860	6,872	0.2%	8,274	20.6%
Worrigee Street Westbound	5,836	0	-100.0%	0	0.0%
Plunkett Street Eastbound	3,156	3,140	-0.5%	0	0.0%
Plunkett Street Westbound	4,964	9,141	84.1%	9,347	88.3%
TOTAL	**39,650**	**39,246**	**-1.0%**	**38,222**	**-3.6%**

The results show that Plunkett Street westbound carries the majority of the re-routed traffic with approximately 90% increase from the base case, followed by North Street Westbound and Worrigee Street Eastbound both with approximately 20% increases from the base.

Considerations of Others Factors

When considering opening a mall several factors need to be considered such as parking, circulation, pedestrian safety, town centre amenity (retention of maximum open space) cost and crime prevention.

Compared to a two way system, a one way system provides better environment for pedestrians due to lower traffic volumes and pedestrians only need to be mindful of traffic in one direction of flow. Depending on available road reserve, a one-way system may provide increased parking opportunity (potential to allow angled v parallel parking) and improved amenity through increased reserve available for landscaped design. A two-way system would introduce higher traffic volumes and higher propensity for rat-running. A one way system could allow enhanced opportunities to control rat-running through appropriate calming design measures. In terms of crime prevention a two-way option allows higher traffic volumes, however as can be seen from the modelling a one way system will still introduce reasonably high traffic volumes - higher traffic volumes in the future than currently on Junction Street (the section between Kinghorne Street and Berry Street).

Conclusion

Of the three Junction Court opening options, no option caused unacceptable congestion or delays in the Paramics models. This is primarily due to the base 2016 model having no capacity issues, subject to road network improvements in accordance with Nowra CBD Strategy (2007 revision). However, the one-way westbound option was found to have slightly better operational performance (lower relative travel times, delays and costs) than the other two options.

The Paramics modelling showed in 2016 approximate volume of 2,500AADT per direction or approximately double that flow (nearer 5,000vpd) for two-way would be expected if the Junction Court was opened to traffic.

This is considerably lower than both 2003 and 2007 TRACKS model analysis, which indicates 2016 approximate volume of 8,000AADT per direction or approximately double that flow (nearer 16,000vpd) for two-way would be expected if the Junction Court was opened to traffic.

The differences in the modelling outputs (TRACKS v Paramics) are most likely related to model operations and study area.

When considering objectives of pedestrian safety, town centre amenity (retention of maximum open space), and network operations, the one-way options would be preferred (noting one way westbound would be preferred on basis of Paramics modelling).

In considering strategy for Junction Court, Council must consider the potential for Junction Court to reach traffic volumes in the order predicted by the 2016 TRACKS models for that year of assessment, if opened to traffic.

On the basis of the modelling undertaken, it is considered that there is no justification on traffic grounds for Junction Court to be opened to traffic.

However, if Council considers that it is necessary for Junction Court to be opened to traffic for reasons (other than traffic management), then it is recommended on the basis of modelling outcomes that one way "westbound" be adopted as the preferred management approach to reduce network impacts (mitigate the adverse impacts of opening Junction Court to traffic), with designs to address issues relating to amenity, pedestrian safety, intersection safety (Junction / O'Connell and Junction / Nowra Lane), access, taxi and parking requirements, etc.

Other than localised impacts which need to be considered, one way westbound flow is unlikely to result in network operational difficulties in the short term, however modelling indicates that by 2016, traffic flows on Junction Court are likely to be in the order of 8,000vpd (marginally higher than the existing two-way flows on Junction Street. Accordingly, design will need to consider appropriate traffic calming and pedestrian safety as important design elements.

Opening up Junction Court to traffic will require resolution of an appropriate safety treatment at intersection Junction Street/O'Connell Lane, as well as resolution of any necessary changes to existing shop front parking and existing taxi zone arrangements (dependent on adopted traffic directional arrangements). These will require liaison with affected parties as part of detailed design process.

If one way westbound is adopted by Council (preferred on basis of detailed Paramics modelling), an option may be to introduce one way westbound on Junction court section only, and provide two-way traffic flow between O'Connell Lane and Nowra Lane (to maintain shop front parking and provide opportunity for retention of taxi zone in this location). This will still require resolution of an appropriate safety treatment at intersection Junction Street/O'Connell Lane. Other options may need to be considered to resolve these issues.

For the Worrigee Street one-way eastbound option, the modelling of this option did not cause unacceptable congestion or delays. However, it is considered that the resultant reduction in accessibility is not justified when considering the strategic objectives of the Nowra CBD strategy (maintain accessibility and maximise side road capacity to combat proportional reduction in green time at Highway intersections), and considering that the impacts of this option do lead to increased trip times, delays and costs for the entire network compared to the 2016 base model. Accordingly, this Option is not recommended.

Appendix A

Trip Summary for all

RTA Standard Seeds

Nowra CBD Strategy Review
Paramics Trips Summary

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Performance Criteria	2016 Performance Value	2016 Modified Performance Value	Option 1 Performance Value	Difference Variation from 2016 Base Modified	Option 2 Performance Value	Difference Variation from 2016 Base Modified	Option 3 Performance Value	Difference Variation from 2016 Base Modified	Option 4 Performance Value	Difference Variation from 2016 Base
Network Normalised Totals										
Freeflow Time (min)	14,602	15,091	**15,041**	-0.3%	14,907	-1.2%	15,037	-0.4%	14,723	0.8%
Trip Time (mins)	36,985	39,589	39,782	0.5%	43,478	9.8%	**39,122**	-1.2%	39,323	6.3%
Distance (km)	13,666	13,977	13,972	0.0%	13,965	-0.1%	**13,949**	-0.2%	13,693	0.2%
Cost ($)	10,386	11,199	**10,899**	-2.7%	11,599	3.6%	11,022	-1.6%	10,814	4.1%
Derived Averages (per vehicle)										
Cost ($)	0.81	0.88	**0.85**	-3.4%	0.9	2.3%	0.86	-2.3%	0.84	3.7%
Trip Time (mins)	2.84	3.05	3.07	0.7%	3.3	8.2%	**3.01**	-1.3%	3.01	6.0%
Distance (km)	1.06	1.09	**1.08**	-0.9%	**1.08**	-0.9%	**1.08**	-0.9%	1.06	0.0%
Speed (km/h)	34.90	34.20	33.1	-3.2%	**33.9**	-0.9%	33.7	-1.5%	34.40	-1.4%
Delay (mins)	1.67	1.85	1.87	1.1%	2.1	13.5%	**1.81**	-2.2%	1.84	10.2%

Seed 560

Performance Criteria	2016 Performance Value	2016 Modified Performance Value	Option 1 Performance Value	Difference Variation from 2016 Base Modified	Option 2 Performance Value	Difference Variation from 2016 Base Modified	Option 3 Performance Value	Difference Variation from 2016 Base Modified	Option 4 Performance Value	Difference Variation from 2016 Base
Network Normalised Totals										
Freeflow Time (min)	14,768	15,135	15,058	-0.5%	14,979	-1.0%	**15,099**	-0.2%	14,681	-0.6%
Trip Time (mins)	36,600	42,059	39,962	-5.0%	40,085	-4.7%	**39,345**	-6.5%	38,240	4.5%
Distance (km)	13,753	14,104	**13,978**	-0.9%	13,994	-0.8%	14,033	-0.5%	13,648	-0.8%
Cost ($)	10,356	11,402	**10,862**	-4.7%	11,186	-1.9%	11,155	-2.2%	10,835	4.6%
Derived Averages (per vehicle)										
Cost ($)	0.81	0.89	**0.85**	-4.5%	0.87	-2.2%	0.87	-2.2%	0.85	4.9%
Trip Time (mins)	2.82	3.22	3.08	-4.3%	3.07	-4.7%	**3.03**	-5.9%	2.94	4.3%
Distance (km)	1.07	1.10	**1.08**	-1.8%	1.09	-0.9%	1.09	-0.9%	1.06	-0.9%
Speed (km/h)	34.90	34.20	33.1	-3.2%	**33.9**	-0.9%	33.7	-1.5%	34.40	-1.4%
Delay (mins)	1.64	2.01	1.88	-6.5%	1.87	-7.0%	**1.82**	-9.5%	1.77	7.9%

Seed 2849

Performance Criteria	2016 Performance Value	2016 Modified Performance Value	Option 1 Performance Value	Difference Variation from 2016 Base Modified	Option 2 Performance Value	Difference Variation from 2016 Base Modified	Option 3 Performance Value	Difference Variation from 2016 Base Modified	Option 4 Performance Value	Difference Variation from 2016 Base
Network Normalised Totals										
Freeflow Time (min)	14,673	15,099	15,054	-0.3%	**15,105**	0.0%	14,919	-1.2%	14,583	-0.6%
Trip Time (mins)	36,961	39,516	39,642	0.3%	39,399	-0.3%	**37,747**	-4.5%	42,881	16.0%
Distance (km)	13,692	14,065	13,988	-0.5%	14,053	-0.1%	**13,885**	-1.3%	13,669	-0.2%
Cost ($)	10,511	11,141	11,009	-1.2%	10,996	-1.3%	**10,713**	-3.8%	11,510	9.5%
Derived Averages (per vehicle)										
Cost ($)	0.82	0.87	0.86	-1.1%	0.86	-1.1%	**0.83**	-4.6%	0.89	8.5%
Trip Time (mins)	2.84	3.04	3.04	0.0%	3.05	0.3%	**2.89**	-4.9%	3.21	13.0%
Distance (km)	1.06	1.09	**1.08**	-0.9%	1.09	0.0%	**1.08**	-0.9%	1.05	-0.9%
Speed (km/h)	34.90	34.20	33.1	-3.2%	**33.9**	-0.9%	33.7	-1.5%	34.40	-1.4%
Delay (mins)	1.67	1.83	1.84	0.5%	1.84	0.5%	**1.7**	-7.1%	2.04	22.2%

