Cardno
Shaping the Future

Calderwood Urban Development Project

Concept Plan Transport Management and Accessibility Plan (TMAP)

FINAL REPORT

Prepared for Delfin Lend Lease
February 2010

Delfin
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Volume i
Main Report

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DOCUMENT CONTROL

FR110026
Calderwood Urban Development Project
Concept Plan Transport Management & Accessibility Plan (TMAP)
FINAL REPORT

Version	Date	Author		Reviewer	
		Name	Initials	Name	Initials
1.0	10.12.2009	Russell Yell Adrian Bateman Sam Laybutt Anissa Levy	RY AB SL AL	Anissa Levy	AL
2.0	22.12.2009	Adrian Bateman Sam Laybutt Anissa Levy	AB SL AL	Anissa Levy	AL
3.0	22.01.2010	Anissa Levy	AL	Anissa Levy	AL
4.0	10.02.2010	Anissa Levy	AB	Anissa Levy	AL
5.0	18.02.2010	Adrian Bateman Anissa Levy	AB	Anissa Levy	AL

Table of Contents

Appendices

List of Figures

List of Tables

List of Charts

EXECUTIVE SUMMARY

Delfin Lend Lease (DLL) commissioned Cardno to undertake a Transport Management & Accessibility Plan (TMAP) to accompany a Concept Plan Application under Part 3A of the *Environmental Planning & Assessment Act, 1979* (EP&A Act) and a proposal for State Significant Site listing under Schedule 3 of *State Environmental Planning Policy Major Development 2005* (SEPP Major Development) in relation to the Calderwood Urban Development Project (CUDP).

During the production of the TMAP the Department of Planning (DoP), transport agencies and local Councils were formally consulted and an appropriate set of land uses and likely road upgrade improvements were determined to assist in the study process.

The Project

The CUDP, master planned community development by DLL, proposes a mix of residential, employment, retail, education, conservation and open space uses. The development proposes approximately 4,800 dwellings and approximately 50 hectares of retail, education, community and mixed use / employment land. The overall development will accommodate approximately 12,400 people and will deliver an estimated $2.9 billion in development expenditure and create approximately 8,000 full time equivalent jobs by 2031.

The CUDP site is located within the Calderwood Valley in the Illawarra Region. The Calderwood Valley has long been recognised as a location for future urban development within key strategic planning documents.

Key themes identified through a review of existing plans and policies in regard to transport are the need to reduce car dependency, increase the attractiveness and usage of sustainable transport modes, reduce the growth in vehicle kilometres travelled and provide an urban form which supports public transport provision.

DLL have undertaken numerous residential master planned community projects which featured the implementation of a range of sustainable transport initiatives. Such measures, which have previously been demonstrated through the successful implementation at other DLL master planned communities, are proposed for inclusion within CUDP to influence travel patterns onto more sustainable transport.

A concept plan has been developed which provides the range of complementary land uses (residential, retail, employment, education & recreational) and public domain features, which are supported by a cohesive and permeable road network. Principle access is provided within the CUDP via a sub arterial north-south road which connects to the existing road network at its southern and northernmost points. Access to the existing Calderwood Road is maintained to the east and west of the site. A further lower order network of internal CUDP roads are proposed with major collector roads capable of accommodating buses, providing a linkage between the sub-arterial road and the lowest category minor collector roads, which will provide the principal pedestrian links.

By committing to a range of sustainable transport and other initiatives DLL is confident that the proposed development can achieve a 10% modal transfer away from private vehicles onto other transport modes. This ‘stretch target’ is based upon their success of implementing a range of similar measures at Ropes Crossing, Rouse Hill and Forde.

Existing Conditions

Traffic modelling was undertaken using the WOLSH TRACKS traffic model to assess the operation of the road network during both a weekday morning and evening commuter peak period. For the base year of 2009 satisfactory operation was generally found to occur except for the Princes Highway between Illawarra Highway and Southern Freeway.

A solution that is being considered by the RTA is for the implementation of an F6 freeway extension between Tallawarra and Oak Flats interchanges which will provide a bypass to the existing section of congested roadways and provide appropriate capacity to provide for the needs of increasing strategic traffic and road freight movements through the area.

Future Planned Land Uses & Transport Network

In accordance with the Director General Requirements (DGR) an agreed set of land use changes were included within the future years traffic modelling. The following road infrastructure upgrades were tested within assessments:

- F6 Freeway extension: Yallah to Oak Flats.
- Tripoli Way (Albion Park Bypass).
- North-facing ramps at Tallawarra interchange.

Traffic Modelling

Sustainable transport planning is a key driver in the urban design and land use process. However, it is recognised that the need to accommodate private vehicle mobility within and external to a site is still of fundamental importance, to ensure the viability and functionality of any urban development project. Accordingly, the transport planning for the CUDP has to ensure that a safe and efficient road network will also be provided for the movement of people and goods.

To assess road network operation an iterative series of traffic modelling runs were performed to test the effects of a range of assumptions on road infrastructure provision and modal transfer targets, both with and without the CUDP development.

Key points from the traffic model assessments identified that in 2031 ***without the CUDP*** the following infrastructure upgrades would be necessary to satisfactorily accommodate the forecast traffic demands:

- North-facing ramps at Tallawarra interchange were not required. It is noted that the future stage of the West Dapto Release Area beyond 2031 may indicate the need for the north facing ramps at Tallawarra interchange.
- F6 Freeway extension: Tallawarra to Oak Flats was required to address existing deficiencies.
- Tripoli Way (Albion Park Bypass) stages 1-3 were required including north and south facing ramp connections to the F6 Freeway extension (including the planned intersection upgrades along its length and at its terminal ends).
- Princes Highway between Mount Brown Road and Southern Freeway northbound offload ramp would need to be duplicated (including intersection upgrades along the duplicated section).
- Princes Highway between the Southern Freeway northbound offload ramp and Yallah Bay Road would require and additional southbound lane.
- The Southern Freeway northbound off load ramp and the southbound on load ramp would need to be duplicated with associated merge diverge improvements undertaken on the Southern Freeway.
- Marshall Mount Road & Yallah Road would need to be upgraded to a suitable two lane-two way standard.

Key points from the traffic model assessments identified that in 2031 ***with the CUDP*** the following infrastructure upgrades would be necessary to satisfactorily accommodate the forecast traffic demands (additional to those identified ***without the CUDP***.

- Upgrade the priority controlled Marshal Mount Road / Yallah Road intersection to a roundabout.
- Upgrade Calderwood Road to the east of the CUDP boundary to a suitable two lane-two way standard.
- Provide the CUDP north-south sub-arterial road and intersection upgrades at its terminal ends.

Mode Share

The post development mode share target was established to be 10% shift away from car based transport following the implementation of a range of sustainability measures to increase non-car mode share.

Public Transport Provision

Public transport principles and a network concept were developed for bus services to integrate the CUDP within the wider bus network at both strategic level and a district level. A Strategic bus corridor is proposed to route to the north of the CUDP along Marshall Mount Road, Huntley Road and Princes Highway to Dapto and Wollongong. To the east of the CUDP site, it is proposed the route proceeds eastwards along Illawarra Highway, Tongarra Road and Princes Highway to Oak Flats interchange and then Shellharbour CBD.

Two lower order routes (classed as 'district routes)' would link the remainder of the CUDP with Calderwood Town Centre and Albion Park for onward connections to local and regional rail services.

The proposed bus services and associated bus stop infrastructure provide a satisfactory level of coverage for the CUDP to in accord with the coverage targets set out in the *Outer Metropolitan Service Planning Guidelines.* A two tier bus stop hierarchy is proposed with higher order facilities (for strategic bus services including shelters/plinth to NSWTI standard) based around the sub-arterial north-south road with and the second order district services providing stops with timetable information. The proposed public transport nodes are located to maximise the opportunity for provision of higher density land uses clusters around the facilities in line with the desired urban design principles and sustainable transport objectives.

TMAP Measures

A package of deliverable sustainable transport measures is identified whose implementation would assist in achieving a 10% mode shift away from private vehicle. The proposed measures are as follows:

- Timely Provision of Facilities and Services.
- Fibre to the Home (FttH) and National Broadband Network.
- Website/Community Portal.
- Resident Kits.
- Promotions.
- Public transport incentives.
- Land Use/Transport Interaction including:
  - Provision of walking and cycling networks.
  - A diversity of land uses and housing types across the project to accommodate a diverse population.
  - Engaging and active streets that provide a positive experience for the users particularly along primary pedestrian and cycle corridors.
  - Crime Prevention Through Environmental Design (CPTED) principles applied to provide a greater sense of safety through passive surveillance of streets, parks and other areas of open space.
  - Establish a sub network of lit paths to provide for safer walking and cycling after dark.
  - Locate key amenities to maximise walkable access.
  - Holistic approach to the design of the street network, carefully balancing the needs for vehicle movement with the needs of pedestrians and cyclists.
- Local Access Street Design.
- Pedestrian and Cycle Hierarchy.
- Way-finding Signage.
- Parking Strategies.
- Safety Elements for Network.
- Bicycle parking at key destinations within CUDP.
- Bus Network Provision
- Bus Service levels that meet and exceed NSWTI's Outer Metropolitan Service Planning Guidelines
- Early bus service provision
- Branding and Publicity
- Bus Stop Infrastructure
- Bus Network Infrastructure

Apportionment

Further traffic model runs were undertaken to determine the required timing for the road network upgrades. Intermediate assessment years (consistent with planning timelines) of 2016, 2021 & 2026 were adopted for this assessment. Using conventional level of service assumptions about acceptable peak hour operations, timings of upgrades were identified and assumed to be implemented within the next assessment year. However, due to the extent of planning, design and construction time required to implement the F6 freeway extension, it was assumed in the modelling that this would be complete within the period 2017 to 2021.

CUDP, if considered in isolation, does not specifically identify the need for the significant range of road upgrades required. An assessment process was undertaken to determine cost allocations for road upgrade works to ensure a reasonable and equitable allocation of costs between those deriving direct benefits from the road network upgrades. The apportionment assessment was undertaken based upon the year which the improvement was implemented.

The overall package of road upgrade costs included the provision of the CUDP north-south sub-arterial road on the basis of its strategic benefits to the wider road network.

A further breakdown of the works package based upon the potential staging of works at CUDP was undertaken and a funding mechanism for these works being undertaken as works in kind or through planning agreements (State Infrastructure Contribution or Voluntary Planning Agreement).

01

Introduction

This Transport Accessibility Study has been prepared as a Transport Management and Accessibility Plan (TMAP) by Cardno to accompany a Concept Plan Application under Part 3A of the *Environmental Planning & Assessment Act, 1979* (EP&A Act) and a proposal for State Significant Site listing under Schedule 3 of *State Environmental Planning Policy Major Development 2005* (SEPP Major Development) in relation to the Calderwood Urban Development Project (CUDP).

The Calderwood Urban Development Project is a master planned community development by Delfin Lend Lease (DLL).

The Calderwood Urban Development Project proposes a mix of residential, employment, retail, education, conservation and open space uses. The development proposes approximately 4,800 dwellings and approximately 50 hectares of retail, education, community and mixed use / employment land. The overall development will accommodate approximately 12,400 people and will deliver an estimated $2.9 billion in development expenditure and create approximately 8,000 full time equivalent jobs by 2031.

1.1 THE SITE

The Calderwood Urban Development Project site is located within the Calderwood Valley in the Illawarra Region. It is approximately 706 hectares in area with approximately 600 hectares of land in the Shellharbour LGA and the balance located within the Wollongong LGA.

The Calderwood Valley is bounded to the north by Marshall Mount Creek (which forms the boundary between the Shellharbour and Wollongong LGAs), to the east by the Macquarie Rivulet, to the south by Johnstons Spur and to the west by the Illawarra Escarpment. Beyond Johnstons Spur to the south is the adjoining Macquarie Rivulet Valley within the suburb of North Macquarie. The Calderwood Urban Development Project land extends south from the Calderwood Valley to the Illawarra Highway. Refer to Location Plan at Figure 1.1.

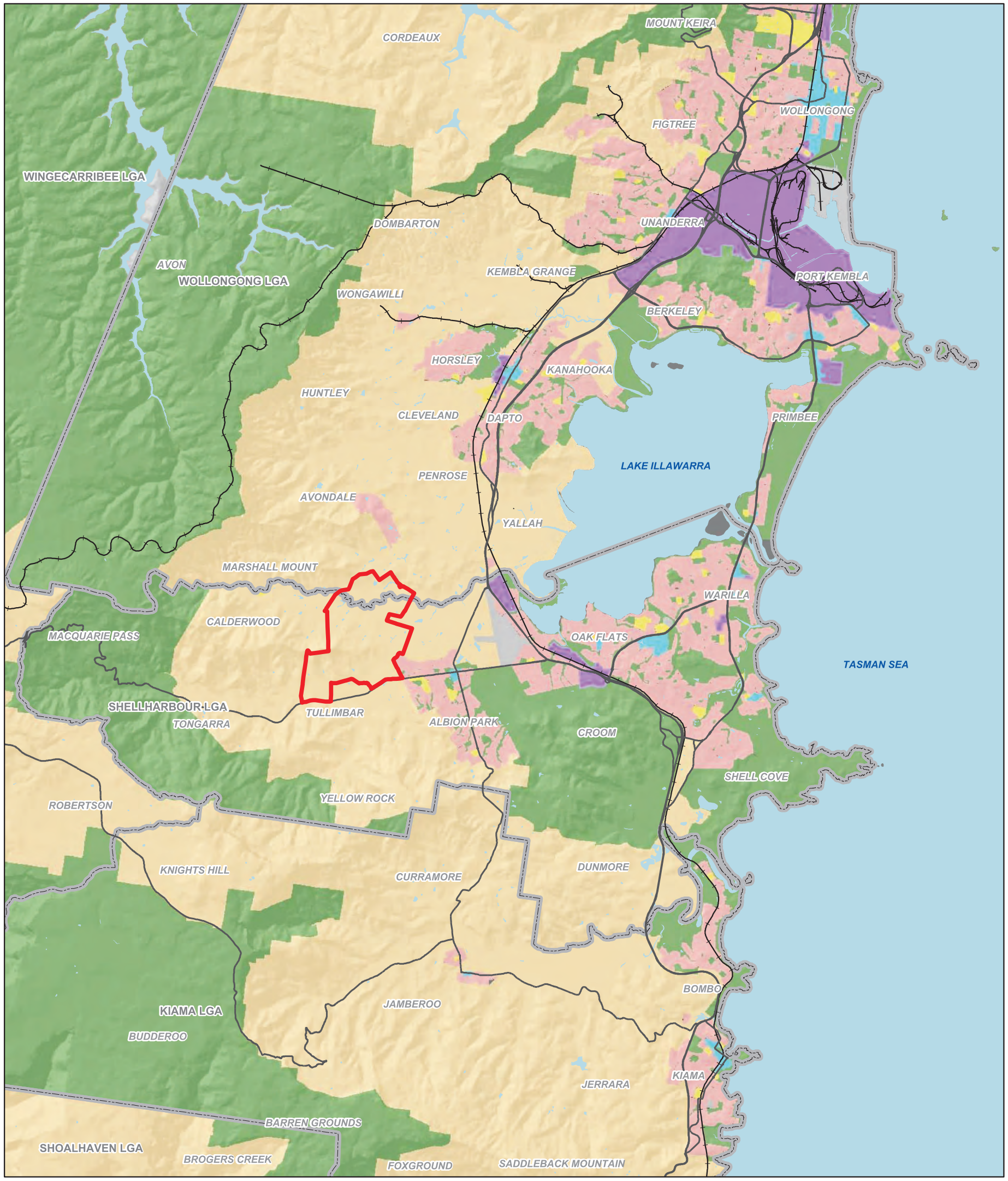
The Calderwood Valley has long been recognised as a location for future urban development, firstly in the Illawarra Urban and Metropolitan Development Programmes and more recently in the Illawarra Regional Strategy (IRS).

The IRS nominates Calderwood as an alternate release area if demand for additional housing supply arises because of growth beyond projections of the Strategy, or if regional lot supply is lower than expected.

In 2008, the former Growth Centres Commission reviewed the proposed West Dapto Release Area (WDRA) draft planning documents . The GCC concluded that forecast housing land supply in the IRS cannot be delivered as expected due to implementation difficulties with the WDRA, and the significantly lower than anticipated supply of housing land to market in the Illawarra Region is now been recognised as a reality.

The GCC Review of the WDRA also recognised that there is merit in the early release of Calderwood in terms of creating a higher dwelling production rate and meeting State government policy to release as much land to the market as quickly as possible. Given the demonstrated shortfall in land supply in the Illawarra Region and the WDRA implementation difficulties highlighted in the GCC Report, the release of Calderwood for urban development now conforms to its strategic role under the IRS as a source of supply triggered by on-going delays in regional lot supply. The Calderwood Urban Development Project can deliver about 12% of the IRS' new dwelling target.

Changes in outlook arising from global, national and regional factors influencing investment and delivery certainty, housing supply and affordability and employment and economic development also add to the case for immediate commencement of the Calderwood Project.



Delfin Lend Lease

Figure 1.1

Location Plan

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

- Site Boundary
- Major Roads (LPMA)
- Railway (LPMA)
- Waterbodies (LPMA)
- Local Government Area (LPMA)

Land Use (ABS)

- Other
- Rural
- Commercial
- Education
- Industrial
- Parkland
- Residential

N
W E
S

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Map Produced by Cardno Forbes Rigby
Date: 22 October 2009
Coordinate System: Zone 56 MGA/GDA 94
GIS MAP REF: 110026-01_18022_LocationPlan.mxd 02

1.2 BACKGROUND

In April 2008 the Minister for Planning issued terms of reference for the preparation of a Justification Report to address the implications of initiating the rezoning of Calderwood for urban development including associated staging, timing and infrastructure considerations.

In February 2009 the Minister for Planning considered a Preliminary Assessment Report for the Calderwood Urban Development Project that provided justification for the planning, assessment and delivery of the project to occur under Part 3A of the EP&A Act, having regard to the demonstrated contribution that the project will have to achieving State and regional planning objectives.

Subsequently, on the 16 April 2009, pursuant to Clause 6 of SEPP Major Development, the Minister for Planning formed the opinion that the Calderwood Urban Development Project constitutes a Major Project to be assessed and determined under Part 3A of the EP&A Act, and also authorised the submission of a Concept Plan for the site. In doing so, the Minister also formed the opinion that a State significant site (SSS) study be undertaken to determine whether to list the site as a State Significant site in Schedule 3 of SEPP Major Development.

The Part 3A process under the EP&A Act allows for the Calderwood Urban Development Project to be planned, assessed and delivered in an holistic manner, with a uniform set of planning provisions and determination by a single consent authority. Given the scale of the proposal, the Concept Plan and SSS listing provide the opportunity to identify and resolve key issues such as land use and urban form, development staging, infrastructure delivery and environmental management in an integrated and timely manner.

1.3 SCOPE OF STUDY

This TMAP has been prepared to fulfil the Environmental Assessment Requirements issued by the Director General for the inclusion of the Calderwood site as a State Significant Site under SEPP Major Development, and for a Concept Plan approval for the development. Specifically, this TMAP addresses the following requirements:

DGR 1:	Prepare a Traffic Management Plan that considers the traffic constraints of the site and surrounding locality.
DGR 2:	Demonstrate a strategy for providing linkages to regional transport networks.
DGR 3:	Demonstrate that there is the ability for sites located within the release area, but not within the proponent's control, to connect to infrastructure.
DGR 4:	Detailed traffic modelling to determine level of infrastructure needed plus annual traffic growth/approved development (including Delmo Albion Park).
DGR 5:	Timing/delivery/scope of local and regional road infrastructure.
DGR 6:	Network modelling for impacts on Illawarra Highway, Princes Highway/Southern Freeway, Tongarra Road, Marshall Mount Road, Yallah Road and the future Southern Freeway corroder between Yallah and Oak Flats.
DGR 7:	Intersection modelling, using SIDRA, for any junctions likely to be impacted by the development as identified in the network modelling, including AM and PM peaks, from the occupation of the Stage 1 development to the completion of the full development of the Concept Plan site.
DGR 8:	Identify infrastructure including road, pedestrian and cycling infrastructure to ameliorate the impacts of the development.
DGR 9:	Measures to promote public transport usage and reduce car usage.
DGR 10:	Identify various Travel Demand Management (TDM) measures that will optimise the opportunity provided by the projects sites proximity to public transport.
DGR 11:	Provide a road network plan identifying the proposed road hierarchy including cycleways, footpaths and car parking. Plan should identify public, private roads and typical cross sections and long sections.

DGR 12: Prepare a Transport Management and Accessibility Plan (TMAP) generally in accordance with the Ministry of Transport's Interim TMAP Guidelines, also including:

a. Staging/Sequencing Plan.
b. Measures to maximise public transport, walking and cycling.
c. Proposed pedestrian, cycling and public transport infrastructure.
d. Measures to mitigate any potential impacts on pedestrian safety.

In addition to the above DGRs a number of issues are to be considered and assessed as part of the study to be undertaken pursuant to clause 8 of the SEPP Major Projects 2005 to determine whether the site should be included as a State significant site in Schedule 3 to the SEPP. The issues to be considered were identified in the Minister for Planning's declaration letter to the proponent dated 22 April 2009. Specifically, this TMAP addresses the following issues:

SSS 1: The suitability of the site for any proposed land use taking into consideration environmental, social or economic factors, the principles of ecologically sustainable development and any relevant State or regional planning strategy.

SSS 2: The implications of any proposed land use for local and regional land use, infrastructure, service delivery and natural resource planning.

These requirements differ slightly from the DGRs although the overall issues follow the same theme to be resolved through this study.

In accordance with the Director General's Requirements this TMAP has been prepared following consultation with the following agencies:

- Department of Planning (Regional).
- Roads and Traffic Authority of NSW (RTA).
- NSW Transport and Infrastructure (NSWTI) formerly known as the Ministry of Transport (MoT).
- Wollongong City Council.
- Shellharbour City Council.
- Premier Illawarra Bus Company.

Copies of relevant documents can be found in the following Appendices:

- Appendix 1-A - DGRs.
- Appendix 1-B - the Minister for Planning's declaration letter (including SSS issues to be considered).
- Appendix 1-C - minutes of the formal consultation with each of the above agencies.
- Appendix 1-D - DLL/RTA correspondence.

1.4 TMAP OBJECTIVES

This TMAP has been prepared in accordance with the Ministry of Transport's Draft Guidelines for TMAPs. The objectives of this TMAP are to generally:

- Meet the DGR's.
- Manage the transport impacts of the Calderwood development.
- Help reduce growth in overall VKT generated by Calderwood, both by cars and by commercial vehicles.
- Help reduce reliance on the private car.
- Maximise the use of public transport, walking and cycling.

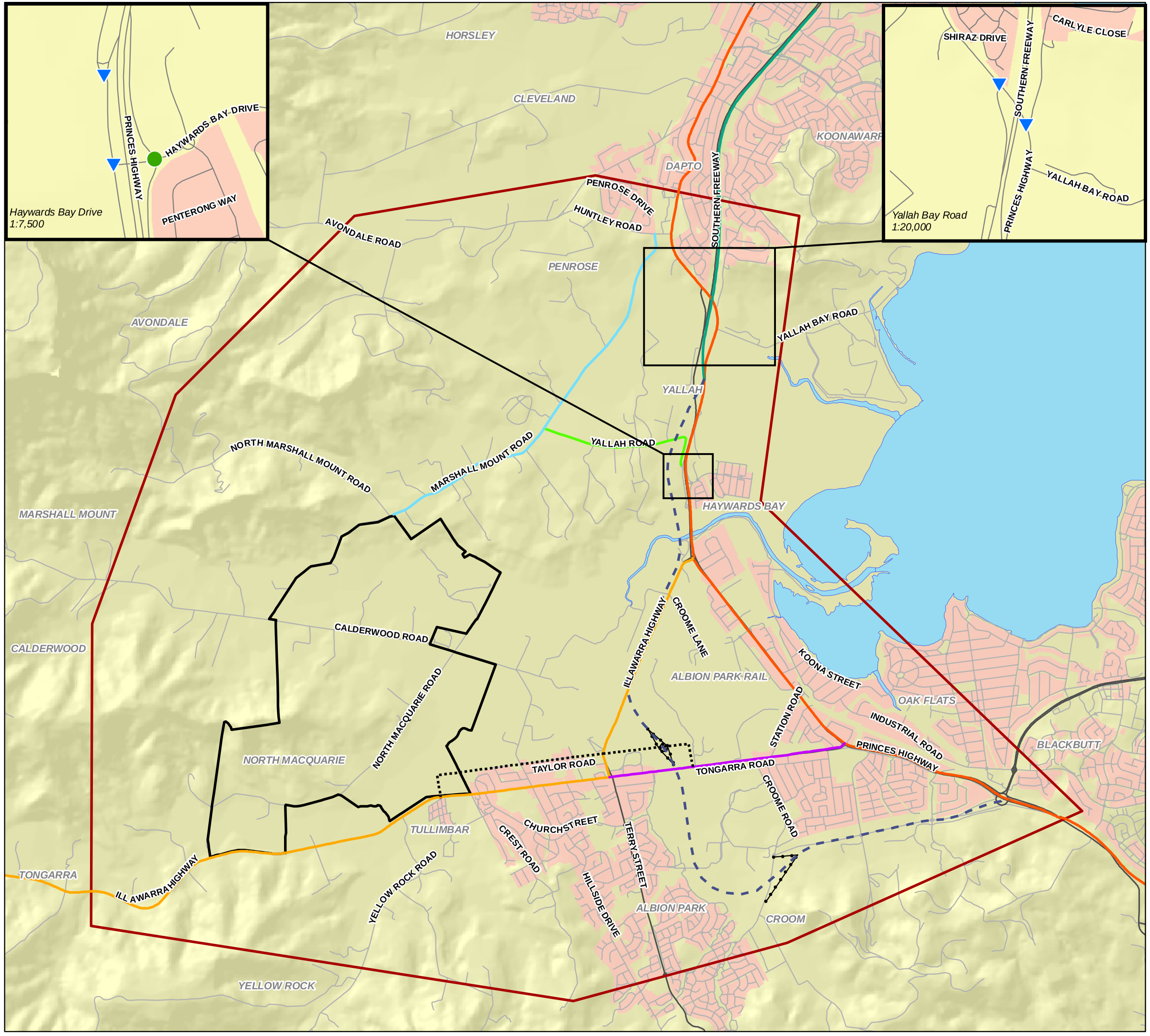
1.5 KEY ACCESS AND TRANSPORT OPPORTUNITIES

Calderwood is an extension of the existing Illawarra urban area. The CUDP location presents a number of opportunities when considering transport accessibility to ensure a satisfactory movement network is provided to accommodate the total sub-regional transport task. Key transport opportunities include:

- An opportunity to create a master planned community with key sustainable transport principles included within its planning and design from the outset.
- The planning of a regional road network sufficient to resolve the currently experienced significant peak period congestion at key intersections and mid-block sections, e.g. Princes Highway/Illawarra Highway intersection.
- The progressive upgrading of the existing low-demand, rural local road network to provide roads capable of providing an acceptable condition with safe and efficient operation to benefit all road users within the local and strategic context.
- A site integrated within the regional road network and existing urban areas by flood-prone riparian corridors.
- The opportunity to rebalance the current regional high car dependence and promote sustainable transport.
- Contribute to a transport network suitable to accommodate other significant urban development planned at nearby Tallawarra, Yallah/Marshall Mount and West Dapto.

1.6 AREA OF INFLUENCE FOR TRANSPORT ASSESSMENT

For the purpose of modelling and for the transport assessment, it has been agreed with the RTA the extent of the road network over which the existing transport network deficiencies and the proposed transport demands associated with the CUDP should be assessed. This area is described as the 'area of influence' the extent of road network is shown in Figure 1.2. The key road sections and intersections within the area of influence that are considered to be significant, and therefore assessed within the transport assessment, are detailed in Appendix 1-E.



Delfin Lend Lease

Figure 1.2

Area of Influence

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

- Major Roads (LPMA)
- Local Roads (LPMA)
- Lake Illawarra (LPMA)
- Existing Built Up Areas (LPMA)
- Site Boundary
- Area Of Influence Boundary

Key Existing Junctions to be Assessed

- Priority Controlled Intersections
- Roundabout
- Traffic Signals
- Grade-Separated Interchange

Key Existing Routes to be Assessed

- A - Illawarra Highway (HW25) - State
- B - Princes Highway (HW1) - State/Regional
- C - Southern Freeway (F6) - State
- D - Tongarra Road (MR262) - State
- E - Marshall Mount Road - Local
- F - Yallah Road - Local

Proposed Major Road Network Upgrades (Do Minimum)

- Proposed Roundabout
- ProposedTraffic Signals
- Potential Freeway Ramps
- Tripoli Way Extension
- F6 Freeway Extension (Yallah to Oak Flats)

N W E S

Scale 1:40,000 (at A3)

Metres

0 250 500 1,000 1,500 2,000 2,500

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Map Produced by Cardno Wollongong
Date: 20 January 2010
Coordinate System: Zone 56 MGA/GDA 94
GIS MAP REF: 110026-01_58012_TransportAreaOfInfluence.mxd 06

1.7 REPORT STRUCTUE

This report is structured to provide a full assessment of the transport accessibility issues relating to the proposed CUDP. This report is laid out in accordance with the TMAP Guidelines as follows:

- **Section 1** provides an overview of the project, background information and the study objectives.
- **Section 2** details the strategic context within which the assessment has taken place. This section provides a literature review of all relevant, state, regional, local and other documents.
- **Section 3** provides a more detailed overview of the project concept plan in terms of land uses, yields, road hierarchy etc.
- **Section 4** establishes the existing transport context in the surrounding area. An assessment of the existing road network has been undertaken to establish road network characteristics, performance criteria and any existing road network deficiencies. The chapter also provides an overview of existing travel patterns in the region as well as existing public transport, walk and cycle provisions.
- **Section 5** provides an overview of the future transport network context in terms of potential growth scenarios and road network upgrades.
- **Section 6** presents the modelling methodology undertaken to assess the road network impacts of the proposed development. This chapter outlines the scenarios that have been tested.
- **Section 7** documents the road network performance under base and development scenarios. The recommended package of road network measures is identified through an iterative testing process.
- **Section 8** provides an assessment of the demand for non car trips including public transport, walk and cycle.
- **Section 9** documents the full package of measure to be implemented as part of the TMAP.
- **Section 10** details the cost apportionment of road network infrastructure upgrades.

02

Strategic Context

2.1 FEDERAL POLICIES

2.1.1 National Broadband Network

As part of The National Broadband Network the Government has announced that all greenfield developments should have fibre optic infrastructure to prepare them for the future.

The objective of the program is to create opportunities for reductions in greenhouse gas emissions through greater use of improved telecommunications technologies and a reduction in the need to travel.

The CUDP will incorporate the broadband network in accordance with the national directions. The infrastructure will facilitate residents to work from home, reducing the need to travel.

2.2 STATE AND REGIONAL STRATEGIC POLICIES

The key driver behind state and regional strategic planning policies in recent years has been the desire to reduce the environmental impact of everyday life, such as through the reduction of greenhouse gas emissions. Key themes in these policies have been the need to reduce car dependency, increase the attractiveness and usage of sustainable transport modes, reduce the growth in vehicle kilometres travelled and provide an urban form which supports public transport provision.

The following New South Wales government policies, plans and strategies contain the strategic context relevant to the local planning and development of the CUDP. The following documents have been reviewed:

- NSW State Plan 2009 and Illawarra Local Action Plan 2009.
- NSW State Infrastructure Strategy 2008.

Other relevant government strategies reviewed include:

- Action for Air (2006 update).
- Action for Bikes (1999).
- Integrating Land Use and Transport (2001).
- Section 117 Ministerial Decisions Direction no.17 – Integrating Land Use and Transport (2005)
- Planning Guidelines for Walking and Cycling (2004).
- Accessible Transport action Plan (2007)
- Review of Bus Services in NSW – Final Report (2004).

Important aspects from the relevant state and regional documents have been summarised in Appendix 2-A. In relation to transport these strategies have the following common themes:

- Improve public transport.
- Integrating land use and transport.
- Reduction of mode share to private motor vehicles.
- Reducing the need to travel.

2.2.1 THE NSW STATE PLAN 2009

The *NSW State Plan* sets out the goals and priorities for government action in a range of key areas. In terms of transport, the key target relevant to this project is to increase public transport mode share to 15% for commuter journeys to Wollongong CBD. There are also a number of public transport improvement projects to encourage public transport use in the region. This TMAP has been developed on the basis of a mode share of 15% (refer to Section 3.4).

2.3 ILLAWARRA TRANSPORT CONTEXT

A large number of transport planning investigations and reports relating to the Southern Illawarra area have been prepared in recent years. These include the following:

- Illawarra Regional Strategy 2006-2031 and 2009 Update Report.
- Illawarra Urban Transport Opportunities Study
- Illawarra Action for Transport
- Moving Together 'Illawarra Regional Strategy'
- West Dapto Release Area Studies
- Albion Park Traffic Study

The key actions from the strategies are:

- Wollongong Strategic Bus Corridor.
- Dapto as one of the three sub-regional transport interchanges.
- Albion Park West Corridor.

The key theme of all strategies is the need to significantly improve public transport in tandem with developing a more sustainable urban form to support public transport provision in order to reduce the dependence on the private vehicle. The key issues and conclusions of relevant documents are provided within Appendix 2-B.

2.4 LOCAL PLANNING CONTEXT

The following local government plans were reviewed to gain an insight into the local planning context for Calderwood and adjoining:

- Shellharbour Rural LEP 2004
- Wollongong LEP 1990 and Draft Wollongong Local Environmental Plan (West Dapto) 2009
- West Dapto Urban Release Area planning documents.

The key issues and conclusions of relevant documents are provided in Appendix 2-C.

2.5 CALDERWOOD PLANNING CONTEXT

DLL controls approximately 706 hectares of land in the Calderwood Valley in the Illawarra Region for which it is seeking government approval for urban development. Approximately 600 hectares of land in the Shellharbour LGA and the balance located within the Wollongong LGA. An overview of the Calderwood planning context is provided in Appendix 2-D.

03

The Project

3.1 DLL EXPERIENCE IN SUSTAINABLE TRANSPORT INITIATIVES

Included as Appendix 3-A are fact sheets provided by DLL which provide examples from three other award-winning master plan communities. These demonstrate the high level of commitment that DLL has to the incorporation of sustainable transport objectives in the planning, design and construction of master planned communities. Some of the objectives incorporated in these communities included:

- Establish an urban form to maximise use of and access to public transport.
- Concentrate high trip generating uses adjacent to major public transport routes and nodes.
- Provide public transport infrastructure and services to achieve higher public transport use.
- Provide public transport and services early in the development to establish use pattern.
- Incorporate a range of uses within the site to minimise demand for travel outside the area.
- Establish high quality and efficient pedestrian and cycle routes to encourage travel by these modes.
- Incorporate fibre to the home or premises in an early stage.
- Community education to support public transport initiatives.

3.2 URBAN DESIGN PRINCIPLES

DLL's philosophy is for the development of sustainable communities, to ensure the development's ongoing viability and desirability. Provision of an appropriate urban form, sustainable transport options and travel demand management are key components of this. This accords with the strategic directions set out by the Government policies reviewed as part of Chapter 2.

The information presented in this TMAP demonstrates the ability of the CUDP to incorporate a broad range of social, economic and environmental sustainability measures. In summary, these include (but are not limited to) the items detailed in the following sections.

3.2.1 INTEGRATED PLANNING

Objective

To establish an integrated land use and transport planning framework within the Calderwood Urban Development Project that minimises travel needs and encourages walkability and public transport use.

Strategy

- Concept Plan is designed based on the principle of walkability. The majority of the residents can gain access to an activity node (commercial centre, bus stop and/or public parkland) within a 10 minute walk (800m).
- Road pattern is designed to facilitate walking, cycling and bus services.
- Mixed use centre to encourage pedestrian activities within the centre.

3.2.2 DIVERSITY CHOICE AND LIFESTYLE

Objective

To deliver and maintain housing choice, diversity and relative affordability levels to cater for a range of local housing needs.

Strategy

The development will incorporate a range of densities, lot sizes and dwelling types. This range will provide housing choice to satisfy the needs of a wide spectrum of households, at different life cycle stages and with varying socio-economic circumstances and lifestyle preferences. Housing solutions to support the creation of a diverse community will range from the more traditional detached homes to smaller attached houses, including studio homes, villas, townhouses, live-work, apartments and retirement units.

Housing types will make also special provision for home based businesses and others who wish to work from home.

3.2.3 NATIONAL BROADBAND

Objective

To encourage residents to work from home, shop from home, be entertained at home, bank from home etc and thereby minimise travel needs.

Strategy

Incorporate Fibre to the Home or Premise (FttH/FttP) in an early stage to service all homes to provide opportunities for residents to work from home and facilitate communication between businesses without the need to travel outside the site.

3.2.4 TOWN AND NEIGHBOURHOOD STRUCTURE

Objective

To create a town centre structure that is accessible to all residents, provide a range of services and facilities to minimise the need to travel elsewhere.

Strategy

The structure of the Calderwood project establishes the Town Centre at a principle focal point in the community and is both visually and physically central to many of the neighbourhoods created as part of this project.

A second smaller centre in the form of a Village Centre will also be established to bring services and amenities closer to the homes of residents and to facilitate in the early delivery of these amenities. Both of these centres will be well connected with a range of distinct neighbourhoods.

The key features of each of these elements are summarised below.

<u>Town centre</u>

- Located adjacent to the main north-south road transecting the Calderwood project and the near the principal east-west road connecting the balance of the Calderwood Valley with Albion Park.
- A mixed use precinct with retail, entertainment, learning, employment, civic and residential uses.
- Street focused retail with a main street feel.
- Primarily a local serving retail centre providing the day-to-day needs of the Calderwood project.
- Both civic and recreational open spaces including a range of gathering spaces.
- Respecting the cultural heritage elements of the site.
- Explore the opportunity for shared parking options in the detailed design to help facilitate a more walkable and pedestrian friendly centre.
- Bicycle parking in several locations throughout the centre.
- The Town Centre will become the key built identity for the whole of the Calderwood community.

- A range of higher density home types including terraces, small lot detached homes, apartments, live-work, shop-top and retirement living.
- Strong pedestrian and cycle linkages to the balance of Calderwood and nearby communities.
- Attractive, high quality built-form, using robust materials and reflecting the sustainability expectations for when it is created.
- Will be designed to accommodate the specific climatic characteristics of the site.
- Attract a range of commercial/retail owners, which will provide for a greater diversity in the retail offering.
- Located to maximise walkable access for many residents.
- A holistic urban design approach that balances the needs of all users creating interesting and engaging streets.

Village centre

- Located in an early stage of the project to provide the ready supply of local retail and basic temporary community needs.
- A street-based centre with a main street character.
- A strong identity with a high quality of built-form.
- Located adjacent to the main north-south road transecting the Calderwood community.
- Provides local serving day-to-day convenience retail needs.
- A range of housing types including possible opportunities for live-work homes.
- A Sales and Information Centre built to a high standard and design to reflect the aspirations of the Calderwood community.
- Incorporates a display village in close proximity to the Sales and Information Centre.
- Will be designed to accommodate the specific climatic characteristics of its location.
- Incorporating a range of community gathering spaces.
- Will also incorporated areas of high quality open space providing both recreation and civic needs.
- Well connected with both pedestrian and cycle routes to the adjacent neighbourhoods, Johnstons Spur, the nearby Macquarie Rivulet and the town centre.
- Consider a shared parking approach to further enhance the walkability and social interaction the centre will offer.
- Serviced by a bus route providing regular public transport.
- Identifiable neighbourhoods.
- The Calderwood community will ultimately be made up of a series of distinct neighbourhoods.
- Each neighbourhood will derive its character from its natural context; more specific urban design approach will be undertaken in detailed design.
- Public art and interpretive elements will further enhance the individual character of each neighbourhood.
- Landscape character will also be a key determinant in defining a neighbourhood.
- Neighbourhoods will be inclusive and inviting for all residents.
- An identifiable heart with be established for each neighbourhood, typically as an element of open space; a natural site characteristic or through leveraging specific views and vistas.
- Even though each neighbourhood will have its own identity, each will have a permeable connection with its adjacent neighbours.

3.2.5 A HEALTHY, SAFE AND ACCESSIBLE ENVIRONMENT

Objectives

- Creating public spaces that are "child friendly".
- Ensuring residents of all ages (children and older people) have access to basic services such as employment opportunities, public facilities, public transport, shops, infrastructure, health care, education and social support, and to diverse activities.
- Providing housing to suit the needs of older people.
- Designing neighbourhoods that encourage physical activity, an active lifestyle and social interaction.
- Environments that promote walking, cycling and incidental physical activity.
- Focus on safety and sense of security.
- Promote activation and passive surveillance of public areas and streets to ensure safety of all users.

Strategy

- All streets will be designed as pedestrian friendly environments to encourage walkability and pedestrian use. This will be achieved through:
  - Provision of well-lit and well-maintained footpaths.
  - Landscaping and streetscapes designed to create interest, shade and promote walking.
  - Legible and permeable street and block patterns.
  - High level of connectivity between centres and residential neighbourhoods.
  - Activation of parks / open space by promoting passive surveillance.
- A cycle friendly environment will be provided, through a range of cycle facilities including both on and off road paths, parking and signage.
- A variety of open spaces and sport and recreation opportunities will be provided to meet the needs of all age groups and promote physical activity and play. An interconnected network of parks, with a high level of pedestrian access, will ensure that most residents will be within five minutes walk from quality open space.
- A variety of public spaces will be provided to encourage informal meeting and gathering, and to provide places for relaxation and community activity. The public domain will be designed to be accessible so that all community members have the opportunity to access a range of spaces and facilities in their local area.
- Streets, walking paths, bike trails, open spaces and civic areas will have planting and lighting strategies to maximise visibility and safety.

3.2.6 ENCOURAGING SOCIAL INTERACTION AND ACTIVE NEIGHBOURHOOD LIFE

Objective

To provide safe and quality public domain to encourage social interaction and encourage pedestrian activities.

Strategy

- Public spaces of appropriate scale around the town and village centres will promote casual social interaction and informal gathering, as well as allow for outdoor civic and cultural activities. This will create attractive environment for pedestrian activities.
- Provide active frontages in all public areas to enhance casual surveillance and a sense of passive ownership, promoting safety and a sense of security.
- Public spaces are designed to meet the needs of different ages and promote equitable access for all segments of the population.
- A mixed-use land use pattern in the town and village centres will further enhance the opportunities for social interaction and minimise travel demand.

3.2.7 ACCESS TO RESOURCES IN THE WIDER AREA

Objective

To encourage residents to take public transport when travelling outside of the Calderwood area.

Strategy

- The town centre is proposed to be well serviced by bus services operating through the development. Investigations have shown that bus services will be the most effective form of public transport for the site, both in terms of economic feasibility and in providing a high quality, high frequency public transport service. Bus priority routes are proposed to be established from Calderwood to Shellharbour and Wollongong to help improve service reliability and to encourage the use of public transport.
- Bus stops will generally be located within five minutes walking distance of the majority of homes. Buses will be routed to travel via the town centre.
- The provision of public transport services will ensure the connectivity of the development with surrounding areas and to the regional transport network, primarily the train services linking with Wollongong and the metropolitan area, enhancing access to jobs, schools, shops, services and opportunities in the wider region.

3.2.8 ACCESSIBILITY OF EMPLOYMENT LANDS

Objectives

Local employment opportunities within the development will include retail, hospitality and commercial services within the centres, community facilities such as schools and childcare centres, and opportunities within the employment lands, the town and village centres.

Strategy

- Effective public transport system and pedestrian and cycle access between the employment area and the shops, services and facilities located in the town centre
- The need to make the employment area a safe and secure place, both for the workforce and for the adjacent residential community by providing appropriate lighting, security, and opportunities to promote activity in order to facilitate casual surveillance over key public areas. The design and location of buildings, entrances and car parking will have regard to safety and security considerations. In addition, strategies are required to ensure that the employment area is not used for anti-social activities at nights and weekends. Crime Prevention through Environmental Design (CPTED) principles will be incorporated into the detailed design of the Precinct
- It is important that all routes leading to and within the Employment Zone be pleasant and appealing for pedestrians, with appropriate lighting, shade, signage and bus shelters, and attractive streetscapes

3.2.9 COMMUNITY IDENTITY AND SENSE OF BELONGING

Objectives

To encourage residents to access local services by creating community identity within the development.

Strategy

- The unique location of the development and its environment and topography, dominated by the Illawarra Escarpment and also incorporating Johnstons Spur, Macquarie Rivulet and a number of other creeks
- The extensive public realm that responds to the unique environmental features of the site, with its outdoor recreation focus
- Elements of high quality and purposeful design in public spaces

- The vibrancy of the town and village centres associated with their integrated mix of uses and their distinct positioning
- Provision of community facilities which are responsive to the needs of residents and reflective of local culture
- The high quality residential environment, dwelling design, open space and landscaping
- Responsiveness to the cultural heritage of the site.
- Public art will be used as an integral place-making component in creating identity for the new community through engagement, a sense of ownership and belonging, and through encouraging the development of a creative community.
- Design elements in open space such as shelters may reflect the design character of existing buildings or themes from the local area

3.2.10 INTEGRATION WITH NEIGHBOURING COMMUNITIES

Objectives

To ensure social facilities are provided locally to service all residents.

Strategy

- Provision of community and recreation facilities, retail, commercial and open space within Calderwood that will be publicly accessible for the surrounding community
- Use of facilities in the surrounding area such as schools by the Calderwood population
- Provision of local employment opportunities within Calderwood. A high degree of integration will be achieved through the employment opportunities to be provided within the development, which will attract a workforce from the surrounding area and wider region. Jobs will be available not only in the Employment Zone, but also in the retail and commercial services within the town and village centres.

3.3 CONCEPT PLAN

The DLL proposal is for a master planned community development with a mix of residential, employment, retail, education, conservation and open space uses. The DLL landholdings, with development potential for 4,800 dwellings, would accommodate about 12,400 people. It also includes approximately 50 hectares of retail, education, community and mixed use/employment land.

DLL has prepared a Concept Plan for its landholding at Calderwood. The Concept Plan has the following attributes:

- Provides the basis for a linear north-south grid with associated environmental benefits in building orientation.
- Promotes logical staging of urban development together with supporting employment, physical and social infrastructure.
- Provides the basis for a movement network that promotes trip containment, walking, cycling and public transport.
- Delivers Town and Village Centres that meet the full range of community needs and are integrated into the urban form.
- Respects the objectives of the 7(n) conservation zone and promotes wider regional open space linkages.
- Provides for water quality and water quantity controls.
- Combines visual engagement with topography.
- Delivers non-urban land solutions.
- Allows for integration of adjoining lands in the broader Calderwood Valley Release Area.

The infrastructure required to implement the scope of the DLL CUDP outlined above can be provided in a managed, predictable and incremental process. These have been designed to meet the needs of both the DLL controlled land and the broader Calderwood Release Area.

The Concept Plan is shown at Figure 3.1.

Section 6.4.3 describes how assessments of the sensitivity of the implementation of these measures are accounted for in the traffic modeling assessments to identify potential road network upgrades.

3.3.1 LAND USE

For traffic modeling purposes DLL identified an indicative subdivision of the CUDP. Figure 3.2 shows the internal CUDP road network with the indicative yields connections shown.

In summary, the following land uses will be provided:

- Residential – approximately 4,800 dwellings including approx 280 retirement living dwellings.
- The Town Centre will include:
  - 25,000sqm of retail floor area.
  - 20,000sqm of mixed use employment floor area.
  - Community facilities.
  - Public Primary School and High School.
  - Residential mixed use dwellings.
- A village centre including:
  - 5,000sqm of retail floor area.
  - 1,000sqm of mixed use employment land.
  - A mix of residential dwellings.

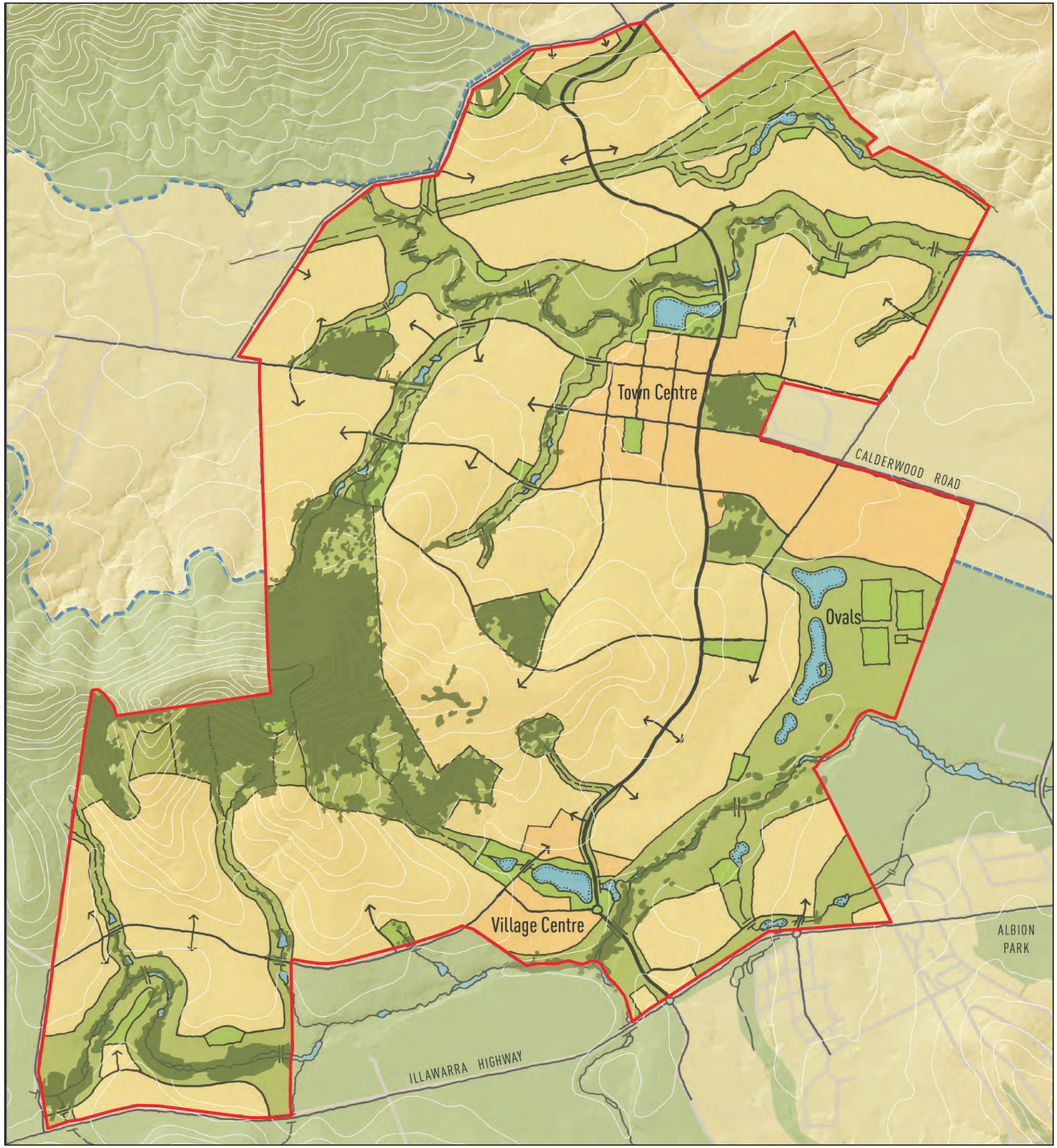

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Figure 3.1

Concept Plan

CALDERWOOD
URBAN DEVELOPMENT PROJECT

- Town and Village Centres
  Mixed Uses including Retail, Employment, Residential, Learning and Community Amenities
- Residential Neighbourhoods
- Parks
  eg Citywide, district and local parks
- Principal Open Space and Drainage
  eg Environmental Conservation, Environmental Management and Drainage Corridors
- Indicative Water Bodies

0 100m 500m 1,000m

February 2010

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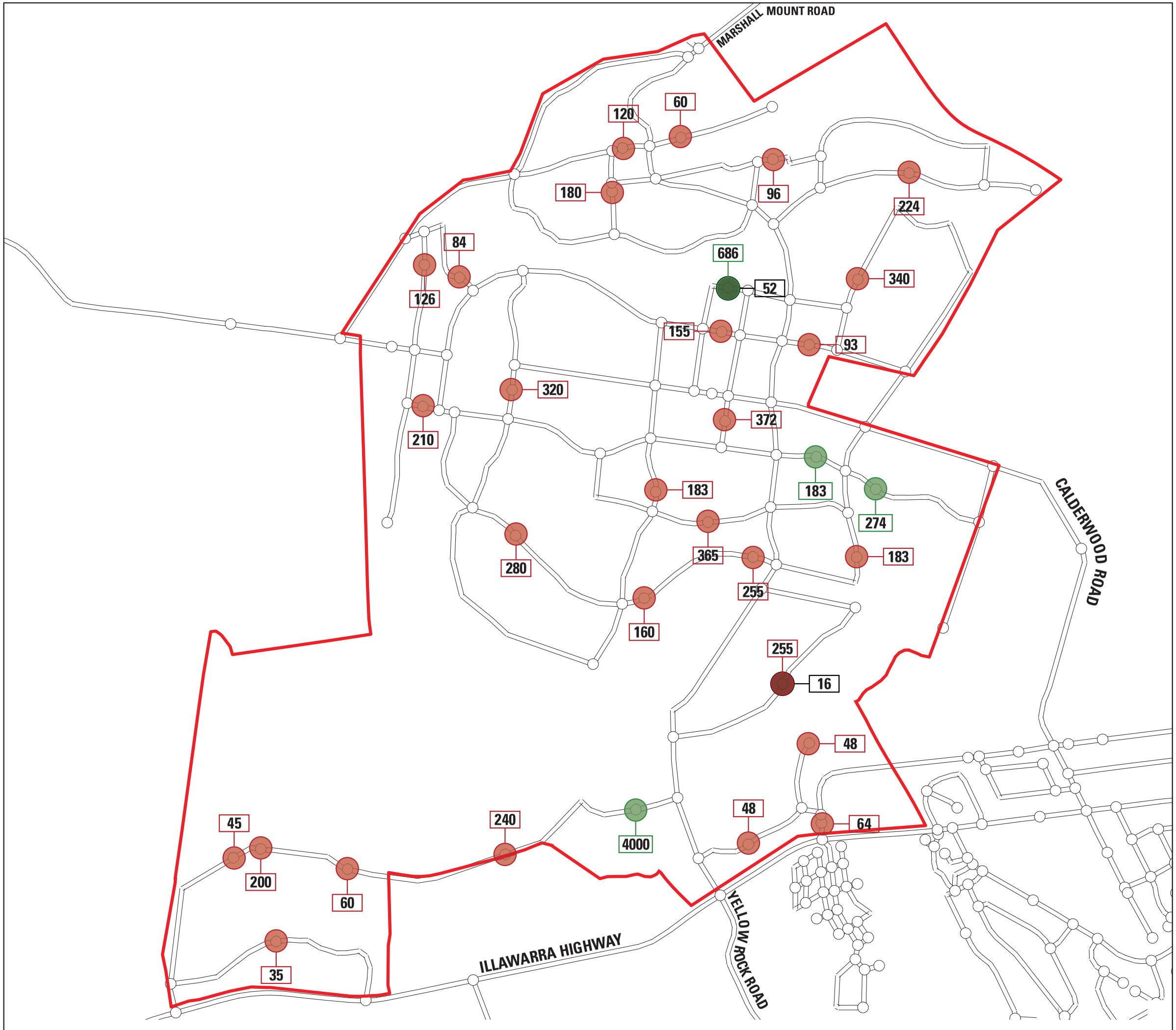

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Figure 3.2

Yield Plan

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

- Modelled Road Network
- Modelled Intersection
- CUDP Boundary (approx)
- Residential Zone Connector
- Employment Zone Connector
- Education Zone Connector
- No. of Dwellings
- No. of Education Jobs
- No. of Other Jobs

CUDP INTERNAL ROAD NETWORK IS INDICATIVE ONLY SHOWN FOR TRAFFIC MODELLING PURPOSES

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3.3.2 ROAD NETWORK

An indicative road network layout and hierarchy has been developed for assessment of the Concept Plan. The road hierarchy is presented in Figure 3.3. Key features of the proposed road network include:

- Key external road connections include:
  - Marshall Mount Road in the north-west.
  - Calderwood Road to the east and the west.
  - Four connections to the Illawarra Highway are proposed:
    - At the existing Illawarra Highway/Broughton Avenue intersection.
    - At the existing Illawarra Highway/Yellow Rock Road intersection.
    - To the east of the existing North Macquarie Road Intersection.
    - At the existing Illawarra Highway/North Macquarie Road intersection.
- A north-south sub-arterial road that connects to:
  - The Illawarra Highway in the south opposite Yellow Rock Road.
  - Marshall Mount Road in the north near North Marshall Mount Road.
- North Macquarie Road is retained to the west of the site although its central section within the CUDP site is realigned.
- Calderwood Road is retained to the east and west of the site although its central section within the CUDP site is realigned.
- Marshall Mount Road is retained in its current alignment forming a boundary along the north-western portion of the site.
- Access to North Marshall Mount Road will remain off Marshall Mount Road.
- Major Collector Roads serving each precinct, designed to facilitate the use of regular bus services.

The detailed form of the road network including intersection controls and cross-sections will be assessed through individual project applications. This concept plan provides a strategic assessment of the primary north-south corridor and other key routes.

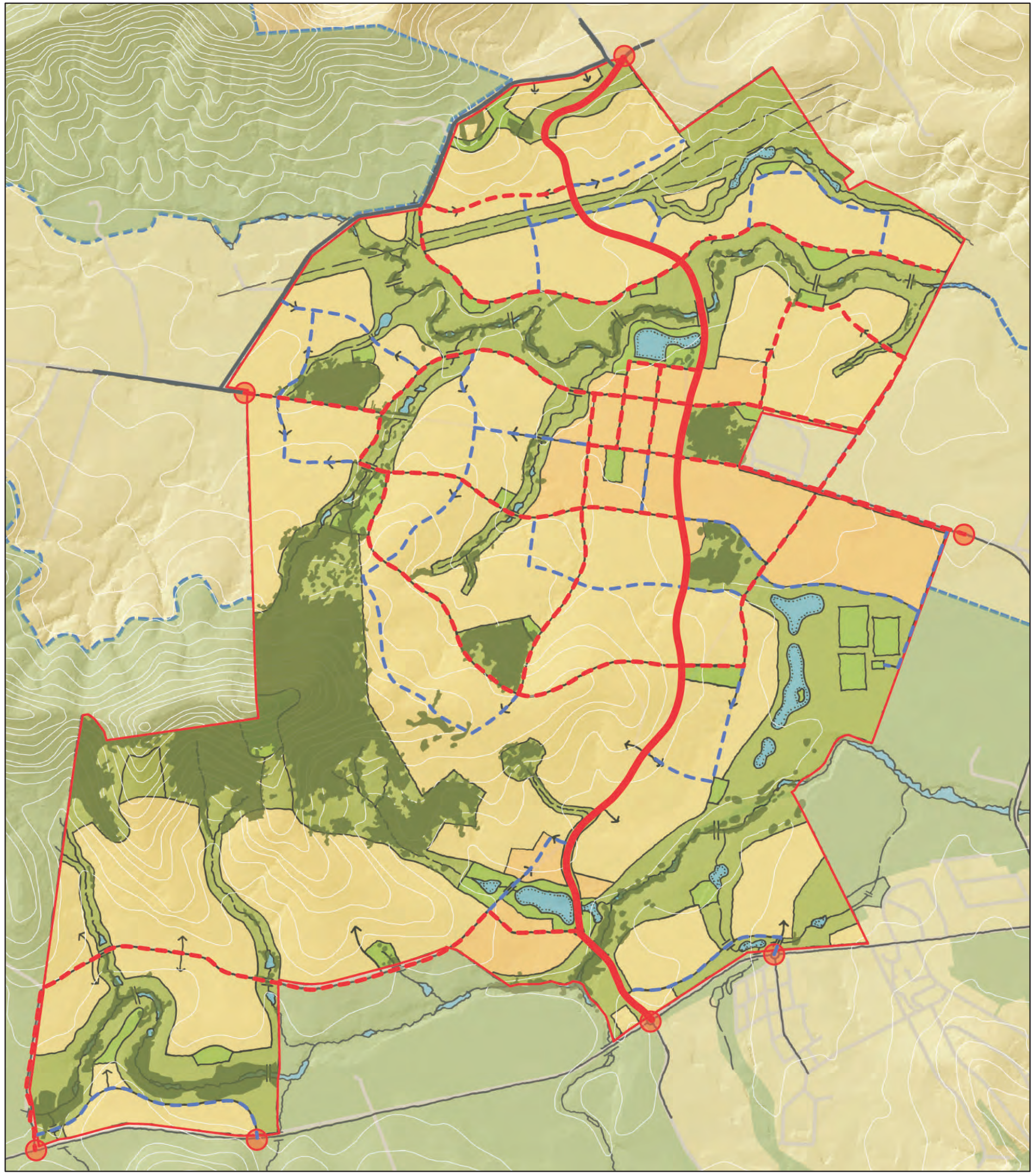

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Figure 3.3
Road Hierarchy

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Road Layout and Hierarchy

- Sub-Arterial Road
  2-4 lanes, Bus Route
- Major Collector Street
  Bus Route
- Minor Collector Street
  Principal Pedestrian Link
- Access Points
  Principal Links

n

1 ha

m 0 100 500 1,000

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3.3.3 PUBLIC TRANSPORT

It is proposed to service the Calderwood Urban Development via a network of bus services. Indicative routes, stop locations and 400m walking catchments are presented in Figure 3.4.

A detailed bus route network with recommended stop locations and walking catchments for the CUDP will be developed as part of the TMAP, however final design will be subject to consideration by NSW Transport & Infrastructure and the relevant service providers.

3.4 MODE SHARE TARGETS

DLL is committed to implementing sustainability initiatives / transport measures and urban design that encourage the uptake of non car mode transport and reduce the dependence on the private motor vehicle.

The current transport mode share across the total Wollongong and Shellharbour LGA's stands at around 90% car based trips, according to the 2006 Journey to Work data provided by the TDC. The remaining 10% consists of 5% public transport trips and 5% other trips which are assumed to be predominantly active transport trips, such as cycling and walking. These travel patterns are discussed in more detail in Section 4.4.

Based upon the experience of DLL in successfully implementing master planned communities which included a range of sustainable transport initiatives (see section 3.1). It is expected that a mode shift of 10% away from private vehicle use is likely to occur in the CUDP.

This TMAP sets out a range of measures which, if implemented in a timely and co-ordinated fashion, can achieve a shift in mode share. Key infrastructure links will be constructed from the outset to ensure that policy measures aimed at changing travel behaviour can be supported by viable alternatives to car travel.

As well as changing the mode split of person trips, DLL is also committed to reducing the actual need to travel long distances at all. With the implementation of the National Broadband Network and other advances in technology relating to home shopping and telecommuting the number of trips made per residence will also reduce.

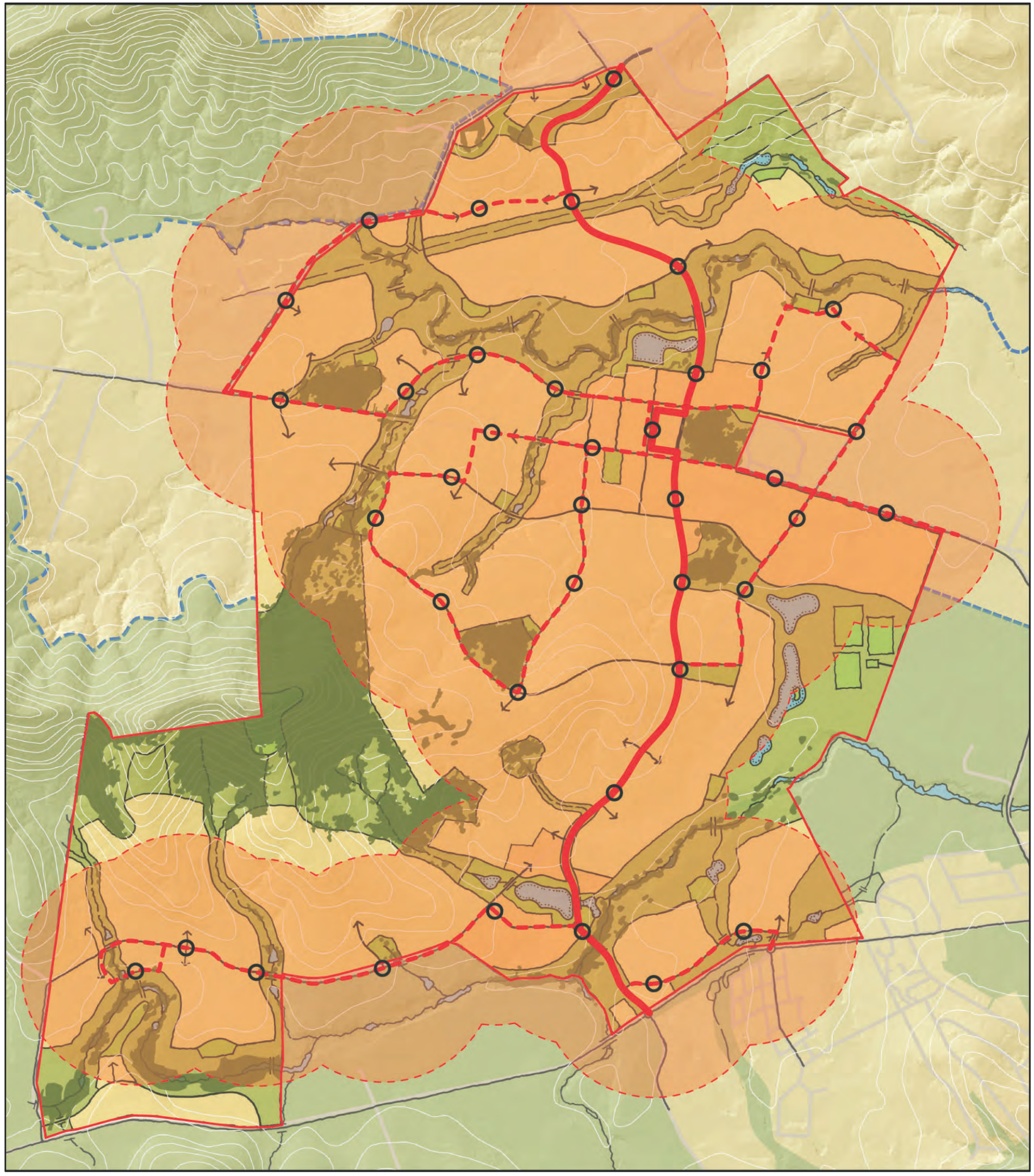

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Figure 3.4
Bus Routes

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Bus Service

- Strategic Trunk Bus Route
  To be negotiated with future operator
- Approximate Bus Route
  To be negotiated with future operator
- Approximate Bus Stop Location
  To be negotiated with future operator
- 400m Radius from Bus Stops
  Typically 5 minute walking radius

n 1 ha

m 0 100 500 1,000

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3.5 STAGING

A staging plan has been developed to deliver incremental community growth over the next two decades. The staging plan is detailed in Table 3.1. It is also of note that the stage yields also envisage completion by 2036. However, for traffic modeling purposes and to align with the agreed 2031 assessment year the full development has been assumed to be completed by 2031 to provide a conservative assessment of the impact of traffic related to CUDP on the road network.

Table 3.1 CUDP Annual Yields

Financial Year End	Annual Occupied dwellings	Cumulative Occupied dwellings	Cumulative Population
2012			
2013	53	53	135
2014	128	180	464
2015	203	383	987
2016	225	608	1,567
2017	225	833	2,148
2018	225	1,058	2,728
2019	225	1,283	3,309
2020	225	1,508	3,889
2021	225	1,733	4,470
2022	225	1,958	5,050
2023	225	2,183	5,631
2024	225	2,408	6,211
2025	225	2,633	6,792
2026	225	2,858	7,372
2027	225	3,083	7,953
2028	225	3,308	8,533
2029	225	3,533	9,114
2030	225	3,758	9,694
2031	225	3,983	10,275
2032	225	4,208	10,855
2033	225	4,433	11,436
2034	225	4,658	12,016
2035	120	4,778	12,326
2036	23	4,800	12,384
TOTAL	**4,800**	**4,800**	**12,400**

Note: These figures are indicative and are for traffic modeling purposes only. The figures are subject to change without notice. DLL & Cardno are not liable for the accuracy of these figures. Estimate assumes 70% of sales will be occupied in 12 months with remaining 30% the following year.

04

Existing Transport Context

4.1 CURRENT ROAD AND FREIGHT INFRASTRUCTURE

An initial area of influence was considered over which to describe the current road infrastructure as described in the following paragraphs. The area of influence is shown in Figure 1.2.

4.1.1 ROAD CLASSIFICATION

There are two main systems for the classification of roads in New South Wales, the functional classification system and the funding classification system. A third system that defines the environmental capacity of residential streets is also a form of classification.

Funding Classification

The RTA has adopted a "funding related" classification system that is primarily for administrative purposes. The key road classifications under the funding classification system are defined as:

- State Roads – roads performing an important state function and for which the RTA fully funds the maintenance cost. State roads are essentially arterial roads.
- Regional Roads – roads performing a significant regional function and for which the RTA and Council share the costs of maintenance. Regional roads are essentially sub-arterial roads.
- Local Roads – roads performing a local or collector function and for which the Councils fully fund the maintenance cost. Additional funding is available from the RTA in certain circumstances on the grounds of urban amenity and road safety.

The funding road classification in the CUDP area of influence is represented in Figure 4.1.

Functional Classification

The functional role or performance of individual roads can be appraised according to the classification of that road within an overall road hierarchy. Changes to traffic flows on the road can then be assessed within the context of the road hierarchy. The functional hierarchy consist of arterial, sub-arterial, collector and local roads. A detailed explanation of functional classification is contained in Appendix 4-A.

The functional road classification (Road Hierarchy) in the Calderwood area is represented in Figure 4.2.

4.1.2 FREIGHT ROUTES

The Southern Freeway and Princes Highway form the dominant freight route through the region, linking Port Kembla and Sydney with the Shoalhaven and South Coast regions. The Illawarra Highway carries some freight between the Illawarra and inland New South Wales, however the steep grades and poor alignment of Macquarie Pass limits its use by heavy vehicles, many of which prefer Picton Road.

Approved B-double routes through the CUDP area of influence are shown in Figure 4.3.

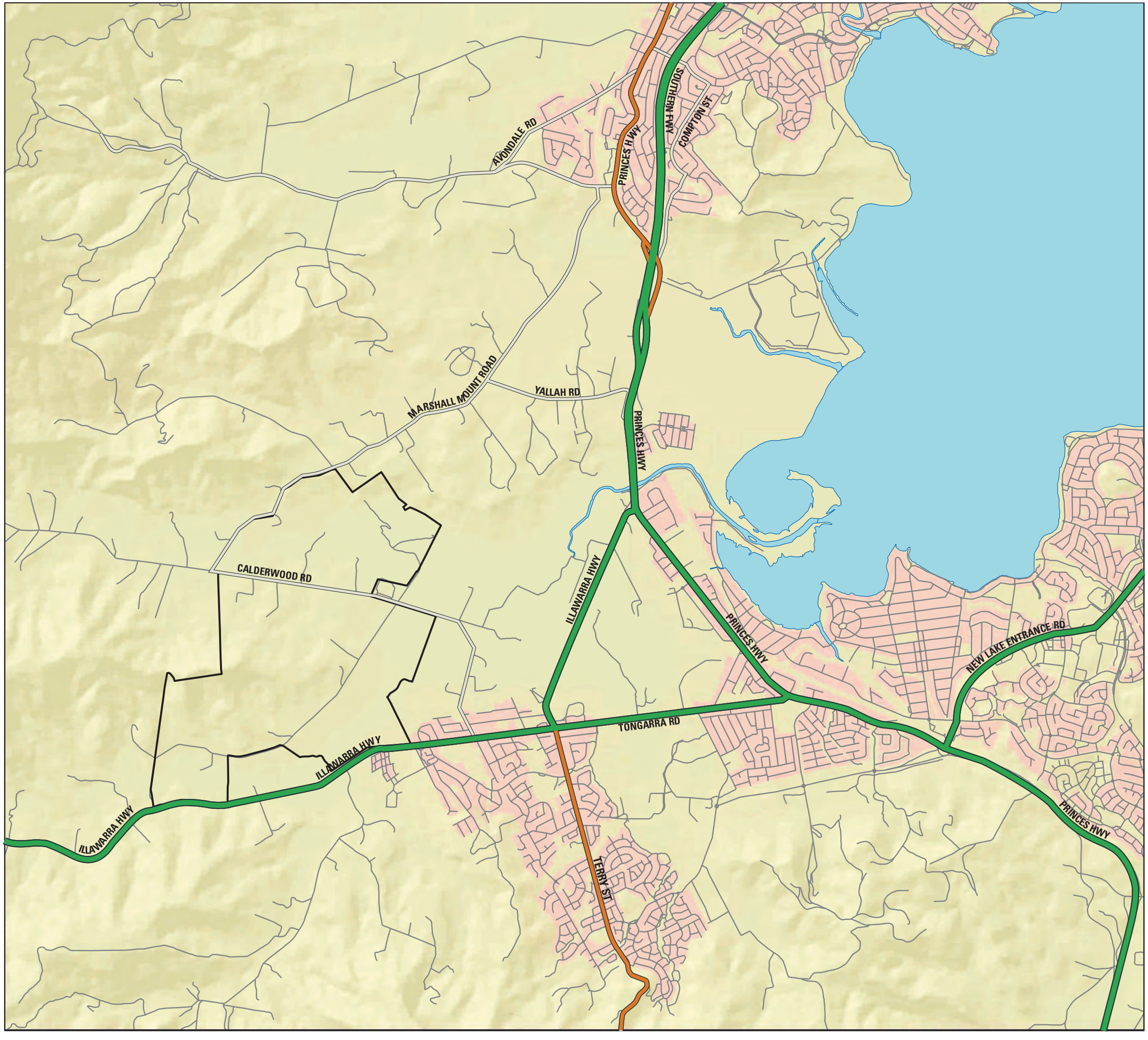

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Figure 4.1

Calderwood Area Road Network - Funding Classifications

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

- Site Boundary
- Local Roads (LPMA)
- Watercourse (LPMA)
- Lake Illawarra (LPMA)
- Existing Built Up Areas (LPMA)
- State Roads
- Regional Roads

Scale 1:40,000 (at A3)

Metres
0 250 500 1,000 1,500 2,000 2,500

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Coordinate System: Zone 56 MGA/GDA 94
GIS MAP REF: 110026-01_58007_TransportBaseMap_CEO.mxd 01

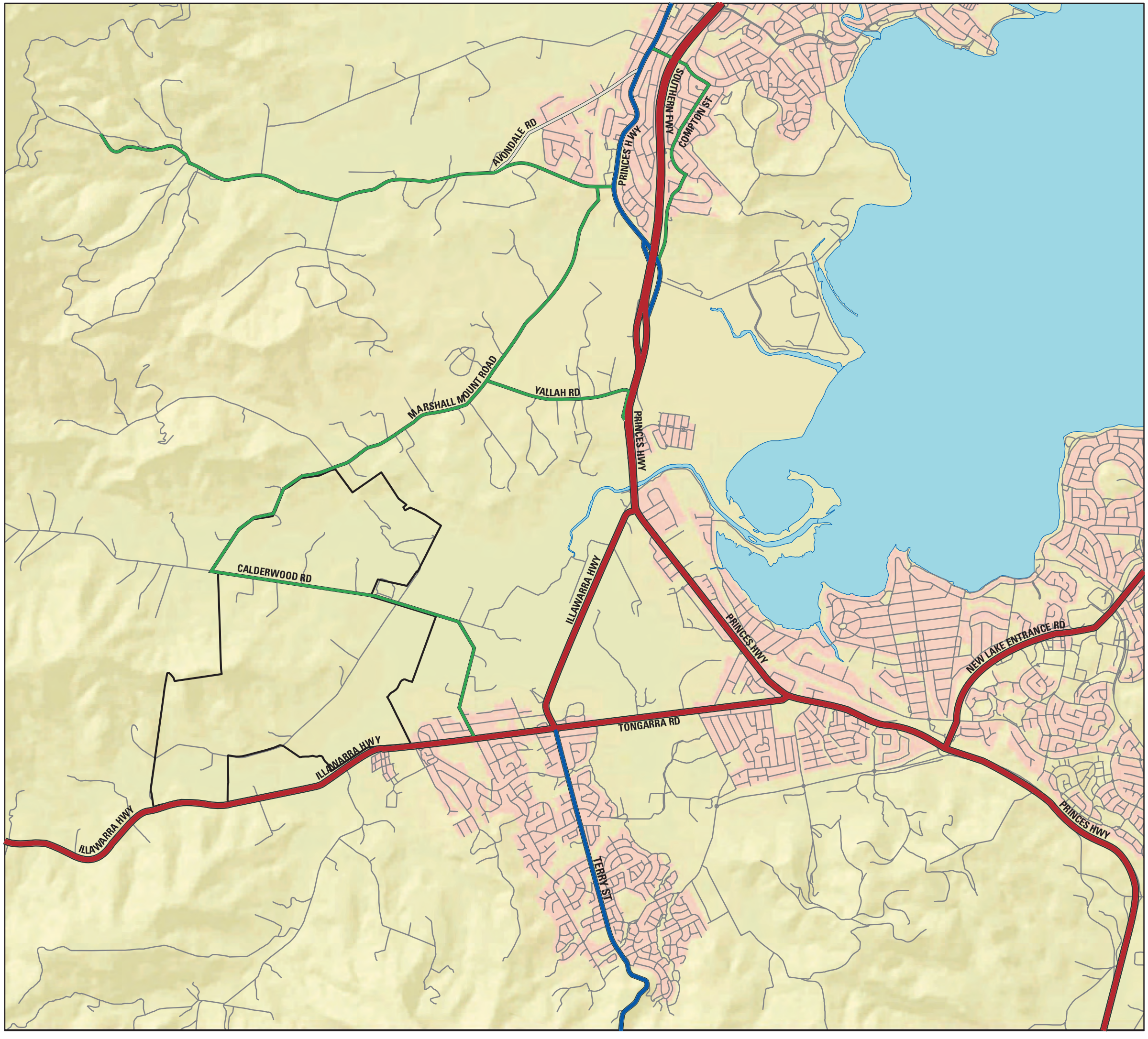

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Figure 4.2

Calderwood Area Road Network - Functional Hierarchy

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

- Site Boundary
- Local Roads (LPMA)
- Watercourse (LPMA)
- Lake Illawarra (LPMA)
- Existing Built Up Areas (LPMA)
- Arterial
- Sub Arterial
- Collector

Scale 1:40,000 (at A3)

Metres
0 250 500 1,000 1,500 2,000 2,500

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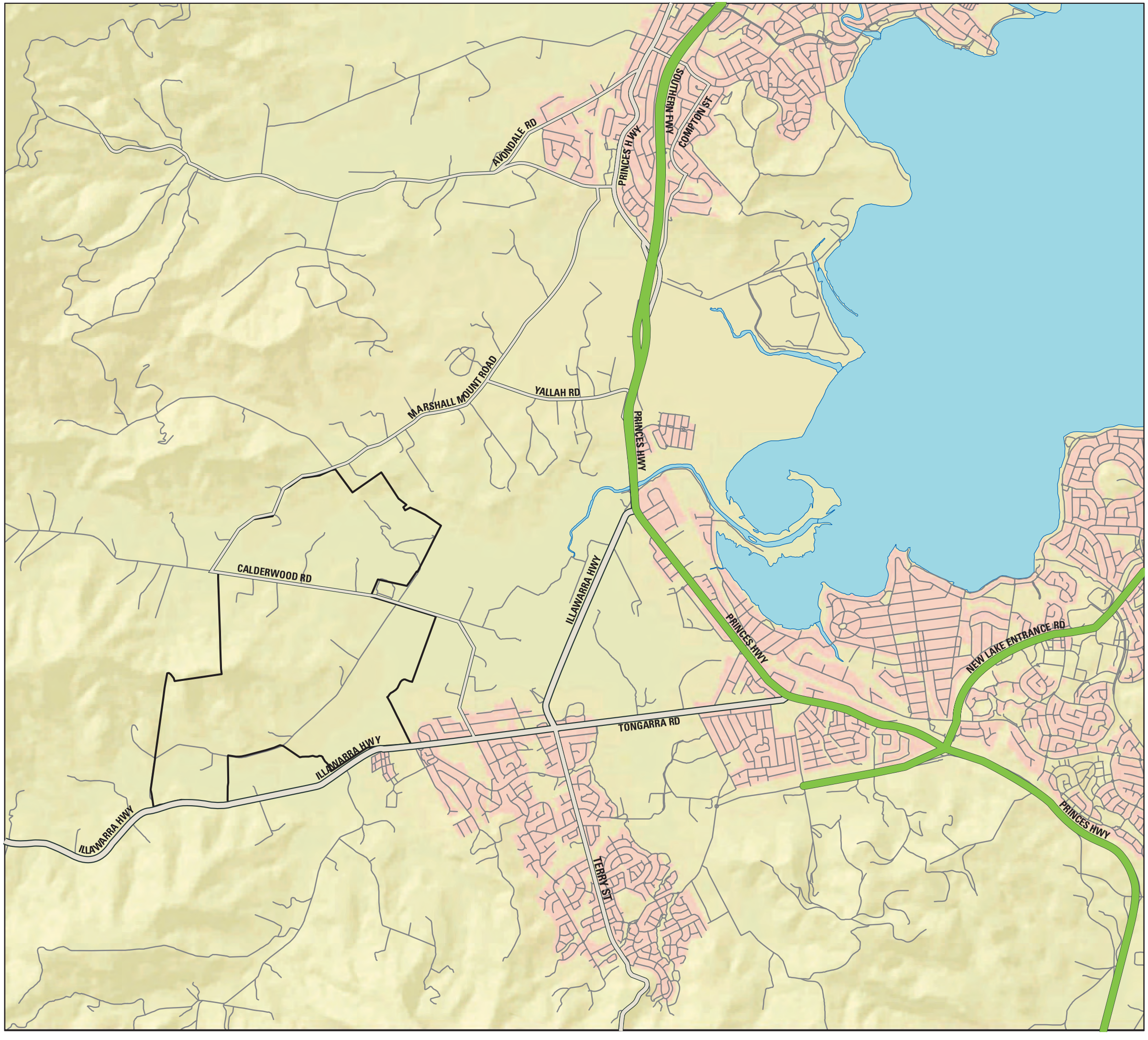

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Figure 4.3
Calderwood Area Road Network - B-double Routes

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

- Site Boundary
- Local Roads (LPMA)
- Watercourse (LPMA)
- Lake Illawarra (LPMA)
- Existing Built Up Areas (LPMA)
- B-double Routes

Scale 1:40,000 (at A3)

Metres
0 250 500 1,000 1,500 2,000 2,500

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GIS MAP REF: 110026-01_58007_TransportBaseMap_CEO.mxd 01

4.1.3 ROAD NETWORK DESCRIPTION

The major road network in the CUDP area of influence is comprised of the following key routes:

- Southern (F6) Freeway
- Princes Highway (north of Tallawarra)
- Illawarra Highway
- Tongarra Road
- Huntley Road
- Marshall Mount Road
- Yallah Road
- Calderwood Road
- North Macquarie Road

Descriptions of these roads are provided in Appendix 4-B.

4.1.4 INTERSECTION CONTROLS

The form of intersection control at the junctions within CUDP area of influence is shown in Figure 4.4.

In addition, it is proposed that the intersections of Tongarra Road and Station Road, and Tongarra Road and the site access road, will be signalised as part of the Illawarra Regional Business Park ('Delmo' Albion Park) development (*Director General's Report*, November 2008).

The roundabout intersection at Princes Highway and Illawarra Highway includes part-time traffic signals. The intersection is monitored by RTA cameras and the signals are used to meter flows where unnecessary congestion is caused by one flow dominating another.

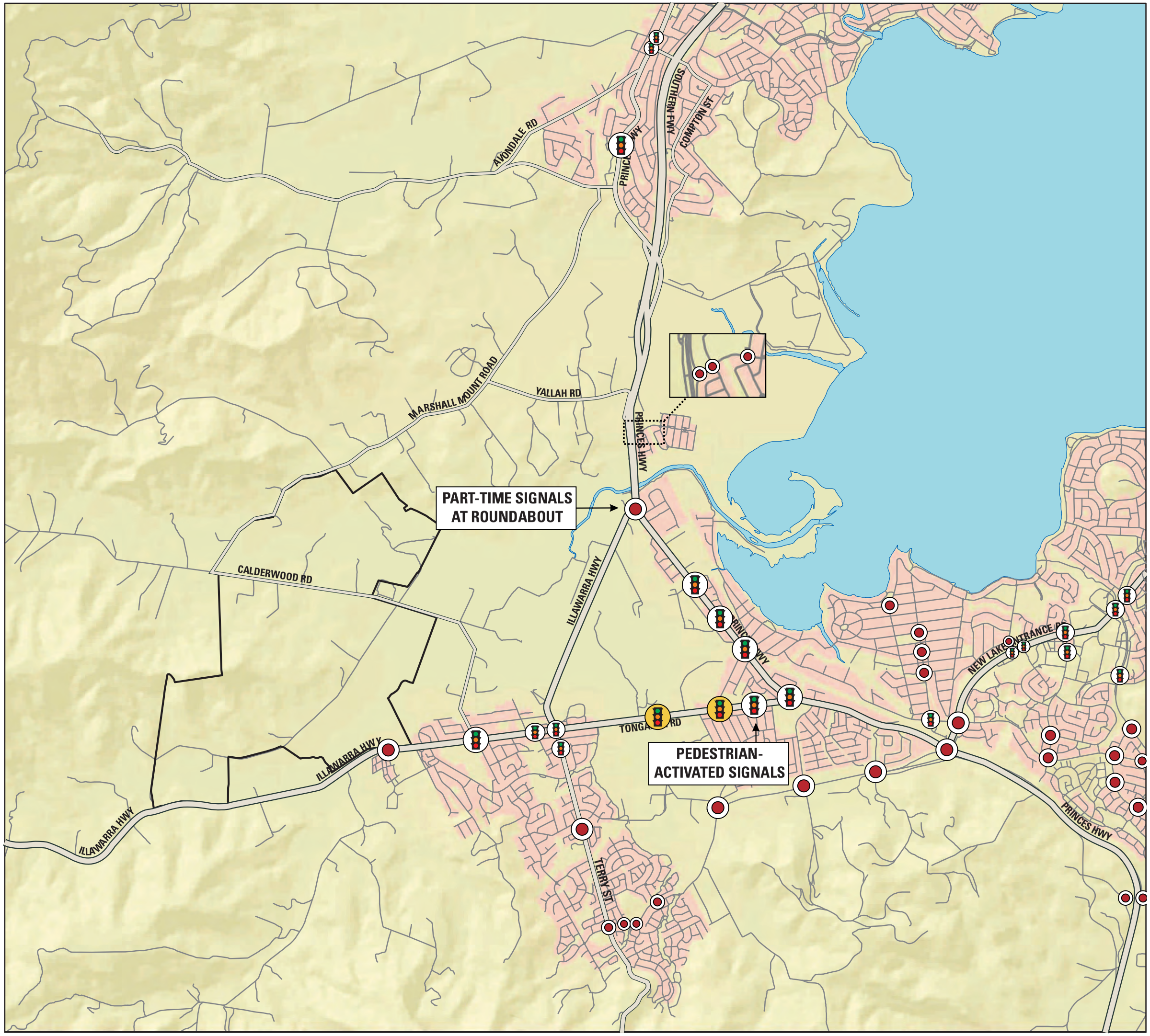

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Figure 4.4
Calderwood Area Road Network - Intersection Controls

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

- Site Boundary
- Local Roads (LPMA)
- Watercourse (LPMA)
- Lake Illawarra (LPMA)
- Existing Built Up Areas (LPMA)
- Traffic Signal
- Roundabout
- Signalised Intersections proposed as part of Delmo Development

Scale 1:40,000 (at A3)

Metres
0 250 500 1,000 1,500 2,000 2,500

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Shaping the Future

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Date: 03 December 2009
Coordinate System: Zone 56 MGA/GDA 94
GIS MAP REF: 110026-01_58007_TransportBaseMap_CEO.mxd 01

4.1.5 ROAD NETWORK CAPACITY & PERFORMANCE CRITERIA

Level of Service (LoS) is an index of the operational efficiency of a roadway or intersection. The analysis is essential in planning and design of the transport network and can influence the number of lanes provided or the arrangement of a traffic control system under study.

LoS can be measured at mid-block or at intersections. As a mid block measure, LoS is a qualitative measure describing the operational conditions on a road and their perception by a driver. At intersections, LoS is considered in terms of average delay experienced by drivers.

Mid-Block Carriageway Capacity

The capacity of major streets within an urban area can be based on an assessment of their operating Level of Service. Level of Service (LoS) is defined by AUSTROADS *Guide to Traffic Engineering Practice – Part 2 Roadway Capacity* (1988) as a qualitative measure of the effects of a number of features, which include speed and travel time, traffic interruptions, freedom to manoeuvre, safety, driving comfort and convenience, and operating costs. LoS is designated from A to F from best (free flow conditions) to worst (forced flow with stop start operation, long queues and delays) as follows[1]:

- A - Free flow (almost no delays).
- B - Stable flow (slight delays).
- C - Stable flow (acceptable delays).
- D - Approaching unstable flow (tolerable delays).
- E - Unstable flow (congestion; intolerable delays).
- F - Forced flow (jammed).

A detailed explanation of Carriageway Level of Service for urban and rural roads is located in Appendix 4-C.

Intersection Performance

The capacity of an urban road network is controlled by the capacity of the intersections within that network. Average delay is commonly used to assess the actual performance of intersections, with Level of Service used as an index. The operating performance of intersections has been assessed using the SIDRA software package to determine the Degree of Saturation (DS), Average Vehicle Delay (AVD in seconds) and LoS at each intersection. The SIDRA program provides LoS Criteria Tables for various intersection types. The key indicator of intersection performance is LoS, where results are placed on a continuum from 'A' to 'F', as detailed in Appendix 4-D.

4.1.6 EXISTING TRAFFIC DEMANDS

A variety of sources of traffic volume counts have been utilised in this study:

- Roads and Traffic Authority maintains a database of Annual Average Daily Traffic (AADT) volumes on key roads in New South Wales.
- Traffic counts undertaken for Cardno on 22 October 2009 at 15 key intersections within the CUDP area of influence.

[1] The colour shown for LoS are typically used throughout this report to highlight LoS

Historical AADT

The available 2005 annual average daily traffic (AADT) volumes are presented in Figure 4.5. Historical RTA published AADT volumes are provided in Appendix 4-E for key arterial roads within the CUDP area of influence for the years 1994 to 2005.

Between the early 1990s and 2003, the key through routes of Princes Highway and Southern Freeway grew at a steady rate; however between 2003 and 2005 only small growth was experienced. The opening of the East West Route in 2001 appears to have resulted in a significant drop in volumes on Princes Highway, east of Tongarra Road, and on Tongarra Road between 2000 and 2003. A significant drop in traffic volumes was also recorded on Illawarra Highway, west of Terry Street, between 2000 and 2003 which may have been the result of the implementation of right turn bans at the Illawarra Highway/Tongarra Road/Terry Street intersection.

Intersection Turning Volumes

Intersection turning counts were undertaken for Cardno on the 22nd October 2009 at 15 key intersections within the initial study area for the assessment of existing conditions. These peak hour traffic volume counts are summarised in Figure 4.6.

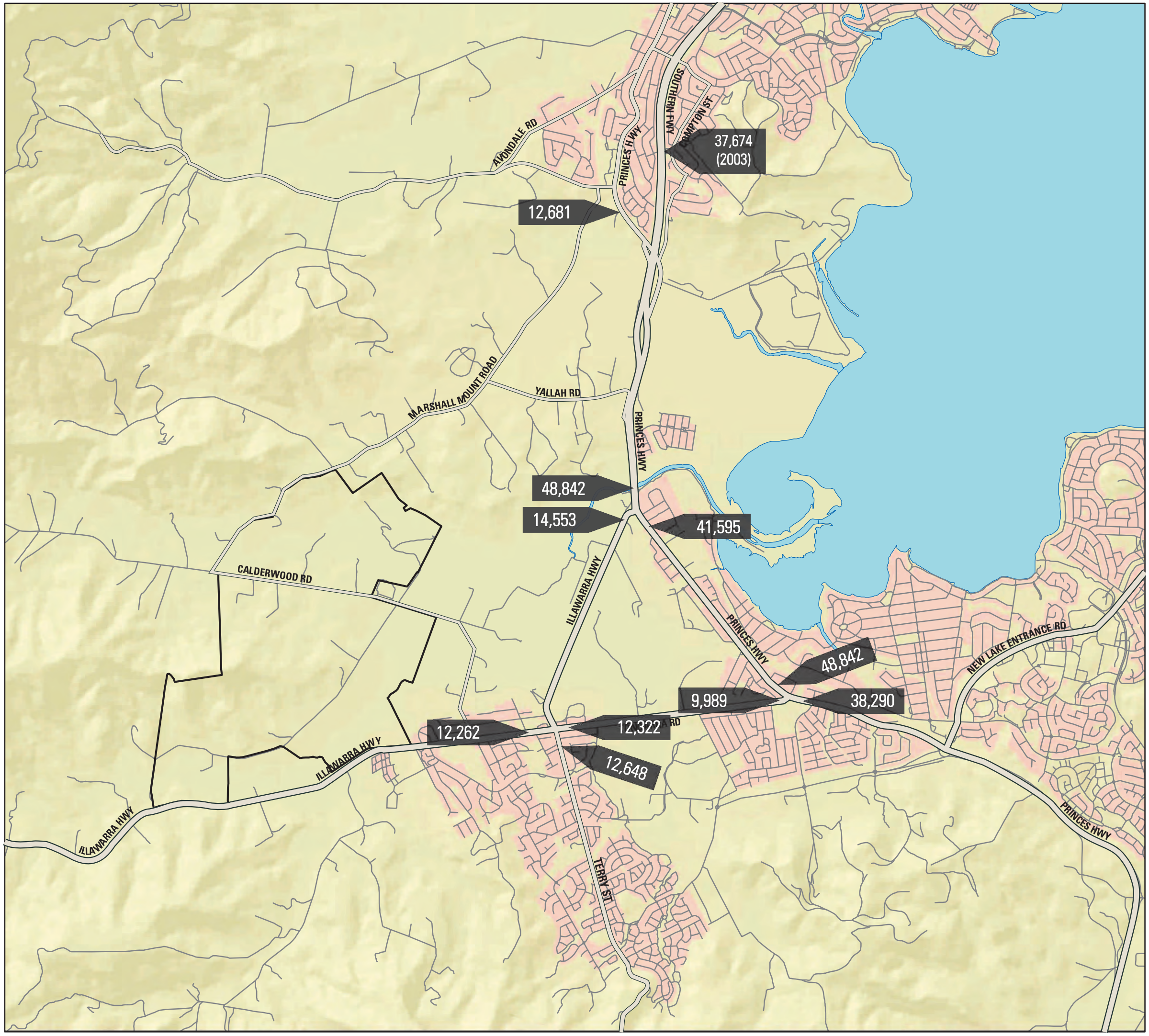

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Figure 4.5
Calderwood Area Road Network - 2005 Average Annual Traffic Volumes (AADT)

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

- Site Boundary
- Local Roads (LPMA)
- Watercourse (LPMA)
- Lake Illawarra (LPMA)
- Existing Built Up Areas (LPMA)

Scale 1:40,000 (at A3)

Metres
0 250 500 1,000 1,500 2,000 2,500

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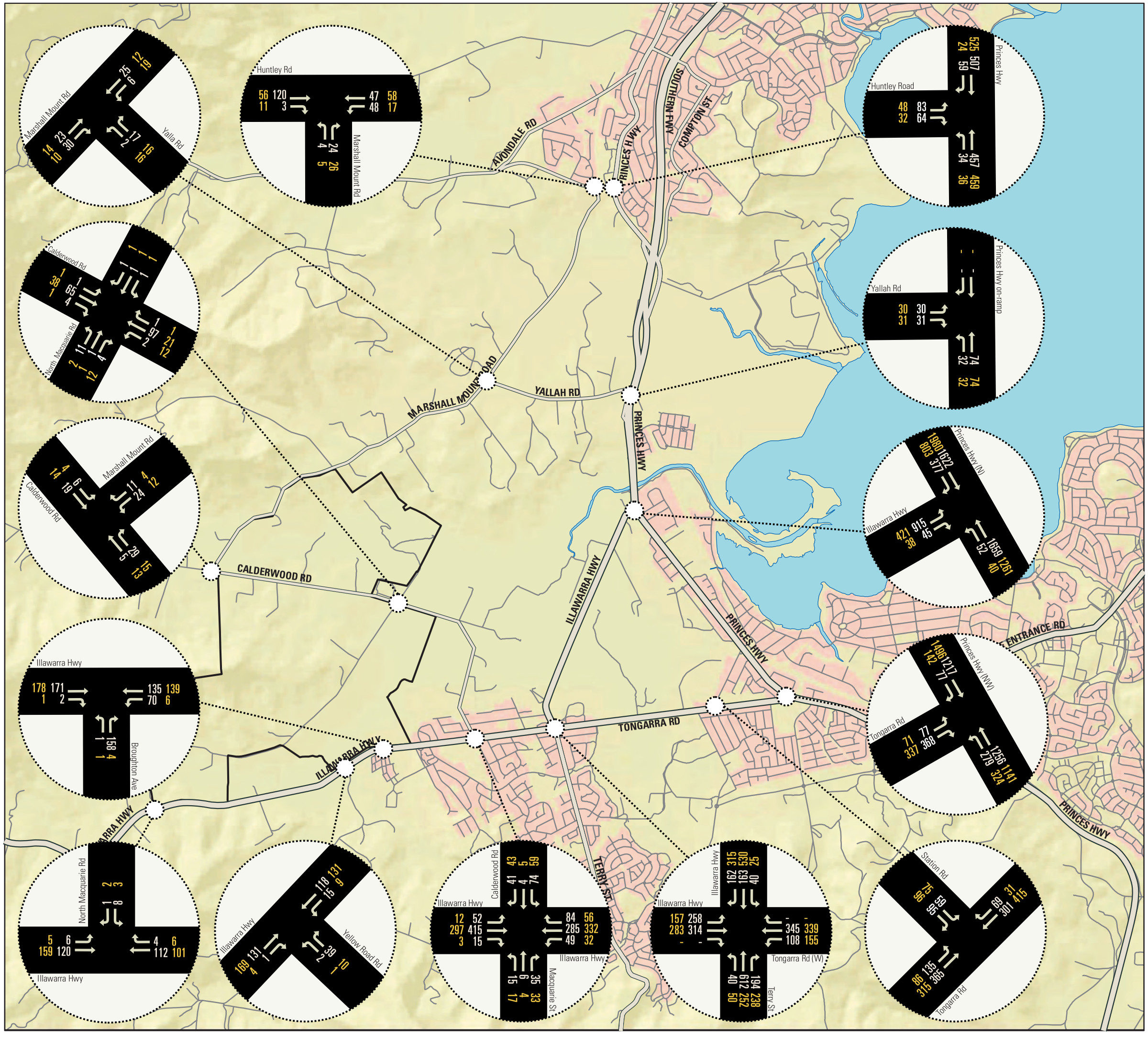

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Figure 4.6
2009 Existing Peak Turning Traffic Volumes

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

- Site Boundary
- Local Roads (LPMA)
- Watercourse (LPMA)
- Lake Illawarra (LPMA)
- Existing Built Up Areas (LPMA)
- XXX AM Peak Traffic Volumes
- XXX PM Peak Traffic Volumes

Scale 1:40,000 (at A3)

Metres
0 250 500 1,000 1,500 2,000 2,500

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Coordinate System: Zone 56 MGA/GDA 94
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4.1.7 ROAD NETWORK PERFORMANCE ASSESSMENT

The performance of the existing road network has been assessed to consider the:

- Mid-block carriageway performance.
- Intersection performance.

Mid-block Carriageway Performance

An assessment of the mid-block traffic volumes and carriageway LoS for key links within vicinity of the site was undertaken. The overall existing level of service on key route sections is presented graphically in Figure 4.7 and Figure 4.8 for the AM and PM peak periods respectively. Appendix 4-F presents a summary of mid-block traffic volumes and carriageway level of service for key links within vicinity of the site.

The mid-block carriageway assessment shows that the road network sections within the area of influence currently provide an acceptable level of operation with the exception of:

- Princes Highway southbound between Southern Freeway and Illawarra Highway which operates at LoS F during the PM Peak.
- Princes Highway northbound between Southern Freeway and Illawarra Highway which operates at LoS E/F during the AM Peak.

Intersection Performance

A summary of the operating performance of critical intersections within the study area is provided in Appendix 4-G. The resulting intersection LoS is presented graphically in Figure 4.7 and Figure 4.8 for the AM and PM peak periods respectively.

The intersection performance assessment shows that all intersections operate satisfactorily at LoS D or better except:

- The intersection of Princes Highway and Illawarra Highway operates at LoS F during the AM Peak period. This is primarily to due to the heavy through traffic along Princes Highway which significantly limits how much time is available for Illawarra Highway traffic to enter the roundabout. This intersection operates satisfactorily in the PM peak, with the worst movement being the southbound through movement operating at a LoS C.

Although other intersections operate at or below LoS D it is worth noting the following:

- The intersection of Illawarra Highway, Tongarra Road and Terry Street operates at LoS C during the AM Peak, mainly due to the heavy northbound traffic flows from Terry Street. The worst movement at the intersection is the right turning movement from the northern approach, operating at the LoS D with a delay of approximately 43 seconds.
- The intersection of Princes Highway and Tongarra Road generally operates well with an average LoS B during both the AM and PM peak. It is important to note that the right turning movement at this intersection is operating at capacity (LoS D) in the peak periods.
- The intersection of Princes Highway and Huntley Road operates at LoS C in the AM Peak and PM Peak due to the difficulty in making uncontrolled right turns from Huntley Road into Princes Highway.
- The intersection of Illawarra Highway and Yellow Rock Road operates satisfactorily in the AM and PM periods with a maximum delay of approximately 15 seconds (LoS C) experienced for vehicles exiting Yellow Rock Road in the PM Peak period.