Nowra CBD Strategy Review
Paramics Trips Summary

Seed 7771

Performance Criteria	2016 Performance Value	2016 Modified Performance Value	Option 1 Performance Value	Difference Variation from 2016 Base Modified	Option 2 Performance Value	Difference Variation from 2016 Base Modified	Option 3 Performance Value	Difference Variation from 2016 Base Modified	Option 4 Performance Value	Difference Variation from 2016 Base
Network Normalised Totals										
Freeflow Time (min)	14,698	15,173	15,009	-1.1%	15,056	-0.8%	**15,154**	-0.1%	14,797	0.7%
Trip Time (mins)	38,296	40,429	40,376	-0.1%	**39,102**	-3.3%	39,676	-1.9%	43,008	12.3%
Distance (km)	13,694	14,106	**13,926**	-1.3%	14,058	-0.3%	14,085	-0.1%	13,736	0.3%
Cost ($)	10,809	11,360	11,109	-2.2%	**11,002**	-3.2%	11,105	-2.2%	11,653	7.8%
Derived Averages (per vehicle)										
Cost ($)	0.84	0.89	0.87	-2.2%	**0.86**	-3.4%	0.87	-2.2%	0.91	8.3%
Trip Time (mins)	2.96	3.11	3.11	0.0%	**3.01**	-3.2%	3.06	-1.6%	3.29	11.1%
Distance (km)	1.06	1.09	**1.08**	-0.9%	1.09	0.0%	1.09	0.0%	1.07	0.9%
Speed (km/h)	34.90	34.20	33.1	-3.2%	**33.9**	-0.9%	33.7	-1.5%	34.40	-1.4%
Delay (mins)	1.79	1.90	1.91	0.5%	**1.8**	-5.3%	1.85	-2.6%	2.11	17.9%

Seed 86524

Performance Criteria	2016 Performance Value	2016 Modified Performance Value	Option 1 Performance Value	Difference Variation from 2016 Base Modified	Option 2 Performance Value	Difference Variation from 2016 Base Modified	Option 3 Performance Value	Difference Variation from 2016 Base Modified	Option 4 Performance Value	Difference Variation from 2016 Base
Network Normalised Totals										
Freeflow Time (min)	14,727	15,055	14,965	-0.6%	**15,037**	-0.1%	14,997	-0.4%	14,703	-0.2%
Trip Time (mins)	37,396	42,818	39,807	-7.0%	38,639	-9.8%	**38,304**	-10.5%	37,430	0.1%
Distance (km)	13,737	14,050	**13,905**	-1.0%	14,007	-0.3%	13,935	-0.8%	13,694	-0.3%
Cost ($)	10,364	11,757	11,072	-5.8%	10,843	-7.8%	**10,787**	-8.3%	10,622	2.5%
Derived Averages (per vehicle)										
Cost ($)	0.81	0.92	0.86	-6.5%	0.85	-7.6%	**0.84**	-8.7%	0.82	1.2%
Trip Time (mins)	2.89	3.28	3.06	-6.7%	2.97	-9.5%	**2.95**	-10.1%	2.86	-1.0%
Distance (km)	1.07	1.09	**1.08**	-0.9%	1.09	0.0%	**1.08**	-0.9%	1.06	-0.9%
Speed (km/h)	34.90	34.20	33.1	-3.2%	**33.9**	-0.9%	33.7	-1.5%	34.40	-1.4%
Delay (mins)	1.72	2.07	1.87	-9.7%	1.77	-14.5%	**1.75**	-15.5%	1.69	-1.7%

Average

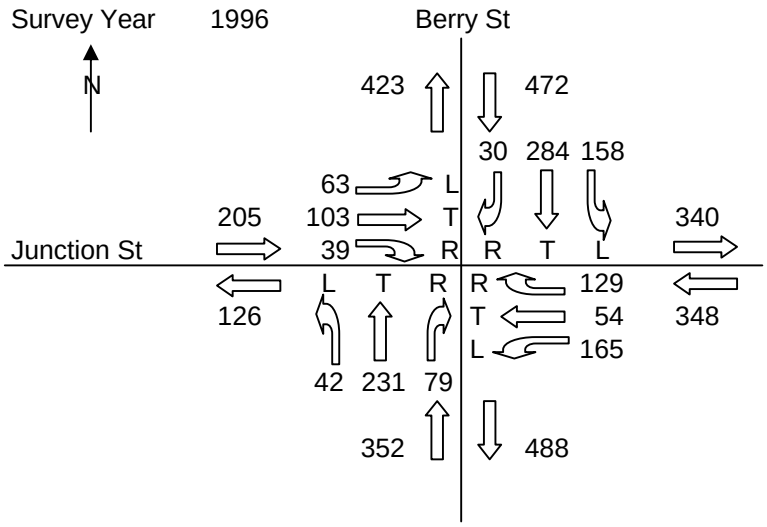
Performance Criteria	2016 Performance Value	2016 Modified Performance Value	Option 1 Performance Value	Difference Variation from 2016 Base Modified	Option 2 Performance Value	Difference Variation from 2016 Base Modified	Option 3 Performance Value	Difference Variation from 2016 Base Modified	Option 4 Performance Value	Difference Variation from 2016 Base
Network Normalised Totals										
Freeflow Time (min)	14,694	15,111	15,025	-0.6%	15,017	-0.6%	**15,041**	-0.5%	14,697	0.0%
Trip Time (mins)	37,248	40,882	39,914	-2.4%	40,141	-1.8%	**38,839**	-5.0%	40,176	7.9%
Distance (km)	13,708	14,060	**13,954**	-0.8%	14,015	-0.3%	13,977	-0.6%	13,688	-0.1%
Cost ($)	10,485	11,372	10,990	-3.4%	11,125	-2.2%	**10,956**	-3.7%	11,087	5.7%
Derived Averages (per vehicle)										
Cost ($)	0.82	0.89	0.86	-3.6%	0.87	-2.5%	**0.85**	-4.0%	0.86	5.4%
Trip Time (mins)	2.87	3.14	3.07	-2.2%	3.08	-1.9%	**2.99**	-4.8%	3.06	6.7%
Distance (km)	1.06	1.09	**1.08**	-1.1%	1.09	-0.4%	1.08	-0.7%	1.06	-0.4%
Speed (km/h)	35.0	33.6	34.0	1.3%	33.6	0.1%	**34.2**	2.0%	33.4	-4.4%
Delay (mins)	1.70	1.93	1.87	-3.0%	1.88	-2.9%	**1.79**	-7.6%	1.89	11.3%

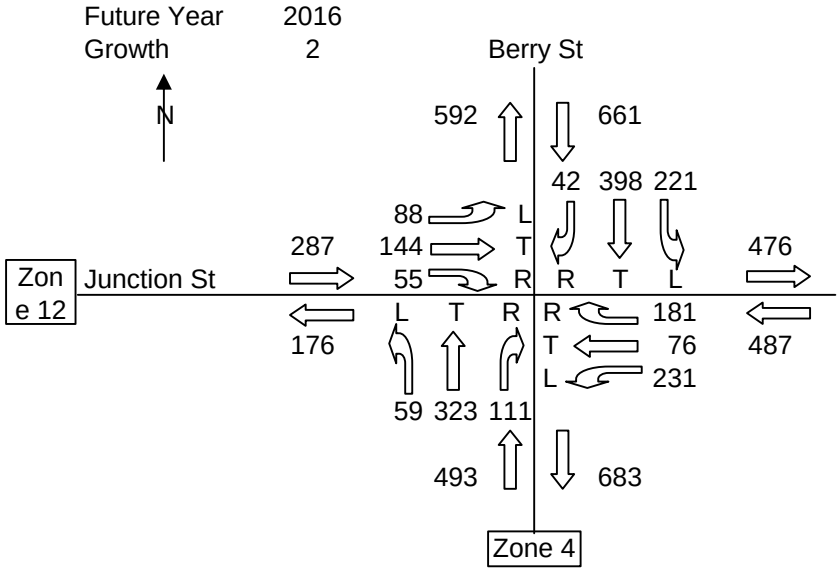
Appendix B

Junction Street/ Berry Street

Surveyed Intersection Counts

and Future Volumes


Survey Year
1996
Berry St
N
423
472
30
284
158
63
L
205
103
T
340
Junction St
39
R
R
T
L
L
T
R
R
129
126
T
54
348
L
165
42
231
79
352
488


Future Year
2016
Growth
2
Berry St
N
592
661
42
398
221
88
L
287
144
T
476
Zon
e 12
Junction St
55
R
R
T
L
L
T
R
R
181
176
T
76
487
L
231
59
323
111
493
683
Zone 4

Appendix C

2016 Nowra CBD Strategy

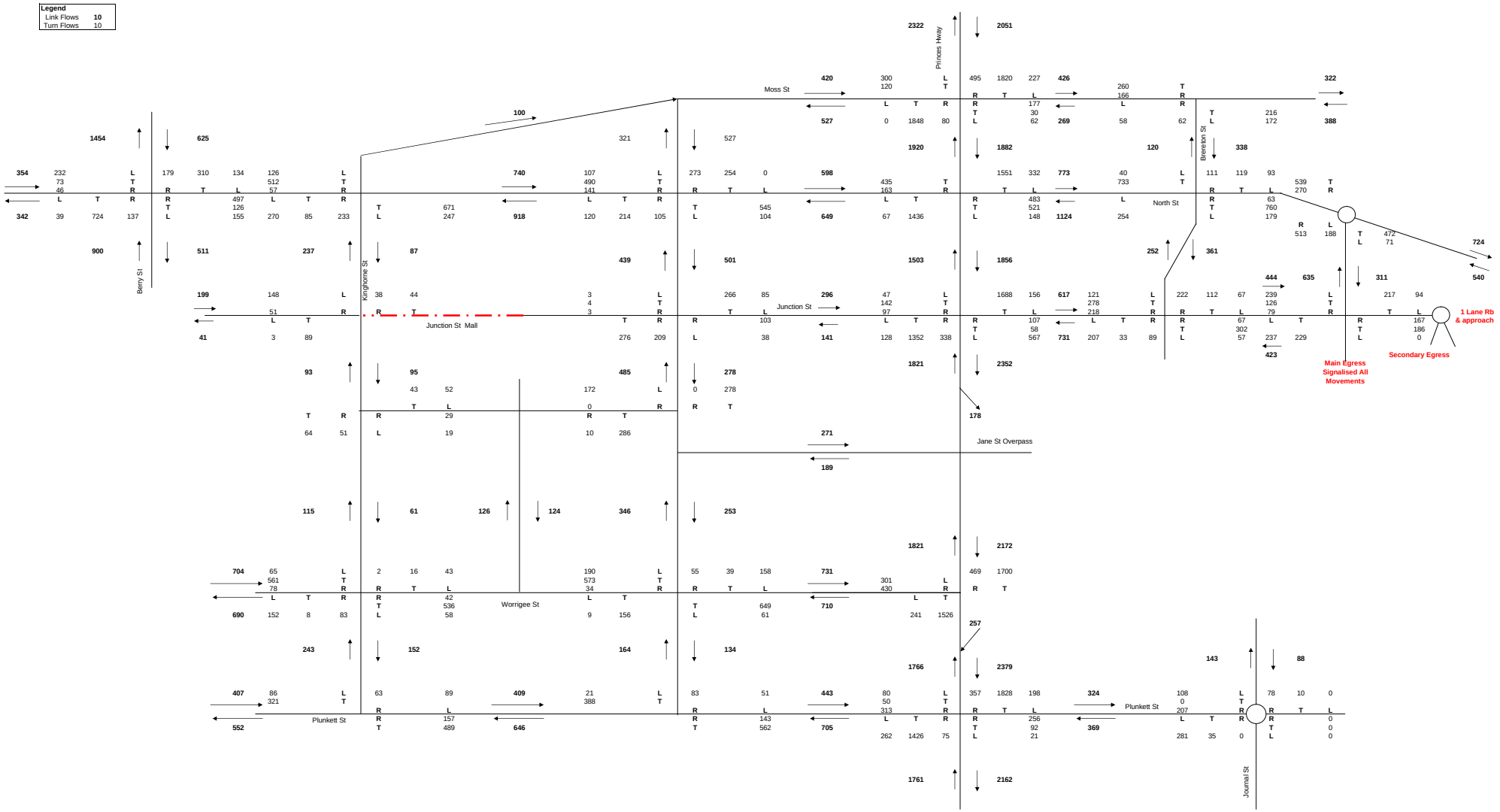
Base and Base Modified

Turning Counts and Link Flows

NOWRA CBD STRATEGY 2016 REVIEW

Paramics Model Turn Counts

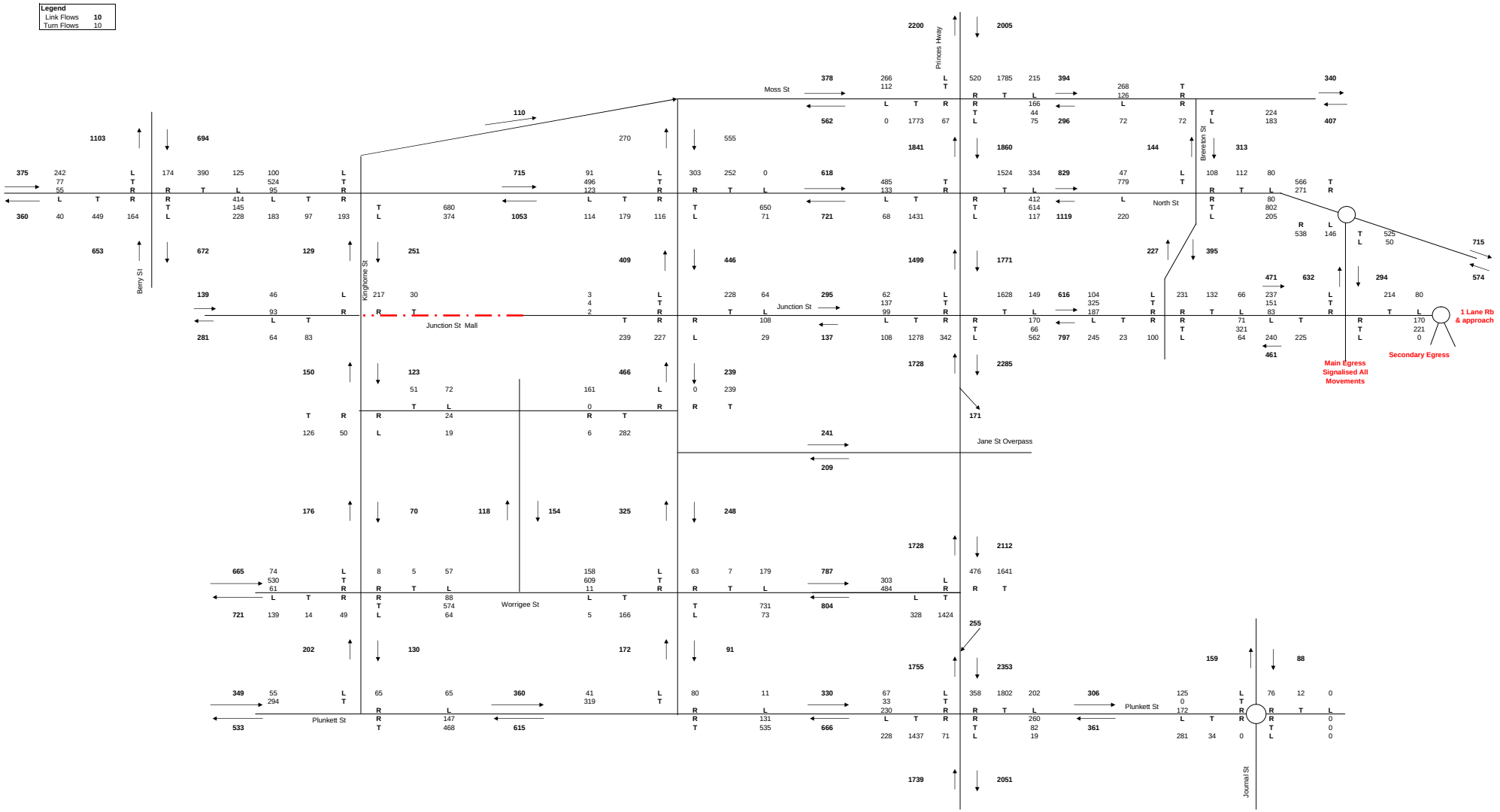
2016 Base



NOWRA CBD STRATEGY 2016 REVIEW

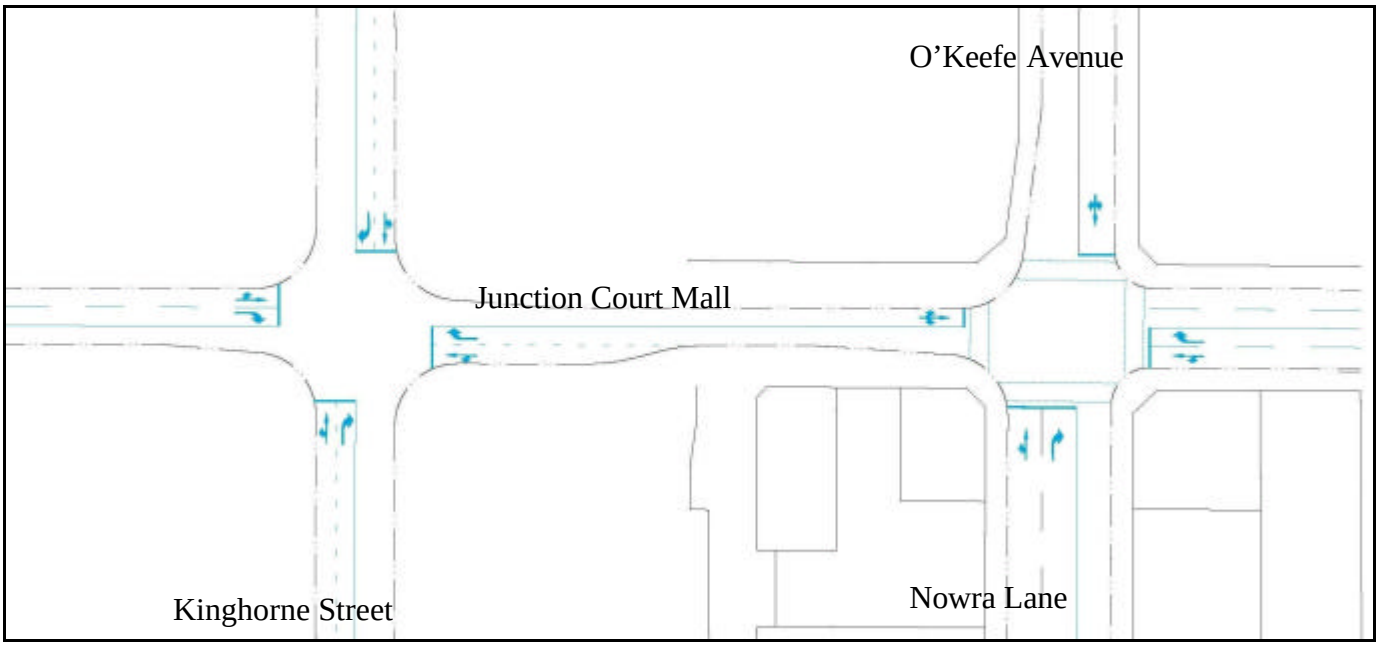
Paramics Model Turn Counts