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Figure 4.7

Road Network Performance AM Peak 2009 Existing

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Haywards Bay Drive
1:7,500

Yallah Bay Road
1:20,000

Legend

Model Ref No. 09_B00

- Site Boundary
- Lake Illawarra (LPMA)
- Local Roads (LPMA)
- Mid-Block Road Sections
- Priority Control
- Roundabout
- Traffic Signals

Level of Service (LoS)

- No Data
- A
- B
- C
- D
- E
- F

Network Statistics - 09_B00A

Ave VKT (km/trip)	10.19
Total VKT (mvkt)	0.59
Ave VoT (min/trip)	11.45
Total VoT ('000 hrs)	11.11

Scale 1:40 000 (at A3)

Metres
0 500 1,000 1,500 2,000 2,500

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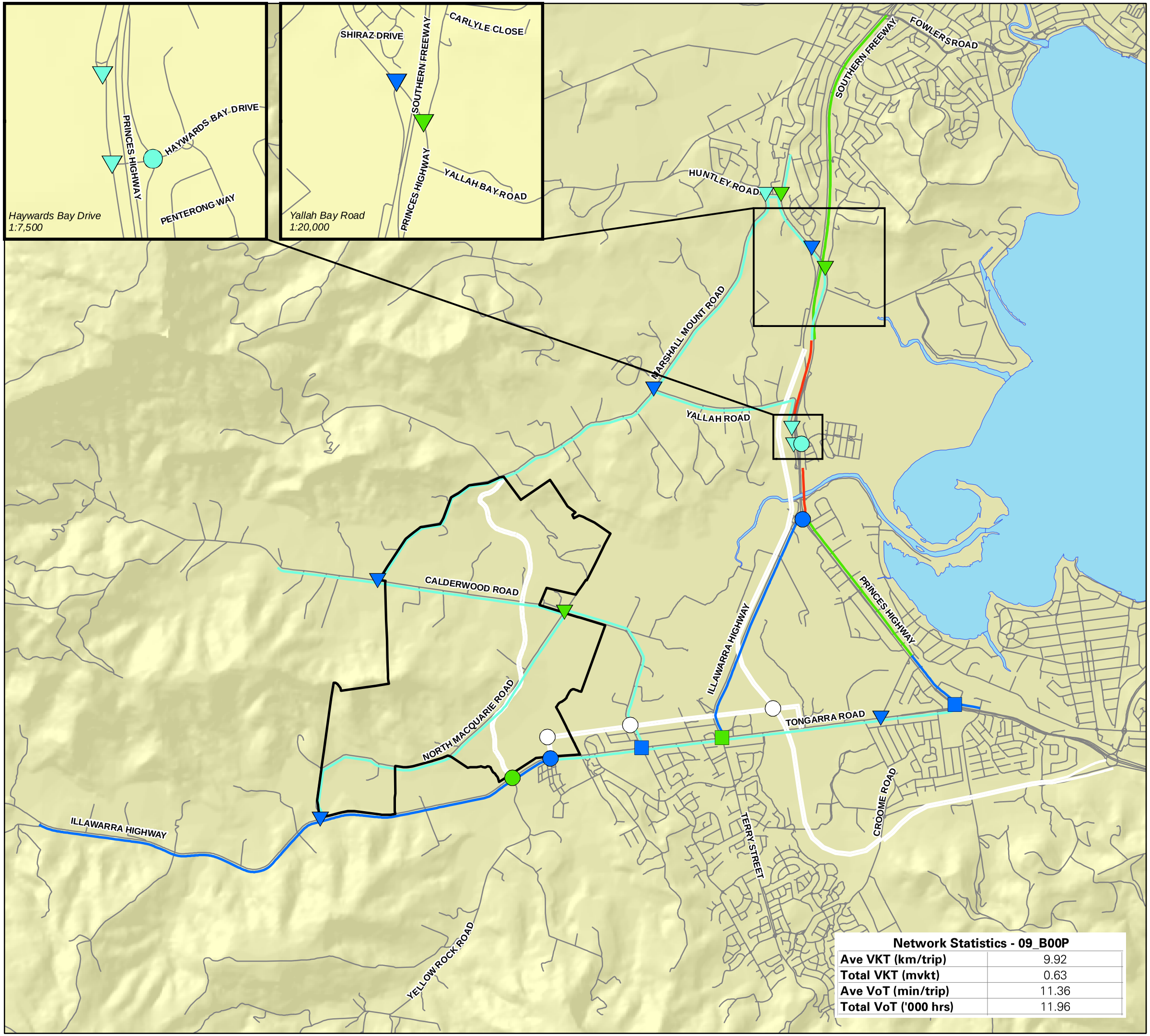
Coordinate System: Zone 56 MGA/GDA 94
GIS MAP REF: 10026-01_58011_KeyRoutes_LevelOfService.mxd 09



Network Statistics - 09_B00P

Ave VKT (km/trip)	9.92
Total VKT (mvkt)	0.63
Ave VoT (min/trip)	11.36
Total VoT ('000 hrs)	11.96

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Figure 4.8

Road Network Performance PM Peak 2009 Existing

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

Model Ref No.: 09_B00

- Site Boundary
- Lake Illawarra (LPMA)
- Local Roads (LPMA)
- Mid-Block Road Sections
- Priority Control
- Roundabout
- Traffic Signals

Level of Service (LoS)

- No Data
- A
- B
- C
- D
- E
- F

N W E S

Scale 1:40 000 (at A3)

Metres
0 500 1,000 1,500 2,000 2,500

Cardno

Map Produced by Cardno Wollongong
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Coordinate System: Zone 56 MGA/GDA 94
GIS MAP REF: 110026-01_58013_KeyRoutes_LevelOfService_2009PM.mxd 04

4.1.8 EXISTING ROAD NETWORK DEFICIENCIES

The existing transport network contains a number of deficiencies which limit the level of service provided to existing peak period traffic. These include:

Mid-block performance

- Princes Highway between Southern Freeway and Illawarra Highway:
  - Southbound operates at LoS F during the PM Peak.
  - Northbound operates at LoS E/F during the AM Peak.

Intersection performance

- Intersection of Princes Highway and Illawarra Highway operates at LoS F during the AM Peak period.

Rural Roads

The existing rural roads within the study area are generally adequate for present traffic volumes, with some exceptions:

- North Macquarie Road - not wide enough for two vehicles to pass in some sections, including the ford across Macquarie Rivulet, and the pavement is in poor condition in some sections.
- Marshall Mount Road - section of very poor pavement between Calderwood Road and Marshall Mount Creek.
- Marshall Mount Road - has a single-lane bridge and a narrow two-lane bridge across a branch of Duck Creek.

4.1.9 POTENTIAL IMPROVEMENTS TO ADDRESS EXISTING ROAD NETWORK DEFICIENCIES

It is to be recognised that the development at CUDP should not be required to contribute to the improvement of road network deficiencies which exist in advance of any development occurring. Since the assessment of the existing condition identified that the Princes Highway (between Illawara Highway and Southern Freeway) and the intersection of Princes Highway and Illawara Highway provide an unsatisfactory level of performance.

Therefore, to remedy this existing deficiency, additional traffic capacity by the addition of a lane in either direction would be appear to resolve the existing deficiency. From an inspection of aerial photography there appears the potential to convert current adjacent verge/parking areas to traffic lanes. This may also require the creation of peak period clearways to ensure traffic capacity is available at the times of most need whilst providing some carriageway to meet the parking needs of adjacent frontage developments. For areas where the available highway corridor may be insufficient to form a desirable road cross section (frontage developments etc) government could seek to utilize compulsory purchase powers.

However, considering the scale of anticipated land use changes within the local area a more appropriate solution, considering the sub regional transport task, would be for the construction of the F6 freeway extension from Tallawarra to Oak Flats and effectively provide a bypass to these over capacity existing sections and provide amenity benefit to those affected frontage residents.

Network improvements recommended to address existing deficiencies are detailed in Table 4.1. In conjunction with the construction of the F6 freeway extension carriageway associated ramps and access roads must be provided. The complimentary freeway extension works are detailed in Table 4.2. No other road network improvements were identified as being required to address existing network deficiencies.

Table 4.1 Proposed Road Network Improvements to Address Existing Deficiencies

Upgrade Number	Location	Proposed Network Improvement
Road Link Upgrades		
Upgrade 1	F6 Extension from Tallawarra Interchange to Tripoli Way Interchange	Construction of a four-lane divided carriageway to freeway standard
Upgrade 2	F6 Extension from Tripoli Way Interchange to Croome Road Interchange	
Upgrade 3	F6 Extension from Croome Road Interchange to Oak Flats Interchange	

Table 4.2 Proposed F6 Extension Complimentary Road Network Improvements

Upgrade Number	Location	Proposed Network Improvement
Road Link Upgrades		
Upgrade 4	F6 Extension Tripoli Way North Facing Ramps	Single lane ramps on all approaches with double roundabouts and single central structure
Upgrade 5	F6 Extension Tripoli Way South Facing Ramps	
Upgrade 6	Tripoli Way extension from Illawarra Highway (East) to F6 Extension	Construct divided two way-four lane carriageway with minimum 3.5m lane widths with kerb and gutter.
Upgrade 7	Tripoli Way extension from F6 Extension to Tongarra Road	
Upgrade 8	F6 Extension Croome Road Ramps	Single lane ramps
Upgrade 9	F6 Extension Complimentary Measures	Install LATM treatments along Princes Highway between F6 extension limits
Intersection Upgrades		
Upgrade 10	Tripoli Way/Illawarra Highway	New signalised intersection
Upgrade 11	Tripoli Way/Tongarra Road	New signalised intersection

Timing for implementation of these measures is discussed in Section 10.2 and 11.3.1.

4.2 CURRENT PUBLIC TRANSPORT PROVISION

As the Calderwood area is primarily a rural area at the present time public transport services are non-existent within the area. The nearest bus and rail services are located in the suburb of Albion Park, to the south of the site, for bus services and 3-5 kilometres to the east for rail services. This section provides an outline of the public transport accessibility to the locality.

4.2.1 RAIL INFRASTRUCTURE AND SERVICES

The South Coast Railway Line is located approximately 3km east of the study area on a north-south axis, running parallel to, and east of, the Princes Highway. It is currently a single, electrified track with a number of at-grade and grade separated road crossings. A review of the rail infrastructure and services is provided in Appendix 4-H.

Key issues to note are:

- Dapto, Albion Park and Oak Flats are the closest railway stations to the proposed development. The development site is located outside of the walking catchment of the stations and consequently it is expected that persons travelling to or from the site by rail will interchange to bus services at Dapto, Albion Park or Oak Flats, or proceed to the site via bicycle or car.
- Dapto Station will most likely be used for journeys to or from Wollongong and Sydney, depending on the availability of connecting bus services, as it sits on the desire line for these journeys.
- Albion Park and Oak Flats Stations are located to the east and would require travellers to/from the north to make a significant detour. It is likely that these stations would be used mainly for journeys to/from the Kiama, Gerringong and Shoalhaven districts.
- Currently, services on the South Coast railway line generally operate as through services between Sydney Terminal and the end of the electrified track at Kiama, although some diesel services commence from Bomaderry and terminate at Dapto with connecting electric services commencing at Dapto and heading to Sydney.

As part of planning for the West Dapto Urban Release Area, a new railway station was proposed adjacent to the Huntley Road Bridge over the South Coast railway line; 3km south of Dapto (refer to Figure 4.9). Should the proposed Huntley railway station be constructed, the Calderwood development would be brought significantly closer to the rail network. It would avoid the necessity for bus passengers or park-and-riders to travel into Dapto to transfer to or from the rail network, potentially improving the attractiveness of the rail network for journeys within the Illawarra. The present time taken to reach Dapto by bus or car versus the travel time to Wollongong via the Southern Freeway reduces the attractiveness of public transport for such journeys.

4.2.2 BUS SERVICES

Premier Illawarra operates bus services in the Wollongong area, with routes stretching from Kiama in the south to Bellambi in the north. A review of the bus services is provided in Appendix 4-I. Due to the rural nature of Calderwood, no bus routes presently serve the immediate area. The closest bus routes are located at Albion Park. Figure 4.10 presents the bus routes operating within the area.

Bus services will need to be extended or created to serve the Calderwood development. An overview of the public transport network deficiencies is provided in Section 4.2.4, Key issues to note are:

- Services are infrequent.
- The routes are circuitous, which increases travel time significantly.
- Public transport information is poor, with network maps and timetables difficult to decipher.
- The interchange arrangements at Albion Park Railway Station are difficult to understand.

4.2.3 ILLAWARRA BUS NETWORK REVIEW

The state government's bus network review for the Illawarra Region 10 was released for public comment in October 2009 and an excerpt of the relevant area is provided in Appendix 4-J. A frequency guide has not been provided so preliminary comments can only be made on the proposed route structure.

It should be noted that this review did not consider the inclusion of CUDP. The proposed route structure retains the separation between Dapto and Albion Park services with only routes 37/57 providing a bus link across Macquarie Rivulet. Services in Albion Park are altered to all run clockwise around the loop and the number of different routes linking Albion Park to Shellharbour City Centre is rationalised from three to two. Some rationalisation of routes is also proposed for the Dapto area.

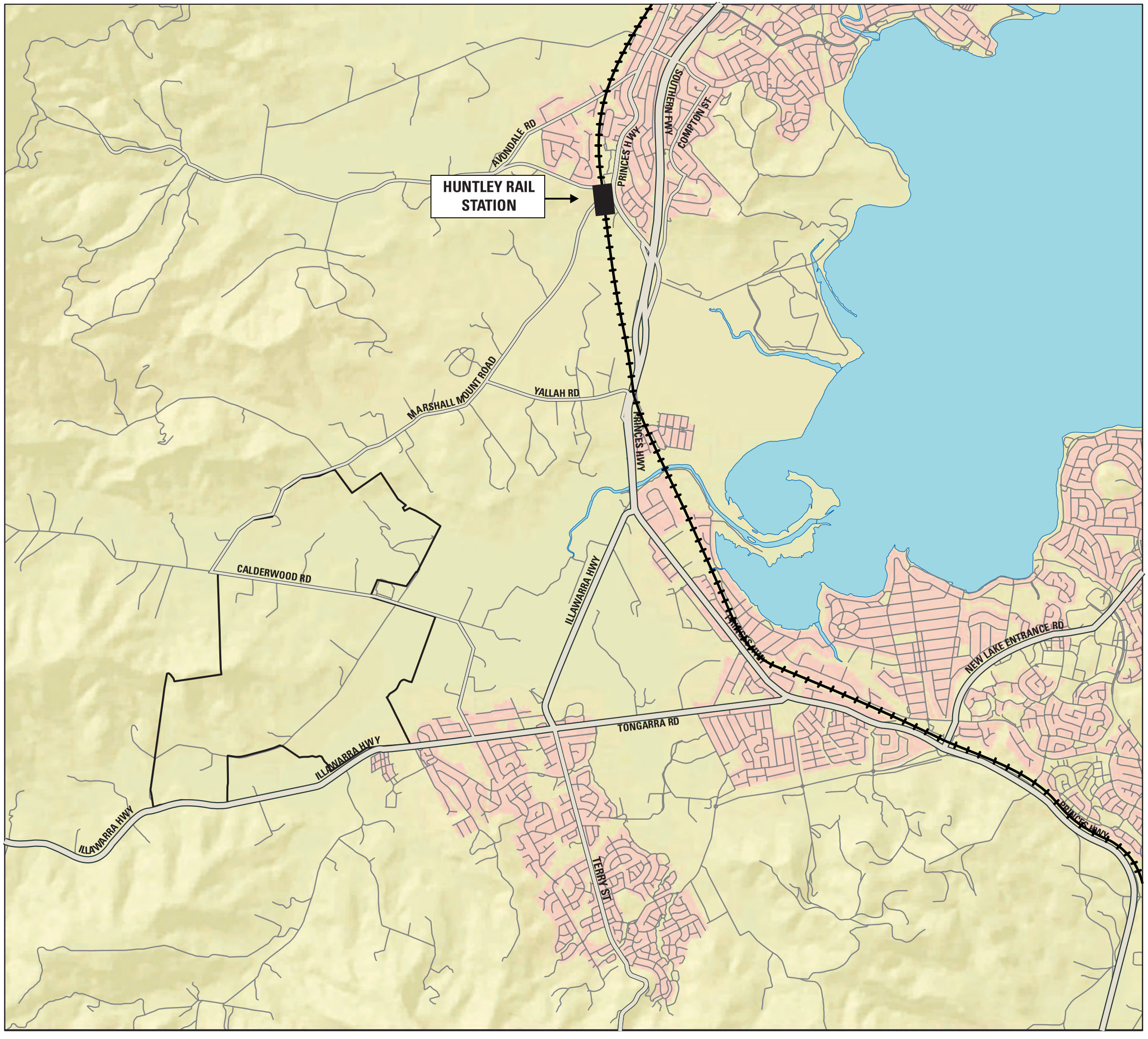

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Figure 4.9
Site of proposed Huntley Railway Station

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

- Site Boundary
- Local Roads (LPMA)
- Watercourse (LPMA)
- Lake Illawarra (LPMA)
- Existing Built Up Areas (LPMA)

Scale 1:40,000 (at A3)

Metres
0 250 500 1,000 1,500 2,000 2,500

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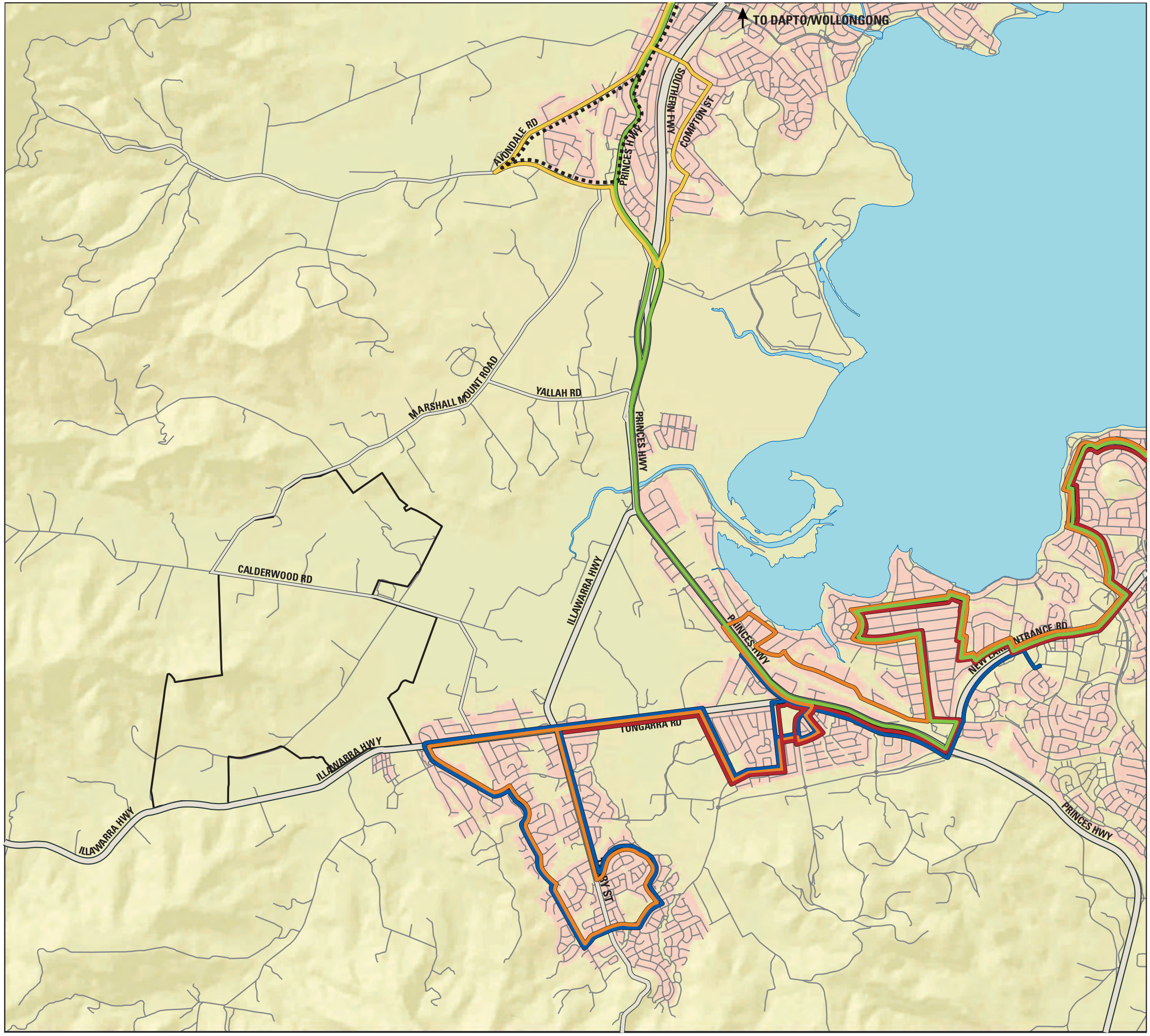

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Figure 4.10

Existing Bus Network

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

- Site Boundary
- Local Roads (LPMA)
- Watercourse (LPMA)
- Lake Illawarra (LPMA)
- Existing Built Up Areas (LPMA)
- Bus Route 37 and 57
- Bus Route 51
- Bus Route 76
- Bus Route 70 and 73
- Bus Route 33
- Bus Route 43

Scale 1:40,000 (at A3)

Metres
0 250 500 1,000 1,500 2,000 2,500

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Date: 03 December 2009
Coordinate System: Zone 56 MGA/GDA 94
GIS MAP REF: 110026-01_58007_TransportBaseMap_CEO.mxd 01

4.2.4 SUMMARY OF EXISTING PUBLIC TRANSPORT DEFICIENCIES

The existing transport network contains a number of deficiencies which pose significant barriers to the use of public transport. These include:

- As the development site is presently rural land, no regular public bus services are provided.
- Bus routes serving nearby urban areas are generally poorly patronised. Routes are typically circuitous and indirect with generally only one bus per hour provided on each route.
- Bus and rail services operate mostly as segregated systems. The low and irregular service frequency of both bus and rail services is an impediment to encouraging transfers and their integration as part of a public transport network. The absence of an integrated fare structure is also a strong discouragement to integrating bus and rail services.
- Urban development is generally located distant from railway stations so the rail line is generally not used for local journeys. It functions mainly as a commuter service to Wollongong and Sydney.

4.3 CURRENT ACTIVE TRANSPORT FACILITIES

As the development site is presently rural land there are no existing pedestrian or cyclist facilities. The closest footpaths are located in the Albion Park urban area, on Calderwood Road at Taylor Road.

Footpaths are generally not provided in the Albion Park urban area. Only Illawarra Highway, Tongarra Road, Terry Street and Taylor Road have footpaths in the older part of Albion Park, whilst some streets in the newest subdivisions are being provided with footpaths.

Albion Park has a small network of off-road shared paths, linking dead-end streets or utilising riparian corridors. Linkages to the wider cycle network are provided only via Tongarra Road and a shared path through the Croome Regional Sporting Complex to Croome Road.

An overview of the City of Wollongong Bicycle Plan is provided in Appendix 4-K and an overview of the Shellharbour LGA Shared Use Path Strategy 2008 is provided in Appendix 4-L

4.3.1 SUMMARY OF EXISTING ACTIVE TRANSPORT DEFICIENCIES

The existing transport network contains a number of deficiencies which pose significant barriers to the use of active transport modes. These include:

- There are presently no pedestrian or cyclist facilities provided within the development site due to the rural nature.
- Existing connections to the development site are difficult due to the presence of Macquarie Rivulet.
- Mansons Bridge on Calderwood Road makes no provision for pedestrians and there is limited sight distance at its southern end which makes it difficult for pedestrians to use the roadway.

4.4 EXISTING TRAVEL DEMAND

An assessment of the existing travel demands in the region was undertaken by analysing the Transport Data Centre's (TDC) 2006 Journey to Work (JTW) data taken from the 2006 Australian Census. An explanation of the JTW data is provide in Appendix 4-M. The assessment of JTW data has been undertaken at a regional, local and site-specific level.

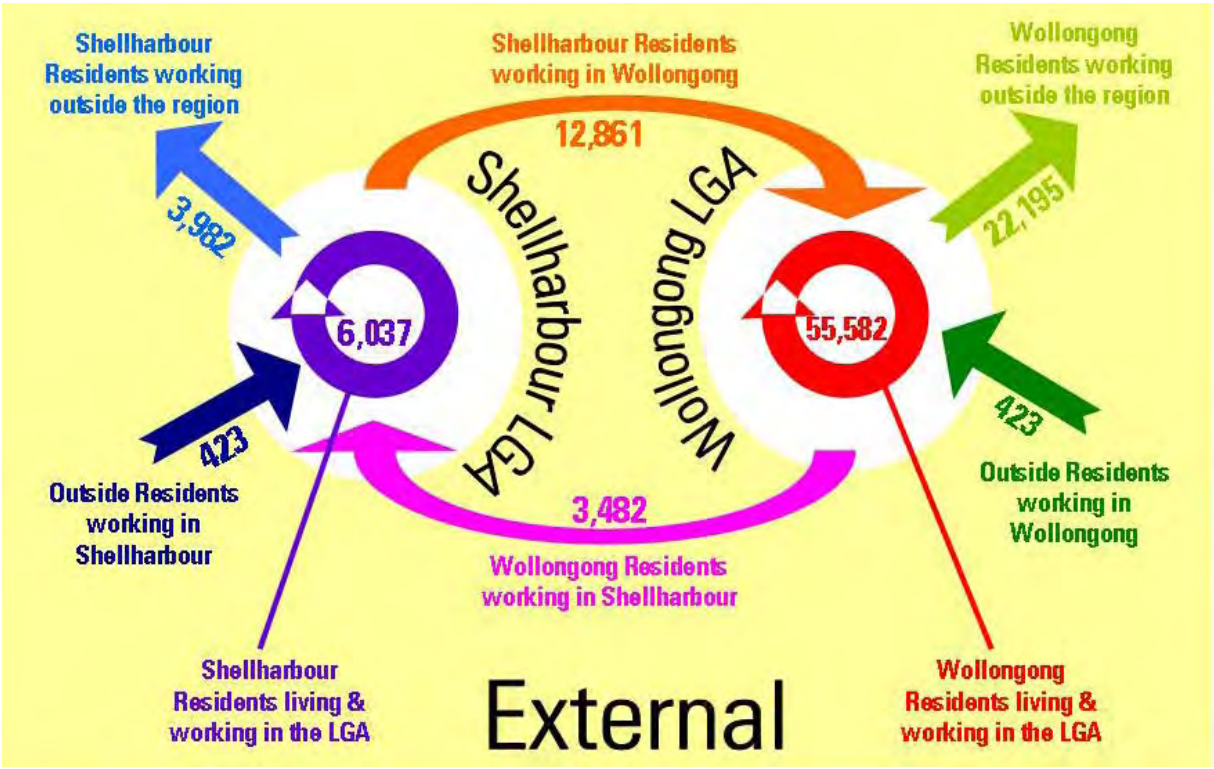
4.4.1 REGIONAL

The regional assessment covers the Wollongong and Shellharbour local government areas.

Workforce and Employment

An analysis of travel patterns of the existing Wollongong and Shellharbour LGA employment and workforce was undertaken. Trips originating within the LGA are considered to be the LGA workforce (living within the LGA). Trips ending in the LGA are considered to be representing employment (jobs within the LGA). Each LGA was divided into CBD and non-CBD areas. The analysis is documented in detail in Appendix 4-N. The net movement of workforce to jobs into, out of, within and between the LGA's is depicted in Figure 4.11.

Figure 4.11 2006JTW: Workforce – Employment Flows

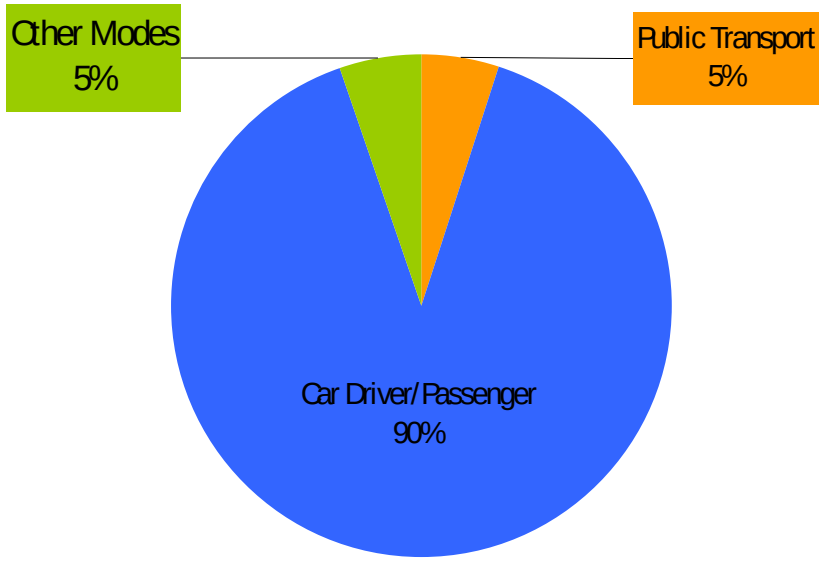


Mode of Travel

The assessment of JTW mode of travel in to and out of the LGAs provides a broad overview of regional travel patterns. The analysis is documented in detail in Appendix 4-N. Car is the predominant model of travel for work trips for both origin and destination trips within both LGA's.

Overall when considering in the total JTW trips into and out of both LGA's the mode share is summarised in Chart 4.1. This shows that there is a total of around 90% of trips made by car (driver or passenger) with 5% of trips made by public transport. The balance of trips by other modes, are assumed to be active transport trips (walking and cycling).

Chart 4.1 2006 JTW: Wollongong and Shellharbour LGA Mode of Travel



The mode share for trips originating in Wollongong or Shellharbour LGA (Workforce Trips) is 89% car based trips and 6.4% public transport trips. The mode share for trips ending in Wollongong or Shellharbour LGA (Employment Trips) is 91% of trips were car based trips and 3.4% public transport trips.

4.4.2 LOCAL

A more detailed analysis of travel patterns in the Travel Zones (TZ) surrounding the site was undertaken to establish the local travel behaviour already established in similar urban residential and employment areas. The assessment provides a broad overview of the following areas:

- Albion Park (TZ 3662, 3664, 3671).
- Albion Park Rail/Croome (TZ 3655, 3666, 3667, 3652).
- Haywards Bay (TZ 3636).

The analysis is documented in detail in Appendix 4-O. Based on the local travel patterns it is observed that majority of the trips (90-97%) within the local areas are undertaken by car. The remaining modes contain very small percentages compared to the car mode. It can be assumed that the reasoning behind this skewed proportion is due to the large car dependency from the lack of public transport facilities available in the local area and, the nature and distance of the trips.

4.4.3 SITE-SPECIFIC

The Calderwood area is rural in nature and lies within travel zone TZ 3661, which represents the areas of Calderwood, North Macquarie, Tongarra and Macquarie Pass. Based on the 2006 JTW Census data there is a workforce of 115 within this area (TZ 3661) and a corresponding 57 jobs. These numbers are very low and cannot be considered representative. It is observed that there is larger number of people travelling from the zone rather than to the zone, this could be because people living in this zone may not be necessarily working in this zone and may need to travel outside this zone for work purposes. However, it can be noted that 96% of departing trips were by car as driver with the remaining 4% by other modes. Whereas for arriving trips, 80% were car driver and 20% other modes.

05

Future Transport Context

5.1 BACKGROUND

The RTA, in collaboration with Wollongong Council and Shellharbour Council, has been planning the necessary transport infrastructure upgrades for the Illawarra Region for some time. This upgrade planning is in response to both existing traffic capacity issues as well as the anticipated travel demands resulting from the substantial growth in population planned in the region.

To inform these infrastructure upgrade plans the Councils and the RTA has been making use of the WOLSH TRACKS traffic model. This model is a three-step generation, distribution and assignment model which covers the whole of the Illawarra Region, as shown in Figure 5.1.

To aid in the assessment of the Calderwood development the RTA provided Cardno with a 2006 and 2026 model of the region. The 2026 model predates the Growth Centres Commission review of West Dapto release Area. As a result the 2026 model contains several upgrade proposals and land use planning assumptions which have now been discounted by the planning authorities.

For Cardno to make use of the models provided it was necessary to use the 2006 model as a base network and extract the background growth assumptions of the 2026 model to extrapolate to a new 2026 model without any infrastructure upgrades. The new 2026 model then had to be factored to reach the model assessment year of 2031. This was done by applying a linear growth factor in line with the growth trend between the 2006 and 2026 models.

5.2 FUTURE GROWTH

Future growth in vehicle trips within and through the WOLSH TRACKS model area has been considered to be as a result of growth in four key areas:

- Regional Growth – major development of new residential and employment areas such as West Dapto (excluding Calderwood).
- Infill Growth – general growth in existing residential and employment areas such as Wollongong CBD.
- External Growth – general background growth in through traffic.
- Calderwood Development Growth – development of DLL's Calderwood site.

The land use planning assumptions for each of these growth areas is discussed in the following sections.

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Figure 5.1

WOLSH/TRACKS
Model Extents

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

Area of Influence

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5.2.1 REGIONAL GROWTH

For the purposes of this assessment it was necessary to define some key planning assumptions on future land uses, their likely yields and whether or not these developments would be realised by the 2031 assessment year. Cardno and DLL reviewed all relevant planning documents relating to new developments in the region and compiled a list of these schemes, broken down by:

- Approved developments.
- Planned developments likely to occur within the 2031 assessment period.
- Planned developments/schemes that are considered to fall outside the 2031 timeframe.

This list of developments can be found in Appendix 5-A. The RTA also provided a list of approved and planned developments in the Illawarra Region, complied by the Department of Planning (DoP). This list of RTA/DoP developments can be found in Appendix 5-B. This list was reconciled against the list drawn up by Cardno and where discrepancies were noted a review of available information was undertaken to determine the most appropriate assumption to be taken. The comparison and reconciled list of schemes can be seen in Appendix 5-C.

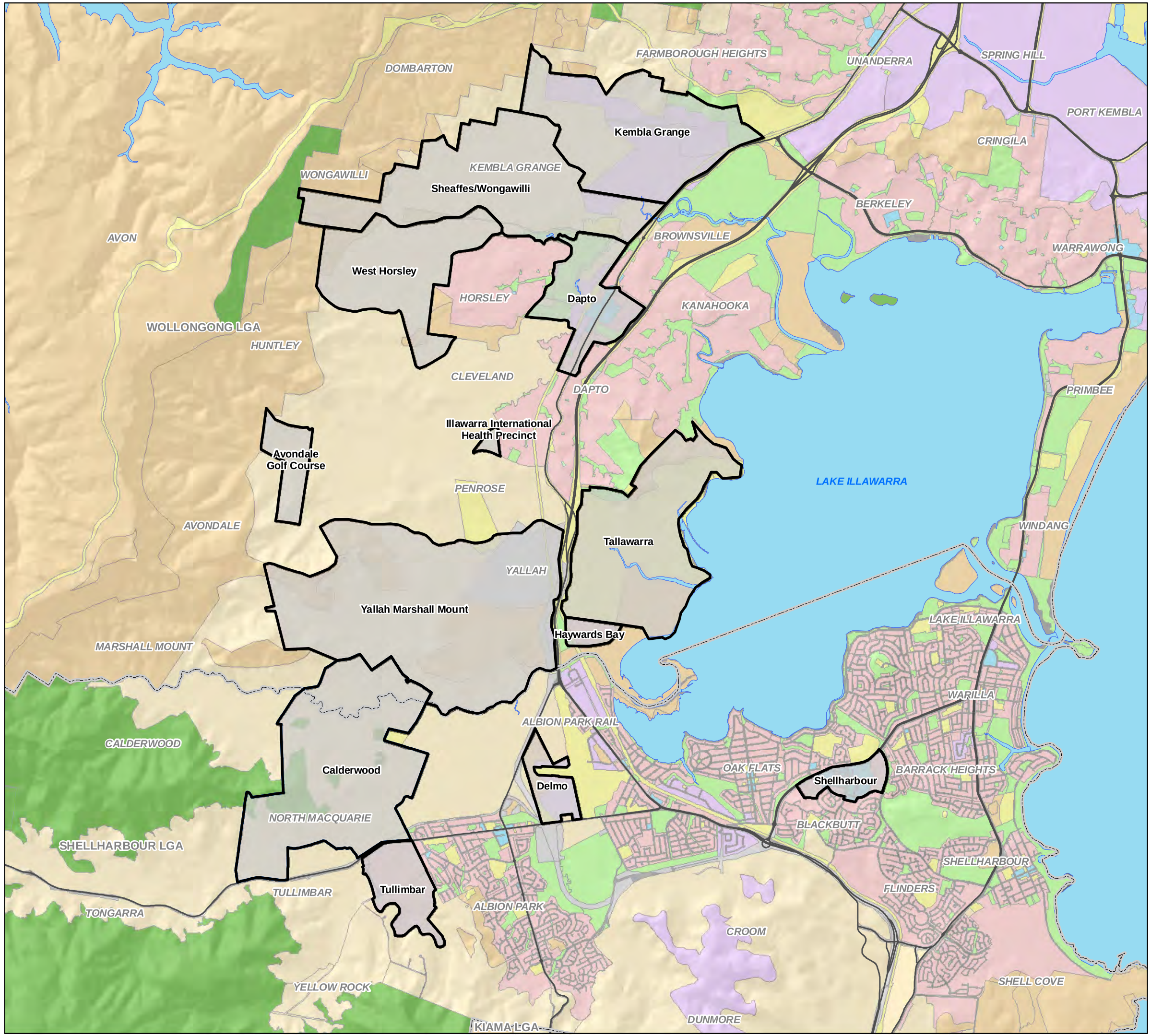
The final reconciled list of development sites has been used as the basis for the cumulative impact assessment and the apportionment of responsibility for future traffic impacts. These sites were agreed with the RTA for modeling purposes. Table 5.1 provides a summary of the proposed developments included in the assessment and gives a breakdown of their expected yields. The proposed sites are presented in

Figure 5.2.

Table 5.1 Regional Land Use Planning Assumptions

Proposal	Development by 2031
Approved projects	
Delmo Albion Park	1650 jobs
Tullimbar	1978 dwellings
Haywards Bay	318 dwellings
Shellharbour Town Centre	282 dwellings
Dapto Town Centre	5200 jobs / 21,600sqm employment
Shell Cove	1135 dwellings[2]
Proposed Projects	
West Dapto Stage 1 – Kembla Grange Employment Land	175Ha Employment land (assumed to be 10,355 jobs[3])
West Dapto Stage 1 - Sheaffes/ Wongawilli	3667 dwellings
West Dapto Stage 2 – West Horsley	2496 dwellings
Tallawarra	700 dwellings
Illawarra International Health Precinct	100,000 sqm medical/hospital (approximately 1,383 jobs[4])
Avondale Golf Course	Golf course + 400 dwellings
Yallah/Marshall Mount	900 dwellings

[2] Under review
[3] Based on SGS Economics assessment of the West Dapto job creation potential.
[4] Based on Cardno's EA in support of the Illawarra International Health Precinct



Delfin Lend Lease

Figure 5.2

Future Growth Areas

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

- Site Boundary
- Major Roads (LPMA)
- LGA Boundary (LPMA)
- Major Waterbodies (LPMA)
- Regional Growth Areas

General Zoning (WCC and SCC LEPs)

- Other
- Rural
- Residential
- Commercial
- Industrial
- Special Uses
- Public/Private Recreation
- Environmental Protection
- National Parks/State Forest

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Scale 1:60 000 (at A3)

Metres
0 1,000 2,000 3,000 4,000

Cardno

Map Produced by Cardno Forbes Rigby Pty Ltd
Date: 10 December 2009
Coordinate System: Zone 56 MGA/GDA 94
GIS MAP REF: 110026-01_18019_ExistingProposedUrban.mxd 05

5.2.2 INFILL GROWTH

In addition to the new development sites defined in Section 5.2.1 it was necessary to make allowances for the natural background traffic growth in the region resulting from gradual redevelopment, infill development and population growth. This level of background growth was established by undertaking an equivalence assessment between the 2006 and 2026 model zones. This provided the level of growth from 2006 to 2026. This was then extrapolated to determine the potential growth to 2031.

5.2.3 EXTERNAL GROWTH

As well as the increase in population as a direct result of the new developments and regional growth in the TRACKS model there was also an amount of external traffic growth in the model. As with the regional background growth, this external increase in traffic volumes was calculated by examining the equivalent external zones in the 2006 and 2026 models then applying a linear growth factor to this to achieve a 2031 external growth level.

5.2.4 CALDERWOOD DLL

The Calderwood site, the site under assessment, is in the south-west of the Illawarra region and has a planned yield of approximately 4,800 dwellings. Detailed descriptions are provided in Section 3.

5.3 FUTURE REGIONAL TRANSPORT NETWORK

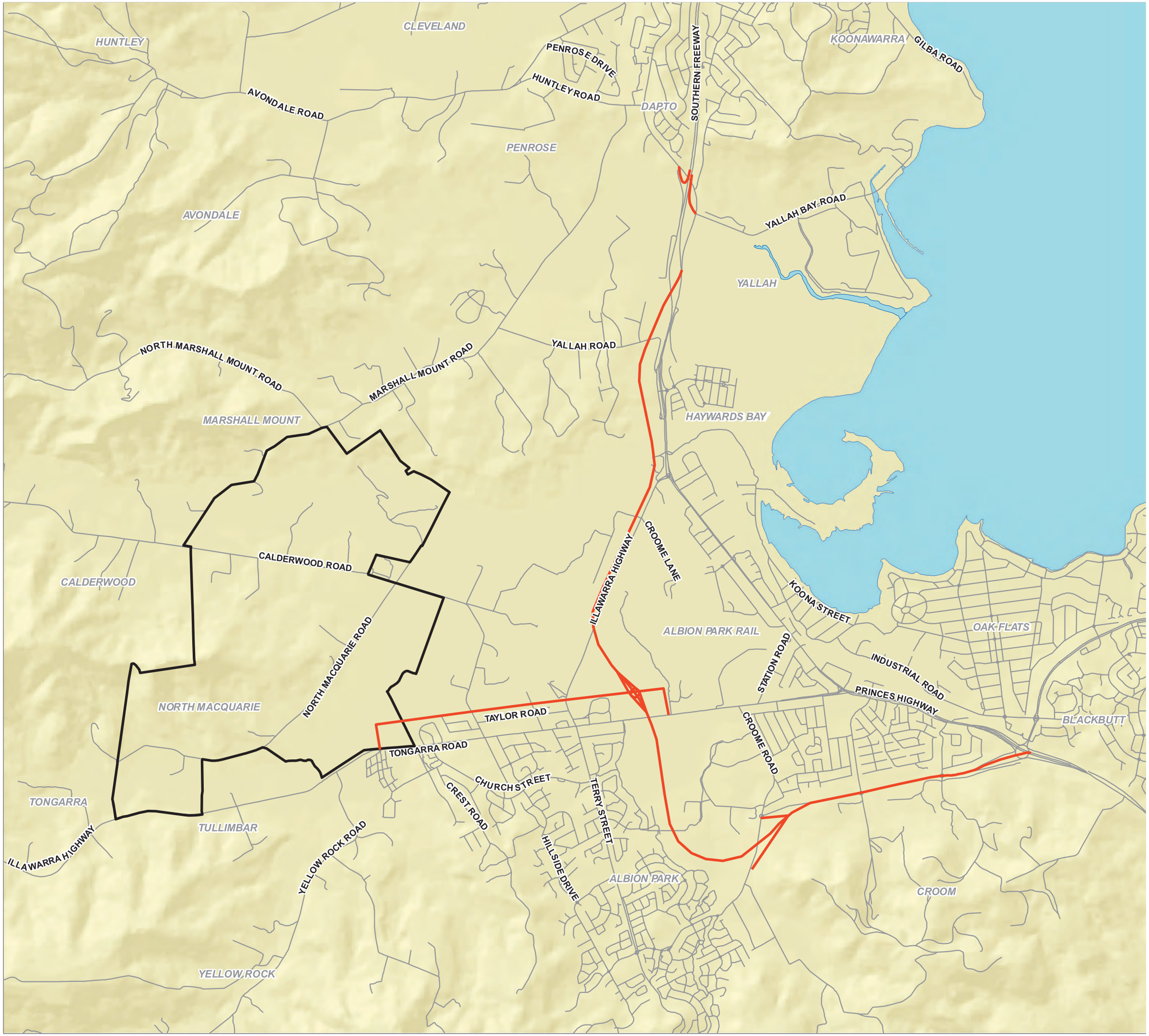
5.3.1 DO MINIMUM UPGRADES

Significant planning for future road network upgrades has been undertaken in the Dapto-Albion Park area over the past ten years. Three major road upgrades were initially assumed to occur before 2031 for the purposes of modelling as follows:

- F6 Freeway extension: Yallah to Oak Flats.
- Tripoli Way (Albion Park Bypass).
- North-facing ramps at Tallawarra interchange.

This package of works was considered to be the 'do minimum' upgrades by 2031. In addition, it has been assumed that the intersection of Princes Highway and Colden Drive will be signalised by 2031 (this work is currently being undertaken in November 2009). No other background or 'do minimum' road network upgrades were assumed.

A detailed description of the above three major projects are included in Appendix 5-D and the 'do minimum' upgrade works are presented in Figure 5.3.



Delfin Lend Lease

Figure 5.3

2031 "Do Minimum" Future Road Network Upgrades

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

- Site Boundary
- Existing Road Network (LPMA) - Do Nothing
- Proposed Major Road Network Upgrades
- Lake Illawarra (LPMA)

Albion Park bypass is indicative

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Scale 1:35,000 (at A3)

Metres
0 250 500 1,000 1,500 2,000

Cardno

Map Produced by Cardno Forbes Rigby Pty Ltd
Date: 17 December 2009
Coordinate System: Zone 56 MGA/GDA 94
GIS MAP REF: 110026-01_58014_DoMinimumRoadUpgrades.mxd 02

5.3.2 DO ABSOLUTE MINIMUM UPGRADES

Preliminary modelling identified that the north-facing ramps at Tallawarra interchange were not required in 2031. Further modelling then proceeded without these ramps but with the other works remaining (F6 extension and Tripoli Way).

The West Dapto Master Plan identifies both Marshall Mount Road and Yallah Road as part of the primary movement structure. Such road connections are particularly required to form the principal road connections between the Yallah/Marshall Mount areas, planned to accommodate 900 dwellings at full development, and the strategic road network. As described in Appendix 4-B both Marshall Mount and Yallah Roads are rural roads and upgrades would be necessary to bring them to a reasonable urban standard given the intensification in traffic movements associated with the planned urbanisation of the surrounding land uses.

In addition, the preliminary modelling investigations also revealed that Marshall Mount Road did accommodate an amount of traffic inappropriate for its 6.0 metre wide unsealed and line-marked condition. Therefore, included within the 'do absolute minimum' infrastructure upgrades was an upgrade of both Marshall Mount Road and Yallah Road to two-lane two-way (i.e. one lane in either direction) with minimum lane widths of 3.5 metres and appropriate width sealed shoulders.

These works were then referred to as the 'do absolute minimum':

- F6 Freeway extension: Yallah to Oak Flats.
- Tripoli Way (Albion Park Bypass).
- Marshall Mount Road and Yallah Rod upgrade.

Detailed descriptions of the above projects are included in Appendix 5-D and presented in Figure 5.4.

5.4 FUTURE CUDP ROAD NETWORK

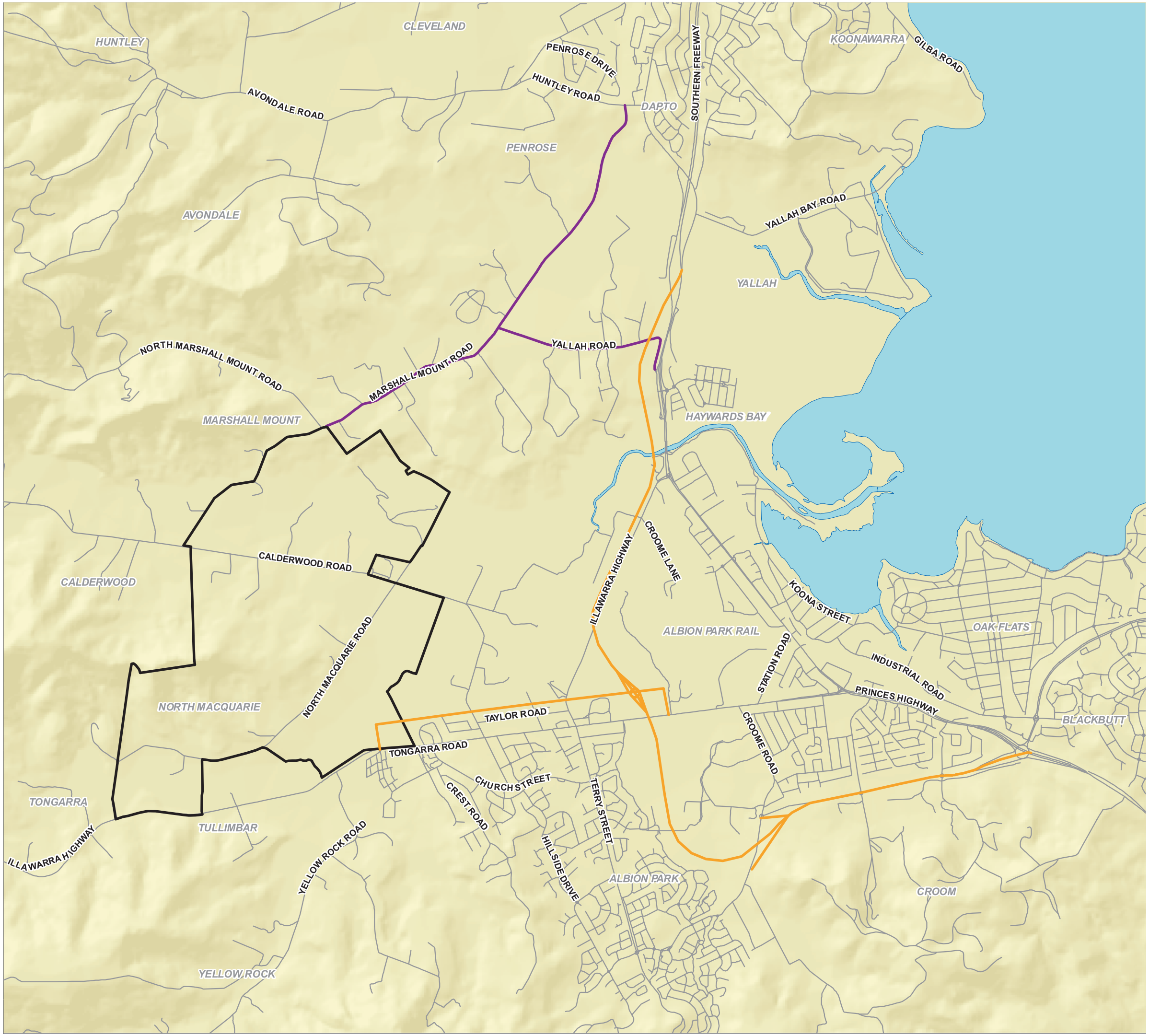
As shown within the CUDP Concept Plan an initial assessment of the road network and external connections to the future road network has been undertaken. This provides an internal road hierarchy suitable for modelling purposes to enable potential further road network development and refinement. The extent of the modelled CUDP road network is modelled in accordance with the indicative Concept Plan layout. A detailed description of the internal CUDP road network and the external road connections is provided in Appendix 5-E.

5.5 FUTURE TRAVEL DEMANDS

Existing travel behaviour data indicates that the current mode share of car based travel is 90% in both the Wollongong and Shellharbour LGA's. The concept plan for the CUDP master planned community development contains a number of key principles relating to transport as follows:

- A modified grid that promotes connectivity and accessibility.
- A movement network that promotes trip containment, walking, cycling and public transport.
- Residential neighbourhoods that provide a mix of dwelling types.
- Inclusion of a range of retail, community, education and employment uses that meet community needs and promotes trip containment.
- Provision of an extensive passive and active open space network.

Through these and other sustainable travel principles DLL expects the Calderwood development to achieve a 10% mode shift from car based to non car-based travel modes.



Delfin Lend Lease

Figure 5.4

2031 "Do Absolute Minimum" Future Road Network Upgrades

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

- Site Boundary
- Proposed Major Road Network Upgrades
- Proposed Minor Road Network Upgrades
- Existing Road Network (LPMA) - 'Do Nothing'
- Lake Illawarra (LPMA)

Albion Park bypass is indicative

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Scale 1:35,000 (at A3)

Metres
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Cardno

Map Produced by Cardno Forbes Rigby Pty Ltd
Date: 17 December 2009
Coordinate System: Zone 56 MGA/GDA 94
GIS MAP REF: 110026-01_58023_DoAbsoluteMinimumRoadUpgrades.mxd 01

06

Transport Modelling

6.1 OBJECTIVE OF THE MODELLING

Transport modelling provides the means by which the road infrastructure requirements of the proposed CUDP can be identified taking into account other planned significant land use and road infrastructure changes in the Shellharbour and Wollongong region.

The 2031 WOLSH CUDP traffic model will be used to generate a range of outputs under a range of land use/infrastructure scenarios which will be used to define transportation impacts and assist in the identification of appropriate ameliorative measures if undesirable outcomes are identified, for example unacceptable levels of traffic queues and delays on the road network.

Specific model outputs used within the TMAP include:

- Road link traffic volumes.
- Intersection turning volumes.
- Road network and intersection operational performance statistics.
- Network vehicle kilometres travelled (VKT).
- Network vehicle operating time (VOT).

The traffic model outputs will thus enable the identification of the overall contribution to transport demand within the region that the CUDP will have, once fully constructed. This enables the appropriate cost allocation to be made towards the State Infrastructure Contributions delivered via the Voluntary Planning Agreement mechanism.

6.2 MODELLING METHODOLOGY

To accord with Director General's requirements for land use/road infrastructure assessment the WOLSH TRACKS strategic traffic model was made available for study purposes by the RTA and Wollongong Council. The TRACKS model provides a representation of the regional, state and local road network and provides forecast traffic demands over the combined LGA areas. The use of the TRACKS traffic model is Council and the RTA's preferred assessment tool to undertake assessments of infrastructure requirements necessary to support land use changes.

Different combinations of land use and road network assumptions (explained below in section 6.4) are used as input to the 2031 TRACKS model to generate, distribute and assign traffic movements within the model area and provide outputs resolved to intersection turning movement level. These intersection turning movements can then be more accurately modelled in the SIDRA intersection modelling software which enables assessment of isolated intersections performance using NSW RTA level of service criteria under a given set of traffic demands.

Subsequent modelling iterations allow the formulation of appropriate intersection configurations/controls to achieve the desired level of intersection performance. Comparisons of 'with' and 'without' CUDP transport demands for comparable road network options allow the impact upon operational performance of road links and intersections to be made for cost allocation purposes.

6.2.1 2009 BASE MODEL

The 2006 TRACKS model supplied by Wollongong Council was recalibrated using current (2009) traffic counts within the area of influence to reflect current traffic conditions. The resultant appropriately calibrated model (2009 WOLSH CUDP Model) provides a satisfactory base for future assessments. Details relating to the model calibration process and results are included within Appendix 6-A.

6.2.2 2031 BASE MODEL

The 2031 design year represents a 20 year construction period for the CUDP. The 2031 Base model was developed to assess background traffic without the CUDP at the design year. The 2031 Base model was developed from the two models provided by the Council's 2006 model and 2026 model. The methodology is detailed in Appendix 6-A. The agreed regional developments growth, infill growth and external background growth (described in section 5.2 above) were incorporated into the 2031 base model.

6.2.3 2031 CUDP MODEL

The 2031 CUDP model was developed to reflect likely transport conditions at the development completion time with the full CUDP development.

6.3 MODELLING SCENARIOS

Each modelling scenario requires a combination of input data:

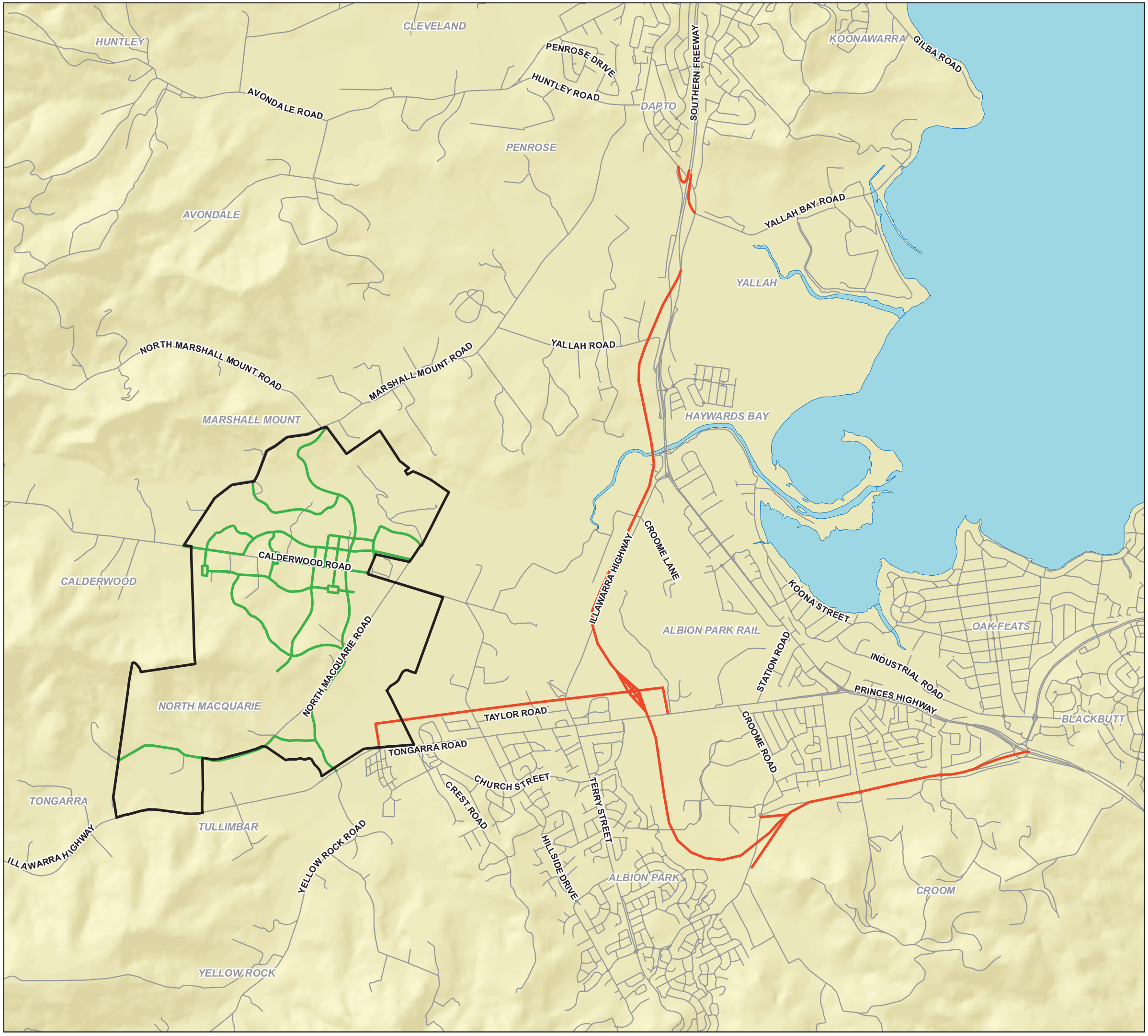
- Road network options - presented in Figure 6.1.
- Travel demand – developed from model trip generation rates[5] and land use planning assumptions (detailed in Section 5.2) including:
  - Regional release area growth excluding CUDP.
  - Regional Infill growth.
  - External growth
  - CUDP Growth.
- Mode shift assumptions :
  - Existing and infill areas assumed to have the same mode share as is currently in the base models described as the 'business as usual' (BAU) case.
  - Regional release area growth excluding CUDP and the CUDP were tested in various scenarios under the BAU case or with a 10% modal shift from car based to non car based modes of transport.

Each of these input options are described in Appendix 6-B.

To undertake assessments of the various combinations of the options identified above a range of scenario options were developed for testing. This is summarised in a matrix format in Table 6.1 and detailed in Appendix 6-C.

Initially a range of 2009 and 2031 base models were run to determine the likely road network improvements in 2031 without CUDP development. This was followed by a testing a significant range of scenarios to assess the road network performance with full 2031 future development including the Calderwood project. This was an iterative process that allowed development of an optimum package of measures.

[5] Trip generation rates are inherent to the TRACKS model



Delfin Lend Lease

Figure 6.1

Road Network Options

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

- Site Boundary
- Existing Road Network (LPMA) - Do Nothing
- Proposed Major Road Network Upgrades - Do Minimum
- Indicative CUDP Internal Road Network
- Lake Illawarra (LPMA)

Albion Park bypass is indicative

Scale 1:35,000 (at A3)

Metres
0 250 500 1,000 1,500 2,000

Cardno
Shaping the Future

Map Produced by Cardno Forbes Rigby Pty Ltd
Date: 09 December 2009
Coordinate System: Zone 56 MGA/GDA 94
GIS MAP REF: 110026-01_58010_RoadCategories.mxd 02

Table 6.1 Key Scenario Summary Matrix

Year/ Scenario Name		2009 Base (BAU)	2031 Base 'do nothing' (BAU)	2031 Base 'do minimum' (BAU)	2031 Base 'do minimum' (mode shift)	2031 Base 'do abs. minimum' (BAU)	2031 Base 'do base upgrades' (BAU)	2031 CUDP 'do nothing' (BAU)	2031 CUDP 'do nothing' (mode shift)	2031 CUDP 'do minimum' (mode shift)	2031 CUDP 'do abs. minimum' (mode shift)	2031 CUDP 'do base upgrades' (mode shift)	2031 CUDP 'full dev. upgrades' (mode shift)
Scenario Ref No.		09_B0 0	31_B0 1	31_B0 2	31_B0 3	31_B0 4	31_B0 5	31_D0 1	31_D0 2	31_D0 4	31_D0 8	31_D1 1	31_D1 2
Road Network	2009 Existing/ 'Do Nothing'	y	y	y	y	y	y	y	y	y	y	y	y
	2031 'Do Minimum'	n	n	y	y	y	y	n	n	y	y	y	y
	2031 'Do Absolute Minimum'	n	n	n	n	y	y	n	n	y	y	y	y
	2031 'Base Upgrades'	n	n	n	n	n	n	y	y	y	y	y	y
	2031 CUDP Internal	n	n	n	n	n	n	y	y	y	y	y	y
	2031 'Full Dev Upgrades'	n	n	n	n	n	n	n	n	n	y	y	y
Planning Assumptions/ Growth & Mode Share	2009 Development	BAU	BAU	BAU	BAU	BAU	BAU	BAU	BAU	BAU	BAU	BAU	BAU
	2031 Regional Infill Growth	n	BAU	BAU	BAU	BAU	BAU	BAU	BAU	BAU	BAU	BAU	BAU
	2031 External Growth	n	BAU	BAU	BAU	BAU	BAU	BAU	BAU	BAU	BAU	BAU	BAU
	2031 Regional New Development	n	BAU	BAU	10%	BAU	BAU	BAU	BAU	BAU	BAU	BAU	BAU
	2031 CUDP	n	n	n	n	n	n	BAU	10%	10%	10%	10%	10%

Mode Share: BAU = business as usual -x% = x% shift to non-car based transport modes
Other: CUDP = Calderwood Urban Development Project

07

Road Network Impact Assessment

7.1 BASE NETWORK ASSESSMENT

In order to establish the characteristic of the future road network without the CUDP a range of base model scenarios was run (as detailed in Section 6.3). This assessment provides a base for comparison against changes required as a result of the CUDP.

For each scenario the following information was extracted from the relevant AM and PM 2031 Base TRACKS models:

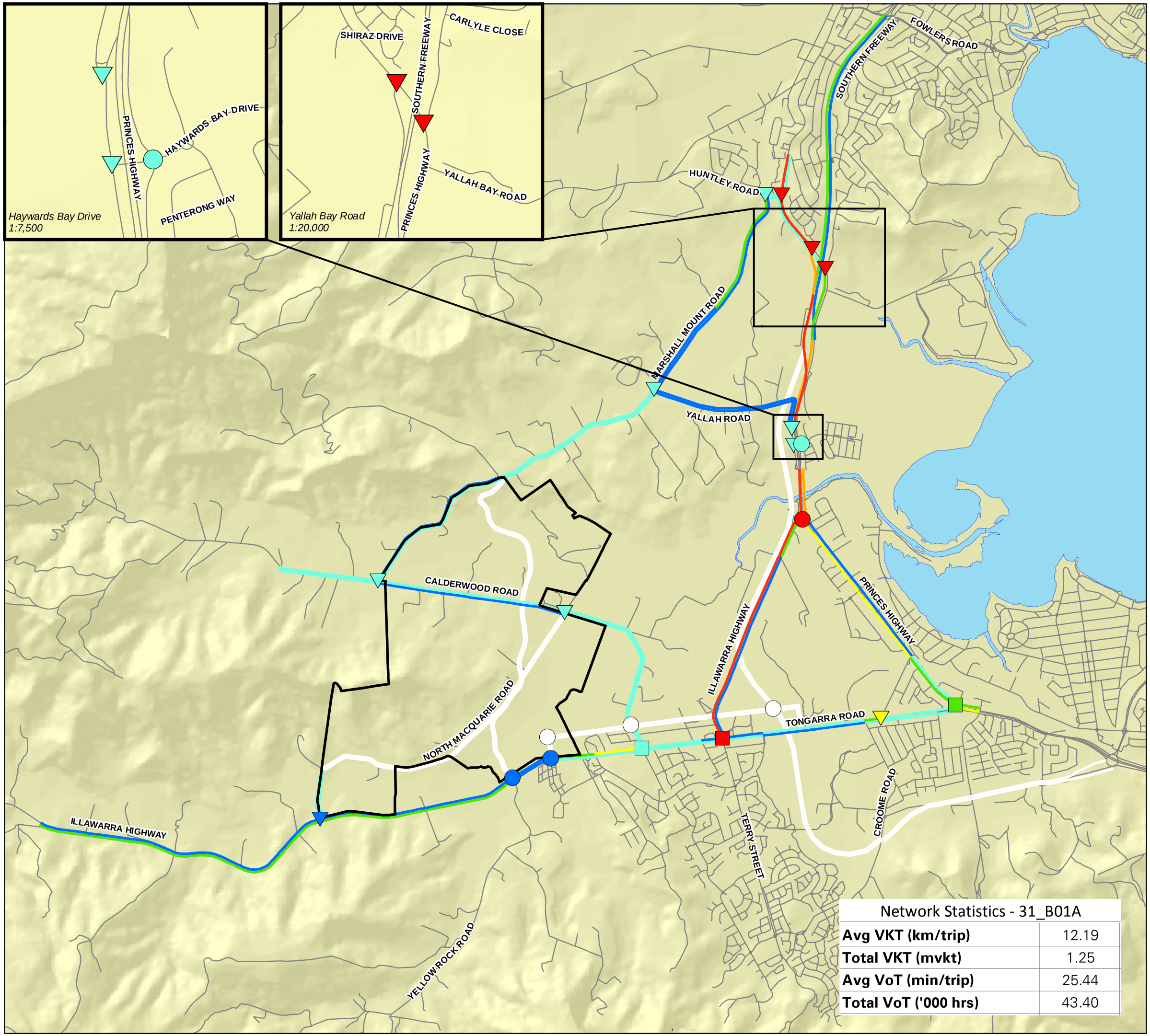
- Mid-block and turning traffic volumes.
- Network VKT and VOT.

The mid-block and turning traffic volumes were used to then assess mid-block carriageway capacity and intersection performance. A summary of each peak period for each scenario was produced to graphically represent mid-block LoS, intersection LoS and network VKT/VOT.

Table 7.1 provides an overview of the base model scenarios, detailing the scenario description and key outcomes for the scenario. Results of each scenario are then summarised in the figures in this chapter with detailed results presented in a series of appendices as identified in Table 7.1.

Table 7.1 2031 Base Model Scenario Outcomes

Scenario Description	Key Outcomes	Results Summary
2031 BASE 'DO NOTHING' BAU SCENARIO {31_B01}		
↘ 2009 road network only with no upgrades. ↘ Regional infill growth, external growth and regional new development growth with no CUDP. ↘ BAU modal splits.	Overall under 2031 base future growth scenario with no 'do minimum' upgrades the road network will be under considerable strain with key road sections and intersections failing.	Figure 7.1 AM peak Figure 7.2 PM peak Appendix 7A
2031 BASE 'DO MINIMUM' BAU SCENARIO {31_B02}		
↘ 2009 road network with 'do minimum' upgrades. ↘ Regional infill growth, external growth and regional new development growth with no CUDP. ↘ BAU modal splits.	Overall the introduction of the 'do minimum' upgrades provides significant benefits to the 2031 road network. However some issues will still need to be resolved. It was established that under the base 2031 scenario there is insufficient demand to warrant the Tallawarra Freeway ramps.	Figure 7.3 AM peak Figure 7.4 PM peak Appendix 7B
2031 BASE 'DO MINIMUM' MODE SHIFT SCENARIO {31_B03}		
↘ 2009 road network with 'do minimum' upgrades. ↘ Regional infill growth and external growth with BAU modal splits. ↘ Regional new development growth with (no CUDP) including a 10% modal shift.	Overall the consideration of a 10% mode shift on regional growth areas has little impact on the road network within the Calderwood area of influence.	Figure 7.5 AM peak Figure 7.6 PM peak Appendix 7C
2031 BASE 'DO ABSOLUTE MINIMUM' BAU SCENARIO {31_B04}		
↘ 2009 road network with 'do absolute minimum' upgrades i.e. 'do minimum' excluding the Tallawarra Freeway ramps. ↘ Regional infill growth, external growth and regional new development growth with no CUDP. ↘ BAU modal splits.	Overall the introduction of the 'do absolute minimum' upgrades provides significant benefits to the 2031 road network. However some issues will still need to be resolved. The section of Princes Hwy between Mount Brown Rd and Southern Fwy (including the southern freeway southbound on-ramp and northbound off-ramp) would operate at a poor LoS during both modelled peak periods. Additional traffic capacity would need to be provided by constructing an additional southbound traffic lane on Princes Hwy to the Southern Fwy. Associated freeway merge /diverge widening works would also need to be undertaken on the Southern Fwy. The introduction of the following road network improvements to address the 2031 base road network deficiencies will be required: ↘ Duplication of Princes Highway (adding an additional traffic lane): ▪ Northbound from Mount Brown Road to the F6 off-ramp. ▪ Southbound from Mount Brown Road to the F6 on-ramp. ↘ In conjunction with the above upgrade to traffic signal control of the following existing intersections: ▪ Princes Highway / Huntley Road ▪ Princes Highway / Southern Freeway northbound off slip ▪ Princes Highway / Cormack Avenue ↘ Southern Freeway southbound on-slip road upgrade to two lanes and associated freeway merge widening works to accommodate. ↘ Southern Freeway northbound off-slip road upgrade to two lanes and associated freeway diverge widening works to accommodate. ↘ Marshall Mount and Yallah Road upgrades to satisfactory one lane width in either direction with sealed shoulders. (The above upgrades in addition to the 'do absolute minimum' upgrades are referred to as the 'do base upgrades'.)	Figure 7.7 AM peak Figure 7.8 PM peak Appendix 7D
2031 BASE 'DO BASE UPGRADES' MODE SHIFT SCENARIO {31_B05}		
↘ 2009 road network with 'do absolute minimum' upgrades i.e. 'do minimum' excluding the Tallawarra Freeway ramps plus the 'do base upgrades', as detailed in previous section ↘ Regional infill growth and external growth with BAU modal splits. ↘ Regional new development growth with (no CUDP) including a 10% modal shift.	The 2031 future base road network will perform satisfactorily with the 'do base upgrade' package of measures.	Figure 7.9 AM peak Figure 7.10 PM peak Appendix 7E



Network Statistics - 31_B01A	
Avg VKT (km/trip)	12.19
Total VKT (mvkt)	1.25
Avg VoT (min/trip)	25.44
Total VoT ('000 hrs)	43.40

Delfin Lend Lease

Figure 7.1

Road Network Performance AM Peak 2031 Base 'Do Nothing' BAU

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

Model Ref No.: 31_B01

- Site Boundary
- Lake Illawarra (LPMA)
- Local Roads (LPMA)
- Mid-Block Road Sections
- Priority Control
- Roundabout
- Traffic Signals

Level of Service (LoS)

- No Data
- A
- B
- C
- D
- E
- F

N W E S

Scale 1:40 000 (at A3)

Metres
0 500 1,000 1,500 2,000 2,500

Cardno

Map Produced by Cardno Wollongong
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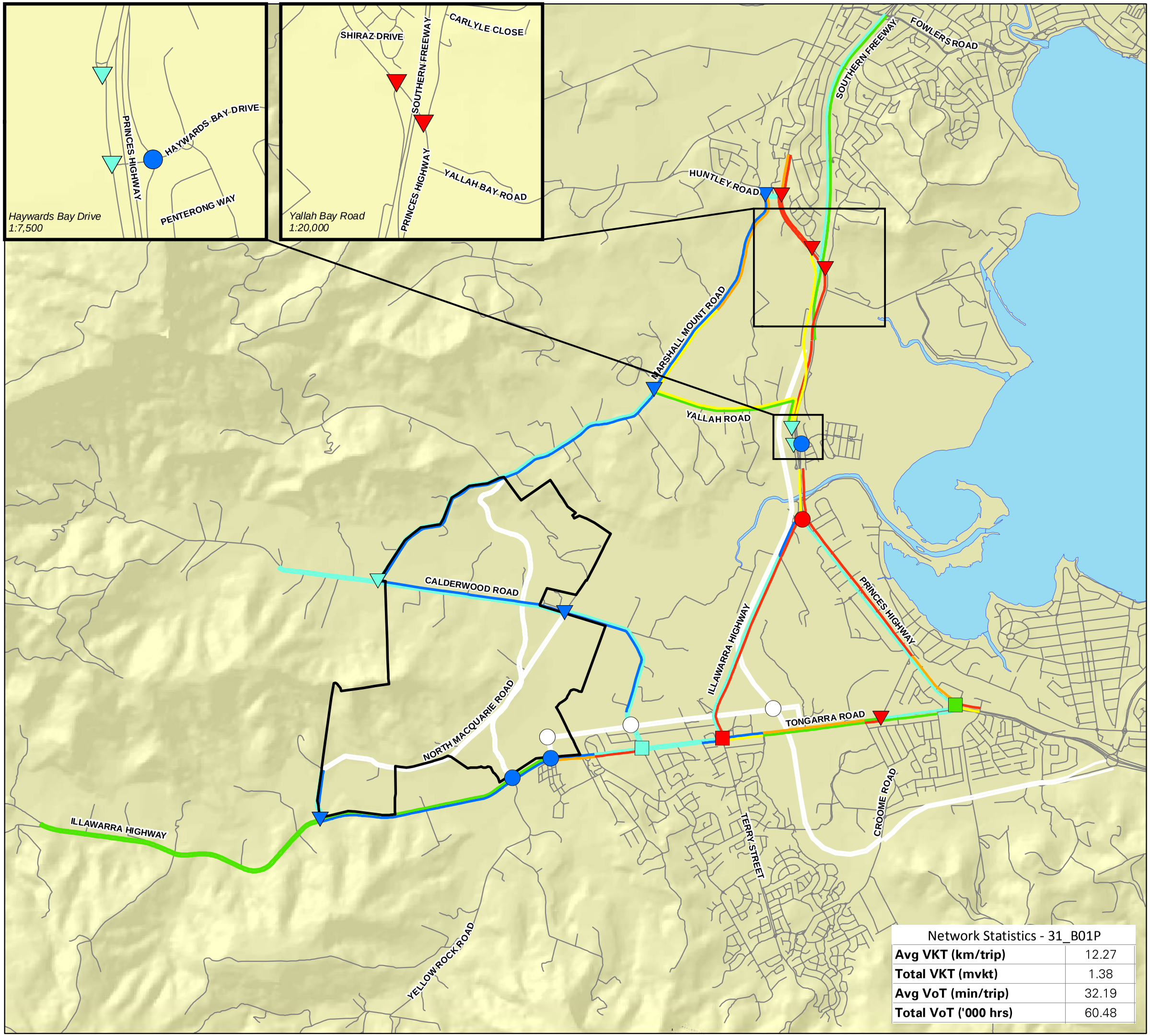

Network Statistics - 31_B01P	
Avg VKT (km/trip)	12.27
Total VKT (mvkt)	1.38
Avg VoT (min/trip)	32.19
Total VoT ('000 hrs)	60.48

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Figure 7.2

Road Network Performance PM Peak 2031 Base 'Do Nothing' BAU

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

Model Ref No.: 31_B01

- Site Boundary
- Lake Illawarra (LPMA)
- Local Roads (LPMA)
- Mid-Block Road Sections
- Priority Control
- Roundabout
- Traffic Signals

Level of Service (LoS)

- No Data
- A
- B
- C
- D
- E
- F

N W E S

Scale 1:40 000 (at A3)

Metres
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Cardno

Map Produced by Cardno Wollongong
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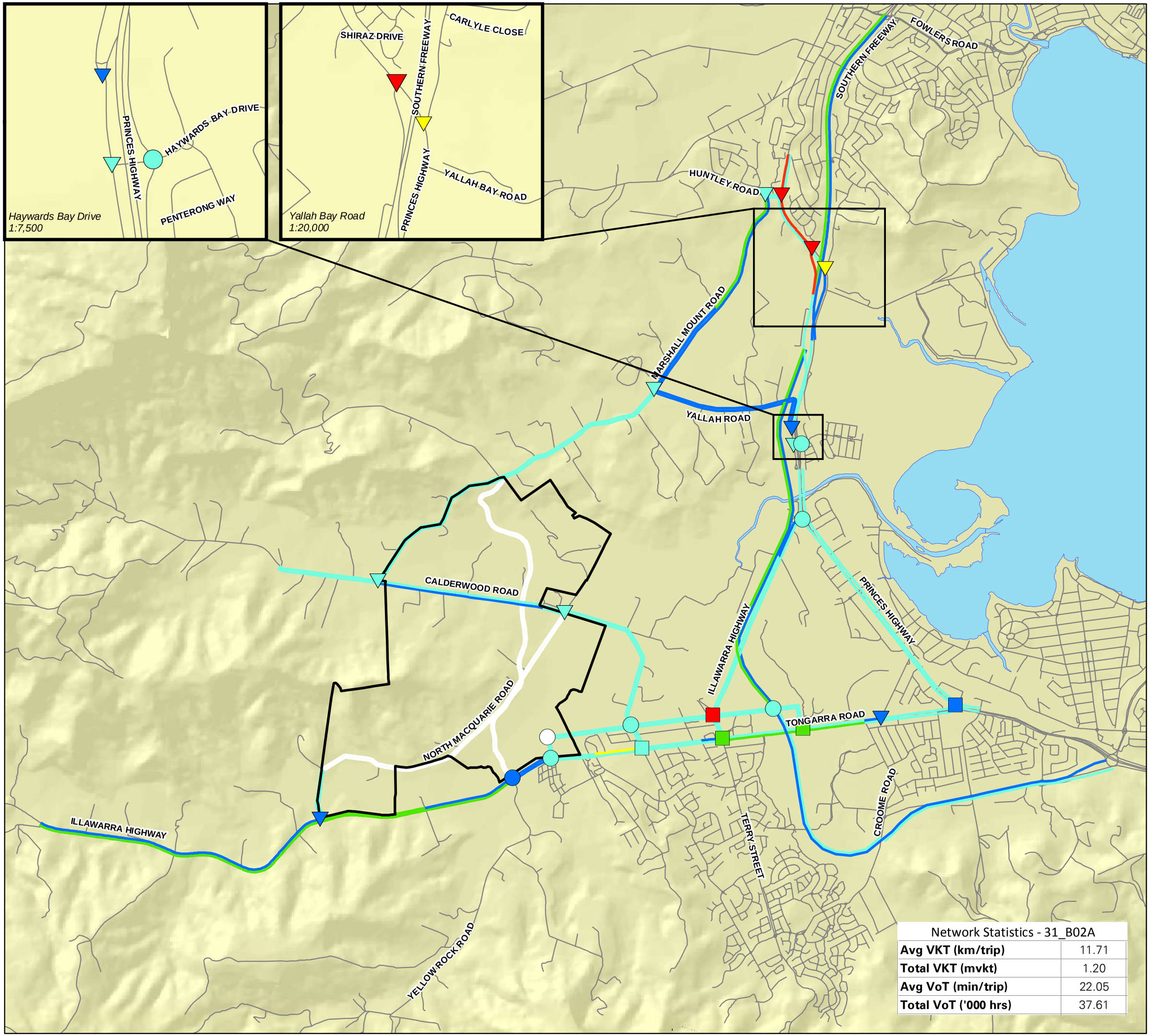

Network Statistics - 31_B02A	
Avg VKT (km/trip)	11.71
Total VKT (mvkt)	1.20
Avg VoT (min/trip)	22.05
Total VoT ('000 hrs)	37.61

Delfin Lend Lease

Figure 7.3

Road Network Performance AM Peak 2031 Base 'Do Minimum' BAU

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

Model Ref No.: 31_B02

- Site Boundary
- Lake Illawarra (LPMA)
- Local Roads (LPMA)
- Mid-Block Road Sections
- Priority Control
- Roundabout
- Traffic Signals

Level of Service (LoS)

- No Data
- A
- B
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- D
- E
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Scale 1:40 000 (at A3)

Metres
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Cardno

Map Produced by Cardno Wollongong
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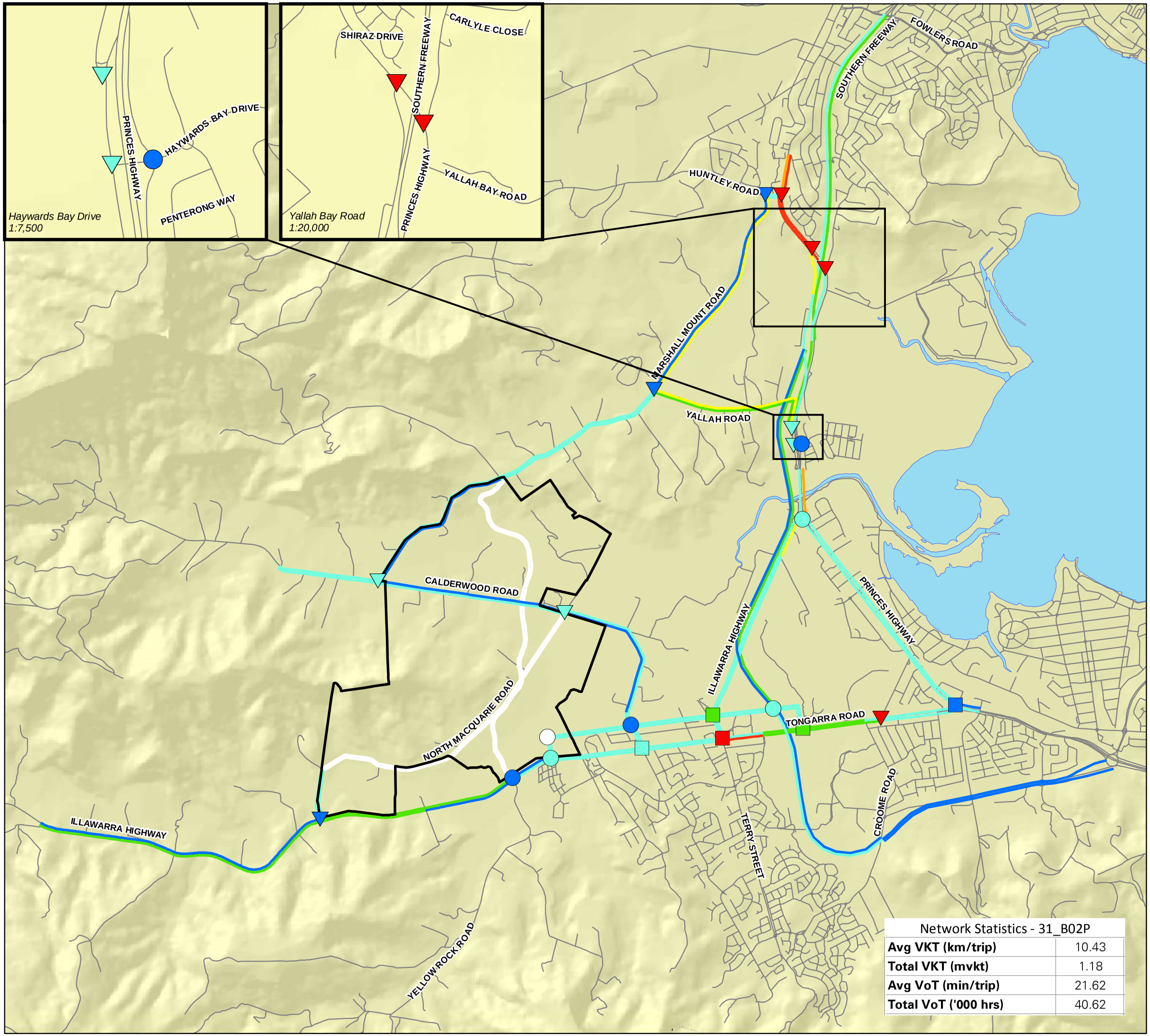

Network Statistics - 31_B02P	
Avg VKT (km/trip)	10.43
Total VKT (mvkt)	1.18
Avg VoT (min/trip)	21.62
Total VoT ('000 hrs)	40.62

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Figure 7.4

Road Network Performance PM Peak 2031 Base 'Do Minimum' BAU

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

Model Ref No.: 31_B02

- Site Boundary
- Lake Illawarra (LPMA)
- Local Roads (LPMA)
- Mid-Block Road Sections
- Priority Control
- Roundabout
- Traffic Signals

Level of Service (LoS)

- No Data
- A
- B
- C
- D
- E
- F

N W E S

Scale 1:40 000 (at A3)

Metres
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Cardno

Map Produced by Cardno Wollongong
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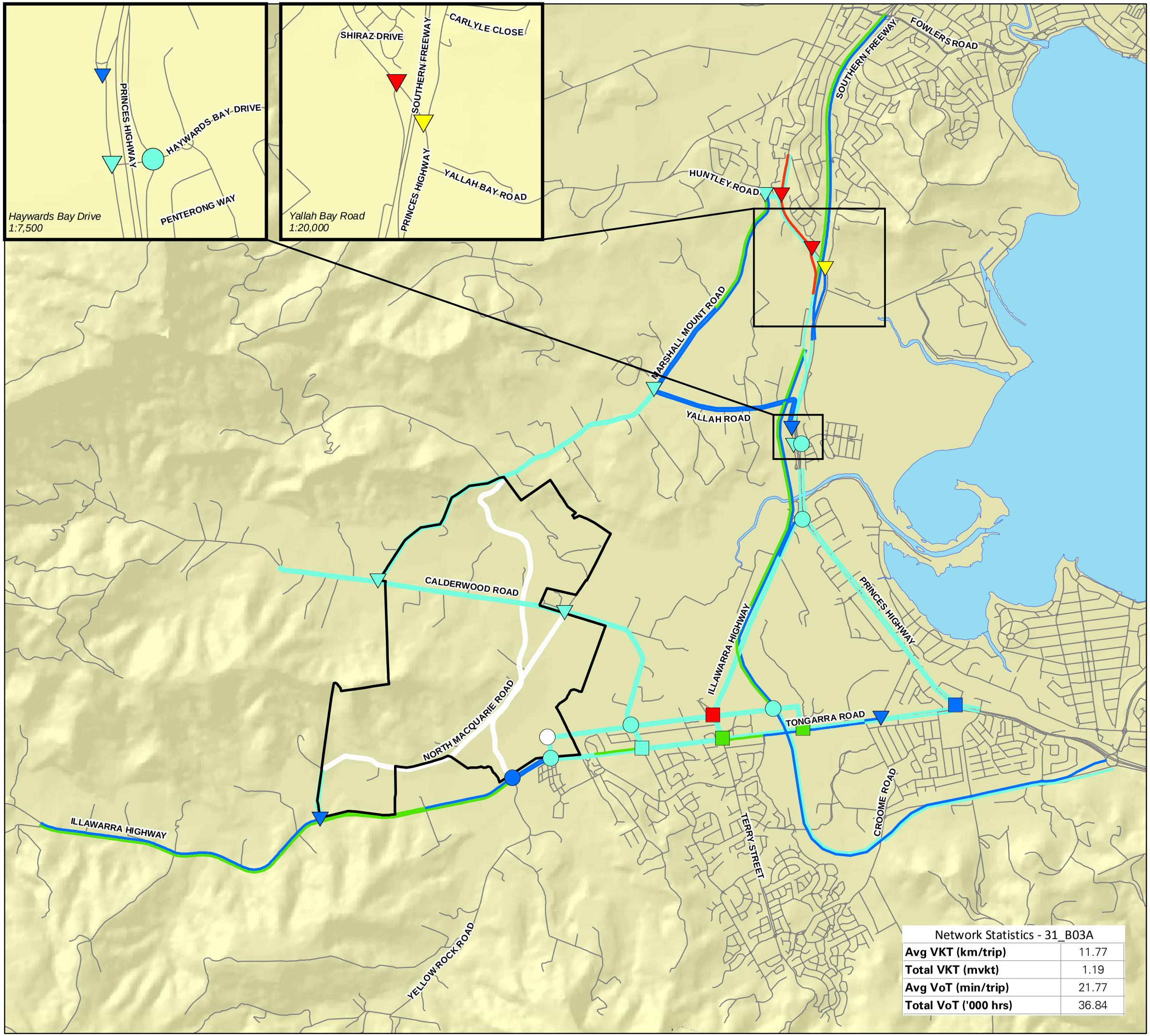

Delfin Lend Lease

Figure 7.5

Road Network Performance AM Peak 2031 Base 'Do Minimum' Mode Shift

CALDERWOOD URBAN DEVELOPMENT PROJECT

Legend

Model Ref No.: 31_B03

- Site Boundary
- Lake Illawarra (LPMA)
- Local Roads (LPMA)
- Mid-Block Road Sections
- Priority Control
- Roundabout
- Traffic Signals

Level of Service (LoS)

- No Data
- A
- B
- C
- D
- E
- F

N W E S

Scale 1:40 000 (at A3)

Metres

0 500 1,000 1,500 2,000 2,500

Cardno

Map Produced by Cardno Wollongong
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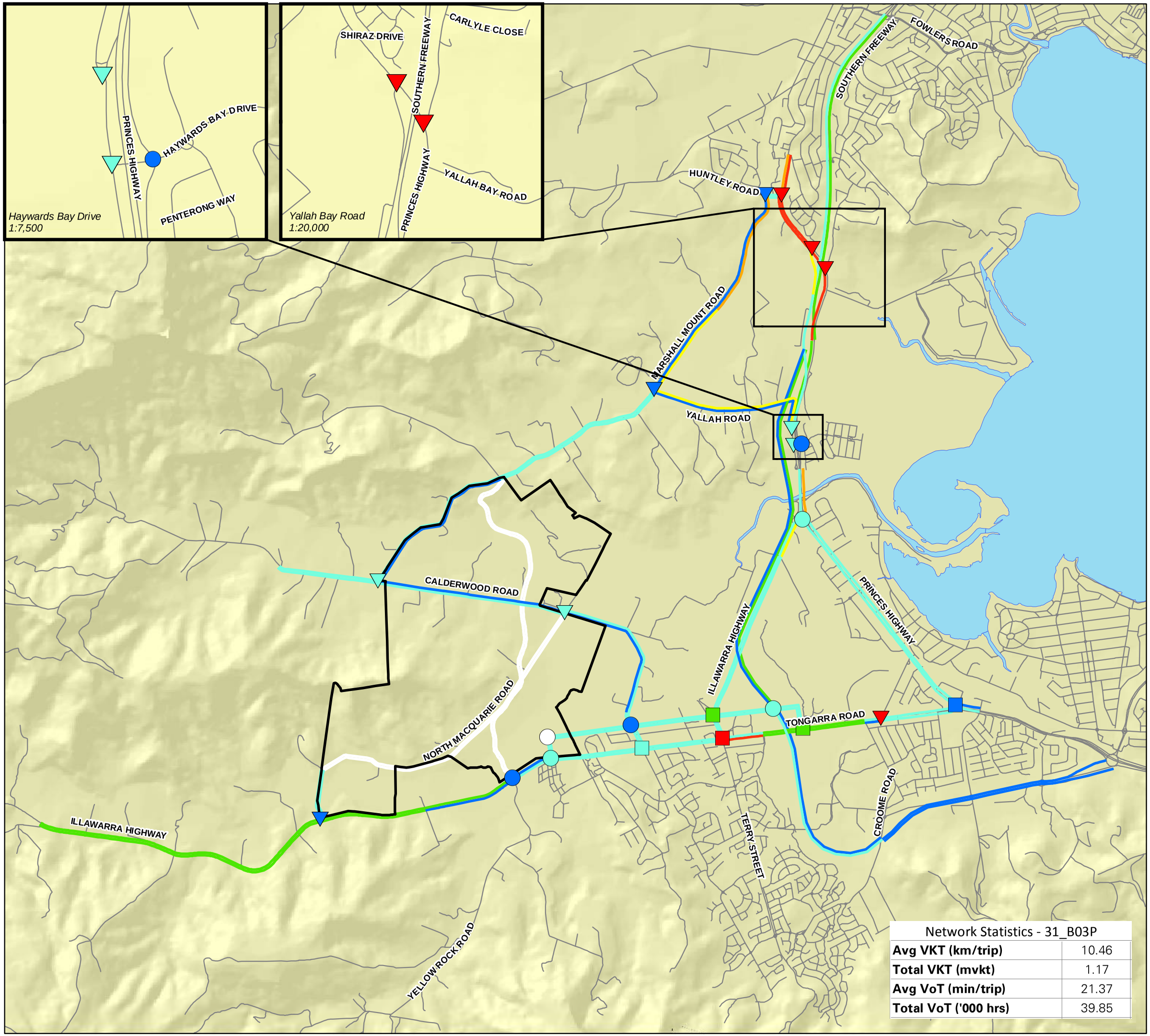
Coordinate System: Zone 56 MGA/GDA 94
GIS MAP REF: 110026-01_58018_KeyRoutes_LevelOfService_31_B03A.mxd 04



Network Statistics - 31_B03P	
Avg VKT (km/trip)	10.46
Total VKT (mvkt)	1.17
Avg VoT (min/trip)	21.37
Total VoT ('000 hrs)	39.85

Delfin Lend Lease

Figure 7.6

Road Network Performance PM Peak 2031 Base 'Do Minimum' Mode Shift

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

Model Ref No.: 31_B03

- Site Boundary
- Lake Illawarra (LPMA)
- Local Roads (LPMA)
- Mid-Block Road Sections
- Priority Control
- Roundabout
- Traffic Signals

Level of Service (LoS)

- No Data
- A
- B
- C
- D
- E
- F

N W E S

Scale 1:40 000 (at A3)

Metres
0 500 1,000 1,500 2,000 2,500

Cardno

Map Produced by Cardno Wollongong
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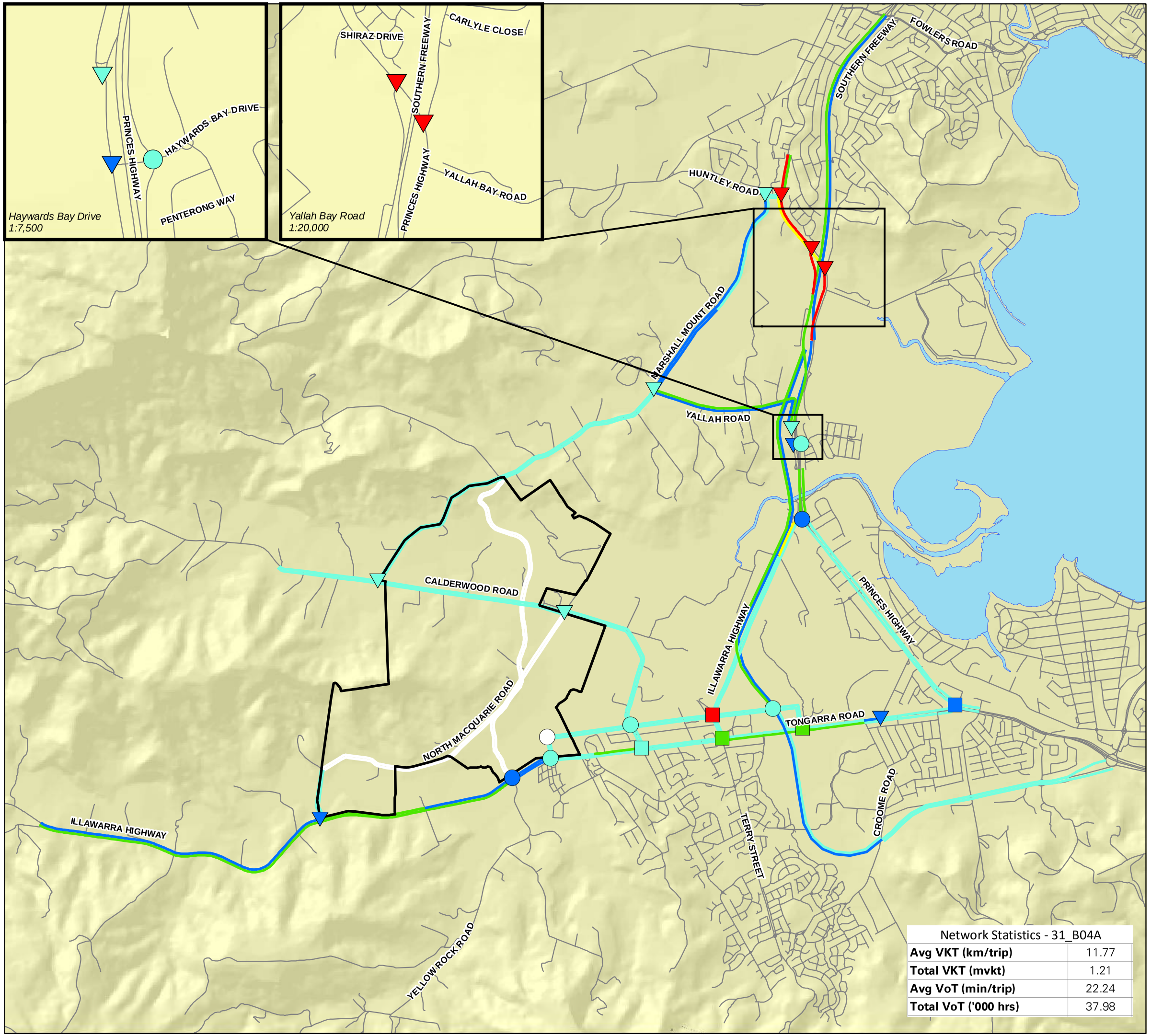

Network Statistics - 31_B04A	
Avg VKT (km/trip)	11.77
Total VKT (mvkt)	1.21
Avg VoT (min/trip)	22.24
Total VoT ('000 hrs)	37.98

Delfin Lend Lease

Figure 7.7

Road Network Performance AM Peak 2031 Base 'Do Absolute Minimum' BAU

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

Model Ref No.: 31_B04

- Site Boundary
- Lake Illawarra (LPMA)
- Local Roads (LPMA)
- Mid-Block Road Sections
- Priority Control
- Roundabout
- Traffic Signals

Level of Service (LoS)

- No Data
- A
- B
- C
- D
- E
- F

N W E S

Scale 1:40 000 (at A3)

Metres
0 500 1,000 1,500 2,000 2,500

Cardno

Map Produced by Cardno Wollongong
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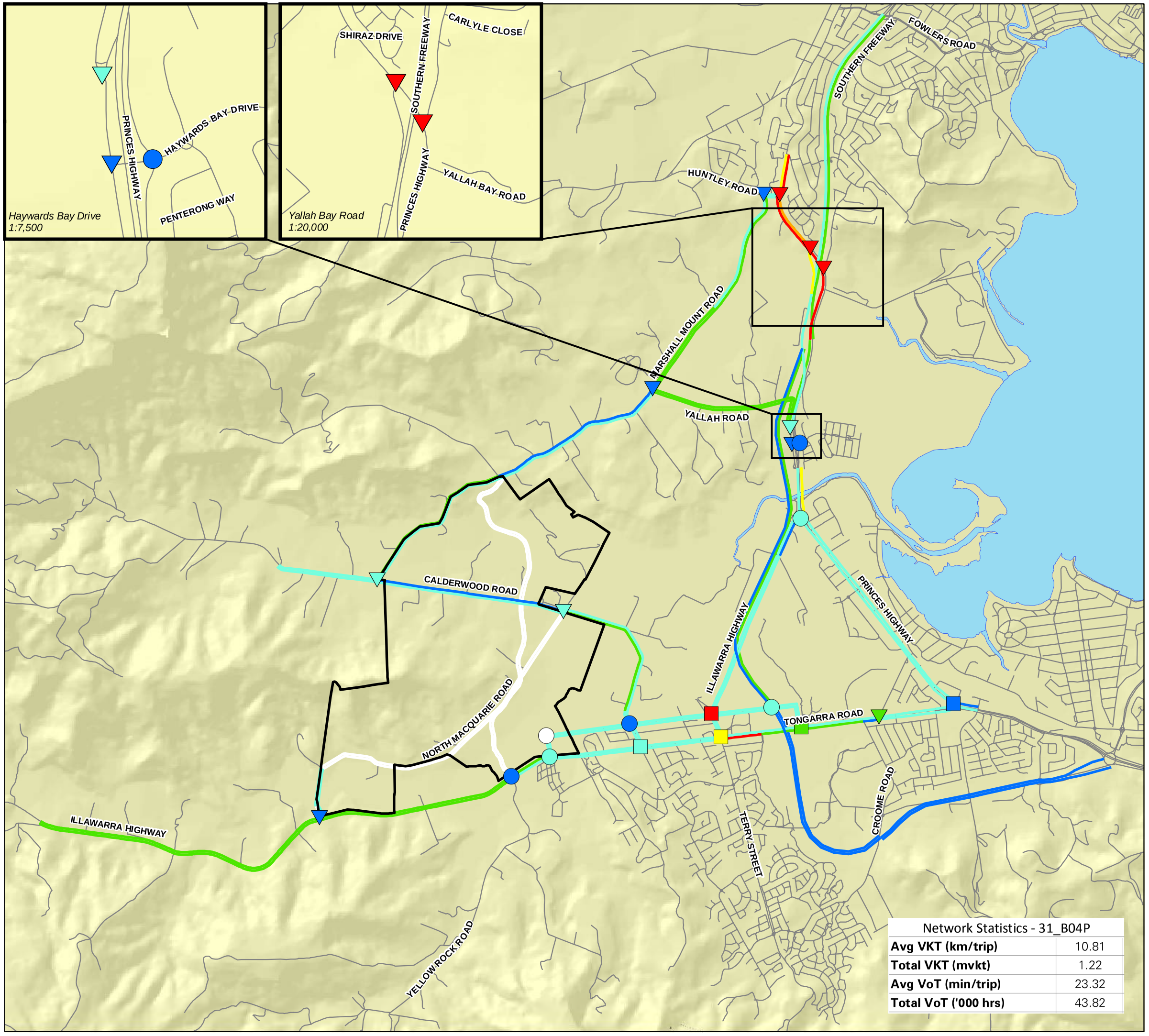
Coordinate System: Zone 56 MGA/GDA 94
GIS MAP REF: 110026-01_58026_KeyRoutes_LevelOfService_31_B04A.mxd 03



Network Statistics - 31_B04P	
Avg VKT (km/trip)	10.81
Total VKT (mvkt)	1.22
Avg VoT (min/trip)	23.32
Total VoT ('000 hrs)	43.82

Delfin Lend Lease

Figure 7.8

Road Network Performance PM Peak 2031 Base 'Do Absolute Minimum' BAU

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

Model Ref No.: 31_B04

- Site Boundary
- Lake Illawarra (LPMA)
- Local Roads (LPMA)
- Mid-Block Road Sections
- Priority Control
- Roundabout
- Traffic Signals

Level of Service (LoS)

- No Data
- A
- B
- C
- D
- E
- F

N W E S

Scale 1:40 000 (at A3)

Metres
0 500 1,000 1,500 2,000 2,500

Cardno

Map Produced by Cardno Wollongong
Date: 20 January 2010
Coordinate System: Zone 56 MGA/GDA 94
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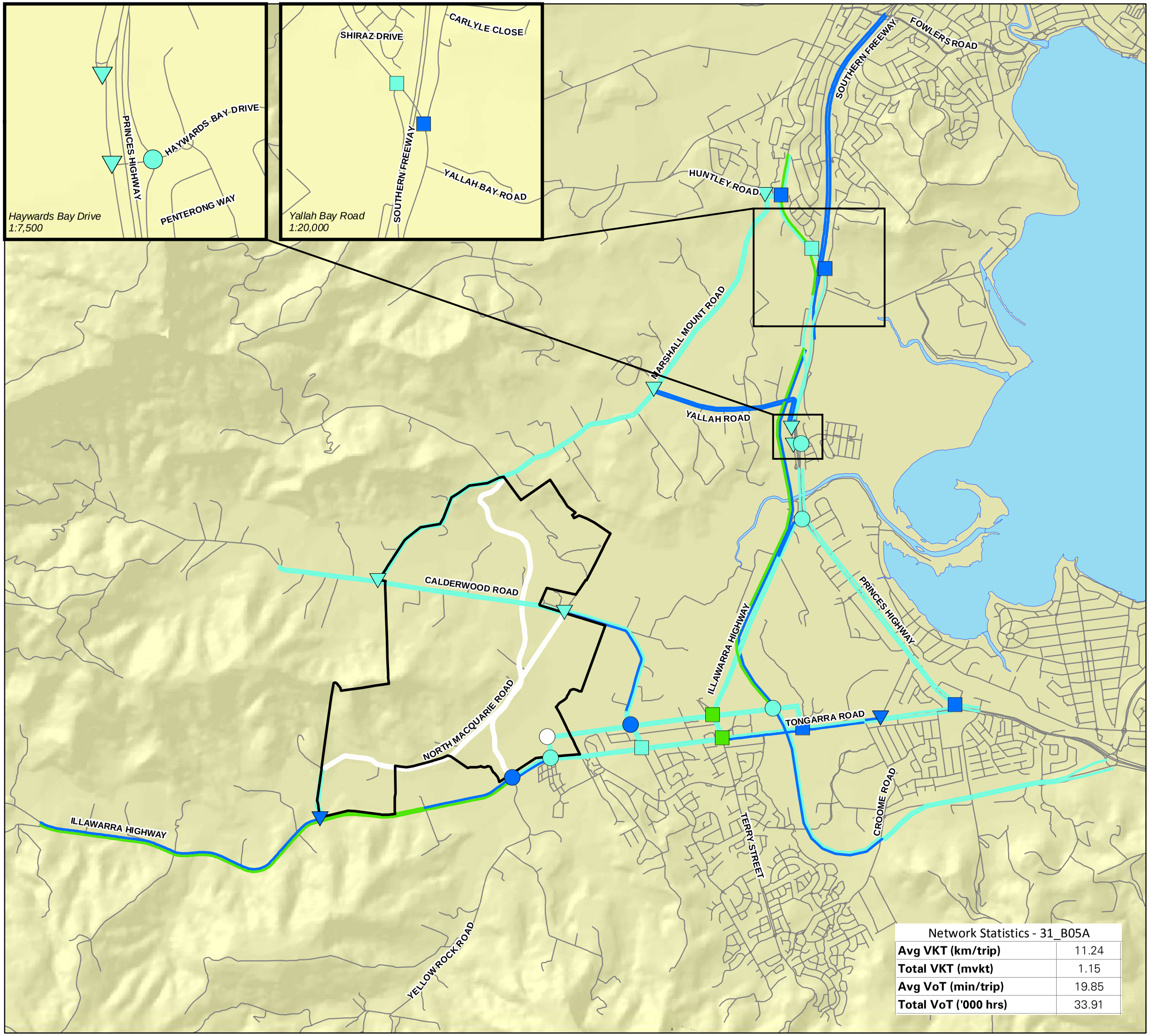

Network Statistics - 31_B05A	
Avg VKT (km/trip)	11.24
Total VKT (mvkt)	1.15
Avg VoT (min/trip)	19.85
Total VoT ('000 hrs)	33.91

Delfin Lend Lease

Figure 7.9

Road Network Performance AM Peak 2031 Base 'Do Base Upgrades' Mode Shift

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

Model Ref No.: 31_B05

- Site Boundary
- Lake Illawarra (LPMA)
- Local Roads (LPMA)
- Mid-Block Road Sections
- Priority Control
- Roundabout
- Traffic Signals

Level of Service (LoS)

- No Data
- A
- B
- C
- D
- E
- F

N W E S

Scale 1:40 000 (at A3)

Metres
0 500 1,000 1,500 2,000 2,500

Cardno

Map Produced by Cardno Wollongong
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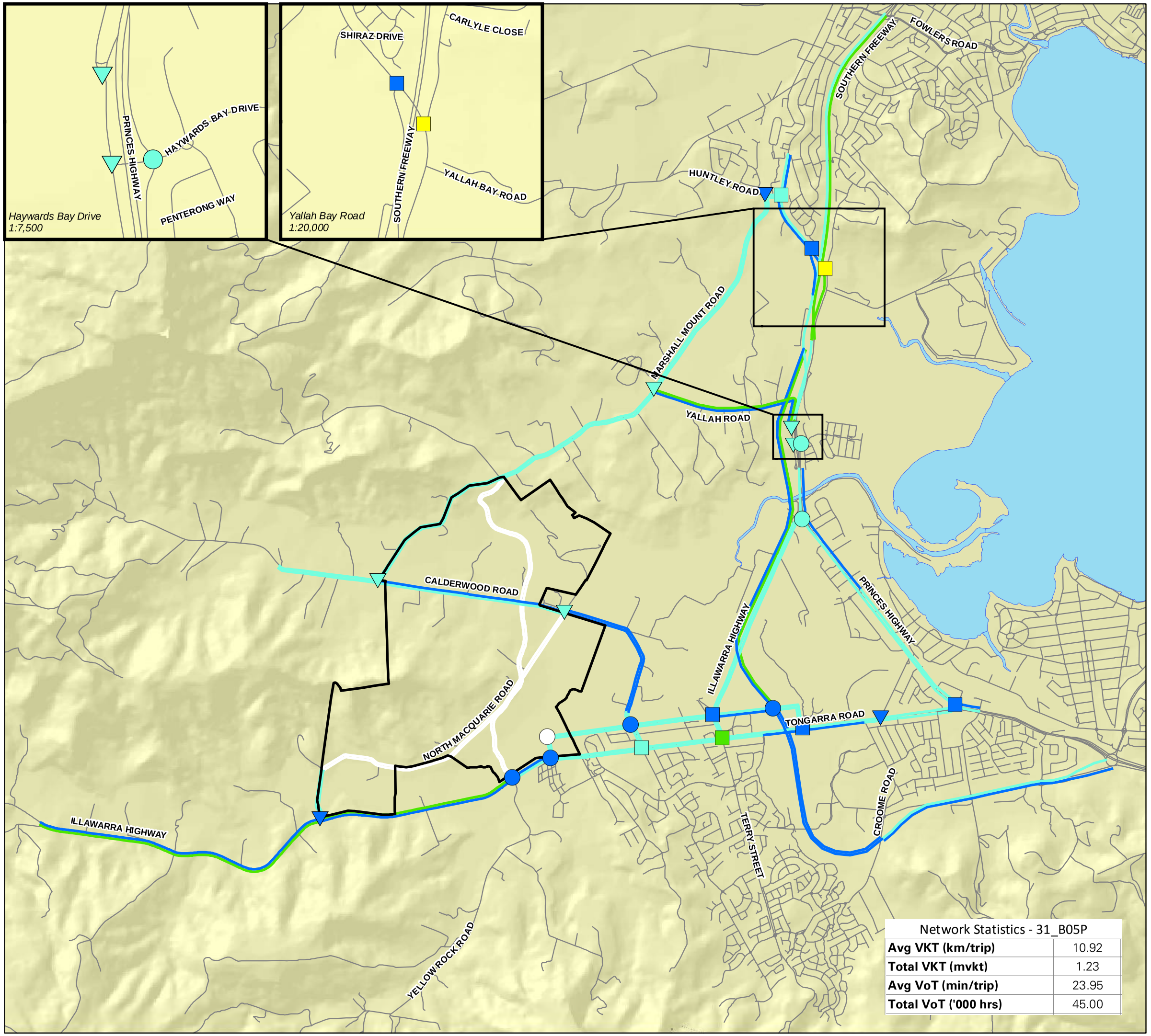
Coordinate System: Zone 56 MGA/GDA 94
GIS MAP REF: 110026-01_58028_KeyRoutes_LevelOfService_31_B05A.mxd 04



Delfin Lend Lease

Figure 7.10

Road Network Performance PM Peak 2031 Base 'Do Base Upgrades' Mode Shift

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

Model Ref No.: 31_B05

- Site Boundary
- Lake Illawarra (LPMA)
- Local Roads (LPMA)
- Mid-Block Road Sections
- Priority Control
- Roundabout
- Traffic Signals

Level of Service (LoS)

- No Data
- A
- B
- C
- D
- E
- F

N W E S

Scale 1:40 000 (at A3)

Metres
0 500 1,000 1,500 2,000 2,500

Cardno

Map Produced by Cardno Wollongong
Date: 20 January 2010
Coordinate System: Zone 56 MGA/GDA 94
GIS MAP REF: 110026-01_58029_KeyRoutes_LevelOfService_31_B05P.mxd 04

7.2 WITH DEVELOPMENT NETWORK ASSESSMENT

In order to establish the characteristic of the future road network with the CUDP a range of 'with development' model scenarios was run (as detailed in Section 6.4.4). This analysis provides an iterative assessment of various model scenarios to determine:

- The impact of the development on the surrounding external road network.
- The performance of the proposed internal CUDP road network.
- Road network infrastructure to ameliorate the impacts of the development.

For each scenario the following information was extracted from the relevant AM and PM 2031 Base TRACKS models:

- Mid-block and turning traffic volumes.
- Network VKT and VOT.

In order to assess the network performance the following steps were undertaken:

1. Run the model for the current scenario.
2. Review mid-block and turning traffic volumes to identify any significant changes or anomalies.
3. Review total network VKT and VOT to see level of change and if positive or negative changes occurred.
4. Mid-block traffic volumes were used to assess mid-block carriageway capacity and performance.
5. Turning traffic volumes were used to assess intersection performance (not in all scenarios this was only done for key scenario tests).
6. Adjust assumptions for input road network, growth and mode share.
7. Implement amelioration measures.
8. Repeat steps 1 through 7 until satisfactory network performance achieved. Mid-block and intersection peak hour operation at LoS D or better is considered a satisfactory outcome.

The mid-block and turning traffic volumes were used to then assess mid-block carriageway capacity and intersection performance. A summary of each peak period for each scenario was produced to graphically represent mid-block LoS, intersection LoS and network VKT/VOT.

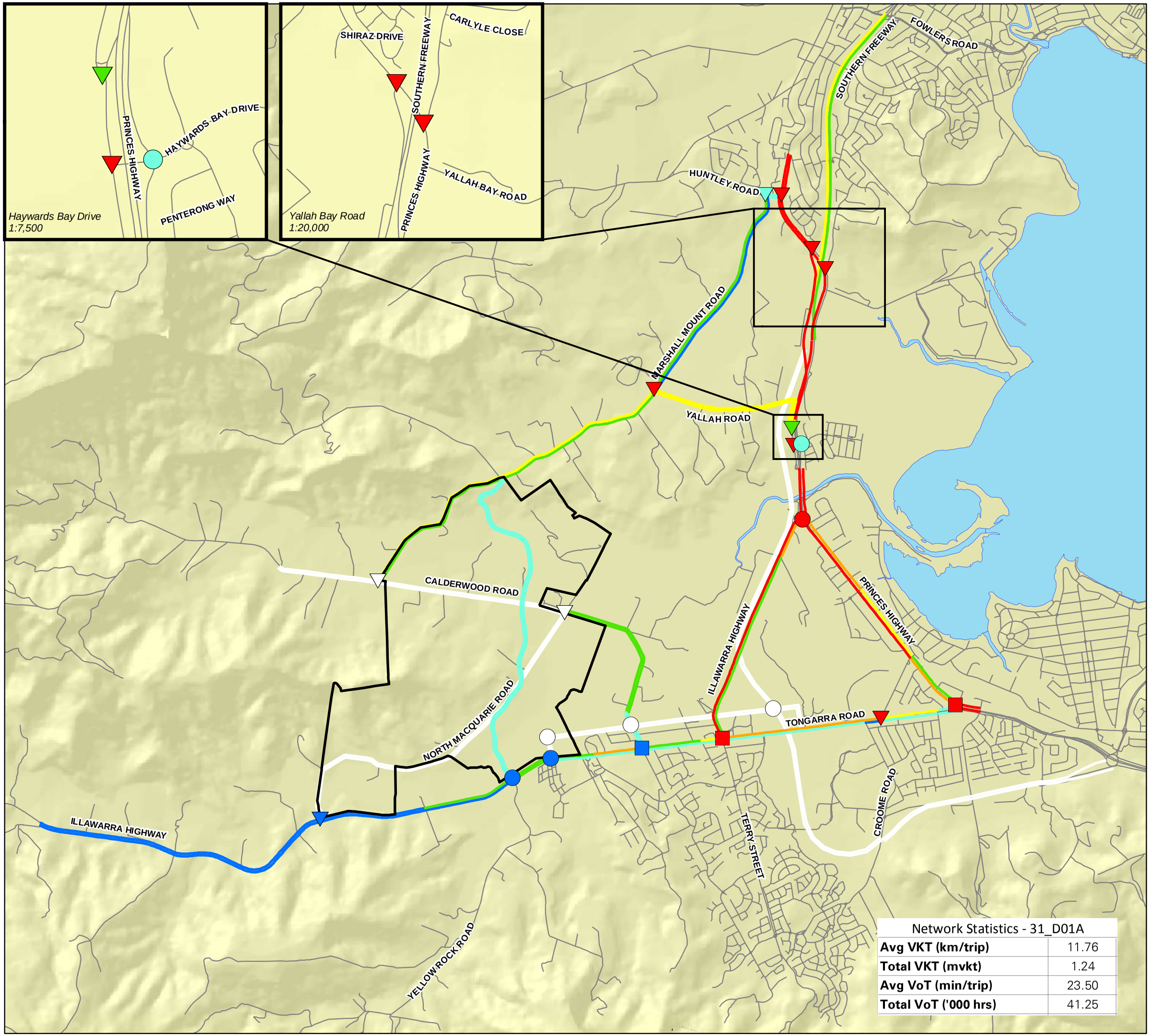
Table 7.2 provides an overview of the CUDP model scenarios, detailing the scenario description and key outcomes for the scenario. Results of each scenario are then summarised in the figures in this chapter with detailed results presented in a series of appendices as identified in Table 7.2.

7.3 SENSITIVITY TESTING

Sensitivity testing was undertaken to determine the potential impact on the road network of changes to the CUDP land use yields. The results of these sensitivity tests are summarised in Appendix 7-L.

Table 7.2 2031 CUDP Model Scenario Outcomes

Scenario Description	Key Outcomes	Results Summary
2031 CUDP 'DO NOTHING' BAU SCENARIO {31_D01}		
↘ 2009 road network with the internal CUDP road network included - no other upgrades. ↘ Regional infill growth, external growth, regional new development growth plus CUDP growth. ↘ BAU modal splits.	As is shown above there are significant sections of the existing road network that would be overcapacity during both modelled peak hour periods. The extent of the road network upgrades largely mirrors the improvements required under the base 'do absolute minimum' scenarios with north-south movement through the study area along Princes Highway and east-west movements along Tongarra Road severely restricted by overcapacity road sections. Additionally movement between Princes Highway and Dapto Town Centre would also be restricted by overcapacity road sections.	Figure 7.11 AM peak Figure 7.12 PM peak Appendix 7F
2031 CUDP 'DO NOTHING' MODE SHIFT SCENARIO {31_D02}		
↘ 2009 road network with the internal CUDP road network included - no other upgrades. ↘ Regional infill growth, external growth, regional new development growth with BAU modal splits ↘ CUDP growth with 10% mode shift.	A 10% modal transfer away from private vehicle usage with the proposed CUDP would have little impact upon the extent of existing road network operating at unsatisfactory peak hour LoS. The scale of overcapacity is of a sufficiently high order that the removal of a modest number of modally shifted car trips would not provide any significant relief to the congested mid-block capacity sections.	Figure 7.13 AM peak Figure 7.14 PM peak Appendix 7G
2031 CUDP 'DO MINIMUM' MODE SHIFT SCENARIO {31_D04}		
↘ 2009 road network with the internal CUDP road network and 'do minimum' upgrades included. ↘ Regional infill growth, external growth, regional new development growth with BAU modal splits ↘ CUDP growth with 10% mode shift.	The 'Do minimum' upgrades go some way to providing a reasonable level of overall satisfactory road network operation although a lack of capacity is still apparent particularly on the Princes Highway and its connections to the Southern Freeway.	Figure 7.15 AM peak Figure 7.16 PM peak Appendix 7H
2031 CUDP 'DO ABSOLUTE MINIMUM' MODE SHIFT SCENARIO {31_D08}		
↘ 2009 road network with the internal CUDP road network and 'do absolute minimum' upgrades included. ↘ Regional infill growth, external growth, regional new development growth with BAU modal splits ↘ CUDP growth with 10% mode shift.	The removal of the north-facing ramps at Tallawarra interchange provides no detrimental impact to road network operation.	Figure 7.17 AM peak Figure 7.18 PM peak Appendix 7I
2031 CUDP 'DO BASE UPGRADES' MODE SHIFT SCENARIO {31_D11}		
↘ 2009 road network with the internal CUDP road network and 'do absolute minimum' upgrades included plus the following upgrades identified to be required to address future base road network deficiencies (without Calderwood) 'do base upgrades': ▪ Duplication of Princes Highway (adding an additional traffic lane): - Northbound from Mount Brown Road to the F6 off-ramp. - Southbound from Mount Brown Road to the F6 on-ramp. ▪ In conjunction with the above upgrade to traffic signal control of the following existing intersections: - Princes Highway / Huntley Road - Princes Highway / Southern Freeway northbound off slip - Princes Highway / Cormack Avenue ▪ Southern Freeway southbound on-slip road upgrade to two lanes and associated freeway merge widening works to accommodate. ▪ Southern Freeway northbound off-slip road upgrade to two lanes and associated freeway diverge widening works to accommodate. ▪ Marshall Mount and Yallah Road upgrades to satisfactory one lane width in either direction with sealed shoulders. ↘ Regional infill growth, external growth, regional new development growth with BAU modal splits ↘ CUDP growth with 10% mode shift.	This scenario identified that the modelled road network (on a mid-block capacity basis) provided a road network capable of satisfactorily accommodating the 2031 future demand (including CUDP). Intersection analysis of this scenario led to the identification of a further intersection improvements at the Marshall Mount Road and Yallah Road which will require one further iteration of the model to ensure its wider network implications.	Figure 7.19 AM peak Figure 7.20 PM peak Appendix 7J
2031 CUDP 'DO FULL DEVELOPMENT UPGRADES' MODE SHIFT SCENARIO {31_D12}		
↘ 2009 road network with the internal CUDP road network, the 'do absolute minimum' upgrades, the 'do base upgrades' included plus the following upgrades identified to be required to address future road network deficiencies (including base upgrades and Calderwood): ▪ Upgrade of Marshall Mount Road and Yallah Road to roundabout control ↘ Regional infill growth, external growth, regional new development growth with BAU modal splits ↘ CUDP growth with 10% mode shift.	Overall it is considered satisfactory network performance results with all road sections operating at LoS D (or close to) during the both 2031 modelled peak hour periods.	Figure 7.21 AM peak Figure 7.22 PM peak Appendix 7K



Network Statistics - 31_D01A	
Avg VKT (km/trip)	11.76
Total VKT (mvkt)	1.24
Avg VoT (min/trip)	23.50
Total VoT ('000 hrs)	41.25

Delfin Lend Lease

Figure 7.11

Road Network Performance AM Peak 2031 CUDP 'Do Nothing' BAU

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

Model Ref No.: 31_D01

- Site Boundary
- Lake Illawarra (LPMA)
- Local Roads (LPMA)
- Mid-Block Road Sections
- Priority Control
- Roundabout
- Traffic Signals

Level of Service (LoS)

- No Data
- A
- B
- C
- D
- E
- F

N W E S

Scale 1:40 000 (at A3)

Metres
0 500 1,000 1,500 2,000 2,500

Cardno

Map Produced by Cardno Wollongong
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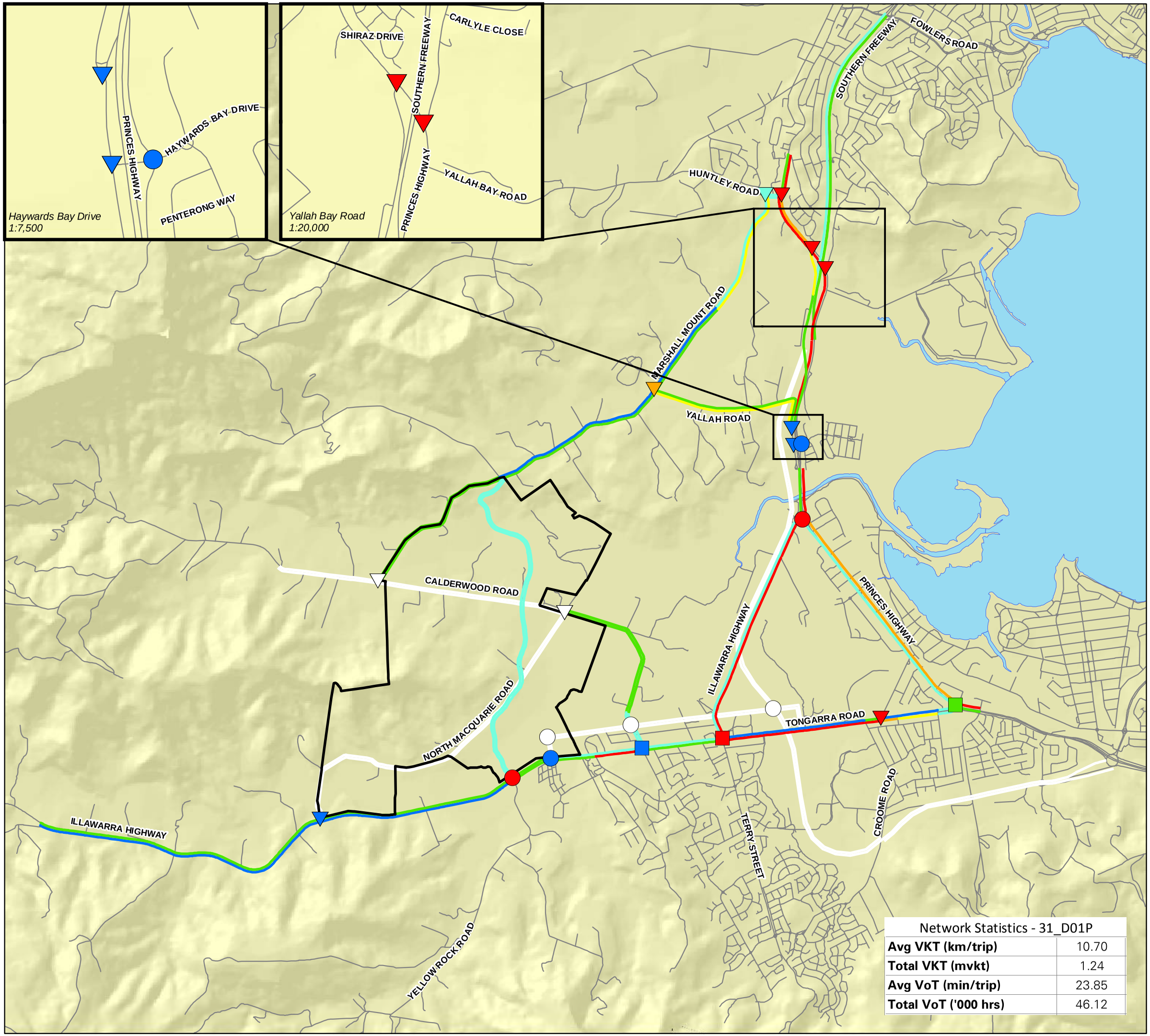

Network Statistics - 31_D01P	
Avg VKT (km/trip)	10.70
Total VKT (mvkt)	1.24
Avg VoT (min/trip)	23.85
Total VoT ('000 hrs)	46.12

Delfin Lend Lease

Figure 7.12

Road Network Performance PM Peak 2031 CUDP 'Do Nothing' BAU

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

Model Ref No.: 31_D01

- Site Boundary
- Lake Illawarra (LPMA)
- Local Roads (LPMA)
- Mid-Block Road Sections
- Priority Control
- Roundabout
- Traffic Signals

Level of Service (LoS)

- No Data
- A
- B
- C
- D
- E
- F

N W E S

Scale 1:40 000 (at A3)

Metres
0 500 1,000 1,500 2,000 2,500

Cardno

Map Produced by Cardno Wollongong
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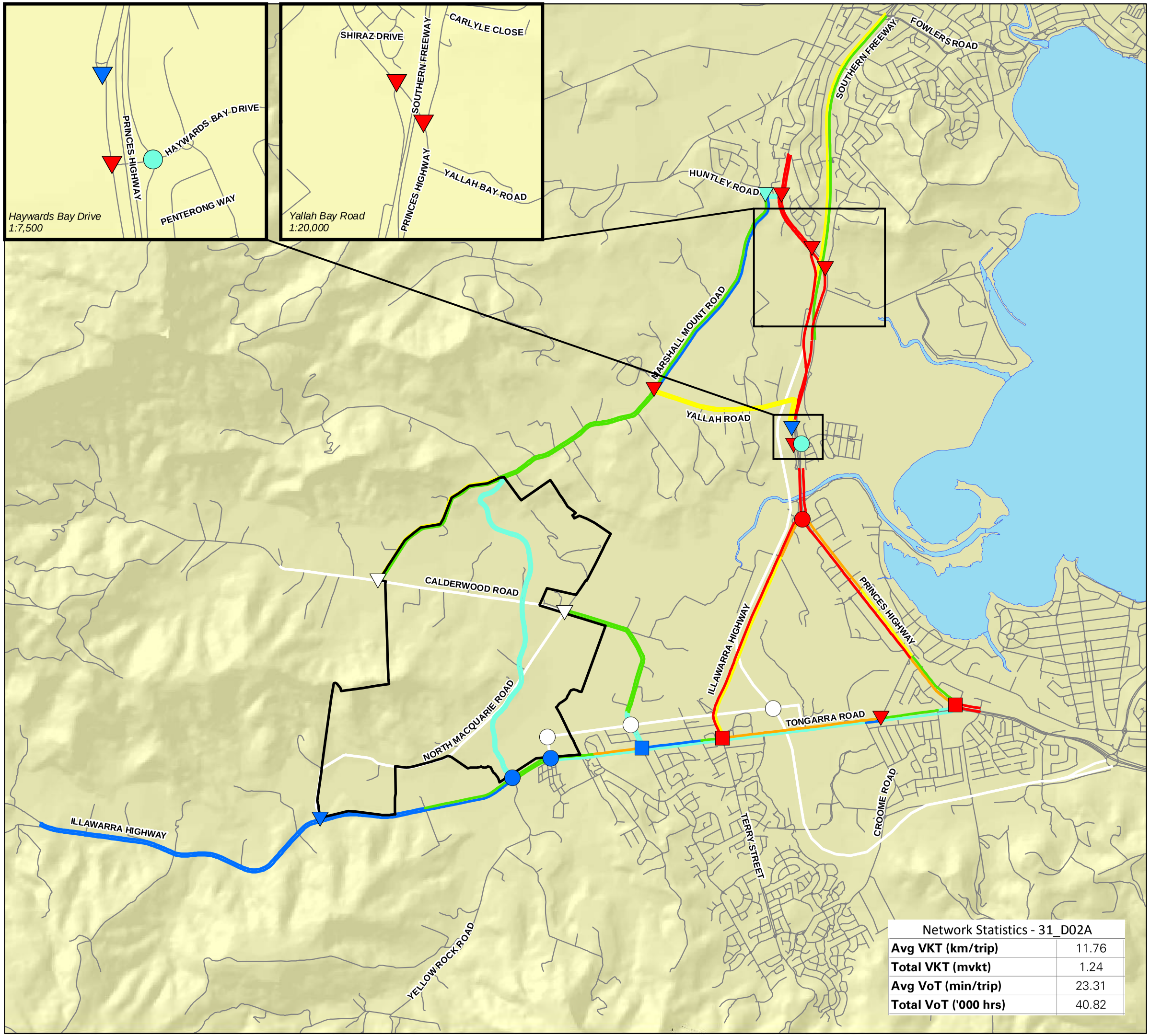

Network Statistics - 31_D02A	
Avg VKT (km/trip)	11.76
Total VKT (mvkt)	1.24
Avg VoT (min/trip)	23.31
Total VoT ('000 hrs)	40.82

Delfin Lend Lease

Figure 7.13

Road Network Performance AM Peak 2031 CUDP 'Do Nothing' Mode Shift

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

Model Ref No.: 31_D02

- Site Boundary
- Lake Illawarra (LPMA)
- Local Roads (LPMA)
- Mid-Block Road Sections
- Priority Control
- Roundabout
- Traffic Signals

Level of Service (LoS)

- No Data
- A
- B
- C
- D
- E
- F

N W E S

Scale 1:40 000 (at A3)

Metres
0 500 1,000 1,500 2,000 2,500

Cardno

Map Produced by Cardno Wollongong
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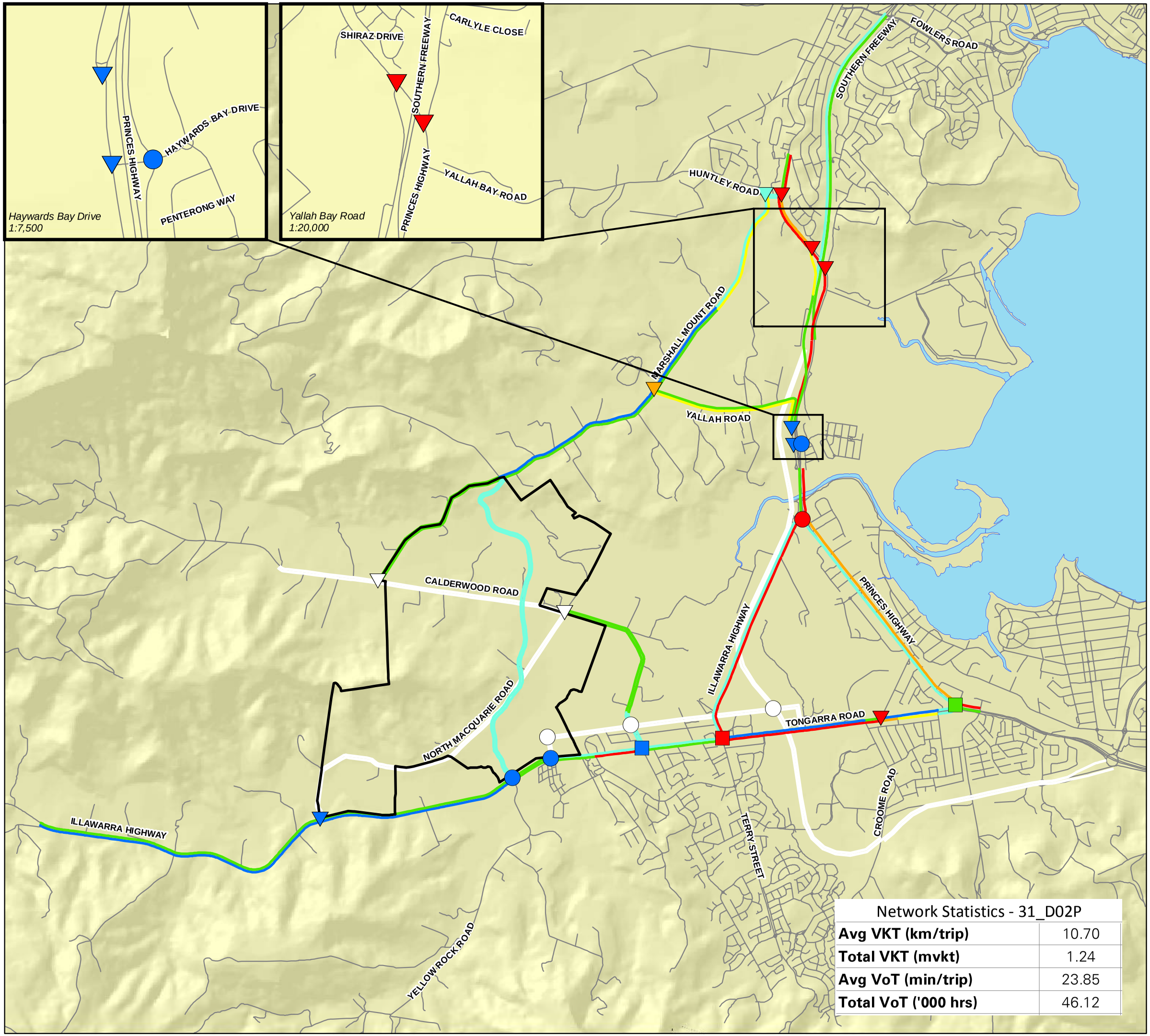

Network Statistics - 31_D02P	
Avg VKT (km/trip)	10.70
Total VKT (mvkt)	1.24
Avg VoT (min/trip)	23.85
Total VoT ('000 hrs)	46.12

Delfin Lend Lease

Figure 7.14

Road Network Performance PM Peak 2031 CUDP 'Do Nothing' Mode Shift

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

Model Ref No.: 31_D02

- Site Boundary
- Lake Illawarra (LPMA)
- Local Roads (LPMA)
- Mid-Block Road Sections
- Priority Control
- Roundabout
- Traffic Signals

Level of Service (LoS)

- No Data
- A
- B
- C
- D
- E
- F

N W E S

Scale 1:40 000 (at A3)

Metres
0 500 1,000 1,500 2,000 2,500

Cardno

Map Produced by Cardno Wollongong
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Coordinate System: Zone 56 MGA/GDA 94
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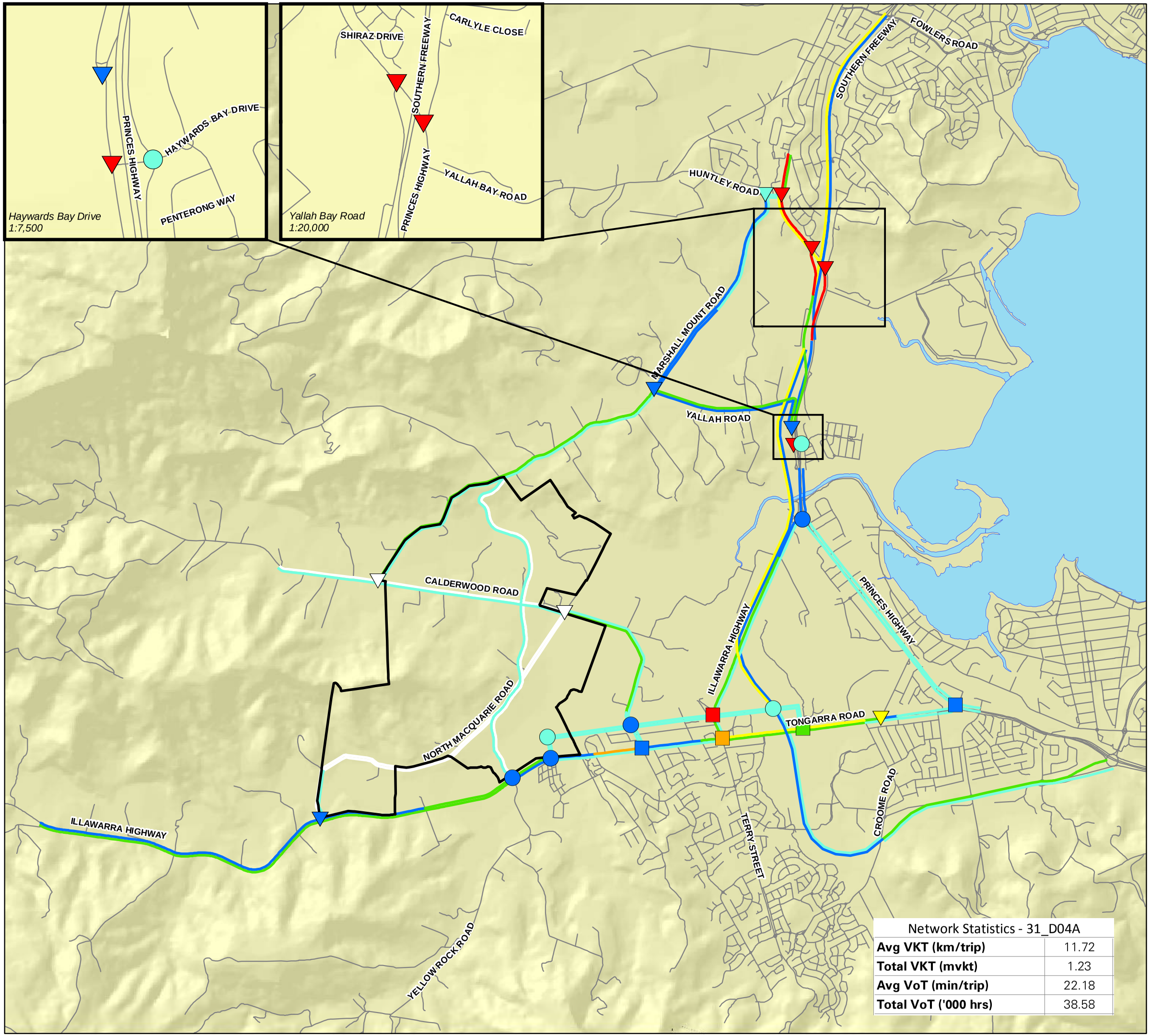

Network Statistics - 31_D04A	
Avg VKT (km/trip)	11.72
Total VKT (mvkt)	1.23
Avg VoT (min/trip)	22.18
Total VoT ('000 hrs)	38.58

Delfin Lend Lease

Figure 7.15

Road Network Performance AM Peak 2031 CUDP 'Do Minimum' Mode Shift

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

Model Ref No.: 31_D04

- Site Boundary
- Lake Illawarra (LPMA)
- Local Roads (LPMA)
- Mid-Block Road Sections
- Priority Control
- Roundabout
- Traffic Signals

Level of Service (LoS)

- No Data
- A
- B
- C
- D
- E
- F

N W E S

Scale 1:40 000 (at A3)

Metres
0 500 1,000 1,500 2,000 2,500

Cardno

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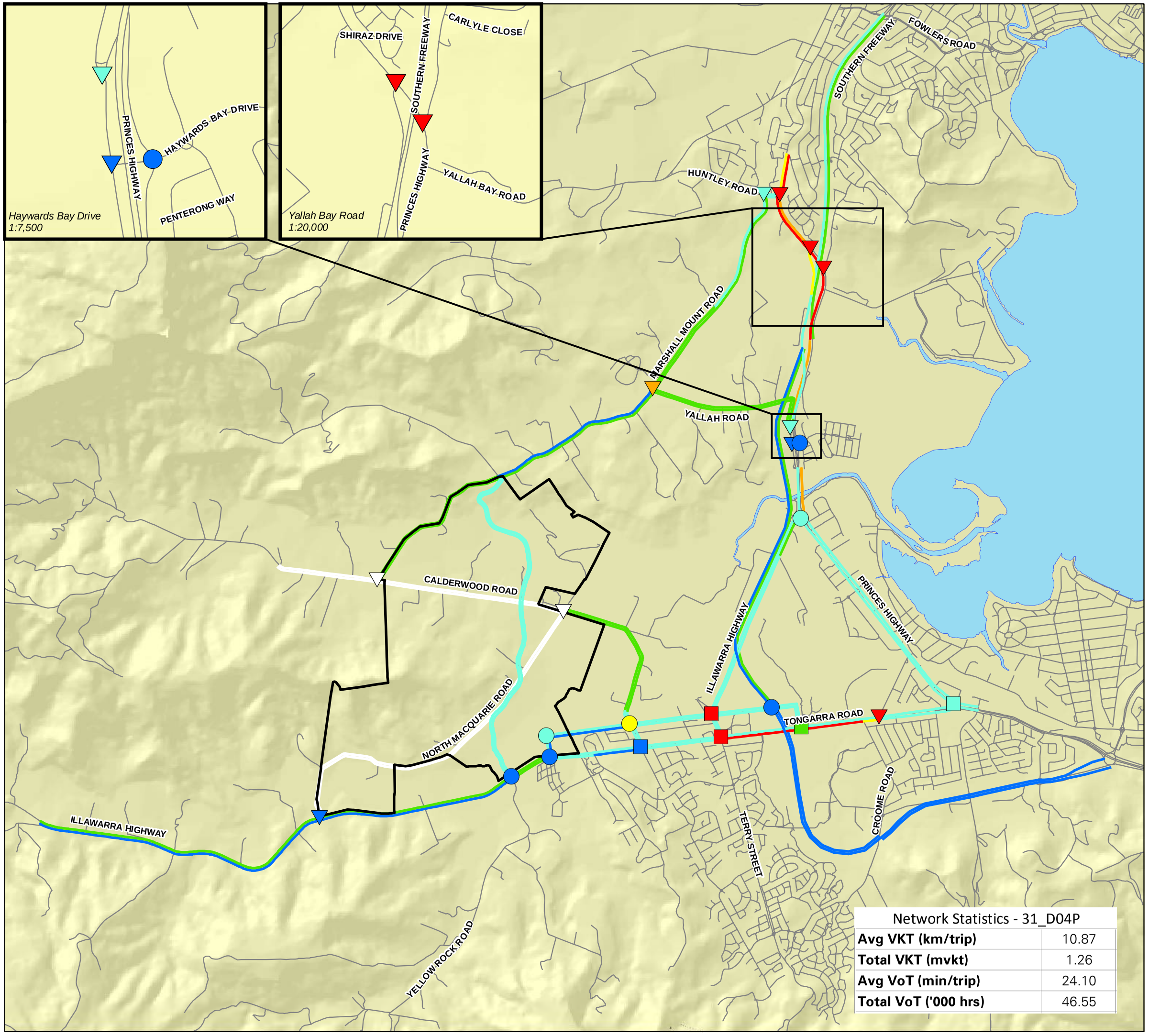

Network Statistics - 31_D04P	
Avg VKT (km/trip)	10.87
Total VKT (mvkt)	1.26
Avg VoT (min/trip)	24.10
Total VoT ('000 hrs)	46.55

Delfin Lend Lease

Figure 7.16

Road Network Performance PM Peak 2031 CUDP 'Do Minimum' Mode Shift

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

Model Ref No.: 31_D04

- Site Boundary
- Lake Illawarra (LPMA)
- Local Roads (LPMA)
- Mid-Block Road Sections
- Priority Control
- Roundabout
- Traffic Signals

Level of Service (LoS)

- No Data
- A
- B
- C
- D
- E
- F

N W E S

Scale 1:40 000 (at A3)

Metres
0 500 1,000 1,500 2,000 2,500

Cardno

Map Produced by Cardno Wollongong
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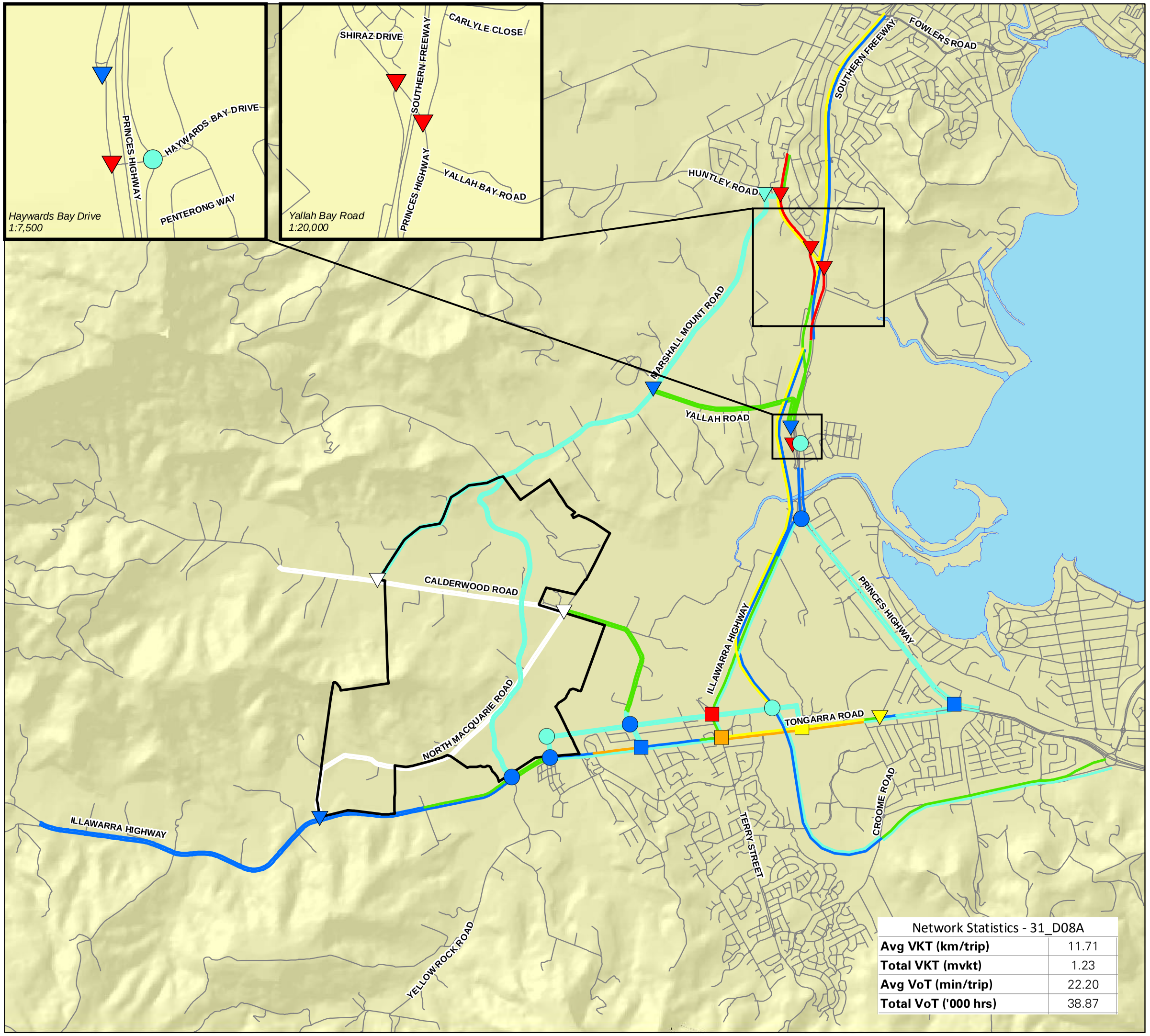

Delfin Lend Lease

Figure 7.17

Road Network Performance AM Peak 2031 CUDP 'Do Absolute Minimum' Mode Shift

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

Model Ref No.: 31_D08

- Site Boundary
- Lake Illawarra (LPMA)
- Local Roads (LPMA)
- Mid-Block Road Sections
- Priority Control
- Roundabout
- Traffic Signals

Level of Service (LoS)

- No Data
- A
- B
- C
- D
- E
- F

N W E S

Scale 1:40 000 (at A3)

Metres
0 500 1,000 1,500 2,000 2,500

Cardno

Map Produced by Cardno Wollongong
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Coordinate System: Zone 56 MGA/GDA 94
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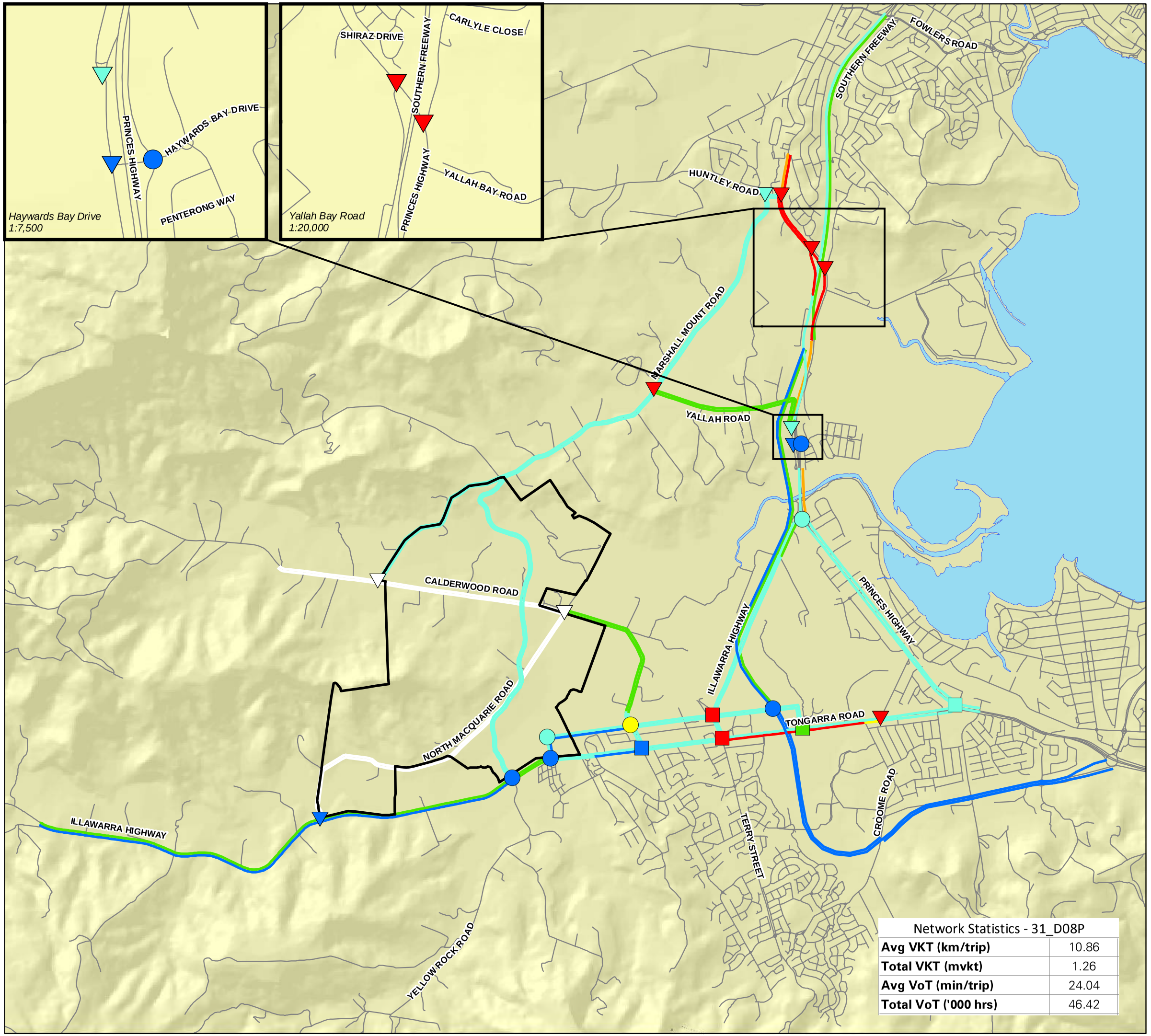

Delfin Lend Lease

Figure 7.18

Road Network Performance PM Peak 2031 CUDP 'Do Absolute Minimum' Mode Shift

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

Model Ref No.: 31_D08

- Site Boundary
- Lake Illawarra (LPMA)
- Local Roads (LPMA)
- Mid-Block Road Sections
- Priority Control
- Roundabout
- Traffic Signals

Level of Service (LoS)

- No Data
- A
- B
- C
- D
- E
- F

N W E S

Scale 1:40 000 (at A3)

Metres
0 500 1,000 1,500 2,000 2,500

Cardno

Map Produced by Cardno Wollongong
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Coordinate System: Zone 56 MGA/GDA 94
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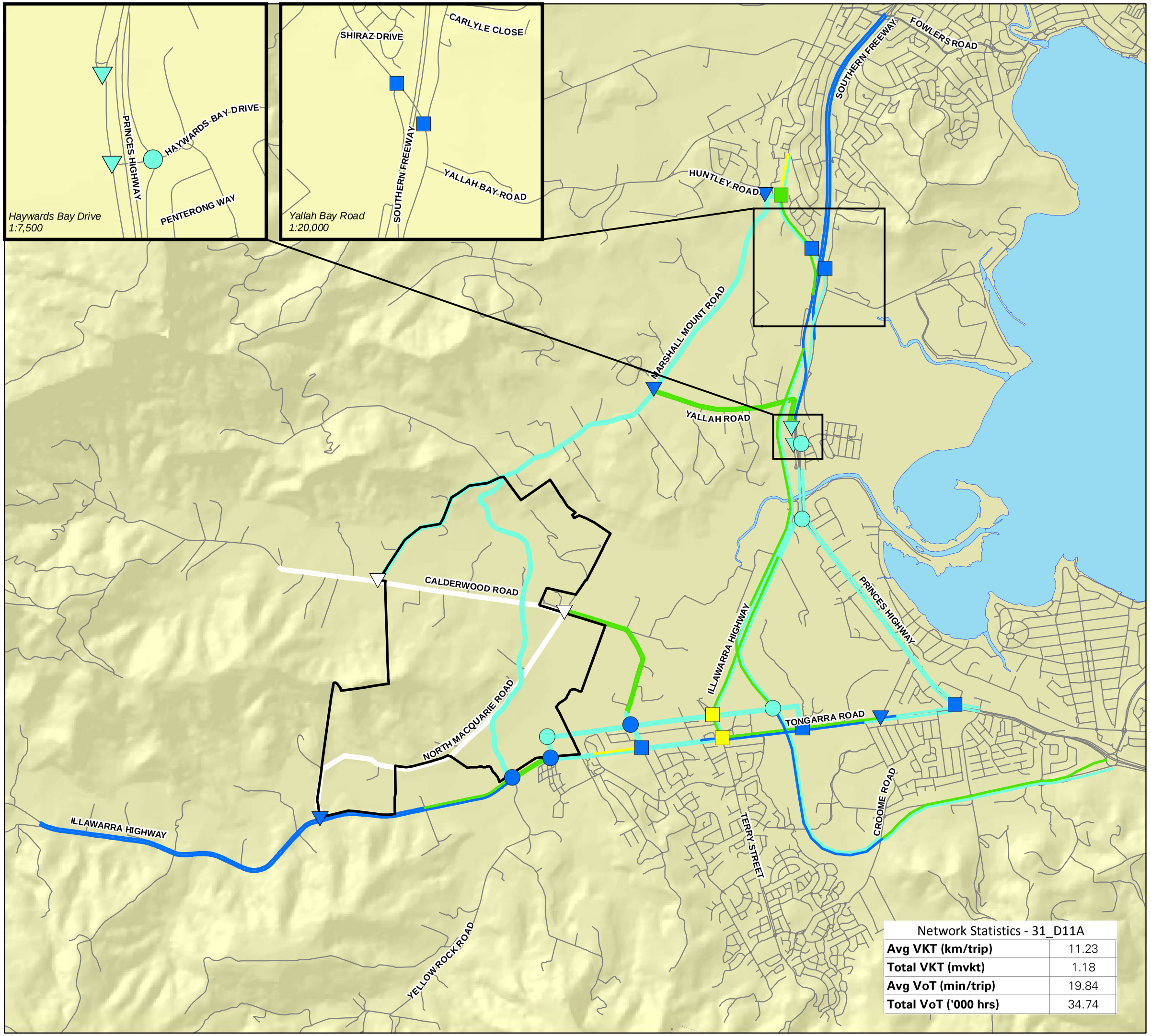


Network Statistics - 31_D11A	
Avg VKT (km/trip)	11.23
Total VKT (mvkt)	1.18
Avg VoT (min/trip)	19.84
Total VoT ('000 hrs)	34.74

Delfin Lend Lease

Figure 7.19

Road Network Performance AM Peak 2031 CUDP 'Do Base Upgrades' Mode Shift

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

Model Ref No.: 31_D11

- Site Boundary
- Lake Illawarra (LPMA)
- Local Roads (LPMA)
- Mid-Block Road Sections
- Priority Control
- Roundabout
- Traffic Signals

Level of Service (LoS)

- No Data
- A
- B
- C
- D
- E
- F

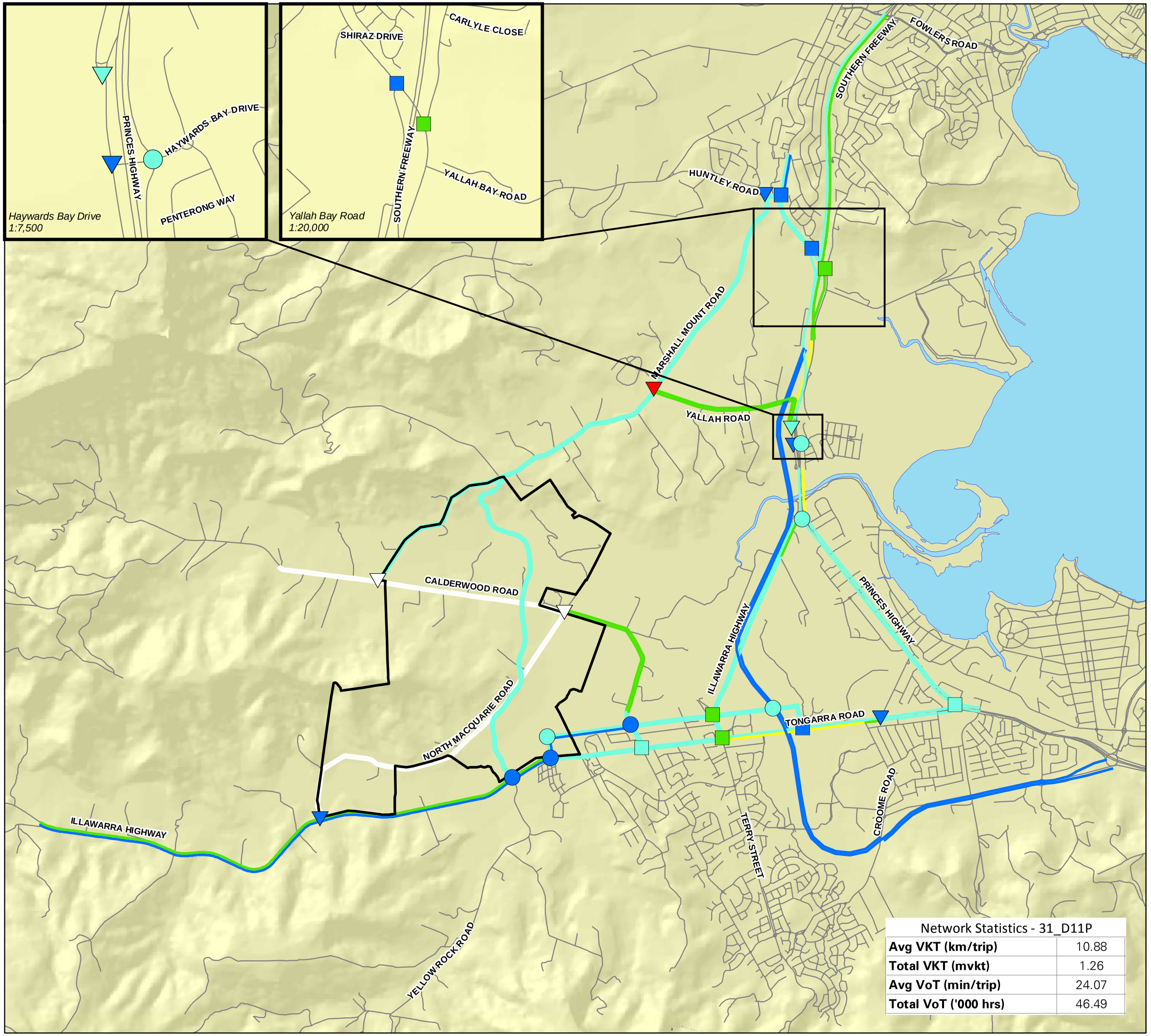
N W E S

Scale 1:40 000 (at A3)

Metres
0 500 1,000 1,500 2,000 2,500

Cardno

Map Produced by Cardno Wollongong
Date: 21 January 2010
Coordinate System: Zone 56 MGA/GDA 94
GIS MAP REF: 110026-01_58038_KeyRoutes_LevelOfService_31_D11A.mxd 04



Delfin Lend Lease

Figure 7.20

Road Network Performance PM Peak 2031 CUDP 'Do Base Upgrades' Mode Shift

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

Model Ref No.: 31_D11

- Site Boundary
- Lake Illawarra (LPMA)
- Local Roads (LPMA)
- Mid-Block Road Sections
- Priority Control
- Roundabout
- Traffic Signals

Level of Service (LoS)

- No Data
- A
- B
- C
- D
- E
- F

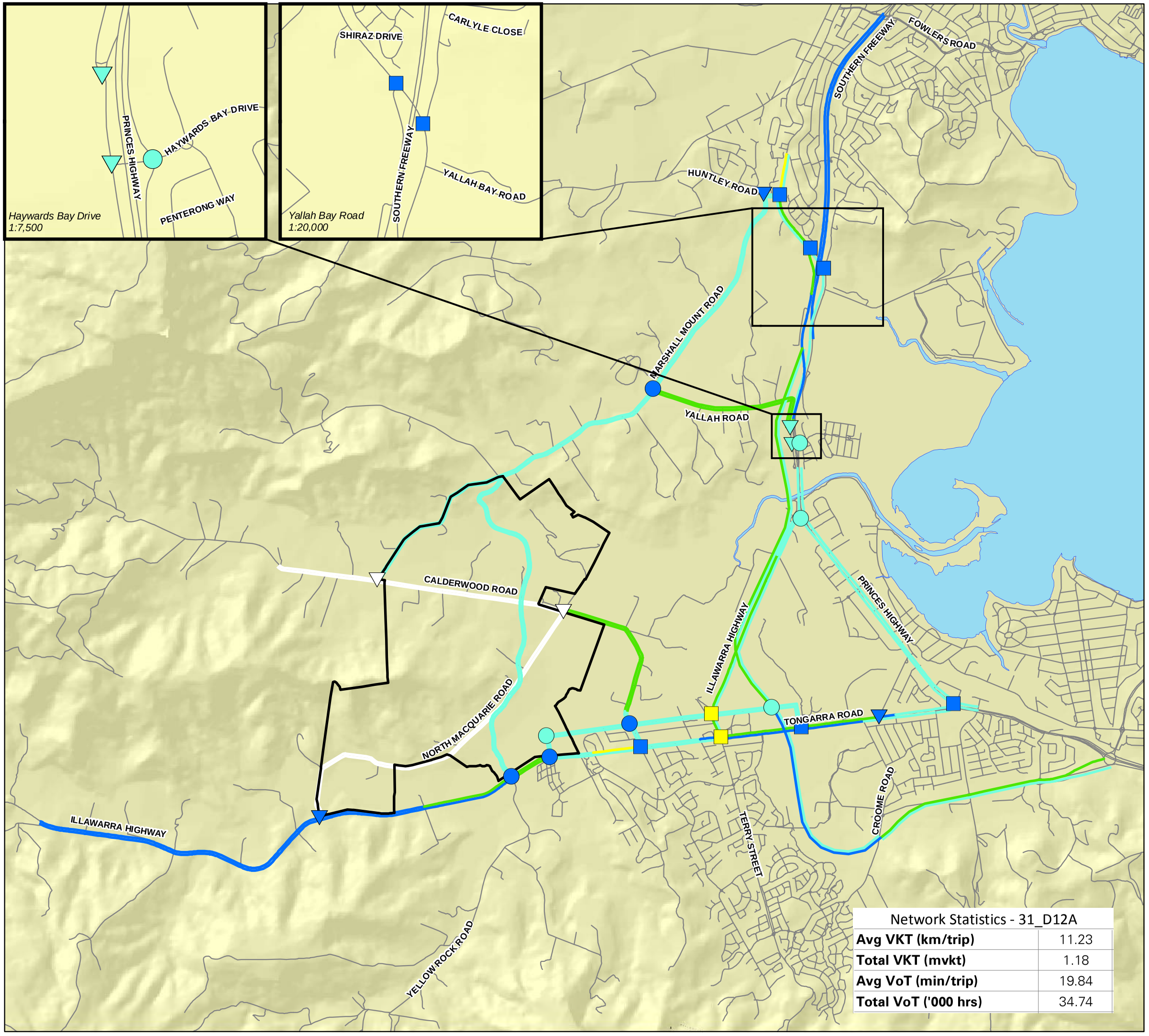
N W E S

Scale 1:40 000 (at A3)

Metres
0 500 1,000 1,500 2,000 2,500

Cardno

Map Produced by Cardno Wollongong
Date: 21 January 2010
Coordinate System: Zone 56 MGA/GDA 94
GIS MAP REF: 110026-01_58039_KeyRoutes_LevelOfService_31_D11P.mxd 04



Delfin Lend Lease

Figure 7.21

Road Network Performance AM Peak 2031 CUDP 'Do Full Development Upgrades' Mode Shift

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

Model Ref No.: 31_D12

- Site Boundary
- Lake Illawarra (LPMA)
- Local Roads (LPMA)
- Mid-Block Road Sections
- Priority Control
- Roundabout
- Traffic Signals

Level of Service (LoS)

- No Data
- A
- B
- C
- D
- E
- F

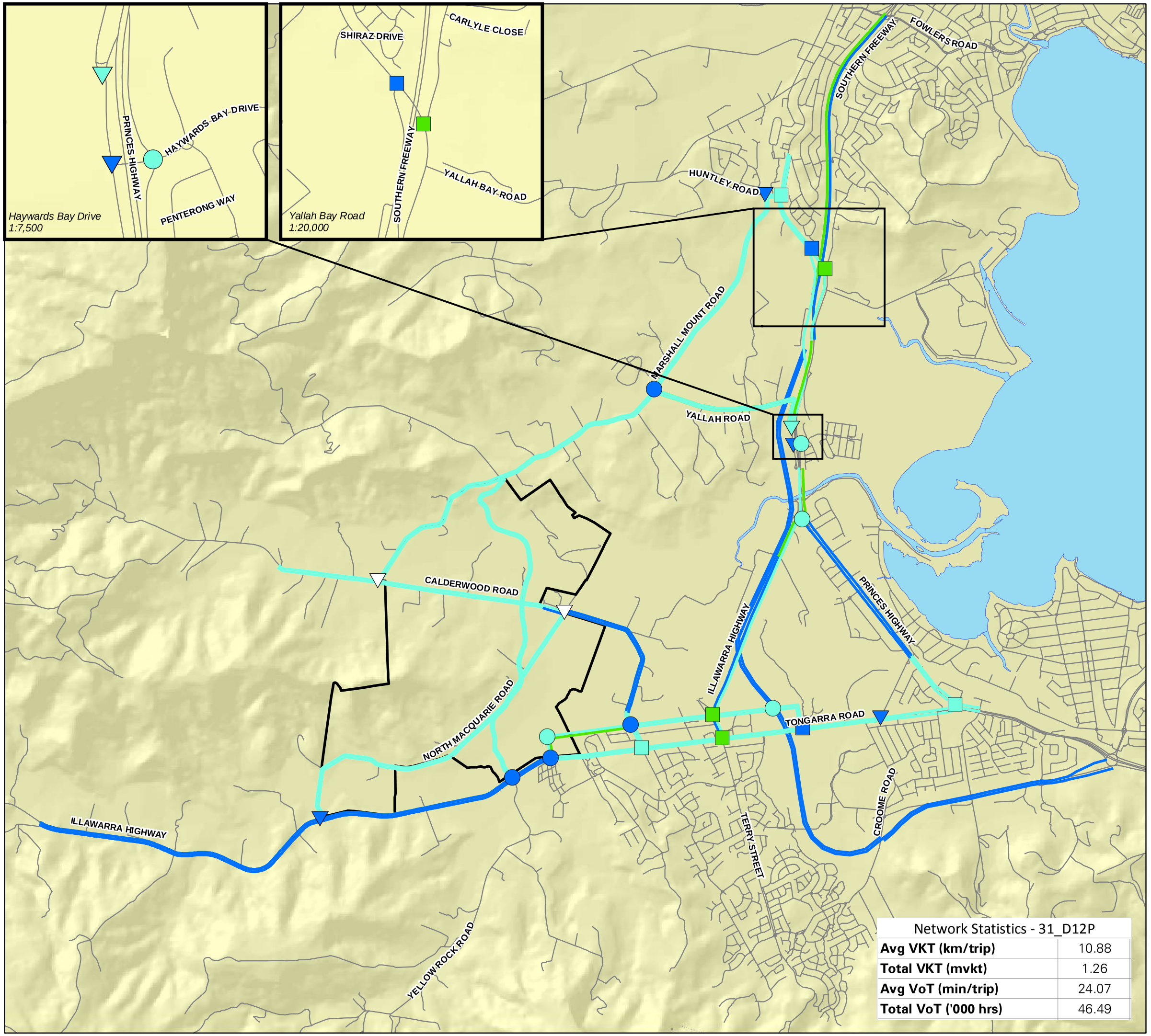
N W E S

Scale 1:40 000 (at A3)

Metres
0 500 1,000 1,500 2,000 2,500

Cardno

Map Produced by Cardno Wollongong
Date: 21 January 2010
Coordinate System: Zone 56 MGA/GDA 94
GIS MAP REF: 110026-01_58040_KeyRoutes_LevelOfService_31_D12A.mxd 04



Network Statistics - 31_D12P	
Avg VKT (km/trip)	10.88
Total VKT (mvkt)	1.26
Avg VoT (min/trip)	24.07
Total VoT ('000 hrs)	46.49

Delfin Lend Lease

Figure 7.22

Road Network Performance PM Peak 2031 CUDP 'Do Full Development Upgrades' Mode Shift

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

Model Ref No.: 31_D12

- Site Boundary
- Lake Illawarra (LPMA)
- Local Roads (LPMA)
- Mid-Block Road Sections
- Priority Control
- Roundabout
- Traffic Signals

Level of Service (LoS)

- No Data
- A
- B
- C
- D
- E
- F

N W E S

Scale 1:40 000 (at A3)

Metres
0 500 1,000 1,500 2,000 2,500

Cardno

Map Produced by Cardno Wollongong
Date: 21 January 2010
Coordinate System: Zone 56 MGA/GDA 94
GIS MAP REF: 110026-01_58041_KeyRoutes_LevelOfService_31_D12P.mxd 04

08

Non-Private Motor Vehicle Transport

8.1 INTRODUCTION

At full development the residents and visitors to Calderwood will be provided with the transport infrastructure and public transport options to meet the mode share target of 10% shift to non personal motor vehicle trips during the peak periods.

There are no set guidelines for quantifying the level of non-motorised trip generation resulting from new developments; however it is possible to estimate this level of generation if one considers the vehicle trip generation rate resulting from the TRACKS model assessment and assuming that an additional 10% of peak hour trips are generated by non-car based modes.

Table 8.1 Peak Hour Trip Generation

Mode	Trip Generation	Proportion
Private Vehicle	3200	80%
Non Private Vehicle	800	20%
Total	4000	100%

Table 8.1 shows the total peak hour trip generation with mode shift for the Calderwood development. This was calculated by taking the trip generation rate in the TRACKS model and assuming that this is 80% of all trips generated.

The resulting 800 non-private vehicle trips will be making both external and internal trips across the area. To estimate the split of these trips between public transport, cycling and walking it is necessary to make a comparison of similar sites in close proximity to Calderwood with similar infrastructure provisions. This was done by comparing the results of the JTW travel behaviour data.

Table 8.2 Non PMV Mode Share of Local Sites

	From	To	Both
Train	42%	14%	33%
Bus	9%	6%	8%
Other	48%	79%	59%

Table 8.2 indicates that in the surrounding areas of Albion Park, Haywards Bay and Yallah that the non-car based modal split for departing trips is fairly well balanced between public transport (train and bus) and other modes including cycling and walking.

As the Calderwood site is not within walking distance from any rail station it is fair to assume that the majority of PT trips made will be predominantly bus trips, but there will be some combined trips where people may travel by bus from Calderwood to the local railway stations. Similarly, some cycle trips may also transfer to rail at key interchanges.

In addition to the trips made during the peak periods there will also be a considerable number of local trips made throughout the day for other purposes such as:

- Retail.
- Healthcare.
- Recreational.
- Educational.
- Personal Business.

Quantifying these trips for the purposes of planning infrastructure is not necessary as the peak hour movements will be larger and in a relatively low density development area such as the CUDP the pedestrian and cycle volumes will rarely require additional capacity over and above design standards.

The approach to pedestrian, cycle and bus infrastructure design for the Calderwood development will be to over-provide so that the best possible facilities are implemented, thereby offering the opportunity for the community to change their travel behaviour.

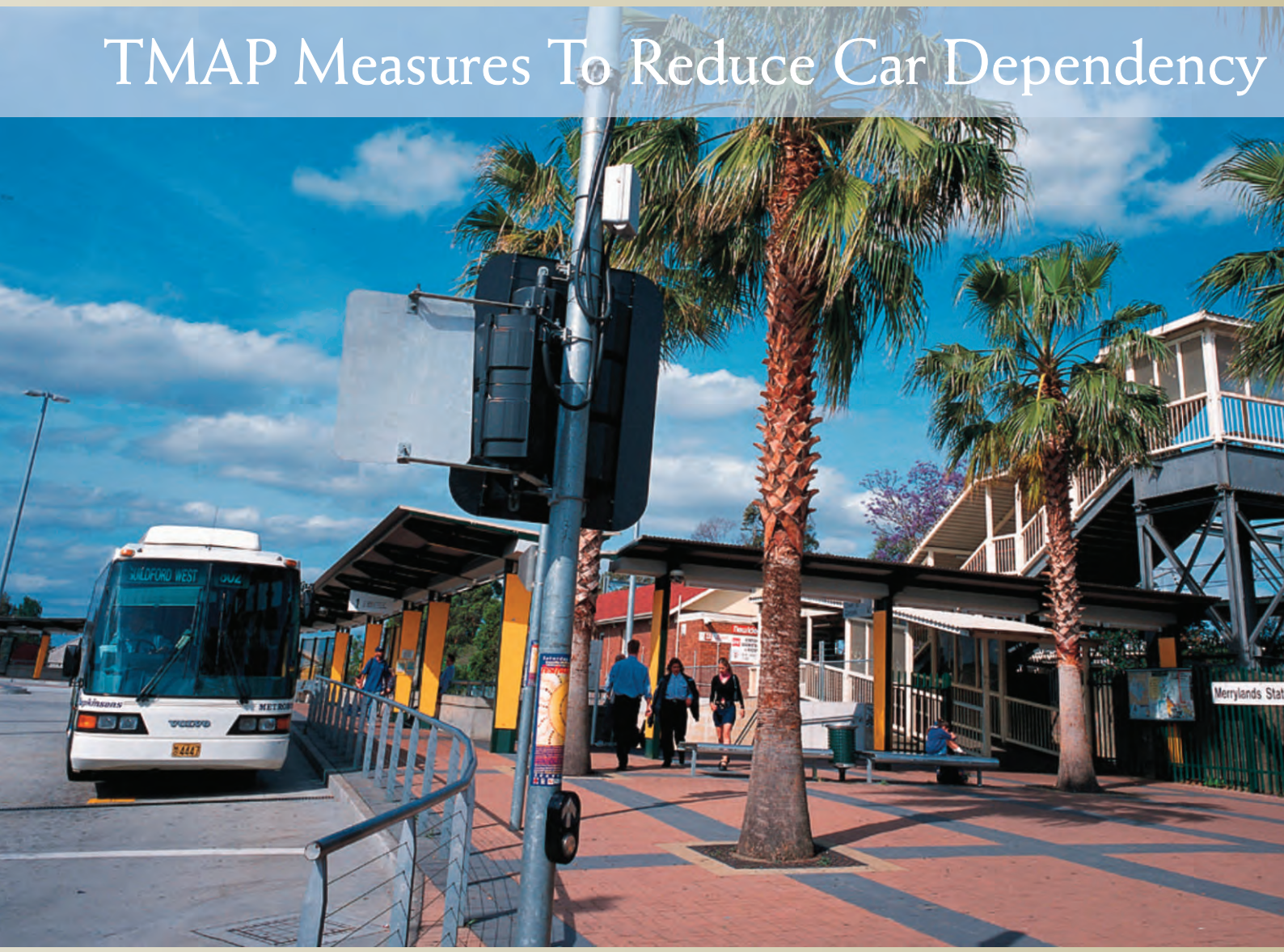
The high activity areas around the village centres will be designed around the fundamentals of:

- Accommodating Pedestrian desire lines.
- Providing safe cycle facilities.
- Making public transport access and interchange as simple as possible.

Section 9 goes into more detail and describes the measures and initiatives proposed for the Calderwood site that will allow for the modal shift in travel behaviour.

09

TMAP Measures To Reduce Car Dependency



9.1 INTRODUCTION

A package of measures has been developed in the following section which, when implemented, will make a significant contribution to the sustainability of the Calderwood development. The development is aiming to achieve high levels of sustainable operation and a significant element of this sustainable operation will be the transport network and infrastructure in place, as well as the travel behaviour of the residents and employees of the area. Given the primarily residential nature of the development, the key challenge is to ensure that a high level of self containment is achieved, to prevent the area from emerging as a dormitory suburb for Wollongong or Sydney.

The following measures have been developed under the broad headings of:

- Travel demand management measures.
- Active transport (walking and cycling) measures.
- Public transport (bus) measures.

This section provides some background analysis to sustainability measures, outlines the proposed travel demand management measures and provide a suggested timing for implementation.

9.2 BACKGROUND TO SUSTAINABILITY MEASURES

The scope with which individual developments can help achieve sustainable transport outcomes has to be considered as a single element in a more complex whole of network approach. Sustainable transport initiatives can be implemented on a precinct by precinct basis as new land uses develop although for meaningful area wide impacts to reduce both reliance and ultimately the number of private vehicle trips on the road system requires a whole of government approach. More meaningful policy levers to drive sustainable transport are the responsibility of Government to drive change at a strategic level.

DLL are committed to helping achieve more sustainable travel at a local level by implementing the measures described in Section 3.1 ad 3.2.

Appendix 9-A provides an overview of potential travel demand management measures that have been reviewed.

9.3 PROPOSED TRAVEL DEMAND MANAGEMENT MEASURES

A fundamental approach in the development of the CUDP area should be based on Traditional Neighbourhood Design (TND). As opposed to Conventional Suburban Development (CSD) which separates uses and encourages a car based society, traditional neighbourhood design mix uses and TND principles centre on providing community design which is pedestrian based.

Measure 1: Timely Provision of Facilities and Services

Timely provision of facilities for the CUDP - including community, retail, learning, employment and recreation facilities. The delivery of these essential services and facilities early in the life of the project ensures that residents have access to services and facilities when they need them, thus establishing a more sustainable walking, cycling and public transport usage behaviour for residents.

Measure 2: Fibre to the Home (FttH) and National Broadband Network

Incorporate FttH in the delivery of homes to provide opportunities for residents to work from home and facilitate communication between businesses without needing to travel outside the development. Consistent with the principles of the national broadband network.

Measure 3: Website/Community Portal

Establish community website/portal to facilitate promotion of public transport information, initiatives, events and activities for residents and workers. The website could provide links to local service providers as appropriate.

Measure 4: Resident Kits

Incorporate public transport information, including public transport route maps and timetables, hike and bike trail maps, fitness trail maps and sustainable community initiatives as part of Resident Kits. Sustainable community initiatives to be investigated may include car pooling, bike pooling, bike hire schemes, etc as appropriate. Kits are distributed to households as they move into the development.

Measure 5: Promotions

Promotion of public transport initiatives via Community Portal, Resident Kits, Community Events and Activities. Promotion of significant relevant sustainable transport events eg. 'cycle to work' day.

Measure 6: Public transport incentives

Investigate with State Government and local transport providers (Premier Illawarra) public transport incentive schemes to encourage resident and worker take up of public transport.

Measure 7: Land Use/Transport Interaction

A mixed-use approach to all areas of the project built within a street and pedestrian framework based on a modified grid. The following key elements support this measure:

- Walking and cycling networks designed to provide for both commuter and recreation users linking key amenities within the Calderwood project as well as providing access to existing neighbouring facilities.
- A diversity of land uses and housing types across the project to accommodate a diverse population.
- Engaging and active streets that provide a positive experience for the users particularly along primary pedestrian and cycle corridors.
- Crime Prevention Through Environmental Design (CPTED) principles applied to provide a greater sense of safety through passive surveillance of streets, parks and other areas of open space.
- Establish a sub network of lit paths to provide for safer walking and cycling after dark.
- Locate key amenities to maximise walkable access.
- Holistic approach to the design of the street network, carefully balancing the needs for vehicle movement with the needs of pedestrians and cyclists. This has to be considered at all levels of the design from parking requirements and intersection function down to the detail of path materials and kerb radii to ensure the whole movement system supports a balanced approach.

Table 9.1 Summary of Proposed Measures

Measure Number	Measure	Timing	Comment
Measure 1	Timely Provision of Facilities and Services	Pre-development	Measures to be considered by design team
Measure 2	Fibre to the Home (FttH) and National Broadband Network	From start of construction and ongoing	Consistent with the principles of the NBN
Measure 3	Website/Community Portal	Commencement of residential habitation, then ongoing	
Measure 4	Resident Kits	Commencement of habitation	Alternative travel information

Measure Number	Measure	Timing	Comment
Measure 5	Promotions	Commencement of residential habitation, then ongoing	
Measure 6	Public transport incentives	commencement of residential habitation, then ongoing	Subject to discussions with state government and transport providers
Measure 7	Land Use/Transport Interaction	Pre-development	Measures to be considered by design team

9.4 ACTIVE TRANSPORT PRINCIPLES

A wide range of active transport measures will be implemented to take advantage of the layout and design of the precincts, which will assist in the encouragement and support of active transport for commuting, recreation and other travel needs.

Measure 8: Local Access Street Design

A holistic approach will be taken to balance all users of the local streets and will include sufficient space to provide a high level of pedestrian amenity. This will include appropriate pavement designs, traffic calming, signage and speed limits as well as built-form controls on adjacent parcels to create a cohesive and robust environment. On some streets with high pedestrian volumes, further measures will be incorporated to enhance the pedestrian environment through the landscape treatment, driveway access controls and other measures to encourage pedestrian priority.

Measure 9: Pedestrian and Cycle Hierarchy

The network established for Calderwood will link all areas of the project with key amenities including open spaces, schools and the facilities in the Town and Village Centres. A hierarchy of paths will be used to create enhanced corridors providing a greater level of amenity for both pedestrians and cyclists. The path network will make extensive use of the open space areas, linkage corridors (including the linear riparian corridors), collector and arterial roads, and pedestrian priority streets. After dark usage will also be facilitated on key paths to further encourage the safe usage of this network.

Measure 10: Wayfinding Signage

The way-finding strategy will be designed to complement the interpretive strategy and will be implemented progressively as the project is built. The signage needs to indicate access routes for the amenities in the project as well as facilities in neighbouring areas. The signage system needs to be clear and co-ordinated and present information on distances, times and accessibility where relevant.

Measure 11: Parking Strategies

Parking in the Town and Village Centres will be co-ordinated and where possible shared across uses. This, along with possible time restrictions and extensive on-street parking, will create more walkable centres. The establishment of a shared parking district could also be considered in the Town Centre to further reduce the parking requirements and to encourage a park once attitude when undertaking multiple activities in the Town Centre.

Measure 12: Safety Elements for Network

Crime Prevention Through Environmental Design (CPTED) principals will be applied where possible to all trails and paths in the network. A sub network of lit paths will be provided to encourage after-dark pedestrian and cycle access. Other amenities will be considered as part of the network including water supply, seats, bike racks, and shade structures where appropriate.

Measure 13: Bicycle Parking

To facilitate cycle usage throughout the project, bicycle parking will be provided in close proximity to the schools and sports ovals, in the Town and Village Centres and will be encouraged as part of the development of employment and other commercial uses. Other areas of key Open Spaces will also have bicycle parking.

Table 9.2 Summary of Active Transport Measures

Measure Number	Measure	Timing	Comment
Measure 8	Local Access Street Design	Pre-development construction	Street design to signal the equal use of the street space by all
Measure 9	Pedestrian and Cycle Hierarchy	Pre-development construction	Determine widths, network, connectivity and implementation
Measure 10	Wayfinding Signage	Predevelopment construction, construction in similitude with staged development	To be consistent, legible and implemented throughout the development
Measure 11	Parking Strategies	Pre-development and ongoing	
Measure 12	Safety Elements for Network	Coincide with staged development	Timed with network implementation
Measure 13	Bicycle Parking	Coincide with staged development	Locations identified in design stage

9.5 PUBLIC TRANSPORT PRINCIPLES

9.5.1 Network Goals

There are two competing goals for a public transport network in lower density environments; patronage goals and coverage goals. Coverage-related goals are met when public transport is available within a certain distance of a prescribed percentage of homes, regardless of whether it is used or not. These goals are expressed in the Outer Metropolitan Service Planning Guidelines as generally 400 metres as the crow flies to a bus route during the daytime. This guideline attempts to ensure that basic mobility is provided to persons who are unable to drive. In contrast, patronage-related goals are met when public transport is used and are met, to a higher degree, the more it is used. It has been widely observed that to attract patronage in a low density area, public transport services need to be frequent, fast and direct.

The service frequency is particularly important in order to reduce waiting time and provide some travel flexibility to mirror the 'go anywhere, anytime' flexibility of the private vehicle. The service frequency is a particularly important factor when transfers between services are required as part of a journey, as the headway between services increase the time, reliability and inconvenience penalties. In a low-density environment, there is often the desire to expand the catchment of these services to increase potential patronage which results in circuitous and time-consuming routes which are unattractive to discretionary users. Bus networks require the development of a balance of these to ensure that the bus routes provide attractive coverage, frequency and travel times.

Another consideration of network planning is to minimise the number of transfers between services required to reach key destinations without unnecessary duplication, and consequently inefficiencies, of resources along common corridors. It is inevitable that any public transport network seeking to serve more than a small percentage of journeys without operating circuitous and time consuming routes must incorporate easy transfers between services. It is with these factors in mind that the proposed network has been developed.

9.5.2 Network Concept

The most important part of the network is the frequent and direct services, i.e. those which will attract discretionary users, facilitate a greater confidence in public transport and potentially avoid the need for households to purchase additional private vehicles. These services will have the most impact on positively addressing growth in private vehicle usage and the consequent growth in traffic, noise and pollution.

For the frequent services, a corridor was identified through the CUDP (herein referred to as the Strategic Bus Corridor) which would provide access to a significant portion of the CUDP, as well as being reasonably direct for journeys between Calderwood and neighbouring centres such as Dapto, Albion Park and Shellharbour. This corridor is located generally along the proposed North South Arterial.

It has been widely observed[6] that waiting time is a significantly higher disincentive to public transport use than in-transit time. The guideline often used in public transport planning is that one minute spent in-transit is equivalent to two minutes spent waiting for the service to arrive. For this reason it is desirable and appropriate to provide a high frequency service with a slightly longer travel time. This principle has been applied to the routing of the Strategic Bus Corridor; the routing via the North South Arterial is longer than the routing via Calderwood Road, however the higher frequency and consequently reduced waiting time will make this service attractive to discretionary users.

North of the CUDP site, it is proposed that the Strategic Bus Corridor proceed northwards along Marshall Mount Road, Huntley Road and Princes Highway to Dapto and Wollongong. To the east of the CUDP site, it is proposed that the Strategic Bus Corridor proceed eastwards along Illawarra Highway, Tongarra Road and Princes Highway to Oak Flats interchange and then Shellharbour CBD. This Strategic Bus Corridor service could be implemented as an alternative to the existing 37/57 service along Princes Highway which has little opportunity to generate passenger numbers between Dapto and Oak Flats. It is considered that this area would be better served by a District Route running from Dapto to Shellharbour CBD via Compton Street, Cormack Avenue, the future Tallawarra development and Princes Highway.

Two lower order routes – classed as 'District Routes' - were then developed to link the remainder of the CUDP with Calderwood Town Centre and Albion Park. These two routes fulfil the coverage goals by bringing bus services within 400 metres of all dwellings. These services will run less frequently than the Strategic Bus Corridor. In conjunction with the Strategic Bus Corridor, the District Routes ensure that all dwellings are provided with a bus service to and from Calderwood Town Centre.

It is proposed that one District Route will service the northern residential areas of Calderwood and, including a loop in the south western area, will exit Calderwood via the residential area located in the south eastern corner, and then proceeding easterly along Illawarra Highway to Albion Park town centre. The other District Route will leave the CUDP via Calderwood Road, also extending to Albion Park town centre.

There is potential for both District Routes to be extended beyond Albion Park town centre to destinations such as Albion Park Railway Station or Shellharbour CBD. However, it is considered that the Strategic Bus Corridor (six services per hour during the daytime) and the existing routes serving Albion Park (1-2 services per hour during the daytime) will provide adequate capacity along the Albion Park – Oak Flats interchange – Shellharbour CBD corridor. A common pair of bus stops on Illawarra Highway at Albion Park town centre would facilitate easy transfers between District Routes and the Strategic Bus Corridor, as well as catering for multi-purpose journeys (e.g. grabbing a coffee and newspaper in the morning, or shopping/dinner in the evening).

[6] ACT Strategic Public Transport Network Plan , (McCormack, Rankin & Cagney, June 2009)

A proposed network, including both internal and external connections, has been designed to provide a legible route hierarchy with clear levels of service based on this hierarchy. Potential passengers will be able to easily plan their journeys based on knowledge of service frequency, operating hours and required transfers. Figure 9.1 illustrates the conceptual layout of the bus network, identifying key destinations accessed by the proposed bus network and the number of changes required.

Figure 9.1 Conceptual Bus Network

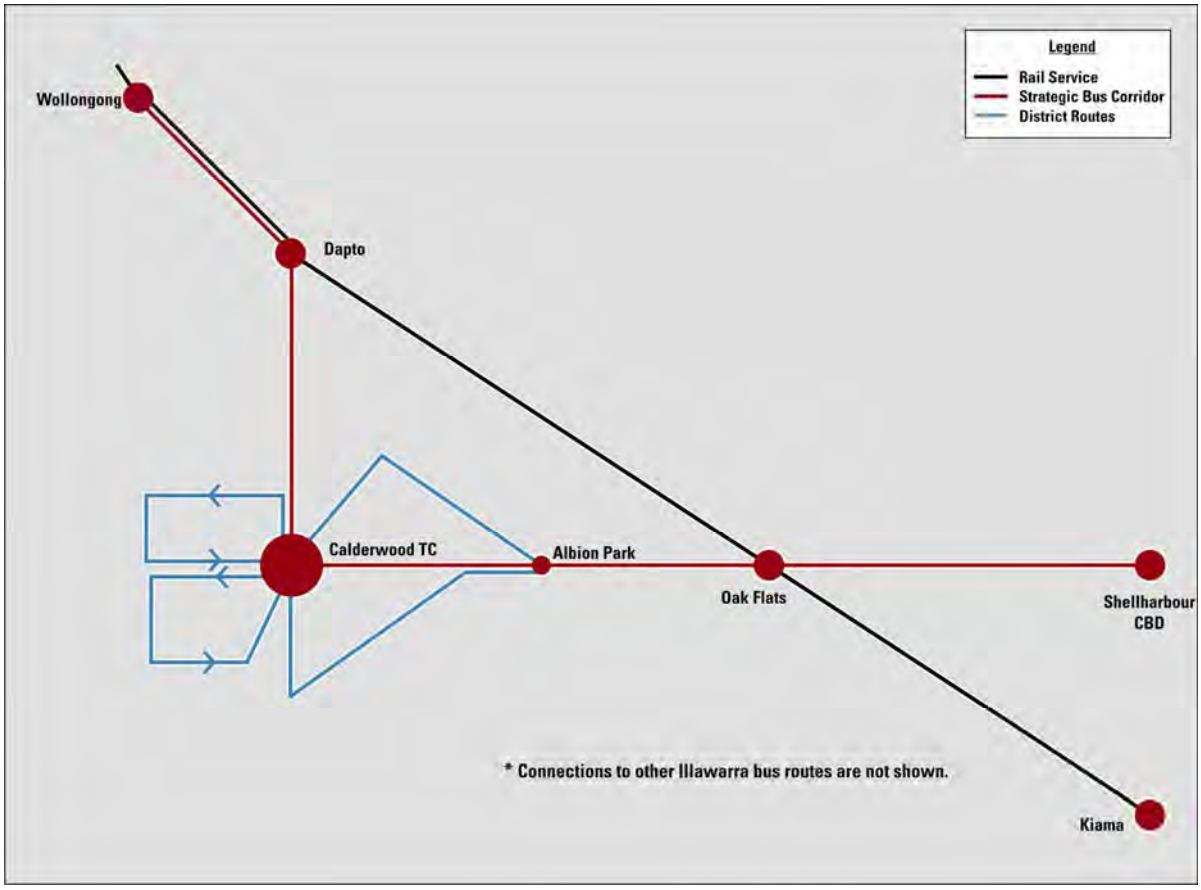


Figure 9.2 presents the proposed bus network relative to the concept plan. Table 9.3 summarises the number of changes required to reach key destinations.

Table 9.3 Summary of transfers required to reach key destinations based on route hierarchy

Service Type	Key destinations reached via:		
	No transfers	1 transfer	2 transfers
Strategic Bus Corridor	↘ Wollongong ↘ Dapto ↘ Calderwood Town Centre ↘ Albion Park ↘ Shellharbour CBD	↘ Sydney ↘ Any other destination in the Illawarra Region	N/A
District Routes	↘ Calderwood Town Centre ↘ Albion Park	↘ Wollongong ↘ Dapto ↘ Shellharbour CBD	↘ Sydney ↘ Any other destination in the Illawarra Region

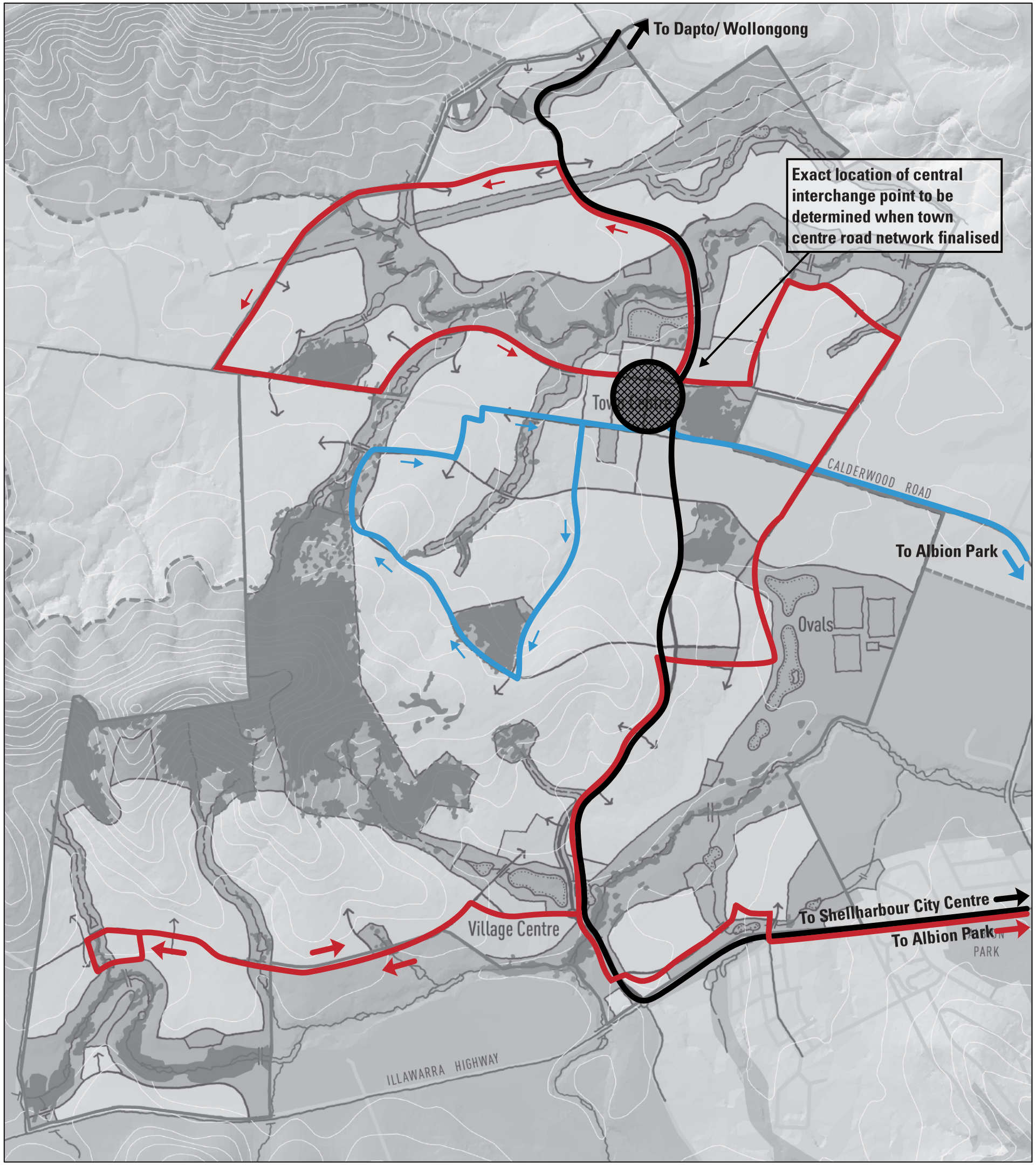


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Figure 9.2

Indicative Bus Network

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

- Strategic Bus Corridor
- Local Route 1
- Local Route 2

All buses operate in both directions unless otherwise noted.

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The table and figure preceding show that both Albion Park and Calderwood Town Centres are accessible from all parts of the CUDP via a single-seat journey. Key regional centres including Dapto, Wollongong, and Shellharbour CBD are accessible via a single-seat journey from within the walking catchment of the Strategic Bus Corridor or, in the worst case scenario, via a single transfer to a frequent SBC service at either Calderwood or Albion Park town centres. In the **worst case scenario**, a potential public transport user may need to make **two transfers** to reach a destination in the Illawarra Region. However, for the **vast majority of journeys**, a **maximum of one transfer** will be required and many journeys will need no transfer. Extending both District Routes to Shellharbour CBD would further increase the journeys which could be made with no transfer required; however this should be balanced against the loss of efficiency resulting from the unnecessary duplication of services between Albion Park and Shellharbour.

Measure 14: Bus Network Provision

A hierarchy of bus routes should be developed and implemented as outlined in Section 9.5.2.

9.5.3 Walking Catchments

NSWTI states that the typical criteria used for walking catchments to public transport services is between 400 and 500 metres during the daytime.[7] Figure 9.3 illustrates that over 95% of the CUDP is within the 400 metre walking catchment of a bus stop, regardless of service level. The areas included in the 5% of the CUDP not within 400 metres of a bus stop included small portions of the extremities of south west, north-west and north-east areas. To re-route bus services to bring these areas within 400 metres of a bus stop would be very difficult, particularly in the north-east area, due to the layout of the road network. It is considered that the provision of a permeable pedestrian and cyclist network will ensure reasonable access to public transport services is available to these areas.

However, it is widely accepted that public transport users are willing to walk further to reach high quality (i.e. frequent, fast and direct) public transport services than the traditional 400 metre/5 minute walk catchment which is based on low service levels. Transportation Research Board (USA) research has indicated that the distance where walking is the dominant access mode to public transport services can vary from the traditional 400 metres to 800 metres or even 1.2 kilometres.

In order to assess the potential catchment of the Strategic Bus Corridor, 800 metre circular buffers were placed around indicative bus stop locations along the corridor. A detailed road network for each precinct has not yet been determined and, as such, minimising the walking distance to bus stops will be a key consideration. In the absence of a detailed road network, it is considered that the circular buffer is acceptable as an indicative measure of walking catchment. Figure 9.4 illustrates the 800 metre walking catchment of the Strategic Bus Corridor stops compared with the 400 metre catchments of bus stops serving the District Routes.

The figure shows that approximately 68% of the CUDP is within the 800 metre walking catchment of a Strategic Bus Corridor stop. The remainder of the CUDP is within 400 metres of a District Route bus stop, meeting the coverage targets set out in the *Outer Metropolitan Service Planning Guidelines*. Consequently, it is expected that able-bodied public transport users will be attracted to the Strategic Bus Corridor due to the higher level of service. The potential exists to encourage the use of cycling to further increase the catchment of the Strategic Bus Corridor stops through the provision of adequate bicycle parking facilities, particularly in Calderwood Town Centre and the Village Centre. Both these locations are well placed for encouraging multi-purpose trips and increasing the catchment of the Strategic Bus Corridor.

[7] Outer Metropolitan Service Planning Guidelines (NSW Transport & Infrastructure, November 2009)

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Figure 9.3

Indicative Bus Routes and Walking Catchments

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

- Site Boundary
- Potential Bus Stops
- Potential Bus Route
- 400m Buffer from Bus Stops

95% of Developable Area within 400m of Potential Bus Stop Locations

N
W E
S

Scale 1:15 000 (at A3)

Metres

0 250 500 750 1,000

Cardno

Map Produced by Cardno Wollongong
Date: 17 February 2010
Coordinate System: Zone 56 MGA/GDA 94
GIS MAP REF: 110026-01_58020_IndicativeBusLayout.mxd 06

Aerial imagery supplied by AAM Hatch (2001)
Concept Base Plan from Delfin Lend Lease - February 2010

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Figure 9.4

Indicative Bus Routes and Expanded Walking Catchments

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

- Site Boundary
- Potential Bus Stops
- SBC Potential Bus Stops
- Potential District Bus Route
- Strategic Bus Corridor (SBC)
- District Route 400m Buffer
- Strategic Bus Corridor 800m Buffer

68% of Developable Area within 800m of Strategic Bus Corridor Bus Stop Locations

N
W E
S

Scale 1:15 000 (at A3)

Metres
0 250 500 750 1,000

Cardno

Map Produced by Cardno Wollongong
Date: 17 February 2010
Coordinate System: Zone 56 MGA/GDA 94
GIS MAP REF: 110026-01_58021_StrategicBusCorridor.mxd 06

Aerial imagery supplied by AAM Hatch (2001)
Concept Base Plan from Delfin Lend Lease - February 2010

9.5.4 Service Frequency and Operating Hours

The service frequency and operating hours for the proposed network have been developed in recognition of the following factors:

- Frequent services are required to attract discretionary users and six services per hour is widely considered as the minimum frequency for a turn-up-and-go service.
- The existing levels of service provided in the Illawarra region have clearly failed to develop any significant public transport ridership.
- The Calderwood area is likely to be settled by families, whose children (including teenagers) will require public transport services to transport them to school and social, employment and recreation activities.
- There is a significant volume of commuters to Sydney from the Illawarra Region and consequently the bus network should cater for early morning and late evening journeys.
- The CUDP is located remote from existing night-time entertainment spots such as Wollongong CBD and as such late night outbound services are desirable on Friday and Saturday nights.

The proposed bus network level of service is provided in Table 9.4.

Table 9.4 Proposed Bus Network Level of Service

Service	Route Classification	NSWTI Service Planning Guidelines	Proposed Service Level	Comments
Strategic Bus Corridor	Regional Route	**Weekdays** ▪ Pre Peak: 60min ▪ Peak: 30min ▪ Inter-peak: 30min ▪ Night: 60min	**Weekdays** ▪ Pre-peak: 30min (northbound services timed to meet Sydney trains at Dapto) ▪ Peaks: 10min ▪ Inter-peak: 10min ▪ Night: 30min from 8:30pmto 10:30pm, hourly until 11:30pm (operates hourly all night on Fridays)	Exceeds standards. Provides an attractive base level of service throughout the day linking large catchment area with major centres.
		Weekends ▪ Saturday: 60min ▪ Sunday: 60min	**Weekends** ▪ Saturday: 10min (8:00am-7:00pm) ▪ Saturday evening: 30min until 10:30pm then hourly all night ▪ ▪ Sunday: 30min daytime ▪ Sunday evening: 60min from 7:00pm to 10:30pm	Exceeds standards. Provides an attractive base level of service on Saturdays with late night transport option. Sunday service provides base level of service.
Local Route 1	District Route	▪ Peaks: 60min ▪ Inter Peak: 60min ▪ Saturday daytime: 60min ▪ Sunday daytime: 120 min	▪ Peaks: 20min ▪ Inter Peak: 60min ▪ Saturday: 60min ▪ Sunday: 60min	Complies with standards. Exceeds standards during peak periods to facilitate easier transfers and multi-purpose trips at Calderwood Town Centre.
Local Route 2	District Route	▪ Peaks: 60min ▪ Inter Peak: 60min ▪ Saturday daytime: 60min ▪ Sunday daytime: 120 min	▪ Peaks: 20min ▪ Inter Peak: 60min ▪ Saturday: 60min ▪ Sunday: 60min	Complies with standards. Exceeds standards during peak periods to facilitate easier transfers and multi-purpose trips at Calderwood Town Centre.

Measure 15: Service levels that meet and exceed NSWTI's *Outer Metropolitan Service Planning Guidelines*

The public transport network should be operated with service levels as outlined in Section 9.5.4, which meet and exceed NSWTI's guidelines.

9.5.5 Early Bus Service Provision

Bus services to the CUDP should be provided from the day that the first resident moves in. The staged development of Calderwood needs to take into account the opportunity to provide efficient bus services as the area develops. The road network should be designed and constructed such that initial bus services can enter and exit the Calderwood development via a different path at all times, avoiding unnecessary loops.

Measure 16: Early bus service provision

Work with State Government and local transport providers (Premier Illawarra) to enable provision of early bus services for the development. Bus services to the CUDP should as a minimum be available from date of first resident moving in, with staging of the development designed to facilitate efficient bus services at all times, subject to negotiations with NSWTI and premier Illawarra.

9.5.6 Branding and Publicity

It is important that this bus network with appropriate branding of service levels be made available to future purchasers. This will allow future Calderwood residents to choose a home location which factors in their choice of lifestyle, such as a greater dependence on the use of public transport. This is a self-fulfilling cycle, i.e. people with the desire to have a higher dependence on public transport can locate adjacent to the frequent services, improving the economic viability of these services and allowing the concentration of public transport resources in the area where it will be most utilised and most cost-effective.

NSWTI should be approached to participate in the branding process. This would provide the opportunity for a consistent brand to be developed for the different levels of service and applied across the Illawarra Region (e.g. Melbourne's 'Smart Bus' branding).

Measure 17: Branding and Publicity

A clear map identifying the proposed bus route hierarchy and indicative stop locations should be made available to purchasers. DLL should make representations to NSWTI and Premier Illawarra to urge the development of a branding strategy based on public transport levels of service.

9.5.7 Bus Stop Infrastructure

Bus stops within the CUDP will be provided with a base level of infrastructure. The facilities at each of the identified bus stops will be determined taking into account surrounding land uses, frequency of bus services, potential patronage and ranking of the stop. Bus stops will be provided with facilities which may include the following:

- Timetable.
- Network map.
- Seat.
- Shelter.
- Bicycle parking rail.