2016 Base Modified

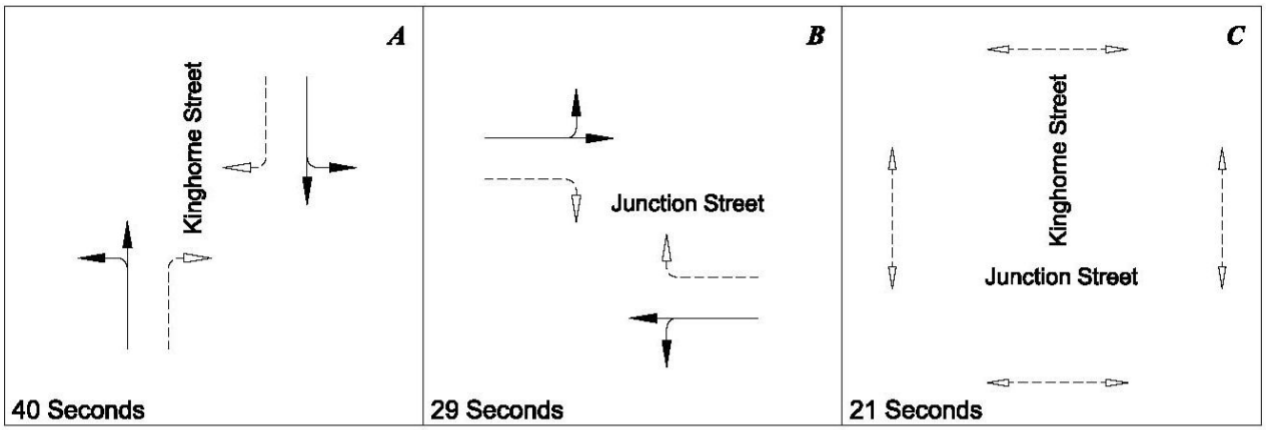


Appendix D

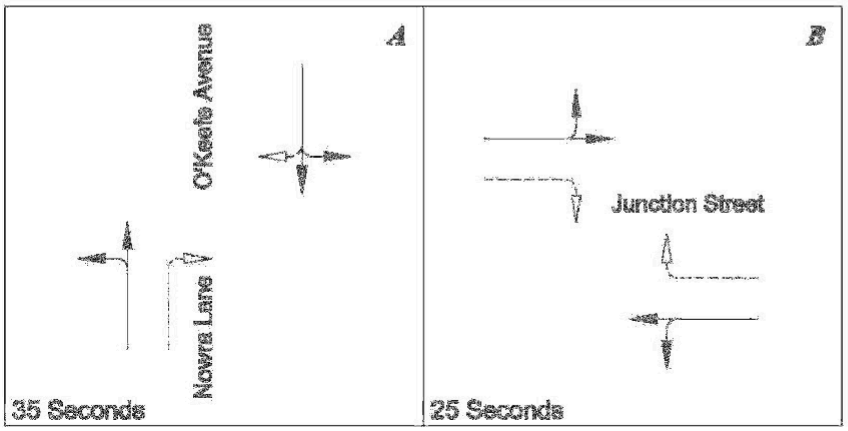
Junction Street Mall Two-way Lane Configuration, Turning counts and Link Flows



OPTION 1 - JUNCTION COURT TWO WAY
Western Intersection



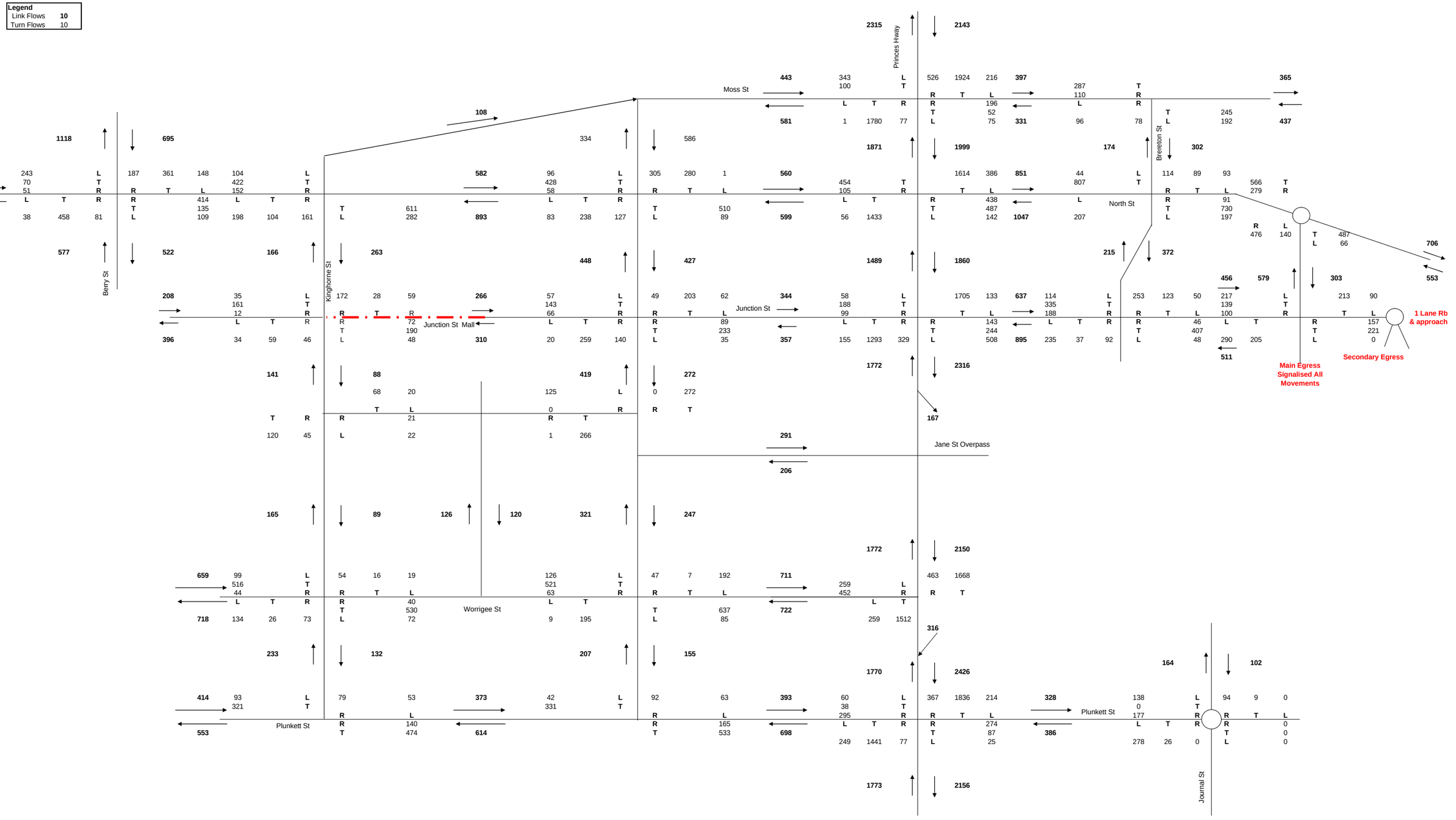
OPTION 1 - JUNCTION COURT TWO WAY
Eastern Intersection