Measure 18: Bus Stop Infrastructure

A hierarchy of bus stops should be developed and implemented as outlined in Section 9.5.2 and 9.5.3.

9.5.8 Bus Priority Infrastructure

All signalised intersections on bus routes within the CUDP will be provided with bus priority where appropriate.

Calderwood town centre will be designed to provide buses with priority access through the centre, including the bus interchange. A detailed design will be developed with the aim of reducing the delay to through passengers as much as practical whilst still providing adequate penetration into the town centre.

Bus queue jumps are proposed on the external road network at the following intersections in order to maintain reliability and speed of bus services: These facilities will be required to be developed as traffic volumes on the existing road network increase:

- Princes Highway/Huntley Road – southbound.
- Huntley Road/Marshall Mount Road – northbound.
- Marshall Mount Road/Yallah Road – northbound and southbound.
- Illawarra Highway/Calderwood Road – eastbound and westbound.
- Illawarra Highway/Tongarra Road/Terry Street – eastbound and westbound.
- Princes Highway/Tongarra Road – eastbound.

Where possible these should be provided as part of intersection upgrades as they occur. Further improvements to bus priority are considered to be outside the scope of the CUDP and will be the responsibility of NSWTI, Premier Illawarra and the RTA.

Measure 19: Bus Network Infrastructure

Bus queue jumps should be provided on approach to all signalised intersections within the CUDP, where appropriate. Calderwood town centre should be designed to provide buses with priority access through the centre, including the bus interchange. Bus priority measures should be provided along the Strategic Bus Corridor, as identified in Section 9.5.2.

9.5.9 External Public Benefits

As a function of the 'network effect', improvements to the wider public transport network in the Illawarra Region are required to realise the full potential public transport patronage. Similarly, the network improvements proposed as a result of the CUDP will contribute to increasing the network effect of the existing public transport and deliver considerable public benefits to areas outside of the CUDP.

The considerable public benefits associated with the recommended public transport network include:

- A substantial increase in service frequency and operating hours compared to existing public transport services in the Wollongong – Figtree – Unanderra – Dapto corridor.

The provision of six services per hour along the Wollongong to Dapto corridor essentially creates a turn-up-and-go service for journeys along the corridor. Combined with existing services, an approximately five-minute headway is provided throughout the day for much of the corridor north of Figtree. This level of service will facilitate the future densification of development along this corridor and positively develop sustained public transport patronage growth in the Illawarra Region.

- A substantial increase in service frequency and operating hours compared to existing public transport services in the Albion Park – Oak Flats – Shellharbour CBD corridor.

Whilst the potential for densification in this corridor is limited by existing urban development, the substantial increase in frequency, operating hours and directness of route dramatically increases the attractiveness for journeys by public transport in this area. This corridor benefits from catering for both bus/rail interchange journeys (e.g. Albion Park to

Sydney or Sydney to Shellharbour CBD) as well as through journeys, allowing efficient concentration of resources with maximum patronage attraction.

- Improving the range of origins and destinations available to existing public transport users.

The provision of frequent services on the Dapto-Wollongong and Albion Park-Shellharbour CBD corridors will significantly reduce wait time and consequently improve the reliability of transfers and reduce door-to-door travel time. Consequently, this will bring a new range of trip origins and destinations within range of existing public transport users, widening the opportunities for economic participation for those who are unable to drive and who are dependent on public transport.

- Encouragement of mode shift in areas affected by the proposed network.

The proposed bus network will encourage mode shift towards public transport in areas external to the CUDP, such as Tullimbar, Albion Park, Shellharbour CBD, Dapto, Unanderra and Wollongong. This is mainly due to the vastly increased service frequency and directness of route provided by the proposed network. These increases reduce waiting time and consequently make public transport significantly more attractive.

- The loading of additional potential patronage onto the network to improve the utilisation of the existing services.

The loading of Calderwood journeys onto the public transport network will improve the utilisation and consequently the economic viability of relevant existing services, such as the Dapto to Wollongong and Albion Park to Shellharbour CBD services.

9.5.10 Network Development Opportunities

The proposed network adequately serves the CUDP, as well as providing considerable public benefits to other parts of the Illawarra Region. Opportunities also exist for others to build on this network in the future. Potential network improvements could include:

- Provide a bus interchange at Illawarra Highway/Broughton Avenue intersection to serve Tullimbar Village.
- Provide bus priority measures along Princes Highway north of Dapto.
- Improve Oak Flats bus/rail interchange to reduce the detour to through passengers.
- Relocate the Strategic Bus Corridor between Oak Flats interchange and Shellharbour CBD to increase potential patronage.

These suggestions are not endorsed by DLL but are provided to demonstrate that the proposed network is based on sound planning principles and can form the basis of a long term strategy for improvement of the public transport network in the Illawarra.

9.5.11 Public Transport Measures

Based on the preceding discussion, the following public transport measures are recommended for implementation as part of the CUDP.

Table 9.5 Summary of Public Transport Measures

Measure Number	Measure	Timing	Comment
Measure 14	Bus Network Provision	Implement SBC as soon as North South Arterial becomes available for traffic. Other routes to be implemented as road network is made available, with interim routings are necessary.	Coordination with NSWTI and Premier Illawarra will be required, including approximately 12 months lead time for the implementation of new routes.
Measure 15	Service levels that meet and exceed NSWTI's *Outer Metropolitan Service Planning Guidelines*	As soon as North South Arterial becomes available.	Frequent services will need to be provided as early as possible to encourage public transport usage and discourage the purchase of additional vehicles.
Measure 16	Early bus service provision	Immediately pre-habitation	Subject to discussions with state government and transport providers
Measure 17	Branding and Publicity	Pre-development/on-goiing.	
Measure 18	Bus Stop Infrastructure	Coincide with construction of relevant road network sections.	
Measure 19	Bus Network Infrastructure	To coincide with intersection upgrades.	

10

Road Infrastructure Improvements

10.1 INTRODUCTION

Regardless of the initiatives to improve public transport and active transport use, the development of the CUDP as well as other regional developments will result in increased usage of the road system. Forecasts of increases in traffic flows have been assessed through detailed modelling as described in the preceding chapters. These forecasts form the basis of the assessment of road infrastructure requirements.

The road network impact assessment included the following strategy for road network improvement within the CUDP area of influence within the Shellharbour and Wollongong local government areas:

- Ensure the existing network operates at an optimum level by implementing the improvements recommended to address existing deficiencies. The justification for these improvements is identified in Sections 4.1.7 and 4.1.8.
- Ensure the future road network operates at an optimum level:
  - Prioritise improvements to identified intersections that will operate at performance levels below acceptable levels.
  - Provide additional link capacities to major roads that have been identified as deficient with the introduction of various planned developments over the coming years.

The assessment of the future road network upgrades was considered in two stages:

- Identify road network upgrades required to ameliorate the impact of base 2031 future development excluding Calderwood.
- Identify additional road network upgrades required to ameliorate the impact of full 2031 future development including Calderwood.

10.2 UPGRADES RECOMMENDED TO ADDRESS EXISTING DEFICIENCIES

Network improvements recommended to address existing deficiencies are discussed in Section 4.1.9. A summary of the proposed upgrades is reproduced in Table 10.1 and Table 10.2.

Table 10.1 Proposed Road Network Improvements to Address Existing Deficiencies

Upgrade Number	Location	Proposed Network Improvement
Road Link Upgrades		
Upgrade 1	F6 Extension from Tallawarra Interchange to Tripoli Way Interchange	Construction of a four-lane divided carriageway to freeway standard
Upgrade 2	F6 Extension from Tripoli Way Interchange to Croome Road Interchange	
Upgrade 3	F6 Extension from Croome Road Interchange to Oak Flats Interchange	

Table 10.2 Proposed F6 Extension Complimentary Road Network Improvements

Upgrade Number	Location	Proposed Network Improvement
Road Link Upgrades		
Upgrade 4	F6 Extension Tripoli Way North Facing Ramps	Single lane ramps on all approaches with double roundabouts and single central structure
Upgrade 5	F6 Extension Tripoli Way South Facing Ramps	
Upgrade 6	Tripoli Way extension from Illawarra Highway (East) to F6 Extension	Construct divided two way-four lane carriageway with minimum 3.5m lane widths with kerb and gutter.
Upgrade 7	Tripoli Way extension from F6 Extension to Tongarra Road	
Upgrade 8	F6 Extension Croome Road Ramps	Single lane ramps
Upgrade 9	F6 Extension Complimentary Measures	Install LATM treatments along Princes Highway between F6 extension limits
Intersection Upgrades		
Upgrade 10	Tripoli Way/Illawarra Highway	New signalised intersection
Upgrade 11	Tripoli Way/Tongarra Road	New signalised intersection

The location of the proposed upgrades is presented in Figure 10.1.

The F6 extension has been identified as required to address the existing network deficiencies. However, due to the extent of planning, design and construction time required to implement the F6 freeway extension, it was assumed in the modelling that this would be complete within the period 2017 to 2021. It was assumed that the complimentary road network improvements would be undertaken in conjunction with the provision of the F6 extension.

In the short to medium-term (5-10 years) the existing capacity and performance issues along the Princes Highway from the Southern Freeway to the Illawarra Highway will remain and will worsen over time with background traffic growth and regional growth. The RTA may need to consider interim works such as providing additional traffic capacity by the addition of a lane in either direction along the Princes Highway. This would include a new bridge structure across Marshall Mount Creek. These works are considered to be provisional and as such have not been included in the recommended works, as the preferred option is early provision of the F6 extension.

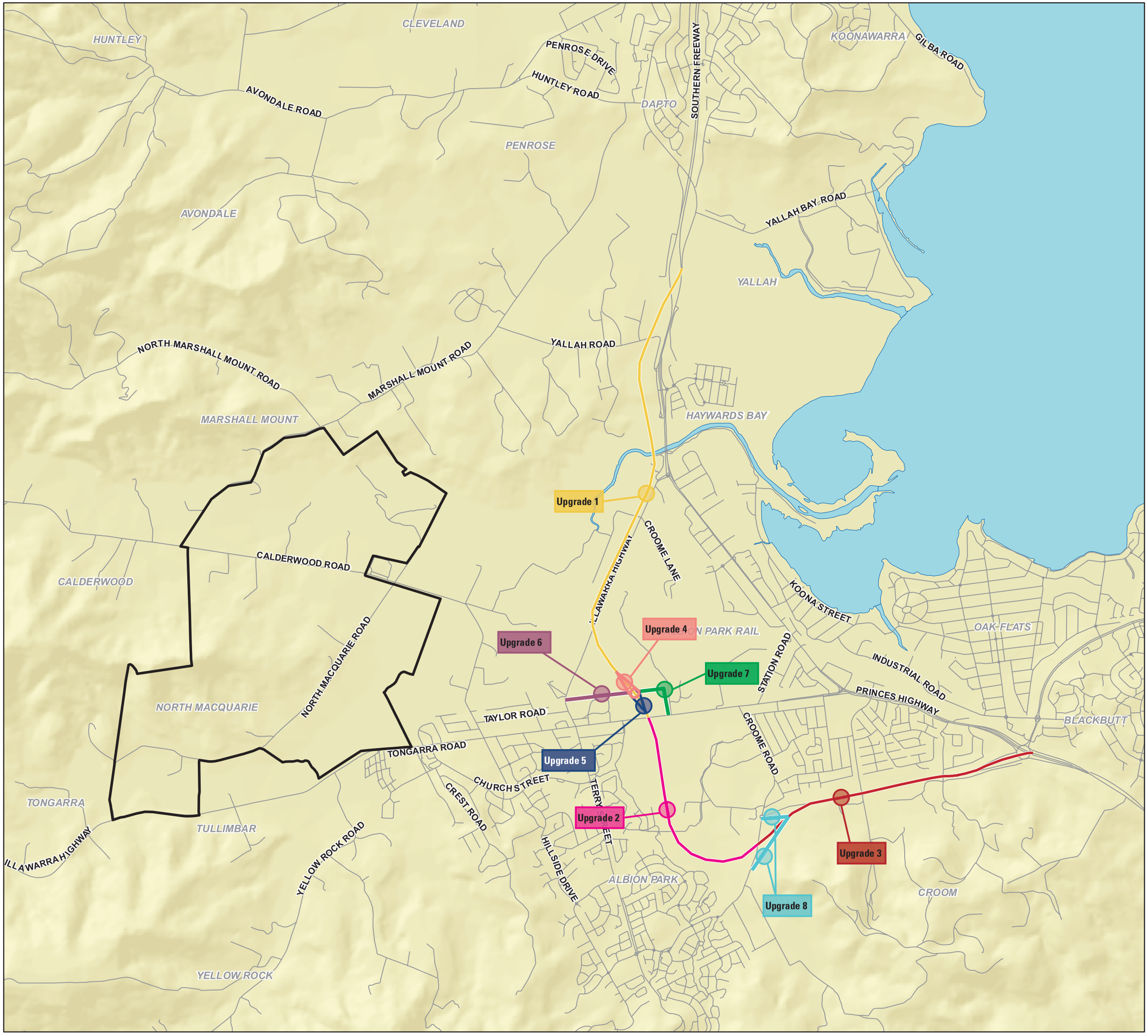

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Figure 10.1
Road Network Upgrades: Existing Deficiencies

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

- Site Boundary
- Local Roads (LPMA)
- Watercourse (LPMA)
- Lake Illawarra (LPMA)
- Existing Built Up Areas (LPMA)
- F6 Extension* from Tallawarra Interchange to Tripoli Way Interchange (Upgrade 1)
- F6 Extension* from Tripoli Way Interchange to Croome Road Interchange (Upgrade 2)
- F6 Extension* from Croome Road Interchange to Oak Flats Interchange (Upgrade 3)
- F6 Extension Tripoli Way North Facing Ramps (Upgrade 4)
- F6 Extension Tripoli Way South Facing Ramps (Upgrade 5)
- Tripoli Way extension from Illawarra Highway (East) to F6 Extension (Upgrade 6)
- Tripoli Way extension from F6 Extension to Tongarra Road (Upgrade 7)
- F6 Extension Croome Road Ramps (Upgrade 8)

*** Construction of a four-lane divided carriageway to freeway standard**

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10.3 UPGRADES RECOMMENDED TO ADDRESS FUTURE BASE DEFICIENCIES

Network improvements recommended to address base future deficiencies (as a result of development to 2031 excluding the CUDP) are detailed in Table 10.3 (excluding the upgrades required as a result of existing network deficiencies).

Table 10.3 Proposed Road Network Improvements to Address Future Base Deficiencies

Upgrade Number	Location	Proposed Network Improvement
Road Link Upgrades		
Upgrade 12	F6 northbound off-ramp at Tallawarra	Provide additional off-ramp lane and associated freeway diverge upgrades
Upgrade 13	F6 southbound on-ramp at Tallawarra	Provide additional on-ramp lane and associated freeway merge upgrades
Upgrade 14	Tripoli Way from Illawarra Highway/ Broughton Avenue to Calderwood Road	Construct undivided two way-two lane carriageway with minimum 3.5m lane widths with kerb and gutter.
Upgrade 15	Tripoli Way from Calderwood Road to Illawarra Highway (East)	
Upgrade 16	Tripoli Way Complimentary Measures	Install LATM treatments along Illawara Highway/ Tongarra Road between Tripoli Way limits
Upgrade 17	Princes Highway from Mount Brown Road to Huntley Road	Provide additional northbound traffic lane
Upgrade 18	Princes Highway from Mount Brown Road to Huntley Road	Provide additional southbound traffic lane
Upgrade 19	Princes Hwy from Huntley Road to F6 Off-ramp	Provide additional northbound traffic lane
Upgrade 20	Princes Hwy from Huntley Road to F6 Off-ramp	Provide additional southbound traffic lane
Upgrade 21	Princes Highway from F6 Off – Yallah Bay Road	Provide additional southbound traffic lane
Upgrade 22	Marshall Mount Road from CUDP North-South Route to Yallah Road	Upgrade road to undivided two way-two lane carriageway with minimum 3.5m lane widths and sealed shoulders
Upgrade 23	Marshall Mount Road from Yallah Road to TAFE	
Upgrade 24	Marshall Mount Road from TAFE to Huntley Rd	
Upgrade 25	Yallah Road from Marshall Mount Road to Haywards Bay Drive	Upgrade road to undivided two way-two lane carriageway with minimum 3.5m lane widths and sealed shoulders
Intersection Upgrades		
Upgrade 26	Princes Highway/Huntley Road	Signalise existing priority controlled intersection
Upgrade 27	Princes Highway/F6 southbound off-ramp	Signalise existing priority controlled intersection
Upgrade 28	Princes Highway/Cormack Avenue	Signalise existing priority controlled intersection
Upgrade 29	Illawarra Highway/Broughton Avenue	Additional northern leg for Calderwood collector road
Upgrade 30	Tripoli Way/Calderwood Road	New roundabout intersection
Upgrade 31	Illawarra Highway/Terry Street	Minor signal alterations

More detailed descriptions of some of the intersection upgrade measures are provided in Appendix 10-A. Figure 10.2 shows cumulative set of upgrade works required to address the 2031 base road network deficiencies (without CUDP) including the upgrades required as a result of existing network deficiencies highlighted in Figure 10.1.

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Figure 10.2

Road Network Upgrades: Futures Base Deficiencies

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

- Lake Illawarra
- Site Boundary
- Existing Road Network (LPMA)
- F6 Extension from Tallawarra Interchange to Tripoli Way Interchange (Upgrade 1)
- F6 Extension from Tripoli Way Interchange to Croome Road Interchange (Upgrade 2)
- F6 Extension from Croome Road Interchange to Oak Flats Interchange (Upgrade 3)
- F6 Extension Tripoli Way North Facing Ramps (Upgrade 4)
- F6 Extension Tripoli Way South Facing Ramps (Upgrade 5)
- Tripoli Way extension from Illawarra Highway (East) to F6 Extension (Upgrade 6)
- Tripoli Way extension from F6 Extension to Tongarra Road (Upgrade 7)
- F6 Extension Croome Road Ramps (Upgrade 8)
- F6 Extension Complimentary Measures (Upgrade 9)
- F6 northbound off-ramp at Tallawarra (Upgrade 12)
- F6 southbound on-ramp at Tallawarra (Upgrade 13)
- Tripoli Way from Illawarra Highway/ Broughton Avenue to Calderwood Road (Upgrade 14)
- Tripoli Way from Calderwood Road to Illawarra Highway (East) (Upgrade 15)
- Tripoli Way Complimentary Measures (Upgrade 16)
- Princes Highway from Mount Brown Road to Huntley Road (Upgrade 17 & 18)
- Princes Hwy from Huntley Road to F6 Off-ramp (Upgrade 19 & 20)
- Princes Highway from F6 Off – Yallah Bay Road (Upgrade 21)
- Marshall Mount Road from CUDP North-South Route to Yallah Road(Upgrade 22)
- Marshall Mount Road from Yallah Road to TAFE (Upgrade 23)
- Marshall Mount Road from TAFE to Huntley Rd (Upgrade 24)
- Yallah Road from Marshall Mount Road to Haywards Bay Drive (Upgrade 25)

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10.4 UPGRADES RECOMMENDED TO ADDRESS FUTURE FULL CUDP DEVELOPMENT DEFICIENCIES

Additional network improvements recommended to address future full development deficiencies (as a result of development to 2031 including the CUDP) are presented in Table 10.4.

Table 10.4 Proposed Road Network Improvements to Address Full CUDP Development Deficiencies

Upgrade Number	Location	Proposed Network Improvement
Road Link Upgrades		
Upgrade 32	Calderwood Road from CUDP to Tripoli Way	Upgrade road to undivided two way-two lane carriageway with minimum 3.5m lane widths and sealed shoulders
Upgrade 33	North-South Route – southern section	Construct undivided two way-two lane carriageway with minimum 3.5m lane widths with kerb and gutter.
Upgrade 34	North-South Route – central section	
Upgrade 35	North-South Route – northern section	
Intersection Upgrades		
Upgrade 36	Marshall Mount Road/Yallah Road	Upgrade existing T-intersection to a roundabout
Upgrade 37	Illawarra Highway/Yellow Rock Road	Upgrade existing T-intersection to a four-arm roundabout

Figure 10.3 shows the full set of upgrade works required to address the 2031 full development road network deficiencies including the base network deficiencies highlighted in Figure 10.2 and existing network deficiencies highlighted in Figure 10.1.

More detailed descriptions of some of the intersection upgrade measures are provided in Appendix 10-B.

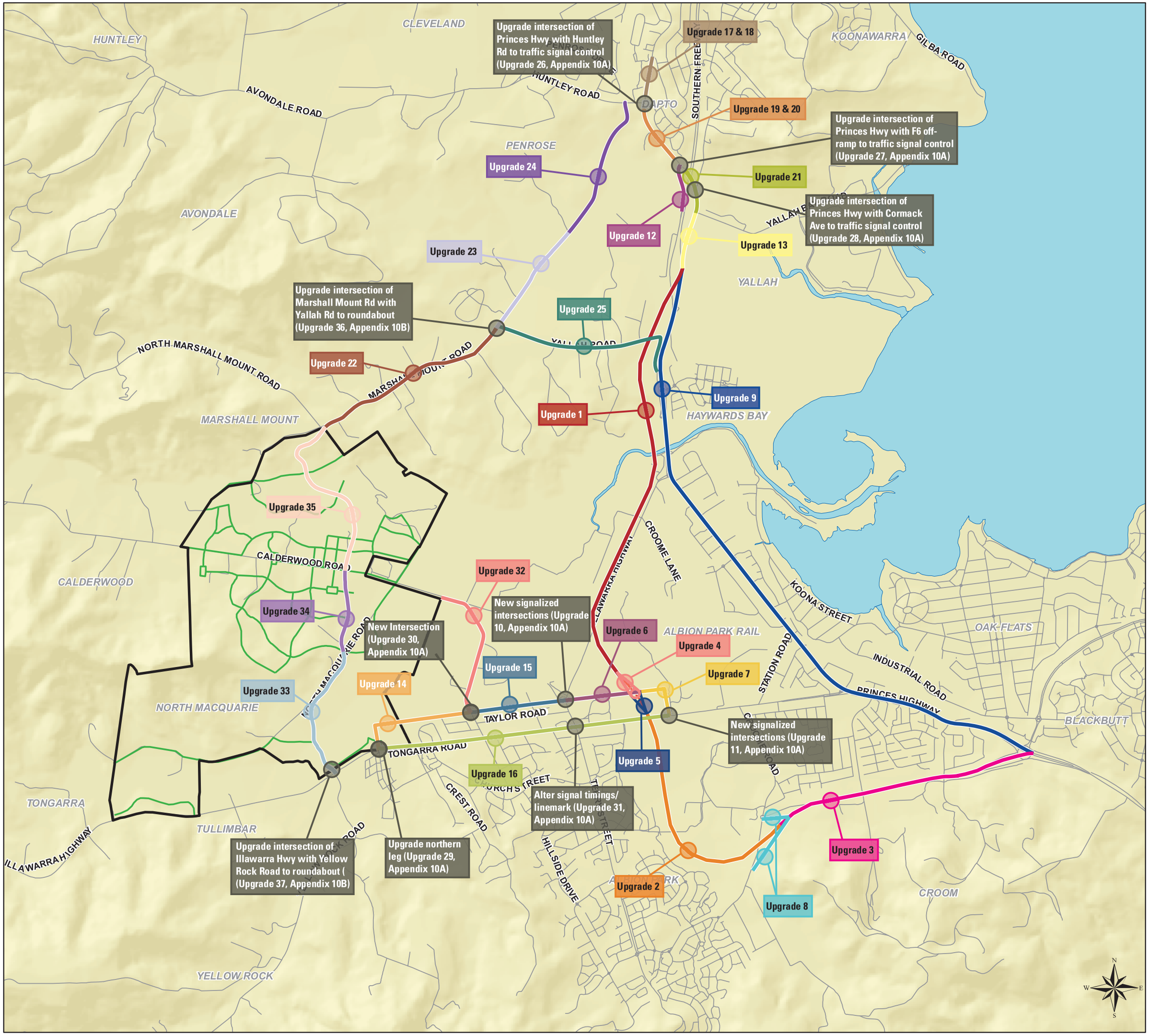

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Figure 10.3

Road Network Upgrades: Full CUDP Development Deficiencies

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

- Lake Illawarra
- Site Boundary
- Existing Road Network (LPMA)
- Indicative CUDP Internal Road Network
- F6 Extension from Tallawarra Interchange to Tripoli Way Interchange (Upgrade 1)
- F6 Extension from Tripoli Way Interchange to Croome Road Interchange (Upgrade 2)
- F6 Extension from Croome Road Interchange to Oak Flats Interchange (Upgrade 3)
- F6 Extension Tripoli Way North Facing Ramps (Upgrade 4)
- F6 Extension Tripoli Way South Facing Ramps (Upgrade 5)
- Tripoli Way extension from Illawarra Highway (East) to F6 Extension (Upgrade 6)
- Tripoli Way extension from F6 Extension to Tongarra Road (Upgrade 7)
- F6 Extension Croome Road Ramps (Upgrade 8)
- F6 Extension Complimentary Measures (Upgrade 9)
- F6 northbound off-ramp at Tallawarra (Upgrade 12)
- F6 southbound on-ramp at Tallawarra (Upgrade 13)
- Tripoli Way from Illawarra Highway/ Broughton Avenue to Calderwood Road (Upgrade 14)
- Tripoli Way from Calderwood Road to Illawarra Highway (East) (Upgrade 15)
- Tripoli Way Complimentary Measures (Upgrade 16)
- Princes Highway from Mount Brown Road to Huntley Road (Upgrade 17 & 18)
- Princes Hwy from Huntley Road to F6 Off-ramp (Upgrade 19 & 20)
- Princes Highway from F6 Off – Yallah Bay Road (Upgrade 21)
- Marshall Mount Road from CUDP North-South Route to Yallah Road(Upgrade 22)
- Marshall Mount Road from Yallah Road to TAFE (Upgrade 23)
- Marshall Mount Road from TAFE to Huntley Rd (Upgrade 24)
- Yallah Road from Marshall Mount Road to Haywards Bay Drive (Upgrade 25)
- Calderwood Road from CUDP to Tripoli Way (Upgrade 32)
- North-South Route – southern section (Upgrade 33)
- North-South Route – central section (Upgrade 34)
- North-South Route – northern section (Upgrade 35)

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11

Apportionment of Transport Initiatives

11.1 INTRODUCTION

The purpose of the establishing the apportionment of trips on various road sections and through intersections is to assist in determining an appropriate contribution for all proposed network upgrades from individual development sites such as the Calderwood Urban Development Project.

It should be noted that the costs to rectify an existing deficiency are not to be borne by those parties developing land. The F6 extension has been identified as required to address an existing deficiency, furthermore the roadworks are strategic in nature. Accordingly the apportionment of trips on the F6 extension (refer to Table 10.1) have been excluded from the apportionment calculations.

However, the associated F6 extension complimentary road network improvements (such as freeway ramps, access roads and intersection improvements at access points) (refer to Table 10.2) have been included in the apportionment calculations. It could be argued that these works are required to provide access to the F6 extension and as such are works required to address existing deficiencies and therefore the costs should not be borne by those parties developing land. It is considered more appropriate and reasonable that these works should be funded (according to the appropriate apportionment) by the regional development in the areas.

11.2 TECHNICAL APPORTIONMENT

Apportionment procedures are technical calculations used to determine a total contribution for all proposed network upgrades from individual development sites such as the Calderwood Urban Development Project. Once the value of the total contribution has been estimated, the allocation of funds towards individual upgrade projects is expected to be rationalised. The selected improvements are considered elements of achieving a better balance and are deliverable.

The apportionment procedures to determine the contribution attributed to the CUDP are clarified further in Sections 11.2.1 and 11.2.2 below.

11.2.1 APPORTIONMENT METHOD - INTERSECTION UPGRADES

The apportionment method applied for intersection upgrades is:

- Model runs were undertaken for the assessment period of 2016, 2021 and 2026. If during any of these model runs an intersection was found to operate at an overall level of service of E or worse it was assumed that an upgrade would be undertaken and implemented within the next model year. For example if an intersection was found to overcapacity (LoS E) during 2016 it was assumed for modeling purposes that the proposed upgrade was implemented for 2021.
- All apportionment calculations are based on the modelled approach flows for the year in which the upgrade is implemented.
- The apportionment calculations for existing intersections requiring upgrades are as follows:
  - Determine total entering volumes at each intersection in 2009 during the AM and PM peak periods.
  - Determine total entering volumes at each intersection in the assessment year during the AM and PM peak periods.
  - Determine the increase in total entering traffic volumes from 2009 to the upgrade year during the AM and PM peak periods.
  - Determine which peak period is critical, i.e. has the greatest increase in total entering volumes.
  - For the critical peak period determine the proportion of additional trips associated with:
    - CUDP.
    - Other Regional growth areas.

- The apportionment calculations for new intersections are as follows:
  - Determine total entering volumes at each intersection in the year in which the upgrade is required during the AM and PM peak periods.
  - Determine which peak period is critical, i.e. has the greatest total entering volumes.
  - For the critical peak period determine the proportion of additional trips associated with:
    - CUDP.
    - Other Regional growth areas.
- Contribution from Government is based on any remaining traffic growth compared to existing flows. If the traffic passing through the intersection which is associated with development sites is greater than the net growth compared to existing flows, then the contribution from Government is zero.

Table 11.1 presents a summary of the apportionment calculated for intersection upgrades for CUDP, other development sites and the Government.

Table 11.1 Technical Apportionment for Intersection Upgrades

Intersection	Funding Road Classification[8]	Timing	Cost Apportionment			
			CUDP	Other Dev. Sites	Govt.	Total
Tripoli Way/ Illawarra Highway (Upgrade 10)	State	2017 - 2021	68%	32%	0%	100%
Tripoli Way/ Tongarra Road (Upgrade 11)	State	2017 - 2021	18%	31%	52%	100%
Princes Highway/ Huntley Road (Upgrade 26)	Regional	2017 - 2021	7%	93%	0%	100%
Princes Highway/ F6 southbound off-ramp (Upgrade 27)	State	2017 - 2021	4%	96%	0%	100%
Princes Highway/ Cormack Avenue (Upgrade 28)	Regional	2017 - 2021	3%	97%	0%	100%
Illawarra Highway/ Broughton Avenue (Upgrade 29)	State	2017 - 2021	57%	33%	10%	100%
Tripoli Way/ Calderwood Road (Upgrade 30)	Local	2027 - 2031	59%	41%	0%	100%
Illawarra Highway/ Terry Street[9] (Upgrade 31)	State	2017 - 2021	-	-	-	-

[8] Based on main road classification
[9] Minor works to upgrade signal timings and phases – no costs associated

Intersection	Funding Road Classification[8]	Timing	Cost Apportionment			
			CUDP	Other Dev. Sites	Govt.	Total
Marshall Mount Road/ Yallah Road (Upgrade 36)	Local	2027 - 2031	47%	44%	9%	100%
Illawarra Highway/ Yellow Rock Road (Upgrade 37)	State	2009 - 2016	66%	22%	12%	100%

11.2.2 APPORTIONMENT METHOD - ROAD UPGRADES

The method applied to determine the technical apportionment of costs for road widening is as follows:

- Model runs were undertaken for the assessment years of 2016, 2021 and 2026. If during any of these model runs a road section was found to operate at level of service of E or worse it was assumed that an upgrade would be undertaken and implemented within the model year. For example if a road link was overcapacity (LoS E) during 2016 it was assumed for modeling purposes that the proposed upgrade was implemented for 2021.
- All apportionment calculations are based on the flows for the assessment year in which the upgrade is implemented.
- Contribution from development sites is based on the direction of traffic during the peak periods that trigger the requirement for the upgrade. i.e. the highest one-way flow (morning or evening) in one direction is used for apportionment of the upgrade of the road in that direction.
- The apportionment calculations for road sections requiring upgrades are as follows:
  - Determine the peak traffic volume in each direction during the AM and PM peak periods for the upgrade year.
  - For the critical peak period determine the proportion of additional trips associated with:
    - CUDP.
    - Other Regional growth areas.
- Contribution from Government is based on any remaining traffic growth compared to existing flows for the directions used for the apportionment. If the traffic associated with development sites is greater than the net growth compared to existing flows, then the contribution from Government is zero.

Table 11.2 presents a summary of the technical apportionment calculated for CUDP, other agreed regional development growth sites, and the Government.

Table 11.2 Technical Apportionment for Road Upgrades

Section of Road	Funding Road Classification	Timing	Cost Apportionment			
			CUDP	Other Dev. Sites	Govt.	Total
F6 Extension Tripoli Way North Facing Ramps (Upgrade 4)	State	2017 - 2021	32%	19%	49%	100%
F6 Extension Tripoli Way South Facing Ramps (Upgrade 5)	State	2017 - 2021	19%	14%	68%	100%
Tripoli Way from Illawarra Highway (East) to F6 Extension (Upgrade 6)	State	2017 - 2021	36%	19%	45%	100%

Section of Road	Funding Road Classification	Timing	Cost Apportionment			
			CUDP	Other Dev. Sites	Govt.	Total
Tripoli Way from F6 Extension to Tongarra Road (Upgrade 7)	State	2017 - 2021	0%	25%	75%	100%
F6 Extension Croome Road Ramps (Upgrade 8)	State	2017 - 2021	0%	3%	97%	100%
F6 Extension Complimentary Measures (Upgrade 9)	State	2017 - 2021	7%	20%	74%	100%
F6 northbound off-ramp at Tallawarra (Upgrade 12)	State	2022 - 2026	4%	94%	2%	100%
F6 southbound on-ramp at Tallawarra (Upgrade 13)	State	2017 - 2021	3%	97%	0%	100%
Tripoli Way from Illawarra Highway/ Broughton Avenue to Calderwood Road (Upgrade 14)	Local	2017 - 2021	34%	40%	26%	100%
Tripoli Way from Calderwood Road to Illawarra Highway (East) (Upgrade 15)	Local	2017 - 2021	64%	19%	17%	100%
Tripoli Way Complimentary Measures (Upgrade 16)	Local	2017 - 2021	34%	44%	23%	100%
Princes Highway from Mount Brown Road to Huntley Road (Northbound) (Upgrade 17)	Regional	2017 - 2021	9%	91%	0%	100%
Princes Highway from Mount Brown Road to Huntley Road (Southbound) (Upgrade 18)	Regional	2017 - 2021	15%	85%	0%	100%
Princes Highway from Huntley Road to F6 Off-ramp (Northbound) (Upgrade 19)	Regional	2017 - 2021	4%	96%	0%	100%
Princes Highway from Huntley Road to F6 Off-ramp (Southbound) (Upgrade 20)	Regional	2017 - 2021	3%	97%	0%	100%
Princes Highway from F6 Off-ramp to F6 On-ramp (Southbound) (Upgrade 21)	Regional	2017 - 2021	3%	97%	0%	100%
Marshall Mount Road from CUDP North-South Route to Yallah Road (Upgrade 22)	Local	2017 - 2021	25%	74%	0%	100%
Marshall Mount Road from Yallah Road to TAFE (Upgrade 23)	Local	2017 - 2021	50%	13%	37%	100%
Marshall Mount Road from TAFE to Huntley Road (Upgrade 24)	Local	2017 - 2021	42%	27%	31%	100%
Yallah Road from Marshall Mount Road to Haywards Bay Drive (Upgrade 25)	Local	2017 - 2021	0%	63%	37%	100%
Calderwood Road from CUDP to Tripoli Way (Upgrade 32)	Local	2027-2031	98%	2%	0%	100%

Section of Road	Funding Road Classification	Timing	Cost Apportionment			
			CUDP	Other Dev. Sites	Govt.	Total
North-South Route – southern section (Upgrade 33)	Local (on-site)	2009 – 2016	84%	12%	4%	100%
North-South Route – central section (Upgrade 34)	Local (on-site)	2017 – 2021	66%	19%	14%	100%
North-South Route – northern section (Upgrade 35)	Local (on-site)	2022 - 2026	67%	24%	9%	100%

11.3 STAGING OF UPGRADES

The location of the specific upgrade works is shown in Figure 11.1.

11.3.1 TIMING OF UPGRADE WORKS

For modelling purposes the timing of proposed works is identified in Table 11.3. The majority of works are required post 2016 in the period between 2017 and 2021.

11.3.2 FUNDING MECHANISM

A funding mechanism by which works could be funded by the CUDP are proposed for each upgrade. These are categorised into three types of funding arrangement alternatives:

- Works in kind (WIK) – works undertaken by the CUDP in developing the site.
- State Infrastructure Contributions (SIC) – works funded by CUDP by contributions paid to the state government under the SIC.
- Voluntary Planning Agreements (VPA) – works funded by CUDP by contributions paid under a VPA.

The proposed funding mechanisms are also identified in Table 11.3.

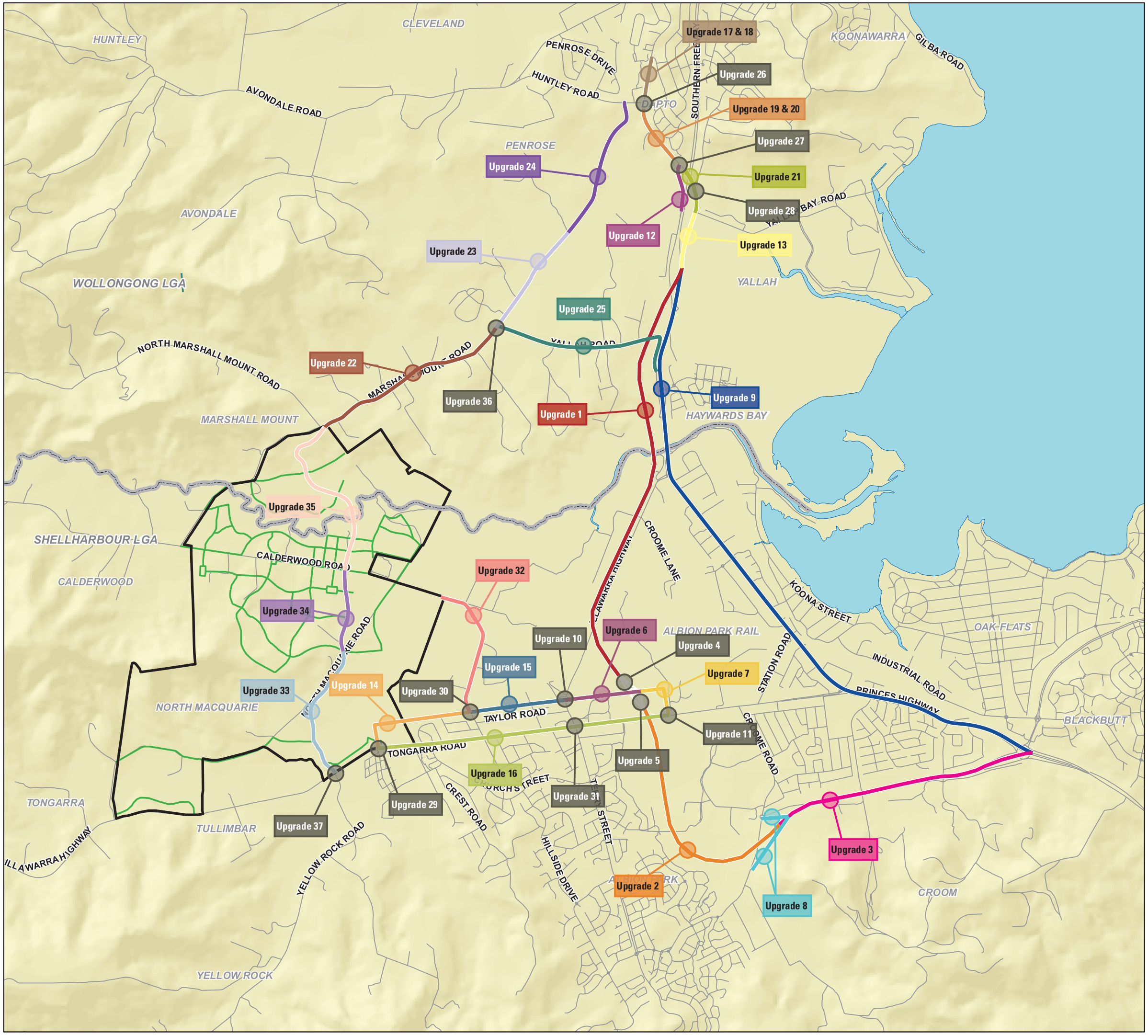
The option of variations to the works in kind, SIC or VPA items should be discussed with the proponent during VPA negotiations.

Table 11.3 CUDP - Transport Infrastructure Funding Mechanism and Timing Arrangements

Upgrade Item	Location	Upgrade Description	Upgrade Type	Funding Road Classification ~[1]	Timing	Funding Mechanism
Works Required without CUDP						
Upgrade 4	F6 Extension Tripoli Way North Facing Ramps	Single lane ramps on all approaches a roundabout	Road	State	2021	SIC
Upgrade 5	F6 Extension Tripoli Way South Facing Ramps	Single lane ramps on all approaches a roundabout	Road	State	2021	SIC
Upgrade 6	Tripoli Way from Illawarra Highway (East) to F6 Extension	Construct divided two way-four lane carriageway with minimum 3.5m lane widths with kerb and gutter.	Road	State	2021	SIC
Upgrade 7	Tripoli Way from F6 Extension to Tongarra Road	Construct divided two way-two lane carriageway with minimum 3.5m lane widths with kerb and gutter.	Road	State	2021	SIC
Upgrade 8	F6 Extension Croome Road Ramps	Single lane ramps - east facing	Road	State	2021	SIC
Upgrade 9	F6 Extension Complimentary Measures	Install LATM treatments along Princes Highway between F6 extension limits	Road	State	2021	SIC
Upgrade 10	Tripoli Way/Illawarra Highway	New signalised intersection	Intersection	State	2021	VPA
Upgrade 11	Tripoli Way/Tongarra Road	New signalised intersection	Intersection	State	2021	VPA
Upgrade 12	F6 northbound off-ramp at Tallawarra	Provide additional off-ramp lane and associated freeway diverge upgrades	Road	State	2026	SIC
Upgrade 13	F6 southbound on-ramp at Tallawarra	Provide additional on-ramp lane and associated freeway merge upgrades - includes bridge	Road	State	2021	SIC
Upgrade 14	Tripoli Way from Illawarra Highway/ Broughton Avenue to Calderwood Road	Construct undivided two way-two lane carriageway with minimum 3.5m lane widths with kerb and gutter.	Road	Local	2021	VPA
Upgrade 15	Tripoli Way from Calderwood Road to Illawarra Highway East	Construct undivided two way-two lane carriageway with minimum 3.5m lane widths with kerb and gutter.	Road	Local	2021	VPA
Upgrade 16	Tripoli Way Complimentary Measures	Install LATM treatments along Illawara Highway/ Tongarra Road between Tripoli Way limits	Road	Local	2021	VPA
Upgrade 17	Princes Highway from Mount Brown Road to Huntley Road	Provide additional northbound	Road	Regional	2021	VPA
Upgrade 18	Princes Highway from Mount Brown Road to Huntley Road	Provide additional southboud traffic lane	Road	Regional	2021	VPA
Upgrade 19	Princes Highway from Huntley Road to F6 Off-ramp	Provide additional northbound traffic lane	Road	Regional	2021	VPA
Upgrade 20	Princes Highway from Huntley Road to F6 Off-ramp	Provide additional southboud traffic lane	Road	Regional	2021	VPA
Upgrade 21	Princes Highway from F6 Off-ramp to Yallah Bay Drive	Provide additional southbound traffic lane	Road	Regional	2021	VPA
Upgrade 22	Marshall Mount Road from CUDP North-South Route to Yallah Road	Upgrade road to undivided two way-two lane carriageway with minimum 3.5m lane widths and sealed shoulders	Road	Local	2021	VPA
Upgrade 23	Marshall Mount Road from Yallah Road to TAFE	3.5m lane widths and sealed shoulders	Road	Local	2021	VPA
Upgrade 24	Marshall Mount Road from TAFE to Huntley Road	3.5m lane widths and sealed shoulders	Road	Local	2021	VPA
Upgrade 25	Yallah Road from Marshall Mount Road to Haywards Bay Drive	Upgrade road to undivided two way-two lane carriageway with minimum 3.5m lane widths and sealed shoulders	Road	Local	2021	N/A
Upgrade 26	Princes Highway/Huntley Road	Signalise existing priority controlled intersection	Intersection	Regional	2021	VPA
Upgrade 27	Princes Highway/F6 southbound off-ramp	Signalise existing priority controlled intersection	Intersection	State	2021	VPA
Upgrade 28	Princes Highway/Cormack Avenue	Signalise existing priority controlled intersection	Intersection	Regional	2021	VPA
Upgrade 29	Illawarra Highway/Broughton Avenue	Additional northern leg for Calderwood collector road	Intersection	State	2021	VPA
Upgrade 30	Tripoli Way/Calderwood Road	New roundabout intersection	Intersection	Local	2031	VPA
Upgrade 31	Illawarra Highway/Terry Street	Minor signal alterations	Intersection	State	2021	N/A
Additional works required as a result of CUDP inclusion						
Upgrade 32	Calderwood Road from CUDP to Tripoli Way	Upgrade road to undivided two way-two lane carriageway with minimum 3.5m lane widths and sealed shoulders	Road	Local	2031	WIK
Upgrade 33	North-South Route – southern section	Construct undivided two way-two lane carriageway with minimum 3.5m lane widths with kerb and gutter including 3 x RAB	Road	Local (on-site)	2016	WIK
Upgrade 34	North-South Route – central section	Construct undivided two way-two lane carriageway with minimum 3.5m lane widths with kerb and gutter. Includes 2 x signals and 1 x RAB	Road	Local (on-site)	2021	WIK
Upgrade 35	North-South Route – northern section	Construct undivided two way-two lane carriageway with minimum 3.5m lane widths with kerb and gutter.	Road	Local (on-site)	2026	WIK
Upgrade 36	Marshall Mount Road/Yallah Road	Upgrade existing T-intersection to a roundabout	Intersection	Local	2031	VPA
Upgrade 37	Illawarra Highway/Yellow Rock Road	Upgrade existing T-intersection to a roundabout	Intersection	State	2016	WIK

Notes:

~[1] RTA 2009 Funding Classification



Delfin
Lend Lease

Figure 11.1

Road Network Upgrades for Costing and Apportionment

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

- Site Boundary
- Local Government Area
- Lake Illawarra (LPMA)
- Existing Road Network (LPMA)
- Indicative CUDP Internal Road Network

N
W E
S

Cardno
Shaping the Future

Map Produced by Cardno Forbes Rigby Pty Ltd
Date: 16 December 2009
Coordinate System: Zone 56 MGA/GDA 94
GIS MAP REF: 110026-01_58022_Road_Infrastructure_Improvements.mxd 01

12

Summary and Conclusions

12.1 SUMMARY

The CUDP Transport Management and Accessibility Plan (TMAP) has been prepared in accordance with the procedures agreed for the Project. A summary of the TMAP on a chapter by chapter basis follows.

12.1.1 Chapter 1

Chapter 1 provides the necessary background information about the Project and the need for the TMAP. In particular Chapter 1 provides information on the following matters.

- This TMAP has been prepared to fulfil the Environmental Assessment Requirements issued by the Director General for the inclusion of the Calderwood site as a State Significant Site under SEPP Major Development, and for a Concept Plan approval for the development.
- The following State agencies and Councils have been involved in preparing the TMS:
  - Roads and Traffic Authority of NSW (RTA).
  - NSW Transport and Infrastructure (NSWTI) formerly known as the Ministry of Transport (MoT).
  - Wollongong City Council.
  - Shellharbour City Council.
- The TMAP objectives are provided.
- Key access and transport issues are identified.
- The area of influence for the transport assessment is defined.
- The structure of the TMAP report is explained.

12.1.2 Chapter 2

Chapter 2 provides the strategic and local context for the development of the CUDP.

- A number of New South Wales government policies, plans and strategies have been reviewed as part of the study process with important strategic policy aspects summarised as follows:
  - The NSW State Plan (2009) And Illawarra Local Action Plan (2009) identifies a target to increase public transport mode share to 15% for commuter journeys to Wollongong CBD.
  - The State Infrastructure Strategy is a rolling 10–year plan for infrastructure projects to support service delivery and provides information on the proposed Dapto Railway Station easy access upgrade.
  - Action for Air is the NSW Government's 25 year air quality management plan for the Greater Metropolitan Region of New South Wales, and identifies a range of actions to make transport greener.
  - Action for Bikes does not detail areas outside of the Sydney metropolitan area although its four point action plan includes the actions of improving the bike network, making it safer to cycle, improving personal and environmental health and raising community awareness.
  - The Integrated Land Use and Transport (ILUT) package (DUAP 2001) specifies the concentration of large trip generators/attractors near each other, the use of parking as a travel demand management tool and the adoption of a minimum density of 15 dwellings per hectare for new residential areas.
  - Planning Guidelines for Walking & Cycling (2004) identifies the provision of facilities and design outcomes that are supportive of walking and cycling.
  - Accessible Transport Action Plan (2007) is reviewed to ensure that the proposed CUDP and transport improvements recommended in this report meet accessibility requirements.
  - Review Of Bus Services In New South Wales – Final Report (Unsworth) (2004) has been reviewed to assist in the identification of an appropriate bus strategy for the CUDP.

- Documents reviewed and summarised as part of the Illawarra transport context include the following:
  - Illawarra Regional Strategy 2006 – 2031 focuses on regional transportation.
  - The Illawarra Urban Transport Opportunities Study (1997 DJA Maunsell for DUAP) identified that a 30% modal split to public transport during the commuter peak periods would be required to improve air quality and reduce the environmental impact of urban development.
  - Illawarra's Action For Transport (1999) strategy identified that modal split to public transport was approximately 4.1% in 1999.
  - The Moving Together (2004) document forms the current broad transport strategy covering the Illawarra region.
  - The West Dapto Release Area studies –
    - West Dapto Urban Development TMAP Stage 1 and Stage 2 Reports – Final Report (2006) identified that widening of the F6 north of Fowlers Road to six lanes and the provision of south-facing ramps at Kanahooka Road and widening of Princes Highway to four lanes across Mullet Creek would be required to support the development of West Dapto.
    - The West Dapto Release Area Draft Infrastructure Implementation Plan (2006) sets out the infrastructure which would be provided as part of the development of the West Dapto Release Area including the F6/Princes Highway north-facing ramps at Tallawarra interchange ($0.85 million – 25% share, with the remaining funded by the State Government and other sources).
    - The West Dapto TMAP Extension Study (2008) recognised the present low levels of public transport usage in the Dapto area, and identified that, if these levels were not markedly improved by 2026, the road network would come under considerable pressure.
    - The West Dapto Release Area Review: Planning and Infrastructure, Planning Report and Supporting Documentation (2008) identified a range of potential infrastructure upgrades for development of 8,000 dwellings at Calderwood including Widening of Illawarra Highway from Broughton Avenue to Terry Street to four lanes, widening of Tongarra Road from Terry Street to Princes Highway to four lanes, upgrade of two-lane road link from Calderwood Road to Yallah Road, upgrade of the Princes Highway/Yallah Road interchange to provide improved northbound on and off-ramps, possible earlier provision of an additional westbound lane across the Haywards Bay Drive overbridge if Calderwood development occurs before or in conjunction with the Yallah/Marshall Mount release and upgrading of the Albion Park railway station interchange.
    - West Dapto Initial Access Strategy Supporting Stages 1 and 2 – Report by Manager of Infrastructure to City of Wollongong Council (2009) report sets out the proposed initial access strategy to facilitate the development of Stages 1 and 2 of the West Dapto Release Area.
  - Albion Park Traffic Study (2006) investigated the need for the Albion Park West Connector, potential future use for a north-south link west of Albion Park., the need and timing for the Tripoli Way extension and the location of the future F6 interchange in Albion Park.
- Local government plans were reviewed to gain an insight into the local planning context for Calderwood and adjoining areas in order to shape the master planning process with the following summaries provided:
  - Shellharbour Rural LEP 2004 identifies that the portions of the development site within Shellharbour LGA are presently zoned 1(a) Agriculture and 7(n) Nature Conservation.
  - Wollongong LEP (1990) and Draft Wollongong (West Dapto) LEP 2009. LEP 1990 identifies that the portion of the CUDP site within Wollongong LGA is presently zoned non-urban, however under the draft 2009 LEP the zoning of this area has been deferred for future resolution.
  - WDRA Planning Documents:
    - Draft West Dapto DCP 2007 (Superseded) recommends enhancements to the public transport and cycling/walking networks, upgrades to Huntley Road, Avondale Road, Cleveland Road, and a new access link aligned north-south, located to the west of the railway.
    - Draft West Dapto Staging Plan (2006) (Superseded).
    - Draft West Dapto Master Plan Report (2006) (Superseded).
- An outlined is provided of the previous Calderwood planning context comprising five significant planning resolutions to define the current status of Calderwood.

12.1.3 Chapter 3

Chapter 3 discusses the CUDP proposal including:

- Sustainability initiatives and examples of successful travel demand management measures adopted at other DLL master planned communities are described.
- The urban design principles for CUDP are defined.
- A description of a concept plan for the proposed development.
- Identification of a breakdown of land uses within CUDP including:
  - Residential – approximately 4,800 dwellings including around 280 retirement living dwellings.
  - The Town Centre will include:
    - 25,000sqm of retail floor area.
    - 20,000sqm of mixed use employment land.
    - Community facilities.
    - Public Primary School and High School.
    - Residential mixed use dwellings.
  - A village centre including:
    - 5,000sqm of retail floor area.
    - 1,000sqm of mixed use employment land.
    - Residential mixed use dwellings.
  - An additional primary school is located in the Macquarie Village precinct.
- Description of an indicative road network layout and hierarchy developed for assessment of the transport impacts of the Concept Plan incorporating a north-south sub arterial road which connects to major and minor collector roads within the CUDP.
- Discussion on potential public transport provisions and bus routes within and the CUDP.
- A mode share target for the CUDP of 80% car based journeys to work by 2031 is identified. This represents a 10% modal shift away from private vehicle use and is a 'stretch target' that DLL, in collaboration with all agency stakeholders, is determined to achieve.
- A staging plan is described which outlines the incremental community growth at CUDP from 2012 to full development achieved at 2036.

12.1.4 Chapter 4

This chapter presents an overview of existing conditions and transport infrastructure surrounding the site.

- The road classification is described.
- Arterial and sub-arterial/regional roads within the study area are identified.
- Freight Routes are identified.
- The characteristics of the existing road network in terms of carriageway and intersection controls.
- Technical assessment criteria are explained
- Existing road network performance is analysed and existing deficiencies are identified.
- The key deficiency is identified as the Princes Highway between the Southern Freeway and Illawarra Highway.
- To rectify existing traffic conditions it is considered that the F6 Freeway extension be constructed including appropriate connections to the road network.
- Existing bus and rail services within the study area are identified.
- Existing and planned cycling facilities are identified.
- Existing travel patterns based on the 2006 JTW data are established.

12.1.5 Chapter 5

This chapter identifies future transport context.

- A three-step generation, distribution and assignment traffic model covering the whole of the Illawarra Region known as the WOLSH TRACKS model was the major tool for the assessment of the transport/land use interactions. The model was recalibrated and validated for 2009 for a smaller study area for assessment.
- Future growth in vehicle trips is determined by consideration of regional growth, infill growth, external growth and CUDP growth. The land use planning assumptions agreed by DoP and RTA for each of these growth areas is discussed.
- A future regional transport network (2031) is described comprising the following infrastructure elements:
  - F6 Freeway extension: Tallawarra to Oak Flats.
  - Tripoli Way (Albion Park Bypass).
  - North-facing ramps at Tallawarra interchange.
  - Upgrade of Marshall Mount Road and Yallah Road.
- The future CUDP road network is described and future travel demands are outlined.

12.1.6 Chapter 6

This chapter provides a description of the purpose of traffic modeling in the technical assessments and describes:

- The objective of the modelling and its outputs.
- The modeling methodology and the extent of the modeled area are described.
- The development of models to represent the years of 2009 (existing) and 2031 (full CUDP) are described.
- An outline is provided as to the modeling scenarios which include road network options, travel demand options, mode share options and scenario options.

12.1.7 Chapter 7

This chapter provides a summary of the evaluation undertaken to assess the road network operation. For base assessments (without CUDP) the following scenarios are reported:

- 2031 Base 'Do Nothing' BAU Scenario - overall under 2031 base future growth scenario with no road infrastructure upgrades it is shown that the road network will be under considerable strain with key road sections and intersections failing.
- 2031 Base 'Do Minimum' BAU Scenario - overall the introduction of the 'do minimum' upgrades provides significant benefits to the 2031 road network. However some issues will still need to be resolved. It was established that under the base 2031 scenario there is insufficient demand to warrant the Tallawarra north facing Freeway ramps.
- 2031 Base 'Do Minimum' Mode Shift Scenario - overall the consideration of a 10% mode shift on regional growth areas has little impact on the road network within the CUDP area of influence.
- 2031 Base 'Do Absolute Minimum' BAU Scenario - overall the introduction of the 'do absolute minimum' upgrades provides significant benefits to the 2031 road network. However some issues will still need to be resolved. It is identified that the following works are required for satisfactory 2031 base operation (without CUDP):
  - Duplication of Princes Highway (adding an additional traffic lane):
    - Northbound from Mount Brown Road to the F6 off-ramp.
    - Southbound from Mount Brown Road to the F6 on-ramp.
  - In conjunction with the above upgrade to traffic signal control of the following existing intersections:
    - Princes Highway / Huntley Road
    - Princes Highway / Southern Freeway northbound off slip
    - Princes Highway / Cormack Avenue

- Southern Freeway southbound on-slip road upgrade to two lanes and associated freeway merge widening works to accommodate.
- Southern Freeway northbound off-slip road upgrade to two lanes and associated freeway diverge widening works to accommodate.
- Marshall Mount and Yallah Road upgrades to satisfactory one lane width in either direction with sealed shoulders.

- 2031 Base 'Do Base Upgrades' Mode Shift Scenario - The 2031 future base road network will perform satisfactorily with the 'do base upgrade' package of measures.

For the with CUDP assessment the following are reported:

- 2031 CUDP 'Do Nothing' BAU Scenario - significant sections of the existing road network would be overcapacity during both modelled peak hour periods. The extent of the road network upgrades largely mirrors the improvements required under the base 'do absolute minimum' scenarios with north-south movement through the study area along Princes Highway and east-west movements along Tongarra Road severely restricted by overcapacity road sections. Additionally movement between Princes Highway and Dapto Town Centre would also be restricted by overcapacity road sections.
- 2031 CUDP 'Do Nothing' Mode Shift Scenario - A 10% modal transfer away from private vehicle usage with the proposed CUDP would have little impact upon the extent of existing road network operating at unsatisfactory peak hour LoS.
- 2031 CUDP 'Do Minimum' Mode Shift Scenario - The 'Do minimum' upgrades go some way to providing a reasonable level of overall satisfactory road network operation although a lack of capacity is still apparent particularly on the Princes Highway and its connections to the Southern Freeway.
- 2031 CUDP 'Do Absolute Minimum' Mode Shift Scenario - The removal of the north-facing ramps at Tallawarra interchange provides no detrimental impact to road network operation.
- 2031 Base 'Do Base Upgrades' Mode Shift Scenario - This scenario identified that the modelled road network (on a mid-block capacity basis) provided a road network capable of satisfactorily accommodating the 2031 future demand (including CUDP). Intersection analysis of this scenario led to the identification of a further intersection improvements at the Marshall Mount Road and Yallah Road
- 2031 CUDP 'Do Full Development Upgrades' Mode Shift Scenario - satisfactory network performance results with all road sections operating at LoS D (or close to) during the both 2031 modelled peak hour periods.

12.1.8 Chapter 8

This chapter identifies the non private motor vehicle (PMV) mode share.

12.1.9 Chapter 9

This chapter details the initiatives developed to reduce car dependency and achieve the target modal transfer of 10% away from car modes. A range of travel demand management type measures has been identified such as:

- Timely Provision of Facilities and Services
- Fibre to the Home (FttH) and National Broadband Network
- Website/Community Portal
- Resident Kits
- Promotions
- Public transport incentives
- Land Use/Transport Interaction
- Local Access Street Design
- Pedestrian and Cycle Hierarchy
- Wayfinding Signage
- Parking Strategies

- Safety Elements for Network
- Bicycle Parking

Furthermore, a detailed range of measures to promote public transport use are recommended. These include such measures as:

- Bus Network Provision
- Service levels that meet and exceed NSWTI's Outer Metropolitan Service Planning Guidelines
- Early Bus Service Provision
- Branding and Publicity
- Bus Stop Infrastructure
- Bus Network Infrastructure

12.1.10 Chapter 10

Road infrastructure improvements identified through the technical assessment are listed as follows:

- Existing deficiencies require the implementation of the F6 Freeway extension.
- Future network deficiencies as a result of identified future development (non CUDP) require the implementation of Tripoli Way, section of Princes Highway duplicated, Southern Freeway /Princes Highway south facing ramp upgrades, Marshall Mount Road and Yallah Road upgrades and other associated intersection upgrades.
- With the addition of CUDP intersection improvements on Illawarra Highway/Yellow Rock Road and Marshall Mount Drive/Yallah Road are required along with upgrade of Calderwood Road.

12.1.11 Chapter 11

This chapter provides the details of the proposed apportionment for intersection upgrades and road improvements.

- To identify the points at which road network upgrades were required model runs were undertaken for the assessment years of 2016, 2021 & 2026.
- If it was demonstrated during an assessment year that a LoS E or worse was identified the upgrade proposal was included as part of the next assessment year.
- Road network infrastructure apportionments were determined based upon the identification of when an upgrade was required and then based upon an apportionment of the sum of all inflows to the roundabout once constructed.
- The method determines apportionment for CUDP, other regional growth areas and government.
- Potential staging of upgrade works was identified.
- Potential funding mechanisms were established for these works being undertaken as works in kind or through planning agreements (State Infrastructure Contribution or Voluntary Planning Agreement).

12.2 REVIEW AGAINST DGR AND SSS REQUIREMENTS

The following sections provide a succinct description as to how the DGR and SSS requirements in relation to transport and accessibility have been considered.

12.2.1 DGR

DGR 1: Prepare a Traffic Management Plan that considers the traffic constraints of the site and surrounding locality.

- This report in its entirety constitutes a Traffic Management Plan and considers the traffic constraints of the site and surrounding locality.
- The extent of the impact on the surrounding locality to be assessed was agreed by the RTA and is detailed in Section 1.6.

DGR 2: Demonstrate a strategy for providing linkages to regional transport networks.

- Section 5.3 and 5.4 provides a detailed description of the proposed future road network, and the links to the existing external network are documented in detail in Appendix 5-E.
- Section 6 provides an overview of the modelling methodology undertaken to assess the regional transport impact of the cumulative growth in the region including CUDP. Section 7 details the impacts of this growth and recommended road network upgrades are provide in Section 10.
- Section 9.5 provides detailed measures to be undertaken to link the CUDP to the regional public transport network through the provision of new strategic and district bus services.

DGR 3: Demonstrate that there is the ability for sites located within the release area, but not within the proponent's control, to connect to infrastructure.

- The proposed internal road network is shown in Section 3.3.2 and is discussed in further detail in Section 5.4. Proposed linkages to external roads are documented in Appendix 5-E.
- These discussions highlight that all existing roads surrounding the site will remain connected to the proposed future road network thus allowing surrounding areas to connect to the transport infrastructure.

DGR 4: Detailed traffic modelling to determine level of infrastructure needed plus annual traffic growth/approved development (including Delmo Albion Park).

- Section 5 provides an overview of the proposed future transport context including proposed changes to the future road network. It also details the assumptions in relation to growth for proposed and approved developments such as Delmo Albion Park. The growth has then been considered in terms of traffic growth through the detailed transport modelling outlined in Section 6.
- Section 7 details the impacts of this growth on the surrounding road network. Recommended road network upgrades are provide in Section 10.

DGR 5: Timing/delivery/scope of local and regional road infrastructure.

- The scope of local and regional road upgrades is documented in Section 10.
- The proposed timing and delivery method for these infrastructure improvements is documented in Section 11.

DGR 6: Network modelling for impacts on Illawarra Highway, Princes Highway/Southern Freeway, Tongarra Road, Marshall Mount Road, Yallah Road and the future Southern Freeway corridor between Yallah and Oak Flats.

- The network modelling methodology is outlined in Section 6 with growth assumptions and base network upgrades outlined in Section 5.
- The impact on the abovementioned roads is documented in Section 7.

DGR 7: Intersection modelling, using SIDRA, for any junctions likely to be impacted by the development as identified in the network modelling, including AM and PM peaks, from the occupation of the Stage 1 development to the completion of the full development of the Concept Plan site.

- Intersection modelling was undertaken using SIDRA.
- SIDRA was used to assess the base existing road network performance at key agreed intersections.
- Each of these key intersections was analysed with SIDRA to consider impact of the full development of the Concept Plan site. This is documented in Section 7.

DGR 8: Identify infrastructure including road, pedestrian and cycling infrastructure to ameliorate the impacts of the development.

- The proposed provisions for cycleways and footpaths are detailed in the *Landscape and Open Space Master Plan (LOSM)* prepared by Environmental Partnerships.
- Specific measures for improvements to pedestrian and cycling infrastructure are outlined in Section 9.4.
- The road infrastructure improvements required to ameliorate the impacts of the development (including cumulative impacts of other regional developments) is detailed in Section 10.

DGR 9: Measures to promote public transport usage and reduce car usage.

- Measures to promote public transport and reduce car usage are outlined in terms of the urban design principles in Section 3.2.
- Further detail is also provided in the *LOSM* prepared by Environmental Partnerships.
- Examples of similar measures implemented at other DLL communities are detailed in Section 3.1.
- Specific measures for inclusion in CUDP are detailed in; Section 9.3 for travel demand management measures; Section 9.4 for specific active transport measures; and Section 9.5 for specific public transport measures.

DGR 10: Identify various Travel Demand Management (TDM) measures that will optimise the opportunity provided by the projects sites proximity to public transport.

- Refer to DGR 9 above.

DGR 11: Provide a road network plan identifying the proposed road hierarchy including cycleways, footpaths and car parking. Plan should identify public, private roads and typical cross sections and long sections.

- The road network plan identifying the proposed road hierarchy is provided in Section 3.3.2. The internal CUDP road network is discussed in further detail in Section 5.4.
- The proposed provision for cycleways and footpaths are detailed in the LOSM and is also considered in the *Development Control Strategy*.
- The principles of cycleway and footpath provision are outlined in the urban design principles in Section 3.2. Specific measures for inclusion in CUDP are detailed in Section 9.4.
- Proposed car parking provision is considered in the *Development Control Strategy*. However, specific car parking requirements for individual stages will be dealt with at the relevant application stage.
- The intention at this stage is that all roads will be public roads and hence no roads have been identified as private.
- Typical road carriageway cross sections are provided in the *Development Control Strategy.*
- Detailed road carriageway cross sections and long sections for individual stages will be dealt with at the relevant application stage.

DGR 12: Prepare a Transport Management and Accessibility Plan (TMAP) generally in accordance with the Ministry of Transport's Interim TMAP Guidelines, also including:

- This report outlines the TMAP and it has been prepared generally in accordance with the Ministry of Transport's Interim TMAP Guidelines.

a. Staging/Sequencing Plan.

- Staging of the proposed road network infrastructure upgrades is detailed in Section 11.3.

b. Measures to maximise public transport, walking and cycling.

- Refer to DGR 9 above.

c. Proposed pedestrian, cycling and public transport infrastructure.

- The proposed provisions for cycleways and footpaths are detailed in the *LOSM* and are also considered in the *Development Control Strategy*.
- General principles to promote public transport and reduce car usage are outlined in terms of the urban design principles in Section 3.2.
- Specific measures for inclusion in CUDP are detailed in Section 9.4 for specific active transport measures and Section 9.5 for specific public transport measures.

d. Measures to mitigate any potential impacts on pedestrian safety.

- Providing for pedestrian safety is a fundamental DLL principle, as discussed in the urban design principles in Section 3.2.
- The proposed provisions for cycleways and footpaths are detailed in the *LOSM*.
- Specific measures for pedestrians are outlined in Section 9.4.
- More detailed measures for individual stages will be dealt with at the relevant application stage.

12.2.2 SSS Requirements

SSS 1: The suitability of the site for any proposed land use taking into consideration environmental, social or economic factors, the principles of ecologically sustainable development and any relevant State or regional planning strategy.

- The suitability of the site in terms of transport and accessibility has been assessed in detail throughout this TMAP.
- A discussion on the relevant state and regional planning policies that have been considered throughout this TMAP study has been provided in Section 2.
- The consideration of regional growth is detailed in Section 5.2 and the future transport network is considered in Section 5.3.

SSS 2: The implications of any proposed land use for local and regional land use, infrastructure, service delivery and natural resource planning.

- The need for additional transport infrastructure is detailed in Section 10 for road network upgrades and in Section 9.5 for public transport improvements.

12.3 CONCLUSIONS

The CUDP TMAP has arrived at the following conclusions:

1) The CUDP TMAP has been prepared in accordance with the Director General's Requirements and State Significant Site Study Requirements for the project (as documented in Section 12.2).
2) Assessment of existing road network operation highlighted satisfactory operation except for the Princes Highway between Illawarra Highway and Southern Freeway. A remedy would be to construct the F6 Freeway extension in view of the planned longer term land use changes within the local area.
3) Regional planning assumptions have been agreed with the DoP and RTA.
4) The modelling base network and assumption for the WOLSH TRACKS model have been agreed with the DoP and RTA.
5) A detailed assessment of the future road network performance (2031) has been undertaken for with CUDP and without CUDP development included under a range of scenarios.
6) The cumulative impact of all regional growth to 2031, including the CUDP, in the area of influence will have a significant impact on the performance of the road network. As a result a significant package of road network upgrades (34) has been identified.
7) The CUDP site will trigger only minor additional works over and above those required to address the network deficiencies due to other non-CUDP growth.
8) Timeframes were identified for when the road upgrade measures will be required.
9) CUDP, if considered in isolation, does not specifically identify the need for the significant range of road upgrades required. However, to ensure a reasonable allocation of costs between all parties benefitting from the road network upgrades, an apportionment method to split costs between CUDP, other planned/proposed land uses and Government was undertaken based upon the year which the improvement is to be implemented.
10) The technical apportionments identified that the CUDP should contribute towards an overall package of road network upgrades.
11) Funding mechanisms to deliver the works have been proposed to incorporate WIK, SIC and VPA.
12) A package of deliverable sustainable transport measures (including public transport improvement measures) has been identified whose implementation would assist in achieving a 10% mode shift away from private motor vehicles.

13

Reference List

13.1 CUDP Documents

Preliminary Assessment Report and Submission to Department of Planning on Delfin Lend Lease's Calderwood Urban Development Project, Delfin Lend Lease, February 2009.

Calderwood Release Area Justification Report, Delfin Lend Lease, June 2008.

13.2 State Government Planning Documents

Accessible Transport Action Plan for NSW Transport, Roads and Maritime Agencies December 2007 Update, NSW Government, December 2007

Action for Air 2006 Update, Department of Environment and Climate Change, August 2006

Action for Bikes: Bike Plan 2010, Roads and Traffic Authority, September 1999

Illawarra Regional Strategy 2006-2031, Department of Planning, January 2007

Moving Together – A Transport Strategy for Wollongong, Shellharbour and Kiama, Illawarra Transport Taskforce Wollongong, January 2004

NSW State Plan, NSW Government, 2009 (including *Illawarra Local Action Plan*)

Review of Bus Services in NSW Final Report, NSW Government, February 2004

State Infrastructure Strategy 2008/09-2017/18, NSW Treasury, June 2008

13.3 Local Government Planning Documents

Albion Park Traffic Study – Final Report, Maunsell, May 2006

City of Wollongong Bicycle Plan 2006-11, Wollongong City Council, October 2005

Shellharbour LGA Shared Use Path Strategy, Shellharbour City Council, 2008

Shellharbour Rural LEP 2004

West Dapto Development Control Plan 2007

West Dapto Initial Access Strategy Supporting Stages 1 & 2 – Report by Manager of Infrastructure to Wollongong City Council, 20 October 2009

West Dapto Release Area Draft Infrastructure Implementation Plan, Wollongong City Council, May 2006

West Dapto Release Area Review: Planning Report and supporting documentation, Growth Centres Commission, November 2008

West Dapto Staging Plan, Wollongong City Council, March 2006

West Dapto TMAP Extension Study, Connell Wagner, October 2008

West Dapto TMAP Stage 1 Report – Baseline Study, Kellogg Brown & Root, 2004

West Dapto TMAP Stage 2 Study– Final Report, Kellogg Brown & Root, March 2007

Wollongong Local Environmental Plan 1990

13.4 Standards and Guidelines

Draft Interim Guidelines on Transport Management and Accessibility Plans, NSW Department of Transport/Roads and Traffic Authority, n.d.

Integrating Land Use and Transport, NSW Department of Urban Affairs and Planning, August 2001

Planning Guidelines for Walking and Cycling, NSW Government, December 2004

Outer Metropolitan Service Planning Guidelines, Ministry of Transport, September 2009

13.5 Other Documents

Towards a High-Bandwidth, Low-Carbon Future – Telecommunications-based Opportunities to Reduce Greenhouse Gas Emissions, Climate Risk Pty Ltd, n.d.

RTA West Gosford Tele-centre Project, Roads and Traffic Authority, 1998/99

14

Glossary

14.1 ACRONYMS

Acronym	Full Name
AADT	Annual Average Daily Traffic
ADT	Average Daily Traffic
AS	Australian Standards
AT	Active Transport
AVD	Average Vehicle Delay
BAU	Business as Usual
BNSW	Bicycle NSW
BSWC	Bus Stop Walking Catchment
BUG	Bicycle User Group
CBD	Central Business District
CCD	Census Collector District
CCTV	Closed Circuit Television
CPTED	Crime Prevention Through Environmental Design
CSD	Conventional Suburban Development
CUDP	Calderwood Urban Development Project
DA	Development Application (defined by EP&A Act)
DCP	Development Control Plan (defined by EP&A Act)
DECC	Department of Environment and Climate Change, NSW
DGR	Director General Requirements
DIPNR	Department of Infrastructure, Planning and Natural Resources *(former)*
DLL	Delfin Lend Lease
DoP	Department of Planning, NSW
DRT	Demand Responsive Transport
DS	Degree of Saturation
EA	Environmental Assessment
EAR	Environmental Assessment Report
EP&A	NSW Environmental Planning and Assessment Act 1979
FttH	Fibre to the Home
GCC	Growth Centres Commission
GIS	Geographic Information system
HTS	Household Travel Survey
ILUT	*Integrated Land Use and Transport*
IRS	Illawarra Regional Strategy
JTW	Journey to Work
LATM	Local Area Traffic Management.
LEP	Local Environmental Plan (defined by EP&A Act)

Acronym	Full Name
LGA	Local Government Area
LoS	Level of Service
MoT	Ministry of Transport
NBN	National Broadband Network
NSW	New South Wales
NSWTI	New South Wales Transport & Infrastructure (formerly Ministry of Transport)
PMV	Private Motor Vehicle
PT	Public Transport
RTA	Roads and Traffic Authority, NSW
SD	Statistical Division
SEPP	State Environmental Planning Policy (defined by EP&A Act)
SLA	Statistical Local Area
SSS	State Significant Site
TAG	Transport Access Guide
TDC	Transport Data Centre (formerly Transport and Population Data Centre)
TND	Traditional Neighbourhood Design
TDM	Travel Demand Management
TMAP	Transport Management and Accessibility Plan
TOD	Transit Oriented Development
TP	Travel Plan
TZ	Travel Zone
VKT	Vehicle Kilometres Travelled
VMS	Variable Message Signs
VOT	Vehicle Operating Time
WDRA	West Dapto Release Area
WOLSH	Wollongong and Shellharbour (Model)

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14.2 TERMS

Term	Definition
Accessibility	The ease with which people can access or undertake a range of daily activities (employment, shopping, education, health, entertainment, social and other) in an area with a minimum of travel. The word 'accessible' is often more narrowly used to describe improvements to transport for people with physical and other disabilities.
Active Transport	Travel modes that involve physical activity - movement undertaken by active means, e.g. walking, cycling, jogging, skating, roller blading etc – including access to public transport.
Bicycle lane	A marked on-road lane provided for the movement of cyclists.
Bus lanes	Traffic lanes on a roadway that are for the use of buses. Bus lanes can be exclusively for buses and or shared with taxis and high occupancy vehicles.
Bus Priority	Traffic management measures where buses have priority over other vehicles in the traffic stream. These include bus-activated traffic signals and bus only lanes.
Census Collector District	The smallest geography for which Census data is available (comprise around 200 households each).
Connectivity	The degree to which streets join to each other.
Cycle Advisory Group	A group of stakeholder representatives that advises on improving cycling conditions.
Cycle Facility	Infrastructure that is cycling-specific, such as cycle lanes, paths and parking.
Cycle Lane	A lane marked on a road with a cycle symbol, which can only be used by cyclists.
Cycle Network Plan	A map of the primary cycle route network (see definition below) and a schedule of the cycle infrastructure projects required to develop it.
Cycle Path	An off-road path for cycles. It can be an exclusive cycle path, a shared-use path or a separated path (see definitions below).
Cycle Provision	The provision of satisfactory conditions for cycling, whether or not there are specific cycle facilities.
Cycle Planner/Champion	A road controlling authority employee who is responsible for the day-to-day planning and implementation of cycle provision in the authority's area.
Cycling Policy	A general course of action relating to cycling to be adopted by the government or an organisation.
(Cycling) Safety Audit	A formal process to identify factors that could either increase the risk of crashes involving cyclists, or increase the severity of cyclists' injuries in a crash.
Cycling Strategic Plan (or Bike Plan)	A document setting out cycling objectives and the actions required to achieve them including a cycle network plan.
Cycleway	An off-road cycling path – in almost all instances in NSW, these are shared walking and cycling paths.
Desire Lines	A straight line or fastest route between the origin and destination of a potential trip.
Developed Areas	Developed areas are considered to be those areas where more intensive land use activity occurs, such as urban residential areas, employment centres etc.
Directness	The degree to which streets lead directly, without deviation, to destinations such as accessible centres.

Term	Definition
Discretionary Users	Also known as 'choice users'. This term describes public transport users who choose to use public transport over other travel modes due to the attractiveness of the service. Generally these users would have access to a vehicle, a drivers license and ample parking at their destinations yet choose to use public transport.
Frontage	The interface between a land use and the street.
GIS	Geographic information system - a computer based mapping system. Other information can be linked to the geographic information using a data base.
Grade Separation	The vertical separation of opposing traffic movements by a bridge or underpass across a roadway, railway line etc. It contrasts with an at-grade intersection or level crossing.
Green Travel Plan	Workplace initiatives undertaken by the employer that are generally appropriate in large workplaces. The aim of these programs is to provide transport options and encouragement for employees in a workplace to encourage more sustainable travel. Travel plans can also be used for commercial, residential, educational and tourism developments. (Refer to 7-A for further information)
Level Of Service	The quality measure of how well conditions provide for road users. For motor traffic it mainly assesses interruptions to free traffic flow. For cycling, other factors such as perceived safety, comfort, and directness of route are more important.
LGA	Local government area i.e. municipality, shire or council.
Managing travel demand	Refers to measures which: • minimise the need to travel and the length of trips, particularly by cars. • Direct travel to the most sustainable mode of transport.
Mixed use centres	Centres containing a variety of services and activities such as businesses, shops, community services and entertainment facilities.
Mixed use development	Development that involves more than one activity, either vertically or horizontally, for example, housing located above shops.
Mode	The means of travel, for example, car, ferry and bicycle.
Multi-purpose trips	Trips taken for more than one purpose, for example, shopping is done on the way home from work.
Net community benefit	Development which has no detrimental effect on public or private investment in centres and which addresses the assessment criteria in this policy.
Nodes	Are centres of activity such as commercial centres, retail centres, education facilities and other centres of human activity. In the transport context they generally refer to centres that are trip origins and/or destinations.
Permeability	The degree to which streets allow pedestrians and cyclist to take short cuts and select multiple alternative route options.
Primary Cycle Network	The most used cycle facilities, designed mainly for trips across town, between suburbs and to major destinations such as schools, shopping centres etc.
Real Time Public Transport Information	Accurately predict the arrival time of buses at bus stops, based on knowing the location of the bus and then disseminating this information to the public. In other areas, this has involved the use of telemetry relaying a bus' position for analysis and arrival prediction.
Shared Use Path	A path provided for use by both cyclists and pedestrians.
Statistical Local Area	A statistical area 'usually' smaller than an LGA.
Strategic Bus Corridor	An identified corridor linking major trip attractors and generators on which frequent services and bus priority improvements are targeted.

Term	Definition
Street network	The pattern of street connections.
Surveillance	Overlooking of streets, laneways and open space areas by people using these spaces, or by people within adjacent dwellings, shops and other buildings. Surveillance generally improves security.
Sustainable transport	Has been defined as transportation that does not endanger public health or ecosystems and meets the needs for access consistent with sustainable use of renewable resources at below their rates of regeneration, and use of non-renewable resources at below the rates of development of renewable solutions (OECD, 1999) from Hans Westerman, ARRB conference, Dec. 2002.
Sustainable Transport Modes	Walking, cycling and public transport, as these modes are seen as important in achieving a more sustainable transport system in future.
Transit Oriented Development	Transit Oriented Development (TOD) is development that is built around and oriented towards public transport services. The design of transit-oriented development is such that development encourages and supports the use of public transport services and, as a corollary, development is supported and enhanced by the public transport services. TODs can be commercial, residential or a mixture of the two and are generally characterized by high to medium building development around a public transport node.
Transport Access Guide (TAG)	A Transport Access Guide presents ways to reach a site or venue using low-energy forms of transport such as public transport, walking or cycling. (Refer to 7-A for further information)
Travel Demand Management	Measures designed to minimise the need for travel as well as the length of trips, particularly by cars. TDM techniques can be broken into the following classifications: • improved transport options. • incentives to use alternative modes and reduce driving. • parking and land use management. • policy and institutional reforms.
TravelSmart	A generic name for Travel Demand Management programs designed to influence people's use of travel modes through travel behavior change. They are generally used to encourage greater use of walking, cycling and public transport.
Traffic Calming	A combination of measures (mostly changes to road environment) aimed at altering driver behavior (such as by reducing speed) and improving conditions for pedestrians/cyclists.
Trip generator	A land use that attracts people and so creates trips. This may be on a regular or irregular basis. Hospitals for example generate many trips on a regular basis, whilst events do so on an irregular basis.
Trip-generating development	Businesses and services that are frequently accessed by many people and create a demand for travel.
Vehicle kilometres Travelled (VKT)	A measure of the total distances of travel by cars, that is, the number of kilometres travelled by private car.
Walking Catchment	The distance which it can be expected that public transport users will walk to/from a public transport stop. For regular bus services this distance is generally accepted as 400 metres, however it has been observed to increase to over 1 kilometre for fast, frequent and direct public transport.

Cardno
Shaping the Future

Calderwood Urban Development Project

Concept Plan Transport Management and Accessibility Plan (TMAP)

FINAL REPORT

Prepared for Delfin Lend Lease
February 2010

Delfin
Lend Lease

Volume iI
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DOCUMENT CONTROL

FR110026
Calderwood Urban Development Project
Concept Plan Transport Management & Accessibility Plan (TMAP)
FINAL REPORT - Appendices

Version	Date	Author		Reviewer	
		Name	Initials	Name	Initials
1.0	10.12.2009	Russell Yell Adrian Bateman Sam Laybutt Anissa Levy	RY AB SL AL	Anissa Levy	AL
2.0	22.12.2009	Adrian Bateman Sam Laybutt Anissa Levy	AB SL AL	Anissa Levy	AL
3.0	22.01.2010	Adrian Bateman Anissa Levy	AB AL	Anissa Levy	AL
4.0	10.02.2010	Adrian Bateman Anissa Levy	AB AL	Anissa Levy	AL
5.0	18.02.2010	Adrian Bateman Anissa Levy	AB	Anissa Levy	AL

Table of Contents

Appendices

Appendix 1A

Director General Requirements (DGR)

Part 3A – Project Application
Director-General's Requirements
Section 75F of the *Environmental Planning and Assessment Act 1979*

Application No.	MP 09_0082 (Concept Plan) and MP 09_00083 (Stage 1 Project Application)
Project	**Concept Plan and Stage 1 Project Application – Calderwood Urban Development Project**
Site	Land at Calderwood (refer to attached schedule)
Proponent	Delfin Lend Lease
Date of Issue	10 June 2009 *(If the environmental assessment is not exhibited within 2 years after this date, the applicant must consult further with the Director-General in relation to the preparation of the environmental assessment.)*
General Requirements	The Environmental Assessment (EA) must include: (1) An executive summary; (2) A detailed description of the project including the: (a) strategic justification for the project; (b) alternatives considered; and (c) various components and stages of the project in detail (and should include infrastructure staging); (3) A consideration of the following with any variations to be justified: (a) all relevant State Environmental Planning Policies, (b) all applicable planning instruments, including relevant Council LEP and DCP instruments, and (c) relevant legislation and policies, including the *Illawarra Regional Strategy.* (4) A draft Statement of Commitments, outlining commitments to the project's management, mitigation and monitoring measures with a clear identification of who is responsible for these measures; (5) A detailed conclusion justifying the project, taking into consideration the environmental impacts of the proposal, mitigation measures to address these impacts, the cumulative impacts of the proposal, the suitability of the site, and whether or not the project is in the public interest; (6) Identify the development contributions applicable to the site and, if relevant, and any public benefits to be provided with the development, and consider any relevant development contributions plans prepared to date; (7) A signed statement from the author of the EA certifying that the information contained in the report is neither false nor misleading; and (8) A report from a quantity surveyor identifying the correct capital investment value for the concept plan and the stage 1 project application.
Key Assessment Requirements	**Strategic Planning** • Demonstrate consistency with the revised MDP boundary as discussed in the Illawarra Regional Strategy, and justification for any variation. • Demonstrate that the site can be serviced independently of the West Dapto release area, and therefore will not significantly impact upon the provision of infrastructure for West Dapto. **Urban Design** • Undertake a site analysis that identifies the relevant natural and built environmental features. The site analysis should form the basis for justifying the configuration of the development of the land and the mix of land uses. • Provide suggested new controls and urban design guidelines to regulate the development, including the subdivision pattern, lot sizes, development controls and management arrangements. • Details of the proposed landscaping and open space areas.

- View analysis, including artist's perspective and photomontages.
- Staging and timing of the development of the site.
- Linkages with existing and proposed urban development adjoining the site.
- Aircraft noise and aircraft safety issues due to the proximity of the Illawarra Regional Airport.

Transport and Accessibility

- Prepare a Traffic Management Plan that considers the traffic constraints of the site and surrounding locality.
- Demonstrate a strategy for providing linkages to regional transport networks.
- Demonstrate that there is the ability for sites located within the release area, but not within the proponent's control, to connect to infrastructure.
- Detailed traffic modelling to determine level of infrastructure needed plus annual traffic growth/approved development (including Delmo Albion Park).
- Timing/delivery/scope of local and regional road infrastructure.
- Network modelling for impacts on Illawarra Highway, Princes Highway/Southern Freeway, Tongarra Road, Marshall Mount Road, Yallah Road and the future Southern Freeway corroder between Yallah and Oak Flats.
- Intersection modelling using SIDRA for any junctions likely to be impacted by the development as identified in network modelling, including AM and PM peaks, from the occupation of the Stage 1 development to the completion of the full development of the Concept Plan site.
- Identify infrastructure including road, pedestrian and cycling infrastructure to ameliorate the impacts of the development.
- Measures to promote public transport usage and reduce car usage.
- Identify various Travel Demand Management (TDM) measures that will optimise the opportunity provided by the projects sites proximity to public transport.
- Provide a road network plan identifying the proposed road hierarchy including cycleways, footpaths and car parking. Plan should identify public, private roads and typical cross sections and long sections.
- Prepare a Transport Management and Accessibility Plan (TMAP) generally in accordance with the Ministry of Transport's *Interim TMAP Guidelines*, also including:
    - Staging/Sequencing Plan;
    - Measures to maximise public transport, walking and cycling;
    - Proposed pedestrian, cycling and public transport infrastructure, and;
    - Measures to mitigate any potential impacts on pedestrian safety.

Biodiversity

- Address the impact of the development on existing native flora and fauna and their habitats, including identified threatened species (eg. Illawarra Lowland Grassy Woodland, and *Lespedeza juncea* and *Chonzema parviflora* species), having regard to the Threatened Species Assessment Guidelines and recommend offset measures to avoid or mitigate impacts on threatened species and their habitat.
- Evaluate the ecological values of Johnsons Spur and Yallah-Calderwood Regional Habitat Corridor on this site for development (including any road upgrades).
- Identify the ecological attributes of the lands proposed for dedication and how the environmental land offsets scheme will mitigate the impacts of the development.
- Discuss the development of ecological corridors to link flora and fauna corridors both on and adjoining the site.

Flooding

- Assessment of any flood risk for the site should be conducted in accordance with the NSW Government's Flood Prone Land Policy as set out in the Floodplain Development Manual 2005.
- Flood Study Report for existing conditions is to be prepared to include hydrologic and hydraulic models, calibration against existing local flood records, downstream and upstream conditions, and floodplain characteristics.

	• Flood Risk Management Assessment Report for the development including estimation of Flood Planning Levels and Flood Planning Area, extent of flood prone and mapping, flood behaviour, flood risks up to the PMF, evacuation, and impacts of climate change.
	• Consider Shellharbour Council's Floodplain Risk Management DCP and justify any departure.
	• Consideration of upstream and downstream flows and impacts of development yet to be built.
	• Assess geomorphic impacts on the watercourses and floodplain area affected by the proposal.
	
	Water Courses/Riparian Corridors
	• Detail protection of watercourses of riparian lands in relation to the following
	  ○ The NSW State Rivers and Estuaries Policy;
	  ○ The NSW Wetlands Management Policy;
	  ○ The State Natural Resource Management Targets (particularly Targets 1 & 5);
	  ○ Stream mapping including watercourses on the site, riparian corridors, APZs and proposed revegetation of riparian corridors.
	• Surface Water and Groundwater assessment including any proposed surface water and groundwater extraction volumes, function and location of proposed storage/ponds, design, layout, pumping and storage capacities, and all associated earthworks and infrastructure works.
	• Details on any water management structures/dams both existing and proposed including size and storage capacity.
	• Identify groundwater issues including predicted highest groundwater table at the site, works likely to affect groundwater surfaces, and proposed extraction, prevention of groundwater pollution.
	• Provide a scaled plan to detail and wetlands on or adjacent to the site, buffer setbacks, any Asset Protection Zones and the footprint of the proposed development.
	• Assess any potential impact on surrounding waterways and wetlands in terms of water quality, aquatic ecosystems and riparian corridors. This should include but not be limited to:
	  ○ Onsite pollution such as accidental spills and sewer overflows;
	  ○ Risks such as weed invasion, encroachment and litter; and
	  ○ Vegetated buffer zones.
	
	Drainage and Stormwater Management
	• The EA should address drainage and stormwater management issues, including: on site detention of stormwater; water sensitive urban design (WSUD); and drainage infrastructure.
	• Consider Shellharbour Council's Stormwater Policy and Subdivision Code for stormwater design and infrastructure, and justify any departure.
	
	Ecologically Sustainable Development (ESD)
	• Detail how the development will incorporate ESD principles in the design, construction and ongoing operation phases of the development including water sensitive urban design measures, water re-use, energy efficiency, energy minimisation/generation, recycling, waste disposal and trip containment.
	
	Heritage
	• A heritage impact statement should be prepared in accordance with NSW Heritage Office guidelines. The statement should assess the impacts of the application on the area and any significant components of the site. The heritage significance of the area and any impacts the proposed development may have upon this significance is to be assessed.

- The EA is to identify the nature and extent of impacts on any Aboriginal cultural heritage and address the requirements set out in the *draft "Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation"*.

Bushfire Risk Assessment

Provide an assessment against *Planning for Bush Fire Protection 2006*. The EA is to identify the ongoing management arrangements of any proposed APZs.

Utilities Infrastructure

- Prepare a utility and infrastructure servicing strategy detailing supply of water, sewerage, stormwater, gas, electricity and telephone services.
- Consideration should be given to technologies which may reduce the demand or need for servicing or provide for the supply of sustainable services.

Social and Community

- Demonstrate that the appropriate housing diversity and affordability are provided.
- Provide a social assessment of the project giving consideration to the range of possible social impacts and identify positive and negative social impacts of the project, including measures to ensure the development will integrate socially with local communities.
- Demand for social and community facilities and proposed S94 contributions.
- Details of open space and community facilities, ongoing maintenance, and arrangement for public use, especially as the site is in 2 local government areas.

Agricultural land

Address the impact of the development on primary production values and practices of adjoining rural areas and whether any impacts on regional significant areas of food production may result.

Planning Agreements and/or Developer Contributions

- The environmental assessment should address and provide the likely scope of planning agreement (should one be proposed) and/or developer contributions between the proponent, Council and other agencies for matters such as community, regional and local infrastructure.
- It should address demand, proposed services, local and regional services and cross boundary/LGA issues.

STAGE 1 PROJECT APPLICATION

Site Preparation Works

The EA should include the following:

- Detailed site survey
- Any likely geotechnical impacts and mitigation measures
- Groundwater details
- Erosion and sediment controls
- Any potential contamination on the site
- Cut and fill proposed and whether any fill is proposed to be imported or exported to/from the site

Subdivision Works

- Detailed subdivision layout, including covenants, easements and notations proposed for each land title.
- Detailed design of infrastructure including roads (including typical cross sections and long sections), drainage, open space, pedestrian and bicycle infrastructure.
- Staging plan.

Test of Adequacy	If the Director-General considers that the Environmental Assessment does not adequately address the Environmental Assessment Requirements, the Director-General may require the proponent to submit a revised Environmental Assessment to address the matters notified to the proponent. The Director-General may modify these requirements by further notice to the proponent.
Consultation Requirements	During the preparation of the Environmental Assessment, you should undertake an appropriate level of consultation with the relevant Local or State government authorities, service providers, and other stakeholders. In addition the EA is to include written evidence of consultation with the following: **Agencies, other authorities and groups:** • Wollongong City Council • Shellharbour City Council • NSW Roads and Traffic Authority • NSW Ministry of Transport • Department of Environment and Climate Change • Department of Water and Energy • Lake Illawarra Authority • NSW Rural Fire Service • Department of Primary Industries • Department of Education and Training • All relevant utility providers A detailed community engagement strategy for the project
Deemed Refusal Period	60 days (see Clause 8E of the *Environmental Planning and Assessment Regulation 2000).*
Application Fee Information	The application fee is based on Capital Investment Value (CIV) of the project as defined in the Major Projects SEPP and as set out in Clause 8H of the *Environmental Planning and Assessment Regulation 2000.* To verify the cost of works for this project you are requested to submit a **Quantity Surveyor's** report to detail the CIVs of the Concept Plan and the Stage 1 Project Application.
Landowners Consent	Landowner's consent is to be provided in accordance with the *Environmental Planning and Assessment Regulation 2000.*

Appendix 1B

Minister for Planning Declaration Letter

NSW GOVERNMENT
Department of Planning

22 April 2009

Contact: Michelle Cramsie
Phone: 9228 6534
Fax: 9228 6570
Email: michelle.cramsie@planning.nsw.gov.au

Our ref: MP 09-0082 & MP 09-0083

Mr Bill Mitchell
Project Director – Calderwood Valley
Delfin Lend Lease
Ropes Crossing Boulevarde
ROPES CROSSING NSW 2760

Dear Mr Mitchell,

Calderwood Urban Release Area – Concept Plan, Stage 1 Project Application and Proposed State Significant Site Listing

I write in response to the letter of 6 February 2009 from Mr Simon Basheer concerning the above project.

I am pleased to advise you that on 16 April 2009, pursuant to Clause 6 of the Major Projects SEPP, the Minister for Planning formed the opinion that the proposed development constitutes a Major Project and also authorised the submission of a Concept Plan for the site. In doing so the Minister also formed the opinion that a State significant site (SSS) study be undertaken to determine whether to list the site a State Significant site in Schedule 3 of the *State Environmental Planning Policy (Major Projects) 2005*. Please find attached the SSS study requirements (Appendix 1).

As discussed, we intend to hold a planning focus meeting with Council and agencies to assist in the preparation of Director General's Environmental Assessment Requirements. In order to progress this matter please provide eight (8) hard copies of the preliminary assessment report prepared by Delfin Lend Lease dated February 2009, and any other additional information that may assist stakeholders to identify the key issues which may be included in the DGRs.

Should you have any questions please do not hesitate to contact Michelle Cramsie on 9228 6534 or by email at michelle.cramsie@ planning.nsw.gov.au

Yours sincerely

Michael File
Director, Strategic Assessments

Scope of study to be undertaken to determine whether the Calderwood Urban Development Project should be inserted in Schedule 3 to the *State Environmental Planning Policy (Major Projects) 2005*

The following issues will be considered and assessed as part of the study to be undertaken pursuant to clause 8 of the *State Environmental Planning Policy (Major Projects) 2005* (Major Projects SEPP) to determine whether the site should be included as a State significant site in Schedule 3 to the SEPP:

(a) the State or regional planning significance of the site (having regard to the Department of Planning's *Guideline for State Significant Sites under the Major Projects SEPP*);

(b) the suitability of the site for any proposed land use taking into consideration environmental, social or economic factors, the principles of ecologically sustainable development and any relevant State or regional planning strategy;

(c) the implications of any proposed land use for local and regional land use, infrastructure, service delivery and natural resource planning;

(d) those parts of the site which should be subject to Part 4 of the *Environmental Planning and Assessment Act 1979* with Council as consent authority;

(e) the development controls for the site that should be included in Schedule 3 of the Major Projects SEPP generally in accordance with the provisions of the *Standard Instrument (Local Environmental Plans) Order 2006* and;

(f) the means by which local and regional developer contributions should be secured in respect of the site.

(g) ecological characteristics such as critical habitat and threatened species.

(h) appropriate arrangements for the dedication of land to council for public open space purposes.

Appendix 1C

Minutes of Agency Consultation

CALDERWOOD URBAN DEVELOPMENT PROJECT (FR110026)
SUMMARY RECORD OF AGENCY CONSULTATION/WCC

Date:	Monday 2 November 2009 – 10.30am At Wollongong City Council	
Project team member / firm	Bill Mitchell (BM) – Calderwood Project Director – Delfin Lend Lease Martin Wells (MW) – Infrastructure Engineer – Cardno Anissa Levy (AL) – Transport and Accessibility Engineer – Cardno	
Organisation	Wollongong City Council	
Name of Contact:	Ted Collins (TC)	Andrew Byers (AB)
Position in Organisation:	Traffic Unit Manager Strategy and Planning Branch Infrastructure Division	Traffic & Transportation Engineer
Contact details	Ph 02 4251 0664 Mb 0419 236 124 Fax 02 4225 1138	

Form of Consultation **Face to face** Phone call Email

Issues Outcomes Discussed	**1. Bill Mitchell** a. Presented background on DLL projects in NSW *TC: WCC not in position to comment at the moment but will listen.*
	2. Bill Mitchell a. Discussed background and context of Calderwood project (refer Briefing Note tabled at meeting) b. Noted documents, timeframes, status. (refer Briefing Note) c. Consultation is consistent with other agency consultations. Most consultation completed except: RTA, MoT, Telstra, DPI, SCC (traffic, water, community), WCC (water) *TC: Asked if plans had progressed beyond schematic?* *BM: Noted that the Master Planning being done new. Iterative process*
	3. Anissa Levy a. Noted that no formal previous correspondence with the WCC had taken place b. Acknowledged that WCC had provided 2006 and 2026 WOLSH Tracks Models via the RTA c. for facilitating provision of the 2006 and 2026 WOLSH Tracks Models
	4. Anissa Levy a. Provided a review of the base year modelling b. DGRs requested strategic modelling, it was agreed to use TRACKS c. Utilising the WCC 2006 WOLSH TRACKS model to develop the Calderwood 2009 model d. Traffic assessment would be carried out with the area of influence (refer to Briefing Note attachment) e. Review Calibration of the model f. Carry out an existing deficiency analysis based on model output and new junction counts

5. Anissa Levy & Bill Mitchell

a. Principles of Integrated Land Use & Transport Planning
b. Urban design principles, community designed for more than just car
c. Early provision infrastructure to influence behaviour e.g. bus services, walking and cycling paths, retail and education facilities
d. Negotiations will commence soon with MoT and bus operators
e. Ropes Crossing has 25km cycleways with linkages to the village centre
f. Woolworths/Coles at early stages and built with 5 star green rating
g. From July 2010 the National Broadband Network (NBN) requirements will be for Fibre to the Premises (FTTP).
h. Other travel demand management measures such as householder packs, travel guides, community support
i. Mode share targets are to be set

TC: Asked if measures will form part of the TMAP?
AL: Cardno will work with DLL to establish cycle paths, safer routes to schools initiatives, buses etc for TMAP therefore justification for mode share. Next step establish mode share targets
AL: Asked if the MST for was assumed to be 15%?
TC: No defined target. Just modelling various scenarios. Heading between 15-20%
TC: Targets difficult to establish and that it would be good to demonstrate track record.
BM: Residents only there between 1 &2 years and difficult to establish MS at this stage esp. with construction related traffic.
TC: It would be worthwhile interviewing Ropes Crossing residents for mode split information. Luke Preston from SCC did his undergraduate thesis on trip generation
BM: Noted that the empirical evidence was in the sales.