NOWRA CBD STRATEGY 2016 REVIEW

Paramics Model Turn Counts

Option 1 - Junction Street Mall Two-way

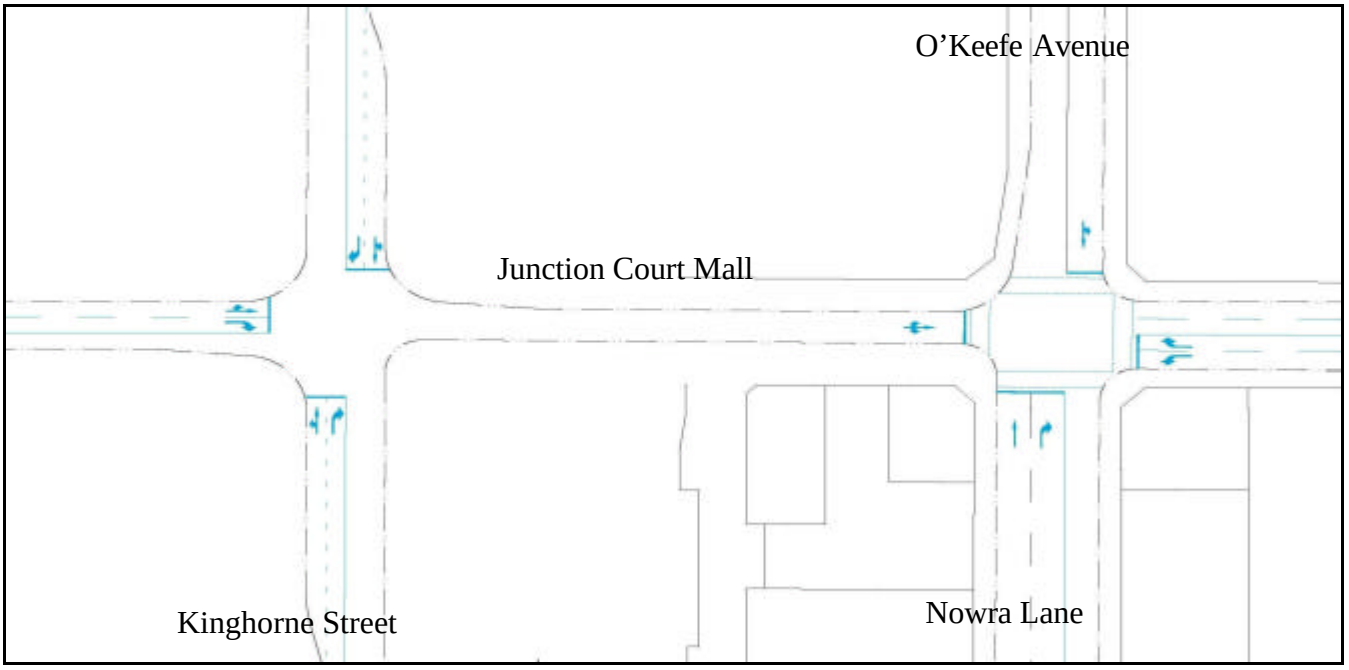


Appendix E

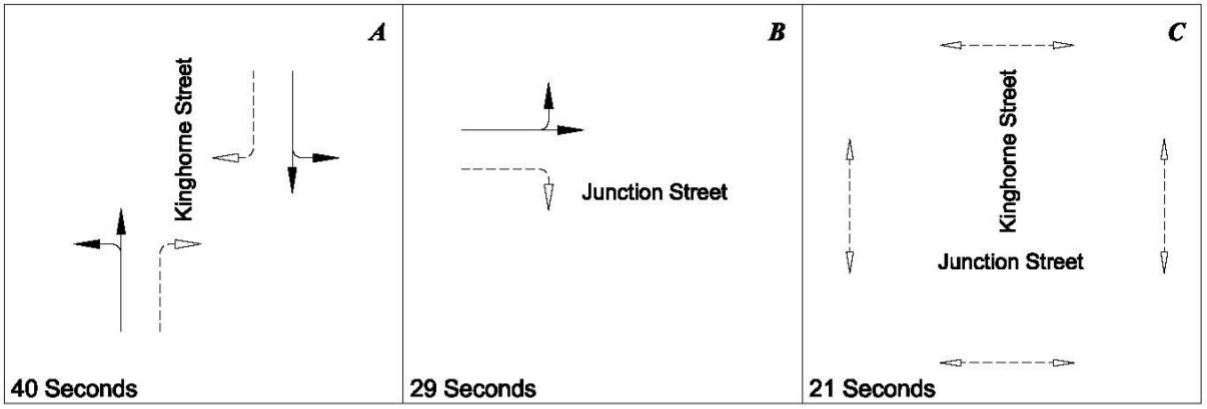
Junction Street Mall One-way Eastbound

Lane Configuration, Turning counts

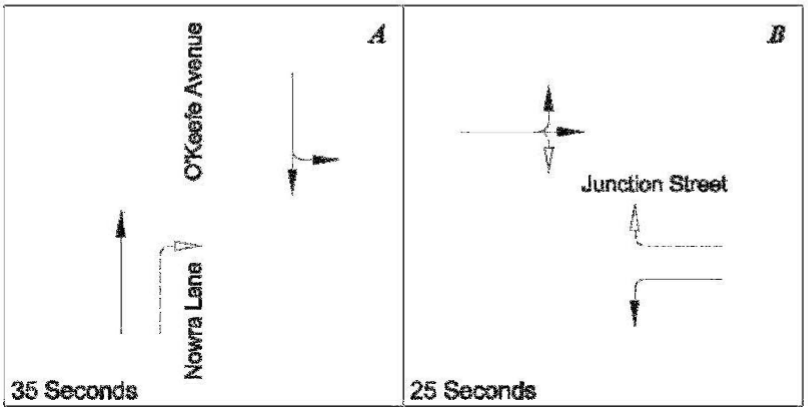
And Link Flows



OPTION 2 - JUNCTION COURT ONE WAY EASTBOUND
Western Intersection



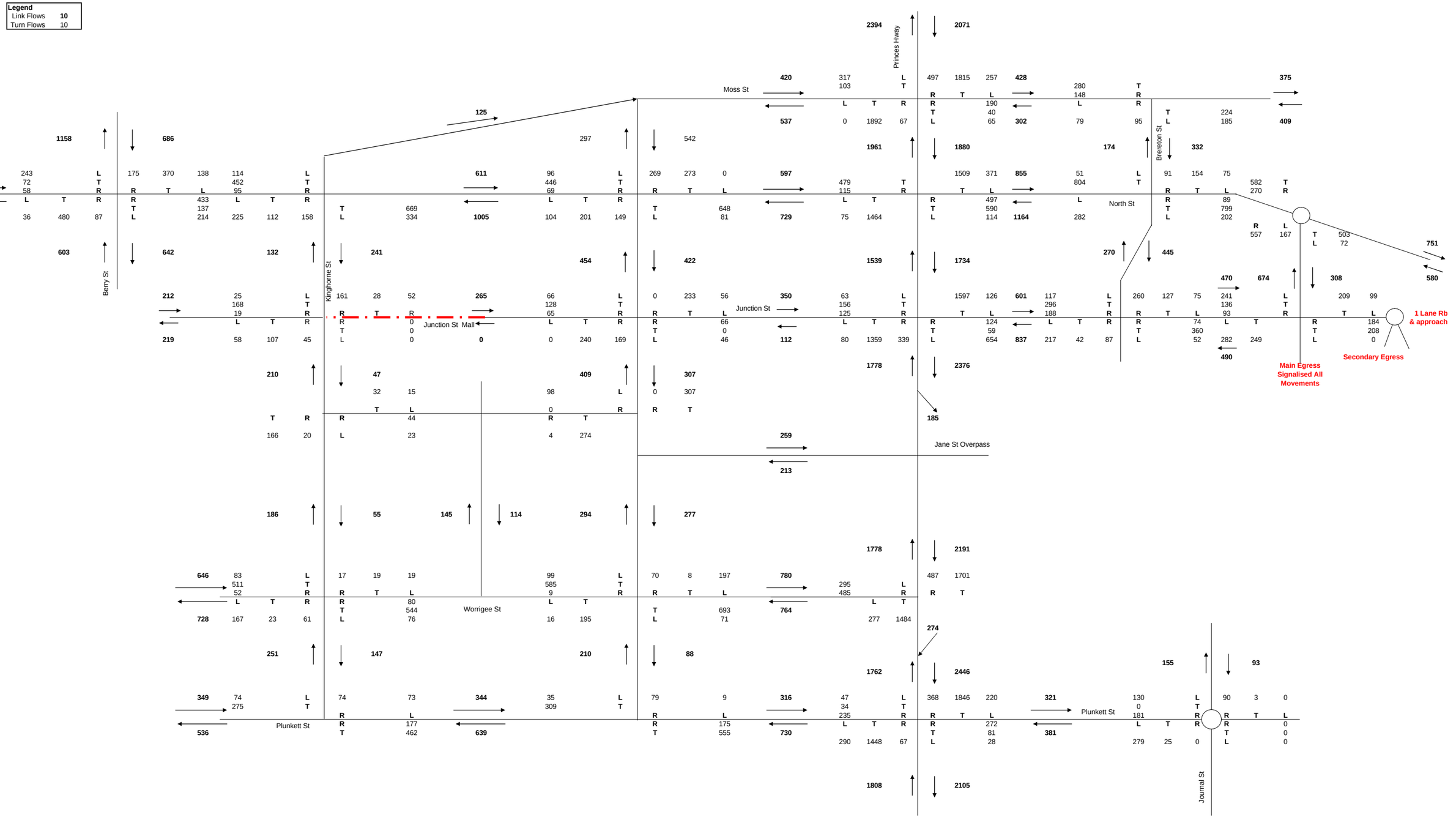
OPTION 2 - JUNCTION COURT ONE WAY EASTBOUND
Eastern Intersection