6. Anissa Levy

a. Provided an overview of the 2031 TRACK modelling
b. 2031 selected as this is full development for this site
c. An assumed set of major road network upgrades were assumed to be required (refer to Briefing Note attachment)
d. Review of potential growth as a result of development in the region was assumed to be as per map and table provided (refer to Briefing Note attachment)
e. Outside of the above areas, growth was assumed to be as per the 2026 model, extrapolated to 2031.
f. Presented an indicative map showing the Calderwood North/South Link (refer to Briefing Note attachment) connecting at Yellow Rock Road in the south

TC: Marshall Mt Road of particular interest to WCC
AL: Noted that the internal road link – still being debated but likely to be high level sub-arterial road

7. Anissa Levy

a. Outlined the process to assess the traffic impact
b. Identify potential road network deficiencies
c. Develop package of mitigation measures
d. Test package of mitigation measures
e. Determine staging of mitigation measures

AL: Noted that interim models will be developed for staging

8. Martin Wells

a. Provided an overview of funding for infrastructure provision, including cost apportionment and VPA versus a SIC

TC: Noted that there is a need to model other loads (Balance of Calderwood) to get apportionment

Actions Arising	1. Minutes to be distributed (AL)

CALDERWOOD URBAN DEVELOPMENT PROJECT (FR110026)
SUMMARY RECORD OF AGENCY CONSULTATION/ RTA

Date:	Monday 2 November 2009 - 12.00pm at DoP Offices, Wollongong
Project team member / firm	Bill Mitchell (BM) – Calderwood Project Director – Delfin Lend Lease Martin Wells (MW) – Infrastructure Engineer – Cardno Anissa Levy (AL) – Transport and Accessibility Engineer – Cardno
Organisation	NSW Roads and Traffic Authority
Name of Contact:	Chris Millett (CM)
Position in Organisation:	Manager, Land Use Development Southern Region
Other Participants:	Simon Bennett (SB), DoP Michelle Cramsie (MC), DoP Linda Davis (LD), DoP
Contact details	Ph 02 4251 0664 Mb 0419 236 124 Fax 02 4225 1138

Form of Consultation **Face to face** Phone call Email

Issues Outcomes Discussed	**1. Bill Mitchell** a. Presented background on DLL projects in NSW
	2. Bill Mitchell a. Discussed background and context of Calderwood project (refer Briefing Note tabled at meeting) b. Noted documents, timeframes, status. (refer Briefing Note) c. Consultation is consistent with other agency consultations. Most consultation completed except: MoT, Telstra, DPI, SCC (traffic, water, community), WCC (water) *LD: Enquired about the % developable land* *BM: Still as per Pg 22 of the justification report (not much changed).*
	3. Anissa Levy a. Noted that previous correspondence with the RTA had taken place b. Thanked RTA for facilitating provision of the 2006 and 2026 WOLSH Tracks Models *CM: Noted that the RTA models were still not sufficiently advanced for use in this project* *AL: Cardno work has taken account of this – see below.*
	4. Anissa Levy a. Provided a review of the base year TRACK modelling b. Utilising the WCC 2006 WOLSH TRACKS model to develop the Calderwood 2009 model c. Traffic assessment would be carried out with the area of influence (refer to Briefing Note attachment) d. Review Calibration of the model e. Carry out an existing deficiency analysis based on model output and new junction counts

BM	**5. Anissa Levy & Bill Mitchell** a. Principles of Integrated Land Use & Transport Planning b. Urban design principles c. Early provision infrastructure to influence behaviour e.g. bus services, walking and cycling paths, retail and education facilities. For example: i. Ropes Crossing has 25km cycleways with linkages to the village centre ii. Woolworths/Coles at early stages and built with 5 star green rating d. From July 2010 the National Broadband Network (NBN) requirements will be for Fibre to the Premises (FTTP). e. Other travel demand management measures such as householder packs, travel guides, community support f. Mode share targets are to be set *LD: Enquired what the mode share targets would be* *AL: Advised they would be conservative with a 10% mode shift to achieve a 15% mode share to non-car based transport.* *CM: Noted that the RTA would like to see information from other developments in relation to mode share* *BM: Ropes Crossing has introduced measures to deliver a 80:20 to 70:30 MS. Difficult to establish actual rates due to construction/thru traffic/other issues such as timeframe* *CM: RTA agrees on the principles.* *SB: Asked if empirical evidence was available* *LD: Suggested Ropes Crossing could be an example* *BM: Asked if others such as WDRA had been required to provide empirical data?* *LD: Suggested a combined approach where a conservative MST was used for considering impacts on roads, and 'aspirational' targets be used when considering other measures* *MW: Noted this had impact on affordability – and may overprovided for some or all mode types* *AL: Design for future mode shift with consideration of aspirational items* *BM: Noted DLL would provide empirical evidence of putting mode share items in place* *CM: Noted that the RTA encourage mode share initiatives*
	6. Anissa Levy a. Provided an overview of the 2031 TRACK modelling b. 2031 selected as this is full development for this site c. An assumed set of major road network upgrades were assumed to be required (refer to Briefing Note attachment) d. Review of potential growth as a result of development in the region was assumed to be as per map and table provided (refer to Briefing Note attachment) e. Outside of the above areas, growth was assumed to be as per the 2026 model, extrapolated to 2031. f. Presented an indicative map showing the Calderwood North/South Link (refer to Briefing Note attachment) connecting at Yellow Rock Road in the south *CM: Asked if Marshall Mt Rd was being included* *AL: Indicated it was*
	7. Anissa Levy a. Outlined the process to assess the traffic impact b. Identify potential road network deficiencies c. Develop package of mitigation measures d. Test package of mitigation measures e. Determine staging of mitigation measures *MW: Asked RTA to comment on the methodology as we can't afford to change assumptions in Feb 2010* *CM: Noted that the process seems logical, but would need to discuss with Nick Boyd and provide feedback in a week.* *AL: Asked the RTA to also comment on area of influence* *CM: Noted it seemed reasonable – to confirm in 1 week.* *AL: Noted that interim models will be developed for staging*

	8. Martin Wells a. Provided an overview of funding for infrastructure provision, including cost apportionment and VPA versus a SIC *MW: Noted that there would be consideration of VPA vs. SIC and asked after the progress of the regional SIC.* *CM: Noted that the proposed upgrade roadworks (by Cardno), dotted lines on the map, were indicative of SIC (except Tripoli Way).* *BM: Asked if there was a timeframe for the SIC?* *LD: Difficult to commit as it had to get Cabinet approval. Noted that it will relate to local infrastructure contribution* *SB: Advised that it was likely to have a number by the Pre-lodgement meeting. Noted that VPA or works in kind (WIK) would be considered. Benchmark against SIC* *BM: Asked if principles of Nexus had been applied* *LD: Yes, nexus had been applied* *BM: Asked if the deliverability of other projects had been considered?* *LD: DoP had to make some assumptions* *CM: RTA will provide comment on planning assumptions made by DLL/Cardno in 1 week.* *AL: Need to draw line in the sand and not re-model if RTA later considers some development may not happen* *CM: Acknowledge that the RTA also needs to draw line in the sand. Comfortable looking at numbers of developments proposed. Proportional contribution from developers to be considered.* *AL: More discussion to occur when looking at staging.* *BM: DLL vs VPA/ RTA SIC. What if RTA spends SIC elsewhere - WIK and $ contribution with payment schedule. DLL prefer WIK where it benefits DLL customers* *CM: RTA's spend would have to be reasonable* *LD: Had written SIC for WDRA - now need to re-write, based on GCC framework* *BM: How can we insulate against change of scope?* *CM: RTA list of indicative projects. High level. Contribution will be set at outset* *MW: Asked if the SIC will be exhibited* *LD: Yes will require Public Exhibition* *BM: If SIC had been developed as per the Planning circular, nexus and WIK would be considered and provide a level playing field* *CM: Noted that the preparation of Calderwood impact should consider impact on proposed roads.*
	9. Anissa Levy a. Presented an indicative map showing the Calderwood North/South Link (refer to Briefing Note attachment) connecting at Yellow Rock Road in the south *CM: Asked if there would be a potential connection to F6 extension.* *AL: Noted, not at this stage*
Actions Arising	1. RTA to provide comment on the methodology and area of influence within 1 week (CM) 2. DLL to provide information on TDM measures implemented at other projects (BM) 3. Minutes to be distributed (AL)

CALDERWOOD URBAN DEVELOPMENT PROJECT (FR110026)
SUMMARY RECORD OF AGENCY CONSULTATION/ MOT

Date:	Thursday 5 November 2009 - 2.00pm at MoT Offices, Elizabeth Street, Sydney
Project team member / firm	Bill Mitchell (BM) – Calderwood Project Director – Delfin Lend Lease Tamara Rasmussen (TR) - Development Manager - Community and Education - Delfin Lend Lease Martin Wells (MW) – Infrastructure Engineer – Cardno Anissa Levy (AL) – Transport and Accessibility Engineer – Cardno
Organisation	Ministry of Transport
Name of Contact:	David Hartmann (DH)
Position in Organisation:	A/Transport Planning Manager Centre for Transport Planning and Product Development NSW Transport & Infrastructure
Contact details	Ph 02 4251 0664 Mb 0419 236 124 Fax 02 4225 1138

Form of Consultation **Face to face** Phone call Email

Issues Outcomes Discussed	**1. Bill Mitchell** a. Presented background on DLL projects in NSW *DH: Advised the following:* *- MoT has been contacted by DoP, RTA & SCC* *- MoT will be different in March due to re-structure* *- MoT has no view on the project as yet*
	2. Bill Mitchell a. Discussed background and context of Calderwood project (refer Briefing Note tabled at meeting) b. Noted documents, timeframes, status. (refer Briefing Note) c. Consultation is consistent with other agency consultations. Most consultation completed except: MoT, Telstra, DPI, SCC (traffic, water, community), WCC (water) *DH: Program is up to DoP, MoT has own timeframes and is meeting them* *TR: Structure Plan is indicative and is being revised during current process*
	3. Anissa Levy a. Noted that no previous formal correspondence with the MoT had taken place

BM	**4. Anissa Levy & Bill Mitchell** a. Principles of Integrated Land Use & Transport Planning b. Urban design principles c. Early provision infrastructure to influence behaviour e.g. bus services, walking and cycling paths, retail and education facilities d. For example, Ropes Crossing has 25km cycleways with linkages to the village centre e. Woolworths/Coles at early stages and built with 5 star green rating f. From July 2010 the National Broadband Network (NBN) requirements will be for Fibre to the Premises (FTTP). g. Other travel demand management measures such as householder packs, travel guides, community support h. Mode share targets are to be set *DH: Advised the following:* *- RTA had produced a document on tele-commuting/Broadband which may be useful* *- MoT focussing on peak periods* *- MoT would like to see TDM measures included in SOC* *- State Gov't no longer collects contributions for PT services, no provision in the Sic for services* *- Integrated Network Planning (INP) (Bus) being undertaken o be consulted around March 2010* *- Adrian DeSanti is looking after the INP review for Illawarra Region* *- State Plan has 'revitalised' mode share targets of 15% (non –car based for JTW) to Wollongong CBD* *- regional transport strategies are to be developed in 2010* *- Transport Blueprint for NSW being prepared* *BM: NBN documentation indicates reduced traffic generation*
	5. Tamara Rassmussen a. DLL would like to facilitate early provision of bus services b. DLL will initiate conversations with MoT and Bus operators *DH: Noted that provision of new bus services was MoT responsibility not operators*
	6. Anissa Levy a. Provided a brief review of the base year TRACKS modelling *DH:* *- MoT not too concerned about the modelling but was mostly concerned about the MST and buses* *- MoT want stretch targets* *- MoT would like to see stretch targets for MST* *- consider options such as satellite parking* *- For buses consideration should be given to interchange locations, street furniture, wide streets, bus stop locations, facilities, bus priority* *- Timing is important to MoT, given consideration to when schools in place and when roads will be built* *- Consideration to be given to density around 'hubs' with mixed use developments* *- Tullimbar had god planning principles applied* *AL: Noted that there is push-pull between agencies in relation to MST* *DH: Noted we cannot expect to keep a 95-5 MS* *TR: Noted that NBN is not just about tele-commuting but home based businesses* *DH: MoT would like to see empirical evidence of MS* *BM: Empirical evidence of introduction of agreed measures will be presented. Extremely difficult to establish actual rates due to construction/thru traffic and other issues* *DH: Report should be focussed on how we can achieve a 15%MS*
	7. Anissa Levy a. Noted that no previous formal correspondence with the MoT had taken place
Actions Arising	1. Minutes to be distributed (AL)

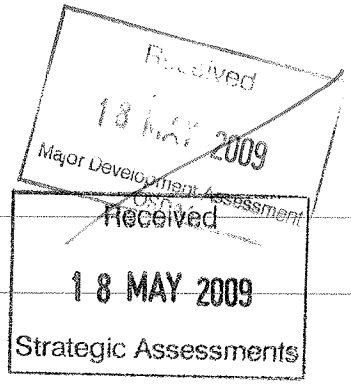
Calderwood Urban Development Project
Summary Record of Agency Consultations

Date	**11.12.09**		
Project team member / firm	**Tamara Rasmussen**		
Organisation	**Premier Illawarra (bus services)**		
Name of contact	**Stuart Blair and Sunny Brailey**		
Position in organisation	**Operations Manager and Contracts Manager**		
Contact details	**stuart@premierillawarra.com.au; sunny@premierillawarra.com.au**		
Form of Consultation	**Face to face**	~~**Phone call**~~	~~**Email**~~
Issues discussed / outcomes	▪ Sunny asked that DLL consider road widths when designing the new community (to accommodate buses) ▪ Sunny noted that if regular bus services are expected to travel along Calderwood Road, this, along with any potential increase in traffic nos, may warrant an upgrade of the Calderwood Road bridge. Currently, school buses travel along Calderwood Road and have to give way to cars as both cannot travel on at once due to the crossing width. ▪ Premier Illawarra would like to have buses in place prior to the first resident ▪ Premier Illawarra are happy to stage delivery of the service with the development ▪ Sunny noted that it would take approx. 6 months to implement the service from time of MOT approval for proposal ▪ Premier Illawarra noted that the Calderwood services would likely be new services, rather than extensions of existing services. This is due to the scale of the development and the fact that the existing services are already long. ▪ Sunny noted that the new services would potentially link Calderwood with the railway stations (Albion Park Rail and Oak Flats) and the Stockland Mall in Shellharbour.		
Actions arising	▪ TR to continue to liaise with Premier Illawarra throughout re-zoning process ▪ TR to send Sunny and Stuart copy of the Regional Context Plan and Concept Plan		

Appendix 1D

DLL/RTA Correspondence

Our Ref: 401da60 (09/600)
Contact: Chris Millet (42212523)
Your Ref: MP 09_0082, MP 09_0083



Major Development Assessment
Department of Planning
GPO Box 39
SYDNEY NSW 2001

14 MAY 2009

Attention: Michelle Cramsie

SHELLHARBOUR CITY COUNCIL – MP 09_0082 & MP 09_0083 – CALDERWOOD VALLEY RELEASE AREA, CALDERWOOD VALLEY

Dear Sir

Reference is made to your letter dated 8 May 2009 regarding the subject Part 3A Project Application forwarded to the RTA for consideration.

The RTA has reviewed the information provided. In addition to the draft key assessment requirements outlined in your letter under the heading "Transport and Accessibility", the RTA considers that the following information should be addressed in the Environmental Assessment (EA):

- Network modelling is required to assess the impacts of the proposal on the Illawarra Highway (HW25), Princes Highway (HW1)/Southern Freeway (F6), Tongarra Road (MR262), Marshall Mount Road, Yallah Road and the future Southern Freeway corridor between Yallah and Oak Flats. Given that there is no firm commitment to the extension of the F6 from Yallah to Oak Flats at this stage, the modelling needs to consider the impact of the development with and without the future Southern Freeway extension between Yallah and Oak Flats. The RTA recommends the use of TRACKS to undertake this assessment and that the proponent liase with the RTA, together with traffic representatives from Wollongong and Shellharbour City Councils, prior to undertaking this analysis. Once the network modelling has been completed the RTA recommends that it is submitted to the RTA with analysis and comments for acceptance prior to proceeding with detailed intersection modelling.
- Intersection modelling using SIDRA should be undertaken for any junctions likely to be significantly impacted by the proposal as identified by the network modelling. The modelling should consider the impact of the development in AM and PM peak periods at occupation and 10 years after occupation. This includes consideration to road infrastructure required at key junctions and intersections on the State Classified Road Network, including the following:
  - Southern Freeway/Princes Highway and the Old Princes Highway (in the vicinity of Tallawarra) for traffic accessing the site to and from the north via Marshall Mount Road, Yallah Road and the Old Princes Highway
  - Princes Highway and the Illawarra Highway
  - Illawarra Highway, Tongarra Road and Terry Street
  - Illawarra Highway and the proposed site access
  - Illawarra Highway and the proposed Albion Park Bypass
  - Any other intersection identified through the network modelling process to be significantly impacted upon by the development.

- The proponent should identify infrastructure, including road, public transport, pedestrian and cycling infrastructure, required to ameliorate the impacts of the development, for both the Stage 1 application and the overall concept plan application. This should be done cognizant of current road safety and accessibility guidelines.
- The proponent should identify appropriate planning mechanism/s to ensure that the infrastructure will be provided, e.g. through a Voluntary Planning Agreement. It should be noted that the RTA are unlikely to support the proposal, including an access to the Illawarra Highway as proposed in Stage 1, unless suitable planning mechanisms are in place and consultation has taken place with relevant stakeholders.
- The RTA recommends that the developer considers the environmental impacts of any proposed roadworks as part of the Statement of Environmental Effects. If these impacts are not considered, then the RTA would require the applicant to provide a separate environmental impact assessment, a 'Review of Environmental Factors' prior to commencing any works that were conditioned as requirements of the development

  Note: The RTA has a responsibility to ensure that all environmental impacts are considered to the fullest extent possible under Section 111 of the Environmental Planning and Assessment Act.

The RTA will commence its detailed assessment once the aforementioned information is provided to its satisfaction. Should you require any clarification on this matter please call Chris Millet on 4221 2570.

Yours faithfully

14 MAY 2009

Trish McClure
Manager, Road Safety and Traffic Management
Southern Operations & Engineering Services

Our Ref FR110026
Contact Anissa Levy

30 September 2009

Trish McLure
Manager, Road Safety and Traffic Management
Roads and Traffic Authority
PO Box 477
Wollongong NSW 2520

CC: Chris Millett
Nick Boyd

Cardno (NSW) Pty Ltd
ABN 95 001 145 035
Transportation and
Traffic Specialists

Level 3
910 Pacific Highway
Gordon, NSW 2072
Australia

Phone: 61 2 9496 7700
Fax: 61 2 9499 3902
Email:
Sydney.Traffic@cardno.com.au

www.cardno.com.au

Dear Ms McLure,

RE: UPDATED WOLSH TRACKS MODELS FOR CALDERWOOD VALLEY RELEASE AREA TRANSPORT ASSESSMENT

I am writing to you to ascertain the availability of the updated RTA WOLSH TRACKS models, which could prove useful and assist us in producing a Transport and Accessibility Assessment (TAA) for the Calderwood Valley Urban Development Release Area Part 3A Concept Plan and Project Applications.

Cardno has been appointed by Delfin Lend Lease (DLL) to produce the TAA to form part of Environmental Assessment Reports (EAR) for the Concept Plan and Project Applications. The TAA is to comply with the Director General's Requirements (DGR) issued 10 June 2009. The TAA will include the preparation of a Transport Management and Accessibility Plan (TMAP) and modelling of the impacts of the proposed development to assess appropriate mitigation measures.

The DLL proposal for Calderwood includes development of approximately 700 hectares of land in the Calderwood Valley in the Illawarra Region as a community development with potential for about 4,500 to 5,000 dwellings, which would accommodate around 12,500 people. DLL's philosophy is for the development of sustainable communities, to ensure viability and desirability into an uncertain future. Provision of an appropriate urban form, sustainable transport options and travel demand management are key components of this.

The DGRs state that "detailed traffic modelling to determine level of infrastructure needed" should be undertaken. The DGRs further state that "network modelling for impacts on Illawarra Highway, Princes Highway/Southern Freeway, Tongarra Road, Marshall Mount Road, Yallah Road and the future Southern Freeway corroder between Yallah and Oak Flats" be undertaken.

In a letter from the RTA to Shellharbour City Council dated the 14th May 2009 it is indicated that network modelling is required to assess the impacts of the proposal on the surrounding road network. Furthermore the letter recommends that TRACKS should be used to undertake this assessment. However, it should be noted that the DGRs do not specify the use of TRACKS modelling specifically.

The RTA has previously advised that they are in the process of updating the Wollongong Shellharbour (WOLSH) TRACKS models for the updated base (2011) and future (2021 and 2036) year models and that the existing 2006, 2016 and 2026 WOLSH TRACKS models are outdated in terms of planning assumptions and proposed road network upgrades. It is Cardno's preference to use the updated RTA WOLSH TRACKS models as a basis for the modelling for Calderwood if they are available for immediate use for the purposes of this assessment.

However, an email from Chris Millett (RTA) to Martin Wells (Cardno) dated the 5th June 2009 stated that both the base and future scenario models would be available within 6-8 weeks, which would have been the first or second week of August.

Discussions on another project with Nick Boyd of the RTA (August 2009) intimated that the 2036 models would be made available by the end of September 2009. Advice in an email dated 11 August 2009 also from Nick Boyd indicated that the 2011 and 2021 models may become available earlier than the 2036 models.

Could you please confirm urgently whether or not the RTA is now in a position to release the following updated RTA WOLSH TRACKS models:

- 2011 AM and PM Peak.
- 2021 AM and PM Peak.
- 2036 AM and PM Peak.

If they are not available immediately could you please advise of a date when the models will be made available.

Our client proposes to lodge the Environmental Assessment Report for their Calderwood Concept Plan and Project Application submissions for assessment under the NSW Department of Planning's strict assessment timeframes, and the modelling will form a critical part of this assessment. In keeping with the modelling for the region it is our preference to use TRACKS for this work. It would be useful to start this process with the RTA's latest TRACKS modelling as a base. If the updated RTA WOLSH TRACKS models won't be available in the very near future (to be used as a basis for this modelling) it will be necessary to discuss an alternate methodology to undertake the modelling and subsequent assessment of the impacts of the proposal on the surrounding road network.

Cardno will continue to consult with the RTA throughout the preparation of the TAA for Calderwood and would welcome input from the RTA. In particular we are seeking input from the RTA in relation to an agreed set of base arterial road network improvements to be included in the future road network for modelling up to 2036. Your advice on this matter is sought urgently. We would be happy to meet with you to discuss this matter in detail.

If you have any queries regarding this letter please do not hesitate in contacting the undersigned on (02) 9496 7809 or at anissa.levy@cardno.com.au.

Yours faithfully,

Anissa Levy
Business Unit Manager
for **Cardno Eppell Olsen**

From: MILLET Christopher P [Christopher_MILLET@rta.nsw.gov.au]
Sent: Thursday, 8 October 2009 4:29 PM
To: Russell Yell (Sydney)
Cc: MCCLURE Trish J; COLLINS Bradley J; BOYD Nick M; Andrew Byers; tcollins@wollongong.nsw.gov.au; Anissa Levy (Sydney); STEVENSON Nicole R
Subject: Calderwood Valley Release Area - TRACKS model request
Attachments: FW: TRACKS Model for Calderwood

Russell

Reference is made to your email to Trish McClure below and your email to Brad Collins earlier today (as attached). Trish is off on leave at the moment however I can provide the following advice:

TRACKS models
The RTA will provide the current TRACKS models to you early next week. At the latest, by close of business Tuesday next week (13/9/09).
However, it should be noted that the RTA is close to finalising a revised model.

Infrastructure Upgrades
The future network upgrades are dependant on future development. In this regard land releases such as Calderwood, West Dapto and Tallawarra will dictate which infrastructure upgrades are required. At this point in time the RTA does not have an adopted list of infrastructure upgrades required to ameliorate the impacts of the development and therefore cannot provide advice on these works.

Cheers

Chris Millet

Chris Millet
Manager, Land Use Development
Southern Region
Roads and Traffic Authority

P - 4221 2570
F - 4221 2777

From: Russell Yell (Sydney) [mailto:russell.yell@cardno.com.au]
Sent: Thursday, 8 October 2009 12:25 PM
To: MCCLURE Trish J
Cc: MILLET Christopher P; BOYD Nick M
Subject: RE: FR110026 Calderwood Valley Release Area - TRACKS model request
Importance: High

Hi Trish,

Following Anissa's mail I'd like to ask whether or not you're in a position to confirm the current anticipated road network upgrades proposed in the Illawarra region.

I need to notify the client before 2pm today so if you could let me know any info that'd be greatly appreciated.

Regards,

Russell

Russell Yell
Senior Transport Engineer
Phone:02 9496 7700
Fax:02 9499 3902

Email:russell.yell@cardno.com.au
Web:www.cardno.com.au

From: Anissa Levy (Sydney)
Sent: Wednesday, 30 September 2009 11:44 AM
To: MCCLURE Trish J
Cc: MILLET Christopher P; BOYD Nick M; Russell Yell (Sydney)
Subject: FR110026 Calderwood Valley Release Area - TRACKS model request

Cardno (NSW) Pty Ltd | ABN 95 001 145
Level 3, Cardno Building
910 Pacific Highway Gordon NSW 2072
Tel:02 9496 7700 Fax:02 9499 3902

Hello Trish

Cardno have been appointed by Delfin Lend Lease to undertake the Transport and Accessibility Assessment fo
Calderwood Release Area Concept Plan and Project Application to DoP.
Please find a letter attached outlining some more information about the project and a request for access to the
updated RTA WOLSH TRACKS models.
Your urgent consideration of the matters in this letter would be greatly appreciated.
Don't hesitate to contact me if you have any questions or would like to discuss the matter in person.

kind regards

Anissa Levy
Business Unit Manager
Traffic and Transport Planning
Cardno Eppell Olsen (NSW)

Phone:61 (0)2 9496 7700
Fax:61 (0)2 9499 3902
Direct:61 (0)2 9496 7809
XTN:309
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Email:anissa.levy@cardno.com.au
Web:www.cardno.com.au

Our Ref: 401da60
Contact: Chris Millet (42212523)
Your Ref: MP 09_0082, MP 09_0083

10 NOV 2009

Mr Bill Mitchell
Delfin Lend Lease Limited
Locked Bag 1
MILLERS POINT NSW 2000

SHELLHARBOUR CITY COUNCIL – MP 09_0082 & MP 09_0083 – CALDERWOOD VALLEY LAND RELEASE AREA, CALDERWOOD VALLEY

Dear Sir

Reference is made to the meeting held for the subject land release between the Roads and Traffic Authority (RTA), the Department of Planning (DoP) and the proponent, Delfin Lend Lease held at the Wollongong Office of the Department of Planning on 2 November 2009. In particular, reference is made to the proposed transport assessment methodology for the strategic modelling of the Calderwood proposal outlined by Anissa Levy (Cardno)

The RTA, in collaboration with Wollongong City Council, has recently developed the Illawarra TRACKS models primarily to assist with the assessment of the proposed land releases in the Illawarra, such as West Dapto, Tallawarra and Calderwood. In this regard, full development models are now available for the 24hour, AM peak and PM peak scenarios. These models can be obtained from Wollongong City Council at a cost of $22,770 (refer to attached correspondence) for the purposes of modelling the Calderwood Land Release. In this regard, Ted Collins, Traffic Unit Manager at Wollongong City Council can be contacted on 4227 7106.

In addition to the comments made by Wollongong City Council in the attached correspondence, if Delfin Lend Lease intend on utilising these models, the following issues must be noted:

- These models represent a full development scenario. Therefore, if Delfin Lend Lease intend on modelling a 2031 scenario, the scale of all land releases will need to be adjusted in accordance with the figures in the attached land use inputs table which were provided to the RTA by DoP. That is, the TRACKS models available from Council assume full development and this is not likely to be achieved for any of the land releases by 2031.
- In order to assess the impacts of the land releases on the State Road Network it was necessary to make a number of assumptions. In this regard, the future State Road Network and associated infrastructure upgrades used for the purposes of this assessment should be considered as "strategic" and the location of any particular element of infrastructure should not be viewed as a commitment to the infrastructure at that exact location. For instance, the location of the Albion Park Interchange, item 5 is purely indicative. That is, whilst the modelling shows a demand for an interchange in the vicinity of Albion Park, the location of the interchange itself has not been determined.

- The infrastructure upgrades identified in the models are required to ameliorate the impact of the proposed land releases in the Illawarra. Therefore, it should be noted that the RTA considers that Calderwood is at least in part responsible for many of the upgrades.

Notwithstanding the above, whilst the updated TRACKS models are now available to the proponent, the RTA offers the following comments on the proponents proposed methodology:

- The RTA does not object to the proponent proposed study area as provided to the RTA in the meeting held on 2 November 2009. The RTA recommends that the outcomes of the TRACKS modelling undertaken by the proponent are provided to the RTA for review and verification prior to proceeding with any intersection modelling. This should include an electronic copy of the modelling.

- The future development assumptions should be consistent with the figures in the attached land use input table which were provided to the RTA by the Department of Planning.

- The RTA notes that the proponent discussed a mode shift in the order of 15% towards public transport at the meeting. Whilst the RTA would support any measures to increase public transport mode share, the RTA considers that a comprehensive package of works, strategies and planning controls would be required to achieve a mode shift of any significant magnitude. Given this, combined with the relative attractiveness of using private vehicles in the Illawarra, the RTA considers that a mode shift in the order of 15% to be highly optimistic. Therefore, any mode split assumptions which differ to mode splits of existing developments in the vicinity of Calderwood must be fully justified and supported. This must include data obtained from similar sites where a mode shift were achieved as well as the strategies, infrastructure and services that will be implemented at Calderwood to achieve any identified shift.

The RTA will commence its detailed assessment once the aforementioned information is provided to its satisfaction. Should you require any clarification on this matter please call Chris Millet on 4221 2570.

Yours faithfully

10 NOV 2009

Trish McClure
Manager, Road Safety and Traffic Management
Southern Operations & Engineering Services

CC

Anissa Levy, Cardno (by email)
Linda Davis, Department of Planning (by email)
Simon Bennett, Department of Planning (by email)
Ted Collins, Wollongong City Council (by email)
Geoff Hoynes, Shellharbour City Council (by email)
David Hartmann, Department of Transport (by email)

Land Use Inputs

The following land use inputs are suggested for the future land use scenarios that will underpin the strategic TRACKS modelling that the RTA is undertaking to identify future network deficiencies.

In addition to existing developments, the following should be included for the western Lake Illawarra area:

Release Area/Project	**2011**	**2021**	**2036**
West Dapto	160 lots (assumes stage 1 [100 lots] + stage 2 [60 lots]	3410 lots (160 + 3250) (assumes ramp up to 250 lots p/a in stage 1 + 60 lots p/a in stage 2 + 50 lots p/a in Marshall Mount from 2013)	8890 lots (3410 + 5480) (assumes ramping down in Stage 1 and ramping up in Stage 2 + commencing of Stage 3 [late in timeframe] + 50 lots p/a in Marshall Mount)
Calderwood	-	2300 lots (assumes ramping up from 100/200 lots in 2011/2012 to 250 lots p/a)	6050 lots (2300 + 3750) (assumes 250 lots p/a – from p8 of Delfin's justification report)
Tallawarra	-	700 (assumes 70 lots p/a from 2011)	
Huntley Heritage	-	Golf course, tourist facility + 400 lots (assumes 50 lots p/a from 2013 until finished)	
Illawarra Health Precinct (refer to Environmental Assessment for details)	Specialists centre and pathology/radiology units	24 hr medical centre, obstetrics unit, hospital, retail centre, nurses accommodation, education facility, aged and disability centre, seniors accommodation.	
Illawarra Employment and Teaching Centre (refer to project application for details)	-	Teaching/conference facilities, accommodation, workshops (total floor space of 320,000 m^2)	
Increased residential densities around Dapto town centre.		Gradual increase in densities up to 6 storeys and up to 1.5:1 FSR)	

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DX 27811 Wollongong Court • **Email** council@wollongong.nsw.gov.au • **Web** www.wollongong.nsw.gov.au • ABN 63 139 525 939 - GST Registered

The Regional Manager
Roads & Traffic Authority
Southern Region
DX 5178
WOLLONGONG

Your Ref :	
Our Ref	I.EC/mf
File	SU 20739
Date	10 November 2009.

Attention: Chris Millet

Dear Chris

I refer to our previous communications regarding the TRACKS modelling of the Wollongong/Shellharbour south-west future development and offer the following advice.

1 Council is prepared to provide the "Full Development" WOLSH models to Cardno in accordance with Council's adopted "Fees and Charges 2009/10" for the sum of $22,770 (including GST).

2 Council requires written acceptance of both the fee payable to Council and the following statement prior to authorisation of the use of the models by others.

"These models must not be distributed to any other parties and are authorised by Council for use in the assessment of the transport impacts of the Delfin Lend Lease Calderwood Valley development only. Whilst Council provides these models in good faith, the accuracy of the models cannot be guaranteed and no responsibility can be accepted for any consequences arising from their use".

3 The attached statement for the models, their inputs and benefits for development assessment is provided for the Authority and other authorised parties. The benefits identified reflect the significant resource expended by Council in the development of the models as well as the consistent planning and assessment outcomes resulting from their use.

I trust the above advice is of assistance to the Authority and would be pleased to discuss these issues further with you should that be necessary.

Yours faithfully

T. Collins.

Ted Collins
Traffic Unit Manager
Infrastructure Division
Wollongong City Council
Direct Line (02) 4227 7106

WCC – RTA FULL DEVELOPMENT WOLSH MODELS

1 THE MODELS

(i) Based on modified 2026 models

(ii) Models provided:
- 24 hr
- am peak
- pm peak

(iii) Mode split = "Business as Usual"

2 MODEL INPUTS

(i) Land Use
- All proposed West Dapto (+ 17,400 (approx.) dwellings; 5,500 (approx.) jobs)
- Tallawarra (+1,200 (approx.) dwellings; 1,500 (approx.) jobs)
- Delfin Lend Lease. (4,500 dwellings; 1,600 (approx.) jobs)
- Remaining zones including CBD = @ 2026 (approx.)

(ii) Road Network
- F6 upgraded to ultimate (general max 3 lanes each way)
- Includes F6 northbound to Masters Road ramp
- Includes West Dapto access upgrades (TMAP and more)
- Includes Tallawarra interchange
- Includes Yallah F6/Highway interchange
- Includes Albion Park Bypass and interchanges (intermediate at Croom Road, Tongarra Road, Tripoli Way)
- Remainder of network = do minimum/committed works

3 DEVELOPMENT ASSESSMENT

(i) Models developed used as "base" for option testing.

(ii) Extensive research, planning, model coding and validation undertaken to date for development of current models. (At significant resource allocation and cost).

(iii) Assessment of development, proposed infrastructure and traffic management would be consistent and expedited if current models were used as base by all.

Delfin
Lend Lease

20th November 2009,

Ms Trish McClure
Manager, Road Safety and Traffic Management
Southern Operations & Engineering Services
Roads and Traffic Authority
PO Box 477
Wollongong NSW 2500

Dear Ms McClure,

RE: CALDERWOOD URBAN DEVELOPMENT PROJECT

I refer to your letter dated 10th November 2009 concerning the approach to meeting the Director General's Requirements for the Calderwood Urban Development Project particularly in respect to Transport and Accessibility. The purpose of this letter is to clarify and respond to the matters raised in your letter.

By way of background there has been considerable discussion and correspondence between your office and Delfin Lend Lease (DLL) / Cardno on the transport assessment methodology including traffic modelling. As a result of this correspondence and discussion, in which RTA staff have been most helpful and co-operative, DLL reached the point where, in order to progress the Project, it was determined to use the 2006 WOLSH TRACKS base model (appropriately calibrated and updated) and the existing 2026 WOLSH TRACKS model for the modelling for the Project. Our reading of your letter is that this remains an appropriate course of action acceptable to the RTA.

Your letter advises that a revised full development TRACKS model is available from Wollongong City Council at a cost of $22,770.00 for the purposes of modelling the Calderwood Urban Development Project. However it is noted that it would still be necessary to adjust the planning assumptions in the model to be in line with both DoP and RTA assumptions and DLL assumptions and undertake an extensive update of the model. It is noted that our respective assumptions are generally consistent. On this basis it would seem to be that there is no benefit to be obtained in using the model while there are considerable disbenefits in terms of costs of the model, time and cost already expended on the previously agreed approach and potential for consequential delays. We also note that the cost advised seems very high compared with the previously quoted $5,000 for access to RTA models.

We note the recommendation to provide the TRACKS modelling results to the RTA prior to undertaking detailed intersection modelling. This is welcome subject to the very tight timeframes we are working to. It should also be noted that this can be an iterative process.

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30 Hickson Road
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Delfin
Lend Lease

As far as the matter of mode shift and mode share is concerned it is understood that the Wollongong region has a mode share of 5% for non-car based transport for journey to work trips. It is anticipated that the measures proposed to be implemented by DLL at Calderwood will aid in achieving a 10% mode shift to non-car based transport resulting in a 15% non-car based mode split or mode share.

Your letter asks that DLL provide data obtained from similar sites where a mode shift were achieved as well as the strategies, infrastructure and services that will be implemented at Calderwood to achieve any identified shift. DLL can provide empirical evidence of measures implemented by DLL to achieve a mode shift on its Projects and this is consistent with the Director General's Requirements. However we note that every Project is unique in this respect. We note that the request to provide data from similar sites where a mode shift were achieved is inconsistent with the Director General's Requirements and is not a requirement of the TMAP Draft Guidelines. We also note that we are not aware of any instances where this has been provided.

DLL looks forward to continuing to work collaboratively with the RTA on this Project and would be pleased to discuss any matters arising from this letter.

Yours sincerely,

BILL MITCHELL
PROJECT DIRECTOR CALDERWOOD

CC: Anissa Levy, Cardno (by email)
Linda Davis, Department of Planning (by email)
Simon Bennett, Department of Planning (by email)
Ted Collins, Wollongong City Council (by email)
Geoff Hoynes, Shellharbour City Council (by email)
David Hartmann, Department of Transport (by email)

Appendix 1E

Area of Influence

APPENDIX 1E - Area of Influence

For modelling purposes, it has been agreed with the RTA the extent of the road network over which the transport demands associated with the CUDP should be assessed. Described as the 'area of influence' the extent of road network is shown in Figure 1.2 in the report.

This area is considered to represent all the road sections and key intersections over which development related transport impacts need to be assessed.

It is shown that the area of influence includes the following key road sections:

- Illawarra Highway between Terry Street and North Macquarie Road
- Tongarra Road between Terry Street and Princes Highway
- Princes Highway between Mount Brown Road and south of New Lake Entrance Road.
- Southern Freeway north of Princes Highway southbound on ramp.
- Yallah Road between Marshall Mount Road and Princes Highway.
- Marshall Mount Road between Calderwood Road and Huntley Road.
- North Macquarie Road between Illawarra Highway and Calderwood Road.
- Calderwood Road between Calderwood Valley Golf Club and Illawarra Highway.
- Huntley Road between Marshall Mount Road and Princes Highway.
- Princes Highway and Southern Freeway southbound On-Ramp
- Princes Highway and Southern Freeway northbound Off-ramp
- Princes Highway and Yallah Bay Road (including F6 southbound off-ramp in 2031 scenarios)

Key existing intersections for assessment within the area of influence (external to CUDP) have been agreed with the RTA to comprise the following:

- Illawarra Highway and North Macquarie Road.
- Illawarra Highway and Tongarra Road/Terry Street.
- Princes Highway and Illawarra Highway.
- Princes Highway and Tongarra Road.
- Marshall Mount Road and Yallah Road.
- Huntley Road and Marshall Mount Road.
- Princes Highway and Huntley Road.
- Illawarra Highway and Calderwood Road/Macquarie Street.
- Illawarra Highway and Broughton Avenue (/Tripoli Way[1] in 2031).
- Tongarra Road and Station Road.
- Yallah Road and Haywards Bay Drive.
- Illawarra Highway and Yellow Rock Road (Proposed North-South Arterial in 2031).
- Haywards Bay Drive and Princes Highway southbound ramps.
- Princes Highway and Tallawarra northbound ramp (including northbound on-ramp in 2031).
- Princes Highway and Cormack Avenue.
- Princes Highway and Southern Freeway northbound Off Ramp
- Princes Highway and Southern Freeway southbound On Ramp
- Princes Highway and Yallah Bay Road (including F6 southbound off-ramp in 2031 scenarios)

Furthermore the following proposed future intersections have been assessed where relevant to the scenario:

- Tripoli Way and proposed major collector street.
- Tripoli Way and Calderwood Road.
- Illawarra Highway and Tripoli Way.
- Tripoli Way and F6 Extension ramps.
- Tongarra Road and Tripoli Way.

[1] Also known as Albion Park Bypass

Appendix 2A

Review of State and Regional Strategic Policies

APPENDIX 2A - Review of State & Regional Strategic Policies

The following documents have been reviewed:

- NSW State Plan 2009 and Illawarra Local Action Plan 2009.
- NSW State Infrastructure Strategy 2008.
- Action for Air (2006 update).
- Action for Bikes (1999).
- Integrating Land Use and Transport (2001).
- Section 117 Ministerial Decisions Direction no.17 – Integrating Land Use and Transport (2005)
- Planning Guidelines for Walking and Cycling (2004).
- Accessible Transport Action Plan (2007)
- Review of Bus Services in NSW – Final Report (2004).

THE NSW STATE PLAN 2009 AND ILLAWARRA LOCAL ACTION PLAN 2009

The *NSW State Plan* sets out the goals and priorities for government action in a range of key areas, with targets for improvements, to guide decision–making and resource allocation. The current version of the plan was prepared in 2009 as a revision of the original plan released in 2006. It is structured around 14 long–term goals and 34 priorities for action. It identifies measurable targets that allow progress to be assessed. In addition, it sets out how government agencies will work to deliver on the targets. The State Plan service delivery priorities for government agencies are underpinned by investment in infrastructure and maintenance of existing assets. The *State Infrastructure Strategy* enables these infrastructure and maintenance programs to be implemented.

In terms of transport, the key target relevant to this project is increase public transport mode share to 15% for commuter journeys to Wollongong CBD. There are also a number of public transport improvement projects to encourage public transport use in the region.

The following are key transport targets which are of importance to this project:

- Develop an Illawarra Region Transport Strategy in 2010.
- Construct additional commuter car park spaces at Waterfall, Wollongong and Woonona railway stations over the next 2 years.
- Carry out an easy access upgrade for Dapto rail station to help ensure the station is accessible to everyone in the community.
- Undertake an integrated bus network review to ensure services continue to match the needs of the local community (underway now).

This TMAP has been developed on the basis of a mode share of 15%.

THE STATE INFRASTRUCTURE STRATEGY 2008

The *State Infrastructure Strategy* is a rolling 10–year plan for infrastructure projects to support service delivery. First published in 2006, it is updated every two years. The Strategy maps infrastructure projects across six broad regions – Sydney, Central Coast, Hunter, North Coast, Illawarra - South East and Inland NSW.

Transport highlights of the *State Infrastructure Strategy* affecting the study area includethe Dapto Railway Station easy access upgrade.

ACTION FOR AIR

Action for Air is the NSW Government's 25 year air quality management plan for the Greater Metropolitan Region of New South Wales, which includes the Illawarra region. It contains a range of measures aimed at reducing emissions from transport.

The *Action for Air: 2006 Update* retains the objectives of *Action for Air* and includes an updated review of the air quality and issues in the Greater Metropolitan Region. The key objective is to make transport greener, by reducing the use of unsustainable transport and reducing the emission levels of existing transport systems. Actions to implement the goals of the plan are also included. Actions relevant to the Calderwood development include:

- Provide public transport to new suburbs.
- Implement an extensive bus priority scheme.
- Introduce integrated ticketing.
- Develop a long-term transport strategy for the Illawarra region.
- Facilitate walking/cycling as a mode of transport.

ACTION FOR BIKES – BIKE PLAN 2010 NSW

This Bike Plan aims to ensure cycling is a viable travel alternative. *Action for Bikes* is a four point plan outlining a range of actions that may be taken to achieve these goals. The plan presents a costed 10 year plan for a series of arterial bicycle networks across NSW, and includes a commitment to provide cycling facilities when new roads are built and to create off-road cycleways wherever possible.

The infrastructure plan is not detailed for areas outside of the Sydney metropolitan area. The only major cycling routes listed in the Illawarra region are:

- Sutherland to Bulli Tops.
- Bulli Tops to Wollongong.
- North Wollongong to Fairy Meadow.
- Warrawong to Kiama Heights.
- Kiama to Nowra.

None of the listed routes will serve the development site directly, being located over ten kilometres away. However they may facilitate the use of cycling as part of a multi-modal journey to or from the site.

The four point action plan includes the actions of improving the bike network, making it safer to cycle, improving personal and environmental health and raising community awareness.

INTEGRATING LAND USE AND TRANSPORT 2001

The *Integrated Land Use and Transport* (ILUT) package (DUAP 2001) provides a framework for State Government agencies, councils and developers to integrate land use and transport planning at the regional and local levels.

This package identified the following opportunities for facilitating the achievement of objectives related to improving access to housing, jobs and services, increasing the choice of available transport, reducing travel demand (especially by car) and supporting efficient and viable operation of public transport services, specifically:

- Concentrating large trip generators/attractors near each other (in centres) and creating a network of these centres linked by good public transport services.
- Using parking as a travel demand management tool.
- A minimum of 15 dwellings per hectare for new residential areas.

The site is an extension of the urban area immediately adjoining Albion Park and Tullimbar, The principles of the package will inform the urban design philosophy for the development.

SECTION 117 MINISTERIAL DECISIONS DIRECTION NO.17 – INTEGRATING LAND USE AND TRANSPORT (2005)

The NSW Government Department of Planning Section 117 direction 17 is applicable to local councils when preparing a draft LEP that creates, removes or alters a zone or a provision relating to urban land, such as for residential, business or industrial Purposes. The direction is intended to ensure that urban structures, building forms, land use locations, development designs, subdivision and street layouts achieve the following planning objectives:

- Improving access to housing, jobs and services by walking, cycling and public transport.
- Increasing the choice of available transport and reducing dependence on cars.
- Reducing travel demand including the number of trips generated by development and the distances travelled, especially by car.
- Supporting the efficient and viable operation of public transport services providing for the efficient movement of freight.

PLANNING GUIDELINES FOR WALKING & CYCLING (2004)

The guidelines have been designed to provide a walking and cycling focus to the NSW Government's Integrating Land Use & Transport Planning Policy Package. They are also designed to provide a planning complement to the RTA's facilities-focused policies and actions.

At the broadest level, these guidelines illustrate how metropolitan strategies, Masterplans and Local Environmental Plans (LEPs) can help create an urban form that is conducive to walking and cycling. At a more detailed level, the guidelines show how Development Control Plans (DCPs), developer contributions plans and development assessment processes can reinforce these broader plans through funding mechanisms, provision of facilities and design outcomes that are supportive of walking and cycling.

These guidelines will form the basis of the walking and cycling recommendations in this report.

ACCESSIBLE TRANSPORT ACTION PLAN (2007)

This Action Plan outlines the legal responsibilities of the transport agencies, with respect to accessibility, the guiding principles of integrated accessible transport services, progress to date in improving accessibility and future strategies to improve accessibility.

One key aspect is a timetable for compliance with the anti-discrimination and disability legislation for transport infrastructure, including information (to be compliant by the end of 2007), buses, coaches and rail services. All buses and coaches are to be compliant with the legislation by 2022, with percentages of stock to be compliant in the preceding years, while all rail stock must be compliant by 2032 (with 90% required to be compliant by 2022).

The Action Plan also outlines an assessment of aspects of the transport system and how compliant they are currently. Results vary, with more work needing to be done.

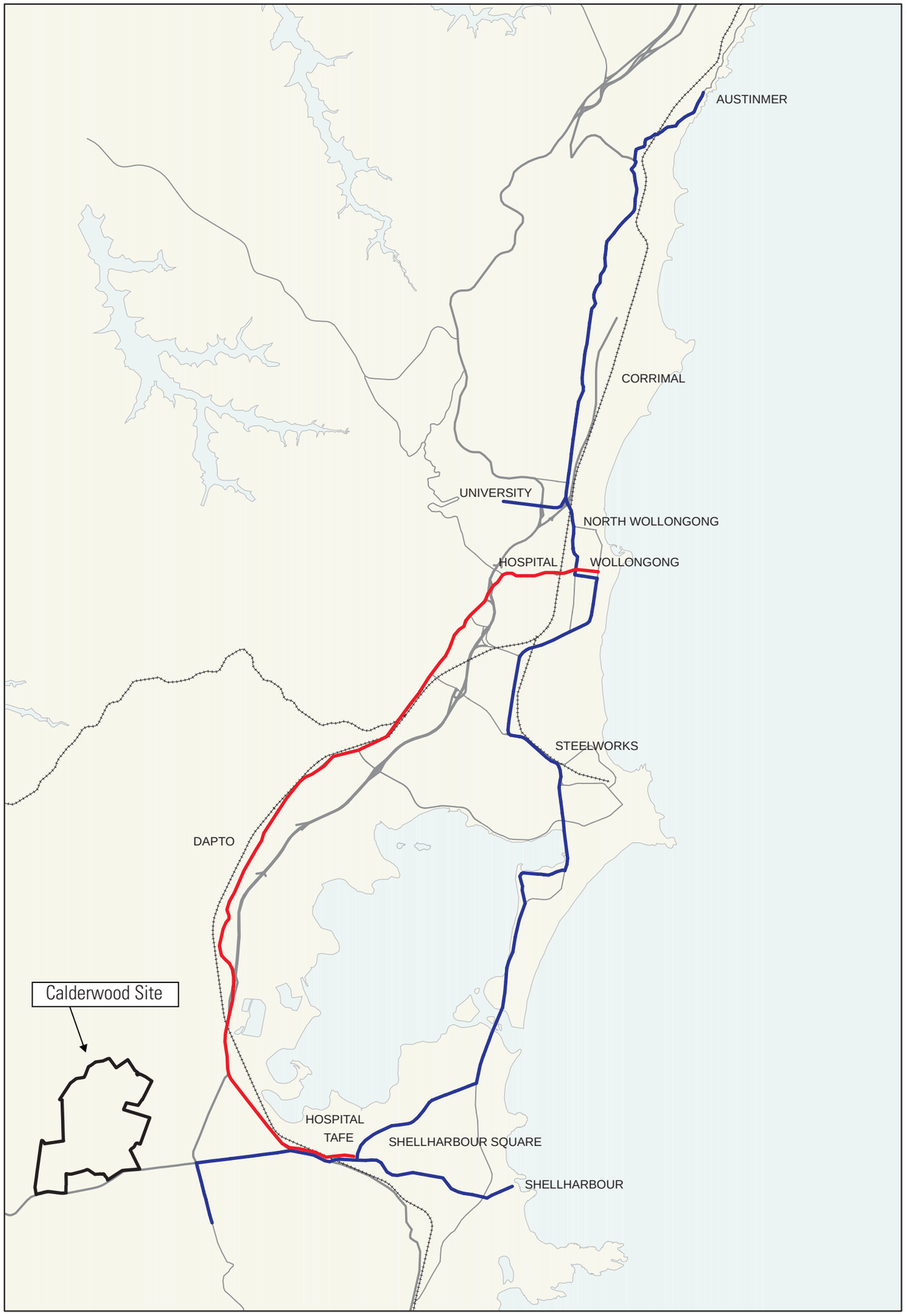
Finally, the plan identifies a series of barriers, with subsequent strategies, responsibilities, budgets and targets aimed at improving key areas of accessibility shortfalls, including related to information provision, adequacy of infrastructure, communication with groups, road and pedestrian access and crossings and the planning of developments to include all users.

The guiding principles of this plan will be used to ensure that transport improvements recommended in this report meet accessibility requirements.

REVIEW OF BUS SERVICES IN NEW SOUTH WALES (UNSWORTH) 2004

The Final Report was released in February 2004 and has since been used as the basis for ongoing reform to bus services in New South Wales. The report contained recommendations covering metropolitan issues (network and service planning, contracting and funding), rural and regional NSW and state-wide issues (fares, ticketing and concessions, school student travel and governance arrangements).

The recommendations from the final report of relevance to this study include a network of viable strategic corridors, regional service planning forums, planning for the provision of bus services being factored into the planning of greenfield sites, high level integrated transport planning at the regional and sub-regional level, the development of viable public transport solutions such as supporting employment and population growth in regional centres and encouraging development along strategic corridors. The corridors for Wollongong are displayed in Figure 2A.



Delfin
Lend Lease

Figure 2A

Wollongong Strategic Bus Corridors

CALDERWOOD
URBAN DEVELOPMENT PROJECT

Legend

- Site Boundary
- Wollongong to Shellharbour
- Austinmer to Shellharbour

N
W E
S

2 0 2 4 Kilometres

Cardno
Shaping the Future

Appendix 2B

Review of Illawarra Regional Transport Context Documents

APPENDIX 2B - Review of Illawarra Regional Transport Context Documents

The following documents have been reviewed:

- Illawarra Regional Strategy 2006-2031 and 2009 Update Report.
- Illawarra Urban Transport Opportunities Study
- Illawarra Action for Transport
- Moving Together 'Illawarra Regional Strategy'
- Albion Park Traffic Study
- West Dapto Release Area Studies:
  - West Dapto Urban Development TMAP Stage 1 Report – Baseline Study (2004) and West Dapto Urban Development TMAP Stage 2 – Final Report (2006).
  - West Dapto Release Area Draft Infrastructure Implementation Plan (2006).
  - West Dapto TMAP Extension Study (2008).
  - West Dapto Release Area Review: Planning And Infrastructure, Planning Report and Supporting Documentation (2008).
  - West Dapto Initial Access Strategy Supporting Stages 1 and 2 – Report by Manager of Infrastructure to City of Wollongong Council (20 October 2009).

ILLAWARRA REGIONAL STRATEGY 2006 – 2031 AND 2009 UPDATE REPORT

The stated aim of the regional strategy is to ensure that adequate land is available and appropriately located to sustainably accommodate the housing and employment needs of the residents to 2031. The strategy incorporates requirements set out in the State Infrastructure Strategy and is the pre-eminent strategic policy document for the region.

Challenges are discussed, including in the areas of employment, economy, environment, population and housing. A vision to meet the challenges is presented, promoting a prosperous, diverse and sustainable region. Regional transport is a key area of focus for the strategy. The following actions emerge from the strategy:

- Protection of the existing transport corridors, including through local environment plans.
- Consideration of transport access implications and travel demand management and inclusion of these measures in planning policies.
- Continued monitoring of the road network.
- Timely implementation of major transport infrastructure projects.
- Identification of strategic transport corridors.
- Monitoring of the functioning and future of the rail lines.
- Protection of Illawarra Airport.

Little detail is given regarding specific transport infrastructure projects, and none are listed in close proximity to the site.

A regional strategy update was published in 2009. Of key relevance to the subject site is the recognition within the regional strategy of the habitat corridor between Yallah and Marshall Mount Road. Future planning will consider opportunities to provide an appropriate balance between conservation and development outcomes within this corridor.

ILLAWARRA URBAN TRANSPORT OPPORTUNITIES STUDY (1997)

In 1997, the *Illawarra Urban Transport Opportunities Study* (DJA Maunsell for DUAP) identified that a 30% modal split to public transport during the commuter peak periods would be required to improve air quality and reduce the environmental impact of urban development. The study identified Dapto as one of three sub-regional transport interchanges, along with Wollongong CBD and Oak Flats, which would be integral to the achievement of that target.

ILLAWARRA'S ACTION FOR TRANSPORT (1999)

In 1999, the Illawarra Transport Taskforce prepared the *Illawarra's Action for Transport* document. The strategy contained a number of goals, including:

- Generate a significant shift to public transport and higher occupancy vehicles for journey within the region.
- Reduce total vehicle kilometres travelled for journeys to school.
- Reduce use of private vehicles for shopping trips within the region.

The strategy identified that modal split to public transport was approximately 4.1% in 1999.

MOVING TOGETHER (2004)

In 2003, the Illawarra Transport Taskforce began reviewing the 1999 *Action for Transport* document with the result being the release of *Moving Together* in 2004. This document forms the current broad transport strategy covering the Illawarra region. Moving Together contains a number of actions relevant to the area, including:

- Apply a 'trunk and feeder' network structure for public transport services, e.g. local bus to main bus route or local to railway station.
- Review public transport services to major trip generators (e.g. University, Hospitals, WIN Stadium, commercial centres) and recommend improvements.
- Review existing neighbourhoods to improve public transport accessibility and the ability to move in and around suburbs.
- Improve the accessibility, attractiveness, safety and frequency of bus and train services.
- Promote off-peak travel using public transport.
- Promote the benefits of public transport and non-motorised transport (i.e. walking, bicycles etc.).
- Work with employers to encourage journey to work by public transport, e.g. transport access information.
- Provide and promote better integration of public transport services through integrated timetables.
- Provide and promote better integration of public transport services through integrated ticketing options.
- Promote and facilitate car pooling, car sharing and 'park and ride' options.
- Provide integrated public transport at commercial centres.
- Apply Transit Oriented Development (TOD) principles in land use planning to support and encourage public transport. A neighbourhood based on TOD principles would include a high density mixed use centre, narrow streets with wide footpaths, active street frontages, quality public open spaces, shared parking, safe pedestrian and cycle routes and an interconnected road network.
- Review planning controls to reallocate parking infrastructure costs to the provision of public transport infrastructure.
- Develop a set of effective parking supply management strategies to manage limited parking resources. These would specify pricing, duration and availability in the CBD's and other busy areas. As an incentive for more desirable modes, provide more parking for buses, taxis, disabled, delivery and high occupancy vehicles.
- Develop a set of effective parking supply management strategies to manage travel demand. These would specify pricing, duration and availability on campuses. Provide incentives for more desirable modes, i.e. for buses, taxis, disabled, delivery and high occupancy vehicles.
- Ensure Council Planning policies encourage alternatives to private transport when assessing Development Applications, e.g. showers at destinations, bicycle storage in new developments, bus stops in subdivisions etc.
- Provide physical and timing priority for preferred road based modes, i.e. pedestrians, buses, taxis and bicycles. e.g. bus lanes, transit lanes and 'B' traffic light phase.

The actions relating to integrating fare structures and timetables will be particularly pertinent to the Calderwood development as it is located outside of the walking catchment of the nearest railway station.

ALBION PARK TRAFFIC STUDY (2006)

This study was undertaken by Maunsell/Aecom to test the validity of the road network which has been used as the basis of developing a Section 94 contributions plan for Shellharbour LGA.

In particular, the study investigated the following issues:

- The need for the Albion Park West Connector.
- The potential future use for a north-south link west of Albion Park.
- The need and timing for the Tripoli Way extension.
- The location of the future F6 interchange within Albion Park.

The study presented a proposed road network for three forecast years; 2010, 2020 and 2030. The 2010 road network includes construction of Tripoli Way as a bypass of Albion Park from Illawarra Highway (east) to Illawarra Highway/Broughton Avenue, although this could be deferred to 2018 by implementing peak-period clearways along Illawarra Highway through Albion Park town centre.

The 2020 road network assumes that the extension of the F6 from Yallah to Oak Flats is constructed by 2020 and consequently Tripoli Way is extended from Illawarra Highway (east) to Tongarra Road via the preferred location for the F6 interchange. If the F6 is not constructed by 2020 then the extension of Tripoli Way to Tongarra Road is not required.

The 2030 road network assumes that the F6 extension and Tripoli Way extension have been constructed. The network includes two new access roads from the Calderwood development, should it proceed, via an upgraded Calderwood Road and via a new east-west crossing of Macquarie Rivulet, north of Albion Park.

The study found that the provision of an interchange with the F6 at Tripoli Way, rather than Tongarra Road, provides the greatest benefit to Tongarra Road and the surrounding road network.

In September 2008, Cardno Forbes Rigby, on behalf of Delfin Lend Lease, submitted to Council a response to the traffic study. The submission identified that the traffic study failed to take into account any urban development in the Calderwood Valley. DLL argued that development of the Calderwood Valley would significantly alter the results of the modelling due to additional travel demand and the provision of alternative travel paths. DLL noted that they had not been contacted by Maunsell.

WEST DAPTO RELEASE AREA STUDIES

The following relevant West Dapto Release Area (WDRA) studies were reviewed as part of the TMAP study process:

- West Dapto Urban Development TMAP Stage 1 Report – Baseline Study (2004) and West Dapto Urban Development TMAP Stage 2 – Final Report (2006).
- West Dapto Release Area Draft Infrastructure Implementation Plan (2006).
- West Dapto TMAP Extension Study (2008).
- West Dapto Release Area Review: Planning And Infrastructure, Planning Report and Supporting Documentation (2008).
- West Dapto Initial Access Strategy Supporting Stages 1 and 2 – Report by Manager of Infrastructure to City of Wollongong Council (20 October 2009).

A summary of the key issues from these reports is provided following.

WEST DAPTO URBAN DEVELOPMENT TMAP STAGE 1 REPORT – BASELINE STUDY (2004) AND WEST DAPTO URBAN DEVELOPMENT TMAP STAGE 2 –REPORT (2006)

In 2004, Kellogg Brown and Root prepared the *West Dapto Urban Development TMAP Stage 1 Report* for Wollongong City Council. The report aimed to identify barriers to public transport use and the impact of poor accessibility. This was followed by the Final Report, prepared in 2006. It is understood that this project is the subject of a gazettal.

The reports identified that the aim of placing bus routes within 400m of an area's population has lead to circuitous and unattractive bus routes and suggests that service provision standards also need to consider the directness of routes, frequency and journey times.

The report identified that long journey times and low service frequency are major barriers to public transport use. It was recognised that modern styles of fringe development forces buses further away from direct routes in order to serve the catchment adequately.

The report also identified that bus/rail interchanges will be an integral part of the public transport network and consequently a fully integrated multi-modal fare structure would be required in order to encourage people to transfer between modes.

The report concluded that the following key improvements would be required to serve West Dapto:

- Widening of the F6 north of Fowlers Road to six lanes and the provision of south-facing ramps at Kanahooka Road.
- Widening of Princes Highway to four lanes across Mullet Creek.
- Grade separation of all existing level crossings.
- High frequency bus routes along key corridors.
- A regional bus/rail interchange at Dapto and smaller bus interchanges at all town centres, including provision for a future railway station at Huntley Road.
- Incorporation of bus priority measures into the road network.
- Duplication of the rail line from Unanderra to Dapto in parallel with development of West Dapto and raising the line above the 1 in 100 year flood level.

WEST DAPTO RELEASE AREA DRAFT INFRASTRUCTURE IMPLEMENTATION PLAN (2006)

The *Draft Infrastructure Implementation Plan* was prepared by Wollongong City Council in 2006 to set out the infrastructure which would be provided as part of the development of the West Dapto Release Area.

Relevant transport infrastructure and estimated costs include:

- F6/Fowlers Road south-facing ramps ($1.70 million plus a matching contribution from State Government).
- Dapto Bus/Rail interchange upgrade ($7.50 million plus a matching contribution from State Government).
- F6/Princes Highway north-facing ramps, Tallawarra interchange ($0.85 million – 25% share, with the remaining funded by the State Government and other sources).
- Huntley Road upgrade ($3.16 million).
- F6/Emerson Road on/off ramps ($2.07 million).

WEST DAPTO TMAP EXTENSION STUDY (2008)

The TMAP Extension Study was prepared by Connell Wagner in 2008 to develop a preferred main roads strategy for the West Dapto area, focusing on links to the Southern Freeway and crossings of the South Coast Rail Line. A combination of TRACKS modelling and multi-criteria assessment was used to determine a preferred package of measures.

The study recommended a schedule of infrastructure improvements be implemented to serve the West Dapto Urban Release Area, in order to achieve the goals of increased road network permeability and grade-separation of existing level crossings.

The study also recognised the present low levels of public transport usage in the Dapto area, and identified that, if these levels were not markedly improved by 2026, the road network would come under considerable pressure. The study recommended that a greater emphasis be placed on the improvement of public transport services, especially in new release areas where the early provision of good public transport services can greatly influence modal choice. This recommendation is particularly relevant for the Calderwood development, given its location in an urban release area.

WEST DAPTO RELEASE AREA REVIEW: PLANNING AND INFRASTRUCTURE, PLANNING REPORT AND SUPPORTING DOCUMENTATION (2008)

The Growth Centres Commission was commissioned by Wollongong City Council in 2008 to undertake a review of West Dapto Release Area planning, following revisions to the anticipated lot yields. The review included the LES, draft LEP, draft s.94 contributions plan, and the Draft Infrastructure Implementation Plan. The previously identified target of a 3.5% modal shift to public transport was accepted by the Commission.

The report also considered the potential transport requirements of the future development of Yallah/Marshall Mount and Calderwood.

Notable findings of the review include:

- Development in the Yallah, Marshall Mount and Calderwood areas is insufficient to warrant the development of the proposed Huntley Railway Station and that associated track amplifications are not cost effective.
- Instead the required road links to the Princes Highway and F6 should be developed to facilitate access to Dapto and Albion Park Stations.
- Albion Park Station is well located to serve any future Calderwood release area.
- Development of new bus/rail interchanges at Dapto and Albion Park stations will required as part of release area development.
- Payment by developers of a start-up bus service subsidy needs further consideration.

The review also found that the release of 8,000 dwellings in Calderwood is likely to generate the need for the following:

- Widening of Illawarra Highway from Broughton Avenue to Terry Street to four lanes.
- Widening of Tongarra Road from Terry Street to Princes Highway to four lanes.
- Upgrade two-lane road link from Calderwood Road to Yallah Road.
- Upgrade of the Princes Highway/Yallah Road interchange to provide improved northbound on and off-ramps.
- Possible earlier provision of an additional westbound lane across the Haywards Bay Drive overbridge if Calderwood development occurs before or in conjunction with the Yallah/Marshall Mount release.
- Upgrading of the Albion Park railway station interchange.

These works are estimated to cost $72.0 million, however this could be reduced to about $57.0 million if the extension of the F6 from Yallah to Oak Flats is constructed. However no detailed basis for these costing is provided within the report.

WEST DAPTO INITIAL ACCESS STRATEGY SUPPORTING STAGES 1 AND 2 – Report by Manager of Infrastructure to City of Wollongong Council (20 October 2009)

This report sets out the proposed initial access strategy to facilitate the development of Stages 1 and 2 of the West Dapto Release Area. The strategy is in response to significant issues that were identified with the 2009 LEP for West Dapto and the GCC review in November 2008 which, among other things, identified the Fowlers Road Extension as unnecessary to support Stages 1 and 2. The strategy also addresses the immediate congestion and flooding access issues for the existing residents of Horsley. Table 1 presents the strategy as adopted by Council.

Table 1 West Dapto Initial Access Strategy

	Road Link	Improvement	Estimated Cost	Programme
1	Bong Bong Road	Widen the level crossing and improve connections to the Princes Highway to increase traffic capacity and reduce congestion	$3.77m	2009/10 to 2013/14
2	West Dapto Road	Realign the intersection with the Princes Highway and install traffic signals to improve safety and traffic capacity	$1.10m	2009/10 to 2010/11

	Road Link	Improvement	Estimated Cost	Programme
3	Shone Avenue	Replace the single lane bridge and realign the intersection with West Dapto Road to improve safety and traffic capacity	$5.80m	2009/10 to 2012/13
4	Fairwater Drive (east)	Construct extension to Cleveland Road to connect to the current rail over pass and the highway	$16.86m	2013/14 to 2017/18
5	Cleveland Road	Replace Mullet Creek Bridge and improve access to Dapto High School to improve safety, traffic capacity	$5.11m	2011/12 to 2013/14
		Widen road from Fairwater Drive to Mullet Creek and widen intersection with Princes Highway to improve safety, traffic capacity and decrease flood affectation	$12.58m	2017/18 to 2021/22
6	Fairwater Drive (west)	Construct extension from Highcroft Boulevard to Bong Bong Road to increase traffic capacity and complete the road network	$0.9m	2014/15
7	West Dapto Road, Shone Avenue and Bong Bong Road	Staged widening of West Dapto Road and Shone Avenue including construction of new bridges. Drainage improvements on Bong Bong Road to improve safety, traffic capacity and reduce flood affectation	$32.37m	2013/14 to 2023/24
		Total Estimated cost	**$78.46m**	

The plan is proposed to be funded primarily from developer contributions and partly from Council's revenue.

Appendix 2C

Review of Local Planning Context Documents

APPENDIX 2C - Review of Local Planning Context Documents

The following documents have been reviewed:

- Shellharbour Rural LEP 2004
- Wollongong LEP 1990 and Draft Wollongong Local Environmental Plan (West Dapto) 2009
- West Dapto Urban Release Area planning documents:
  - Draft West Dapto DCP 2007 (Superseded).
  - Draft West Dapto Staging Plan (2006) (Superseded).
  - Draft West Dapto Master Plan Report (2006) (Superseded).

SHELLHARBOUR RURAL LEP 2004

The Shellharbour Rural LEP is the principal planning document that guides land use management and development in the rural parts of Shellharbour LGA. Towards achieving management of development, the following aims have been outlined by Council:

- To provide a comprehensive rural planning framework based on the principles of ecologically sustainable development,
- To establish ecologically sustainable development goals and require those goals to be taken into consideration when determining development applications,
- To ensure that the primary use of prime agricultural land and other land in the 1 (a) Agriculture Zone is for sustainable agricultural pursuits and associated development that supports a diversified range of agricultural uses,
- To preserve and enhance the visual rural landscape character of land in the 1 (rl) Rural Landscape Zone,
- To provide for the management of the extraction of mineral resources in a manner that has regard to the surrounding land uses and end-use options of the altered landscape while minimising the environmental impacts of mineral extraction,
- To protect, enhance and manage environmentally important land having special aesthetic, historic, ecological or conservation values for the benefit of present and future generations.

The portions of the development site within Shellharbour LGA are presently zoned 1(a) Agriculture and 7(n) Nature Conservation.

WOLLONGONG LEP 1990 AND DRAFT WOLLONGONG (WEST DAPTO) LEP 2009

The Wollongong LEP is the principal planning document that guides land use management and development in the Wollongong LGA (excluding the Wollongong City Centre). Towards achieving management of development, the following aims have been outlined by Council:

The actions and initiatives employed to ensure the implementation of these aims include:

- To regulate development to coincide with the particular zones.
- To implement development and performance criteria to direct specific types of development and development in specific zones.
- To allow appropriate rezoning of particular areas, to further enable development.
- To combine all relevant planning documents and policies to enhance efficiency.
- To decrease the number of zones and definitions, while also reducing the level of permission required for minor development.

The LEP also outlines the provisions for exempt and complying development, the objectives and land use tables for each proposed zone and permitted and prohibited development activities. The draft 2009 LEP is presently under review by the Department of Planning and approval by the Minister for Planning is anticipated in the near future.

The portion of the development site within Wollongong LGA was previously zoned non-urban, however under the draft 2009 LEP the zoning of this area has been deferred for future resolution.

WEST DAPTO RELEASE AREA PLANNING DOCUMENTS

Significant planning work has been undertaken by both Wollongong City Council and the Department of Planning for the West Dapto Urban Release Area since the late 1980s. Due to high infrastructure costs and low demand for housing, release beyond the suburb of Horsley did not proceed. Planning for the release area began again in 2004 when the then Department of Infrastructure, Planning and Natural Resources (DIPNR) announced that the release would be developed to ease anticipated future shortages of land in the Illawarra.

Comprehensive planning documents, including a Master Plan, Staging Plan, Infrastructure Implementation Plan and statutory planning documents were prepared and exhibited in 2006 and 2007 with the intention of releasing land for development during 2006. However, following exhibition of the Draft LEP in 2007, it was decided that the complex environmental and infrastructure issues required further consideration.

In 2008, Council appointed the Growth Centres Commission to review all planning for the West Dapto Release Area and the recommendations of this review were adopted by Council later that year. Subsequently, a revised draft LEP (2009) has been prepared and is awaiting approval from the Minister for Planning. Staging of the release area has been revised, with Stages 1 and 2 being release concurrently (first DAs expected to be lodged in early 2010) and a revised access strategy has been prepared in order to reduce the costs associated with infrastructure provision.

The delays related to the West Dapto Urban Release Area (currently running four years behind the timeframe stated in the 2006 Master Plan) have contributed to a shortage of developable land on the market and created upward pressure on land prices.

The following relevant WDRA Council documents were reviewed as part of the TMAP study process:

A summary of the key issues from these documents is provided following.

WEST DAPTO DEVELOPMENT CONTROL PLAN 2007

The West Dapto Development Control Plan aims to regulate and control the development of land, through the implementation of specific requirements and standards. Through the satisfaction of these minimum standards, the DCP works towards achieving improved neighbourhood amenity, diversity and availability of housing types and environmental accountability.

In defining the urban structure of West Dapto, the DCP recommends enhancements to the public transport and cycling/walking networks. To allow for better accessibility to these network systems, more services and connections have been proposed, including upgrades to Huntley Road, Avondale Road, Cleveland Road, and a new access link aligned north-south, located to the west of the railway.

Additionally, there is a possibility of a new railway station located 3km south of the Dapto Station, at Huntley Road, Penrose. This has been included as part of the Master Planning process.

Towards a more sustainable community, Council has highlighted the need for an efficient transport system to reduce private vehicle usage and the main road network has been developed to support this system. A primary bus loop has been designed for express services, providing links for key centres, while a secondary network links all other centres to this. This has been aimed at providing public transport access to residents within a 5-minute walk (or 400m).

Further to this, the urban structure has been planned to provide for walkable communities, supported by several town and village centres, local bus stops, local shops and amenities, community facilities and schools, denser housing types and mixed use job opportunities. The aim is to design walkable communities, while reducing vehicle kilometres travelled (VKT) and promoting more cycling and pedestrian activity.

To encourage more cycling activity, several off-road and on-road routes, linking to major centres and attractions have been identified. These will also include east-west routes along the riparian corridors. Council is aiming for a well-connected network of routes that will promote a healthy lifestyle for residents.

WEST DAPTO STAGING PLAN (2006)

The West Dapto Proposed Staging Plan details the staged development of areas within the West Dapto release area. The proposed staging plan is reproduced as Figure 2C1.

The portion of the CUDP site that is located in the Wollongong LGA falls within the Stage 5 Precinct – Yallah/Marshall Mount, which will ultimately yield approximately 1,070 dwellings according to the estimates prior to the Growth Centres Commission review in 2008.

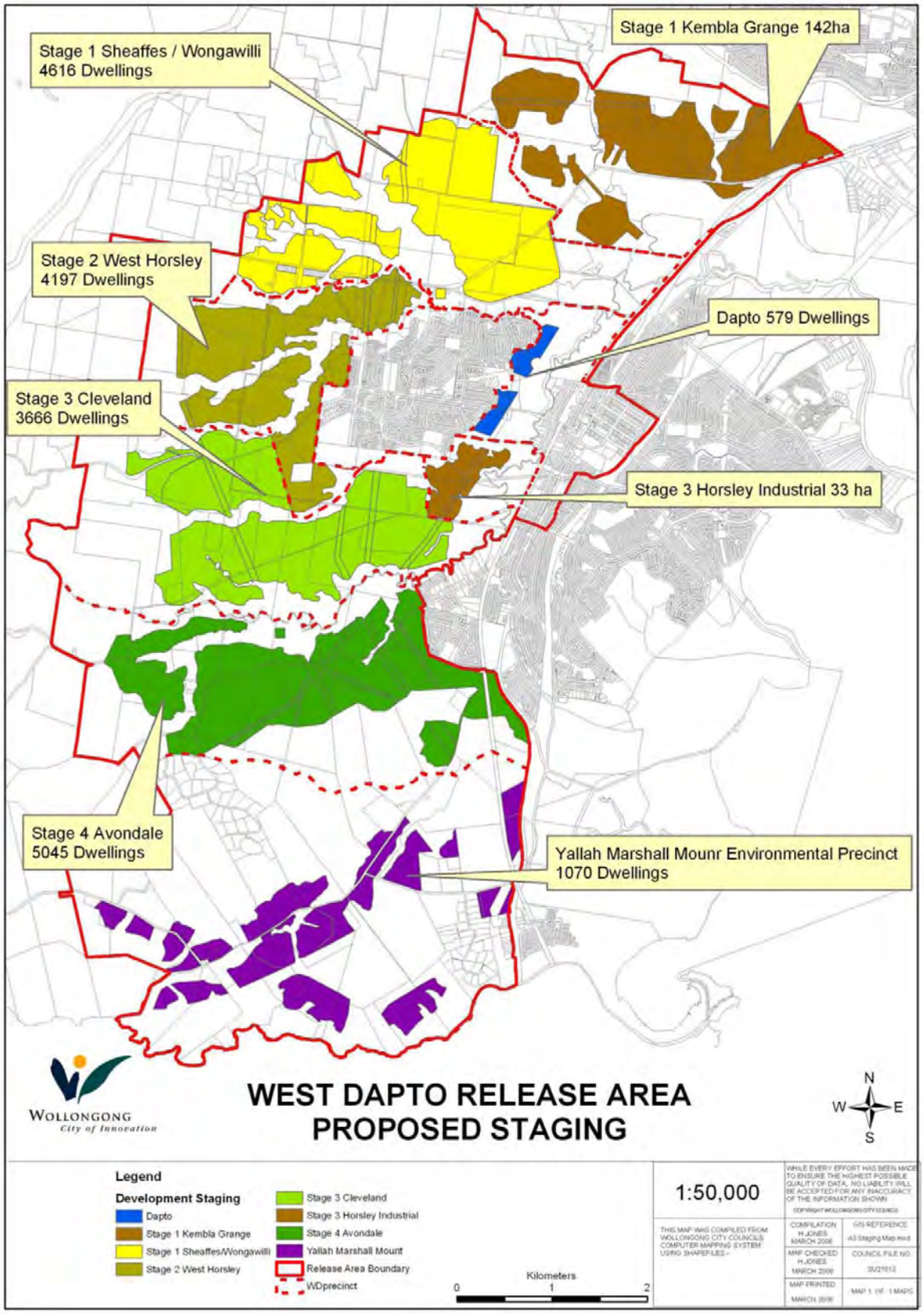
WEST DAPTO MASTER PLAN REPORT (2006)

The West Dapto Master Plan Report summarises all the different planning reports undertaken to 2006 and synthesises them into a physical structure for growth. The proposed master plan is reproduced as Figure 2C2.

The report identifies key initiatives to provide a sustainable transport network, including:

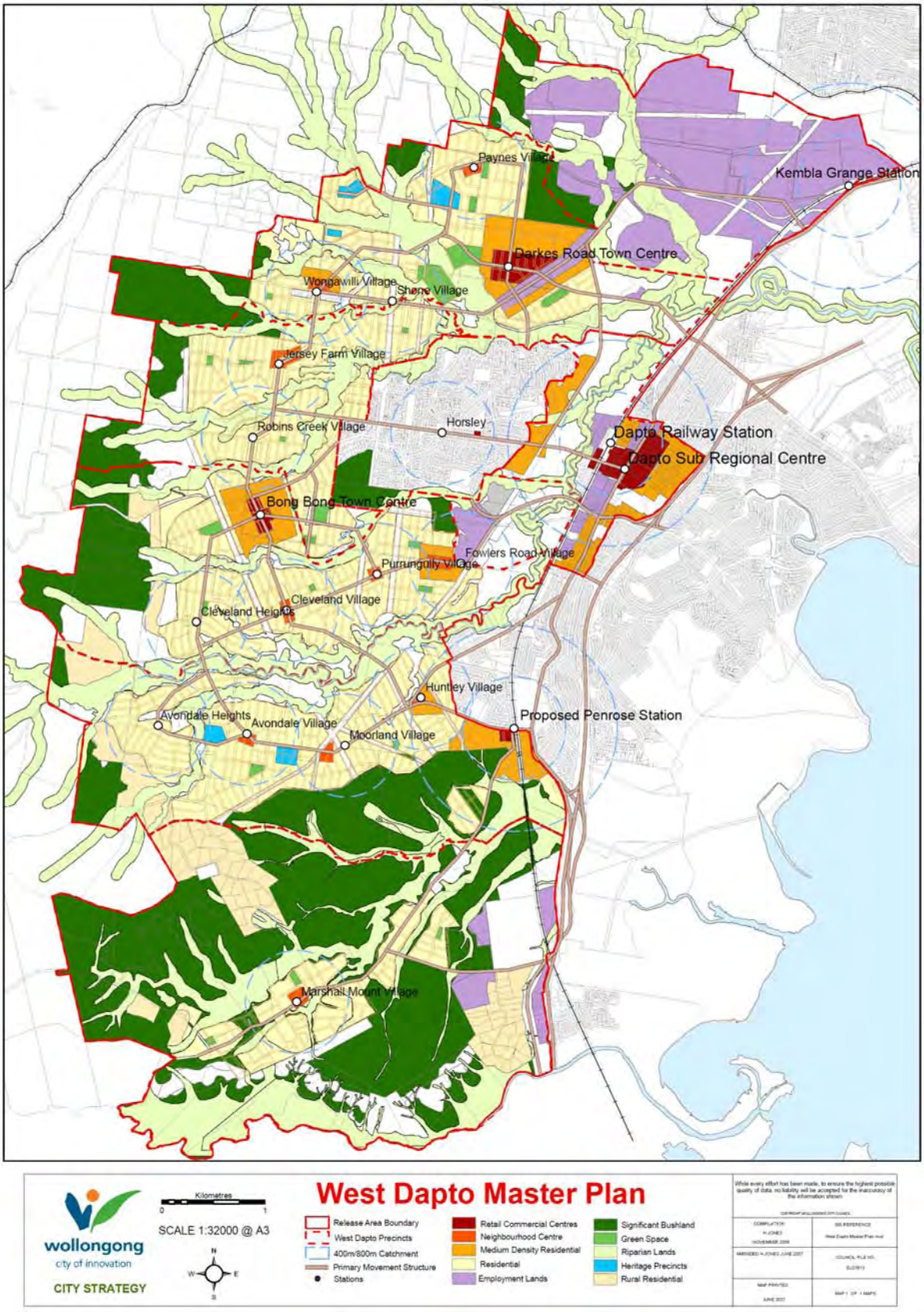
- Provision of a railway station at Huntley Road and the development of increased residential densities and a town centre around it.
- Design of the urban release area around a direct, north-south bus spine.
- The design of neighbourhood, village and town centres to have high permeability and walkability as well as supporting multi-purpose trips.

Figure 2C1 West Dapto Proposed Staging



Source: Wollongong City Council

Figure 2C2 West Dapto Master Plan



Source: Wollongong City Council

Appendix 2D

Review of Calderwood Planning Context

APPENDIX 2D - Review of Calderwood Planning Context

DLL controls approximately 700 hectares of land in the Calderwood Valley in the Illawarra Region for which it is seeking government approval for urban development. Approximately 107 hectares of the land is located in the Wollongong LGA while the balance is located within the Shellharbour LGA.

The Calderwood Valley has long been recognised as a location for future urban development, firstly in the Illawarra Urban and Metropolitan Development Programmes and more recently in the Illawarra Regional Strategy (IRS).

The IRS nominates Calderwood as an alternate release area if regional land supply is lower than expected. Following the recently completed review of the proposed West Dapto Release Area (WDRA) planning documents by the Growth Centres Commission (GCC), this situation has now been recognised as a reality. Also, the GCC report concluded that there is merit in the early release of Calderwood.

Changes in outlook arising from global, national and regional factors influencing investment and delivery certainty, housing supply and affordability and employment and economic development also add to the case for immediate commencement of the Calderwood Project.
DLL has established the conditions for the CUDP which enable effective and efficient implementation of major urban projects. These are:

- Committed landowners.
- A viable and uncomplicated infrastructure and servicing strategy.
- A well resourced proponent with the core business skills to implement the proposal.

There are five significant planning resolutions that define the current status of Calderwood:

- In September 2006, for that part of the land in its LGA, Shellharbour Council formally resolved to commence the rezoning process as part of its comprehensive LEP. However, the Department of Planning advised that it would be premature to study Calderwood at that time.
- In September 2007, Wollongong Council commenced public exhibition of the draft WDRA planning documents. These have the potential to affect the 107 hectares of land under DLL control in that LGA.
- The announcement on 15 May 2008 by Wollongong Council Administrators that significant issues have been identified in the proposed WDRA planning and the NSW Growth Centres Commission has been asked to assist to resolve these.
- On the 16 April 2009, pursuant to Clause 6 of SEPP Major Development, the Minister for Planning formed the opinion that the CUDP constitutes a Major Project to be assessed and determined under Part 3A of the EP&A Act.
- On 10 June 2009 the Department of Planning issued the Director General's Requirements to guide the preparation of the Concept Plan, Environmental Assessment Report and Stage 1 Project Application.

In summary, the following public documentation has previously been prepared for Calderwood:

- Rezoning Application (2006).
- Justification Report (2008).
- Preliminary Environmental Assessment (2009).

This TMAP, and associated documentation, is a natural continuation of the planning process for Calderwood.

Appendix 3A

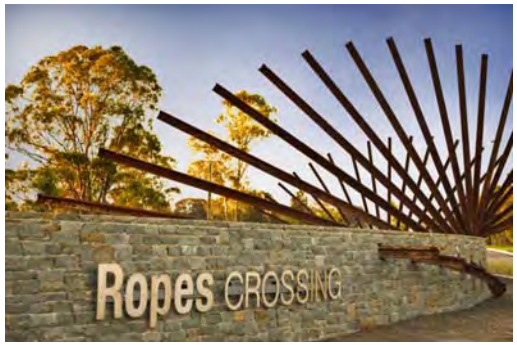
DLL Example TDM Measures

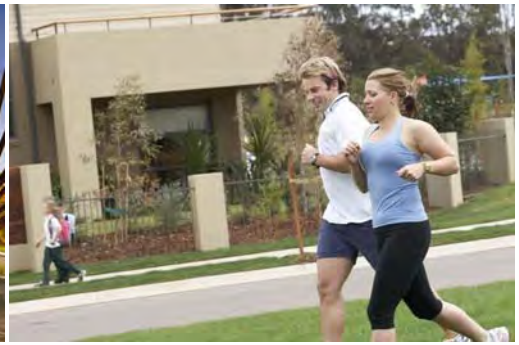
DELFIN LEND LEASE MODE SHARE INITIATIVES
ROPES CROSSING

Ropes Crossing Key Facts	
Area	161 ha
No. of Lots	Approximately 1,800 dwellings
Residential Population	Approximately 5,000

Broad objectives of access and movement initiatives:

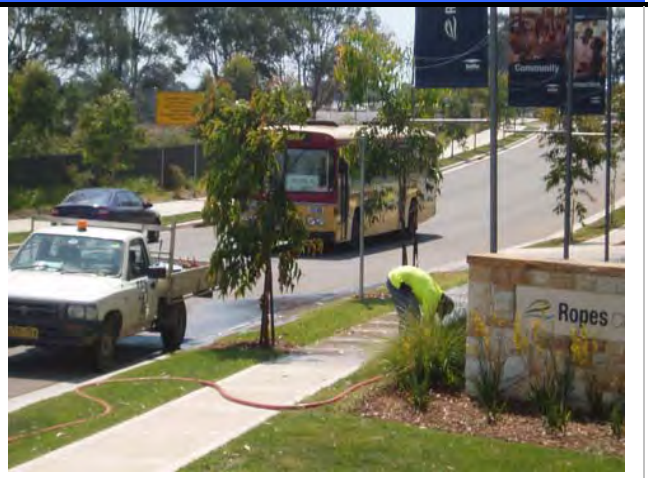
- Establish an urban form to maximise use of and access to public transport
- Concentrate high trip generating uses adjacent to major public transport routes and nodes
- Provide public transport infrastructure and services to achieve higher public transport use than other similar established areas in Blacktown and Penrith
- Provide public transport and services early in the development to establish use pattern
- Incorporate a range of uses within the site to minimise demand for travel outside the area
- Establish high quality and efficient pedestrian and cycle routes to encourage travel by these modes
- Community education to support public transport initiatives



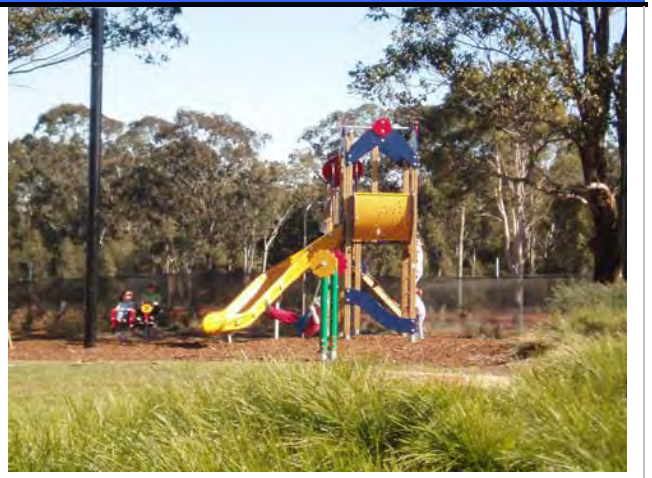



OBJECTIVES	INITIATIVES	IMPLEMENTATION
Establish an urban form to maximise use of public transport	• **Appropriately locate services and facilities** to ensure accessibility of these services by all groups • Establish a **permeable modified grid street system** to promote connectivity and ease of movement for pedestrians, bicycles, buses and vehicles • Create a **legible street hierarchy** responding to the intended uses and scale and is designed to calm traffic and encourage active uses on the street level • Maximise safety in individual streets by implementing measures to **minimise the potential for 'rat-running' or shortcut routes** including roundabouts, appropriate speed limits and raised 'wombat' type pedestrian crossing at appropriate locations. • Provide a **variety of lot sizes** to create dynamic and diverse streetscapes. • **Active frontages** to all streets and open spaces.	 *Simple and permeable street system to cater for pedestrian, cyclists, vehicles and buses*  *Establish legible street hierarchy and create roundabouts to calm traffic*

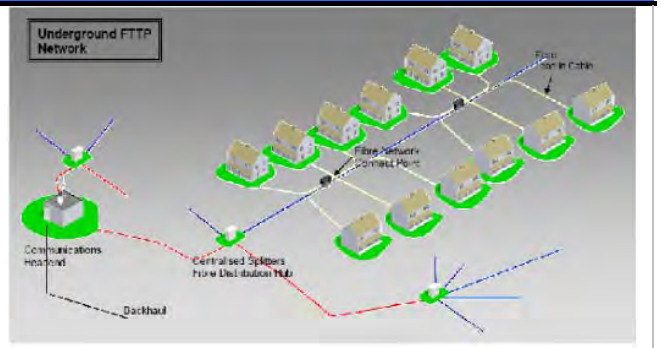
OBJECTIVES	INITIATIVES	IMPLEMENTATION
Concentrate high trip generating uses adjacent to major public transport routes and nodes	• **Consolidate key land uses within the Village Centre** which is located adjacent to bus routes • Provide a range of **medium density residential development** in appropriate locations close to key activity nodes and bus stops • Create a vibrant main street by **establishing active uses on the ground level**, **wide footpaths and landscaping**, to provide an attractive pedestrian environment in the Village Centre.	 *Village Centre is located next to public transport routes to promote accessibility*  *Ropes Crossing Primary School located adjacent to public transport routes*

OBJECTIVES	INITIATIVES	IMPLEMENTATION
Provide public transport infrastructure and services to achieve higher public transport use than other similar established areas in Blacktown and Penrith	• Locate bus stops within 5 minute walk (400m) of the majority of dwellings • Open space is generally located within 3-5 minutes walk to the majority of the homes • Strategically locate the Village Centre to ensure most homes are within a 10 minute walk (800m)of the Centre or can easily access the centre by public transport • Ensure public transport services connect the site with surrounding neighbourhoods and the established transport systems outside the site to enhance accessibility to jobs, shops, services and opportunities in the wider region • Engage bus service operators and Ministry of Transport early in the development stage to ensure bus services are running when the first resident moved in	 *Connect bus services with the surrounding areas to ensure accessibility to jobs and services in the wider region*  *Bus stops are generally located within a 5 minutes walking distance of dwellings*

OBJECTIVES	INITIATIVES	IMPLEMENTATION
Provide public transport and services early in the development to establish use pattern	• Infrastructure and services, including public transportation, are **provided early in each stage to establish a walking, cycling and public transport usage behaviour** for new residents	• **High quality streetscape** (street trees and furniture) was established prior to occupation of the site • **Bus routes and services** were established before the first resident moved in • **Ropes Crossing Primary School** was opened when only 6% of the total number of dwellings were completed and occupied • **Village Centre** was opened with key anchor tenants operating when only 8% of the total number of dwellings were completed and occupied • **3 key village parks and village greens and 50% of the hike and bike network** were completed when only 10% of the total number of dwellings were completed and occupied • **Ropes Crossing Community Centre** commenced construction when only 10% of the total number of dwellings were completed and occupied  *Ropes Crossing Community Bus commenced operation prior to the first resident moving into the community*

OBJECTIVES	INITIATIVES	IMPLEMENTATION
Incorporate a range of uses within the site to minimise demand for travel outside the area	• Provide a range of local facilities and services to meet the needs of the community within the site to minimise the need to travel to other areas for the same facilities. • Provide a mix of land uses within the site to provide local retail, community, education and employment opportunities. • Provide a range of local passive and active open spaces to cater for the all recreational needs	 *Children playgrounds are provided within walking distance to the majority of the residents to minimise the need to travel to other areas*  *Provide a range of retail and community uses within the site*

OBJECTIVES	INITIATIVES	IMPLEMENTATION
Establish quality and efficient pedestrian and cycle routes to encourage travel by these modes	• Provide a **clear and simple hike and bike network** to provide links throughout the neighbourhoods • Ensure a safe pedestrian environment by **incorporate crime prevention through urban design principles** • Incorporate **pedestrian priority streets with footpaths on both sides, increased verge widths and additional landscaping and street tree planting** to maximise amenity for pedestrians and cyclists • Provide **links to commuter cycle networks beyond the site** • Ensure **supermarkets and shops are accessible from the street level** to create activate streetscapes • Civic spaces and pedestrian oriented uses such as cafes and restaurants are located with a **northerly outlook** to maximise amenity for users in all seasons. • Generally **all streets have footpaths on both sides** to facilitate walkability of the community. • Pedestrian network hierarchy with **pedestrian priority routes and width footpaths** • **Street trees** to provide shaded routes • **Minimise driveway crossings** on key pedestrian routes on collector roads.	 *Hike and bike network to promote walking and cycling*  *Wider than standard verge to ensure ease of pedestrian movement and encourage walkability*

OBJECTIVES	INITIATIVES	IMPLEMENTATION
National Broadband Network	• Incorporate **Fibre to the Home or Premise (FttH/FttP)** in an early stage to service all homes to provide opportunities for residents to work from home and facilitate communication between businesses without the need to travel outside the site	 *Provide underground FTTP Network to all homes*
Community education to support public transport initiatives	• Provide **public transport information** in Welcome Kits • Provide **information and links to service provider** on Community Portal • Implement a range of **promotional initiative to increase public transport usage** (eg. discount vouchers for public transport usage (one month free bus travel)) • Work with schools to establish **School Walking Bus initiatives**	 *Community education event to promote cycling, public transport usage and road safety.*

DELFIN LEND LEASE MODE SHARE INITIATIVES
ROUSE HILL

Forde Key Facts	
Area	120 ha
No. of Lots	Approximately 1,800 dwellings
Residential Population	Approximately 4,000 – 5,000

Relevant Masterplanning Principles

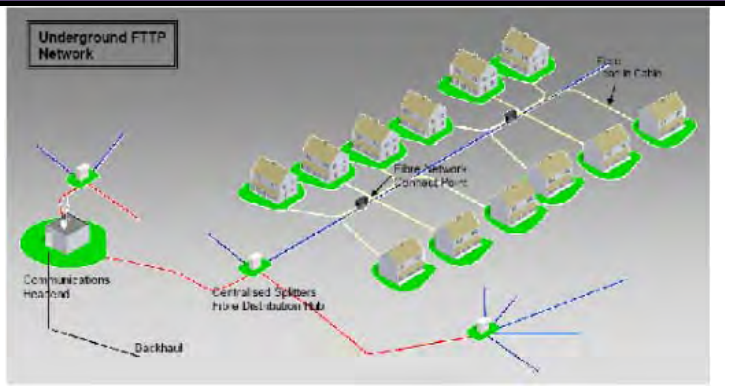
- Transit and pedestrian oriented development
- Pedestrian connectivity as built form determinant
- Power of Place and Civic Identity
- Discrete/Neighbourhoods with Identifiable Structure
- Compact Town Centre form and footprint
- National Broadband network

OBJECTIVES	INITIATIVES	IMPLEMENTATION
Transit and pedestrian oriented development	• Maximise higher density residential and employment uses within 400m of transit interchange to enhance transit use • Aim to reduce car dependency by providing pedestrian and cycle friendly streets and facilities within a 5-10 minute walk of the town centre and the transit station • Provide convenient access to public transport within a 5-10 walk throughout the town centre • Organise transit interchange as gateway and arrival experience with the provision for supportive commercial and retail uses at a later time • Enhance pedestrian orientated development with provision of facilities, such as benches and landscaping, which will also create identifiable road character • Enhance the pedestrian orientated development with primary and secondary pedestrian linkages, particularly throughout the Town Centre Core and to the surrounding residential neighbourhoods. • Provide for an integrated transit and rail station at the termination of Main Street of the Town Centre connecting the community to the metropolitan network • Local bus service network linking to the transit station • Provide community bus service • Cycle and pedestrian areas linking to the transit station.	 *Transit oriented development where bus interchange is located adjacent to the town centre and forms the gateway of the development.*  *Community centre located within the town centre to improve accessibility for pedestrian and by public transport*

OBJECTIVES	INITIATIVES	IMPLEMENTATION
Pedestrian connectivity as built form determinant	• Provide high degree of permeability through the Town Centre built form to create convenience, safety and fine grain experience; • Provide publicly accessible routes through large footprint land uses and integrated open space and public domain network to create connection throughout the Town Centre • Provide off street cycleway network throughout the development to encourage cycling	 *Pedestrian oriented streets to improve pedestrian connectivity.*  *Active streetscape to promote safe pedestrian activities, improve surveillance and encourage people to walk around the town centre.*

OBJECTIVES	INITIATIVES	IMPLEMENTATION
Discrete/Neighbourhoods with identifiable Structure	• Focus each neighbourhood on an internal park and establish clear edges and character t each precinct or neighbourhood • Ensure a permeable and legible street structure • Define a hierarchical network of streets providing convenient and legible access that clearly links to other neighbourhoods • Acknowledge streets as view corridors, critical to orientation and way finding • Acknowledge architectural treatment and diversity of the different neighbourhoods • Define the neighbourhoods and the town centre by: - Fingers of open space created by the Caddies Creek system and its tributaries - One or more neighbourhood parks, centrally focused - Less than 5 minute walk from neighbourhood centre to its outer limit and into adjacent neighbourhood 	 *Neighbourhood park forms the focus of the neighbourhood*  *Caddies Creek is accessible from the neighbourhoods to provide regional recreational opportunities for residents.*

OBJECTIVES	INITIATIVES	IMPLEMENTATION
Compact Town Centre form and footprint	• Reduce the extent of Town Centre footprint through possible vertical layering of land uses, reduction in road reserve areas and innovative approaches to mixed use • Increase density of housing forms in the Town Centre and optimise all land development opportunities within a 5 min walking distance to the Main Street form employment and living	 *Mixed use development facing town square to create civic gathering place*  *Vertical integration of development to promote a compact urban form in the town centre.*

OBJECTIVES	INITIATIVES	IMPLEMENTATION
National Broadband Network	• Incorporate Fibre to the Home or Premise (FttH/FttP) in an early stage to service all homes to provide opportunities for residents to work from home and facilitate communication between businesses without the need to travel outside the site	 *Provide underground FTTP Network to all homes*

DELFIN LEND LEASE MODE SHARE INITIATIVES
FORDE

Forde Key Facts	
Area	131 ha
No. of Lots	Approximately 1,100 dwellings
Residential Population	Approximately 2,700

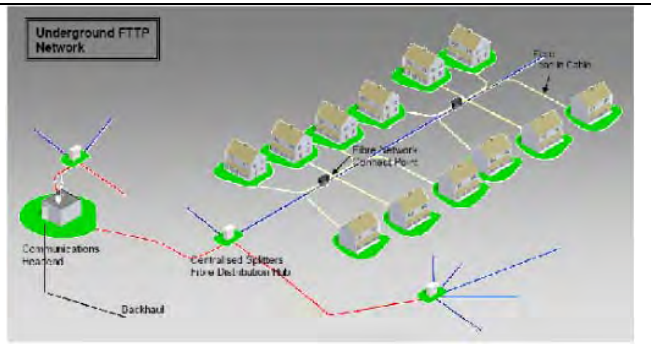
Broad Access and Movement Objectives from North Gungahlin Structure Plan

- Reduce dependence on private cars and increase public transport use
- Road network capable of supporting efficient private and public vehicle use
- Encourage walking and cycling as alternative means of transport
- Establish a development pattern to encourage a greater use of public transport with resultant reductions in private car use
- Increase opportunities for locally based service provision and home based employment, reducing the need for travel to other areas
- National Broadband network

OBJECTIVES	INITIATIVES	IMPLEMENTATION
Reduce dependence on private cars and increase public transport use	• Infrastructure and services, including public transportation, are **provided early in each stage to establish a walking, cycling and public transport use behaviour** for new residents • **Engage bus service operators early** in the development stage to ensure bus services are running when the first resident moved in • Design a public transport network to **connect Forde with the broader public transport network** in North Gungahlin and other major centres. Locate bus route on the collector road network, which connects Forde with adjoining town centres and areas of higher density. • Locate **bus route within 400m of at lease 90% of dwellings** • Locate **bus stops within 500m for 95% of dwellings**	 *Bus stops are located within 5 minutes walk from 95% of the dwellings to maximise public transport uses.*
Road network capable of supporting efficient private and public vehicle use	• Establish a **clear and identifiable road hierarchy** to promote connectivity and ease of movement for pedestrians, bicycles, buses and vehicles • Design of new roads to provide adequate capacity for vehicle traffic on the assumption that up to 20% **of total peak hour travel will take place using public transport**. • Maximise safety in local streets by designing a road network that would **minimise through traffic and reduce 'rat running'** from Bonner and future suburbs to the Gungahlin Town Centre and areas south. • **Internal road network is connected with Horse Park Drive**, which is the major arterial within the broader North Gungahlin area. • **Connect internal road network with future entry point at Bonner** to promote connectivity between suburbs.	 *Clear road hierarchy and internal road network to promote connectivity*

OBJECTIVES	INITIATIVES	IMPLEMENTATION
Encourage walking and cycling as alternative means of transport	• Provide a comprehensive network of both trunk on-road and off road pedestrian and cycle network that allows safe connections to all public open space, Mulligans Flat Nature Reserve, schools, community facilities and local centre. • Establish an open space spine along the natural creek line linking the Mulligans Flat to the central and mixed use higher density housing area. A pedestrian pathway and cycleway network is incorporated along the open space spine to encourage walking and cycling. • Create pedestrian connection to the existing suburb of Gungahlin via a pedestrian underpass to an existing bridge. • Appropriately locate services and facilities to ensure accessibility of services by all groups • Provide a variety of lot sizes to create dynamic and diverse streetscapes. • Active frontages to all streets and open spaces. • Incorporate pedestrian priority streets with footpaths on both sides, increased verge widths and additional landscaping and street tree planting to maximise amenity for pedestrians and cyclists • Incorporate high quality streetscape design to define space, provide shade and enhance pedestrian amenity. Streetscape design is provided in a Landscape Master Plan which incorporates a variety of street trees to define neighbourhood character. • Minimise driveway crossings on key pedestrian routes on collector roads.	 *Open space spine incorporated with pedestrian walkway and cycleway to maximise recreational opportunities and reduce private care use.*

OBJECTIVES	INITIATIVES	IMPLEMENTATION
Establish a development pattern to encourage a greater use of public transport with resultant reductions in private car use	• Strategically locate the local centre on major road to ensure most homes are within a 5 minute walk (400m)of the Centre or can easily access the centre by public transport • Maximise housing diversity within subdivision design and allow higher residential densities adjacent to centres to encourage greater use of public transport. • Local neighbourhood is planned based on a walkable radius of 400m, and focussed on activity node such as shops, community facility, school or a bus stop to allow accessibility to these facilities. • Open space is generally located within 3-5 minutes walk to the majority of the homes	 *Community facility located along major road next to local centre and bus routes. It is connected by pedestrian pathways and cycleway to encourage walking and cycling.*  *Local centre is strategically locate close to public transport node to encourage public transport use.*

OBJECTIVES	INITIATIVES	IMPLEMENTATION
Increase opportunities for locally based service provision and home based employment, reducing the need for travel to other areas	• Create **mixed use local centre** to accommodate a range of retail, commercial and community uses to increase opportunities for locally based service provision and home based employment. This can also reduce the need for travel to other areas. • Provide a **range of functions within the open space network**, including passive and active recreation, the retention and regeneration of riparian areas, green corridors, and historically and culturally important sites. The network of neighbourhood Parks and activity areas can provide a range of recreational opportunities for residents locally within the neighbourhood.	 *A range of local recreation facilities are provided within walking distance to residential areas to minimise the need to travel to other areas*
National Broadband Network	• Incorporate **Fibre to the Home or Premise (FttH/FttP)** in an early stage to service all homes to provide opportunities for residents to work from home and facilitate communication between businesses without the need to travel outside the site	 *Provide underground FTTP Network to all homes*

Appendix 4A

Functional Road Classification

APPENDIX 4A - FUNCTIONAL ROAD CLASSIFICATION

The functional role or performance of individual roads can be appraised according to the classification of that road within an overall road hierarchy. Changes to traffic flows on the road can then be assessed within the context of the road hierarchy.

The RTA published guidelines for the classifications of roads in a functional system in their document *Functional Classification of Roads*. The objectives of these guidelines can be summarised as:

- In planning terms – the classification of streets and development of an operational hierarchy is seen as an essential component of structural planning at the neighbourhood level; and
- In operational terms – the concept of functional classification is seen as an endeavour to match the class of road to its use and to the environmental needs of the community.

The RTA document classifies roads according to the role they fulfil and the appropriate volume of traffic that they should convey:

- Arterial Road - is typically a main road carry in excess of 15,000 vehicles per day and over 1,500 vehicles per hour in the peak period. They predominantly carry traffic from one region to another, forming principal avenues of communication for metropolitan traffic movements.
- Sub-Arterial Road – is typically a secondary road carrying between 5,000 and 20,000 vehicles per day and over 500 and 2,000 vehicles per hour in the peak period. They predominantly carry traffic from one sub-region to another forming secondary inter-regional transport links.
- Collector Road – is typically a minor road carrying between 2,000 and 10,000 vehicles per day and over 250 and 1,000 vehicles per hour in the peak period. They provide a link between local areas and regional road carrying low traffic volumes. At volumes greater than 5,000 vehicles per day, residential amenity begins to decline noticeably.
- Local Road – is typically a local street carrying less than 2,000 vehicles per day and 250 vehicles per hour in the peak period. They provide immediate access to individual houses and carry low traffic volumes.

Table 1 provides details of the characteristics of different functional classifications of roads. The table shows that there is considerable overlap between the functions of the various classes of roads.

Table 1 Functional Classification of Roads - Parameters

Factor/Measure of Effectiveness	Arterial/ Freeway	Sub-Arterial	Collector	Local
Vehicle Speed / Operating Speed				
	70-110km/h	60-80km/h	40-60km/h	40km/h (or less)
Traffic Volume (AADT)				
Residential Area	No Limit	< 20,000	< 5,000	< 2,000
Other Area	No Limit	< 20,000	< 10,000	< 4,000
Intersection Spacing				
	Approximately 1km	Approximately 0.5km	-	-
Road Geometry				
Number of Lanes	4 or more	2 or more	2 or more	1 or more
Medians	✔	As needed	no	no
Minimum Carriageway Width	13m	7m	7m	4m
Heavy Vehicle Load Restrictions				
	None	Preferably none	Yes, if residential	Yes, if residential
Traffic Management				
Intersection Control	Refer to Table 2			
Lane and Separation Lines	✔	✔	✔	✔
Property Access	Minimised	Minimised	✔	✔
Control of Turning Vehicle mid-block access	Median controlled	Maybe control	no	no
Right Turn Bays	✔	Preferred	no	no
Road Closures	none	none	possible	✔
LATM devices	-	-	✔	✔
SATM devices	-	✔	-	-
Interconnections				
	sub-arterial	arterial / collector	sub-arterial / local	collector
Parking				
Peak Period	no	no	✔	✔
Off Peak	no	✔	✔	✔
Period Parking	no	maybe	✔	✔
Unrestricted	no	no	maybe	✔
Parallel Parking	no	no	maybe	✔
Pedestrian Crossings				
	Grade Separated or Signals	Signals or Refuge	Marked Crossing, Children's Crossing or Refuge	Marked Crossing, Children's Crossing or Refuge
Bus and Transit Lanes				
	✔	✔	✔	-

Sources: "Functional Classification of Roads", Roads and Traffic Authority of New South Wales
"Road Design Guide", Roads and Traffic Authority of New South Wales

Table 2 Suitability for Provision of Right Turn Movements

		Right Turn To			
		Arterial/ Freeway	Sub-Arterial	Collector	Local
Right Turn From	Arterial/Freeway	Yes	Yes	Possible	No
	Sub-Arterial	Yes	Yes	Yes	Possible
	Collector	Possible	Yes	Yes	Yes
	Local	No	Possible	Yes	Yes

Source: "Road Design Guide", Roads and Traffic Authority of New South Wales

The Growth Centres Development Code classifications, shown in Table 3, are consistent with the RTA classifications. These classifications have been designed for the growth centres and have therefore been adopted in this study.

Table 3 Functional Classification of Roads (Growth Centres Commission)

Road Classification	AADT	Functions and Connections	Speed Limit
Arterial/Freeway	35,000+	Connects large urban areas	Up to 80km/h
Sub-Arterial	10,000 – 35,000	Arterial roads to town centres Carries major bus routes	Up to 70km/h
Collector	3,000 – 10,000	Connects neighbourhoods Can accommodate public transport	Up to 60km/h
Local	1,000 – 3,000	Priority to pedestrians and cyclists Designed to slow residential traffic	Up to 50km/h

Source: Growth Centres Development Code, Growth Centres Commission, October 2006

Appendix 4B

Road Network Description

APPENDIX 4B - ROAD NETWORK DESCRIPTION

Southern (F6) Freeway

The Southern (F6) Freeway is located to the north east of the development site, running north-south and has a speed limit of 110 km/hr. The Freeway assumes the role of providing for through traffic between Sydney, Wollongong and points further south, bypassing the Princes Highway and Dapto Town Centre. In the study area, the Freeway is comprised of dual two-lane carriageways, separated by a wide, grassed median. Grade-separated crossings of the Freeway are provided at Martin Street (footbridge only), Emerson Road and Fowlers Road. Access to/from the Freeway is provided via north-facing ramps at Fowlers Road and south-facing ramps at Princes Highway, Tallawarra (the southern terminus of the freeway). There are no south-facing ramps on the Freeway south of Northcliffe Drive at Berkeley, and no north-facing ramps at the Princes Highway junction at Tallawarra.

Photograph 1 Southern Freeway looking north from Fowlers Road

Princes Highway (north of Tallawarra)

This section of **Princes Highway**, formerly part of the main inter-regional route between Sydney, Wollongong and points further south, now functions as a sub-arterial route serving Dapto Town Centre. Through the study area, the Highway generally comprises of a two-lane undivided carriageway. The speed limit through the study area is 80 km/hr, slowing to 60km/h as it enters the built up area of Dapto.

Photograph 2 Princes Highway looking north from the Southern Freeway

Princes Highway (south of Tallawarra)

This section of Princes Highway forms part of the major inter-regional route between Sydney, Wollongong and the South Coast, linking directly to the southern end of the Southern Freeway at Tallawarra. It generally consists of two travel lanes in each direction, on dual carriageways north of Illawarra Highway and on a single, undivided carriageway south of Illawarra Highway. The speed limit is 100km/h between the Southern Freeway and Macquarie Rivulet, 70km/h between Macquarie Rivulet and Creamery Road, 60km/h between Creamery Road and Tongarra Road, and 70km/h from Tongarra Road to the edge of the study area.

Photograph 3 Princes Highway looking north from Tongarra Road

Illawarra Highway

Illawarra Highway is located to the south and east of the development site and is a major highway linking the Illawarra with inland New South Wales. It commences at a roundabout at the intersection with the Princes Highway, running south across floodplain to Albion Park before turning west and running through the Macquarie Rivulet valley en route to Macquarie Pass. It is generally a two-lane undivided carriageway, except through Albion Park where it becomes a four-lane undivided carriageway. West of Hamilton Road, the carriageway widens from 12 metres to 18 metres before narrowing again east of Polock Crescent. A speed limit of 60km/h applies through Albion Park, increasing to 90km/h between Albion Park and Princes Highway and 100km/h west of Broughton Avenue. A school zone applies between Polock Crescent and Calderwood Road at Albion Park.

Photograph 4Illawarra Highway looking east from Calderwood Road

Tongarra Road

Tongarra Road is an arterial road linking Illawarra Highway at Albion Park with Princes Highway at Oak Flats. It is a two-lane undivided carriageway for most of its length, widening to four lanes on approach to the junctions with Princes Highway and Illawarra Highway. The eastern-most 600 metres has a concrete median. The speed limit alternates between 60km/h and 80km/h – the 80km/h zone being located between the eastern edge of Albion Park and Croome Road.

Photograph 5Tongarra Road looking west across Frazers Creek

Huntley Road

Huntley Road is a collector road, running east-west between the Princes Highway and Avondale Road. It is generally a two-lane undivided carriageway. Through the existing urban area it has a 10 metre wide pavement with kerb and gutter on the northern side. The line markings are also off-centre, to allow on-street parking along the northern side of the pavement. To the west of the existing urban area, Huntley Road is a two-lane rural carriageway 5 metres wide, with unsealed shoulders. The speed limit is 80 km/hr. It reduces to 50 km/hr in the built up area between Penrose Street and Princes Highway

Photograph 6 Huntley Road looking east towards the existing urban area

Marshall Mount Road

Marshall Mount Road is a two-lane undivided, 6 metre wide carriageway with an 80km/h speed limit. It links Huntley Road at the rail overpass with Calderwood Road, skirting the north-western edge of the development site. A single-lane bridge over a branch of Duck Creek is located 1.3km north of Yallah Road. The pavement is generally in good condition except for the final 500m on approach to Calderwood Road.

Photograph 7Marshall Mount Road looking north near Calderwood Road

Yallah Road

Yallah Road is a two-lane undivided carriageway linking Princes Highway with Marshall Mount Road. It has a speed limit of 80km/h, except in the vicinity of Princes Highway where a 60km/h speed limit applies. Pavement width is generally 6 metres, widening to 7 metres on approach to Yallah.

Photograph 8 Yallah Road looking west to Marshall Mount Road

Calderwood Road

Calderwood Road is a two-lane undivided carriageway linking Albion Park with a number of rural properties in the Calderwood area. Pavement width is generally 6 metres in the rural section, widening to 12 metres within Albion Park urban area. A speed limit of 50km/h applies within the Albion Park urban area and a speed limit of 80km/h in the rural area. A school zone also applies for 600 metres west from the intersection with North Macquarie Road.

Photograph 9 Calderwood Road

North Macquarie Road

North Macquarie Road is a two-lane undivided carriageway, generally 4-5 metres in width, linking Illawarra Highway with Calderwood Road along the northern side of Macquarie Rivulet. It has a signposted speed limit of 80km/h for the majority of the route, with a 60km/h limit applying in the vicinity of the small concrete ford over Macquarie Rivulet. The immediate southern approach to Macquarie Rivulet is only one-lane wide.

Photograph 10 North Macquarie Road at Macquarie Rivulet

Appendix 4C

Carriageway Capacity Performance Criteria

APPENDIX 4C - CARRIAGEWAY CAPACITY PERFORMANCE CRITERIA

ENVIRONMENTAL CAPACITY

Typically road hierarchy classifications are based purely on road function and capacity. Within more sensitive land use zones, such as residential zones, a more appropriate classification would be based on the environmental capacity concept. The RTA Guide to Traffic Generating Developments (October 2002) gives the guidance on the environmental capacity of residential streets, as detailed in Table 1 below.

Table 1 Environmental Capacity Performance Standards on Residential Streets

Road Class	Maximum Speed (kilometres/hour)	Maximum Peak Hour Volume (vehicle/hour)
Collector Street		
Environmental Goal	50	300
Maximum	50	500
Local Street		
Environmental Goal	50	200
Maximum	50	300

Source: RTA Guide to Traffic Generating Developments

URBAN ROADS MID-BLOCK CAPACITY

The typical capacity of urban lanes with interrupted flow is provided in Table 2 for each LoS, as defined in the RTA Guide to Traffic Generating Developments. These capacities may increase when priority is given to the major traffic flow at intersections or if there is flaring at intersections to accommodate more traffic. The spacing of intersections will differ with the hierarchy and function of the road.

Table 2 Mid-block Level of Service and Capacity

LoS	Description	Hourly Flow (vehicles)	
		1 Lane	2 Lane
A	Free flow - A condition of free flow in which individual drivers are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to manoeuvre within the traffic stream is extremely high, and the general level of comfort and convenience provided is excellent.	200	900
B	Stable flow (slight delays) - In the zone of stable flow and drivers still have the reasonable freedom to select their desired speed and to manoeuvre within the traffic stream, although the general level of comfort and convenience is a little less than with LOS A.	380	1400
C	Stable flow (acceptable delays) - Also in the zone of stable flow, but most drivers are restricted to some extent in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience declines noticeably at this level.	600	1800
D	Approaching unstable flow (tolerable delays) - Close to the limit of stable flow and is approaching unstable flow. All drivers are severely restricted in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience is poor, and small increases in traffic flow will generally cause operational problems.	900	2200
E	Unstable flow (congestion; intolerable delays) - Occurs when traffic volumes are at or close to capacity, and there is virtually no freedom to select desired speeds or to manoeuvre within the traffic stream. Flow is unstable and minor disturbances within the traffic stream will cause break-down.	1400	2800
F	Forced flow (jammed)	>1400	>2800

Source: RTA Guide to Traffic Generating Developments

A service volume, as defined by AUSTROADS, is the maximum number of vehicles that can pass over a given section of roadway in one direction during one hour while operating conditions are maintained at a specified LoS. It is suggested that ideally arterial and sub-arterial roads should not exceed service volumes at LoS C. At this level, whilst most drivers are restricted in their freedom to manoeuvre, operating speeds are still reasonable and acceptable delays experienced. However, in urban situations, arterial and sub-arterial roads operating at LoS D are still considered adequate. It is acceptable to provide road capacity at Level of Service 'D' in the peak hour since overprovision of road capacity is not conducive to promoting alternative transport modes to the car. The LoS for uninterrupted flow conditions along urban roads is identified in Table 3.

Table 3 Level of Service Uninterrupted Flow Conditions Along Urban Roads (One Way Hourly Volumes)

Road Description	LEVEL OF SERVICE (LoS)					
	A	B	C	D	E	F
2 Lane Undivided (2U)	760	880	1000	1130	1260	Forced Flows
2 Lane with Clearways and limited access (2CL)	1010	1170	1330	1500	1680	
4 Lane Undivided (13m) (4U)	1260	1470	1680	1890	2100	
4 Lane Undivided with Clearways (4UC)	1510	1760	2010	2270	2520	
4 Lane Divided with Clearways (4DC)	1600	1860	2130	2400	2660	
4 Lane Divided with Clearways, limited access and intersections(4DCI)	2250	2620	3000	3380	3740	
6 Lane Undivided (6U)	2020	2350	2690	3020	3360	
6 Lane Divided with Clearway (6DC)	2440	2840	3250	3660	4060	
6 Lane Divided with Clearways, limited access and intersections (6DCL)	3375	3930	4500	5070	5610	

Source: AUSTROADS *Guide to Traffic Engineering Guidelines – Part 2 - Roadway Capacity (1988)*

UNINTERRUPTED TWO-LANE RURAL ROAD CAPACITY

Uninterrupted Two-Lane Two-Way roads have one lane for use by traffic travelling in each direction. Overtaking of slower vehicles requires the use of the opposing traffic lane when sight distance and gaps in the opposing traffic stream permit. The term 'uninterrupted' describes the flow facilities where traffic flow conditions are the result of interactions between vehicles in the traffic stream, and between vehicles and the geometric and environmental characteristics of the road, and not the result of traffic controls. The Uninterrupted Two-Lane Two-Way roadway capacity is affected by factors such as, terrain, sight distance, lane widths, percentage of heavy vehicles, and directional distribution.

The roadway capacity for an uninterrupted two-lane two-way road is calculated using the following equation:

$$SFi = 2{,}800\,(v/c)I\,f_d\,f_w\,f_{HV}$$

Where:

SF_i	=	Total service flow rate in vehicles per hour in both directions under prevailing roadway and traffic conditions for level of service i
(v/c)	=	Maximum volume/capacity ratio which can be accommodated at level of service I for a given terrain and percent of length with no overtaking, from Table 3.1
f_d	=	Adjustment factor for directional distribution of traffic, from Table 3.2
f_w	=	Adjustment factor for narrow lanes and shoulders from Table 3.3
f_{HV}	=	Adjustment factor for heavy vehicles
P_T & P_B	=	The proportion of trucks and buses respectively in the traffic stream
E_T & E_B	=	The average passenger car equivalents for trucks and buses, from Table 3.4

The volume/capacity ratio is based on two factors, the type of terrain and the percent of length with sight distance less than 450m.

Reference: Austroads Guide to Traffic Engineering Practice, PART 2, Roadway Capacity, Section 3 Uninterrupted Two-Lane Two-Way Roads.

UNINTERRUPTED MULTI-LANE RURAL ROAD CAPACITY

Uninterrupted Multi-Lane roads have two or more lanes for use by traffic in each direction. They may be classified as either divided or undivided. Divided is when opposing direction of traffic are physically separated by a median. Undivided is when opposing directions of traffic are not physically separated. The Uninterrupted Multi-Lane roadway capacity is affected by factors such as, design speed, terrain, lane widths, number of lanes, percentage heavy vehicles, driver population, and development environment.

The roadway capacity for an uninterrupted multi-lane road is calculated using the following equation:

$$SF_i = C_j (v/c)_i N f_w f_{HV} f_e f_p$$

Where:

SF_i	=	Total service flow rate in one direction under prevailing roadway and traffic conditions for level of service *i*
C_j	=	Capacity per lane under ideal conditions for a multi-lane highway with a design speed *j*, i.e. 2,000 pc/h/lane for *j* = 100km/h or 110km/h and 1,900 pc/h/lane for *j* = 80km/h
N	=	Number of lanes in one direction
(v/c)	=	Maximum volume/capacity ratio which can be accommodated at level of service *i*, obtained from Table 4.1
f_w	=	Adjustment factor for lane width and/or lateral clearance restrictions, see Table 4.2
f_{HV}	=	Adjustment factor for heavy vehicles
	=	$1 / [1 + P_T(E_T - 1) + P_B(E_B - 1)]$
P_T & P_B	=	The proportion of trucks and buses respectively in the traffic stream
E_T & E_B	=	The average passenger car equivalents for trucks and buses, from Table 4.3
f_e	=	Adjustment factor for development environment and type of multi-lane road, obtained from Table 4.4
f_p	=	Adjustment factor for driver population, obtained from Table 4.5

Reference: Austroads Guide to Traffic Engineering Practice, PART 2, Roadway Capacity, Section 4 Uninterrupted Multi-Lane Roads

FREEWAY CAPACITY

A freeway is a divided road with two or more lanes for use by traffic travelling in each direction, with no at-grade intersections and with full control of access from abutting property. In addition to the factors affecting an uninterrupted multi-lane road, freeway capacity is also affected by ramps, and weaving areas.

The roadway capacity for a freeway is calculated using the following equation:

$$SF_i = C_j (v/c)_i N f_w f_{HV} f_p$$

Where:

SF_i	=	Total service flow rate in one direction under prevailing roadway and traffic conditions for level of service *i*
C_j	=	Capacity per lane under ideal conditions for a freeway with a design speed *j*, ie 2,000 pc/h/lane for *j* = 100km/h or 110km/h and 1,900 pc/h/lane for *j* = 80km/h
N	=	Number of lanes in one direction
(v/c)	=	Maximum volume/capacity ratio which can be accommodated at level of service *i*, obtained from Table 5.1
f_w	=	Adjustment factor for lane width and/or lateral clearance restrictions, see Table 4.2
f_{HV}	=	Adjustment factor for heavy vehicles
	=	$1 / [1 + P_T(E_T - 1) + P_B(E_B - 1)]$
P_T & P_B	=	The proportion of trucks and buses respectively in the traffic stream
E_T & E_B	=	The average passenger car equivalents for trucks and buses, from Table 4.3
f_p	=	Adjustment factor for driver population, obtained from Table 4.5

Reference: Austroads Guide to Traffic Engineering Practice, PART 2, Roadway Capacity, Section 5 Freeways

Appendix 4D

Intersection Performance Criteria

APPENDIX 4D - INTERSECTION PERFORMANCE CRITERIA

The existing intersection operating performance was assessed using the SIDRA software package to determine the Degree of Saturation (DS), Average Delay (AVD in seconds) and LoS at each intersection. The SIDRA program provides LoS Criteria Tables for various intersection types. The key indicator of intersection performance is LoS, where results are placed on a continuum from 'A' to 'F', as shown in Table 1.

Table 1 Intersection Level of Service

LoS	Traffic Signal / Roundabout	Give Way / Stop Sign / T-Junction control
A	Good operation	Good operation
B	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	Satisfactory	Satisfactory, but accident study required
D	Operating near capacity	Near capacity & accident study required
E	At capacity, at signals incidents will cause excessive delays.	At capacity, requires other control mode
F	Unsatisfactory and requires additional capacity, Roundabouts require other control mode	At capacity, requires other control mode

The Average Vehicle Delay (AVD) provides a measure of the operational performance of an intersection as indicated below, which relates AVD to LOS. The AVD's should be taken as a guide only as longer delays could be tolerated in some locations (i.e. inner city conditions) and on some roads (i.e. minor side street intersecting with a major arterial route). For traffic signals, the average delay over all movements should be taken. For roundabouts and priority control intersections (sign control) the critical movement for LoS assessment should be that movement with the highest average delay.

Table 2 Intersection Average Delay (AVD)

LoS	Average Delay per Vehicles (seconds/vehicle)
A	Less than 14
B	15 to 28
C	29 to 42
D	43 to 56
E	57 to 70
F	>70

The degree of saturation (DS) is another measure of the operational performance of individual intersections. For intersections controlled by traffic signals both queue length and delay increase rapidly as DS approaches 1. It is usual to attempt to keep DS to less than 0.9. Degrees of Saturation in the order of 0.7 generally represent satisfactory intersection operation. When DS exceed 0.9 queues can be anticipated.

Intersection modelling has been completed using the SIDRA intersection modelling program. The 2008 base case scenarios for both the AM and PM peaks have been assessed as part of this study. The modelled volumes have been derived from the TRACKS model and reassigned into SIDRA. The intersections were analysed to determine the operating characteristics under the existing traffic conditions with existing traffic volumes. The intersections were analysed using the existing intersection layout. The analysis results are presented in the following sections.

Appendix 4E

Annual Average Daily Traffic (AADT) Volumes 1994 to 2005

APPENDIX 4E - Annual Average Daily Traffic (AADT) Volumes (vehicles per day)

	Years					
Location	**1994**	**1997**	**1998**	**2000**	**2003**	**2005**
Southern Freeway						
South of Fowlers Road	-	-	29,969	33,091	37,674	-
Princes Highway						
South of Huntley Road	9,656	10,322	10,416	10,692	11,954	12,681
At Macquarie Rivulet bridge	37,781	40,752	41,873	44,635	48,648	48,842
South of Illawarra Highway	33,644	34,575	35,687	37,869	41,413	41,595
North of Tongarra Road	37,781	40,752	41,873	44,635	48,648	48,842
East of Tongarra Road	42,204	37,472	39,401	40,689	31,749	38,290
Illawarra Highway						
South of Princes Highway	11,514	11,471	12,180	13,355	13,773	14,553
West of Terry Street	12,124	12,329	12,575	14,124	12,061	12,262
Tongarra Road						
West of Princes Highway	14,614	14,937	15,767	15,368	9,472	9,989
East of Illawarra Highway	11,678	13,800	14,302	15,421	11,562	12,322
Terry Street						
South of Illawarra Highway	11,846	13,347	13,699	17,404	12,547	12,648

Source: Roads and Traffic Authority of New South Wales, Average Annual Traffic Volume Data for Southern Region, 2006

Appendix 4F

Existing Mid-block Traffic Volumes & Carriageway Level of Service

Appendix 4F - Existing Mid-block Traffic Volumes & Carriageway LoS
AM Peak

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie	113	126	239	B	B
Illawarra Highway	North Macquarie	Tullimbar Lane	128	115	243	B	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	131	123	254	B	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	173	136	309	B	B
Illawarra Highway	Broughton Avenue	Church Street	229	205	434	A	A
Illawarra Highway	Church Street	Calderwood Road	482	351	833	A	A
Illawarra Highway	Calderwood Road	Russell Street	526	428	954	A	A
Illawarra Highway	Russell Street	Terry Street	572	547	1,119	A	A
Illawarra Highway	Terry Street	Croome Lane	870	365	1,235	B	A
Illawarra Highway	Croome Lane	Princes Highway	960	427	1,387	C	A
Yallah Road	Marshall Mount	Princes Highway	61	32	93	A	A
Marshall Mount Road	Calderwood Road	North Marshall	36	36	72	A	A
Marshall Mount Road	North Marshall	Yallah Road	53	28	81	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	40	32	72	A	A
Marshall Mount Road	Yallah TAFE	Huntley Road	30	51	81	A	A
Calderwood Road	Calderwood valley	Marshall Mount	27	17	44	A	A
Calderwood Road	Marshall Mount	Illawarra Christian	44	34	78	A	A
Calderwood Road	Illawarra Christian	North Macquarie	69	108	177	A	B
Calderwood Road	CUDP	Mansons Bridge	69	99	168	B	B
Calderwood Road	Mansons Bridge	Illawarra Highway	142	133	275	A	A
North Macquarie Road	Illawarra Highway	Macquarie Rivulet	9	9	18	A	A
North Macquarie Road	Macquarie Rivulet	Calderwood Road	15	6	21	A	A
Huntley Road	Marshall Mount	Princes Highway	147	93	240	A	A
Tongarra Road	Terry Street	Stapleton Avenue	546	453	999	A	A
Tongarra Road	Stapleton Avenue	Croome Road	410	394	804	A	A
Tongarra Road	Croome Road	Station Road	500	396	896	A	A
Tongarra Road	Station Road	Ti-Tree Avenue	424	370	794	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	323	317	640	A	A
Tongarra Road	Ash Avenue	Princes Highway	445	356	801	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	1,535	1,585	3,120	A	A
Princes Highway	Tongarra Road	Station Road	1,333	1,294	2,627	A	A
Princes Highway	Station Road	Airport Road	1,561	1,378	2,939	A	A
Princes Highway	Airport Road	Illawarra Highway	1,709	1,667	3,376	B	B
Princes Highway	Illawarra Highway	Yallah Bay Road	2,671	1,894	4,565	F	C
Princes Highway	Yallah Bay Road	Southern Freeway	2,610	1,894	4,504	E	C
Princes Highway	Southern Freeway	Huntley Road	491	571	1,062	A	A
Princes Highway	Huntley Road	Mount Brown Road	540	566	1,106	A	A
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	1,229	1,229		C
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	994	-	994	C	
Southern Freeway	Princes Highway	Fowlers Road	1,643	1,092	2,735	B	B

Appendix 4F - Existing Mid-block Traffic Volumes & Carriageway LoS
PM Peak

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie	104	164	268	B	B
Illawarra Highway	North Macquarie	Tullimbar Lane	162	107	269	B	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	173	131	304	B	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	172	140	312	B	B
Illawarra Highway	Broughton Avenue	Church Street	175	145	320	A	A
Illawarra Highway	Church Street	Calderwood Road	311	390	701	A	A
Illawarra Highway	Calderwood Road	Russell Street	383	418	801	A	A
Illawarra Highway	Russell Street	Terry Street	440	704	1,144	A	A
Illawarra Highway	Terry Street	Croome Lane	409	870	1,279	A	B
Illawarra Highway	Croome Lane	Princes Highway	459	843	1,302	A	B
Yallah Road	Marshall Mount	Princes Highway	34	33	67	A	A
Marshall Mount Road	Calderwood Road	North Marshall	19	16	35	A	A
Marshall Mount Road	North Marshall	Yallah Road	24	28	52	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	30	31	61	A	A
Marshall Mount Road	Yallah TAFE	Huntley Road	31	28	59	A	A
Calderwood Road	Calderwood valley	Marshall Mount	18	17	35	A	A
Calderwood Road	Marshall Mount	Illawarra Christian	26	28	54	A	A
Calderwood Road	Illawarra Christian	North Macquarie	39	23	62	A	A
Calderwood Road	CUDP	Mansons Bridge	50	33	83	A	A
Calderwood Road	Mansons Bridge	Illawarra Highway	71	101	172	A	A
North Macquarie Road	Illawarra Highway	Macquarie Rivulet	11	6	17	A	A
North Macquarie Road	Macquarie Rivulet	Calderwood Road	14	13	27	A	A
Huntley Road	Marshall Mount	Princes Highway	80	60	140	A	A
Tongarra Road	Terry Street	Stapleton Avenue	546	494	1,040	A	A
Tongarra Road	Stapleton Avenue	Croome Road	493	446	939	A	A
Tongarra Road	Croome Road	Station Road	401	511	912	A	A
Tongarra Road	Station Road	Ti-Tree Avenue	390	446	836	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	365	374	739	A	A
Tongarra Road	Ash Avenue	Princes Highway	408	466	874	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	1,465	1,833	3,298	A	B
Princes Highway	Tongarra Road	Station Road	1,212	1,638	2,850	A	B
Princes Highway	Station Road	Airport Road	1,090	1,883	2,973	A	C
Princes Highway	Airport Road	Illawarra Highway	1,301	2,018	3,319	A	C
Princes Highway	Illawarra Highway	Yallah Bay Road	1,779	2,927	4,706	B	F
Princes Highway	Yallah Bay Road	Southern Freeway	1,785	2,873	4,658	B	F
Princes Highway	Southern Freeway	Huntley Road	495	557	1,052	A	A
Princes Highway	Huntley Road	Mount Brown Road	507	549	1,056	A	A
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	1,159	1,159		C
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	968	-	968	C	
Southern Freeway	Princes Highway	Fowlers Road	816	1,714	2,530	A	B

Appendix 4G

2009 Existing Intersection Performance

Appendix 4G - 2009 Existing Intersection Performance

Intersection	Intersection Control	AM Peak			PM Peak		
		Degree of Saturation	Delays (sec)	LoS	Degree of Saturation	Delays (sec)	LoS
Illawarra Hwy/ Nth Macquarie Rd	Priority	0.009	13.1	A	0.056	13.1	B
Illawarra Hwy/ Tongarra Rd/Terry St	Signals	0.805	29.5	C	0.793	29.1	C
Illawarra Hwy/ Princes Hwy	Roundabout	1.000	88.2	F	0.362	15.6	B
Princes Hwy/ Tongarra Rd	Signals	0.637	16.3	B	0.780	17.5	B
Calderwood Road/ Nth Macquarie Road	Priority	0.016	15.1	C	0.014	16.2	C
Calderwood Road/ Marshall Mount Road	Priority	0.019	10.9	B	0.010	12.4	B
Marshall Mount Road/ Yallah Road	Priority	0.043	11.1	B	0.022	11.6	B
Huntley Rd/ Marshall Mount Rd	Priority	0.029	10.2	B	0.029	9.9	A
Princes Hwy/ Huntley Rd	Priority	0.294	30.3	D	0.107	22.0	C
Illawarra Hwy/ Calderwood Rd/Macquarie St	Signals	0.393	12.7	B	0.431	10.5	B
Illawarra Hwy/ Broughton Ave	Roundabout	0.138	11.8	B	0.004	11.6	B
Tongarra Rd/ Station Rd	Priority	0.290	14.7	B	0.294	13.7	B
Yallah Rd/ Princes Hwy on-ramp	Priority	0.057	10.0	A	0.057	10.0	A
Yallah Rd/ Haywards Bay Dr	Priority	0.061	8.8	A	0.039	8.9	A
Illawarra Hwy/ Yellow Rock Rd	Priority	0.044	15.5	C	0.013	15.7	C
Haywards Bay Drive/ Princes Highway southbound ramps	Roundabout	0.034	11.3	A	0.026	11.4	A
Princes Highway/ Southern Freeway (Tallawarra northbound off-ramp)	Priority	0.349	17.7	B	0.583	23.6	B
Princes Hwy/ Cormack Ave	Priority	0.674	20.2	B	0.999	36.7	C

Appendix 4H

Rail Infrastructure and Services

APPENDIX 4H - RAIL INFRASTRUCTURE AND SERVICES

The South Coast Railway Line is located approximately 3km east of the study area on a north-south axis, running parallel to, and east of, the Princes Highway. It is currently a single, electrified track with a number of at-grade and grade separated road crossings. Vehicular and pedestrian crossing opportunities within the study area are located at:

- Huntley Road (road overbridge).
- Princes Highway (road overbridge).
- Haywards Bay Drive (road overbridge)
- Windang Street (level crossing).
- New Lake Entrance Road (road overbridge).

Dapto, Albion Park and Oak Flats are the closest railway stations to the proposed development. Dapto Railway Station is located approximately 6-8 kilometres north and accessed via Marshall Mount Road and Princes Highway, whilst Albion Park is located approximately 4km to the east via Tongarra and Station Roads. Oak Flats station is located approximately 5km to the east.

A bus interchange is located at Dapto but is presently unused as most services do not deviate off the Princes Highway which is only a short walk away. There are currently no direct bus services between Albion Park and Dapto. Bus travel between Albion Park and Dapto would require a transfer on the Princes Highway at Albion Park Rail to one of the "Lake Loop" services for travel to or from Dapto or Wollongong. Bus/rail transfers at Albion Park Station are facilitated by bus stops located on Princes Highway near the station entrance. Limited commuter parking is provided at both stations.

Currently, services on the South Coast railway line generally operate as through services between Sydney Terminal and the end of the electrified track at Kiama, although some diesel services commence from Bomaderry and terminate at Dapto with connecting electric services commencing at Dapto and heading to Sydney.

Table 1 presents a guide to the frequency of rail services serving Albion Park and Dapto railway stations.

Table 1 Frequency of Rail Services serving Albion Park and Dapto Railway Stations

Direction	Weekdays				Weekends	
	AM Peak	Daytime	PM Peak	Evening	Daytime	Evening
Northbound	2tph	1tph	1-2tph	1-3tph	1tph	1tph
Southbound	1-2tph	1tph	1-2tph	2tph	1tph	1tph

Note: tph = trains per hour

The service frequency levels quoted in Table 1 are approximate only, as services do not operate to a consistent clock face timetable. The infrequency and irregularity of services is a disincentive to travel, as waiting times are significant and variable, requiring passengers to plan around the rail timetable. Infrastructure constraints, including the single track and at-grade road crossings, are impediments to any increase in service frequency.

As part of planning for the WDRA, a new railway station was proposed adjacent to the Huntley Road bridge over the South Coast railway line, 3km south of Dapto. The station was a long-term proposal, with the intention of forming the focus of a higher density residential node and assisting the provision of viable public transport services. Railcorp estimated that the critical point for determining whether the station would be provided or not would be reached in 10-15 years time. The Growth Centres Commission review of planning for the WDRA in November 2008 questioned the need for the provision of a railway station at Huntley, indicating that it was unlikely that development of the release area would produce sufficient patronage to justify the cost of the station and associated track amplifications.

Appendix 4I

Bus Services

APPENDIX 4I - BUS SERVICES

Premier Illawarra operates bus services in the Wollongong area, with routes stretching from Kiama in the south to Bellambi in the north. A network of three routes serves the greater Dapto area and a network of three local routes serves the Albion Park area. They function as the primary mode of public transport for local trips and trips within the Wollongong region, with the railway used predominately for longer trips.

Due to the rural nature of Calderwood, no bus routes presently serve the immediate area. The closest bus routes are located at Albion Park. Table 1 provides a summary of these nearby routes and the level of service provided.

Table 1 Summary of Bus Services in Calderwood Area

Route No.	Route	Frequency Guide (approximate headway in minutes)					
		Direction	Weekday			Saturday	Sunday
			Peak	Off-Peak	Night	Daytime	Daytime
31	Horsley – Dapto - Wollongong	Northbound	30*	60	60*	60	120
		Southbound	30*	60	60*	60	120
33	Penrose – Dapto – Horsley – Dapto – Koonawarra – Kanahooka – Wollongong	Northbound	30	60	1 service only	60	120
		Southbound	1 service only	60	60	60	120
37	LAKE LINK – ANTI-CLOCKWISE LOOP University – Wollongong – Warrawong – Shellharbour – Dapto – University	Southbound	60	60	120	60	60
43	Penrose – Dapto – Koonawarra – Kanahooka – Berkeley – Warrawong – Port Kembla	Northbound	60	60	No service	60	60
		Southbound	60	60	No service	60	120
51	Albion Park – Oak Flats – Shellharbour City Centre - Windang – Wollongong - University	Northbound	120	120	No service	No service	No service
		Southbound	120	120	No service	No service	No service
57	LAKE LINK – CLOCKWISE LOOP University – Dapto – Shellharbour – Warrawong – Wollongong – University	Northbound	60	60	120	60	60
70	Albion Park – Oak Flats – Shellharbour City Centre - Mt Warrigal – Barrack Point - Shellharbour Beach	Eastbound	1 service only	120	No service	120	1 service only
		Westbound	100	120	1 service only	120	No service
73	Albion Park – Oak Flats – Shellharbour City Centre – Mt Warrigal – Shell Cove – Shellharbour City Centre	Clockwise	No service	No service	No service	No service	120
		Anti-clockwise	No service	No service	No service	No service	120
76	Albion Park – Shellharbour City Centre	Eastbound	60	60	60	120	120
		Westbound	40	120	1 service only	120	120

Route No.	Route	Frequency Guide (approximate headway in minutes)					
		Direction	Weekday			Saturday	Sunday
			Peak	Off-Peak	Night	Daytime	Daytime
Cityrail Bus – Wollongong to Moss Vale		Eastbound	2 services only	1 service only	1 service only	4 services only	4 services only
		Westbound	1 service only	1 service only	No service	3 services only	3 services only

* Approximate average headway due to irregular service frequency

Whilst services are infrequent, most operate at, or close to, a clock face timetable (i.e. services arrive at the same time in each hour) at most times of the day. This format is easy to memorise and makes travel planning around a public transport timetable significantly easier.

However, as shown in **Error! Reference source not found.**, the routes are circuitous, which increases travel time significantly. Public transport information is poor, with network maps and timetables difficult to decipher. The interchange arrangements at Albion Park Railway Station are difficult to understand and it is not clear to potential users of the system whether Route 37/57 buses stop at Yallah.

Improvements to service frequency and fare structures would significantly increase the attractiveness of interchanging between bus and rail services, reducing journey time for longer distance trips. It would also increase the attractiveness of transferring between the different bus services, increasing the number of potential origin and destination combinations accessible by public transport.

Bus services will need to be extended or created to serve the Calderwood development. This is discussed further in Section **Error! Reference source not found.**.

Appendix 4J

Proposed Bus Network

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Figure 4J

Illawarra Bus Network Review - Proposed Bus Network

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Appendix 4K

City Of Wollongong Bicycle Plan 2006-11

APPENDIX 4K - CITY OF WOLLONGONG BICYCLE PLAN 2006-11

The *City of Wollongong Bicycle Plan 2006-11* provides a plan of action for the provision of bicycle facilities within Wollongong local government area. Maps are provided identifying existing and proposed cycleways, however whether these are provided as on or off-road facilities is not specified. The plan is reproduced in the following figure and key features are summarised below:

- Relevant existing cycleways include:
  - Princes Highway from Huntley Road to Macquarie Rivulet (on-road cycle lanes using the road shoulder, except across Macquarie Rivulet bridge where an off-road path is provided).
- Relevant proposed cycleways include:
  - Princes Highway and Marshall Street from Huntley Road to Dapto town centre.
  - Southern Freeway north of Princes Highway.

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Figure 4K

Wollongong Bicycle Plan 2006-2011

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- Cycleway
- Proposed Cycleway
- Wollongong LGA Boundary
- Learn To Ride Facility

Wollongong
City of Innovation

NCS International
CERTIFIED QUALITY MANAGEMENT SYSTEM
ISO 9001

N	GIS ref. gi05773-05
	Printed: 4/04/2006
	ArcGIS 9.1 - ArcMap - ArcInfo
	Scale 1:30,000

250 0 250 500 750 1,000
Meters

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Appendix 4L

Shellharbour Local Government Area Shared Use Path Strategy 2008

APPENDIX 4L - SHELLHARBOUR LOCAL GOVERNMENT AREA SHARED USE PATH STRATEGY 2008

The recent 2008 Shellharbour LGA Shared Use Path Strategy replaces the *Shellharbour Bike Plan 1996* and provides details of the cycle facilities to be implemented, along with design guidelines. Existing and proposed on and off-road facilities are defined, as well as proposed 'Preferred Routes' along quiet streets and 'Dismount Zones' through areas of high pedestrian activity. The plan is reproduced in the following figure and the key features are summarised below:

- Relevant existing on-road facilities include:
  - Tongarra Road between Albion Park and Albion Park Rail.
- Relevant existing off-road facilities include:
  - Terry Street shared path.
  - Tullimbar Village shared path.
  - Various sections of shared paths around Church Street area of Albion Park.
- Relevant proposed off-road facilities include:
  - Illawarra Highway from Russell Street to Tullimbar Village.
- Relevant proposed Preferred Routes include:
  - Taylor Road and Calderwood Road from Illawarra Highway to Mansons Bridge.
- Relevant proposed Dismount Zones include:
  - Illawarra Highway, Terry Street and Tongarra Road in the immediate vicinity of Albion Park town centre.

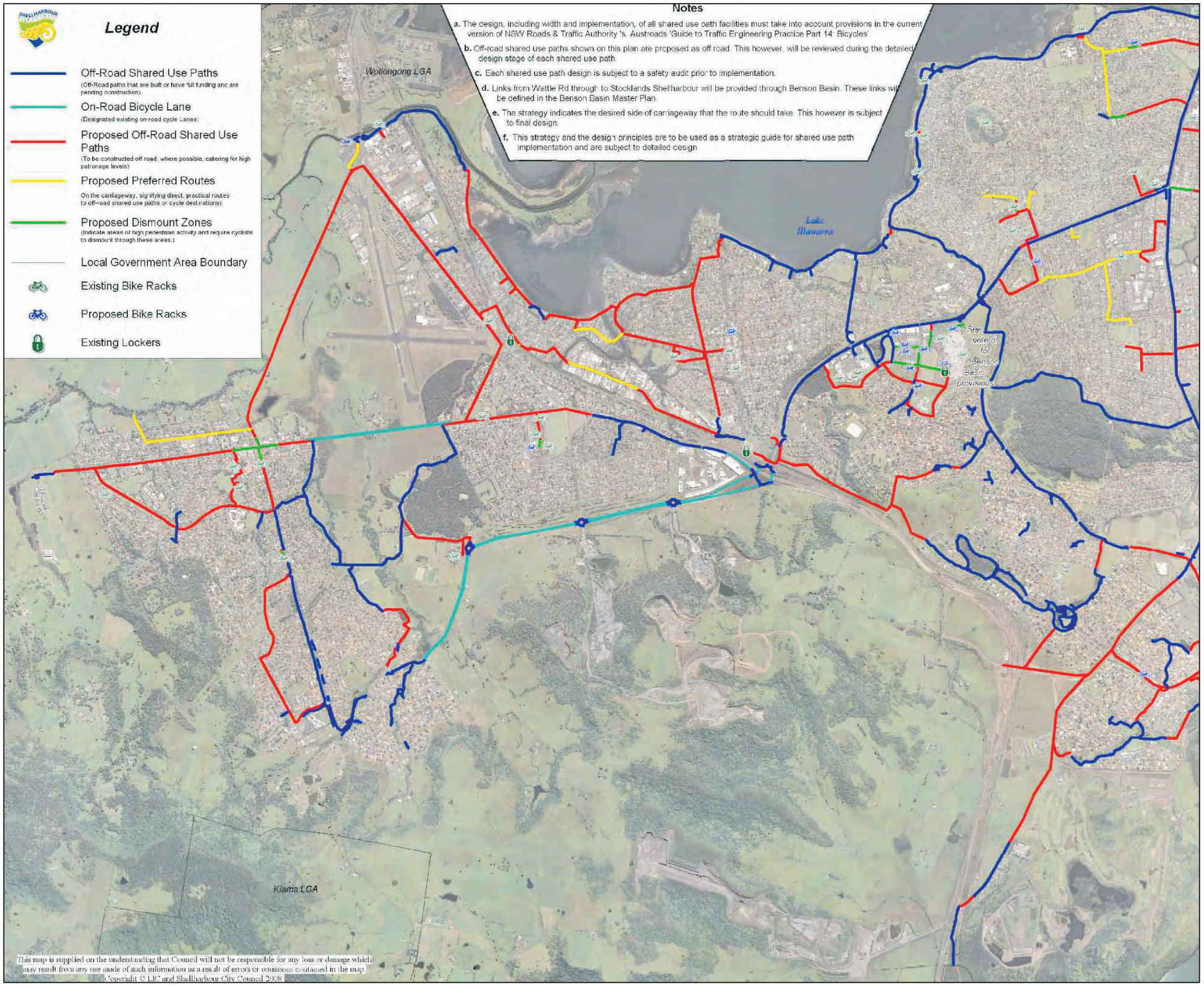

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Figure 4L

Shellharbour Shared Path Strategy 2008

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URBAN DEVELOPMENT PROJECT

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Shaping the Future

Appendix 4M

JTW Data Explanation

APPENDIX 4M - JTW DATA EXPLANATION

Before interpreting the JTW data provided in this section it is important to briefly describe what the data represents and its limitations and strengths to determine its reliability for making important decisions.

Journey to Work

Journey to Work data is collected by the Australian Bureau of Statistics as part of the Australian national census. Data consists of employment counts for specific locations and method of travel to work gathered via a completion Census form that is carried out every five years. All commuting trips are recorded. The data represents linked trips (explanation is provided below).

This dataset highlights one of the key trip generating purposes which is "commuting" (i.e. travel to or from a place of employment). This dataset is a good bench mark as it is a 100% sample dataset. As a result, it is ideal for estimating peak trip counts and to make comparisons between different years. However the dataset does not provide a comprehensive picture of travel modes used. Refer to discussion on mode hierarchy below.

Data Coverage

The 2006 JTW data covers the Greater Metropolitan Area (GMA) (made up of Sydney, Illawarra, and Newcastle Statistical Subdivisions (SD06s)) plus areas surrounding the GMA (as specified in the data).

Linked and Unlinked trips

An **unlinked trip** is each component of a linked trip, including each mode used. For example, a person living in Dapto and working in the Wollongong CBD travels by train with a walk trip at either end of the train trip. This would be one linked trip (mode=Train) and three unlinked trips as shown in Table 1.

Table 1 Example of linked and unlinked trips

Trip No.	Origin	Destination	Mode	Purpose
1	Home	Dapto Station	Walk	Change mode
2	Dapto Station	Wollongong Station	Train	Change mode
3	Wollongong Station	Workplace	Walk	Work

Mode Hierarchy

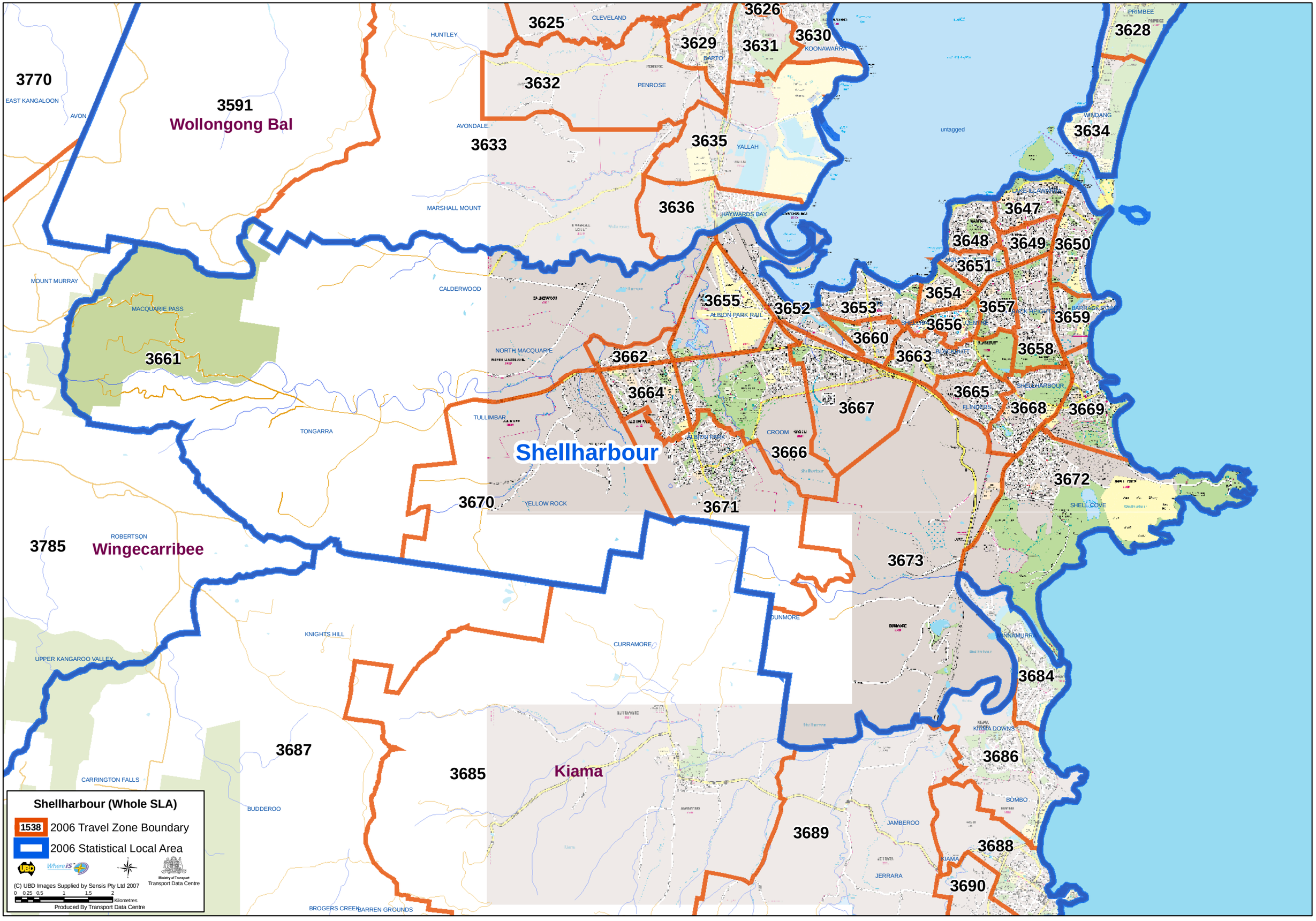
Travel data is aggregated based on a modal hierarchy that attributes the trip only to the highest-ranking mode in the hierarchy (shown in Table **Error! No text of specified style in document.**.2). For example, driving to a station and taking the train to work would is considered as a trip by train, as is catching the bus to the station and taking the trip to work. For this reason, some modes are unrepresented, especially bus trips, and the extent of intermodal transfer is not recognised.

Table Error! No text of specified style in document..**2 Journey to Work Mode Hierarchy**

Mode	JTW Priority
Train	**Highest**
Bus	
Ferry	
Light rail/tram	
Taxi	
Car driver	
Car passenger	
Truck	
Motorbike	
Bicycle	**Lowest**
Other	
Walk	

Zones

To identify the origin or destination of trips to/from different areas within LGAs, travel zones are used. These are defined in the following figures for the Wollongong and Shellharbour LGAs.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KNIGHTS HILL
CURRAMORE
UPPER KANGAROO VALLEY
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CARRINGTON FALLS
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BUDDEROO
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BROGERS CREEK
BARREN GROUNDS
Shellharbour (Whole SLA)
1538 2006 Travel Zone Boundary
2006 Statistical Local Area
(C) UBD Images Supplied by Sensis Pty Ltd 2007
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Shellharbour (East)
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2006 Travel Zone Boundary
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(C) UBD Images Supplied by Sensis Pty Ltd 2007
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MACQUARIE PASS

MARSHALL MOUNT

AVONDALE

PENROSE

YALLAH

HAYWARDS BAY

CALDERWOOD

NORTH MACQUARIE

TULLIMBAR

ALBION PARK

YELLOW ROCK

TONGARRA

ROBERTSON

CARRINGTON FALLS

BUDDEROO

KNIGHTS HILL

JAMBEROO

CROOM

CURRAMORE

Shellharbour (West)

1538 2006 Travel Zone Boundary

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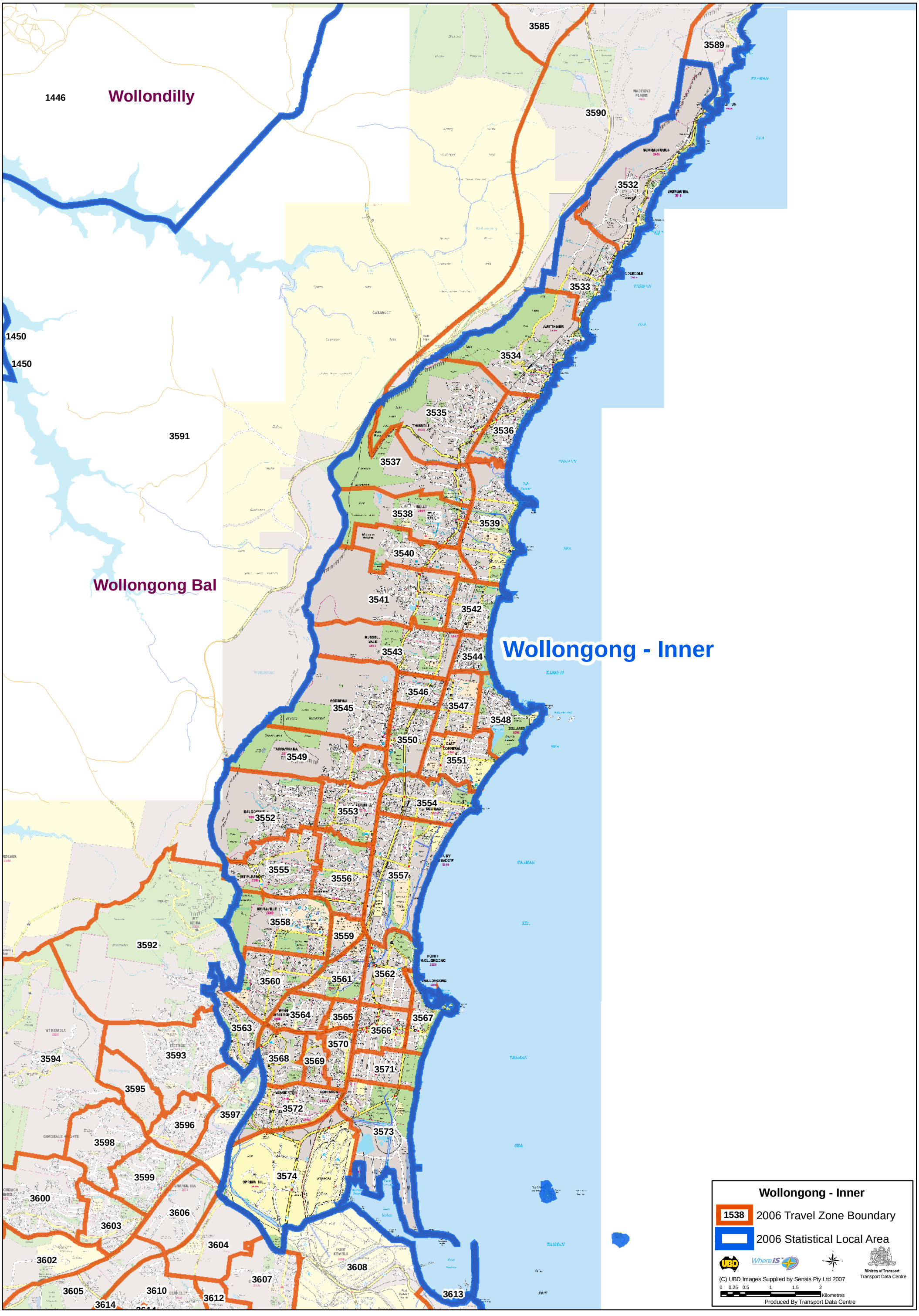
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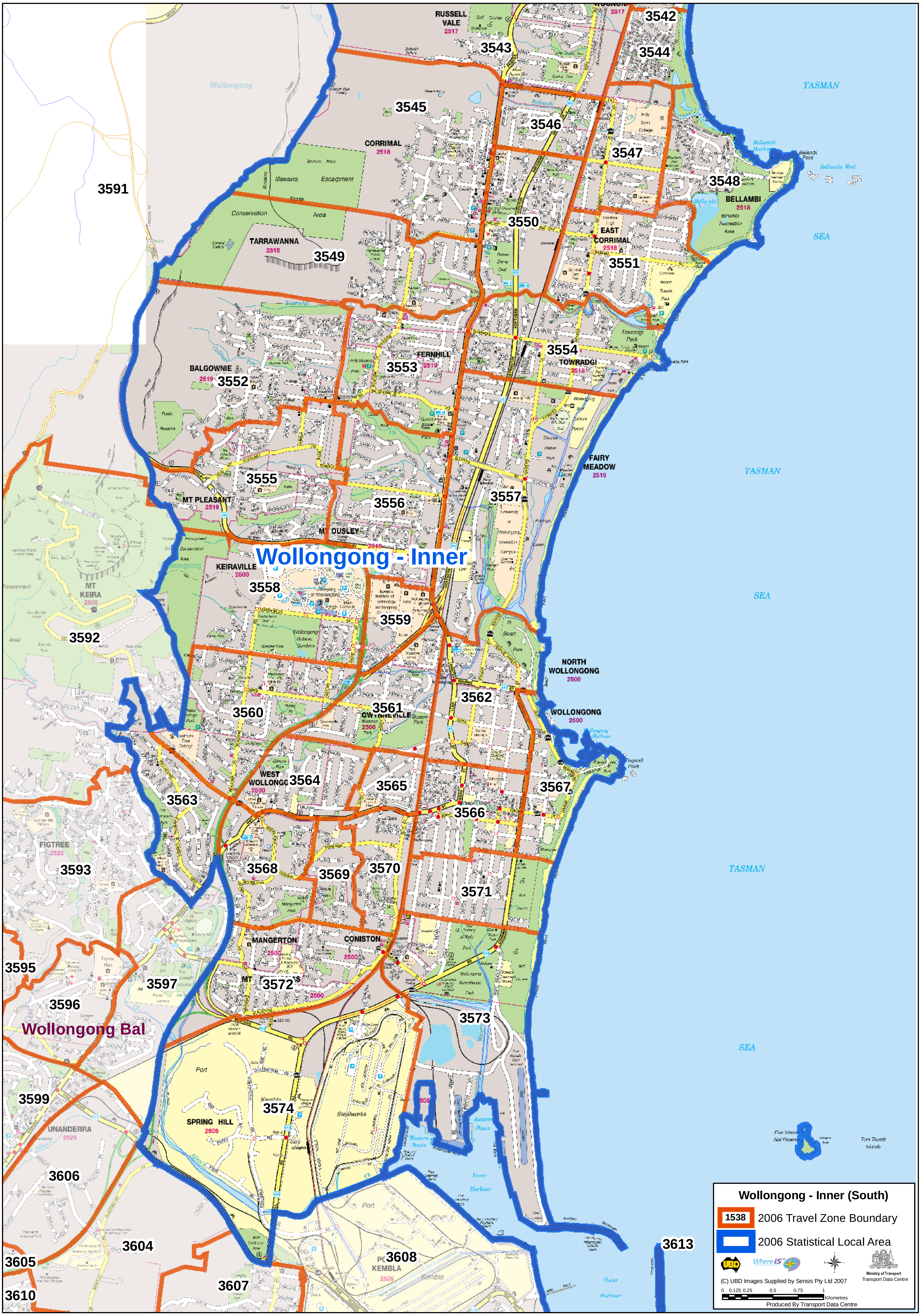
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KEMBLA 2505
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Illawarra Escarpment State Conservation Area
Bellambi Recreation Area
Wollongong Harbour
Flagstaff Point
Five Islands Nat Reserve
Tom Thumb Islands
Inner Harbour
Outer Harbour
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Wollongong - Inner (South)
1538 2006 Travel Zone Boundary
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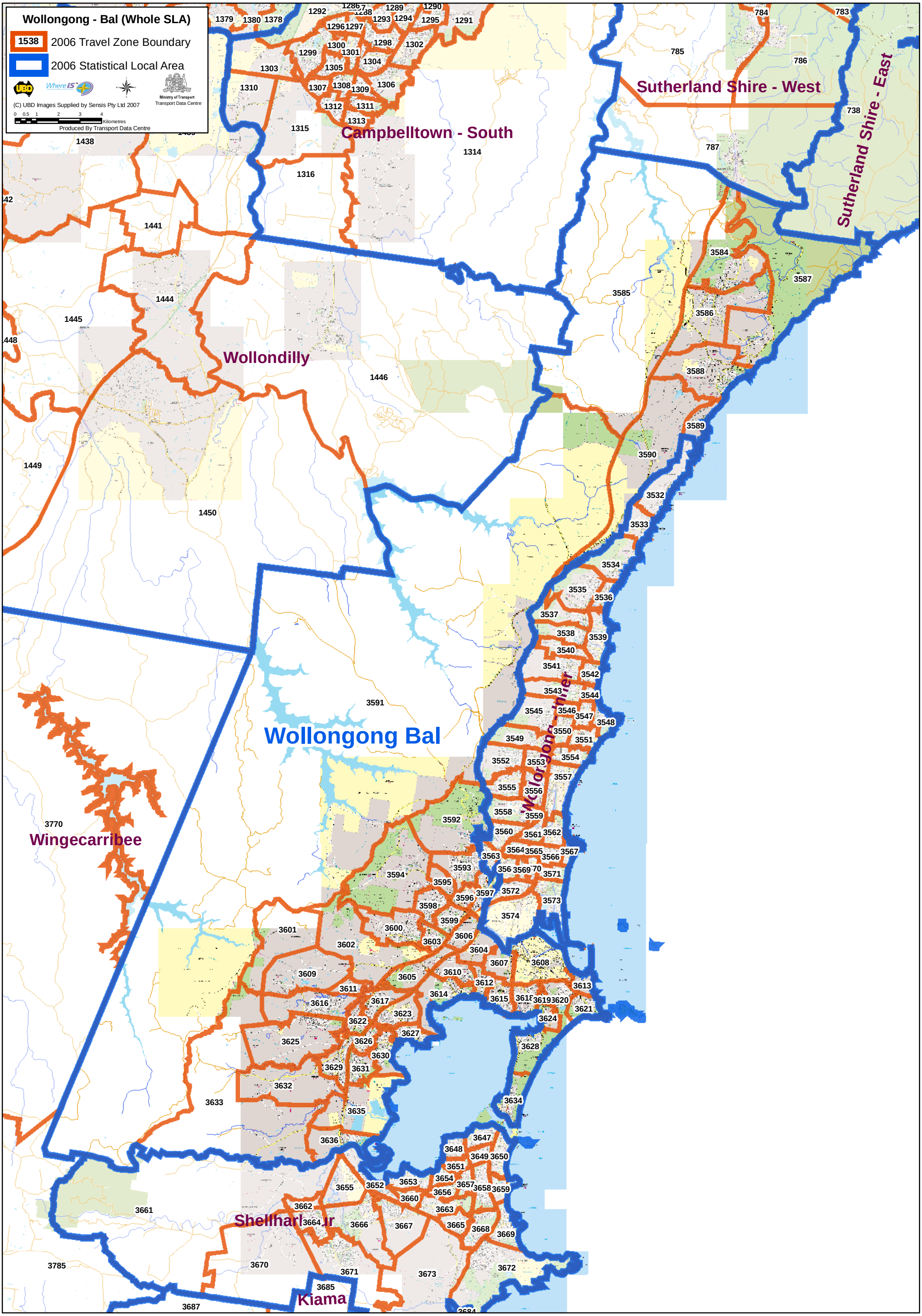
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MADDENS PLAINS
CLIFTON
SCARBOROUGH
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KEMBLA GRANGE
WONGAWILLI
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BERKELEY
BROWNSVILLE
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LAKE HEIGHTS
KANAHOOKA
HUNTLEY
CLEVELAND
CORDEAUX
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1538 2006 Travel Zone Boundary
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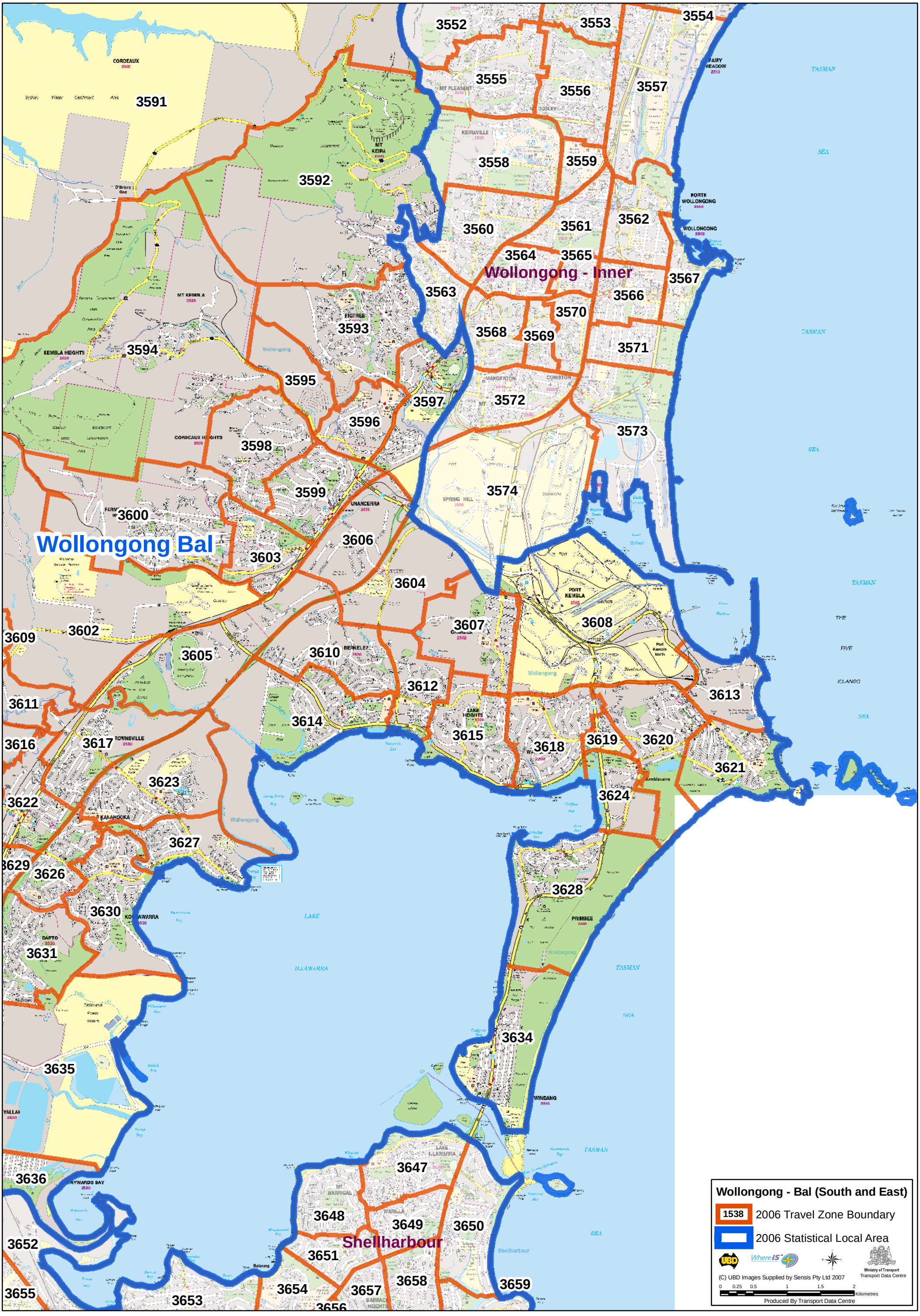
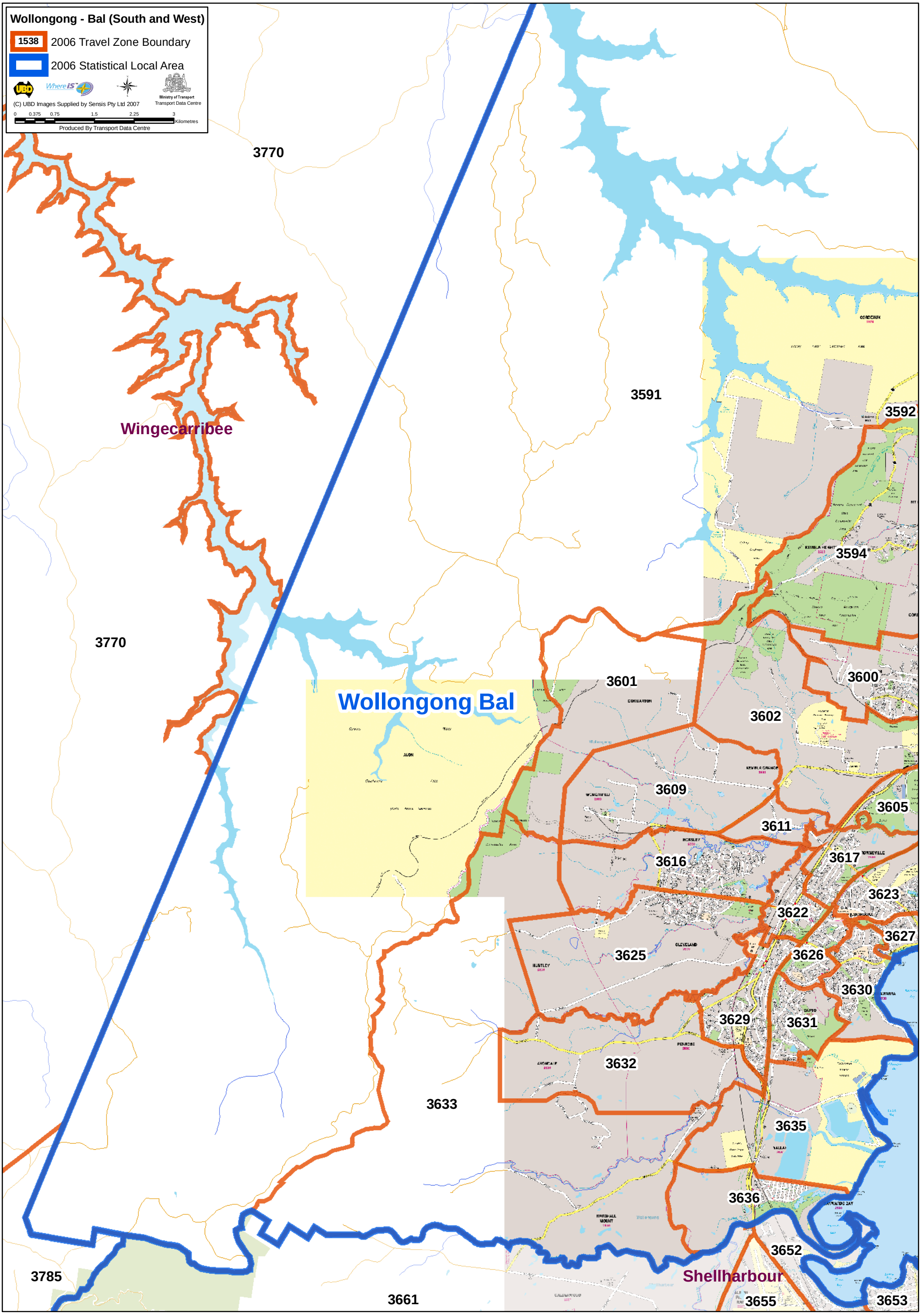


Wollongong - Bal (South and East)

1538 2006 Travel Zone Boundary

2006 Statistical Local Area


Wollongong - Bal (South and West)
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2006 Travel Zone Boundary
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Appendix 4N

JTW Regional Assessment

APPENDIX 4N - JTW Regional Assessment

The regional assessment covers the Wollongong and Shellharbour local government areas.

Workforce and Employment

An analysis of travel patterns of the existing Wollongong and Shellharbour local government area employment and workforce was undertaken. Trips originating within the LGA are considered to be the LGA workforce living within the LGA. Trips ending in the LGA are considered to be representing employment or jobs within the LGA. Each LGA was divided into CBD and non-CBD areas. The total workforce and jobs in the two LGA's are summarised in Table 1.

Table 1 shows that in 2006 the Shellharbour LGA had a workforce of almost 23,000 people but less than 10,000 jobs within the LGA; hence there is a deficit of jobs of almost 13,000. Wollongong LGA has a workforce of over 104,000 people with almost 83,000 jobs within the LGA; hence there is a deficit of jobs of over 21,000.

Table 1 2006 JTW: Wollongong and Shellharbour LGA Workforce & Jobs

Population	Shellharbour LGA			Wollongong LGA			TOTAL
	CBD	Non-CBD	ALL	CBD	Non-CBD	ALL	
Workforce[1]	5,157	17,723	22,880	1,388	79,781	81,259	104139
Jobs[2]	4,071	5,871	9,942	14,558	58,358	72,916	82,858
Surplus/Deficit of Jobs (compared to Workforce)	**-1,086**	**-11,852**	**-12,938**	**+13,170**	**-21,513**	**-8,343**	**-21,281**

The movement of workforce to jobs is complex and is summarised in detail in **Error! Not a valid bookmark self-reference.**. This highlights the general movement of workers to jobs in broad categories.

Table 2 2006 JTW: Wollongong and Shellharbour LGA Total Work Trips

		To Shellharbour			To Wollongong			To Wollongong/ Shellharbour	To External	TOTAL
		CBD	Other	Σ	CBD	Other	Σ			
From Shellharbour	**CBD**	771	586	**1,357**	419	2,317	**2,736**	4,093	1,064	**5,157**
	Other	1,613	3,067	**4,680**	1,835	8,290	**10,125**	14,805	2,918	**17,723**
	Σ	**2,384**	**3,653**	**6,037**	**2,254**	**10,607**	**12,861**	**18,898**	**3,982**	**22,880**
From Wollongong	**CBD**	10	20	**30**	395	608	**1,003**	1,033	355	**1,388**
	Other	1,507	1,945	**3,452**	10,778	43,801	**54,579**	58,031	21,840	**79,871**
	Σ	**1,517**	**1,965**	**3,482**	**11,173**	**44,409**	**55,582**	**59,064**	**22,195**	**81,259**
From Wollongong/ Shellharbour		3,901	5,618	**9,519**	13,427	55,016	**68,443**	77,962	26,177	**104,139**
From External		170	253	**423**	1,131	3,342	**4,473**	4,896		**4,896**
TOTAL		**4,071**	**5,871**	**9,942**	**14,558**	**58,358**	**72,916**	**82,858**	**26,177**	**109,035**

[1] Workforce is people residing in the LGA who are employed or looking for work. This workforce may or may not work within the LGA.

[2] Jobs are number of employees working within the LGA. These may be filled with LGA residents or non-residents.

In Shellharbour there are some 23,000 workers and almost 10,000 jobs. However only 6,000 workers (26%) live and work in Shellharbour, 56% work in Wollongong LGA and the remainder (17%) work outside the region.

In Wollongong there are some 81,000 workers and almost 73,000 jobs. However only 56,000 workers (68%) live and work in Wollongong, 4% work in Shellharbour LGA and the remainder (27%) work outside the region.

Mode of Travel

The assessment of mode of travel in to and out of the LGAs provides a broad overview of regional travel patterns. A summary of the results of the analysis is presented in Table 3 and Table 4.

Table 3 2006 JTW: Wollongong and Shellharbour LGA Origin Travel Patterns

	Shellharbour LGA			Wollongong LGA			
Mode of Travel	**CBD**	**Non-CBD**	**ALL**	**CBD**	**Non-CBD**	**ALL**	**TOTAL**
Train	89	323	412	69	3,865	3,934	4,346
Ferry or Tram	0	3	3	0	35	35	38
Bus	60	86	146	15	936	951	1,097
Car as Driver (incl Bus & Motorbike)	3,562	13,168	16,730	654	52,357	53,011	69,741
Car as Passenger	369	987	1,356	92	5,271	5,363	6,719
Other Modes	172	314	486	300	3,439	3,739	4,225
Sub-Total	**4,252**	**14,881**	**19,133**	**1,130**	**65,903**	**67,033**	**86,166**
Not Stated	132	322	454	21	1,511	1,532	1,986
Worked at Home/Did not go to Work	773	2,520	3,293	237	12,457	12,694	15,987
Total	**5,157**	**17,723**	**22,880**	**1,388**	**79,871**	**81,259**	**104,139**
% Car Driver/Passenger of Sub-Total	*92.5%*	*95.1%*	*94.5%*	*66.0%*	*87.4%*	*87.1%*	*88.7%*

Table 4 2006 JTW: Wollongong and Shellharbour LGA Destination Travel Patterns

	Shellharbour LGA			Wollongong LGA			
Mode of Travel	**CBD**	**Non-CBD**	**ALL**	**CBD**	**Non-CBD**	**ALL**	**TOTAL**
Train	23	47	70	367	764	1,131	1,201
Ferry or Tram	0	0	0	5	24	29	29
Bus	34	17	51	299	609	908	959
Car as Driver (incl Bus & Motorbike)	2,683	3,988	6,671	9,555	41,111	50,666	57,337
Car as Passenger	305	337	642	1,040	3,557	4,597	5,239
Other Modes	157	204	361	940	2,523	3,463	3,824
Sub-Total	**3,202**	**4,593**	**7,795**	**12,206**	**48,588**	**60,794**	**68,589**
Not Stated	79	69	148	141	724	865	1,013
Worked at Home/Did not go to Work	790	1,209	1,999	2,211	9,046	11,257	13,256
Total	**4,071**	**5,871**	**9,942**	**14,558**	**58,358**	**72,916**	**82,858**
% Car Driver/Passenger of Sub-Total	*93.3%*	*94.2%*	*93.8%*	*86.8%*	*91.9%*	*90.9%*	*91.2%*

Car is the predominant model of travel for work trips for both origin and destination trips within both LGA's.

Trips Originating in Wollongong or Shellharbour LGA (Workforce Trips)

The mode share is presented graphically in Chart 1 and Chart 2 for trips originating in Wollongong or Shellharbour LGA.

Chart 1 2006 JTW: Wollongong and Shellharbour LGA Origin Travel Patterns – All Modes

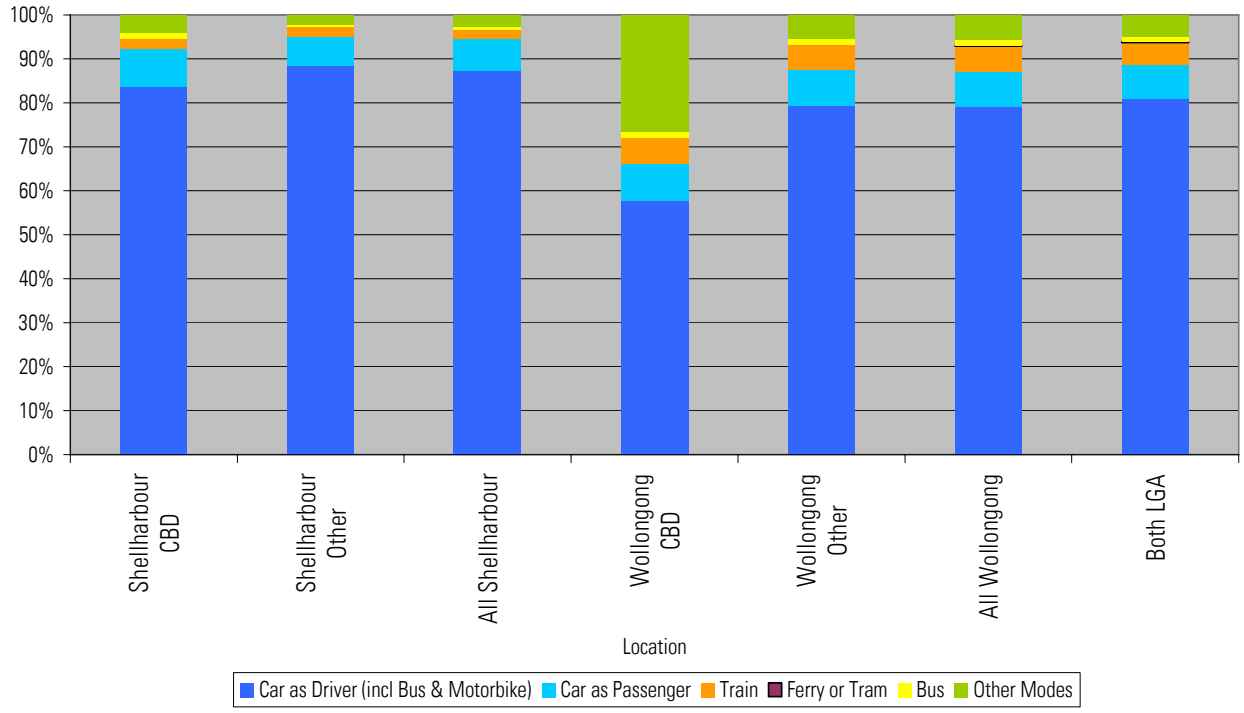
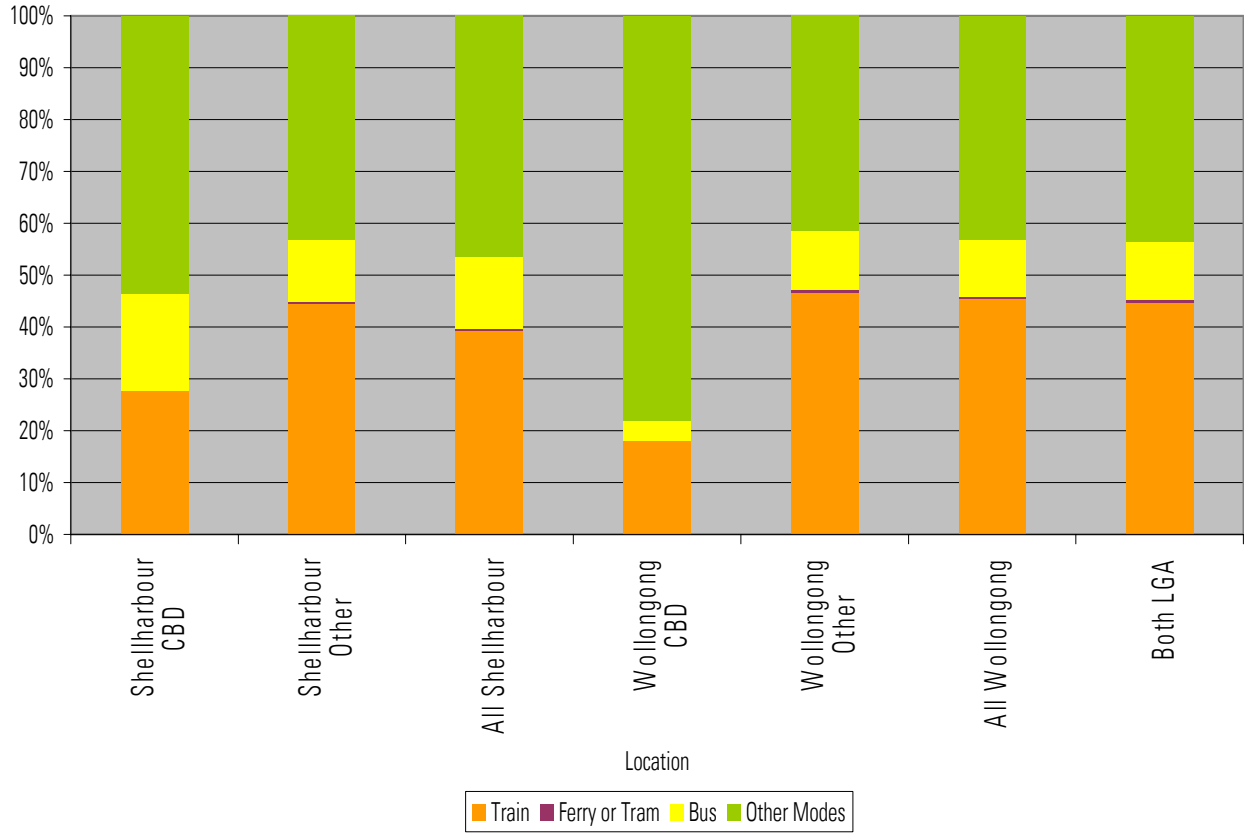


Chart 2 2006 JTW: Wollongong and Shellharbour LGA Origin Travel Patterns – Non-Car Modes



The most commonly used mode of travel among all the modes for trips originating within the region was the car. On average 89% of people who live in Wollongong and Shellharbour LGA travel by car (as either a driver or passenger). Generally Wollongong had a lower mode share, 87.1% for car use (driver and passenger) than Shellharbour with 95%. It should be noted in most cases the percentage of public transport use was similar across all the locations, ranging from 3-7%.

Wollongong CBD had a significantly lower car mode share for trips originating in the CBD, 66%. However, in the case of the Wollongong CBD the proportion of other modes increased significantly to 27%. Other modes would include active transport modes such as walking and cycling. This would lead us to believe that people living within the Wollongong CBD use other forms of transport like walking or cycling possibly as a transport mode to travel from the CBD. Over 28% of people who live in the Wollongong CBD also work in the CBD.

For Shellharbour CBD the mode of travel was consistent with the rest of the LGA, with a slightly lower car mode share and slightly higher other mode use. In the Shellharbour CBD only 15% of people who live in the Shellharbour CBD also work in the CBD.

Trips Ending in Wollongong or Shellharbour LGA (Employment Trips)

The mode share is presented graphically in Chart 3 and Chart 4 for trips ending in Wollongong or Shellharbour LGA.

Chart 3 2006 JTW: Wollongong and Shellharbour LGA Destination Travel Patterns – All Modes

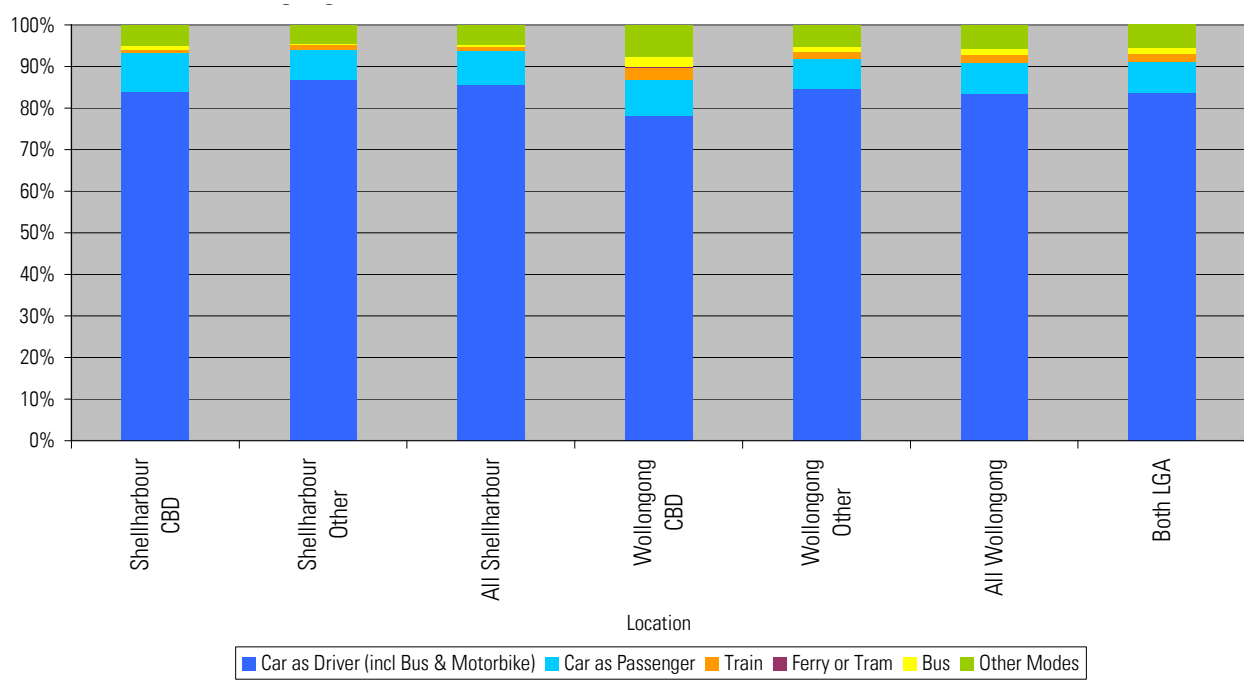
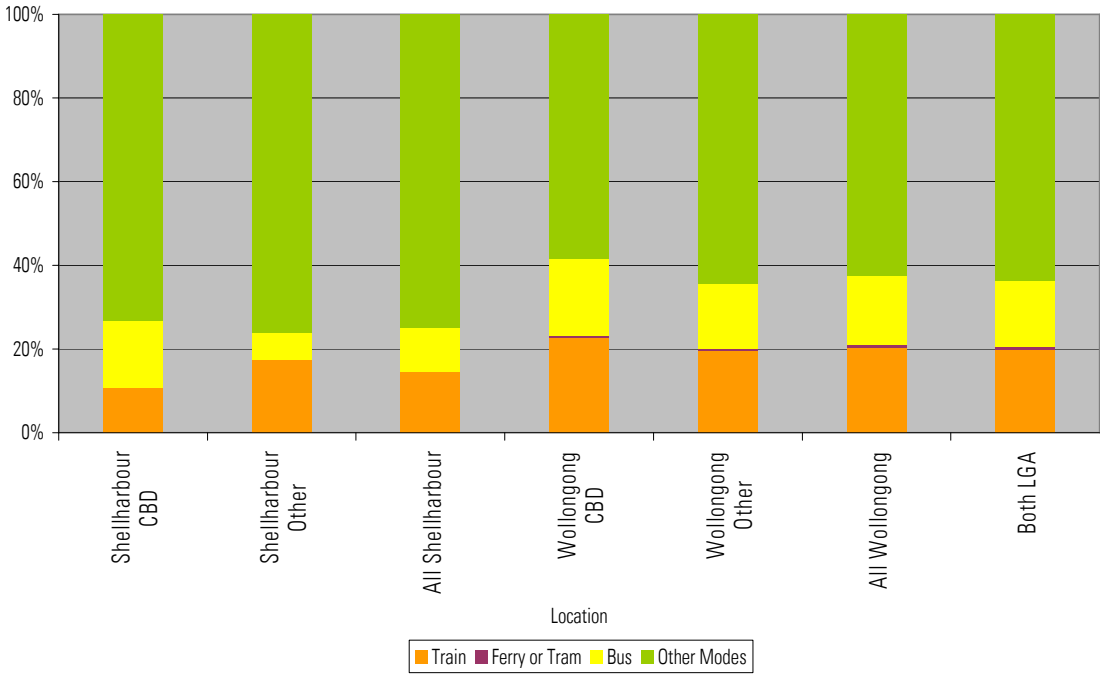


Chart 4 2006 JTW: Wollongong and Shellharbour LGA Destination Travel Patterns – Non-Car Modes



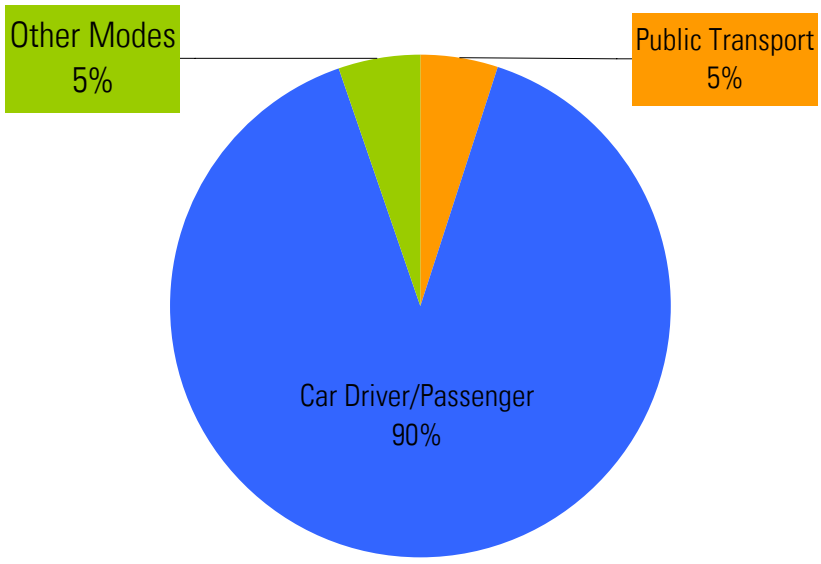
In the case of travelling to jobs within the LGA the most commonly used mode was still the car. On average 91% of people who work in Wollongong and Shellharbour LGA travel by car (as either a driver or passenger), Generally Wollongong had a lower mode share, 91% for car use (driver and passenger) than Shellharbour with 94%. It should be noted in most cases the percentage of public transport use was similar across all the locations, ranging from 1-5%.

Wollongong CBD had a notably lower car mode share for trips ending in the CBD, 78%. However, in the case of the Wollongong CBD the proportion of other modes did not increase significantly as with the origin trips.

All Trips to/from Wollongong or Shellharbour LGA

Overall when considering in the total JTW trips into and out of both LGA's the mode share is summarised in Chart 5. This shows that there is around 90% of total trips made by car (driver or passenger) with 5% of trips made by public transport. The balance of trips to other modes are assumed to be active transport trips (walking and cycling).

Chart 5 2006 JTW: Wollongong and Shellharbour LGA Mode of Travel



Appendix 4O

JTW Local Assessment

APPENDIX 40 - JTW Local Assessment

A more detailed analysis of travel patterns in the Travel Zones (TZ) surrounding the site was undertaken to establish the local travel behaviour already established in similar urban residential and employment areas. The assessment provides a broad overview of the following areas:

- Albion Park (TZ 3662, 3664, 3671).
- Albion Park Rail/Croom (TZ 3655, 3666, 3667, 3652).
- Haywards Bay (TZ 3636).

Mode of Travel

A summary of the results of the mode share analysis is presented in Table 1 and Table 2.

Based on the local travel patterns it is observed that majority of the trips within the local areas are undertaken by car. The remaining modes contain very small percentages compared to the car mode. It can be assumed that the reasoning behind this skewed proportion is due to the large car dependency from the lack of public transport facilities available in the local area and, the nature and distance of the trips.

Table 1 2006 JTW: Calderwood Local Area Origin Travel Patterns

Mode of Travel	Albion Park N (TZ 3662)	Albion Park Central (TZ 3664)	Albion Park S (TZ 3671)	Albion Park Rail NW (TZ 3655)	Albion Park Rail SW/ Croom W (TZ 3666)	Albion Park Rail SE/ Croom E (TZ 3667)	Haywards Bay/ Yallah (TZ 3636)	Albion Park Rail NE (TZ 3652)
Train	3	33	38	12	33	25	0	23
Ferry or Tram	0	0	0	0	3	0	0	0
Bus	5	9	9	0	3	6	4	0
Car as Driver (incl Bus & Motorbike)	240	1,538	1,812	170	1,371	622	212	552
Car as Passenger	13	131	131	12	124	54	14	43
Other Modes	19	54	16	4	50	18	6	21
Sub-Total	**280**	**1,765**	**2,006**	**198**	**1,584**	**725**	**236**	**639**
Not Stated	11	48	35	3	38	15	0	10
Worked at Home/Did not go to Work	53	344	323	30	280	104	48	122
Total	**344**	**2,157**	**2,364**	**231**	**1,902**	**844**	**284**	**771**
% Car Driver/Passenger of Sub-Total	*90.4%*	*94.6%*	*96.9%*	*91.9%*	*94.4%*	*93.2%*	*95.8%*	*93.1%*

Table 2 2006 JTW: Calderwood Local Area Destination Travel Patterns

Mode of Travel	Albion Park N (TZ 3662)	Albion Park Central (TZ 3664)	Albion Park S (TZ 3671)	Albion Park Rail NW (TZ 3655)	Albion Park Rail SW/ Croom W (TZ 3666)	Albion Park Rail SE/ Croom E (TZ 3667)	Haywards Bay/ Yallah (TZ 3636)	Albion Park Rail NE (TZ 3652)
Train	3	33	38	12	33	25	0	23
Ferry or Tram	0	0	0	0	3	0	0	0
Bus	5	9	9	0	3	6	4	0
Car as Driver (incl Bus & Motorbike)	240	1,538	1,812	170	1,371	622	212	552
Car as Passenger	13	131	131	12	124	54	14	43
Other Modes	19	54	16	4	50	18	6	21
Sub-Total	**280**	**1,765**	**2,006**	**198**	**1,584**	**725**	**236**	**639**
Not Stated	11	48	35	3	38	15	0	10
Worked at Home/Did not go to Work	53	344	323	30	280	104	48	122
Total	**344**	**2,157**	**2,364**	**231**	**1,902**	**844**	**284**	**771**
% Car Driver/Passenger of Sub-Total	*90.4%*	*94.6%*	*96.9%*	*91.9%*	*94.4%*	*93.2%*	*95.8%*	*93.1%*

Trips Originating in the Local Area (Workforce Trips)

The mode share is presented graphically in Chart 1 and Chart 2 for trips originating in Calderwood surrounding local areas.

Chart 1 2006 JTW: Calderwood Origin Local Area Travel Patterns – All Modes

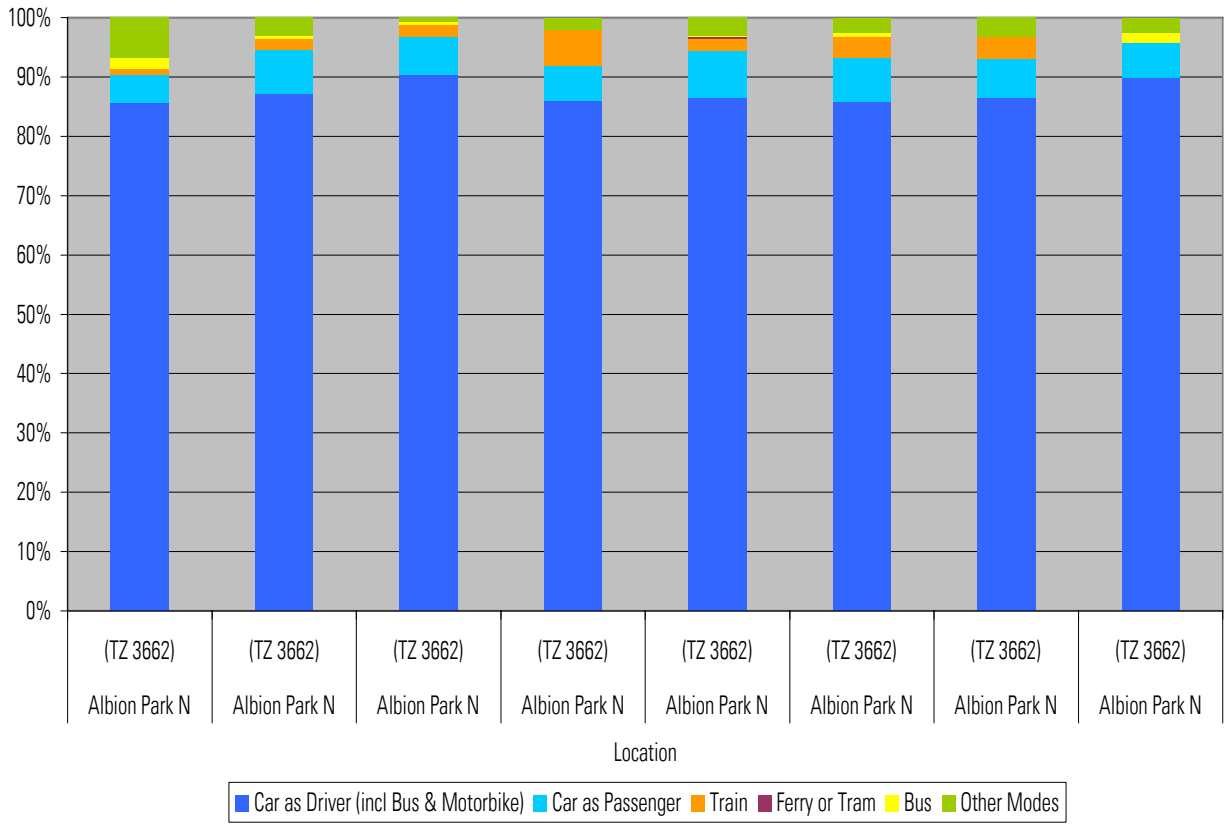
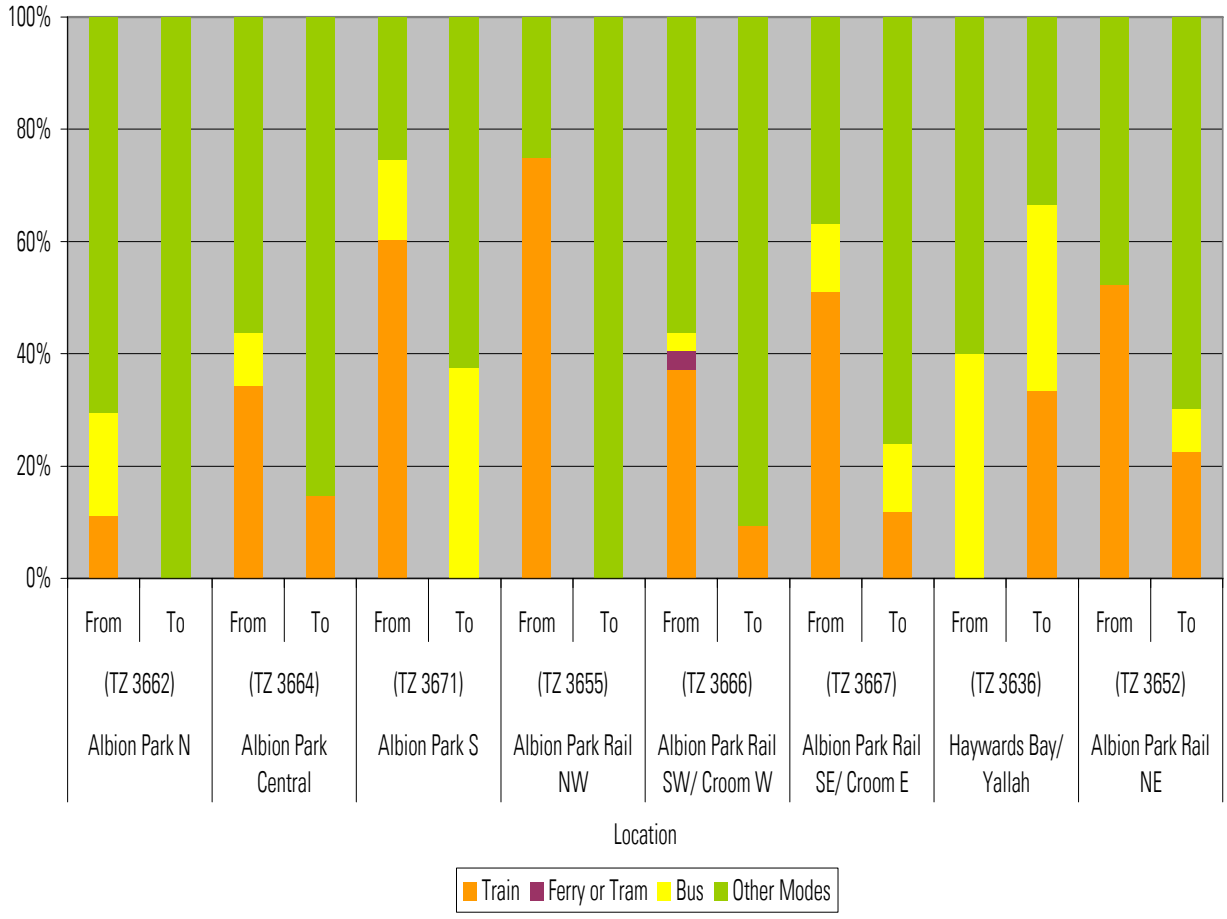


Chart 2 2006 JTW: Calderwood Origin Local Area Travel Patterns – Non-Car Modes



Trips Ending in the Local Area (Employment Trips)

The mode share is presented graphically in Chart 3 and Chart 4 for trips ending in Calderwood surrounding local areas.