NOWRA CBD STRATEGY 2016 REVIEW

Paramics Model Turn Counts

Option 2 - Junction Street Mall One-way Eastbound

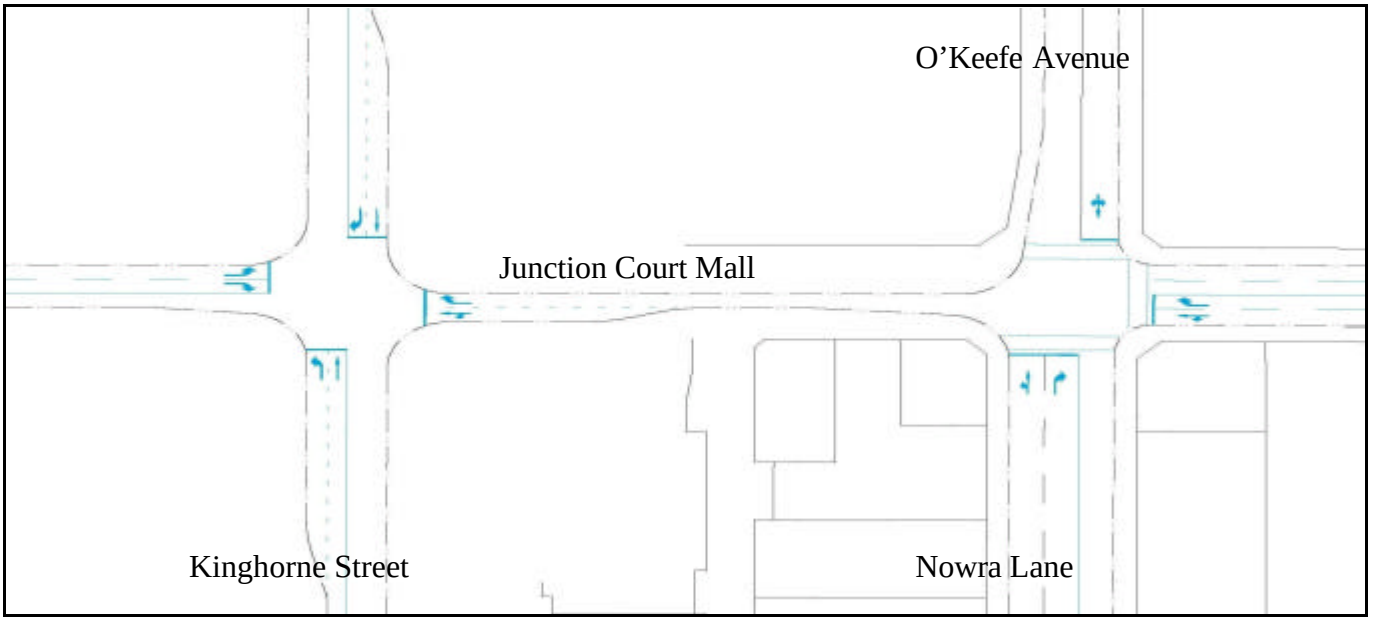


Appendix F

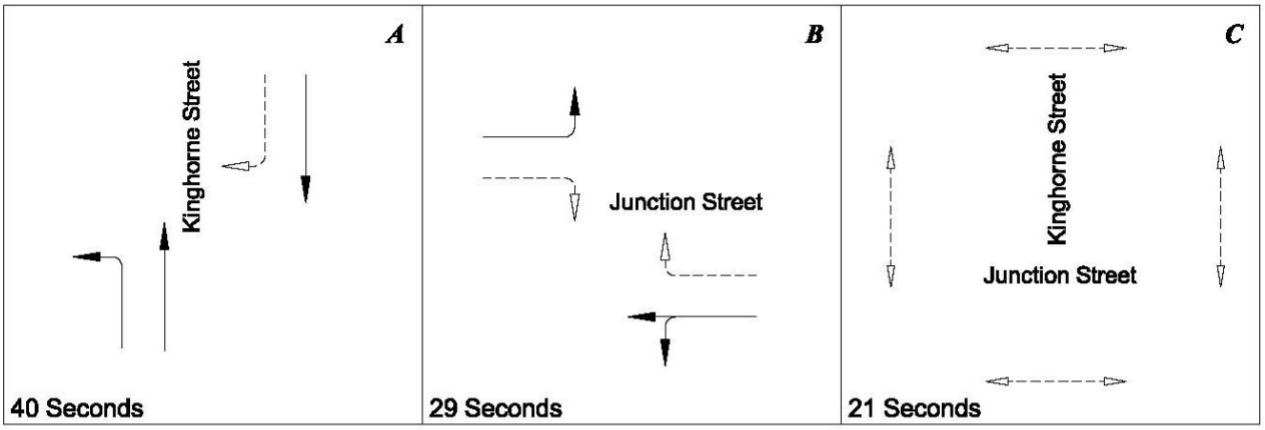
Junction Street Mall One-way Westbound

Lane Configuration, Turning counts

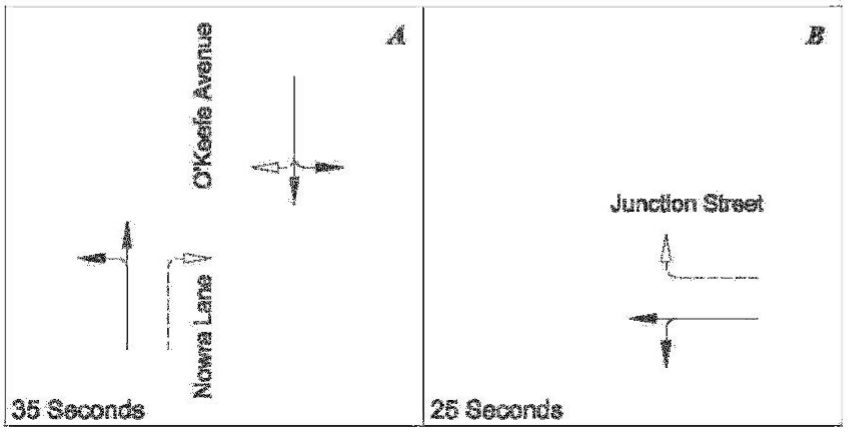
And Link Flows



OPTION 3 - JUNCTION COURT ONE WAY WESTBOUND
Western Intersection



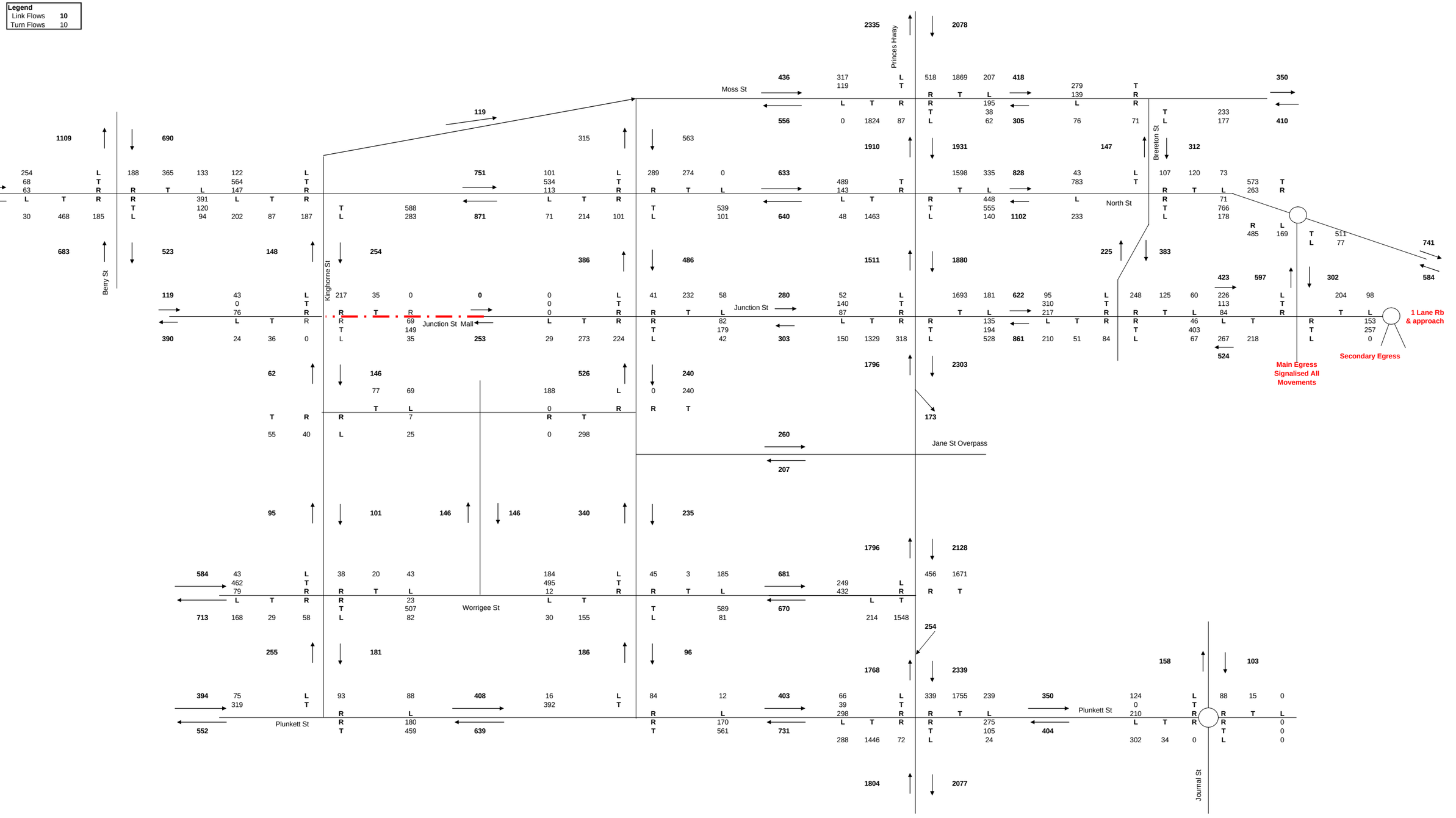
OPTION 3 - JUNCTION COURT ONE WAY WESTBOUND
Eastern Intersection