Chart 3 2006 JTW: Calderwood Destination Local Area Travel Patterns – All Modes

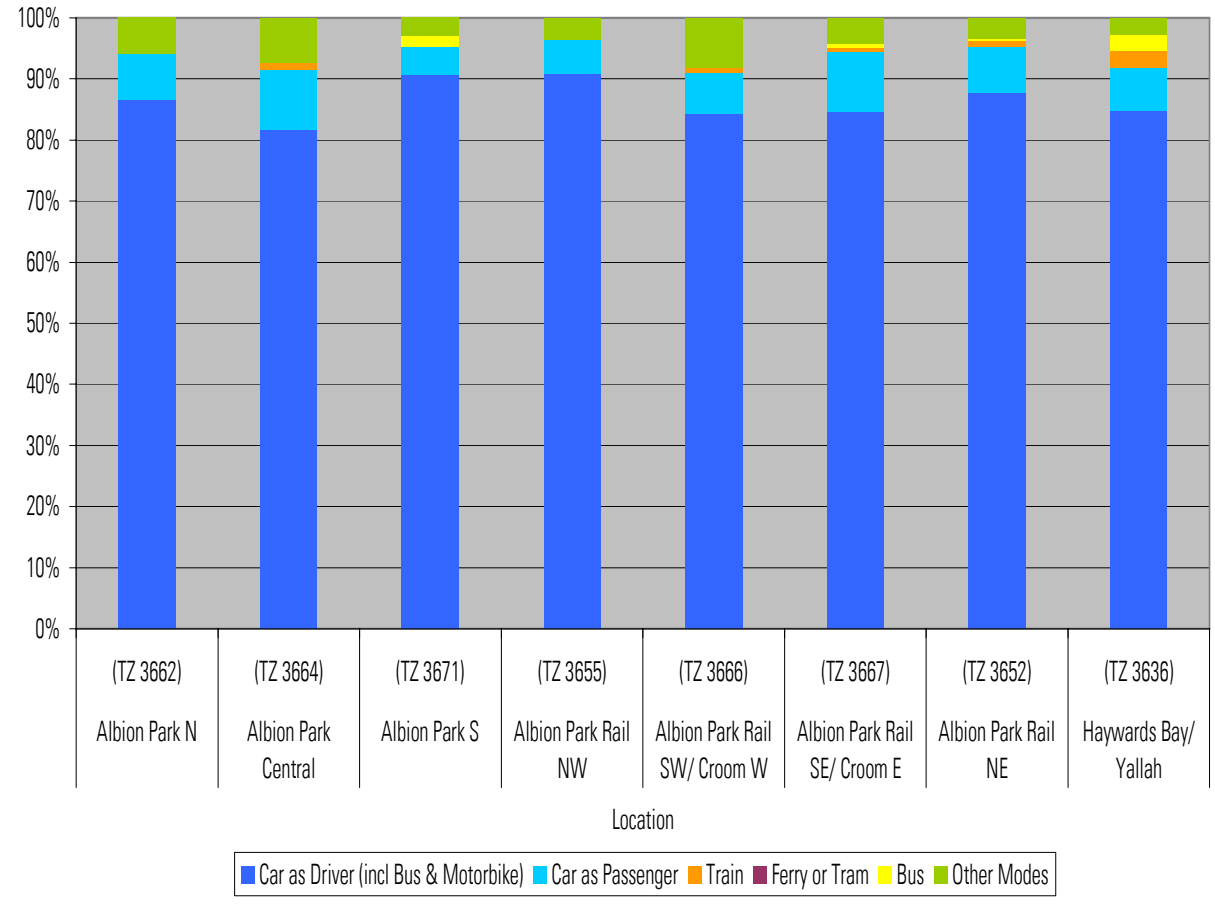
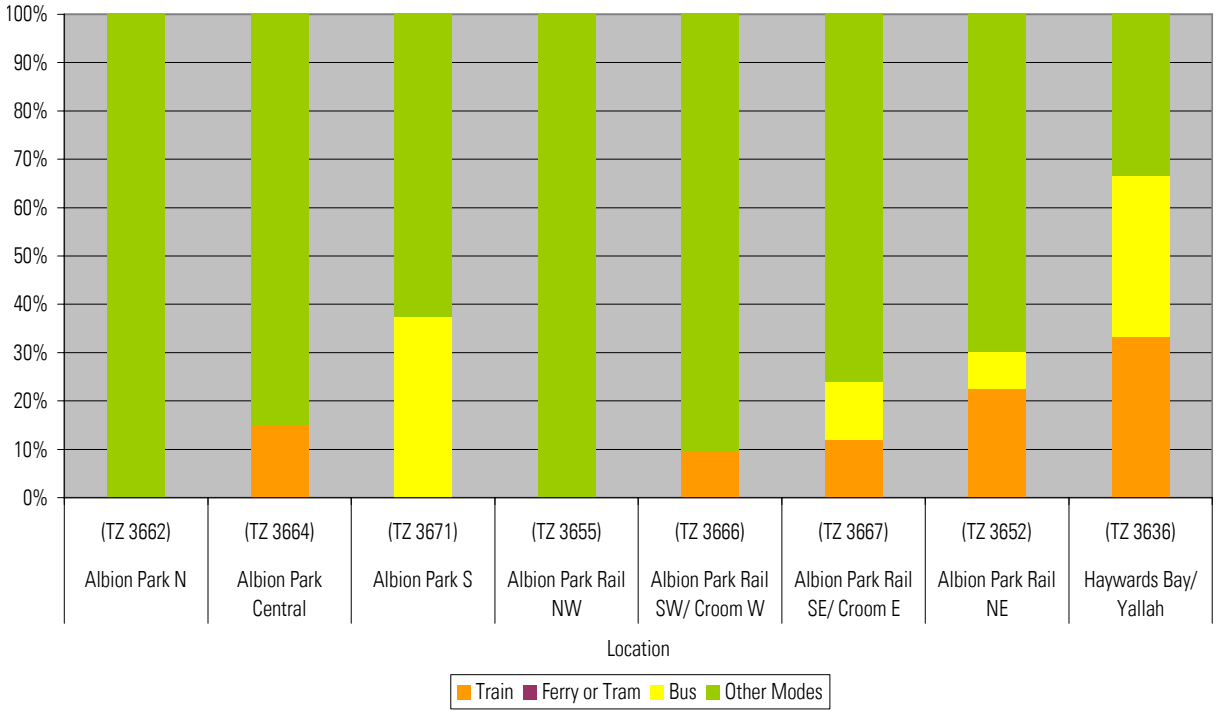


Chart 4 2006 JTW: Calderwood Destination Local Area Travel Patterns – Non-Car Modes



Appendix 5A

Cardno/DLL Review of Regional Planning Assumptions

APPENDIX 5A – CARDNO/DLL TRANSPORT PLANNING ASSUMPTIONS

Proposal	Status/authority	Scope	Timing		Transport Impact	Comment
			Proposed by Authorities	Assumed by DLL		
Approved Projects (assumed to occur prior to 2031)						
Delmo Albion Park	Declared by DoP as a State Significant Site pm 11 July 2008. Concept Approval in Jan 09.	43ha (developable) of employment land 1,650 full time positions when completed	Stage 1 – 18 lots, cut and fill, subdivision works. Stage 2 – creek rehabilitation, no lots Stage 3 – 34 lots, complete creek rehabilitation and riparian buffer Stage 4 – Building construction Stage 5 – 8 lots, creek rehabilitation.	As per proposed	Traffic generation = app 525 vehicles per hour in the AM peak and 602 vehicles per hour in the PM peak. The majority of the traffic would access the site via the Princes Highway, travelling through the Croome Road and Station Street intersections. Based on the comments from the RTA, the final approval contains the following conditions: • Upgrade of the Tongarra Rd/Station St and the Tongarra Rd/Croome Rd intersections in Stage 1 • Redesign site access to include traffic signals at the junction of Tongarra Rd and the site. This will require the proponent to obtain an option to acquire land to facilitate the construction of the intersection. Further consultation with the RTA to address and agree on the site access arrangement is required in Stage 1/Stage 2 of the development.	This Project was recently advertised for sale. The timeframe for commencement is not known. The consent conditions appear to be significant.
Tullimbar	Approved	1978 dwellings	2007/8 to 2024/2025	As per proposed	Steady production rate of 125 lots per annum.	Source: GCC report
Haywards Bay	Approved	318 dwellings	2007/8 to 2012/2013	As per proposed	Steady production rate of c75 lots per annum.	Source: GCC report
Shellharbour Town Centre	Approved	282 dwellings	2007/8 to 2012/2013	As per proposed	Steady production rate of c60 lots per annum.	Source: GCC report
Dapto Town Centre	Approved	The Dapto town centre revitalisation strategy was developed based on the following growth assumptions within Dapto and its surrounding areas: • Population increase from 26,400 in 2006 to 74,000 in 2026 • Additional 50,000m^2 of GFA of employment lands • Job projection from 4,340 in 2001 to 16,390 in 2026	2007 and staged thereafter.	Timing of growth assumptions appear to be aligned to West Dapto. The GCC timing as adopted by WCC indicates that about 23%% of the population increase is likely to occur in the period to 2026 increasing to about 40% by 2036. DLL assumed development of town centre will be proportional to population increase in WDRA. Assuming Stage 1 and 2 only occur, results in 43% of total development: • Additional 21,600m^2 of GFA of employment lands • 5200 additional jobs	The Dapto Town Centre Access and Movement Strategy commissioned by Council to identify the necessary upgrades to the existing road network and transport system suggested the following necessary changes: • Signalisation of Princes Highway/Jerrematta Street intersection • Provision of a short right turn lane on the Princes Highway (south) at the Moombara Street/Princes Highway intersection • Left in/left out at the intersection of MacCabe Street and Princes Highway • Left in/left out at Yorshire Road and Fowlers Road • New connection extending Moombara Street (at Princes Highway) through to Station Street (near Bong Bong Road) towards the west of the town centre • New north south link between Fowlers Road to Byamee Street though the Dapto Dogs site; • Signalisation of Moombara/Princes Highway intersection; • Roundabout at new road and Marshall Street; • Investigate signals Fowlers Road/Heininger Street; • Roundabout at new north south link and Byamee Street; • Bong Bong Road to be investigated as a shared zone; • Princes Highway to be implemented as a main street between Moombara Street and Baan Baan Street. • Implement Fowlers Road extension to West Dapto • Consider closure of Marshall Street as a result of the Fowlers Road extension. • Retain accessibility across Bong Bong Road for vital connections between West Dapto and the town centre.	Population growth prorated to GCC assumed stages and timing.
Shell Cove	Approved	1,135	2007/8 to 2015/16	As per proposed	Production shown at 195 per annum for 2007/08 to 2008/09 inclusive with ongoing production rate of 100 lots per annum thereafter.	Source: GCC report

Proposal	Status/authority	Scope	Timing		Transport Impact	Comment
			Proposed by Authorities	Assumed by DLL		
Proposed Projects (assumed to occur prior to 2031)						
West Dapto *Stage 1 – Kembla Grange Employment Land*	GCC Report Dec 08 recommended this Employment Land proceed; adopted by WCC 16 Dec 08	175 of employment land	2010/11	As per proposed	GCC review of the potential traffic impact based on a revised lot yield of 16,000 (previously 19,000) and covered the proposed WDRA, Yallah/Marshall Mount and Calderwood areas.	Need to clarify gross site; net developable area
West Dapto *Stage 1 - Sheaffes/ Wongawilli*	GCC report Dec 98 recommended Stage 1 proceed; adopted by WCC 16 Dec 08	3,617	2011/12 to 2026/27	As per proposed	Strategy for delivery of a package of works with 7 key upgrades totalling $78.5m for stages 1 and 2 of West Dapto endorsed by WCC on 27th October 2009 for inclusion in capital works planning process and Section 94 Contributions Plan.	
West Dapto *Stage 2 – West Horsley*	GCC report Dec 08 recommended Stage 2 proceed; adopted by WCC 16 Dec 08	2,496	2016/17 to 2036/37	As per proposed	Strategy for delivery of a package of works with 7 key upgrades totalling $78.5m for stages 1 and 2 of West Dapto endorsed by WCC on 27th October 2009 for inclusion in capital works planning process and Section 94 Contributions Plan.	
Tallawarra	The rezoning proposal was revised by WCC Jun 09 to remove part of the residential areas from 130ha in the original rezoning proposal to 80ha.	Est. 1,000	Next 5 years	As per proposed	RTA has requested the following upgrade in the future development: • North facing ramps for the Southern Freeway • Major intersection upgrades on the Princes Highway	
Illawarra International Health Precinct	Part 3A application lodged to DoP Jun 09. Applicant currently reviewing submissions.	100,000m^2 (net) floor area of medical and associated services.	8 stages 1 – c2011 to c 2022	As per proposed	No major upgrade to existing road network is proposed. The development is likely to impact on: • the intersection of Princes Highway and Huntley Road • the intersection of Princes Highway and Fowlers Road These intersections currently experience congestion regardless of the traffic generated by proposed development or other developments in the area.	
Avondale Golf Course	Rezoning application has been lodged to allow residential development on the golf course land.	21 rural res; 491 residential lots	Under consideration by Council	Not known assumed <2031	To be determined.	
Calderwood DLL	• 16/4/09 – Minister declared State Significant Site • 6/05/09 – Planning Focus Meeting • 1/06/09 – DGR issued	4,800 dwellings	2011-2028 (GCC Report)	2011-2031	**GCC Report Table 3.7.6 – Yallah/Marshall Mount and Calderwood Infrastructure Requirements identified the following list of works for the entire Calderwood Release Area and the Yallah/Marshall Mount Precinct:** YM Mount Haywards Bay Drive Bridge widening1 Calderwood Illawarra Highway widening (Broughton Road to Terry Street) Calderwood Tongarra Road widening (Terry to Princes Highway) Calderwood Upgrade Yallah Rd/F6 Freeway interchange Calderwood Albion Park station interchange upgrade	
Yallah Marshall Mount	Deferred by WCC Dec 08 based on GCC's recommendations. Subsequently decided on 26/5/09 to abandon the draft planning controls for the precinct in the draft West Dapto LEP. Revised draft planning controls will be proposed.	Estimates vary from 1,300 or 3,000	2041 (GCC Report) Indeterminate for revised proposal.	As per proposed	See comment above re GCC assessment.	
Proposed Projects Not Included as outside timeframe						
West Dapto *Stage 3 – Cleveland*	Deferred by WCC Dec 08 based on GCC's recommendations.	3,926	2027/28 to 2051/51	Post 2031	Not known.	
West Dapto *Stage 4 – Avondale*	Deferred by WCC Dec 08 based on GCC's recommendations.	4,162	2034/35 to 2051/52 and beyond	Post 2031		
Balance of Calderwood	Identified MDP, IRS as future urban area	3,000	2029 – 2040/41	Post 2031	See comment above re GCC assessment.	

Appendix 5B

DoP/RTA DLL Review of Regional Planning Assumptions

APPENDIX 5B – DOP/RTA LAND USE INPUTS

Release Area/Project	2011	2021	2036
West Dapto	160 lots Assumes: - Stage 1 = 100 lots + - Stage 2 = 60lots	3410 lots (160 + 3250) Assumes: - ramp up to 250 lots p/a in Stage 1 + - 60 lots p/a in Stage 2 + - 50 lots p/a in Marshall Mount from 2013	8890 lots (3410 + 5480) Assumes: - Ramping down in Stage 1 + - Ramping up in Stage 2 + - Commencing of Stage 3 (late in timeframe) + - 50 lots p/a in Marshall Mount
Calderwood	-	2300 lots Assumes: - Ramping up from 100/200 lots in 2011/2012 to 250 lots p/a	6050 lots (2300 + 3750) Assumes: - 250 lots p/a (from p8 of Delfin's justification report)
Tallawarra	-	700 lots Assumes: - 70 lots p/a from 2011	
Huntley Heritage	-	Golf course, tourist facility + 400 lots Assumes: - 50 lots p/a from 2013 until finished	
Illawarra Health Precinct (refer to Environmental Assessment for details)	Specialists centre and pathology/radiology units	24 hr medical centre, obstetrics unit, hospital, retail centre, nurses accommodation, education facility, aged and disability centres, seniors accommodation.	
Illawarra Employment and teaching Centre (refer to project application for details)	-	Teaching/conference facilities, accommodation, workshops (total floor spaces of 320,00m^2)	
Increased residential densities around Dapto town centre	-	Gradual increase in densities up to 6 storeys and up to 1.5:1 FSR	

Appendix 5C

Cardno/DLL vs DoP/RTA Review of Regional Planning Assumptions

APPENDIX 5C – CARDNO/DLL – DOP/RTA PLANNING ASSUMPTION COMPARISON

Proposal	Development by 2031			Comment
	Cardno/DLL	DoP/RTA	Assumed for Modelling	
Approved Projects (assumed to occur prior to 2031)				
Delmo Albion Park	1650 jobs	-	1650 jobs	As per DGR's
Tullimbar	1978 jobs	-	1978 jobs	As per GCC report
Haywards Bay	318 dwellings	-	318 dwellings	As per GCC report
Shellharbour Town Centre	282 dwellings	-	282 dwellings	As per GCC report
Dapto Town Centre	5200 jobs + 21,600 sqm employment	Gradual increase in densities up to 6 storeys and up to 1.5:1 FSR	5200 jobs + 21,600 sqm employment	Refer to note below
Shell Cove	1135 dwellings	-	1135 dwellings	As per GCC report
Proposed Projects (assumed to occur prior to 2031)				
West Dapto *Stage 1 – Kembla Grange Employment Land*	175 Ha employment land	-	175 Ha employment land	As per GCC report
West Dapto *Stage 1 - Sheaffes/ Wongawilli*	3617 dwellings	3667 dwellings	3667 dwellings	RTA/DOP figure used
West Dapto *Stage 2 – West Horsley*	2496 dwellings	2496 dwellings	2496 dwellings	RTA/DOP figure used
Tallawarra	1000 dwellings	700 dwellings	700 dwellings	RTA/DOP figure used
Illawarra International Health Precinct	100,000sqm as per EA	Non-specific (refer to EA)	100,000sqm as per EA	EA figure used
Avondale Golf Course/ Huntley Heritage	21 rural residential lots + 491 dwellings	Golf course, tourist facility + 400 lots	Golf course, tourist facility + 400 lots	RTA/DOP figure used
Calderwood DLL	4,800 dwellings	4,800 dwellings	4,800 dwellings	Agree
Yallah Marshall Mount	1300-3000 dwellings	900 dwellings	900 dwellings	RTA/DOP figure used

Note:
Dapto Town Centre development assumed to develop in proportion with WDRA development proportion.
In 2031 assume Stage 1 and 2 have developed i.e. 6113 of potential 14,165 lots – hence 43%.
At full development DTC assumed to have additional 50,000sqm employment land plus 12,050 jobs.
Hence by 2031 - 21,600sqm employment land plus 5,200 jobs.

Appendix 5D

Description of Base Future Road Network Upgrade Works

APPENDIX 5D - Description of Base Future Road Network Upgrade Works

F6 FREEWAY EXTENSION

This project involves the extension of the F6 Freeway from its present terminus at Tallawarra interchange (Princes Highway) to the Oak Flats interchange, bypassing the section of Princes Highway through Yallah and Albion Park Rail.

The following assumptions have been made regarding the layout of this project in the absence of official advice from the RTA:

- Two-lanes in each direction on a dual, grade-separated carriageways.
- A north-facing connection to the existing Princes Highway/Southern Freeway interchange with access available to/from Princes Highway (north) and the Southern Freeway.
- No access at Yallah Road or Illawarra Highway.
- Extension of Tripoli Way from Illawarra Highway to Tongarra Road as a four-lane, divided carriageway.
- An elevated roundabout interchange at the extension of Tripoli Way.
- No access at Tongarra Road.
- East-facing ramps at Croome Road.
- Absorption of the present East West Route into the freeway.
- No access at Woollybutt Drive or Colden Drive/quarry access.
- The existing approaches from East West Route to the Oak Flats interchange become on and off ramps from the freeway.
- A direct connection from the freeway to Princes Highway (east), beneath the roundabout.
- Removal of the existing direct connection between Princes Highway (east) and Princes Highway (west) and re-routing of all traffic to/from Princes Highway (west) through the roundabout.

The F6 freeway extension would accommodate a significant proportion of strategic through trips travelling between origins and destinations to the north and south of the new road infrastructure. Traffic demands for the extension would compose the following trip types:

- Generated traffic (consists of diverted trips shifted in time, route and destination).
- Induced traffic (shifts from other modes, longer trips and new vehicle trips). These trips are accounted for in modelling assessments by the inclusion of strategic through traffic growth and new trips from the increasing intensification over time of land use developments in the surrounding area. It is recognised that the effects of induced traffic are limited due to existing road network constraints at the terminal ends of the freeway extension.

In order to gain the maximum benefit of the freeway on the existing roads which its bypasses complimentary measure would need to be installed to prevent induced traffic using up the resultant spare capacity created by trips that have diverted to the new freeway. Such measure would typically include roadspace reallocation (conversion of through traffic lanes to bus/parking lanes etc) to reduce through traffic capacity, installation of local area traffic management measures and reductions of road speed limits to control vehicle speeds thereby enabling the installation of improved pedestrian/cyclist facilities and the retiming/re-phasing of traffic signals to reduce through journey times.

For modelling purposes it has been assumed that the Princes Highway between the northern and southern extents of the F6 freeway extension will be treated with complimentary measures to restrict through traffic movements and to encourage traffic to transfer to the strategic road network.

TRIPOLI WAY

Tripoli Way, also known as the Albion Park Bypass, is expected to be constructed by 2020 as per the Albion Park Traffic Study.

This project involves the provision of a two-lane undivided carriageway along the Tripoli Way alignment between Illawarra Highway/Broughton Avenue intersection and the Illawarra Highway north of Taylor Road. The intersections with Illawarra Highway/Broughton Avenue, Calderwood Road and Hamilton Avenue are assumed to be one-lane roundabouts. The intersection with Illawarra Highway (east) is assumed to be signalised. As part of the F6 Extension project, Tripoli Way would be extended east from Illawarra Highway to Tongarra Road as a four-lane divided carriageway.

As identified above in section 0 for modelling purposes it has been assumed that complimentary measures will be installed along the section of the Tongarra Road / Illawara Highway which will be bypassed by the upgraded Tripoli Way.

TALLAWARRA INTERCHANGE NORTH-FACING RAMPS

This project involves the provision of north-facing ramps at the existing Princes Highway/Southern Freeway interchange at Tallawarra. Due to the steep grade immediately north of the interchange, it has been assumed that the new ramps will be provided in a folded diamond arrangement – i.e. a northbound on-ramp running parallel to the existing northbound off-ramp before entering a hairpin bend to turn northwards; and a southbound off-ramp forming a new western leg at the intersection of Princes Highway and Yallah Bay Road.

MARSHALL MOUNT ROAD AND YALLAH ROAD

As discussed in Section 5.3.2, the emergent urbanisation of the land uses surrounding both Marshall Mount Road and Yallah Road will intensify traffic movements along both of these roads. Sub regional planning undertaken to date and structure planning has also identified the need to upgrade the inadequacies of the existing road infrastructure (narrow two way road widths providing no delineation, minimal road signage and shoulders) to provide access for the planned land use changes.

It is considered that fundamentally for the development of the Yallah Marshall Mount Environmental Precinct an upgrade of these roads to provide adequately sized and delineated traffic lanes with appropriate edge treatments and road side hazard protective measures would need to be implemented.

Traffic from the CUDP whilst not fundamentally requiring use of these roads (subject to the provision of additional road capacity through the F6 Freeway extension and Tripoli Way upgrades) could also potentially make use of the upgraded road network as a local access route between the CUDP and both Dapto and northbound connection to the F6 Freeway Extension.

Appendix 5E

Future CUDP Road Network

APPENDIX 5E - Future CUDP Road Network

Key assumptions/description of CUDP internal road network:

- A north-south sub-arterial road providing two lane two way traffic operation (ie one traffic lane in each direction) through the precinct forming the main precinct spine road. The sub-arterial road would accommodate bus movements and be designed for an 80 km/h design speed but carry a posted 60 kph speed limit. Due to the sub-arterial function it would be desirable to limit direct access from it and also limit the number of intersection along its length to permit the free flow of traffic. Carriageway edge friction (from parking movements) along its length should be minimised except in the town centre area where a concentration of on-street parking opportunities may be desirable.
- Major collector Roads would form the links between the sub arterial road and minor collector roads. These roads would be two lane two-way (ie one traffic lane in each direction) and would also carry bus movements and provide a lower speed environment (50kph or lower would be desirable). The lower speed environment would also be reinforced through design features in the horizontal and geometric design, and the use of roundabouts at four way intersections.
- Minor collector Roads would form the lowest level of road within the hierarchy and would provide direct access opportunities to individual dwellings. Roads would ideally be subject to 40kph speed limits reinforced through appropriate horizontal and vertical design and intersection control strategy.

The road network and its internal intersections would be designed to accommodate the largest anticipated vehicle types required to serve the retail, commercial and industrial uses within the precinct.

External connections between the CUDP internal road network and the existing/planned road network are as follows:

- A connection from the north-south sub arterial road to the existing Marshall Mount Road at its northernmost section is proposed. Such an intersection form would provide an appropriate gateway feature for entry/exit movements to the precinct. A three arm roundabout is assessed such that the major collector road forming the CUDP north-western boundary can tie into the north-south sub arterial/Marshall Mount Road.
- The southern end of the north-south sub arterial road would connect to the external road network via a four arm roundabout at the location of the existing Illawarra Highway /Yellow Rock Road priority controlled intersection. A roundabout is considered an appropriate form of intersection control at this location due to consistency of intersection types along the Illawarra Highway, its ability to act as a speed control device for through traffic and to provide adequate capacity and safety performance.
- A minor collector road would connect to the Illawarra Highway at the eastern end of the southern CUDP frontage as a fourth (northern arm) to the existing Illawarra Highway / Broughton Avenue roundabout.
- At the western edge of the CUDP southern frontage two priority controlled intersections would be provided to connect the minor and major collector roads to the Illawarra Highway. The major collector road would connect where North Macquarie Road currently connects. These intersection types would provide appropriate capacity to serve the lower traffic volumes on both the CUDP internal road network and the Illawarra Highway at this location.
- Calderwood Road provides an existing east-west route through the CUDP. It is proposed to upgrade and re-align the extent of the road within the internal CUDP internal road network to a major/minor collector road. Its outward eastward connection to the external road network will therefore similarly need to be upgraded from its current rural narrow non-delineated state to one appropriate to its functional role within the road hierarchy. To the west of the site Calderwood Road will be retained in it s current form.
- Access to North Marshall Mount Road will remain off Marshall Mount Road.

Based upon the CUDP internal road network hierarchy and for modelling purposes a series of assumptions were made as to the intersection control strategy to be adopted within the precinct as follows:

- Town centre sub arterial road – major collector road intersections – due to the concentration of activities within the town centre housing, retail, commercial) and the consequent focus of traffic, pedestrian and bus movements it is considered that traffic signal controlled four way intersections would be appropriate intersection controls.
- Intersections of sub-arterial road and major collector roads - where four arm intersections are proposed as part of the road hierarchy plan these should be controlled by roundabout for speed reduction and operational reasons.
- Intersections of sub-arterial road and minor collector roads - where four arm intersections are proposed as part of the road hierarchy plan these should be controlled by roundabout for speed reduction and operational reasons and three arm intersections priority control considered adequate on capacity grounds.
- Intersections of major collector roads and minor collector roads - where four arm intersections are proposed as part of the road hierarchy plan these should be controlled by roundabout for three arm intersections priority control considered adequate on capacity grounds.

Appendix 6A

Modelling Methodology

APPENDIX 6A - Modelling Methodology

MODELLING METHODOLOGY OVERVIEW

To accord with Director General's requirements for land use/road infrastructure assessment the WOLSH TRACKS strategic traffic model was made available for study purposes by the RTA and Wollongong Council.

The TRACKS model provides a representation of the regional, state and local road network and provides forecast traffic demands over the combined LGA areas. The use of the TRACKS traffic model is Council and the RTA's preferred assessment tool to undertake assessments of infrastructure requirements necessary to support land use changes.

Different combinations of land use and road network assumptions are used as input to the 2031 TRACKS model to generate, distribute and assign traffic movements within the model area and provide outputs resolved to intersection turning movement level. These intersection turning movements can then be more accurately modelled in the SIDRA intersection modelling software which enables assessment of isolated intersections performance using NSW RTA level of service criteria under a given set of traffic demands.

Subsequent modelling iterations allow the formulation of appropriate intersection configurations/controls to achieve the desired level of intersection performance. Comparisons of 'with' and 'without' CUDP transport demands for comparable road network options allow the impact upon operational performance of road links and intersections to be made for cost allocation purposes.

AREA OF INFLUENCE

For modelling purposes, it has been agreed with the RTA the extent of the road network over which the transport demands associated with the CUDP should be assessed. Described as the 'area of influence' the extent of road network is detailed in Section **Error! Reference source not found.**. This area is considered to represent all the road sections and key intersections over which development related transport impacts need to be assessed.

MODEL DEVELOPMENT

2009 BASE MODEL DEVELOPMENT AND CALIBRATION

The 2006 TRACKS model supplied by Wollongong Council contains a 550 zone network and land use data set. To reflect current traffic conditions and provide the model extents within the area of influence, the model was recalibrated using current (2009) traffic counts within the area of influence. The resultant appropriately calibrated model provides a satisfactory base for future assessments. Details relating to the model calibration process and results are provided below.

The 2009 model was developed by comparing 2009 traffic count data with the 2006 base year model to ensure that the base case model is adequately replicating current observed traffic flows on the network in the agreed area of influence. Iterative changes were made to the 2006 model until a good level of calibration was achieved. These changes included modifying intersection characteristics to correspond with actual network conditions, as well as changing link types to more accurately model road characteristics and corresponding traffic volumes. A summary table of the comparison of observed versus modelled flows is provided in Table 1 and Table 2 for the AM and PM peak periods respectively.

Table 1 AM Peak Observed versus Modelled Flow Comparison

Intersection	Approach	Movement	2009 TRACKS (Modelled)	2009 Count (Observed)	GEH
Princes Highway / Tongarra Road	Princes Highway (S)	Left	388	279	6.0
		Through	1227	1256	0.8
	Princes Highway (N)	Through	1138	1217	2.3
		Right	74	77	0.3
	Tongarra Road (W)	Left	122	11	4.5
		Right	404	368	1.8
Princes Highway / Illawarra Highway	Princes Highway (S)	Left	0	50	10.0
		Through	1712	1659	1.3
	Princes Highway (N)	Through	1428	1622	5.0
		Right	504	377	6.1
	Illawarra Highway (W)	Left	957	915	1.4
		Right	27	45	3.0
Princes Highway / Yallah Road Off-ramp	Princes Highway (S)	Left	69	84	1.7
		Through	2602	2555	0.9
	Princes Highway (N)	Through	1894	2006	2.5
Yallah Road / Princes Highway On-ramp	Yallah Road (S)	Left	38	32	1.0
		Through	27	77	6.9
	Yallah Road (W)	Left	8	30	5.0
		Right	21	31	2.0
Princes Highway / Huntley Road	Princes Highway (S)	Left	111	34	9.0
		Through	681	457	9.4
	Princes Highway (N)	Through	401	507	5.0
		Right	68	59	1.1
	Huntley Road (W)	Left	73	83	1.1
		Right	100	64	4.0
Tongarra Road / Station Road	Tongarra Road (E)	Through	338	301	2.1
		Right	15	69	8.3
	Tongarra Road (W)	Left	163	135	2.3
		Through	322	365	2.3
	Station Road (N)	Left	28	59	4.7
		Right	118	95	2.2
Tongarra Road / Illawarra Highway / Terry Street	Tongarra Road (E)	Left	184	108	6.3
		Through	214	345	7.8
	Illawarra Highway (W)	Left	77	258	1.1
		Through	232	314	5.0
	Illawarra Highway (N)	Left	10	40	6.0
		Through	302	163	9.1
		Right	86	162	6.8
	Terry Street (S)	Left	77	40	4.8
		Through	674	612	2.4
		Right	152	194	3.2

Intersection	Approach	Movement	2009 TRACKS (Modelled)	2009 Count (Observed)	GEH
Illawarra Highway / Calderwood Road	Illawarra Highway (E)	Left	0	49	9.9
		Through	245	295	3.0
		Right	55	84	3.5
	Illawarra Highway (W)	Left	13	52	6.8
		Through	286	415	6.9
		Right	0	15	5.5
	Calderwood Road (N)	Left	32	76	6.0
		Through	1	16	5.1
		Right	10	41	6.1
	Calderwood Road (S)	Left	1	15	4.9
		Through	1	6	2.7
		Right	0	35	8.4
Illawarra Highway / Broughton Ave	Illawarra Highway (E)	Left	30	70	5.7
		Through	85	135	4.8
	Illawarra Highway (W)	Through	75	171	8.7
		Right	0	2	2.0
	Broughton Avenue (S)	Left	1	1	0.0
		Right	46	58	1.7
Illawarra Highway / Yellow Rock Road	Illawarra Highway (E)	Left	0	18	6.0
		Through	86	118	3.2
	Illawarra Highway (W)	Through	75	131	5.5
		Right	0	0	-
	Yellow Rock Road (S)	Left	0	5	3.2
		Right	0	42	9.2
Illawarra Highway / North Macquarie Road	Illawarra Highway (E)	Through	86	112	2.6
		Right	0	3	2.4
	Illawarra Highway (W)	Left	4	6	0.9
		Through	75	120	4.6
	North Macquarie Road (N)	Left	0	8	4.0
		Right	1	1	0.0
Calderwood Road / North Macquarie Road	Calderwood Road (E)	Left	0	2	2.0
		Through	73	97	2.6
	Calderwood Road (W)	Through	47	65	2.4
		Right	1	4	1.9
	North Macquarie Road (S)	Left	4	11	2.6
		Right	0	4	2.8
Calderwood Road / Marshall Mount Road	Calderwood Road (E)	Through	43	5	7.8
		Right	38	29	1.6
	Calderwood Road (W)	Left	30	7	5.3
		Through	26	20	1.3
	North Macquarie Road (N)	Left	23	24	0.2
		Right	30	12	3.9
Huntley Road / Marshall Mount Road	Huntley Road (E)	Left	67	48	2.5
		Through	112	47	7.3
	Huntley Road (W)	Through	109	120	1.0
		Right	6	3	1.4
	Marshall Mount Road (S)	Left	4	4	0.0
		Right	64	26	5.7

Table 2 PM Peak Observed versus Modelled Flow Comparison

Intersection	Approach	Movement	2009 TRACKS (Modelled)	2009 Count (Observed)	GEH
Princes Highway / Tongarra Road	Princes Highway (S)	Left	463	324	7.0
		Through	858	1141	9.0
	Princes Highway (N)	Through	1492	1496	0.1
		Right	135	142	0.6
	Tongarra Road (W)	Left	77	71	0.7
		Right	424	337	4.5
Princes Highway / Illawarra Highway	Princes Highway (S)	Left	0	40	8.9
		Through	1231	1261	0.8
	Princes Highway (N)	Through	1921	1980	1.3
		Right	1006	803	6.7
	Illawarra Highway (W)	Left	548	421	5.8
		Right	20	38	3.3
Princes Highway / Yallah Road Off-ramp	Princes Highway (S)	Left	46	49	0.4
		Through	1733	1694	0.9
	Princes Highway (N)	Through	2847	2687	3.0
Yallah Road / Princes Highway On-ramp	Yallah Road (S)	Left	24	33	1.7
		Through	33	41	1.3
	Yallah Road (W)	Left	18	14	1.0
		Right	39	20	3.5
Princes Highway / Huntley Road	Princes Highway (S)	Left	116	36	9.2
		Through	597	159	6.0
	Princes Highway (N)	Through	613	525	3.7
		Right	80	24	7.8
	Huntley Road (W)	Left	70	48	2.9
		Right	129	32	10.8
Tongarra Road / Station Road	Tongarra Road (E)	Through	392	415	1.1
		Right	9	31	4.9
	Tongarra Road (W)	Left	101	86	1.6
		Through	365	315	2.7
	Station Road (N)	Left	47	75	3.6
		Right	208	96	9.1
Tongarra Road / Illawarra Highway / Terry Street	Tongarra Road (E)	Left	181	155	2.0
		Through	311	339	1.6
	Illawarra Highway (W)	Left	188	157	2.4
		Through	302	283	1.1
	Illawarra Highway (N)	Left	13	25	2.8
		Through	599	530	2.9
		Right	279	315	2.1
	Terry Street (S)	Left	42	50	1.2
		Through	315	252	3.7
		Right	132	238	7.8

Intersection	Approach	Movement	2009 TRACKS (Modelled)	2009 Count (Observed)	GEH
Illawarra Highway / Calderwood Road	Illawarra Highway (E)	Left	0	30	7.7
		Through	357	332	1.3
		Right	38	56	2.6
	Illawarra Highway (W)	Left	11	11	0.0
		Through	303	297	0.3
		Right	0	3	2.4
	Calderwood Road (N)	Left	55	55	0.0
		Through	1	5	2.3
		Right	14	41	5.1
	Calderwood Road (S)	Left	1	17	5.3
		Through	0	4	2.8
		Right	0	31	7.9
Illawarra Highway / Broughton Ave	Illawarra Highway (E)	Left	55	6	8.9
		Through	115	139	2.1
	Illawarra Highway (W)	Through	122	171	4.0
		Right	2	1	0.8
	Broughton Avenue (S)	Left	1	1	0.0
		Right	34	4	6.9
Illawarra Highway / Yellow Rock Road	Illawarra Highway (E)	Left	0	9	4.2
		Through	115	131	1.4
	Illawarra Highway (W)	Through	123	169	3.8
		Right	0	4	2.8
	Yellow Rock Road (S)	Left	0	0	-
		Right	0	10	4.5
Illawarra Highway / North Macquarie Road	Illawarra Highway (E)	Through	115	101	1.3
		Right	0	6	3.5
	Illawarra Highway (W)	Left	1	5	2.3
		Through	123	159	3.0
	North Macquarie Road (N)	Left	5	3	2.4
		Right	0	3	1.0
Calderwood Road / North Macquarie Road	Calderwood Road (E)	Left	0	12	4.9
		Through	55	21	5.5
	Calderwood Road (W)	Through	77	38	5.1
		Right	5	1	2.3
	North Macquarie Road (S)	Left	1	2	0.8
		Right	0	12	4.9
Calderwood Road / Marshall Mount Road	Calderwood Road (E)	Through	29	13	3.5
		Right	24	15	2.0
	Calderwood Road (W)	Left	33	4	6.7
		Through	49	14	6.2
	North Macquarie Road (N)	Left	34	12	5.6
		Right	41	4	6.9
Huntley Road / Marshall Mount Road	Huntley Road (E)	Left	79	17	8.9
		Through	117	58	6.3
	Huntley Road (W)	Through	139	56	8.4
		Right	5	11	2.1
	Marshall Mount Road (S)	Left	6	5	0.4
		Right	60	26	5.8

The **GEH Statistic** is a formula used in traffic engineering, traffic forecasting, and traffic modelling to compare two sets of traffic volumes. It is an empirical formula that has proven useful for a variety of traffic analysis purposes.

The formula for the "GEH Statistic" is:

$$GEH = \sqrt{\frac{2(M-C)^2}{M+C}}$$

Where M is the hourly traffic volume from the traffic model (or new count) and C is the real-world hourly traffic count (or the old count).

The use of GEH as an acceptance criterion for travel demand forecasting models is recognised in the UK Highways Agency's *Design Manual for Roads and Bridges* (DMRB), Volume 12, Section 2, and in other references.

For traffic modelling work in the "baseline" scenario, a GEH of less than 5.0 is considered a good match between the modelled and observed hourly volumes (flows of longer or shorter durations should be converted to hourly equivalents to use these thresholds). According to DMRB, 85% of the volumes in a traffic model should have a GEH less than 5.0. GEHs in the range of 5.0 to 10.0 may warrant investigation. If the GEH is greater than 10.0, there is a high probability that there is a problem with either the travel demand model or the data (this could be something as simple as a data entry error, or as complicated as a serious model calibration problem).

Table 1 and Table 2 show that there is a good correlation between the observed traffic flows and the 2009 base case model and the model is therefore suitable for further testing of the proposed development. It should be noted that the correlation did not achieve a GEH of less than 5.0 for 85% of the volumes; however the model is primarily strategic in nature, covering the whole of the Wollongong and Shellharbour. It therefore uses generation rates and distribution parameters that are averages for the entire region. It is therefore unlikely that traffic flows and patterns in a specific area will be replicated precisely. Additionally, the strategic nature of the model means that traffic is generated and loaded on to the network from traffic zones at the CCD level. This can mean 100-200 households can be loaded on to the network at one or two points. Furthermore, strategic models are generally calibrated to mid-block daily counts and at times to peak hour counts. To have 98% of turning movements calibrated to a GEH of 10 or less and 62% of turning movements calibrated to a GEH of 5 or less and 98% of turning movements calibrated to a GEH of 10 or less and 69% of turning movements calibrated to a GEH of 5 or less for the AM peak and PM peak, respectively, is a good result for the calibration of a strategic model

2031 BASE MODEL

The 2031 design year represents a 20 year construction period for the CUDP. The 2031 CUDP model was developed to reflect likely transport conditions at the development completion time. The 2031 Base model was developed to assess background traffic without the CUDP.

Two models were initially provided by the Council's as follows:

- A 550 zone 2006 model
- A 470 zone 2026 model

The two above models were developed separately over time. The traffic demands from the 2026 470 zone model were used in conjunction with the 2006 550 zone traffic model structure (modelled road network and land use patterns). This provided a 2026 550 zone model.

Traffic growth factors calculated from the difference between the 2006 and 2026 models were incorporated into the 2026 model to derive the 2031 model for assessment purposes. Additionally, the agreed regional developments growth, infill growth and external background growth (described in section 5.2 above) were incorporated into the 2031 base model.

Appendix 6B

Modelling Scenario Inputs

APPENDIX 6B - Modelling Scenario Inputs

ROAD NETWORK OPTIONS

The road network options that were developed to determine the base case (without CUDP) as follows:

- 2009 existing road network.
- 2031 'do nothing' road network, as per the 2009 existing road network.
- 2031 'do minimum' road network which is the 'do nothing' road network and including:
  - F6 extension and associated ramps.
  - Tallawarra F6 North Facing Ramps.
  - All 3 stages of the Albion Park Bypass (Tripoli Way).
- 2031 'do absolute minimum' road network which is the:
  - 'do minimum' road network excluding Tallawarra F6 North Facing Ramps.
  - Upgrade of Marshall Mount and Yallah Road.
- 2031 'do base upgrades' road network which is the 2031 'do absolute minimum' road network and including additional infrastructure identified through the modelling process to overcome any network deficiencies.

To examine the impact of the CUDP on the base road network operation, development road network options were developed as follows:

- 2031 'do nothing' road network with CUDP road network.
- 2031 'do minimum' road network with CUDP road network.
- 2031 'do absolute minimum' road network with CUDP road network.
- 2031 'do base upgrades' road network with CUDP road network[1].

TRAVEL DEMAND OPTIONS

As described above in Section 5 there are a number of potential land use changes that can lead to resulting changes in travel demand over the assessment timeframe period. These potential sources of travel demand increases are considered to comprise the following:

- 2009 development – assumes all development is as per the existing situation with no growth.
- 2031 Regional release area growth – includes approved and proposed sites (as detailed in Section 5.2.1):
  - Approved sites which have the benefit of development/project application approval which remain to be implemented and as such are not accounted for in the use of the 2009 traffic data.
  - Sites which are allocated for redevelopment within the Illawarra Regional Strategy and the draft West Dapto Release Area (WDRA) planning documents and are expected to be progressively developed through the assessment timeframe period.
- Regional infill growth - Sites which are progressively re-developed over time and development relating to natural population expansion (as detailed in Section 5.2.2).
- External growth – this is natural traffic growth which occurs outside of the traffic model area of influence but may have origins or destinations which involve travel through the area of influence (through trips) (as detailed in Section 5.2.3).
- CUDP - The DLL landholdings, with development potential for about 4,800 accommodates about 12,500 people or about 60% of the future Calderwood Release Area population.

[1] Additional upgrade works required as a result of future growth to 2031 excluding Calderwood (these are discussed in detail in Sections **Error! Reference source not found.**)

The following combinations of potential travel demand increases were used in the assessments:

- 2009 Base – with 2009 development only.
- 2031 Base scenarios include:
  - Regional release area growth excluding CUDP.
  - Regional Infill growth.
  - External growth
- 2031 with CUDP scenarios include:
  - Regional release area growth including CUDP.
  - Regional Infill growth.
  - External growth.

MODE SHARE OPTIONS

Current modals splits within the LGA areas reflect a lack of public transport and active transport opportunities with only 10% of travel undertaken by non-car modes across both the Wollongong and Shellharbour LGA's. This is described as the 'business as usual' (BAU) case.

As described in Section 3 the concept plan for the CUDP contains a number of key principles relating to transport and travel demand management.

Such measures on other similarly master planned community developments undertaken by DLL have achieved positive modal shift results away from car based transport. Accordingly, at least a 10% modal shift from car based to non car based modes of transport is expected and is incorporated into the modelling of the transport demands relating to the CUDP.

However, in transport demand assessment terms an unknown variable is the extent by which the other agreed planned developments can contribute to positive modal shift to non car based modes. Scenario testing will account for the following range of potential outcomes:

- CUDP and other planned regional developments BAU (no change from current mode splits).
- CUDP 10% modal transfer to non car modes and other planned regional developments BAU (no change from current mode splits).
- CUDP 10% modal transfer to non car modes and other planned developments appropriately designed and constructed to also achieve a 10% modal transfer to non car modes.

Appendix 6B - Modelling Scenario Testing Summary Matrix

		Year	09		31		31		31				31		31		31		31		31		31	
		Scenario Name	2009 Base (bau)		2031 Base 'do nothing' (bau)		2031 Base 'do minimum' (bau)		2031 Base 'do minimum' (mode shift)		2031 Base 'do absolute minimum' (bau)		2031 Base 'base upgrades' (bau)		2031 CUDP 'do nothing' (bau)		2031 CUDP 'do nothing' (mode shift)		2031 CUDP 'do minimum' (mode shift)		2031 CUDP 'do absolute minimum' (mode shift)		2031 CUDP 'base upgrades' (mode shift)		2031 CUDP 'full upgrades' (mode shift)	
		Scenario Ref	B00		B01		B02		B03		B04		B05		D01		D02		D04		D08		D11		D12	
		Peak	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P
		Filename	09_B00A	09_B00P	31_B01A	31_B01P	31_B02A	31_B02P	31_B03A	31_B03P	_B04A	_B04P	_B05A	_B05P	31_D01A	31_D01P	31_D02A	31_D02P	31_D04A	31_D04P	31_D08A	31_D08P	31_D11A	31_D11P	31_D12A	31_D12P
Road Network	Base Road Network	2009	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
	'Do Minimum'/'Do Absolute Minimum' Upgrades	F6 Extension and ramps	n	n	n	n	y	y	y	y	y	y	y	y	n	n	n	n	y	y	y	y	y	y	y	y
		Tallawarra F6 North Facing Ramps	n	n	n	n	y	y	y	y	n	n	n	n	n	n	n	n	y	y	n	n	n	n	n	n
		Albion Park Bypass (Tripoli Way)	n	n	n	n	y	y	y	y	y	y	y	y	n	n	n	n	y	y	y	y	y	y	y	y
	Calderwood Road Network	2031	n	n	n	n	n	n	n	n	n	n	n	n	y	y	y	y	y	y	y	y	y	y	y	y
	Strategic Road Network Improvements*	Marshall Mount Rd upgrade	n	n	n	n	n	n	n	n	n	n	y	y	n	n	n	n	n	n	n	n	y	y	y	y
		Yallah Road Rd upgrade	n	n	n	n	n	n	n	n	n	n	y	y	n	n	n	n	n	n	n	n	y	y	y	y
		Traffic Calming Tongarra Rd (Tripoli)	n	n	n	n	n	n	n	n	n	n	y	y	n	n	n	n	n	n	n	n	y	y	y	y
		Duplicate Princes Highway between F6 & Mt Brown Rd	n	n	n	n	n	n	n	n	n	n	y	y	n	n	n	n	n	n	n	n	y	y	y	y
		Signalise Princes Hwy/Huntley Rd	n	n	n	n	n	n	n	n	n	n	y	y	n	n	n	n	n	n	n	n	y	y	y	y
		Signalise Princes Hwy/Cormack Ave	n	n	n	n	n	n	n	n	n	n	y	y	n	n	n	n	n	n	n	n	y	y	y	y
		Signalise Princes Hwy/Tallawarra Off-ramp	n	n	n	n	n	n	n	n	n	n	y	y	n	n	n	n	n	n	n	n	y	y	y	y
		F6 southbound on ramp additional lane	n	n	n	n	n	n	n	n	n	n	y	y	n	n	n	n	n	n	n	n	y	y	y	y
		F6 northbound off ramp additional lane	n	n	n	n	n	n	n	n	n	n	y	y	n	n	n	n	n	n	n	n	y	y	y	y
		Signalise Marshall Mount Rd/Yallah Rd Tongarra Rd/Station Rd	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
		Signalise Tongarra Rd/Station Rd	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
		Roundabout at Yallah Rd/Haywards Bay Dr	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	y	y
Land Use Planning Assumptions	Growth	2009 Development	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
		2031 Regional Infill Growth	n	n	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
		2031 External Growth	n	n	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
		2031 Regional New Development	n	n	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
		2031 CUDP	n	n	n	n	n	n	n	n	n	n	n	n	y	y	y	y	y	y	y	y	y	y	y	y
		2031 Other Calderwood	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
	Mode Share	2009 Development	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau
		2031 Regional Infill Growth	n	n	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau
		2031 External Growth	n	n	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau
		2031 Regional New Development	n	n	bau	bau	bau	bau	-10%	-10%	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau	bau
		2031 CUDP	n	n	n	n	n	n	n	n	n	n	n	n	bau	bau	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%	-10%
		2031 Other Calderwood	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Mode Share:
bau = business as usual
-x% = x% shift to non-car based transport modes

Peak:
A = AM
P = PM

Other:
CUDP = Calderwood Urban Development Project

Appendix 6C

Modelling Scenarios

APPENDIX 6C - Modelling Scenarios

Base Assessment Scenarios - No CUDP

The following scenarios (during both weekday AM and PM peak hours) were examined to establish the road network performance without the CUDP:

- 2009 Base BAU scenario {B00}:
  - 2009 road network.
  - No growth.
  - BAU modal splits.
- 2031 Base 'do nothing' BAU scenario {B01} including:
  - 2009 road network.
  - Regional infill growth, external growth and regional new development growth with no CUDP.
  - BAU modal splits.
- 2031 Base 'do minimum' BAU scenario {B02} including:
  - 2009 road network with 'do minimum' upgrades.
  - Regional infill growth, external growth and regional new development growth with no CUDP.
  - BAU modal splits.
- 2031 Base 'do minimum' mode shift scenario {B03} including:
  - 2009 road network with 'do minimum' upgrades.
  - Regional infill growth and external growth with BAU modal splits.
  - Regional new development growth (with no CUDP) including a 10% modal shift.
- 2031 Base 'do absolute minimum' BAU scenario {B04} including:
  - 2009 road network with 'do absolute minimum' upgrades i.e. 'do minimum' excluding the Tallawarra Freeway ramps.
  - Regional infill growth, external growth and regional new development growth with no CUDP.
  - BAU modal splits.
- 2031 Base 'do base upgrades' BAU scenario {B05} including:
  - 2009 road network with 'do absolute minimum' upgrades i.e. 'do minimum' excluding the Tallawarra Freeway ramps plus the following upgrades identified to be required to address future base road network deficiencies (without Calderwood)[1]:
    - Upgrade Marshall Mount Road from the CUDP boundary to Huntley Road to an appropriate minimum 2 lane two-way carriageway with sealed shoulders.
    - Upgrade Yallah Road between Marshall Mount Road and Haywards Bay Drive to an appropriate minimum 2 lane two-way carriageway with sealed shoulders.
    - Duplication of the Princes Highway between Mount Brown Road and Cormack Avenue (both directions).
    - Duplication of Princes Highway southbound between Cormack Avenue and Yallah Bay Road
    - Duplication of the F6 Freeway southbound on-ramp south of Yallah Bay Road and associated freeway widening to accommodate improved merge area .
    - Duplication of the F6 Freeway northbound off-ramp at Tallawarra Interchange and associated F6 widening to accommodate ramp upgrade.
    - Provide traffic signals at the intersection of Princes Highway and Huntley Road.
    - Provide traffic signals at the intersection of Princes Highway and F6 northbound off-ramp at Tallawarra Interchange.
    - Provide traffic signals at the intersection of Princes Highway and Cormack Avenue.
  - Regional infill growth, external growth and regional new development growth with no CUDP.
  - BAU modal splits.

[1] Additional upgrade works required as a result of future growth to 2031 excluding Calderwood (these are discussed in detail in Sections **Error! Reference source not found.**)

With Development (CUDP) Assessment Scenarios

A significant range of scenarios were tested to assess the road network performance with full 2031 future development including the Calderwood project. Many scenarios were required to be run in an iterative process to determine an appropriate package of measures. Some scenarios were tested and discarded others formed part of the ultimate package of measures. Only key scenarios have been reported on that demonstrate the impacts of the future development with the CUDP and the optimum package of measures. Furthermore selected scenarios were run to test the model sensitivity for assumptions and to demonstrate the robust process.

The following key scenarios (during both weekday AM and PM peak hours) were examined to establish the road network performance with the CUDP:

- 2031 With CUDP 'do nothing' BAU scenario {D01} including:
  - 2009 road network plus Calderwood internal road network.
  - Regional infill growth, external growth and regional new development growth.
  - CUDP growth.
  - BAU modal splits.
- 2031 With CUDP 'do nothing' mode shift scenario {D02} including:
  - 2009 road network plus Calderwood internal road network.
  - Regional infill growth, external growth and regional new development growth with BAU modal splits.
  - CUDP growth including a 10% modal shift.
- 2031 With CUDP 'do minimum' mode shift scenario {D04} including:
  - 2009 road network with 'do minimum' upgrades plus Calderwood internal road network.
  - Regional infill growth, external growth and regional new development growth with BAU modal splits.
  - CUDP growth including a 10% modal shift.
- 2031 With CUDP 'do absolute minimum' mode shift scenario {D08} including:
  - 2009 road network with 'do absolute minimum' upgrades plus Calderwood internal road network.
  - Regional infill growth, external growth and regional new development growth with BAU modal splits.
  - CUDP growth including a 10% modal shift.
- 2031 With CUDP 'do base upgrades' with mode shift scenario {D11} including:
  - 2009 road network with 'do absolute minimum' upgrades plus Calderwood internal road network plus the following upgrades identified to be required to address future base road network deficiencies (without Calderwood):
    - Upgrade Marshall Mount Road from the CUDP boundary to Huntley Road to an appropriate minimum 2 lane two-way carriageway with sealed shoulders.
    - Upgrade Yallah Road between Marshall Mount Road and Haywards Bay Drive to an appropriate minimum 2 lane two-way carriageway with sealed shoulders.
    - Duplication of the Princes Highway between Mount Brown Road and Cormack Avenue (both directions).
    - Duplication of the F6 Freeway southbound on-ramp south of Yallah Bay Road.
    - Duplication of the F6 Freeway northbound off-ramp at Tallawarra Interchange and associated F6 widening to accommodate ramp upgrade.
    - Provide traffic signals at the intersection of Princes Highway and Huntley Road.
    - Provide traffic signals at the intersection of Princes Highway and F6 northbound off-ramp at Tallawarra Interchange.
    - Provide traffic signals at the intersection of Princes Highway and Cormack Avenue.
  - Regional infill growth, external growth and regional new development growth with BAU modal splits.
  - CUDP growth including a 10% modal shift.

It should be noted that the 'do base upgrade' road network would need to consider the road linkages between the Princes Highway, Southern Freeway and F6 extension holistically as part of a design process based upon a range of factors including safety, capacity, cost etc. Therefore assessments of the road links between the F5 extension and Princes Highway / Southern Freeway have been undertaken on the basis of its existing two lane section.

A range of additional scenarios were run iteratively to test a variety of network options and potential mitigation measures. Furthermore, scenarios were run to test the sensitivity of measures under different assumptions.

Appendix 7A

Network Performance Characteristics - 2031 Base ‘Do Nothing’ BAU Model {31_B01}

Appendix 7A - Network Performance Characteristics - 2031 Base 'Do Nothing' BAU Model
Mid-block Carriageway Performance - AM Peak {31_B01A}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	282	308	590	B	C
Illawarra Highway	North Macquarie Road	Tullimbar Lane	265	275	540	B	C
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	265	275	540	B	C
Illawarra Highway	Yellow Rock Road	Broughton Avenue	266	275	541	B	B
Illawarra Highway	Broughton Avenue	Church Street	952	670	1,622	C	A
Illawarra Highway	Church Street	Calderwood Road	1,110	628	1,738	D	A
Illawarra Highway	Calderwood Road	Russell Street	1,114	636	1,750	A	A
Illawarra Highway	Russell Street	Terry Street	1,351	701	2,052	B	A
Illawarra Highway	Terry Street	Croome Lane	1,532	817	2,349	F	B
Illawarra Highway	Croome Lane	Princes Highway	1,593	923	2,516	F	C
Yallah Road	Marshall Mount Road	Princes Highway	261	163	424	B	B
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	116	69	185	B	A
Marshall Mount Road	North Marshall Mount Road	Yallah Road	94	44	138	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	224	271	495	B	B
Marshall Mount Road	Yallah TAFE	Huntley Road	344	215	559	C	B
Calderwood Road	Calderwood valley Golf Club	Marshall Mount Road	17	31	48	A	A
Calderwood Road	Marshall Mount Road	Illawarra Christian School	63	124	187	A	B
Calderwood Road	Illawarra Christian School	North Macquarie Road	69	110	179	A	B
Calderwood Road	CUDP	Mansons Bridge	62	67	129	A	A
Calderwood Road	Mansons Bridge	Illawarra Highway	60	58	118	A	A
North Macquarie Road	Illawarra Highway	Macquarie Rivulet	43	7	50	A	A
North Macquarie Road	Macquarie Rivulet	Calderwood Road	43	7	50	A	A
Huntley Road	Marshall Mount Road	Princes Highway	361	306	667	A	A
Tongarra Road	Terry Street	Stapleton Avenue	780	580	1,360	B	A
Tongarra Road	Stapleton Avenue	Croome Road	660	861	1,521	A	B
Tongarra Road	Croome Road	Station Road	903	703	1,606	C	A
Tongarra Road	Station Road	Ti-Tree Avenue	654	528	1,182	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	635	480	1,115	A	A
Tongarra Road	Ash Avenue	Princes Highway	893	627	1,520	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	2,361	2,037	4,398	D	C
Princes Highway	Tongarra Road	Station Road	2,000	1,410	3,410	C	A
Princes Highway	Station Road	Airport Road	2,285	1,621	3,906	D	B
Princes Highway	Airport Road	Illawarra Highway	2,281	1,685	3,966	D	B
Princes Highway	Illawarra Highway	Yallah Road	3,858	2,592	6,450	F	E
Princes Highway	Yallah Road	Southern Freeway	3,821	2,405	6,226	F	E
Princes Highway	Southern Freeway	Huntley Road	1,550	667	2,217	F	A
Princes Highway	Huntley Road	Mount Brown Road	1,659	721	2,380	F	A
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	1,229	1,229		C
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	1,667	-	1,667	E	
Southern Freeway	Princes Highway	Fowlers Road	2,154	1,332	3,486	C	B

Appendix 7A - Network Performance Characteristics - 2031 Base 'Do Nothing' BAU Model
Mid-block Carriageway Performance - PM Peak {31_B01P}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	274	395	669	C	C
Illawarra Highway	North Macquarie Road	Tullimbar Lane	380	176	556	C	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	380	176	556	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	380	176	556	C	B
Illawarra Highway	Broughton Avenue	Church Street	869	1,234	2,103	B	E
Illawarra Highway	Church Street	Calderwood Road	743	1,272	2,015	A	F
Illawarra Highway	Calderwood Road	Russell Street	729	1,224	1,953	A	A
Illawarra Highway	Russell Street	Terry Street	910	1,385	2,295	A	B
Illawarra Highway	Terry Street	Croome Lane	757	1,561	2,318	A	F
Illawarra Highway	Croome Lane	Princes Highway	824	1,705	2,529	B	F
Yallah Road	Marshall Mount Road	Princes Highway	692	335	1,027	D	C
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	59	238	297	A	B
Marshall Mount Road	North Marshall Mount Road	Yallah Road	42	201	243	A	B
Marshall Mount Road	Yallah Road	Yallah TAFE	328	843	1,171	B	D
Marshall Mount Road	Yallah TAFE	Huntley Road	139	892	1,031	B	E
Calderwood Road	Calderwood valley Golf Club	Marshall Mount Road	29	17	46	A	A
Calderwood Road	Marshall Mount Road	Illawarra Christian School	249	58	307	B	A
Calderwood Road	Illawarra Christian School	North Macquarie Road	230	67	297	B	A
Calderwood Road	CUDP	Mansons Bridge	132	52	184	B	A
Calderwood Road	Mansons Bridge	Illawarra Highway	47	122	169	A	A
North Macquarie Road	Illawarra Highway	Macquarie Rivulet	15	98	113	A	A
North Macquarie Road	Macquarie Rivulet	Calderwood Road	15	98	113	A	B
Huntley Road	Marshall Mount Road	Princes Highway	238	559	797	A	A
Tongarra Road	Terry Street	Stapleton Avenue	766	1,108	1,874	B	D
Tongarra Road	Stapleton Avenue	Croome Road	1,138	920	2,058	E	C
Tongarra Road	Croome Road	Station Road	895	1,281	2,176	C	F
Tongarra Road	Station Road	Ti-Tree Avenue	756	964	1,720	A	C
Tongarra Road	Ti-Tree Avenue	Ash Avenue	737	918	1,655	A	C
Tongarra Road	Ash Avenue	Princes Highway	868	1,160	2,028	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	2,162	3,074	5,236	D	F
Princes Highway	Tongarra Road	Station Road	1,297	2,501	3,798	A	E
Princes Highway	Station Road	Airport Road	1,469	2,791	4,260	A	F
Princes Highway	Airport Road	Illawarra Highway	1,571	2,855	4,426	A	F
Princes Highway	Illawarra Highway	Yallah Road	2,371	4,535	6,906	D	F
Princes Highway	Yallah Road	Southern Freeway	2,192	4,117	6,309	D	F
Princes Highway	Southern Freeway	Huntley Road	1,303	1,728	3,031	F	F
Princes Highway	Huntley Road	Mount Brown Road	1,193	1,939	3,132	E	F
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	2,284	2,284		F
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	1,429	-	1,429	D	
Southern Freeway	Princes Highway	Fowlers Road	763	2,082	2,845	A	C

Appendix 7A - Network Performance Characteristics - 2031 Base 'Do Nothing' BAU Model

Intersection Performance {31_B01}

		Scenario 31_B01 AM Peak			Scenario 31_B01 PM Peak		
Intersection	Intersection Control	Degree of Saturation	Delays (s)	LoS	Degree of Saturation	Delays (s)	LoS
Illawarra Hwy/Nth Macquarie Rd	Priority	0.154	15.3	B	0.095	16.2	B
Illawarra Hwy/Tongarra Rd/Terry St	Signals	>1.000	>120	F	>1.000	>120	F
Illawarra Hwy/Princes Hwy	Roundabout	>1.000	>120	F	>1.000	>120	F
Princes Hwy/Tongarra Rd	Signals	0.886	33.0	C	0.898	31.9	C
Calderwood Road/Nth Macquarie Road	Priority	0.044	13.5	A	0.010	14.1	A
Calderwood Road/Marshall Mount Road	Priority	0.039	11.2	A	0.134	11.2	A
Marshall Mount Road/Yallah Road	Priority	0.177	12.7	A	0.674	25.4	B
Huntley Rd/Marshall Mount Rd	Priority	0.423	12.9	A	0.378	20.7	B
Princes Hwy/Huntley Rd	Priority	>1.000	>120	F	>1.000	>120	F
Illawarra Hwy/Calderwood Rd/Macquarie St	Signals	0.704	8.2	A	0.849	11.5	A
Illawarra Hwy/Broughton Ave	Roundabout	0.636	14.3	A	0.508	16.9	B
Tongarra Rd/Station Rd	Priority	0.855	50.8	D	>1.000	>120	F
Yallah Rd/Princes Hwy on-ramp	Priority	0.099	10.4	A	0.709	14.3	A
Yallah Rd/Haywards Bay Dr	Priority	0.126	10.4	A	0.498	15.2	B
Illawarra Hwy/Yellow Rock Rd	Priority	0.010	19.6	B	0.009	19.2	B
Haywards Bay Drive/Princes Highway southbound ramps	Roundabout	0.120	12.8	A	0.469	19.1	B
Princes Highway and Southern Freeway (Tallawarra northbound off-ramp)	Priority	>1.000	>120	F	>1.000	>120	F
Princes Hwy/Cormack Ave	Priority	>1.000	>120	F	>1.000	>120	F

APPENDIX 7A - Network Performance Characteristics - 2031 Base 'Do Nothing' BAU Model {31_B01}

SCENARIO FINDINGS

The traffic volumes in this scenario have increased considerably over the 2009 model, but the network capacity has remained the same. This increase in traffic has resulted in the following key changes in network performance:

- Traffic volumes on the Illawara Highway between Broughton Avenue and the Princes Highway have increased significantly, with an increase in traffic of around 1,400 vehicles in the AM Peak and 2,100 vehicles in the PM peak. This pushes the LoS from an A to an E/F.
- Traffic on Tongarra Road between Terry Street and the Princes Highway roughly doubles in the AM Peak, with a resulting increase in LoS from A to a maximum of F between Terry Street and Station Road. A similar increase in volumes also occurs in the PM Peak with a resulting increase of LoS up to F.
- The intersection of Illawara Highway, Tongarra Road and Terry Street operates with a LoS of C in the 2009 base scenario. This increases to an F in both the AM and PM peaks in this scenario.
- The intersection of Illawara Highway and the Princes Highway worsens in the PM peak from a LoS B to F.
- The intersection of Princes Highway and Tongarra Road increases from a B to F in the AM Peak.
- Traffic on the Princes Highway increases by around 2,000 vehicles overall during the AM Peak, representing a 30% increase in traffic. The mid-block LoS along Princes Highway shifts from a LoS E to F between the Illawara Highway and Yallah Road.
- Traffic on the Princes Highway increases by a maximum of around 2,500 vehicles during the PM Peak, with a resulting increase in LoS to F along almost the whole stretch between Wollybutt Drive and Mount Brown Road.
- The intersection of the Princes Highway with Huntley Road has to accommodate a significantly greater volume of traffic, and as such experiences an increase in LoS from a D to F in the AM Peak and C to F in the PM Peak.
- The intersection of Tongarra Road and Station Road experiences a worsened LoS during both peaks, from B to F.
- The intersection of the Princes Highway with Cormack Avenue and the Southern Freeway operate at a LoS of F during both the AM and PM Peaks.

Appendix 7B

Network Performance Characteristics - 2031 Base ‘Do Minimum’ BAU Model {31_B02}

Appendix 7B - Network Performance Characteristics - 2031 Base 'Do Minimum' BAU Model
Mid-block Carriageway Performance - AM Peak {31_B02A}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	285	308	593	B	C
Illawarra Highway	North Macquarie Road	Tullimbar Lane	284	280	564	C	C
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	284	279	563	B	C
Illawarra Highway	Yellow Rock Road	Broughton Avenue	244	173	417	B	B
Illawarra Highway	Broughton Avenue	Church Street	410	233	643	A	A
Illawarra Highway	Church Street	Calderwood Road	1,001	387	1,388	D	A
Illawarra Highway	Calderwood Road	Russell Street	993	400	1,393	A	A
Illawarra Highway	Russell Street	Terry Street	1,273	433	1,706	B	A
Illawarra Highway	Terry Street	Tripoli Way	1,618	190	1,808	A	A
Illawarra Highway	Tripoli Way	Princes Highway	816	446	1,262	B	A
Yallah Road	Marshall Mount Road	Princes Highway	209	212	421	B	B
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	89	54	143	A	A
Marshall Mount Road	North Marshall Mount Road	Yallah Road	84	55	139	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	267	235	502	B	B
Marshall Mount Road	Yallah TAFE	Huntley Road	421	204	625	C	B
Calderwood Road	Calderwood valley Golf Club	Marshall Mount Road	17	30	47	A	A
Calderwood Road	Marshall Mount Road	Illawarra Christian School	52	100	152	A	B
Calderwood Road	Illawarra Christian School	North Macquarie Road	54	79	133	A	A
Calderwood Road	CUDP	Mansons Bridge	49	55	104	A	A
Calderwood Road	Mansons Bridge	Illawarra Highway	49	25	74	A	A
North Macquarie Road	Illawarra Highway	Macquarie Rivulet	24	5	29	A	A
North Macquarie Road	Macquarie Rivulet	Calderwood Road	24	5	29	A	A
Huntley Road	Marshall Mount Road	Princes Highway	367	317	684	A	A
Tongarra Road	Terry Street	Stapleton Avenue	741	940	1,681	A	C
Tongarra Road	Stapleton Avenue	Croome Road	634	884	1,518	A	C
Tongarra Road	Croome Road	Station Road	817	564	1,381	B	A
Tongarra Road	Station Road	Ti-Tree Avenue	647	443	1,090	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	618	379	997	A	A
Tongarra Road	Ash Avenue	Princes Highway	835	465	1,300	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	659	1,123	1,782	A	A
Princes Highway	Tongarra Road	Station Road	348	442	790	A	A
Princes Highway	Station Road	Airport Road	558	628	1,186	A	A
Princes Highway	Airport Road	Illawarra Highway	749	712	1,461	A	A
Princes Highway	Illawarra Highway	Yallah Road	1,528	1,121	2,649	A	A
Princes Highway	Yallah Road	Southern Freeway	1,424	903	2,327	A	A
Princes Highway	Southern Freeway	Huntley Road	1,648	568	2,216	F	A
Princes Highway	Huntley Road	Mount Brown Road	1,739	609	2,348	F	A
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	775	775		B
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	2,112	-	2,112	F	
Southern Freeway Ext	Princes Highway	Croome Road	1,850	544	2,394	B	A
Southern Freeway Ext	Croome Road	Tripoli Way	1,419	429	1,848	B	A
Southern Freeway Ext	Tripoli Way	Princes Highway	2,486	1,073	3,559	C	B
Southern Freeway	F6 Extension	Princes Highway	3,910	1,073	4,983	F	B
Southern Freeway	Princes Highway	Fowlers Road	2,023	1,446	3,469	C	B
Tripoli Way	Illawarra Highway (West)	Calderwood Road	136	277	413	A	A
Tripoli Way	Calderwood Road	Illawarra Highway (East)	166	289	455	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	1,016	135	1,151	A	A
Tripoli Way	Southern Freeway	Tongarra Road	144	601	745	A	A

Appendix 7B - Network Performance Characteristics - 2031 Base 'Do Minimum' BAU Model
Mid-block Carriageway Performance - PM Peak {31_B02P}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	275	395	670	B	C
Illawarra Highway	North Macquarie Road	Tullimbar Lane	378	225	603	C	C
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	378	225	603	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	254	73	327	B	A
Illawarra Highway	Broughton Avenue	Church Street	322	168	490	A	A
Illawarra Highway	Church Street	Calderwood Road	659	707	1,366	A	A
Illawarra Highway	Calderwood Road	Russell Street	622	721	1,343	A	A
Illawarra Highway	Russell Street	Terry Street	786	987	1,773	A	A
Illawarra Highway	Terry Street	Tripoli Way	746	646	1,392	A	A
Illawarra Highway	Tripoli Way	Princes Highway	259	1,081	1,340	A	D
Yallah Road	Marshall Mount Road	Princes Highway	689	287	976	D	C
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	59	129	188	A	B
Marshall Mount Road	North Marshall Mount Road	Yallah Road	62	124	186	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	309	774	1,083	B	D
Marshall Mount Road	Yallah TAFE	Huntley Road	164	856	1,020	B	D
Calderwood Road	Calderwood valley Golf Club	Marshall Mount Road	30	17	47	A	A
Calderwood Road	Marshall Mount Road	Illawarra Christian School	141	58	199	B	A
Calderwood Road	Illawarra Christian School	North Macquarie Road	125	70	195	B	A
Calderwood Road	CUDP	Mansons Bridge	75	53	128	B	A
Calderwood Road	Mansons Bridge	Illawarra Highway	37	17	54	A	A
North Macquarie Road	Illawarra Highway	Macquarie Rivulet	17	50	67	A	A
North Macquarie Road	Macquarie Rivulet	Calderwood Road	17	50	67	A	A
Huntley Road	Marshall Mount Road	Princes Highway	235	512	747	A	A
Tongarra Road	Terry Street	Stapleton Avenue	614	1,385	1,999	A	F
Tongarra Road	Stapleton Avenue	Croome Road	936	983	1,919	C	C
Tongarra Road	Croome Road	Station Road	684	886	1,570	A	C
Tongarra Road	Station Road	Ti-Tree Avenue	572	643	1,215	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	523	567	1,090	A	A
Tongarra Road	Ash Avenue	Princes Highway	614	700	1,314	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	795	1,725	2,520	A	B
Princes Highway	Tongarra Road	Station Road	225	1,241	1,466	A	A
Princes Highway	Station Road	Airport Road	426	1,510	1,936	A	A
Princes Highway	Airport Road	Illawarra Highway	652	1,540	2,192	A	A
Princes Highway	Illawarra Highway	Yallah Road	886	2,596	3,482	A	E
Princes Highway	Yallah Road	Southern Freeway	694	1,965	2,659	A	C
Princes Highway	Southern Freeway	Huntley Road	1,341	1,669	3,010	F	F
Princes Highway	Huntley Road	Mount Brown Road	1,234	2,117	3,351	E	F
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	405			A
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	1,475	-	1,475	D	
Southern Freeway Ext	Princes Highway	Croome Road	1,771	1,035	2,806	B	B
Southern Freeway Ext	Croome Road	Tripoli Way	916	1,080	1,996	A	B
Southern Freeway Ext	Tripoli Way	Princes Highway	1,485	2,659	4,144	B	C
Southern Freeway	F6 Extension	Princes Highway	2,179	2,035	4,214	C	C
Southern Freeway	Princes Highway	Fowlers Road	910	2,453	3,363	A	C
Tripoli Way	Illawarra Highway (West)	Calderwood Road	86	598	684	A	A
Tripoli Way	Calderwood Road	Illawarra Highway (East)	120	589	709	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	634	318	952	A	A
Tripoli Way	Southern Freeway	Tongarra Road	145	847	992	A	A

Appendix 7B - Network Performance Characteristics - 2031 Base 'Do Minimum' BAU Model

Intersection Performance {31_B02}

		Scenario 31_B02 AM Peak			Scenario 31_B02 PM Peak		
Intersection	Intersection Control	Degree of Saturation	Delays (s)	LoS	Degree of Saturation	Delays (s)	LoS
Illawarra Hwy/Nth Macquarie Rd	Priority	0.016	15.7	B	0.125	16.3	B
Illawarra Hwy/Tongarra Rd/Terry St	Signals	1.000	38.7	C	>1.000	>120	F
Illawarra Hwy/Princes Hwy	Roundabout	0.439	14.4	A	0.399	13.6	A
Princes Hwy/Tongarra Rd	Signals	0.636	16.8	B	0.593	15.3	B
Calderwood Road/Nth Macquarie Road	Priority	0.027	13.5	A	0.021	13.7	A
Calderwood Road/Marshall Mount Road	Priority	0.030	11.2	A	0.073	11.2	A
Marshall Mount Road/Yallah Road	Priority	0.109	12.6	A	0.539	18.5	B
Huntley Rd/Marshall Mount Rd	Priority	0.494	13.1	A	0.398	19.5	B
Princes Hwy/Huntley Rd	Priority	>1.000	>120	F	>1.000	>120	F
Illawarra Hwy/Calderwood Rd/Macquarie St	Signals	0.642	6.9	A	0.667	7.9	A
Illawarra Hwy/Broughton Ave	Roundabout	0.200	12.0	A	0.158	11.3	A
Tongarra Rd/Station Rd	Priority	0.494	24.9	B	>1.000	>120	F
Yallah Rd/Princes Hwy on-ramp	Priority	0.111	11.2	A	0.709	13.9	A
Yallah Rd/Haywards Bay Dr	Priority	0.423	11.0	A	0.421	13.5	A
Illawarra Hwy/Yellow Rock Rd	Priority	0.010	19.9	B	0.022	16.9	B
Haywards Bay Drive/Princes Highway southbound ramps	Roundabout	0.030	12.6	A	0.185	16.9	B
Princes Highway and Southern Freeway (Tallawarra northbound off-ramp)	Priority	>1.000	>120	F	>1.000	>120	F
Princes Hwy/Cormack Ave	Priority	0.167	53.2	D	>1.000	>120	F
Tripoli Way and Calderwood Road.	Roundabout	0.053	12.6	A	0.056	14.9	B
Illawarra Highway and Tripoli Way.	Signals	>1.000	>120	F	>1.000	97.4	F
Tripoli Way and F6 Extension ramps.	Roundabout	0.031	12.4	A	0.124	12.5	A
Tongarra Road and Tripoli Way.	Signals	0.816	28.7	C	0.883	35.3	C

APPENDIX 7B - Network Performance Characteristics - 2031 Base 'Do Minimum' BAU Model {31_B02}

SCENARIO FINDINGS

The 2031 'Do Nothing' scenario highlighted some of the deficiencies in the existing network, especially around Albion Park and the connections onto the Princes Highway. With the implementation of the 'Do Minimum' upgrades the key network performance changes can be summarized as:

- The mid-block LoS on the Illawara Highway drops to below C on all sections except for between Terry Street and Croome Lane eastbound during the AM Peak, with a LoS of F.
- The peak volume on the Illawara Highway between Russell Street and Terry Street drops by 40% during the AM Peak and 60% during the PM Peak.
- The mid-block LoS on all of Tongarra Road drops to below C in both peaks except for between Terry Street and Stapleton Avenue.
- The peak volume on Tongarra Road between Croome Road and Station Road drops by 42% during the AM Peak and 44% during the PM Peak
- With the introduction of the F6 extension the traffic on the Princes Highway south of Haywards Bay drops by up to 70% during the AM Peak and 60% during the PM Peak
- Traffic on the Princes Highway between the Illawara Highway and Yallah Road drops by 50% in the AM Peak and 75% during the PM Peak
- Traffic volumes southbound on the Princes Highway between Yallah Road and Mount Brown Road actually increase during the PM Peak by 12%.
- With the introduction of the 'Do Minimum' measures the intersection of the Princes Highway and Huntley Road still remains at LoS F.
- The intersection of the Princes Highway and Southern Freeway remains at LoS F in this scenario.
- The intersection of Illawara Highway and Tripoli Way operates at a LoS of F in the AM Peak.
- The modelling indicated there would be minimal traffic demand (less than 20 peak hour movements) for the north facing ramps at the Tallawarra Freeway ramps.
- The section linking the F6 extension to Princes Highway/Southern Freeway is overcapacity in the northbound direction in the AM peak hour and the southbound direction in the PM peak hour. Any mitigating treatment at the intersection would need to be considered as part of the treatment of the F6 extension northern interchange. For example, it may be appropriate to provide three traffic lanes subject to satisfactory resultant merge/diverge area design appropriate for the anticipated volume of traffic and safety considerations. However it has been modelled as two lanes in both directions for the purposes of this assessment.

Appendix 7C

Network Performance Characteristics - 2031 Base ‘Do Minimum’ Mode Shift Model {31_B03}

Appendix 7C - Network Performance Characteristics - 2031 Base 'Do Minimum' Mode Shift Model
Mid-block Carriageway Performance - AM Peak {31_B03A}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	283	308	591	B	C
Illawarra Highway	North Macquarie Road	Tullimbar Lane	289	279	568	C	C
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	289	279	568	B	C
Illawarra Highway	Yellow Rock Road	Broughton Avenue	249	173	422	B	B
Illawarra Highway	Broughton Avenue	Church Street	423	241	664	A	A
Illawarra Highway	Church Street	Calderwood Road	974	381	1,355	C	A
Illawarra Highway	Calderwood Road	Russell Street	966	394	1,360	A	A
Illawarra Highway	Russell Street	Terry Street	1,243	426	1,669	A	A
Illawarra Highway	Terry Street	Tripoli Way	1,618	184	1,802	A	A
Illawarra Highway	Tripoli Way	Princes Highway	811	430	1,241	B	A
Yallah Road	Marshall Mount Road	Princes Highway	178	172	350	B	B
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	84	54	138	A	A
Marshall Mount Road	North Marshall Mount Road	Yallah Road	78	54	132	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	229	211	440	B	B
Marshall Mount Road	Yallah TAFE	Huntley Road	384	199	583	C	B
Calderwood Road	Calderwood valley Golf Club	Marshall Mount Road	17	30	47	A	A
Calderwood Road	Marshall Mount Road	Illawarra Christian School	52	95	147	A	A
Calderwood Road	Illawarra Christian School	North Macquarie Road	52	74	126	A	A
Calderwood Road	CUDP	Mansons Bridge	48	55	103	A	A
Calderwood Road	Mansons Bridge	Illawarra Highway	49	25	74	A	A
North Macquarie Road	Illawarra Highway	Macquarie Rivulet	19	4	23	A	A
North Macquarie Road	Macquarie Rivulet	Calderwood Road	19	4	23	A	A
Huntley Road	Marshall Mount Road	Princes Highway	352	318	670	A	A
Tongarra Road	Terry Street	Stapleton Avenue	718	934	1,652	A	C
Tongarra Road	Stapleton Avenue	Croome Road	626	860	1,486	A	B
Tongarra Road	Croome Road	Station Road	793	556	1,349	B	A
Tongarra Road	Station Road	Ti-Tree Avenue	624	435	1,059	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	595	371	966	A	A
Tongarra Road	Ash Avenue	Princes Highway	814	458	1,272	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	650	1,094	1,744	A	A
Princes Highway	Tongarra Road	Station Road	346	434	780	A	A
Princes Highway	Station Road	Airport Road	555	619	1,174	A	A
Princes Highway	Airport Road	Illawarra Highway	750	698	1,448	A	A
Princes Highway	Illawarra Highway	Yallah Road	1,523	1,091	2,614	A	A
Princes Highway	Yallah Road	Southern Freeway	1,430	884	2,314	A	A
Princes Highway	Southern Freeway	Huntley Road	1,608	584	2,192	F	A
Princes Highway	Huntley Road	Mount Brown Road	1,674	616	2,290	F	A
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	770	770		B
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	2,025	-	2,025	F	
Southern Freeway Ext	Princes Highway	Croome Road	1,819	549	2,368	B	A
Southern Freeway Ext	Croome Road	Tripoli Way	1,390	432	1,822	B	A
Southern Freeway Ext	Tripoli Way	Princes Highway	2,459	1,077	3,536	C	B
Southern Freeway	F6 Extension	Princes Highway	3,889	1,077	4,966	F	B
Southern Freeway	Princes Highway	Fowlers Road	2,080	1,432	3,512	C	B
Tripoli Way	Illawarra Highway (West)	Calderwood Road	129	267	396	A	A
Tripoli Way	Calderwood Road	Illawarra Highway (East)	159	280	439	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	1,016	133	1,149	A	A
Tripoli Way	Southern Freeway	Tongarra Road	144	602	746	A	A

Appendix 7C - Network Performance Characteristics - 2031 Base 'Do Minimum' Mode Shift Model
Mid-block Carriageway Performance - PM Peak {31_B03P}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	276	394	670	C	C
Illawarra Highway	North Macquarie Road	Tullimbar Lane	379	224	603	C	C
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	379	224	603	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	262	74	336	B	A
Illawarra Highway	Broughton Avenue	Church Street	326	166	492	A	A
Illawarra Highway	Church Street	Calderwood Road	636	676	1,312	A	A
Illawarra Highway	Calderwood Road	Russell Street	601	689	1,290	A	A
Illawarra Highway	Russell Street	Terry Street	765	956	1,721	A	A
Illawarra Highway	Terry Street	Tripoli Way	732	645	1,377	A	A
Illawarra Highway	Tripoli Way	Princes Highway	263	1,048	1,311	A	D
Yallah Road	Marshall Mount Road	Princes Highway	711	272	983	D	B
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	57	128	185	A	B
Marshall Mount Road	North Marshall Mount Road	Yallah Road	60	123	183	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	288	790	1,078	B	D
Marshall Mount Road	Yallah TAFE	Huntley Road	144	853	997	B	E
Calderwood Road	Calderwood valley Golf Club	Marshall Mount Road	30	17	47	A	A
Calderwood Road	Marshall Mount Road	Illawarra Christian School	140	56	196	B	A
Calderwood Road	Illawarra Christian School	North Macquarie Road	125	68	193	B	A
Calderwood Road	CUDP	Mansons Bridge	73	53	126	B	A
Calderwood Road	Mansons Bridge	Illawarra Highway	35	17	52	A	A
North Macquarie Road	Illawarra Highway	Macquarie Rivulet	15	52	67	A	A
North Macquarie Road	Macquarie Rivulet	Calderwood Road	15	52	67	A	A
Huntley Road	Marshall Mount Road	Princes Highway	222	485	707	A	A
Tongarra Road	Terry Street	Stapleton Avenue	607	1,356	1,963	A	F
Tongarra Road	Stapleton Avenue	Croome Road	914	967	1,881	C	C
Tongarra Road	Croome Road	Station Road	680	865	1,545	A	B
Tongarra Road	Station Road	Ti-Tree Avenue	563	625	1,188	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	519	550	1,069	A	A
Tongarra Road	Ash Avenue	Princes Highway	610	685	1,295	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	776	1,738	2,514	A	B
Princes Highway	Tongarra Road	Station Road	224	1,261	1,485	A	A
Princes Highway	Station Road	Airport Road	423	1,516	1,939	A	A
Princes Highway	Airport Road	Illawarra Highway	622	1,557	2,179	A	A
Princes Highway	Illawarra Highway	Yallah Road	860	2,580	3,440	A	E
Princes Highway	Yallah Road	Southern Freeway	692	1,941	2,633	A	C
Princes Highway	Southern Freeway	Huntley Road	1,296	1,647	2,943	F	F
Princes Highway	Huntley Road	Mount Brown Road	1,235	1,849	3,084	E	F
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	2,133	2,133		F
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	1,454	-	1,454	D	
Southern Freeway Ext	Princes Highway	Croome Road	1,767	1,071	2,838	B	B
Southern Freeway Ext	Croome Road	Tripoli Way	906	1,079	1,985	A	B
Southern Freeway Ext	Tripoli Way	Princes Highway	1,468	2,024	3,492	B	C
Southern Freeway	F6 Extension	Princes Highway	2,160	2,023	4,183	C	C
Southern Freeway	Princes Highway	Fowlers Road	893	2,354	3,247	A	C
Tripoli Way	Illawarra Highway (West)	Calderwood Road	83	554	637	A	A
Tripoli Way	Calderwood Road	Illawarra Highway (East)	116	549	665	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	631	312	943	A	A
Tripoli Way	Southern Freeway	Tongarra Road	142	842	984	A	A

Appendix 7C - Network Performance Characteristics - 2031 Base 'Do Minimum' Mode Shift Model
Intersection Performance {31_B03}

		Scenario 31_B03 AM Peak			Scenario 31_B03 PM Peak		
Intersection	Intersection Control	Degree of Saturation	Delays (s)	LoS	Degree of Saturation	Delays (s)	LoS
Illawarra Hwy/Nth Macquarie Rd	Priority	0.143	15.3	B	0.111	16.3	B
Illawarra Hwy/Tongarra Rd/Terry St	Signals	1.000	33.0	C	0.770	26.6	B
Illawarra Hwy/Princes Hwy	Roundabout	0.548	15.9	B	0.253	13.5	A
Princes Hwy/Tongarra Rd	Signals	0.590	15.9	B	0.583	14.0	A
Calderwood Road/Nth Macquarie Road	Priority	0.042	13.6	A	0.010	13.8	A
Calderwood Road/Marshall Mount Road	Priority	0.053	11.2	A	0.102	11.2	A
Marshall Mount Road/Yallah Road	Priority	0.074	12.5	A	0.358	11.9	A
Huntley Rd/Marshall Mount Rd	Priority	0.212	10.9	A	0.075	14.3	A
Princes Hwy/Huntley Rd	Priority	>1.000	>120	F	>1.000	>120	F
Illawarra Hwy/Calderwood Rd/Macquarie St	Signals	0.616	7.3	A	0.619	9.3	A
Illawarra Hwy/Broughton Ave	Roundabout	0.128	11.9	A	0.036	11.3	A
Tongarra Rd/Station Rd	Priority	0.426	22.7	B	0.603	21.2	B
Yallah Rd/Princes Hwy on-ramp	Priority	0.016	12.6	A	0.016	9.9	A
Yallah Rd/Haywards Bay Dr	Priority	0.526	11.0	A	0.158	10.6	A
Illawarra Hwy/Yellow Rock Rd	Priority	0.010	19.6	B	0.025	16.4	B
Haywards Bay Drive/Princes Highway southbound ramps	Roundabout	0.019	12.5	A	0.182	16.9	B
Princes Highway and Southern Freeway (Tallawarra northbound off-ramp)	Priority	>1.000	>120	F	>1.000	>120	F
Princes Hwy/Cormack Ave	Priority	>1.000	>120	F	>1.000	>120	F
Tripoli Way and Calderwood Road.	Roundabout	0.062	12.6	A	0.067	14.4	A
Illawarra Highway and Tripoli Way.	Signals	>1.000	>120	F	0.933	38.0	C
Tripoli Way and F6 Extension ramps.	Roundabout	0.006	12.6	A	0.119	13.0	A
Tongarra Road and Tripoli Way.	Signals	0.837	30.8	C	0.652	17.2	B

APPENDIX 7C - Network Performance Characteristics - 2031 Base 'Do Minimum' Mode Shift Model {31_B03}

SCENARIO FINDINGS

A review of the model results highlighted the following notable changes and issues:

- The reduction in traffic resulting from the 10% mode shift applied to the developmental growth is negligible in most areas when compared to the total traffic volumes in the network.
- During the PM Peak the model indicates that 257 vehicles more will travel southbound between Croome Lane and the Princes Highway on the Illawara Highway.
- Similarly, 118 vehicles more will travel westbound on Tongarra Road between Terry Street and Stapleton Avenue.
- On the Princes Highway, between Yallah Road and the Illawara Highway 253 vehicles more travel in the westbound direction during the PM Peak.
- 268 vehicles less travel south on the Southern Freeway between Tripoli Way and the Princes Highway
- 214 vehicles less travel westbound on Tripoli Way between Illawara Highway and the Southern Freeway during the PM Peak.
- The section linking the F6 extension to Princes Highway/Southern Freeway is overcapacity in the northbound direction in the AM peak hour and the southbound direction in the PM peak hour. Any mitigating treatment at the intersection would need to be considered as part of the treatment of the F6 extension northern interchange. For example, it may be appropriate to provide three traffic lanes subject to satisfactory resultant merge/diverge area design appropriate for the anticipated volume of traffic and safety considerations. However it has been modelled as two lanes in both directions for the purposes of this assessment.

Appendix 7D

Network Performance Characteristics - 2031 Base ‘Do Absolute Minimum’ BAU Model {31_B04}

Appendix 7D - Network Performance Characteristics - 2031 Base 'Do Absolute Minimum' BAU Model
Mid-block Carriageway Performance - AM Peak {31_B04A}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	281	309	590	B	C
Illawarra Highway	North Macquarie Road	Tullimbar Lane	293	271	564	C	C
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	293	270	563	B	C
Illawarra Highway	Yellow Rock Road	Broughton Avenue	221	118	339	B	B
Illawarra Highway	Broughton Avenue	Church Street	283	142	425	A	A
Illawarra Highway	Church Street	Calderwood Road	917	313	1,230	C	A
Illawarra Highway	Calderwood Road	Russell Street	925	287	1,212	A	A
Illawarra Highway	Russell Street	Terry Street	1,219	329	1,548	A	A
Illawarra Highway	Terry Street	Tripoli Way	1,586	200	1,786	A	A
Illawarra Highway	Tripoli Way	Princes Highway	1,082	555	1,637	D	A
Yallah Road	Marshall Mount Road	Princes Highway	372	296	668	C	B
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	65	66	131	A	A
Marshall Mount Road	North Marshall Mount Road	Yallah Road	63	65	128	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	275	354	629	B	B
Marshall Mount Road	Yallah TAFE	Huntley Road	91	45	136	B	A
Calderwood Road	Calderwood valley Golf Club	Marshall Mount Road	17	30	47	A	A
Calderwood Road	Marshall Mount Road	Illawarra Christian School	58	70	128	A	A
Calderwood Road	Illawarra Christian School	North Macquarie Road	67	59	126	A	A
Calderwood Road	CUDP	Mansons Bridge	57	43	100	A	A
Calderwood Road	Mansons Bridge	Illawarra Highway	47	71	118	A	A
North Macquarie Road	Illawarra Highway	Macquarie Rivulet	16	10	26	A	A
North Macquarie Road	Macquarie Rivulet	Calderwood Road	16	10	26	A	A
Huntley Road	Marshall Mount Road	Princes Highway	201	181	382	A	A
Tongarra Road	Terry Street	Stapleton Avenue	716	963	1,679	A	C
Tongarra Road	Stapleton Avenue	Croome Road	600	894	1,494	A	C
Tongarra Road	Croome Road	Station Road	782	529	1,311	B	A
Tongarra Road	Station Road	Ti-Tree Avenue	592	405	997	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	568	355	923	A	A
Tongarra Road	Ash Avenue	Princes Highway	742	433	1,175	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	617	1,365	1,982	A	A
Princes Highway	Tongarra Road	Station Road	331	770	1,101	A	A
Princes Highway	Station Road	Airport Road	575	1,000	1,575	A	A
Princes Highway	Airport Road	Illawarra Highway	1,003	1,355	2,358	A	A
Princes Highway	Illawarra Highway	Yallah Road	2,061	1,886	3,947	C	C
Princes Highway	Yallah Road	Southern Freeway	2,094	1,699	3,793	C	B
Princes Highway	Southern Freeway	Huntley Road	1,728	1,069	2,797	F	D
Princes Highway	Huntley Road	Mount Brown Road	1,640	961	2,601	F	C
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	1,737	1,737		F
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	2,132	-	2,132	F	
Southern Freeway Ext	Princes Highway	Croome Road	2,245	857	3,102	C	A
Southern Freeway Ext	Croome Road	Tripoli Way	1,830	693	2,523	B	A
Southern Freeway Ext	Tripoli Way	Princes Highway	2,672	1,447	4,119	C	B
Southern Freeway	F6 Extension	Princes Highway	4,766	1,447	6,213	F	B
Southern Freeway	Princes Highway	Fowlers Road	2,634	1,636	4,270	C	B
Tripoli Way	Illawarra Highway (West)	Calderwood Road	182	331	513	A	A
Tripoli Way	Calderwood Road	Illawarra Highway (East)	234	394	628	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	803	164	967	A	A
Tripoli Way	Southern Freeway	Tongarra Road	156	706	862	A	A

Appendix 7D - Network Performance Characteristics - 2031 Base 'Do Absolute Minimum' BAU Model
Mid-block Carriageway Performance - PM Peak {31_B04P}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	274	395	669	C	C
Illawarra Highway	North Macquarie Road	Tullimbar Lane	376	240	616	C	C
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	376	240	616	C	C
Illawarra Highway	Yellow Rock Road	Broughton Avenue	246	44	290	B	A
Illawarra Highway	Broughton Avenue	Church Street	287	79	366	A	A
Illawarra Highway	Church Street	Calderwood Road	615	583	1,198	A	A
Illawarra Highway	Calderwood Road	Russell Street	590	574	1,164	A	A
Illawarra Highway	Russell Street	Terry Street	717	820	1,537	A	A
Illawarra Highway	Terry Street	Tripoli Way	645	457	1,102	A	A
Illawarra Highway	Tripoli Way	Princes Highway	222	859	1,081	A	B
Yallah Road	Marshall Mount Road	Princes Highway	585	404	989	D	C
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	59	100	159	A	A
Marshall Mount Road	North Marshall Mount Road	Yallah Road	61	92	153	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	394	605	999	C	C
Marshall Mount Road	Yallah TAFE	Huntley Road	1	405	406	A	C
Calderwood Road	Calderwood valley Golf Club	Marshall Mount Road	29	17	46	A	A
Calderwood Road	Marshall Mount Road	Illawarra Christian School	113	60	173	B	A
Calderwood Road	Illawarra Christian School	North Macquarie Road	100	74	174	B	A
Calderwood Road	CUDP	Mansons Bridge	66	55	121	A	A
Calderwood Road	Mansons Bridge	Illawarra Highway	50	32	82	A	A
North Macquarie Road	Illawarra Highway	Macquarie Rivulet	19	34	53	A	A
North Macquarie Road	Macquarie Rivulet	Calderwood Road	19	34	53	A	A
Huntley Road	Marshall Mount Road	Princes Highway	184	323	507	A	A
Tongarra Road	Terry Street	Stapleton Avenue	626	1,367	1,993	A	F
Tongarra Road	Stapleton Avenue	Croome Road	826	939	1,765	B	C
Tongarra Road	Croome Road	Station Road	625	780	1,405	A	B
Tongarra Road	Station Road	Ti-Tree Avenue	512	542	1,054	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	467	467	934	A	A
Tongarra Road	Ash Avenue	Princes Highway	545	590	1,135	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	729	1,626	2,355	A	B
Princes Highway	Tongarra Road	Station Road	265	1,207	1,472	A	A
Princes Highway	Station Road	Airport Road	462	1,470	1,932	A	A
Princes Highway	Airport Road	Illawarra Highway	577	1,483	2,060	A	A
Princes Highway	Illawarra Highway	Yallah Road	774	2,316	3,090	A	D
Princes Highway	Yallah Road	Southern Freeway	633	1,960	2,593	A	C
Princes Highway	Southern Freeway	Huntley Road	1,350	1,843	3,193	F	F
Princes Highway	Huntley Road	Mount Brown Road	1,148	1,780	2,928	E	F
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	2,460			F
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	1,507	-	1,507	D	
Southern Freeway Ext	Princes Highway	Croome Road	1,712	1,047	2,759	B	B
Southern Freeway Ext	Croome Road	Tripoli Way	954	1,068	2,022	B	B
Southern Freeway Ext	Tripoli Way	Princes Highway	1,508	2,220	3,728	B	C
Southern Freeway	F6 Extension	Princes Highway	2,141	2,219	4,360	C	C
Southern Freeway	Princes Highway	Fowlers Road	634	2,115	2,749	A	C
Tripoli Way	Illawarra Highway (West)	Calderwood Road	103	701	804	A	A
Tripoli Way	Calderwood Road	Illawarra Highway (East)	155	724	879	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	600	484	1,084	A	A
Tripoli Way	Southern Freeway	Tongarra Road	210	924	1,134	A	A

Appendix 7D - Network Performance Characteristics - 2031 Base 'Do Absolute Minimum' BAU Model

Intersection Performance {31_B04}

		Scenario 31_B04 AM Peak			Scenario 31_B04 PM Peak		
Intersection	Intersection Control	Degree of Saturation	Delays (s)	LoS	Degree of Saturation	Delays (s)	LoS
Illawarra Hwy/Nth Macquarie Rd	Priority	0.143	15.3	B	0.133	16.4	B
Illawarra Hwy/Tongarra Rd/Terry St	Signals	1.000	32.7	C	>1.000	47.6	D
Illawarra Hwy/Princes Hwy	Roundabout	0.667	17.8	B	0.320	13.6	A
Princes Hwy/Tongarra Rd	Signals	0.566	15.8	B	0.580	15.1	B
Calderwood Road/Nth Macquarie Road	Priority	0.020	13.5	A	0.023	13.6	A
Calderwood Road/Marshall Mount Road	Priority	0.037	11.2	A	0.057	11.2	A
Marshall Mount Road/Yallah Road	Priority	0.218	14.4	A	0.418	19.2	B
Huntley Rd/Marshall Mount Rd	Priority	0.098	10.8	A	0.013	17.5	B
Princes Hwy/Huntley Rd	Priority	>1.000	>120	F	>1.000	>120	F
Illawarra Hwy/Calderwood Rd/Macquarie St	Signals	0.571	10.7	A	0.778	11.7	A
Illawarra Hwy/Broughton Ave	Roundabout	0.060	11.7	A	0.182	11.4	A
Tongarra Rd/Station Rd	Priority	0.438	22.4	B	0.813	35.6	C
Yallah Rd/Princes Hwy on-ramp	Priority	0.367	14.3	A	0.552	12.5	A
Yallah Rd/Haywards Bay Dr	Priority	0.669	16.3	B	0.470	14.6	B
Illawarra Hwy/Yellow Rock Rd	Priority	0.010	19.9	B	0.023	16.9	B
Haywards Bay Drive/Princes Highway southbound ramps	Roundabout	0.142	12.8	A	0.286	15.5	B
Princes Highway and Southern Freeway (Tallawarra northbound off-ramp)	Priority	>1.000	>120	F	>1.000	>120	F
Princes Hwy/Cormack Ave	Priority	>1.000	>120	F	>1.000	>120	F
Tripoli Way and Calderwood Road.	Roundabout	0.051	12.9	A	0.075	15.8	B
Illawarra Highway and Tripoli Way.	Signals	>1.000	>120	F	>1.000	>120	F
Tripoli Way and F6 Extension ramps.	Roundabout	0.006	12.6	A	0.119	13.0	A
Tongarra Road and Tripoli Way.	Signals	0.866	29.7	C	0.902	37.2	C

APPENDIX 7D - Network Performance Characteristics - 2031 Base 'Do Absolute Minimum' BAU Model {31_B04}

SCENARIO FINDINGS

After review of the implementation of the 'do absolute minimum' upgrades the key network performance changes can be summarized by describing the results of the mid-block assessments as follows:

- Tongarra Road between Terry Street and Stapleton Avenue in the westbound direction operates at LoS F during the PM peak carrying about 1,350 vehicles. It was determined during this model run of the appropriateness of complimentary measures implemented along Illawarra Highway to ensure maximum utilisation of Tripoli Way (Albion Park Bypass) by through traffic to provide relief to the bypassed section of Tongarra Road/Illawarra Highway.
- Princes Highway between Southern Freeway and Mount Brown Road is Los F in the northbound direction during the AM peak and LoS E/F during the PM peak. The southbound direction is LoS F in the PM peak.
- The section linking the F6 extension to Princes Highway/Southern Freeway is overcapacity in the northbound direction in the AM peak hour and the southbound direction in the PM peak hour. Any mitigating treatment at the intersection would need to be considered as part of the treatment of the F6 extension northern interchange. For example, it may be appropriate to provide three traffic lanes subject to satisfactory resultant merge/diverge area design appropriate for the anticipated volume of traffic and safety considerations. However it has been modelled as two lanes in either direction for the purposes of this assessment.
- All other road sections indicate satisfactory mid-block performance during the modelled peak hour periods.