NOWRA CBD STRATEGY 2016 REVIEW

Paramics Model Turn Counts

Option 3 - Junction Street Mall One-way Westbound

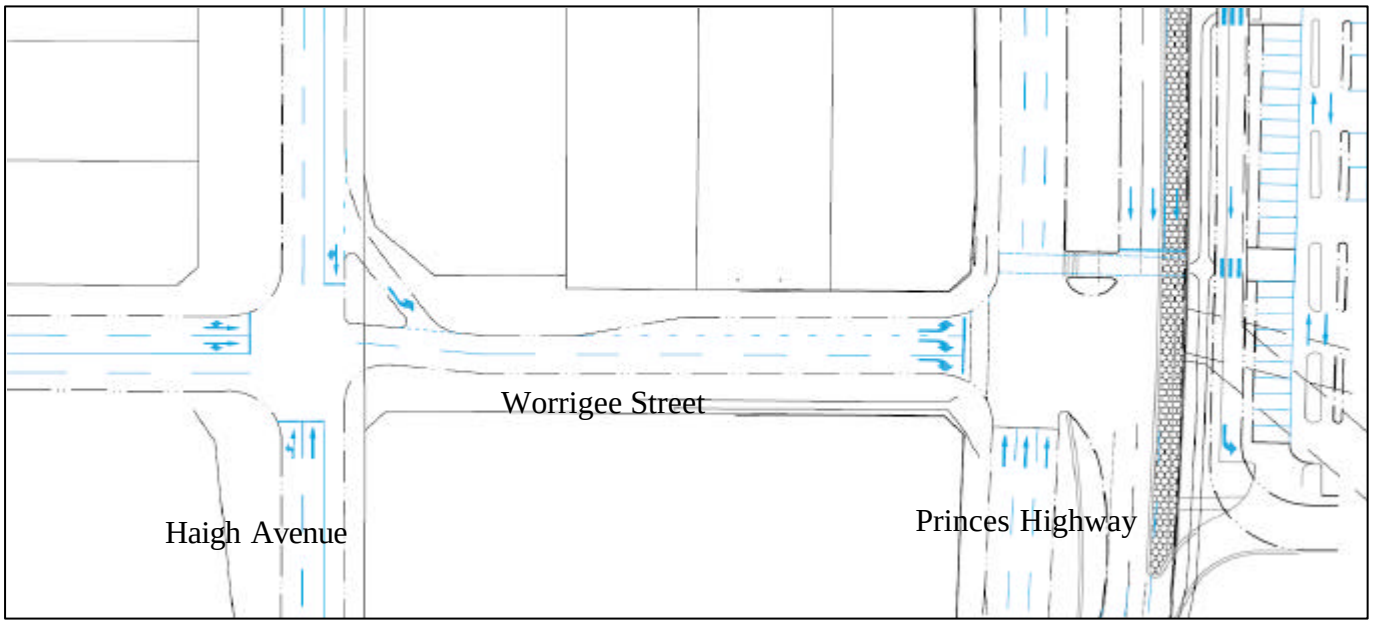


Appendix G

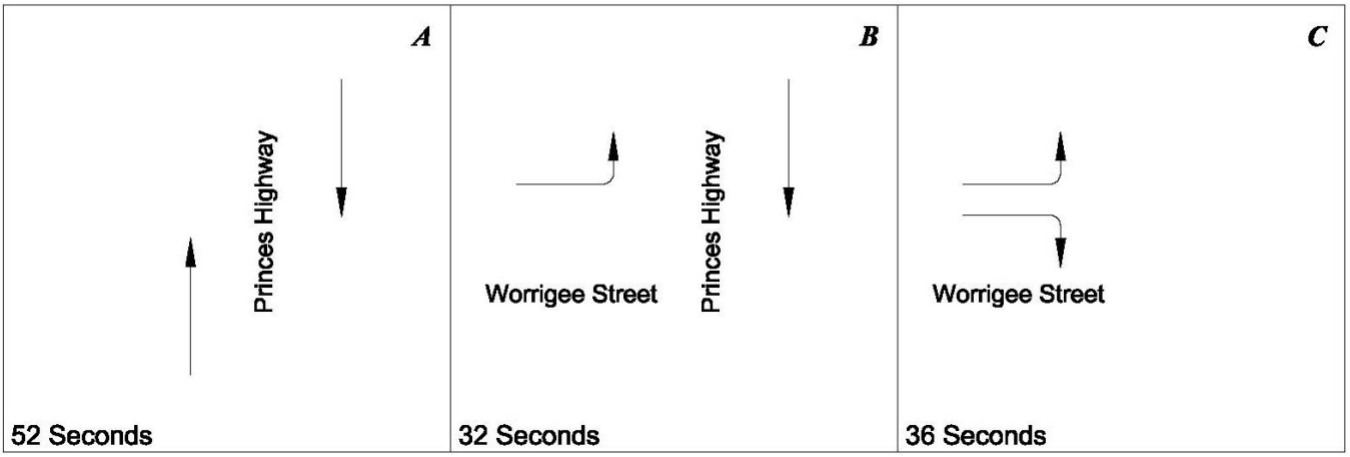
Worrigee Street One-way Eastbound

Lane Configuration, Turning counts

And Link Flows



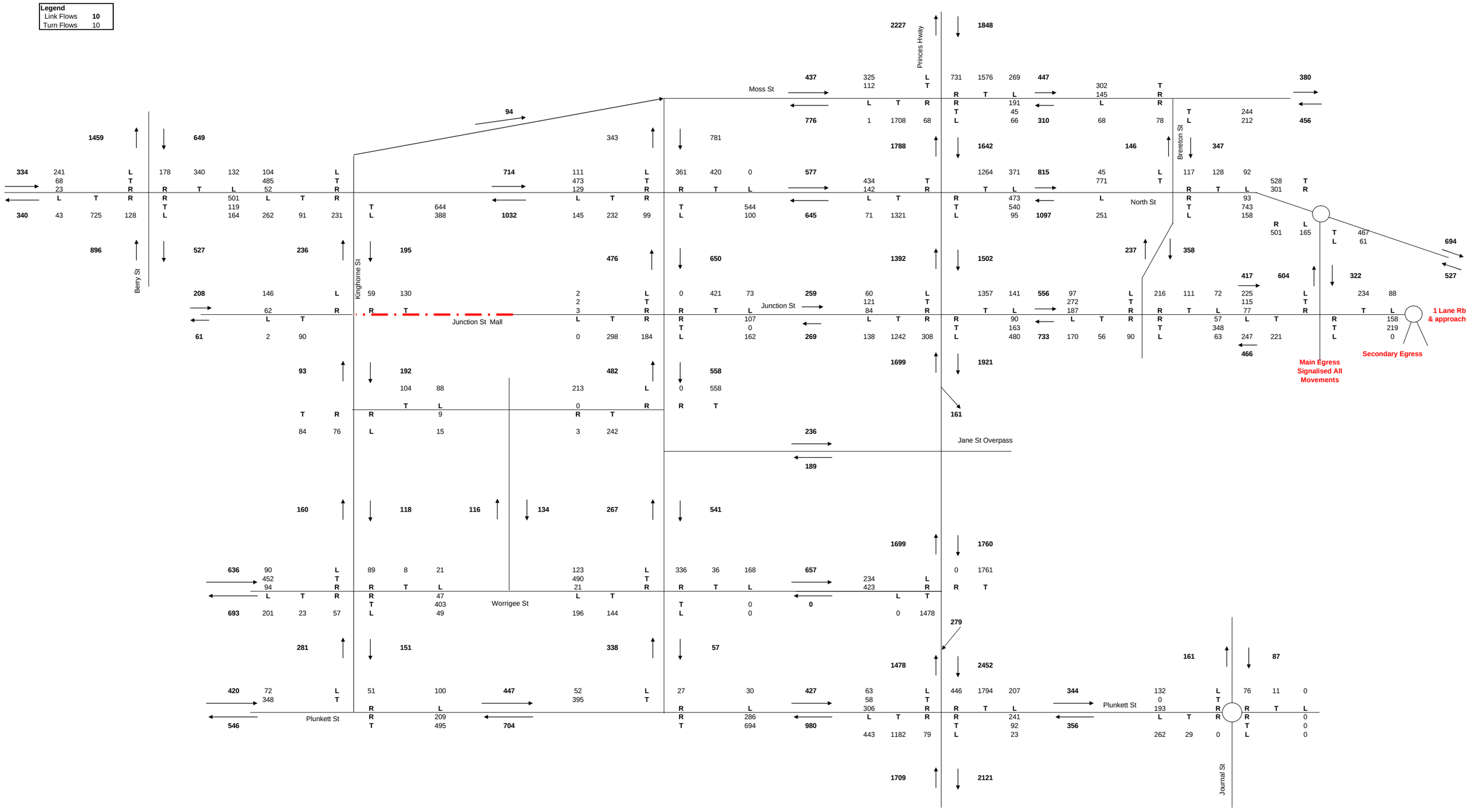
OPTION 4 - WORRIGEE STREET ONE WAY EASTBOUND



NOWRA CBD STRATEGY 2016 REVIEW

Paramics Model Turn Counts

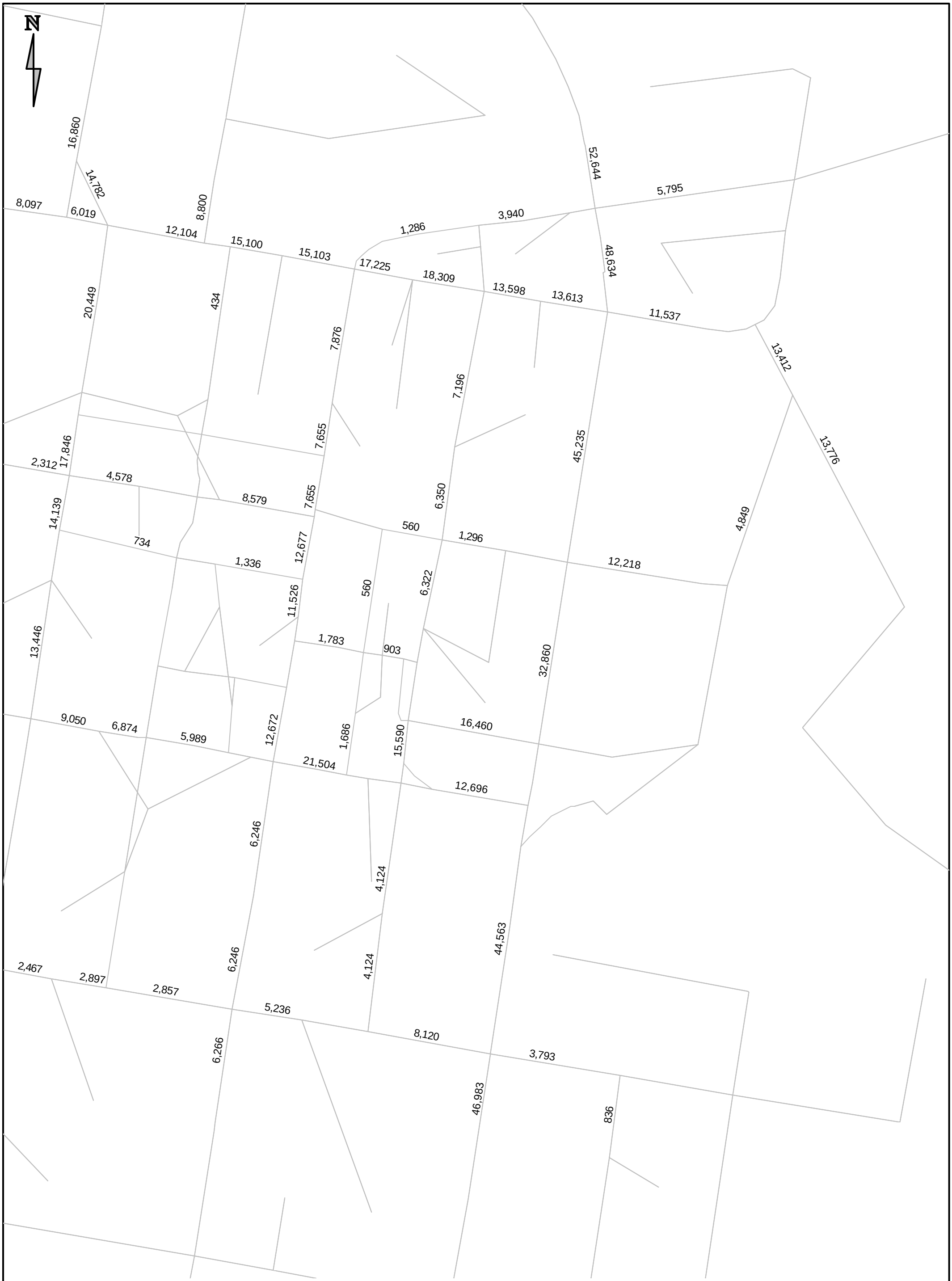
Option 4 - Worrigee Street One-way Eastbound



Appendix H

Base TRACKS 2016

24hr Two-Way Flows



Cardno Eppell Olsen	PROJECT TITLE: NOWRA CBD (EAST) ROAD NETWORK STRATEGY REVIEW DRAWING TITLE: *2016 BASE TRACKS 24hr VOLUMES*	FIGURE NO. 1 PROJECT NO. 9544 DATE DRAWN 20/07/2007

Appendix I

Junction Court Options

TRACKS 2016 24hr Two-Way Flows

N

Two-Way 24hr
Volume Difference

-10,000 to -2,000
-5,000 to -2,000
-5,000 to -250
-250 to -50
50 to 250
250 to 500
500 to 2,000
2,000 to 17,000
all others

16,889
17,170
2,877
7,122
8,565
9,332
12,058
12,062
654
3,065
52,878
5,528
10,092
10,966
8,426
8,444
49,884
8,619
18,351
91
5,008
3,456
10,188
5,482
18,903
4,081
9,317
13,720
5,481
16,233
16,292
17,394
24,798
46,673
13,619
6,248
13,520
744
2,141
9,313
4,748
7,358
441
3,788
12,225
1,081
1,245
40,772
6,692
4,530
3,686
7,148
1,714
7,465
7,533
12,436
8,621
4,736
2,154
48,263
2,562
2,992
2,928
5,074
5,926
3,831
5,208
48,359
836

Cardno
Eppell Olsen

PROJECT TITLE:
NOWRA CBD (EAST) ROAD NETWORK STRATEGY REVIEW

DRAWING TITLE:
JUNCTION COURT TWO-WAY OPTION TRACKS 24hr VOLUMES

FIGURE NO. 2

PROJECT NO. 9544

DATE DRAWN 20/07/2007

N

Two-Way 24hr
Volume Difference

- -10,000 to -2,000
- -5,000 to -2,000
- -5,000 to -250
- -250 to -50
- 50 to 250
- 250 to 500
- 500 to 2,000
- 2,000 to 10,000
- all others

16,826
17,052
2,948
7,171
8,610
10,280
13,289
13,293
713
3,318
52,863
5,958
49,199
14,528
15,658
11,033
11,047
9,115
11,127
19,472
344
5,961
5,700
18,417
6,087
3,383
7,095
11,212
6,086
6,789
6,859
9,386
21,025
6,445
45,834
5,144
13,456
13,845
740
1,308
9,963
70
5,644
38,530
8,840
1,150
1,476
12,846
7,838
5,654
4,810
9,811
1,815
10,967
10,201
16,811
10,339
4,591
2,767
47,841
2,630
3,058
3,010
5,226
6,531
3,834
5,126
48,566
836

Cardno Eppell Olsen	PROJECT TITLE: NOWRA CBD (EAST) ROAD NETWORK STRATEGY REVIEW DRAWING TITLE: *JUNCTION COURT ONE-WAY EB OPTION TRACKS 24hr VOLUMES*	FIGURE NO. 3 PROJECT NO. 9544 DATE DRAWN 20/07/2007

N

Two-Way 24hr
Volume Difference

-10,000 to -2,000
-5,000 to -2,000
-5,000 to -250
-250 to -50
50 to 250
250 to 500
500 to 2,000
2,000 to 15,000
all others

16,942
17,263
2,879
7,162
8,564
10,552
13,347
13,351
1,293
12,542
13,641
3,549
9,904
9,920
5,307
52,849
49,546
9,602
10,933
19,381
130
5,500
4,711
18,308
3,349
7,011
11,236
5,656
8,404
9,799
12,534
23,320
5,581
46,792
5,439
13,590
13,698
760
2,130
11,588
9,644
1,767
3,637
12,666
2,431
1,372
38,855
7,862
5,701
4,862
8,810
1,818
8,229
8,200
15,396
10,129
5,408
1,826
47,912
2,601
3,031
2,972
5,181
6,302
3,826
5,231
48,407
836

Cardno Eppell Olsen	PROJECT TITLE: NOWRA CBD (EAST) ROAD NETWORK STRATEGY REVIEW DRAWING TITLE: *JUNCTION COURT ONE-WAY WB OPTION TRACKS 24hr VOLUMES*	FIGURE NO. 4 PROJECT NO. 9544 DATE DRAWN 20/07/2007

Appendix J

Worrigee Street and Plunkett Street Options

TRACKS 2016 24hr Two-Way Flows

N

Two-Way 24hr
Volume Difference

-6,000 to -2,000
-2,000 to -500
-500 to -250
-250 to -50
50 to 250
250 to 500
500 to 2,000
2,000 to 7,000
all others

8,135 6,057 17,079 15,001 8,800 12,178 15,065 15,067 1,289 4,114 6,320 52,371 47,731 17,543 18,626 14,722 14,733 11,012 20,628 325 8,229 7,874 13,431

2,315 18,036 4,578 8,676 7,789 0 535 1,257 12,211 14,323 734 1,356 12,993 7,789 7,050 43,947 13,792 4,820 11,823 535 7,007 2,101 901 13,666 7,944 5,598 4,676 18,147 6,872 12,686 1,335 16,745 16,490 31,557 8,800 4,648 40,113

3,690 4,120 4,080 8,660 12,281 3,796 6,648 46,537 836

N

Two-Way 24hr
Volume Difference

-5,000 to -2,000
-2,000 to -500
-500 to -250
-250 to -50
50 to 250
250 to 500
500 to 2,000
2,000 to 10,000
all others

8,161 6,084 14,953 17,031 12,214 8,802 15,194 15,197 1,288 17,914 4,118 6,330 52,396 18,998 15,169 15,179 47,759 11,083 13,519 20,644 434 8,450 7,710 8,006 18,048 2,328 4,619 8,601 14,293 734 1,417 13,077 0 582 1,315 6,857 44,350 4,839 13,864 12,620 6,903 582 11,845 1,925 889 31,528 13,617 8,082 5,734 4,828 12,553 1,327 16,461 15,887 18,527 8,274 8,753 4,267 41,360 3,271 3,702 3,599 8,126 6,282 9,347 3,807 44,867 836

Cardno Eppell Olsen	PROJECT TITLE: NOWRA CBD (EAST) ROAD NETWORK STRATEGY REVIEW DRAWING TITLE: *PLUNKETT STREET OPTION TRACKS 24hr VOLUMES*	FIGURE NO. 6 PROJECT NO. 9544 DATE DRAWN 20/07/2007