Appendix 7E

Network Performance Characteristics - 2031 Base ‘Do Base Upgrades’ BAU Model {31_B05}

Appendix 7E - Network Performance Characteristics - 2031 Base 'Do Base Upgrades' BAU Model
Mid-block Carriageway Performance - AM Peak {31_B05A}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	285	309	594	B	C
Illawarra Highway	North Macquarie Road	Tullimbar Lane	305	281	586	C	C
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	304	281	585	B	C
Illawarra Highway	Yellow Rock Road	Broughton Avenue	87	157	244	A	B
Illawarra Highway	Broughton Avenue	Church Street	125	180	305	A	A
Illawarra Highway	Church Street	Calderwood Road	366	291	657	A	A
Illawarra Highway	Calderwood Road	Russell Street	483	195	678	A	A
Illawarra Highway	Russell Street	Terry Street	728	243	971	A	A
Illawarra Highway	Terry Street	Tripoli Way	1,139	170	1,309	A	A
Illawarra Highway	Tripoli Way	Princes Highway	848	368	1,216	B	A
Yallah Road	Marshall Mount Road	Princes Highway	183	162	345	B	B
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	65	73	138	A	A
Marshall Mount Road	North Marshall Mount Road	Yallah Road	50	41	91	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	175	187	362	A	A
Marshall Mount Road	Yallah TAFE	Huntley Road	341	181	522	A	A
Calderwood Road	Calderwood valley Golf Club	Marshall Mount Road	17	29	46	A	A
Calderwood Road	Marshall Mount Road	Illawarra Christian School	73	77	150	A	A
Calderwood Road	Illawarra Christian School	North Macquarie Road	74	59	133	A	A
Calderwood Road	CUDP	Mansons Bridge	70	55	125	B	A
Calderwood Road	Mansons Bridge	Illawarra Highway	51	119	170	A	A
North Macquarie Road	Illawarra Highway	Macquarie Rivulet	4	4	8	A	A
North Macquarie Road	Macquarie Rivulet	Calderwood Road	4	4	8	A	A
Huntley Road	Marshall Mount Road	Princes Highway	341	333	674	A	A
Tongarra Road	Terry Street	Stapleton Avenue	719	789	1,508	A	B
Tongarra Road	Stapleton Avenue	Croome Road	513	864	1,377	A	B
Tongarra Road	Croome Road	Station Road	795	463	1,258	B	A
Tongarra Road	Station Road	Ti-Tree Avenue	626	333	959	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	599	278	877	A	A
Tongarra Road	Ash Avenue	Princes Highway	836	373	1,209	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	572	1,093	1,665	A	A
Princes Highway	Tongarra Road	Station Road	346	404	750	A	A
Princes Highway	Station Road	Airport Road	547	590	1,137	A	A
Princes Highway	Airport Road	Illawarra Highway	732	658	1,390	A	A
Princes Highway	Illawarra Highway	Yallah Road	1,547	994	2,541	A	A
Princes Highway	Yallah Road	Southern Freeway	1,494	813	2,307	A	A
Princes Highway	Southern Freeway	Huntley Road	1,912	264	2,176	C	A
Princes Highway	Huntley Road	Mount Brown Road	1,993	337	2,330	C	A
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	742	742		A
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	2,212	-	2,212	C	
Southern Freeway Ext	Princes Highway	Croome Road	2,001	537	2,538	C	A
Southern Freeway Ext	Croome Road	Tripoli Way	1,532	452	1,984	B	A
Southern Freeway Ext	Tripoli Way	Princes Highway	2,448	1,047	3,495	C	B
Southern Freeway	F6 Extension	Princes Highway	3,943	1,047	4,990	F	B
Southern Freeway	Princes Highway	Fowlers Road	1,731	1,290	3,021	B	B
Tripoli Way	Illawarra Highway (West)	Calderwood Road	619	302	921	A	A
Tripoli Way	Calderwood Road	Illawarra Highway (East)	665	392	1,057	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	1,010	217	1,227	A	A
Tripoli Way	Southern Freeway	Tongarra Road	126	597	723	A	A

Appendix 7E - Network Performance Characteristics - 2031 Base 'Do Base Upgrades' BAU Model
Mid-block Carriageway Performance - PM Peak {31_B05P}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	273	392	665	B	C
Illawarra Highway	North Macquarie Road	Tullimbar Lane	369	201	570	C	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	370	201	571	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	170	40	210	B	A
Illawarra Highway	Broughton Avenue	Church Street	193	67	260	A	A
Illawarra Highway	Church Street	Calderwood Road	348	403	751	A	A
Illawarra Highway	Calderwood Road	Russell Street	326	382	708	A	A
Illawarra Highway	Russell Street	Terry Street	458	545	1,003	A	A
Illawarra Highway	Terry Street	Tripoli Way	384	916	1,300	A	A
Illawarra Highway	Tripoli Way	Princes Highway	225	224	449	A	A
Yallah Road	Marshall Mount Road	Princes Highway	331	212	543	C	B
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	77	173	250	A	A
Marshall Mount Road	North Marshall Mount Road	Yallah Road	36	131	167	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	210	424	634	A	A
Marshall Mount Road	Yallah TAFE	Huntley Road	162	598	760	A	A
Calderwood Road	Calderwood valley Golf Club	Marshall Mount Road	29	17	46	A	A
Calderwood Road	Marshall Mount Road	Illawarra Christian School	186	78	264	B	A
Calderwood Road	Illawarra Christian School	North Macquarie Road	174	90	264	B	A
Calderwood Road	CUDP	Mansons Bridge	102	67	169	B	B
Calderwood Road	Mansons Bridge	Illawarra Highway	47	50	97	A	A
North Macquarie Road	Illawarra Highway	Macquarie Rivulet	23	72	95	A	A
North Macquarie Road	Macquarie Rivulet	Calderwood Road	23	72	95	A	A
Huntley Road	Marshall Mount Road	Princes Highway	237	474	711	A	A
Tongarra Road	Terry Street	Stapleton Avenue	577	650	1,227	A	A
Tongarra Road	Stapleton Avenue	Croome Road	664	861	1,525	A	B
Tongarra Road	Croome Road	Station Road	615	631	1,246	A	A
Tongarra Road	Station Road	Ti-Tree Avenue	511	381	892	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	459	316	775	A	A
Tongarra Road	Ash Avenue	Princes Highway	549	453	1,002	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	587	1,626	2,213	A	B
Princes Highway	Tongarra Road	Station Road	256	1,199	1,455	A	A
Princes Highway	Station Road	Airport Road	441	1,482	1,923	A	A
Princes Highway	Airport Road	Illawarra Highway	575	1,621	2,196	A	B
Princes Highway	Illawarra Highway	Yallah Road	776	1,822	2,598	A	B
Princes Highway	Yallah Road	Southern Freeway	571	1,489	2,060	A	A
Princes Highway	Southern Freeway	Huntley Road	828	1,640	2,468	A	B
Princes Highway	Huntley Road	Mount Brown Road	765	1,814	2,579	A	B
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	2,398	2,398		C
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	1,336	-	1,336	B	
Southern Freeway Ext	Princes Highway	Croome Road	1,915	997	2,912	C	B
Southern Freeway Ext	Croome Road	Tripoli Way	1,078	981	2,059	B	B
Southern Freeway Ext	Tripoli Way	Princes Highway	1,381	2,556	3,937	B	C
Southern Freeway	F6 Extension	Princes Highway	1,952	2,556	4,508	C	C
Southern Freeway	Princes Highway	Fowlers Road	616	1,996	2,612	A	C
Tripoli Way	Illawarra Highway (West)	Calderwood Road	302	770	1,072	A	A
Tripoli Way	Calderwood Road	Illawarra Highway (East)	337	774	1,111	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	570	1,729	2,299	A	B
Tripoli Way	Southern Freeway	Tongarra Road	189	303	492	A	A

Appendix 7E - Network Performance Characteristics - 2031 Base 'Do Base Upgrades' BAU Model
Intersection Performance {31_B05}

		Scenario 31_B05 AM Peak			Scenario 31_B05 PM Peak		
Intersection	Intersection Control	Degree of Saturation	Delays (s)	LoS	Degree of Saturation	Delays (s)	LoS
Illawarra Hwy/Nth Macquarie Rd	Priority	0.015	16.0	B	0.111	16.2	B
Illawarra Hwy/Tongarra Rd/Terry St	Signals	0.851	31.3	C	0.909	34.3	C
Illawarra Hwy/Princes Hwy	Roundabout	0.452	14.5	A	0.089	13.5	A
Princes Hwy/Tongarra Rd	Signals	0.642	17.5	B	0.635	15.3	B
Calderwood Road/Nth Macquarie Road	Priority	0.011	13.8	A	0.028	13.8	A
Calderwood Road/Marshall Mount Road	Priority	0.041	11.2	A	0.097	11.2	A
Marshall Mount Road/Yallah Road	Priority	0.122	12.5	A	0.041	12.4	A
Huntley Rd/Marshall Mount Rd	Priority	0.423	13.0	A	0.285	14.9	B
Princes Hwy/Huntley Rd	Signals	1.000	22.1	B	1.000	13.7	A
Illawarra Hwy/Calderwood Rd/Macquarie St	Signals	0.517	13.6	A	0.310	8.8	A
Illawarra Hwy/Broughton Ave	Roundabout	0.400	14.3	A	0.125	16.8	B
Tongarra Rd/Station Rd	Priority	0.442	21.2	B	0.694	24.1	B
Yallah Rd/Princes Hwy on-ramp	Priority	0.114	11.3	A	0.046	10.2	A
Yallah Rd/Haywards Bay Dr	Priority	0.403	10.9	A	0.315	10.4	A
Illawarra Hwy/Yellow Rock Rd	Priority	0.005	20.3	B	0.019	18.7	B
Haywards Bay Drive/Princes Highway southbound ramps	Roundabout	0.046	12.5	A	0.102	13.7	A
Princes Highway and Southern Freeway (Tallawarra northbound off-ramp)	Signals	0.674	14.4	A	0.851	27.7	B
Princes Hwy/Cormack Ave	Signals	0.532	22.9	B	0.881	44.8	D
Tripoli Way and Calderwood Road.	Roundabout	0.096	15.1	B	0.076	16.5	B
Illawarra Highway and Tripoli Way.	Signals	1.000	36.7	C	0.606	21.3	B
Tripoli Way and F6 Extension ramps.	Roundabout	0.072	12.4	A	0.183	15.0	B
Tongarra Road and Tripoli Way.	Signals	0.823	28.0	B	0.555	15.7	B

APPENDIX 7E - Network Performance Characteristics - 2031 Base 'Do Base Upgrades' BAU Model {31_B05}

SCENARIO FINDINGS

A review of the model results highlighted the following notable changes and issues:

- During the morning and evening peak hour the road links which comprise the study area all operate at satisfactory LoS (C or better).
- However as identified above the section linking the F6 extension to Princes Highway/Southern Freeway is overcapacity in the northbound direction in the AM peak hour and the southbound direction in the PM peak hour. Any mitigating treatment at the intersection would need to be considered as part of the treatment of the F6 extension northern interchange. For example, it may be appropriate to provide three traffic lanes subject to satisfactory resultant merge/diverge area design appropriate for the anticipated volume of traffic and safety considerations. However it has been modelled as two lanes in both directions for the purposes of this assessment.

Appendix 7F

Network Performance Characteristics – 2031 CUDP ‘Do Nothing’ BAU Model {31_D01}

Appendix 7F - Network Performance Characteristics – 2031 CUDP 'Do Nothing' BAU Model
Mid-block Carriageway Performance - AM Peak {31_D01A}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	309	282	591	B	B
Illawarra Highway	North Macquarie Road	Tullimbar Lane	308	261	569	B	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	435	272	707	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	636	546	1,182	C	C
Illawarra Highway	Broughton Avenue	Church Street	947	728	1,675	C	A
Illawarra Highway	Church Street	Calderwood Road	1,222	752	1,974	E	A
Illawarra Highway	Calderwood Road	Russell Street	1,488	1,059	2,547	C	A
Illawarra Highway	Russell Street	Terry Street	1,702	1,050	2,752	D	A
Illawarra Highway	Terry Street	Croome Lane	1,534	994	2,528	F	C
Illawarra Highway	Croome Lane	Princes Highway	1,598	1,252	2,850	F	E
Yallah Road	Marshall Mount Road	Princes Highway	757	713	1,470	D	D
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	869	574	1,443	D	C
Marshall Mount Road	North Marshall Mount Road	Yallah Road	783	471	1,254	D	C
Marshall Mount Road	Yallah Road	Yallah TAFE	634	366	1,000	C	B
Marshall Mount Road	Yallah TAFE	Huntley Road	499	131	630	C	B
Calderwood Road	CUDP	Mansons Bridge	584	466	1,050	C	C
Calderwood Road	Mansons Bridge	Illawarra Highway	402	403	805	A	A
Huntley Road	Marshall Mount Road	Princes Highway	223	162	385	A	A
Tongarra Road	Terry Street	Stapleton Avenue	1,200	710	1,910	E	A
Tongarra Road	Stapleton Avenue	Croome Road	1,200	710	1,910	E	A
Tongarra Road	Croome Road	Station Road	1,219	846	2,065	E	B
Tongarra Road	Station Road	Ti-Tree Avenue	1,012	626	1,638	D	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	1,000	577	1,577	D	A
Tongarra Road	Ash Avenue	Princes Highway	1,303	765	2,068	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	2,892	2,799	5,691	F	F
Princes Highway	Tongarra Road	Station Road	2,604	1,973	4,577	E	C
Princes Highway	Station Road	Airport Road	2,854	2,265	5,119	F	D
Princes Highway	Airport Road	Illawarra Highway	3,103	2,526	5,629	F	E
Princes Highway	Illawarra Highway	Yallah Road	4,693	3,769	8,462	F	F
Princes Highway	Yallah Road	Southern Freeway	5,029	4,002	9,031	F	F
Princes Highway	Southern Freeway	Huntley Road	1,759	1,426	3,185	F	F
Princes Highway	Huntley Road	Mount Brown Road	1,737	1,343	3,080	F	F
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	2,130	2,130		F
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	2,167	-	2,167	F	
Southern Freeway	Princes Highway	Fowlers Road	2,861	2,020	4,881	D	C
North South Arterial	Section 1		572	655	1,227	A	A
North South Arterial	Section 2		482	494	976	A	A
North South Arterial	Section 3		482	494	976	A	A
North South Arterial	Section 4		433	338	771	A	A
North South Arterial	Section 5		459	303	762	A	A
North South Arterial	Section 6		372	161	533	A	A
North South Arterial	Section 7		492	199	691	A	A
North South Arterial	Section 8		524	273	797	A	A
North South Arterial	Section 9		567	295	862	A	A
North South Arterial	Section 10		656	499	1,155	A	A
North South Arterial	Section 11		646	445	1,091	A	A
North South Arterial	Section 12		634	411	1,045	A	A

Appendix 7F - Network Performance Characteristics – 2031 CUDP 'Do Nothing' BAU Model
Mid-block Carriageway Performance - PM Peak {31_D01P}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	396	274	670	C	B
Illawarra Highway	North Macquarie Road	Tullimbar Lane	366	267	633	C	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	450	283	733	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	546	617	1,163	C	C
Illawarra Highway	Broughton Avenue	Church Street	725	996	1,721	A	C
Illawarra Highway	Church Street	Calderwood Road	710	1,270	1,980	A	F
Illawarra Highway	Calderwood Road	Russell Street	944	1,500	2,444	A	C
Illawarra Highway	Russell Street	Terry Street	946	1,544	2,490	A	C
Illawarra Highway	Terry Street	Croome Lane	620	1,405	2,025	A	F
Illawarra Highway	Croome Lane	Princes Highway	707	1,676	2,383	A	F
Yallah Road	Marshall Mount Road	Princes Highway	568	669	1,237	C	D
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	383	768	1,151	C	C
Marshall Mount Road	North Marshall Mount Road	Yallah Road	283	658	941	B	C
Marshall Mount Road	Yallah Road	Yallah TAFE	323	598	921	B	C
Marshall Mount Road	Yallah TAFE	Huntley Road	12	474	486	A	D
Calderwood Road	CUDP	Mansons Bridge	593	561	1,154	C	C
Calderwood Road	Mansons Bridge	Illawarra Highway	411	527	938	A	A
Huntley Road	Marshall Mount Road	Princes Highway	179	439	618	A	A
Tongarra Road	Terry Street	Stapleton Avenue	855	1,297	2,152	B	F
Tongarra Road	Stapleton Avenue	Croome Road	855	1,297	2,152	B	F
Tongarra Road	Croome Road	Station Road	997	1,427	2,424	C	F
Tongarra Road	Station Road	Ti-Tree Avenue	850	1,182	2,032	B	E
Tongarra Road	Ti-Tree Avenue	Ash Avenue	827	1,122	1,949	B	D
Tongarra Road	Ash Avenue	Princes Highway	962	1,369	2,331	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	2,129	3,031	5,160	C	F
Princes Highway	Tongarra Road	Station Road	1,103	2,412	3,515	A	E
Princes Highway	Station Road	Airport Road	1,279	2,606	3,885	A	E
Princes Highway	Airport Road	Illawarra Highway	1,319	2,514	3,833	A	E
Princes Highway	Illawarra Highway	Yallah Road	1,988	4,152	6,140	C	F
Princes Highway	Yallah Road	Southern Freeway	2,087	4,453	6,540	C	F
Princes Highway	Southern Freeway	Huntley Road	1,168	1,763	2,931	E	F
Princes Highway	Huntley Road	Mount Brown Road	972	1,827	2,799	C	F
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	2,372	2,372		F
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	1,319	-	1,319	D	
Southern Freeway	Princes Highway	Fowlers Road	769	2,326	3,095	A	C
North South Arterial	Section 1		771	768	1,539	A	A
North South Arterial	Section 2		551	653	1,204	A	A
North South Arterial	Section 3		551	653	1,204	A	A
North South Arterial	Section 4		380	522	902	A	A
North South Arterial	Section 5		334	520	854	A	A
North South Arterial	Section 6		183	315	498	A	A
North South Arterial	Section 7		242	322	564	A	A
North South Arterial	Section 8		281	388	669	A	A
North South Arterial	Section 9		304	429	733	A	A
North South Arterial	Section 10		349	509	858	A	A
North South Arterial	Section 11		289	495	784	A	A
North South Arterial	Section 12		254	480	734	A	A

Appendix 7F - Network Performance Characteristics - 2031 CUDP 'Do Nothing' BAU Model
Intersection Performance {31_D01}

		Scenario 31_D01 AM Peak			Scenario 31_D01 PM Peak		
Intersection	Intersection Control	Degree of Saturation	Delays (s)	LoS	Degree of Saturation	Delays (s)	LoS
Illawarra Hwy/Nth Macquarie Rd	Priority	0.143	15.3	B	0.143	16.5	B
Illawarra Hwy/Tongarra Rd/Terry St	Signals	>1.000	>120	F	>1.000	>120	F
Illawarra Hwy/Princes Hwy	Roundabout	>1.000	>120	F	>1.000	>120	F
Princes Hwy/Tongarra Rd	Signals	>1.000	>120	F	0.927	35.0	C
Marshall Mount Road/Yallah Road	Priority	>1.000	>120	F	0.978	63.3	E
Huntley Rd/Marshall Mount Rd	Priority	0.498	11.3	A	0.026	13.6	A
Princes Hwy/Huntley Rd	Priority	>1.000	>120	F	>1.000	>120	F
Illawarra Hwy/Calderwood Rd/Macquarie St	Signals	>1.000	28.2	B	1.000	27.7	B
Illawarra Hwy/Broughton Ave	Roundabout	0.129	18.4	B	0.258	15.7	B
Tongarra Rd/Station Rd	Priority	>1.000	>120	F	>1.000	>120	F
Yallah Rd/Princes Hwy on-ramp	Priority	0.889	34.3	C	0.674	16.3	B
Yallah Rd/Haywards Bay Dr	Priority	>1.000	>120	F	0.637	22.5	B
Illawarra Hwy/Yellow Rock Rd	Priority	0.118	22.0	B	>1.000	>120	F
Haywards Bay Drive/Princes Highway southbound ramps	Roundabout	0.483	13.3	A	0.664	16.6	B
Princes Highway and Southern Freeway (Tallawarra northbound off-ramp)	Priority	>1.000	>120	F	>1.000	>120	F
Princes Hwy/Cormack Ave	Priority	>1.000	>120	F	>1.000	>120	F

APPENDIX 7F - Network Performance Characteristics - 2031 CUDP 'DO NOTHING' BAU SCENARIO {31_D01}

SCENARIO FINDINGS

A review of the model results highlighted the following road sections to be overcapacity (LoS E or worse):

- Illawarra Highway sections between Church Street and Calderwood Road and Terry Street and Princes Highway.
- Yallah Road between Marshall Mount Road and Princes Highway.
- Tongarra Road between Terry Street and Station Road.
- Princes Highway between Woollybutt Drive and Southern Freeway and Southern Freeway to Mount Brown Road.
- Southern Freeway northbound off-ramp to Princes Highway
- Southern Freeway southbound on-ramp from Princes Highway
- Southern Freeway between Princes Highway and Fowlers Road.

Appendix 7G

Network Performance Characteristics – 2031 CUDP ‘Do Nothing’ Mode Shift Model {31_D02}

Appendix 7G - Network Performance Characteristics – 2031 CUDP 'Do Nothing' Mode Shift Model
Mid-block Carriageway Performance - AM Peak {31_D02A}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	308	281	589	B	B
Illawarra Highway	North Macquarie Road	Tullimbar Lane	308	261	569	B	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	434	272	706	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	598	532	1,130	C	C
Illawarra Highway	Broughton Avenue	Church Street	908	713	1,621	C	A
Illawarra Highway	Church Street	Calderwood Road	1,193	749	1,942	E	A
Illawarra Highway	Calderwood Road	Russell Street	1,452	1,049	2,501	B	A
Illawarra Highway	Russell Street	Terry Street	1,642	1,047	2,689	C	A
Illawarra Highway	Terry Street	Croome Lane	1,527	1,001	2,528	F	D
Illawarra Highway	Croome Lane	Princes Highway	1,598	1,259	2,857	F	E
Yallah Road	Marshall Mount Road	Princes Highway	722	705	1,427	D	D
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	813	562	1,375	D	C
Marshall Mount Road	North Marshall Mount Road	Yallah Road	731	460	1,191	C	C
Marshall Mount Road	Yallah Road	Yallah TAFE	620	366	986	C	B
Marshall Mount Road	Yallah TAFE	Huntley Road	482	130	612	C	B
Calderwood Road	CUDP	Mansons Bridge	573	444	1,017	C	C
Calderwood Road	Mansons Bridge	Illawarra Highway	394	392	786	A	A
Huntley Road	Marshall Mount Road	Princes Highway	216	161	377	A	A
Tongarra Road	Terry Street	Stapleton Avenue	1,177	704	1,881	E	A
Tongarra Road	Stapleton Avenue	Croome Road	1,177	704	1,881	E	A
Tongarra Road	Croome Road	Station Road	1,188	842	2,030	E	B
Tongarra Road	Station Road	Ti-Tree Avenue	983	622	1,605	C	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	970	573	1,543	C	A
Tongarra Road	Ash Avenue	Princes Highway	1,277	756	2,033	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	2,902	2,772	5,674	F	F
Princes Highway	Tongarra Road	Station Road	2,617	1,966	4,583	E	C
Princes Highway	Station Road	Airport Road	2,866	2,261	5,127	F	D
Princes Highway	Airport Road	Illawarra Highway	3,118	2,528	5,646	F	E
Princes Highway	Illawarra Highway	Yallah Road	4,707	3,779	8,486	F	F
Princes Highway	Yallah Road	Southern Freeway	5,013	4,007	9,020	F	F
Princes Highway	Southern Freeway	Huntley Road	1,755	1,428	3,183	F	F
Princes Highway	Huntley Road	Mount Brown Road	1,727	1,345	3,072	F	F
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	2,133	2,133		F
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	2,156	-	2,156	F	
Southern Freeway	Princes Highway	Fowlers Road	2,857	2,022	4,879	D	C
North South Arterial	Section 1		552	608	1,160	A	A
North South Arterial	Section 2		461	457	918	A	A
North South Arterial	Section 3		461	457	918	A	A
North South Arterial	Section 4		415	313	728	A	A
North South Arterial	Section 5		437	284	721	A	A
North South Arterial	Section 6		349	149	498	A	A
North South Arterial	Section 7		456	187	643	A	A
North South Arterial	Section 8		491	256	747	A	A
North South Arterial	Section 9		525	276	801	A	A
North South Arterial	Section 10		618	487	1,105	A	A
North South Arterial	Section 11		609	439	1,048	A	A
North South Arterial	Section 12		598	407	1,005	A	A

Appendix 7G - Network Performance Characteristics – 2031 CUDP 'Do Nothing' Mode Shift Model
Mid-block Carriageway Performance - PM Peak {31_D02P}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	396	274	670	C	B
Illawarra Highway	North Macquarie Road	Tullimbar Lane	366	267	633	C	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	450	283	733	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	546	617	1,163	C	C
Illawarra Highway	Broughton Avenue	Church Street	725	996	1,721	A	C
Illawarra Highway	Church Street	Calderwood Road	710	1,270	1,980	A	F
Illawarra Highway	Calderwood Road	Russell Street	944	1,500	2,444	A	C
Illawarra Highway	Russell Street	Terry Street	946	1,544	2,490	A	C
Illawarra Highway	Terry Street	Croome Lane	620	1,405	2,025	A	F
Illawarra Highway	Croome Lane	Princes Highway	707	1,676	2,383	A	F
Yallah Road	Marshall Mount Road	Princes Highway	568	669	1,237	C	D
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	383	768	1,151	C	C
Marshall Mount Road	North Marshall Mount Road	Yallah Road	283	658	941	B	C
Marshall Mount Road	Yallah Road	Yallah TAFE	323	598	921	B	C
Marshall Mount Road	Yallah TAFE	Huntley Road	12	474	486	A	D
Calderwood Road	CUDP	Mansons Bridge	593	561	1,154	C	C
Calderwood Road	Mansons Bridge	Illawarra Highway	411	527	938	A	A
Huntley Road	Marshall Mount Road	Princes Highway	179	439	618	A	A
Tongarra Road	Terry Street	Stapleton Avenue	855	1,297	2,152	B	F
Tongarra Road	Stapleton Avenue	Croome Road	855	1,297	2,152	B	F
Tongarra Road	Croome Road	Station Road	997	1,427	2,424	C	F
Tongarra Road	Station Road	Ti-Tree Avenue	850	1,182	2,032	B	E
Tongarra Road	Ti-Tree Avenue	Ash Avenue	827	1,122	1,949	B	D
Tongarra Road	Ash Avenue	Princes Highway	962	1,369	2,331	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	2,129	3,031	5,160	C	F
Princes Highway	Tongarra Road	Station Road	1,103	2,412	3,515	A	E
Princes Highway	Station Road	Airport Road	1,279	2,606	3,885	A	E
Princes Highway	Airport Road	Illawarra Highway	1,319	2,514	3,833	A	E
Princes Highway	Illawarra Highway	Yallah Road	1,988	4,152	6,140	C	F
Princes Highway	Yallah Road	Southern Freeway	2,087	4,453	6,540	C	F
Princes Highway	Southern Freeway	Huntley Road	1,168	1,763	2,931	E	F
Princes Highway	Huntley Road	Mount Brown Road	972	1,827	2,799	C	F
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	2,372	2,372		F
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	1,319	-	1,319	D	
Southern Freeway	Princes Highway	Fowlers Road	769	2,326	3,095	A	C
North South Arterial	Section 1		771	768	1,539	A	A
North South Arterial	Section 2		551	653	1,204	A	A
North South Arterial	Section 3		551	653	1,204	A	A
North South Arterial	Section 4		380	522	902	A	A
North South Arterial	Section 5		334	520	854	A	A
North South Arterial	Section 6		183	315	498	A	A
North South Arterial	Section 7		242	322	564	A	A
North South Arterial	Section 8		281	388	669	A	A
North South Arterial	Section 9		304	429	733	A	A
North South Arterial	Section 10		349	509	858	A	A
North South Arterial	Section 11		289	495	784	A	A
North South Arterial	Section 12		254	480	734	A	A

Appendix 7G - Network Performance Characteristics - 2031 CUDP 'Do Nothing' Mode Shift Model
Intersection Performance {31_D02}

		Scenario 31_D02 AM Peak			Scenario 31_D02 PM Peak		
Intersection	Intersection Control	Degree of Saturation	Delays (s)	LoS	Degree of Saturation	Delays (s)	LoS
Illawarra Hwy/Nth Macquarie Rd	Priority	0.143	15.3	B	0.021	16.4	B
Illawarra Hwy/Tongarra Rd/Terry St	Signals	>1.000	>120	F	>1.000	>120	F
Illawarra Hwy/Princes Hwy	Roundabout	>1.000	>120	F	>1.000	>120	F
Princes Hwy/Tongarra Rd	Signals	>1.000	>120	F	0.927	35.0	C
Marshall Mount Road/Yallah Road	Priority	>1.000	>120	F	0.978	63.3	E
Huntley Rd/Marshall Mount Rd	Priority	0.479	11.2	A	0.026	13.6	A
Princes Hwy/Huntley Rd	Priority	>1.000	>120	F	>1.000	>120	F
Illawarra Hwy/Calderwood Rd/Macquarie St	Signals	>1.000	26.0	B	1.000	27.7	B
Illawarra Hwy/Broughton Ave	Roundabout	0.108	17.8	B	0.258	15.7	B
Tongarra Rd/Station Rd	Priority	>1.000	>120	F	>1.000	>120	F
Yallah Rd/Princes Hwy on-ramp	Priority	0.822	27.9	B	0.674	16.3	B
Yallah Rd/Haywards Bay Dr	Priority	>1.000	>120	F	0.637	22.5	B
Illawarra Hwy/Yellow Rock Rd	Priority	0.118	21.8	B	0.597	26.4	B
Haywards Bay Drive/Princes Highway southbound ramps	Roundabout	0.475	13.3	A	0.664	16.6	B
Princes Highway and Southern Freeway (Tallawarra northbound off-ramp)	Priority	>1.000	>120	F	>1.000	>120	F
Princes Hwy/Cormack Ave	Priority	>1.000	>120	F	>1.000	>120	F

APPENDIX 7G - Network Performance Characteristics - 2031 CUDP 'DO NOTHING' MODE SHIFT SCENARIO {31_D02}

SCENARIO FINDINGS

A review of the model results highlighted the following road sections to be overcapacity (LoS E or worse):

- Illawarra Highway sections between Church Street and Calderwood Road, Russell Street and Princes Highway.
- Marshall Mount Road between Calderwood Road and Yallah Road.
- Tongarra Road between Terry Street and Ti-Tree Avenue.
- Princes Highway between Woollybutt Drive and Southern Freeway and Southern Freeway to Mount Brown Road.
- Southern Freeway northbound off-ramp to Princes Highway.
- Southern Freeway southbound on-ramp from Princes Highway.
- The section linking the F6 extension to Princes Highway/Southern Freeway is overcapacity in the northbound direction in the AM peak hour and the southbound direction in the PM peak hour. Any mitigating treatment at the intersection would need to be considered as part of the treatment of the F6 extension northern interchange. For example, it may be appropriate to provide three traffic lanes subject to satisfactory resultant merge/diverge area design appropriate for the anticipated volume of traffic and safety considerations. However it has been modelled as two lanes in both directions for the purposes of this assessment.

Appendix 7H

Network Performance Characteristics – 2031 CUDP ‘Do Minimum’ Mode Shift Model {31_D04}

Appendix 7H - Network Performance Characteristics – 2031 CUDP 'Do Minimum' Mode Shift Model
Mid-block Carriageway Performance - AM Peak {31_D04A}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	308	281	589	B	B
Illawarra Highway	North Macquarie Road	Tullimbar Lane	308	262	570	B	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	391	272	663	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	682	456	1,138	C	C
Illawarra Highway	Broughton Avenue	Church Street	838	423	1,261	B	A
Illawarra Highway	Church Street	Calderwood Road	1,214	446	1,660	E	A
Illawarra Highway	Calderwood Road	Russell Street	1,322	722	2,044	B	A
Illawarra Highway	Russell Street	Terry Street	1,620	715	2,335	C	A
Illawarra Highway	Terry Street	Tripoli Way	1,642	273	1,915	C	A
Illawarra Highway	Croome Lane	Princes Highway	831	645	1,476	B	A
Yallah Road	Marshall Mount Road	Princes Highway	635	444	1,079	C	C
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	540	474	1,014	C	C
Marshall Mount Road	North Marshall Mount Road	Yallah Road	534	468	1,002	C	B
Marshall Mount Road	Yallah Road	Yallah TAFE	355	479	834	B	C
Marshall Mount Road	Yallah TAFE	Huntley Road	157	155	312	B	B
Calderwood Road	CUDP	Mansons Bridge	652	550	1,202	C	C
Calderwood Road	Mansons Bridge	Illawarra Highway	360	224	584	A	A
Huntley Road	Marshall Mount Road	Princes Highway	208	240	448	A	A
Tongarra Road	Terry Street	Stapleton Avenue	1,017	1,144	2,161	D	E
Tongarra Road	Stapleton Avenue	Croome Road	1,017	1,144	2,161	D	E
Tongarra Road	Croome Road	Station Road	990	677	1,667	C	A
Tongarra Road	Station Road	Ti-Tree Avenue	765	537	1,302	B	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	739	475	1,214	A	A
Tongarra Road	Ash Avenue	Princes Highway	862	524	1,386	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	804	1,395	2,199	A	A
Princes Highway	Tongarra Road	Station Road	417	670	1,087	A	A
Princes Highway	Station Road	Airport Road	687	899	1,586	A	A
Princes Highway	Airport Road	Illawarra Highway	925	1,219	2,144	A	A
Princes Highway	Illawarra Highway	Yallah Road	1,721	1,828	3,549	B	B
Princes Highway	Yallah Road	Southern Freeway	2,075	1,856	3,931	C	B
Princes Highway	Southern Freeway	Huntley Road	1,595	1,015	2,610	F	D
Princes Highway	Huntley Road	Mount Brown Road	1,546	998	2,544	F	C
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	2,190	2,190		F
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	2,139	-	2,139	F	
Southern Freeway Ext	Princes Highway	Croome Road	2,254	878	3,132	C	A
Southern Freeway Ext	Croome Road	Tripoli Way	1,864	878	2,742	B	A
Southern Freeway Ext	Tripoli Way	Princes Highway	2,961	1,516	4,477	D	B
Southern Freeway	F6 Extension	Princes Highway	5,037	3,455	8,492	F	E
Southern Freeway	Princes Highway	Fowlers Road	3,028	1,870	4,898	D	B
Tripoli Way	Illawarra Highway (West)	Calderwood Road	226	663	889	A	A
Tripoli Way	Calderwood Road	Illawarra Highway (East)	479	597	1,076	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	1,163	214	1,377	A	A
Tripoli Way	Southern Freeway	Tongarra Road	186	675	861	A	A
North South Arterial	Section 1		365	640	1,005	A	A
North South Arterial	Section 2		315	452	767	A	A
North South Arterial	Section 3		315	452	767	A	A
North South Arterial	Section 4		269	295	564	A	A
North South Arterial	Section 5		281	265	546	A	A
North South Arterial	Section 6		160	127	287	A	A
North South Arterial	Section 7		207	154	361	A	A
North South Arterial	Section 8		238	211	449	A	A
North South Arterial	Section 9		264	218	482	A	A
North South Arterial	Section 10		361	409	770	A	A
North South Arterial	Section 11		351	358	709	A	A
North South Arterial	Section 12		340	323	663	A	A

Appendix 7H - Network Performance Characteristics – 2031 CUDP 'Do Minimum' Mode Shift Model
Mid-block Carriageway Performance - PM Peak {31_D04P}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	395	274	669	C	B
Illawarra Highway	North Macquarie Road	Tullimbar Lane	369	268	637	C	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	443	284	727	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	542	518	1,060	C	C
Illawarra Highway	Broughton Avenue	Church Street	568	474	1,042	A	A
Illawarra Highway	Church Street	Calderwood Road	677	801	1,478	A	B
Illawarra Highway	Calderwood Road	Russell Street	771	1,056	1,827	A	A
Illawarra Highway	Russell Street	Terry Street	845	1,172	2,017	A	A
Illawarra Highway	Terry Street	Tripoli Way	727	690	1,417	A	A
Illawarra Highway	Croome Lane	Princes Highway	298	998	1,296	A	C
Yallah Road	Marshall Mount Road	Princes Highway	580	579	1,159	C	C
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	366	591	957	C	C
Marshall Mount Road	North Marshall Mount Road	Yallah Road	362	581	943	B	C
Marshall Mount Road	Yallah Road	Yallah TAFE	436	655	1,091	C	C
Marshall Mount Road	Yallah TAFE	Huntley Road	33	441	474	A	C
Calderwood Road	CUDP	Mansons Bridge	691	600	1,291	C	C
Calderwood Road	Mansons Bridge	Illawarra Highway	331	239	570	A	A
Huntley Road	Marshall Mount Road	Princes Highway	179	379	558	A	A
Tongarra Road	Terry Street	Stapleton Avenue	656	1,456	2,112	A	F
Tongarra Road	Stapleton Avenue	Croome Road	656	1,456	2,112	A	F
Tongarra Road	Croome Road	Station Road	549	1,037	1,586	A	D
Tongarra Road	Station Road	Ti-Tree Avenue	401	754	1,155	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	362	667	1,029	A	A
Tongarra Road	Ash Avenue	Princes Highway	399	784	1,183	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	931	1,371	2,302	A	A
Princes Highway	Tongarra Road	Station Road	324	1,149	1,473	A	A
Princes Highway	Station Road	Airport Road	530	1,429	1,959	A	A
Princes Highway	Airport Road	Illawarra Highway	667	1,465	2,132	A	A
Princes Highway	Illawarra Highway	Yallah Road	926	2,425	3,351	A	E
Princes Highway	Yallah Road	Southern Freeway	981	2,445	3,426	A	E
Princes Highway	Southern Freeway	Huntley Road	1,228	1,775	3,003	E	F
Princes Highway	Huntley Road	Mount Brown Road	1,055	1,802	2,857	D	F
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	1,724	1,724		F
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	1,464	-	1,464	D	
Southern Freeway Ext	Princes Highway	Croome Road	1,794	1,275	3,069	B	B
Southern Freeway Ext	Croome Road	Tripoli Way	988	1,275	2,263	B	B
Southern Freeway Ext	Tripoli Way	Princes Highway	1,224	1,969	3,193	B	C
Southern Freeway	F6 Extension	Princes Highway	2,204	4,578	6,782	C	F
Southern Freeway	Princes Highway	Fowlers Road	767	2,451	3,218	A	C
Tripoli Way	Illawarra Highway (West)	Calderwood Road	116	1,115	1,231	A	B
Tripoli Way	Calderwood Road	Illawarra Highway (East)	439	957	1,396	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	730	678	1,408	A	A
Tripoli Way	Southern Freeway	Tongarra Road	172	682	854	A	A
North South Arterial	Section 1		628	710	1,338	A	A
North South Arterial	Section 2		498	573	1,071	A	A
North South Arterial	Section 3		498	573	1,071	A	A
North South Arterial	Section 4		348	452	800	A	A
North South Arterial	Section 5		309	442	751	A	A
North South Arterial	Section 6		170	241	411	A	A
North South Arterial	Section 7		224	241	465	A	A
North South Arterial	Section 8		280	278	558	A	A
North South Arterial	Section 9		277	292	569	A	A
North South Arterial	Section 10		335	359	694	A	A
North South Arterial	Section 11		280	345	625	A	A
North South Arterial	Section 12		244	332	576	A	A

Appendix 7H - Network Performance Characteristics - 2031 CUDP 'Do Minimum' Mode Shift Model
Intersection Performance {31_D04}

		Scenario 31_D04 AM Peak			Scenario 31_D04 PM Peak		
Intersection	Intersection Control	Degree of Saturation	Delays (s)	LoS	Degree of Saturation	Delays (s)	LoS
Illawarra Hwy/Nth Macquarie Rd	Priority	0.143	15.3	B	0.019	16.6	B
Illawarra Hwy/Tongarra Rd/Terry St	Signals	>1.000	68.8	E	>1.000	>120	F
Illawarra Hwy/Princes Hwy	Roundabout	0.507	15.7	B	0.370	13.6	A
Princes Hwy/Tongarra Rd	Signals	0.464	18.8	B	0.581	14.1	A
Marshall Mount Road/Yallah Road	Priority	0.589	23.5	B	0.967	63.2	E
Huntley Rd/Marshall Mount Rd	Priority	0.175	11.1	A	0.047	12.0	A
Princes Hwy/Huntley Rd	Priority	>1.000	>120	F	>1.000	>120	F
Illawarra Hwy/Calderwood Rd/Macquarie St	Signals	>1.000	17.5	B	0.868	15.9	B
Illawarra Hwy/Broughton Ave	Roundabout	0.479	19.7	B	0.686	20.3	B
Tongarra Rd/Station Rd	Priority	0.789	49.3	D	>1.000	>120	F
Yallah Rd/Princes Hwy on-ramp	Priority	0.619	20.5	B	0.584	14.3	A
Yallah Rd/Haywards Bay Dr	Priority	>1.000	>120	F	0.172	18.6	B
Illawarra Hwy/Yellow Rock Rd	Priority	0.030	21.2	B	0.420	21.8	B
Haywards Bay Drive/Princes Highway southbound ramps	Roundabout	0.300	12.9	A	0.449	14.5	B
Princes Highway and Southern Freeway (Tallawarra northbound off-ramp)	Priority	>1.000	>120	F	>1.000	>120	F
Princes Hwy/Cormack Ave	Priority	>1.000	>120	F	>1.000	>120	F
Tripoli Way/Major Collector Street	Roundabout	0.038	11.8	A	0.030	11.4	A
Tripoli Way and Calderwood Road.	Roundabout	0.500	17.0	B	1.000	50.3	D
Illawarra Highway and Tripoli Way.	Signals	>1.000	>120	F	>1.000	116.0	F
Tripoli Way and F6 Extension ramps.	Roundabout	0.007	13.2	A	0.111	14.6	B
Tongarra Road and Tripoli Way.	Signals	0.911	42.3	C	0.903	37.8	C

APPENDIX 7H - Network Performance Characteristics - 2031 CUDP 'DO MINIMUM' MODE SHIFT SCENARIO {31_D04}

SCENARIO FINDINGS

A review of the model results highlighted the following notable changes and issues:

- The 'do minimum' upgrades provide a greater level of satisfactory modelled peak hour operation compared with the previous scenario (31_D02) although the following road sections would be continue to overcapacity:
  - Illawarra Highway between Church Street and Calderwood Road.
  - Tongarra Road between Terry Street and Terry Street and Croome Road.
  - Princes Highway between Southern Freeway and Mount Brown Road.
  - Southern Freeway northbound off ramp to Princes Highway.
  - Southern Freeway southbound on ramp from Princes Highway.
- As with the base scenarios the section linking the F6 extension to Princes Highway/Southern Freeway is overcapacity in the northbound direction in the AM peak hour and the southbound direction in the PM peak hour. Any mitigating treatment at the intersection would need to be considered as part of the treatment of the F6 extension northern interchange. For example, it may be appropriate to provide three traffic lanes subject to satisfactory resultant merge/diverge area design appropriate for the anticipated volume of traffic and safety considerations. However it has been modelled as two lanes in both directions for the purposes of this assessment.

Appendix 7I

Network Performance Characteristics – 2031 CUDP 'Do Absolute Minimum' Mode Shift Model {31_D08}

Appendix 7I - Network Performance Characteristics – 2031 CUDP 'Do Absolute Minimum' Mode Shift Model
Mid-block Carriageway Performance - AM Peak {31_D08A}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	308	281	589	B	B
Illawarra Highway	North Macquarie Road	Tullimbar Lane	308	262	570	B	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	392	272	664	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	681	456	1,137	C	C
Illawarra Highway	Broughton Avenue	Church Street	840	425	1,265	B	A
Illawarra Highway	Church Street	Calderwood Road	1,215	449	1,664	E	A
Illawarra Highway	Calderwood Road	Russell Street	1,323	725	2,048	B	A
Illawarra Highway	Russell Street	Terry Street	1,622	719	2,341	C	A
Illawarra Highway	Terry Street	Tripoli Way	1,644	274	1,918	C	A
Illawarra Highway	Croome Lane	Princes Highway	832	643	1,475	B	A
Yallah Road	Marshall Mount Road	Princes Highway	633	472	1,105	C	C
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	538	473	1,011	A	A
Marshall Mount Road	North Marshall Mount Road	Yallah Road	533	468	1,001	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	374	469	843	A	A
Marshall Mount Road	Yallah TAFE	Huntley Road	181	144	325	A	A
Calderwood Road	CUDP	Mansons Bridge	652	549	1,201	C	C
Calderwood Road	Mansons Bridge	Illawarra Highway	360	224	584	A	A
Huntley Road	Marshall Mount Road	Princes Highway	218	217	435	A	A
Tongarra Road	Terry Street	Stapleton Avenue	1,017	1,147	2,164	D	E
Tongarra Road	Stapleton Avenue	Croome Road	1,017	1,147	2,164	D	E
Tongarra Road	Croome Road	Station Road	990	678	1,668	C	A
Tongarra Road	Station Road	Ti-Tree Avenue	765	538	1,303	B	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	740	475	1,215	A	A
Tongarra Road	Ash Avenue	Princes Highway	863	525	1,388	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	804	1,396	2,200	A	A
Princes Highway	Tongarra Road	Station Road	416	670	1,086	A	A
Princes Highway	Station Road	Airport Road	687	899	1,586	A	A
Princes Highway	Airport Road	Illawarra Highway	934	1,219	2,153	A	A
Princes Highway	Illawarra Highway	Yallah Road	1,730	1,826	3,556	B	B
Princes Highway	Yallah Road	Southern Freeway	2,066	1,864	3,930	C	C
Princes Highway	Southern Freeway	Huntley Road	1,688	1,031	2,719	F	D
Princes Highway	Huntley Road	Mount Brown Road	1,656	998	2,654	F	C
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	1,753	1,753		F
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	2,139	-	2,139	F	
Southern Freeway Ext	Princes Highway	Croome Road	2,248	878	3,126	C	A
Southern Freeway Ext	Croome Road	Tripoli Way	1,858	878	2,736	B	A
Southern Freeway Ext	Tripoli Way	Princes Highway	2,957	1,520	4,477	D	B
Southern Freeway	F6 Extension	Princes Highway	5,023	3,465	8,488	F	E
Southern Freeway	Princes Highway	Fowlers Road	2,911	1,852	4,763	D	B
Tripoli Way	Illawarra Highway (West)	Calderwood Road	226	660	886	A	A
Tripoli Way	Calderwood Road	Illawarra Highway (East)	478	594	1,072	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	1,163	214	1,377	A	A
Tripoli Way	Southern Freeway	Tongarra Road	186	678	864	A	A
North South Arterial	Section 1		363	640	1,003	A	A
North South Arterial	Section 2		313	452	765	A	A
North South Arterial	Section 3		313	452	765	A	A
North South Arterial	Section 4		267	296	563	A	A
North South Arterial	Section 5		279	265	544	A	A
North South Arterial	Section 6		158	127	285	A	A
North South Arterial	Section 7		195	156	351	A	A
North South Arterial	Section 8		230	213	443	A	A
North South Arterial	Section 9		262	219	481	A	A
North South Arterial	Section 10		359	411	770	A	A
North South Arterial	Section 11		349	359	708	A	A
North South Arterial	Section 12		338	324	662	A	A

Appendix 7I - Network Performance Characteristics – 2031 CUDP 'Do Absolute Minimum' Mode Shift Model
Mid-block Carriageway Performance - PM Peak {31_D08P}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	395	274	669	C	B
Illawarra Highway	North Macquarie Road	Tullimbar Lane	369	268	637	C	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	443	284	727	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	545	516	1,061	C	C
Illawarra Highway	Broughton Avenue	Church Street	570	473	1,043	A	A
Illawarra Highway	Church Street	Calderwood Road	679	799	1,478	A	B
Illawarra Highway	Calderwood Road	Russell Street	773	1,054	1,827	A	A
Illawarra Highway	Russell Street	Terry Street	850	1,171	2,021	A	A
Illawarra Highway	Terry Street	Tripoli Way	730	688	1,418	A	A
Illawarra Highway	Croome Lane	Princes Highway	298	994	1,292	A	C
Yallah Road	Marshall Mount Road	Princes Highway	578	577	1,155	C	C
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	363	598	961	A	A
Marshall Mount Road	North Marshall Mount Road	Yallah Road	360	589	949	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	436	666	1,102	A	A
Marshall Mount Road	Yallah TAFE	Huntley Road	32	453	485	A	A
Calderwood Road	CUDP	Mansons Bridge	686	600	1,286	C	C
Calderwood Road	Mansons Bridge	Illawarra Highway	331	239	570	A	A
Huntley Road	Marshall Mount Road	Princes Highway	181	383	564	A	A
Tongarra Road	Terry Street	Stapleton Avenue	658	1,456	2,114	A	F
Tongarra Road	Stapleton Avenue	Croome Road	658	1,456	2,114	A	F
Tongarra Road	Croome Road	Station Road	549	1,042	1,591	A	D
Tongarra Road	Station Road	Ti-Tree Avenue	400	759	1,159	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	363	672	1,035	A	A
Tongarra Road	Ash Avenue	Princes Highway	399	789	1,188	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	934	1,371	2,305	A	A
Princes Highway	Tongarra Road	Station Road	324	1,151	1,475	A	A
Princes Highway	Station Road	Airport Road	530	1,430	1,960	A	A
Princes Highway	Airport Road	Illawarra Highway	668	1,468	2,136	A	A
Princes Highway	Illawarra Highway	Yallah Road	926	2,422	3,348	A	E
Princes Highway	Yallah Road	Southern Freeway	976	2,437	3,413	A	E
Princes Highway	Southern Freeway	Huntley Road	1,318	1,804	3,122	F	F
Princes Highway	Huntley Road	Mount Brown Road	1,146	1,834	2,980	E	F
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	2,436	2,436		F
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	2,139	-	2,139	F	
Southern Freeway Ext	Princes Highway	Croome Road	1,791	1,271	3,062	B	B
Southern Freeway Ext	Croome Road	Tripoli Way	982	1,271	2,253	B	B
Southern Freeway Ext	Tripoli Way	Princes Highway	1,226	1,963	3,189	B	C
Southern Freeway	F6 Extension	Princes Highway	2,203	4,565	6,768	C	F
Southern Freeway	Princes Highway	Fowlers Road	740	2,354	3,094	A	C
Tripoli Way	Illawarra Highway (West)	Calderwood Road	116	1,110	1,226	A	B
Tripoli Way	Calderwood Road	Illawarra Highway (East)	439	952	1,391	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	732	675	1,407	A	A
Tripoli Way	Southern Freeway	Tongarra Road	172	676	848	A	A
North South Arterial	Section 1		628	714	1,342	A	A
North South Arterial	Section 2		497	577	1,074	A	A
North South Arterial	Section 3		497	577	1,074	A	A
North South Arterial	Section 4		348	454	802	A	A
North South Arterial	Section 5		307	446	753	A	A
North South Arterial	Section 6		168	248	416	A	A
North South Arterial	Section 7		222	248	470	A	A
North South Arterial	Section 8		277	284	561	A	A
North South Arterial	Section 9		275	299	574	A	A
North South Arterial	Section 10		332	366	698	A	A
North South Arterial	Section 11		277	352	629	A	A
North South Arterial	Section 12		241	338	579	A	A

Appendix 7I - Network Performance Characteristics - 2031 CUDP 'Do Absolute Minimum' Mode Shift Model
Intersection Performance {31_D08}

		Scenario 31_D08 AM Peak			Scenario 31_D08 PM Peak		
Intersection	Intersection Control	Degree of Saturation	Delays (s)	LoS	Degree of Saturation	Delays (s)	LoS
Illawarra Hwy/Nth Macquarie Rd	Priority	0.143	15.3	B	0.019	16.6	B
Illawarra Hwy/Tongarra Rd/Terry St	Signals	>1.000	68.9	E	>1.000	>120	F
Illawarra Hwy/Princes Hwy	Roundabout	0.515	15.8	B	0.369	13.6	A
Princes Hwy/Tongarra Rd	Signals	0.464	18.8	B	0.469	14.3	A
Marshall Mount Road/Yallah Road	Priority	0.589	24.5	B	0.977	71.3	F
Huntley Rd/Marshall Mount Rd	Priority	0.198	11.0	A	0.046	12.1	A
Princes Hwy/Huntley Rd	Priority	>1.000	>120	F	>1.000	>120	F
Illawarra Hwy/Calderwood Rd/Macquarie St	Signals	1.000	17.5	B	0.888	18.0	B
Illawarra Hwy/Broughton Ave	Roundabout	0.477	19.7	B	0.686	20.3	B
Tongarra Rd/Station Rd	Priority	0.789	49.5	D	>1.000	>120	F
Yallah Rd/Princes Hwy on-ramp	Priority	0.643	21.3	B	0.573	14.3	A
Yallah Rd/Haywards Bay Dr	Priority	>1.000	>120	F	0.174	18.6	B
Illawarra Hwy/Yellow Rock Rd	Priority	0.027	21.3	B	0.493	22.4	B
Haywards Bay Drive/Princes Highway southbound ramps	Roundabout	0.310	12.9	A	0.447	14.5	B
Princes Highway and Southern Freeway (Tallawarra northbound off-ramp)	Priority	>1.000	>120	F	>1.000	>120	F
Princes Hwy/Cormack Ave	Priority	>1.000	>120	F	>1.000	>120	F
Tripoli Way/Major Collector Street	Roundabout	0.038	11.8	A	0.030	11.4	A
Tripoli Way and Calderwood Road.	Roundabout	0.500	16.9	B	1.000	47.8	D
Illawarra Highway and Tripoli Way.	Signals	>1.000	>120	F	>1.000	113.5	F
Tripoli Way and F6 Extension ramps.	Roundabout	0.007	13.2	A	0.111	14.6	B
Tongarra Road and Tripoli Way.	Signals	0.913	43.1	D	0.917	38.0	C

APPENDIX 7I - Network Performance Characteristics - 2031 CUDP 'DO ABSOLUTE MINIMUM' MODE SHIFT SCENARIO {31_D08}

SCENARIO FINDINGS

A review of the model results highlighted the following notable changes and issues:

- The 'do absolute minimum' upgrades provide a greater level of satisfactory modelled peak hour operation compared with the previous scenario (31_D04)although the following road sections would be continue to overcapacity:
  - Illawarra Highway between Church Street and Calderwood Road.
  - Tongarra Road between Terry Street and Croome Road.
  - Princes Highway between Southern Freeway and Mount Brown Road.
  - Southern Freeway northbound off ramp to Princes Highway.
  - Southern Freeway southbound on ramp from Princes Highway.
- The section linking the F6 extension to Princes Highway/Southern Freeway is overcapacity in the northbound direction in the AM peak hour and the southbound direction in the PM peak hour. Any mitigating treatment at the intersection would need to be considered as part of the treatment of the F6 extension northern interchange. For example, it may be appropriate to provide three traffic lanes subject to satisfactory resultant merge/diverge area design appropriate for the anticipated volume of traffic and safety considerations. However it has been modelled as two lanes in both directions for the purposes of this assessment.

Appendix 7J

Network Performance Characteristics – 2031 CUDP ‘Do Base Upgrades’ Mode Shift Model {31_D11}

Appendix 7J - Network Performance Characteristics – 2031 CUDP 'Do Base Upgrades' Mode Shift Model
Mid-block Carriageway Performance - AM Peak {31_D11A}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	308	284	592	B	B
Illawarra Highway	North Macquarie Road	Tullimbar Lane	308	265	573	B	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	375	275	650	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	595	479	1,074	C	C
Illawarra Highway	Broughton Avenue	Church Street	602	382	984	A	A
Illawarra Highway	Church Street	Calderwood Road	1,036	363	1,399	D	A
Illawarra Highway	Calderwood Road	Russell Street	1,110	445	1,555	A	A
Illawarra Highway	Russell Street	Terry Street	1,370	408	1,778	B	A
Illawarra Highway	Terry Street	Tripoli Way	1,583	265	1,848	C	A
Illawarra Highway	Croome Lane	Princes Highway	683	562	1,245	A	A
Yallah Road	Marshall Mount Road	Princes Highway	481	361	842	C	C
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	770	517	1,287	A	A
Marshall Mount Road	North Marshall Mount Road	Yallah Road	698	431	1,129	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	581	434	1,015	A	A
Marshall Mount Road	Yallah TAFE	Huntley Road	658	345	1,003	A	A
Calderwood Road	CUDP	Mansons Bridge	690	454	1,144	C	C
Calderwood Road	Mansons Bridge	Illawarra Highway	236	217	453	A	A
Huntley Road	Marshall Mount Road	Princes Highway	410	349	759	A	A
Tongarra Road	Terry Street	Stapleton Avenue	904	804	1,708	C	B
Tongarra Road	Stapleton Avenue	Croome Road	904	804	1,708	C	B
Tongarra Road	Croome Road	Station Road	945	624	1,569	C	A
Tongarra Road	Station Road	Ti-Tree Avenue	765	482	1,247	B	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	729	402	1,131	A	A
Tongarra Road	Ash Avenue	Princes Highway	876	474	1,350	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	800	1,140	1,940	A	A
Princes Highway	Tongarra Road	Station Road	448	386	834	A	A
Princes Highway	Station Road	Airport Road	639	572	1,211	A	A
Princes Highway	Airport Road	Illawarra Highway	783	632	1,415	A	A
Princes Highway	Illawarra Highway	Yallah Road	1,417	1,145	2,562	A	A
Princes Highway	Yallah Road	Southern Freeway	1,641	1,147	2,788	B	A
Princes Highway	Southern Freeway	Huntley Road	1,818	111	1,929	C	A
Princes Highway	Huntley Road	Mount Brown Road	2,018	250	2,268	D	A
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	687	687		A
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	2,112	-	2,112	C	
Southern Freeway Ext	Princes Highway	Croome Road	1,909	523	2,432	C	A
Southern Freeway Ext	Croome Road	Tripoli Way	1,454	523	1,977	B	A
Southern Freeway Ext	Tripoli Way	Princes Highway	2,354	871	3,225	C	A
Southern Freeway	F6 Extension	Princes Highway	3,995	2,066	6,061	F	C
Southern Freeway	Princes Highway	Fowlers Road	1,883	1,497	3,380	B	B
Tripoli Way	Illawarra Highway (West)	Calderwood Road	441	932	1,373	A	A
Tripoli Way	Calderwood Road	Illawarra Highway (East)	536	838	1,374	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	1,156	296	1,452	A	A
Tripoli Way	Southern Freeway	Tongarra Road	154	461	615	A	A
North South Arterial	Section 1		341	526	867	A	A
North South Arterial	Section 2		310	394	704	A	A
North South Arterial	Section 3		310	394	704	A	A
North South Arterial	Section 4		282	289	571	A	A
North South Arterial	Section 5		323	275	598	A	A
North South Arterial	Section 6		224	159	383	A	A
North South Arterial	Section 7		310	196	506	A	A
North South Arterial	Section 8		346	247	593	A	A
North South Arterial	Section 9		385	267	652	A	A
North South Arterial	Section 10		480	412	892	A	A
North South Arterial	Section 11		484	379	863	A	A
North South Arterial	Section 12		481	356	837	A	A

Appendix 7J - Network Performance Characteristics – 2031 CUDP 'Do Base Upgrades' Mode Shift Model
Mid-block Carriageway Performance - PM Peak {31_D11P}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	395	274	669	C	B
Illawarra Highway	North Macquarie Road	Tullimbar Lane	367	268	635	C	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	448	283	731	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	461	370	831	C	B
Illawarra Highway	Broughton Avenue	Church Street	450	318	768	A	A
Illawarra Highway	Church Street	Calderwood Road	546	603	1,149	A	A
Illawarra Highway	Calderwood Road	Russell Street	558	725	1,283	A	A
Illawarra Highway	Russell Street	Terry Street	687	853	1,540	A	A
Illawarra Highway	Terry Street	Tripoli Way	653	690	1,343	A	A
Illawarra Highway	Croome Lane	Princes Highway	253	936	1,189	A	C
Yallah Road	Marshall Mount Road	Princes Highway	453	476	929	C	C
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	440	885	1,325	A	A
Marshall Mount Road	North Marshall Mount Road	Yallah Road	336	785	1,121	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	476	903	1,379	A	A
Marshall Mount Road	Yallah TAFE	Huntley Road	315	956	1,271	A	A
Calderwood Road	CUDP	Mansons Bridge	605	580	1,185	C	C
Calderwood Road	Mansons Bridge	Illawarra Highway	238	154	392	A	A
Huntley Road	Marshall Mount Road	Princes Highway	265	514	779	A	A
Tongarra Road	Terry Street	Stapleton Avenue	557	1,128	1,685	A	D
Tongarra Road	Stapleton Avenue	Croome Road	557	1,128	1,685	A	D
Tongarra Road	Croome Road	Station Road	556	885	1,441	A	C
Tongarra Road	Station Road	Ti-Tree Avenue	436	607	1,043	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	377	523	900	A	A
Tongarra Road	Ash Avenue	Princes Highway	421	621	1,042	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	829	1,314	2,143	A	A
Princes Highway	Tongarra Road	Station Road	322	1,007	1,329	A	A
Princes Highway	Station Road	Airport Road	519	1,323	1,842	A	A
Princes Highway	Airport Road	Illawarra Highway	665	1,498	2,163	A	A
Princes Highway	Illawarra Highway	Yallah Road	882	2,399	3,281	A	D
Princes Highway	Yallah Road	Southern Freeway	796	2,302	3,098	A	D
Princes Highway	Southern Freeway	Huntley Road	848	1,349	2,197	A	A
Princes Highway	Huntley Road	Mount Brown Road	858	1,608	2,466	A	B
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	2,204	2,204		C
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	1,195	-	1,195	A	
Southern Freeway Ext	Princes Highway	Croome Road	1,857	1,260	3,117	B	B
Southern Freeway Ext	Croome Road	Tripoli Way	1,027	1,260	2,287	B	B
Southern Freeway Ext	Tripoli Way	Princes Highway	1,120	1,686	2,806	B	B
Southern Freeway	F6 Extension	Princes Highway	1,916	4,151	6,067	C	F
Southern Freeway	Princes Highway	Fowlers Road	721	2,178	2,899	A	C
Tripoli Way	Illawarra Highway (West)	Calderwood Road	388	1,164	1,552	A	B
Tripoli Way	Calderwood Road	Illawarra Highway (East)	582	948	1,530	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	820	740	1,560	A	A
Tripoli Way	Southern Freeway	Tongarra Road	144	555	699	A	A
North South Arterial	Section 1		580	791	1,371	A	A
North South Arterial	Section 2		486	715	1,201	A	A
North South Arterial	Section 3		486	715	1,201	A	A
North South Arterial	Section 4		369	622	991	A	A
North South Arterial	Section 5		338	615	953	A	A
North South Arterial	Section 6		206	429	635	A	A
North South Arterial	Section 7		325	444	769	A	A
North South Arterial	Section 8		335	527	862	A	A
North South Arterial	Section 9		366	553	919	A	A
North South Arterial	Section 10		399	631	1,030	A	A
North South Arterial	Section 11		346	620	966	A	A
North South Arterial	Section 12		313	607	920	A	A

Appendix 7J - Network Performance Characteristics - 2031 CUDP 'Do Base Upgrades' Mode Shift Model

Intersection Performance {31_D11}

		Scenario 31_D11 AM Peak			Scenario 31_D11 PM Peak		
Intersection	Intersection Control	Degree of Saturation	Delays (s)	LoS	Degree of Saturation	Delays (s)	LoS
Illawarra Hwy/Nth Macquarie Rd	Priority	0.143	15.3	B	0.019	16.6	B
Illawarra Hwy/Tongarra Rd/Terry St	Signals	1.000	53.5	D	0.950	37.3	C
Illawarra Hwy/Princes Hwy	Roundabout	0.379	14.1	A	0.135	13.2	A
Princes Hwy/Tongarra Rd	Signals	0.473	18.9	B	0.431	13.9	A
Marshall Mount Road/Yallah Road	Priority	0.899	26.7	B	>1.000	>120	F
Huntley Rd/Marshall Mount Rd	Priority	0.840	21.3	B	0.708	24.9	B
Princes Hwy/Huntley Rd	Signals	>1.000	28.8	C	>1.000	14.9	B
Illawarra Hwy/Calderwood Rd/Macquarie St	Signals	0.682	17.5	B	0.507	12.6	A
Illawarra Hwy/Broughton Ave	Roundabout	0.366	15.4	B	0.561	16.2	B
Tongarra Rd/Station Rd	Priority	0.589	26.7	B	0.798	27.4	B
Yallah Rd/Princes Hwy on-ramp	Priority	0.643	14.4	A	0.379	11.5	A
Yallah Rd/Haywards Bay Dr	Priority	0.091	14.1	A	0.182	15.5	B
Illawarra Hwy/Yellow Rock Rd	Priority	0.027	21.2	B	0.222	21.2	B
Haywards Bay Drive/Princes Highway southbound ramps	Roundabout	0.230	12.8	A	0.347	14.3	A
Princes Highway and Southern Freeway (Tallawarra northbound off-ramp)	Signals	0.529	16.6	B	0.842	18.2	B
Princes Hwy/Cormack Ave	Signals	0.532	23.0	B	0.866	33.9	C
Tripoli Way/Major Collector Street	Roundabout	0.067	12.0	A	0.047	11.6	A
Tripoli Way and Calderwood Road.	Roundabout	0.007	21.2	B	0.448	21.6	B
Illawarra Highway and Tripoli Way.	Signals	1.000	45.7	D	1.000	38.7	C
Tripoli Way and F6 Extension ramps.	Roundabout	0.150	12.7	A	0.111	14.3	A
Tongarra Road and Tripoli Way.	Signals	0.817	24.8	B	0.795	19.5	B

APPENDIX 7J - Network Performance Characteristics - 2031 CUDP 'DO BASE UPGRADES' MODE SHIFT SCENARIO {31_D11}

SCENARIO FINDINGS

A review of the model results highlighted the following notable changes and issues:

- Significant improvements to overall network operation with all road section providing a mid-block LoS of D or better.
- Intersection modelling as part of this option also indicated the need for the intersection of Marshall Mount Road and Yallah Road to be upgraded from its current priority to roundabout ccontrol to ensure acceptable peak hour operation. All other intersection layouts assessed provide an overall LoS of D or better.
- The section linking the F6 extension to Princes Highway/Southern Freeway is overcapacity in the northbound direction in the AM peak hour and the southbound direction in the PM peak hour. Any mitigating treatment at the intersection would need to be considered as part of the treatment of the F6 extension northern interchange. For example, it may be appropriate to provide three traffic lanes subject to satisfactory resultant merge/diverge area design appropriate for the anticipated volume of traffic and safety considerations. However it has been modelled as two lanes in both directions for the purposes of this assessment.

Appendix 7K

Network Performance Characteristics – 2031 CUDP ‘Do Full Development Upgrades’ Mode Shift Model {31_D12}

Appendix 7K - Network Performance Characteristics – 2031 CUDP 'Do Full Development Upgrades' Mode Shift Model
Mid-block Carriageway Performance - AM Peak {31_D12A}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	308	284	592	B	B
Illawarra Highway	North Macquarie Road	Tullimbar Lane	308	265	573	B	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	374	275	649	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	595	478	1,073	C	C
Illawarra Highway	Broughton Avenue	Church Street	603	382	985	A	A
Illawarra Highway	Church Street	Calderwood Road	1,037	363	1,400	D	A
Illawarra Highway	Calderwood Road	Russell Street	1,116	444	1,560	A	A
Illawarra Highway	Russell Street	Terry Street	1,380	408	1,788	B	A
Illawarra Highway	Terry Street	Tripoli Way	1,585	266	1,851	C	A
Illawarra Highway	Croome Lane	Princes Highway	683	560	1,243	A	A
Yallah Road	Marshall Mount Road	Princes Highway	482	367	849	C	C
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	768	520	1,288	A	A
Marshall Mount Road	North Marshall Mount Road	Yallah Road	695	435	1,130	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	578	433	1,011	A	A
Marshall Mount Road	Yallah TAFE	Huntley Road	654	342	996	A	A
Calderwood Road	CUDP	Mansons Bridge	687	455	1,142	C	C
Calderwood Road	Mansons Bridge	Illawarra Highway	235	222	457	A	A
Huntley Road	Marshall Mount Road	Princes Highway	409	349	758	A	A
Tongarra Road	Terry Street	Stapleton Avenue	912	804	1,716	C	B
Tongarra Road	Stapleton Avenue	Croome Road	912	804	1,716	C	B
Tongarra Road	Croome Road	Station Road	952	624	1,576	C	A
Tongarra Road	Station Road	Ti-Tree Avenue	773	482	1,255	B	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	736	402	1,138	A	A
Tongarra Road	Ash Avenue	Princes Highway	884	473	1,357	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	801	1,148	1,949	A	A
Princes Highway	Tongarra Road	Station Road	449	385	834	A	A
Princes Highway	Station Road	Airport Road	639	573	1,212	A	A
Princes Highway	Airport Road	Illawarra Highway	784	633	1,417	A	A
Princes Highway	Illawarra Highway	Yallah Road	1,418	1,143	2,561	A	A
Princes Highway	Yallah Road	Southern Freeway	1,642	1,151	2,793	B	A
Princes Highway	Southern Freeway	Huntley Road	1,819	111	1,930	C	A
Princes Highway	Huntley Road	Mount Brown Road	2,017	249	2,266	D	A
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	691	691		A
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	2,115	-	2,115	C	
Southern Freeway Ext	Princes Highway	Croome Road	1,909	516	2,425	C	A
Southern Freeway Ext	Croome Road	Tripoli Way	1,454	516	1,970	B	A
Southern Freeway Ext	Tripoli Way	Princes Highway	2,356	870	3,226	C	A
Southern Freeway	F6 Extension	Princes Highway	3,998	2,069	6,067	F	C
Southern Freeway	Princes Highway	Fowlers Road	1,883	1,497	3,380	B	B
Tripoli Way	Illawarra Highway (West)	Calderwood Road	432	929	1,361	A	A
Tripoli Way	Calderwood Road	Illawarra Highway (East)	532	835	1,367	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	1,124	296	1,420	A	A
Tripoli Way	Southern Freeway	Tongarra Road	153	461	614	A	A
North South Arterial	Section 1		339	524	863	A	A
North South Arterial	Section 2		308	392	700	A	A
North South Arterial	Section 3		308	392	700	A	A
North South Arterial	Section 4		279	288	567	A	A
North South Arterial	Section 5		320	274	594	A	A
North South Arterial	Section 6		221	158	379	A	A
North South Arterial	Section 7		307	195	502	A	A
North South Arterial	Section 8		344	249	593	A	A
North South Arterial	Section 9		383	270	653	A	A
North South Arterial	Section 10		478	414	892	A	A
North South Arterial	Section 11		481	381	862	A	A
North South Arterial	Section 12		478	358	836	A	A

Appendix 7K - Network Performance Characteristics – 2031 CUDP 'Do Full Development Upgrades' Mode Shift Model
Mid-block Carriageway Performance - PM Peak {31_D12P}

Location			Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	395	274	669	C	B
Illawarra Highway	North Macquarie Road	Tullimbar Lane	367	268	635	C	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	448	283	731	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	461	370	831	C	B
Illawarra Highway	Broughton Avenue	Church Street	450	318	768	A	A
Illawarra Highway	Church Street	Calderwood Road	547	599	1,146	A	A
Illawarra Highway	Calderwood Road	Russell Street	564	722	1,286	A	A
Illawarra Highway	Russell Street	Terry Street	687	850	1,537	A	A
Illawarra Highway	Terry Street	Tripoli Way	653	688	1,341	A	A
Illawarra Highway	Croome Lane	Princes Highway	253	940	1,193	A	C
Yallah Road	Marshall Mount Road	Princes Highway	456	478	934	C	C
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	439	878	1,317	A	A
Marshall Mount Road	North Marshall Mount Road	Yallah Road	335	778	1,113	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	475	895	1,370	A	A
Marshall Mount Road	Yallah TAFE	Huntley Road	315	948	1,263	A	A
Calderwood Road	CUDP	Mansons Bridge	605	579	1,184	C	C
Calderwood Road	Mansons Bridge	Illawarra Highway	238	158	396	A	A
Huntley Road	Marshall Mount Road	Princes Highway	264	505	769	A	A
Tongarra Road	Terry Street	Stapleton Avenue	557	1,127	1,684	A	D
Tongarra Road	Stapleton Avenue	Croome Road	557	1,127	1,684	A	D
Tongarra Road	Croome Road	Station Road	556	885	1,441	A	C
Tongarra Road	Station Road	Ti-Tree Avenue	437	607	1,044	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	377	522	899	A	A
Tongarra Road	Ash Avenue	Princes Highway	421	620	1,041	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	828	1,314	2,142	A	A
Princes Highway	Tongarra Road	Station Road	322	1,007	1,329	A	A
Princes Highway	Station Road	Airport Road	520	1,324	1,844	A	A
Princes Highway	Airport Road	Illawarra Highway	665	1,499	2,164	A	A
Princes Highway	Illawarra Highway	Yallah Road	883	2,403	3,286	A	E
Princes Highway	Yallah Road	Southern Freeway	797	2,308	3,105	A	D
Princes Highway	Southern Freeway	Huntley Road	843	1,365	2,208	A	A
Princes Highway	Huntley Road	Mount Brown Road	853	1,616	2,469	A	B
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	2,212	2,212		C
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	1,196	-	1,196	A	
Southern Freeway Ext	Princes Highway	Croome Road	1,859	1,260	3,119	B	B
Southern Freeway Ext	Croome Road	Tripoli Way	1,028	1,260	2,288	B	B
Southern Freeway Ext	Tripoli Way	Princes Highway	1,120	1,688	2,808	B	B
Southern Freeway	F6 Extension	Princes Highway	1,917	4,158	6,075	C	F
Southern Freeway	Princes Highway	Fowlers Road	721	2,178	2,899	A	C
Tripoli Way	Illawarra Highway (West)	Calderwood Road	389	1,175	1,564	A	C
Tripoli Way	Calderwood Road	Illawarra Highway (East)	576	958	1,534	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	821	745	1,566	A	A
Tripoli Way	Southern Freeway	Tongarra Road	143	554	697	A	A
North South Arterial	Section 1		580	784	1,364	A	A
North South Arterial	Section 2		486	709	1,195	A	A
North South Arterial	Section 3		486	709	1,195	A	A
North South Arterial	Section 4		369	615	984	A	A
North South Arterial	Section 5		338	608	946	A	A
North South Arterial	Section 6		206	422	628	A	A
North South Arterial	Section 7		324	438	762	A	A
North South Arterial	Section 8		335	519	854	A	A
North South Arterial	Section 9		365	545	910	A	A
North South Arterial	Section 10		398	623	1,021	A	A
North South Arterial	Section 11		346	612	958	A	A
North South Arterial	Section 12		312	599	911	A	A

Appendix 7K - Network Performance Characteristics - 2031 CUDP 'Do Full Development Upgrades' Mode Shift Model

Intersection Performance {31_D12}

		Scenario 31_D12 AM Peak			Scenario 31_D12 PM Peak		
Intersection	Intersection Control	Degree of Saturation	Delays (s)	LoS	Degree of Saturation	Delays (s)	LoS
Illawarra Hwy/Nth Macquarie Rd	Priority	0.143	15.3	B	0.019	16.6	B
Illawarra Hwy/Tongarra Rd/Terry St	Signals	1.000	55.1	D	0.950	37.3	C
Illawarra Hwy/Princes Hwy	Roundabout	0.379	14.1	A	0.350	13.6	A
Princes Hwy/Tongarra Rd	Signals	0.596	18.0	B	0.489	13.7	A
Marshall Mount Road/Yallah Road	Roundabout	0.300	16.9	B	0.547	21.3	B
Huntley Rd/Marshall Mount Rd	Priority	0.697	16.4	B	0.704	24.6	B
Princes Hwy/Huntley Rd	Signals	>1.000	27.0	B	1.000	14.1	A
Illawarra Hwy/Calderwood Rd/Macquarie St	Signals	0.717	15.9	B	0.498	12.0	A
Illawarra Hwy/Broughton Ave	Roundabout	0.366	15.4	B	0.408	14.8	B
Tongarra Rd/Station Rd	Priority	0.598	27.1	B	0.800	27.5	B
Yallah Rd/Princes Hwy on-ramp	Priority	0.644	14.4	A	0.382	11.5	A
Yallah Rd/Haywards Bay Dr	Priority	0.092	14.3	A	0.183	15.5	B
Illawarra Hwy/Yellow Rock Rd	Priority	0.027	21.2	B	0.500	16.2	B
Haywards Bay Drive/Princes Highway southbound ramps	Roundabout	0.236	12.8	A	0.350	14.3	A
Princes Highway and Southern Freeway (Tallawarra northbound off-ramp)	Signals	0.638	14.6	B	0.748	17.0	B
Princes Hwy/Cormack Ave	Signals	0.748	22.4	B	0.877	34.8	C
Tripoli Way/Major Collector Street	Roundabout	0.067	12.0	A	0.047	11.6	A
Tripoli Way and Calderwood Road.	Roundabout	0.007	21.2	B	0.464	22.0	B
Illawarra Highway and Tripoli Way.	Signals	1.000	45.8	D	1.000	34.7	C
Tripoli Way and F6 Extension ramps.	Roundabout	0.140	12.7	A	0.111	14.3	A
Tongarra Road and Tripoli Way.	Signals	0.817	25.0	B	0.795	19.5	B

APPENDIX 7K - Network Performance Characteristics - 2031 CUDP 'DO FULL DEVELOPMENT UPGRADES' MODE SHIFT SCENARIO {31_D12}

SCENARIO FINDINGS

A review of the model results highlighted the following notable changes and issues:

- The introduction of a roundabout at the Marshall Mount Road and Yallah Road leads to a removal of intersection delay which in turn promotes an additional 5 vehicles to use Princes Highway between Illawara Highway and Yallah Road. This small rise in vehicles is sufficient to change the mid-block LoS from a D to an E. However, given the future uncertainties in terms of final road network and land use releases and in terms of sustainable transport aims it is proposed to retain the existing layout rather than produce an additional traffic lane along the affected section.
- The section linking the F6 extension to Princes Highway/Southern Freeway is overcapacity in the northbound direction in the AM peak hour and the southbound direction in the PM peak hour. Any mitigating treatment at the intersection would need to be considered as part of the treatment of the F6 extension northern interchange. For example, it may be appropriate to provide three traffic lanes subject to satisfactory resultant merge/diverge area design appropriate for the anticipated volume of traffic and safety considerations. However it has been modelled as two lanes in both directions for the purposes of this assessment.

Appendix 7L

2031 CUDP Full Development Sensitivity Testing

APPENDIX 7L – 2031 CUDP Full Development Sensitivity Testing

In order to test the sensitivity of the future road network (2031) to potential increased yields within CUDP, two model scenarios were run as follows:

- Additional 10% CUDP dwellings.
- Additional 15% CUDP dwellings.

Both of the above models were run for the AM and PM peaks with the following assumptions:

- The 2009 road network with the internal CUDP road network plus the full 2031 full development road network upgrades.
- Regional infill growth, external growth, regional new development growth with BAU modal splits
- CUDP growth + 10% or 15% additional dwellings with 10% mode shift.

For each scenario the mid-block and turning traffic volumes were extracted from the relevant 2031 AM and PM TRACKS models.

In order to assess the network performance the following steps were undertaken:

1. Run the model for the current scenario with additional dwellings and mode share.
2. Review mid-block and turning traffic volumes to identify any significant changes or anomalies.
3. Mid-block traffic volumes were used to assess mid-block carriageway capacity and performance.
4. Turning traffic volumes were used to assess intersection performance.

The mid-block and turning traffic volumes were used to then assess mid-block carriageway capacity and intersection performance. This sensitivity tests identified that the modelled road network (on a mid-block capacity basis) provided a road network generally capable of satisfactorily accommodating the 2031 future demand with the additional 10% or 15% yield in dwellings in CUDP.

Detailed results (mid-block volumes and carriageway LoS and intersection Los) for the worst case scenario of +15% additional CUDP dwellings are provided in the tables on following pages.

A summary of the key findings of the analysis of +15% CUDP additional dwellings scenario follows:

- There will be no change in mid-block LoS during the AM peak when compared to the full development CUDP scenario, with the exception of:
  - Tongarra Road southbound between Ti-Tree Avenue and Ash Avenue will change from LoS A to LoS B.
- There will be minor changes in mid-block LoS during the PM peak when compared to the full development CUDP scenario at the following locations (all sections will still operate at LoS C or better):
  - Illawarra Highway westbound between Yellow Rock Road and Broughton.
  - Marshall Mount Road southbound south of North Marshall Mount Road and south of Huntley.
  - Southern Freeway off-ramp between the Southern Freeway and Princes.
  - Southern Freeway extension northbound between Princes Highway and Croome Road.
- The layout of the section of the Princes Highway southbound between the south-facing ramps at the Tallawarra Interchange and the F6 extension will need to be considered as part of the design process for the F6 extension based upon the forecast traffic volumes. As a result of the 15% increase in CUDP yields traffic volumes along this section of road will increase by approximately 4% (in the section south of Yallah Road) during the PM Peak. This will result in a change in LoS from D to E for this section.

- The following intersections will experience a change in overall LoS (but will still operate at LoS C or better) as a result of the 15% increase in yield in CUDP:
  - Princes Highway/Huntley Road.
  - Tongarra Road/Station Road.
  - Yallah Road/Princes Highway On-ramp.
  - Haywards Bay Drive/Princes Highway southbound ramps.
  - Tripoli Way/Calderwood Road.
- Intersection analysis showed that the intersection of Illawarra Highway with Tongarra Road and Terry Street will perform at a LoS F in the PM peak period (Los D in the AM Peak). It is difficult to provide additional capacity through the addition of traffic lanes due to frontage development on all sides of the intersection. It is likely that if constructed the Tripoli Way Extension will create a significant redistribution of traffic. It is recommended that should additional development beyond the yields contemplated by the Concept Plan eventuate that further detailed investigation be undertaken with Council/RTA on potential improvements at this intersection. This would also be better understood based upon a re-survey of traffic volumes and subsequent analysis once the Tripoli Way Extension is completed.

Appendix L - Network Performance Characteristics

2031 CUDP 'Do Full Development Upgrades' Mode Shift Model - +15% CUDP Sensitivity Test

		Sensitivity Scenario 15% (5520 Dwellings)					
		Scenario 31_S15 AM Peak			Scenario 31_S15 PM Peak		
Intersection	Intersection Control	Degree of Saturation	Delays (s)	LoS	Degree of Saturation	Delays (s)	LoS
Illawarra Hwy/Nth Macquarie Rd	Priority	0.143	15.3	B	0.019	16.6	B
Illawarra Hwy/Tongarra Rd/Terry St	Signals	>1.000	71.3	F	>1.000	49.6	D
Illawarra Hwy/Princes Hwy	Roundabout	0.376	14.1	A	0.353	13.6	A
Princes Hwy/Tongarra Rd	Signals	0.512	19.2	B	0.433	13.9	A
Marshall Mount Road/Yallah Road	Roundabout	0.305	17.0	B	0.706	27.3	B
Huntley Rd/Marshall Mount Rd	Priority	0.896	25.6	B	0.721	26.4	B
Princes Hwy/Huntley Rd	Signals	>1.000	25.7	B	1.000	17.1	B
Illawarra Hwy/Calderwood Rd/Macquarie St	Signals	0.735	18.1	B	0.596	14.5	A
Illawarra Hwy/Broughton Ave	Roundabout	0.389	15.7	B	0.596	17.1	B
Tongarra Rd/Station Rd	Priority	0.638	29.6	C	0.878	36.4	C
Yallah Rd/Princes Hwy on-ramp	Priority	0.664	14.8	B	0.408	12.1	A
Yallah Rd/Haywards Bay Dr	Priority	0.094	14.3	A	0.186	17.7	B
Illawarra Hwy/Yellow Rock Rd	Priority	0.028	21.4	B	0.545	23.6	B
Haywards Bay Drive/Princes Highway southbound ramps	Roundabout	0.235	12.9	A	0.423	14.6	B
Princes Highway and Southern Freeway (Tallawarra northbound off-ramp)	Signals	0.549	17.1	B	0.744	15.2	B
Princes Hwy/Cormack Ave	Signals	0.561	23.0	B	0.909	38.8	C
Tripoli Way and Calderwood Road.	Roundabout	0.007	21.3	B	0.600	30.3	C
Illawarra Highway and Tripoli Way.	Signals	>1.000	50.0	D	1.000	38.8	C
Tongarra Road and Tripoli Way.	Signals	0.972	52.0	D	0.776	18.7	B

Appendix 7L - Network Performance Characteristics
Mid-block Carriageway Performance - 2031 CUDP 'Additional 15%' Mode Shift Model

Location			AM Peak					PM Peak				
			Peak Flow (Veh/hr)			LoS		Peak Flow (Veh/hr)			LoS	
Street	Between	And	E/N bound	W/S Bound	Total	E/N bound	W/S Bound	E/N bound	W/S Bound	Total	E/N bound	W/S Bound
Illawarra Highway	Tongarra Lane	North Macquarie Road	309	285	594	B	B	397	274	671	C	B
Illawarra Highway	North Macquarie Road	Tullimbar Lane	308	264	572	B	B	365	267	632	C	B
Illawarra Highway	Tullimbar Lane	Yellow Rock Road	379	275	654	C	B	473	287	760	C	B
Illawarra Highway	Yellow Rock Road	Broughton Avenue	636	486	1,122	C	C	488	443	931	C	C
Illawarra Highway	Broughton Avenue	Church Street	638	393	1,031	A	A	478	387	865	A	A
Illawarra Highway	Church Street	Calderwood Road	1,059	376	1,435	D	A	569	658	1,227	A	A
Illawarra Highway	Calderwood Road	Russell Street	1,148	472	1,620	A	A	588	812	1,400	A	A
Illawarra Highway	Russell Street	Terry Street	1,425	419	1,844	B	A	698	917	1,615	A	A
Illawarra Highway	Terry Street	Tripoli Way	1,571	270	1,841	C	A	644	763	1,407	A	A
Illawarra Highway	Croome Lane	Princes Highway	682	570	1,252	A	A	279	949	1,228	A	C
Yallah Road	Marshall Mount Road	Princes Highway	497	365	862	C	C	488	535	1,023	C	C
Marshall Mount Road	Calderwood Road	North Marshall Mount Road	857	570	1,427	A	A	495	1,064	1,559	A	B
Marshall Mount Road	North Marshall Mount Road	Yallah Road	770	467	1,237	A	A	371	941	1,312	A	A
Marshall Mount Road	Yallah Road	Yallah TAFE	622	451	1,073	A	A	482	1,005	1,487	A	A
Marshall Mount Road	Yallah TAFE	Huntley Road	703	368	1,071	A	A	308	1,044	1,352	A	B
Calderwood Road	CUDP	Mansons Bridge	692	495	1,187	C	C	707	624	1,331	C	C
Calderwood Road	Mansons Bridge	Illawarra Highway	237	225	462	A	A	273	192	465	A	A
Huntley Road	Marshall Mount Road	Princes Highway	381	349	730	A	A	217	500	717	A	A
Tongarra Road	Terry Street	Stapleton Avenue	984	813	1,797	C	B	568	1,112	1,680	A	D
Tongarra Road	Stapleton Avenue	Croome Road	984	813	1,797	C	B	568	1,112	1,680	A	D
Tongarra Road	Croome Road	Station Road	993	627	1,620	C	A	565	950	1,515	A	C
Tongarra Road	Station Road	Ti-Tree Avenue	810	484	1,294	B	A	442	666	1,108	A	A
Tongarra Road	Ti-Tree Avenue	Ash Avenue	777	411	1,188	B	A	382	578	960	A	A
Tongarra Road	Ash Avenue	Princes Highway	940	475	1,415	A	A	420	673	1,093	A	A
Princes Highway	Woollybutt Drive	Tongarra Road	794	1,222	2,016	A	A	871	1,316	2,187	A	A
Princes Highway	Tongarra Road	Station Road	442	405	847	A	A	321	1,019	1,340	A	A
Princes Highway	Station Road	Airport Road	643	593	1,236	A	A	520	1,339	1,859	A	A
Princes Highway	Airport Road	Illawarra Highway	775	663	1,438	A	A	678	1,520	2,198	A	A
Princes Highway	Illawarra Highway	Yallah Road	1,404	1,181	2,585	A	A	919	2,431	3,350	A	E
Princes Highway	Yallah Road	Southern Freeway	1,639	1,182	2,821	B	A	874	2,402	3,276	A	E
Princes Highway	Southern Freeway	Huntley Road	1,882	134	2,016	C	A	940	1,106	2,046	A	A
Princes Highway	Huntley Road	Mount Brown Road	2,052	272	2,324	D	A	904	1,353	2,257	A	A
Southern Freeway On-Ramp	Cormack Avenue	Southern Freeway	-	720	720		A	-	2,216	2,216		C
Southern Freeway Off-Ramp	Southern Freeway	Princes Highway	2,208	-	2,208	C		1,272	-	1,272	B	
Southern Freeway Ext	Princes Highway	Croome Road	1,982	544	2,526	C	A	1,910	1,283	3,193	C	B
Southern Freeway Ext	Croome Road	Tripoli Way	1,531	544	2,075	B	A	1,065	1,283	2,348	B	B
Southern Freeway Ext	Tripoli Way	Princes Highway	2,434	870	3,304	C	A	1,138	1,731	2,869	B	B
Southern Freeway	F6 Extension	Princes Highway	4,073	2,102	6,175	F	C	2,012	4,294	6,306	C	F
Southern Freeway	Princes Highway	Fowlers Road	1,864	1,494	3,358	B	B	740	2,311	3,051	A	C
Tripoli Way	Illawarra Highway (West)	Calderwood Road	473	937	1,410	A	A	425	1,259	1,684	A	C
Tripoli Way	Calderwood Road	Illawarra Highway (East)	578	838	1,416	A	A	610	1,051	1,661	A	A
Tripoli Way	Illawarra Highway (East)	Southern Freeway	1,164	298	1,462	A	A	830	869	1,699	A	A
Tripoli Way	Southern Freeway	Tongarra Road	172	461	633	A	A	144	480	624	A	A
North South Arterial	Section 1		359	580	939	A	A	677	840	1,517	A	A
North South Arterial	Section 2		331	435	766	A	A	566	778	1,344	A	A
North South Arterial	Section 3		331	435	766	A	A	566	778	1,344	A	A
North South Arterial	Section 4		300	317	617	A	A	419	694	1,113	A	A
North South Arterial	Section 5		349	302	651	A	A	386	665	1,051	A	A
North South Arterial	Section 6		263	181	444	A	A	248	483	731	A	A
North South Arterial	Section 7		361	222	583	A	A	426	503	929	A	A
North South Arterial	Section 8		388	284	672	A	A	385	611	996	A	A
North South Arterial	Section 9		439	308	747	A	A	434	652	1,086	A	A
North South Arterial	Section 10		532	452	984	A	A	448	742	1,190	A	A
North South Arterial	Section 11		536	415	951	A	A	384	730	1,114	A	A
North South Arterial	Section 12		533	389	922	A	A	344	714	1,058	A	A

Appendix 9A

Background Review – Sustainability Measures

APPENDIX 9A – Background Review - Sustainability Measures

URBAN DESIGN

Good urban design is not just about making places visually attractive, good urban design:

- Delivers value for money. Design costs are a small percentage of construction costs, but it is through the design process that the greatest impact can be made on the quality, efficiency and overall sustainability of buildings and travel patterns.
- Encourages local community identity creating places that respond to people's needs and aspirations. This in turn can help influence peoples travel patterns by for example shopping locally.
- Improves the longer-term "liveability", management and maintenance of the built environment, including public places such as streets and parks, to ensure spaces can stay clean, safe and green and achieve a vitality that may further support local leisure employment and retailing patterns.
- Contributes to the achievement of sustainable development by respecting historic or local context (where appropriate) and making best use of resources, whilst being able to respond to change.

ACTIVE TRANSPORT MEASURES

Provision of infrastructure for walk/cycle modes can encourage travel by these sustainable modes which is beneficial to overall environmental objectives and the participant's health.

The provision of an adequate footpath network (adequate widths for intended usage, suitable grades, street lit for security, provision of safe pedestrian crossing points, available for mobility impaired users etc) can help encourage local trips to be undertaken by foot to reduce the number of vehicle trips and promote healthier travel and also provide good pedestrian access to public transport nodes to promote efficient integration. It is recognised that pedestrians have a propensity to minimize trips lengths although research suggest that regular walk trips in the range 400m-800m are commonplace and even up to 1 km are not inappropriate.

Bicycle trips provide an ideal transport mode to undertake medium length trips (up to 5km) and bicycle usage can be promoted if good dedicated cycle infrastructure is provided along main corridors of movements and to key local destinations such as town centre uses, recreational and educational uses and key transport nodes.

WAYFINDING SIGNAGE

As part of a good footpath network providing wayfinding information can encourage residents and visitors to walk to local centres and key destinations. Effective wayfinding signage could include comprehensive maps, showing destinations, distances, landmarks and safety contacts. Lighting is also an important element of the footpath network of the wayfinding strategy. An example of an effective cycle wayfinding signage is shown in **Error! Reference source not found.**.

Photograph Error! No text of specified style in document.**.1** **Example of effective cycle wayfinding signage**

EARLY PROVISION OF BUS SERVICES

Early provision of bus services is essential to ensure that sustainable travel behavior is encouraged from the commencement of development. The provision of bus services from the outset potentially allows residents to establish their patterns of travel when moving into a new home. This may result in avoiding the need to purchase a second or third vehicle for their family without compromising access to employment and services. These services should be of an appropriate standard to ensure they are seen as a realistic alternative to the private vehicle and to develop positive perceptions of public transport.

TELE-WORKING/TELE-COMMUTING

National Broadband Network

The Australian Government announced on 7 April 2009 it would establish a new company to invest up to $43 billion over eight years delivering superfast broadband to Australian homes and workplaces. As part of this program, the Government announced on 7 April 2009 that greenfield estates across Australia should have fibre optic infrastructure to prepare them for the future. The CUDP will be developed with fibre to the premises technology.

The National Broadband Network (NBN) will dramatically increase the speed and capacity of telecommunications facilities in Australia. The greatest potential impact that the NBN will have on transport will be a reduced need to travel through the greater use of telecommuting and video conference technologies.

Telecommuting is still in its relative infancy, although trials have been occurring in Australia for at least ten years. Research has shown that the effectiveness of telecommuting programs is variable, with factors affecting the success of such programs including the availability of high-speed broadband, commuting distance, job compatibility and business enthusiasm/reluctance. Research by the Fibre to the Home Council in the USA has shown that telecommuters with access to fibre to the home technology are likely to work from home for an additional two days per month than telecommuters utilising regular broadband internet connections.

Research in Australia has identified that a reduction in travel demand of 6-12% is potentially achievable; however this is yet to be tested through large-scale trials.

Towards a High-Bandwidth, Low Carbon Future (2009)

This report provides an analysis of the opportunities for Australia to achieve nationally significant reductions in greenhouse gas emissions through the greater utilisation of telecommunications networks.

The report cites tele-working and decentralised workplaces as examples of how telecommunications networks can be used to reduce travel demand. Tele-working would allow employees to work from home, for all or part of the working week, eliminating the need for commuting. The decentralised workplace involves allowing employees to work remotely from a ‘tele-work centre’ or a regional centre located closer to their home than the normal workplace. As well as reducing commuting distance and travel time, the decentralised workplace can allow employees to live and work from a regional centre, shifting travel demand from the congested areas of Sydney to less congested areas within New South Wales. The report cites that the average commute time in Sydney is 4.9 hours per week, whilst the average commute time for the rest of the New South Wales is only 2.7 hours per week.

The report also cites the greater use of real-time data transfers to provide improved public transport services. This may involve the use of mobile phones to order taxis or for service operators to respond quickly to spikes in demand. The integration of demand data can assist in improving the viability of the transport network.

RTA West Gosford Tele-centre Project (1998/99)

This report summarises the results of a tele-centre experiment conducted by the RTA in 1998/99. A tele-centre was established at West Gosford at an existing RTA depot to obviate the need for local employees to commute to RTA offices in Sydney or Newcastle. Most participants in the experiment tele-worked for less than the full working week.

Travel time, distance and cost savings were significant for tele-workers who would otherwise have travelled long distances to their regular workplace. Some participants experienced no reduction in travel costs due to the continued use of periodical rail tickets for the days which they travelled to their regular workplace. 53% of participants tended to use some of the travel time savings to work longer hours at the tele-centre.

Appendix 10A

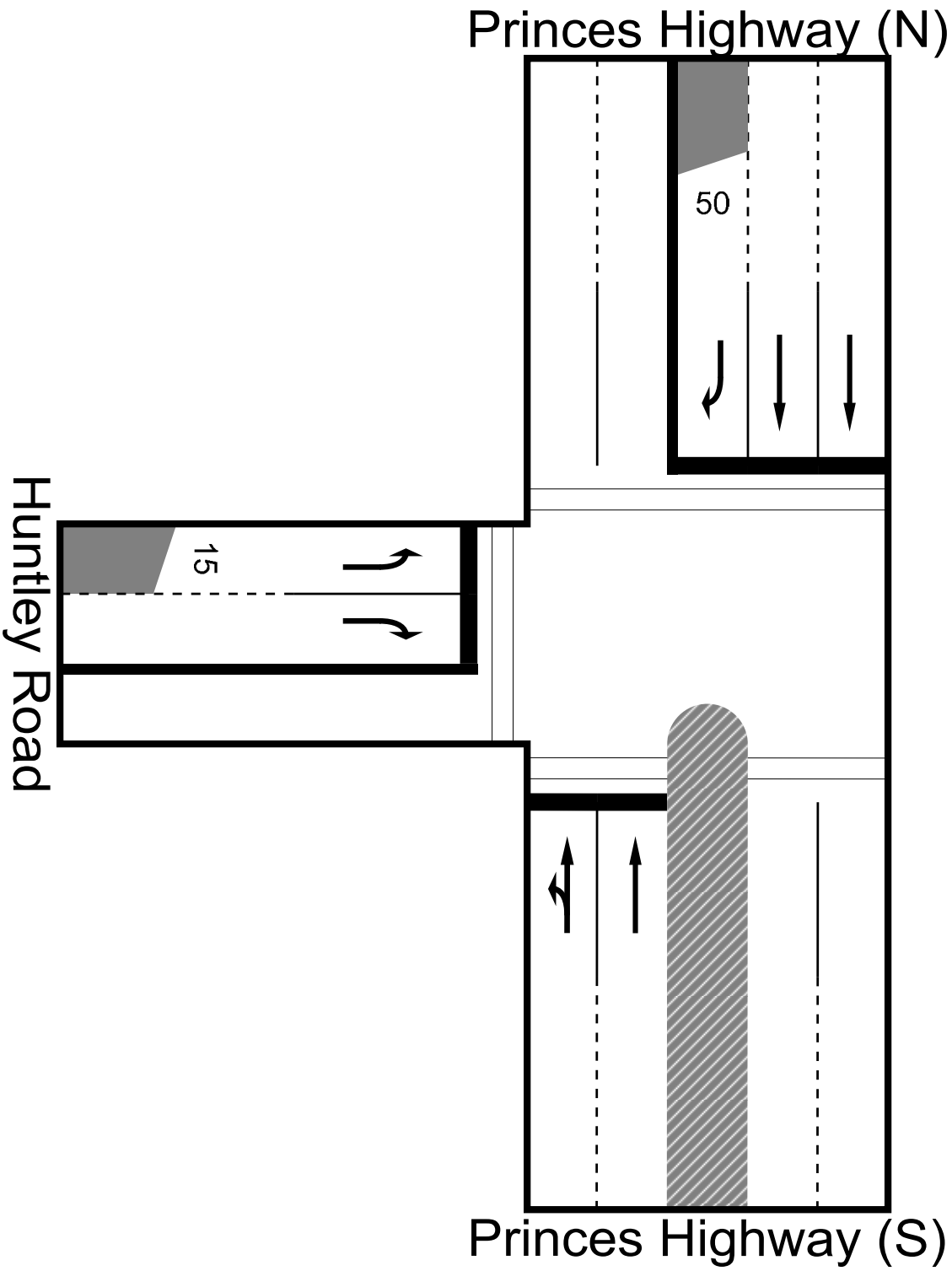
Concept Intersection Layouts – Future Base Upgrades

APPENDIX 10A – Concept Intersection Layouts - Future Base Upgrades

Princes Highway and Huntley Road

Signalise existing priority controlled intersection plus provide an additional right turn bay (50m) on the northern approach. Refer to Figure 10A-1.

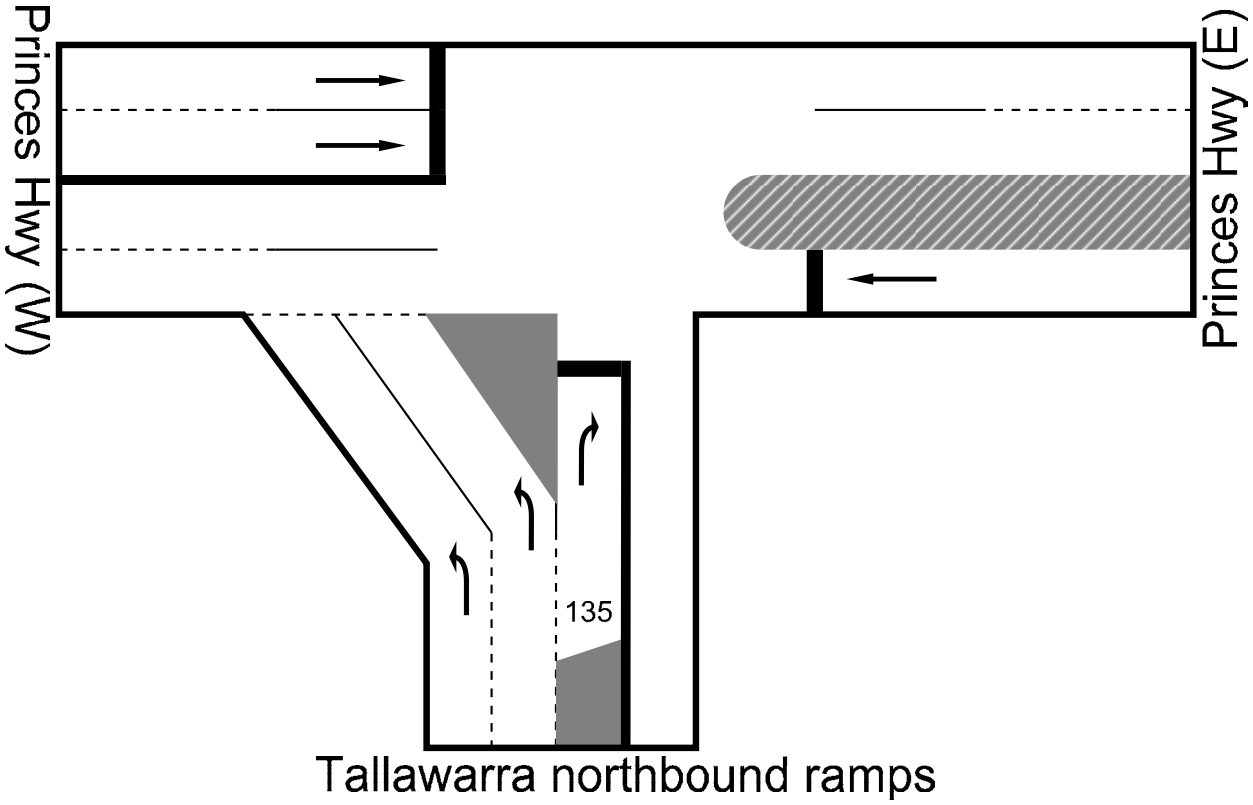
Figure 10A-1 Proposed Conceptual Layout of Princes Hwy/Huntley Rd



Princes Highway and F6 Southbound Off-Ramp

Signalise existing priority controlled intersection with left turn on off-ramp converted to left slip lane, as well as additional through lane on Princes Highway as per carriageway upgrade. Refer to Figure 10A-2.

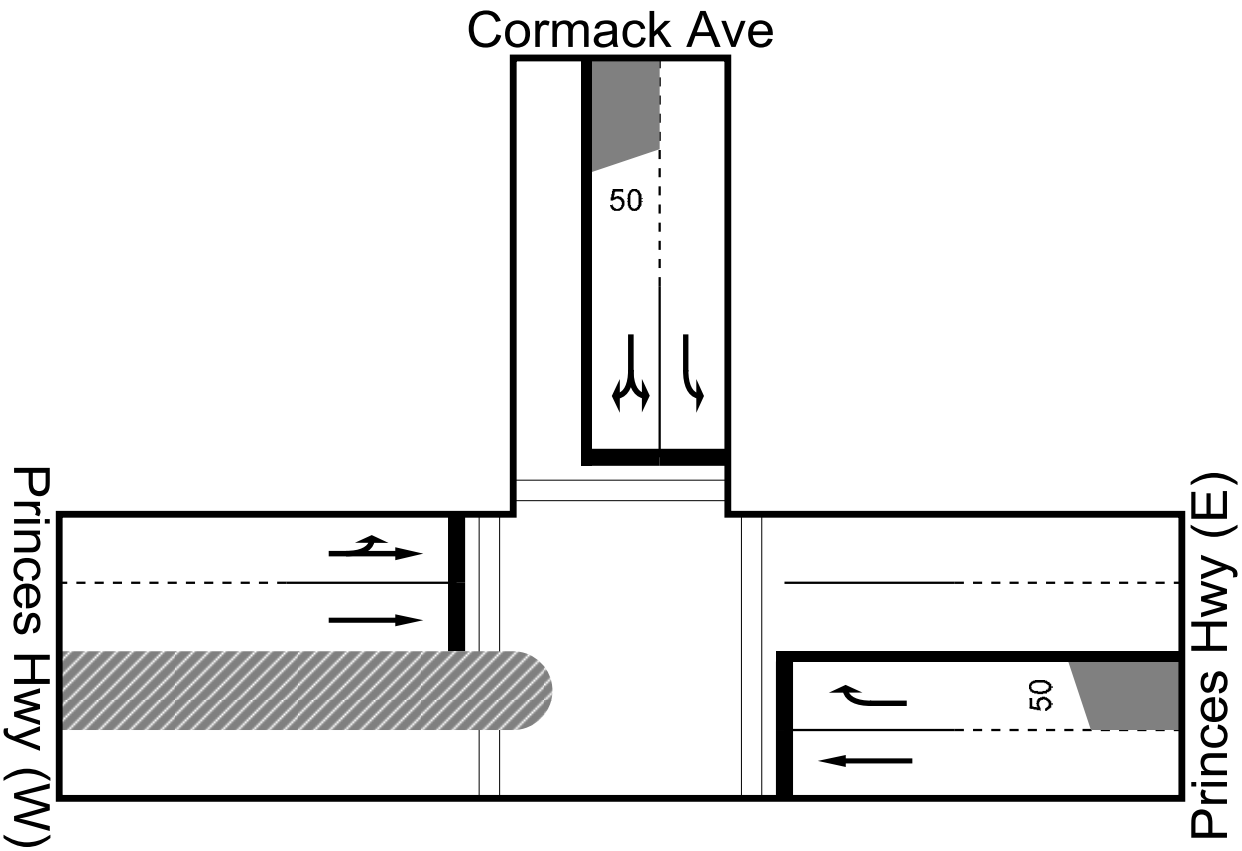
Figure 10A-2 Proposed Conceptual Layout of Princes Hwy/ F6 Southbound Off-Ramp



Princes Highway and Cormack Avenue

Signalise existing priority controlled intersection plus provide an additional right turn bay (50m) on south/eastern approach, additional through lane south\eastbound as per carriageway upgrade, as well as mark approach lanes on northern approach to provide left turn lane and right turn bay (50m). Refer to Figure 10A-3.

Figure 10A-3 Proposed Conceptual Layout of Princes Hwy/ Cormack Ave



Tripoli Way Junctions

In conjunction with the provision of the Tripoli Way connection (Albion Park By-pass) upgrades to intersection controls will be required at the following locations:

- Illawarra Highway and Broughton Avenue - provide a fourth leg to the roundabout (northern approach) for connecting in one of the Calderwood collector roads. Refer to Figure 10A-4.
- Calderwood Road upgrade to Roundabout. Refer to Figure 10A-5.
- Illawarra Highway upgrade to Traffic signals. Refer to Figure 10A-6.
- Tongarra Road upgrade to Traffic signals Roundabout. Refer to Figure 10A-7.

Figure 10A-4 Proposed Conceptual Layout of Illawarra Hwy/ Broughton Ave

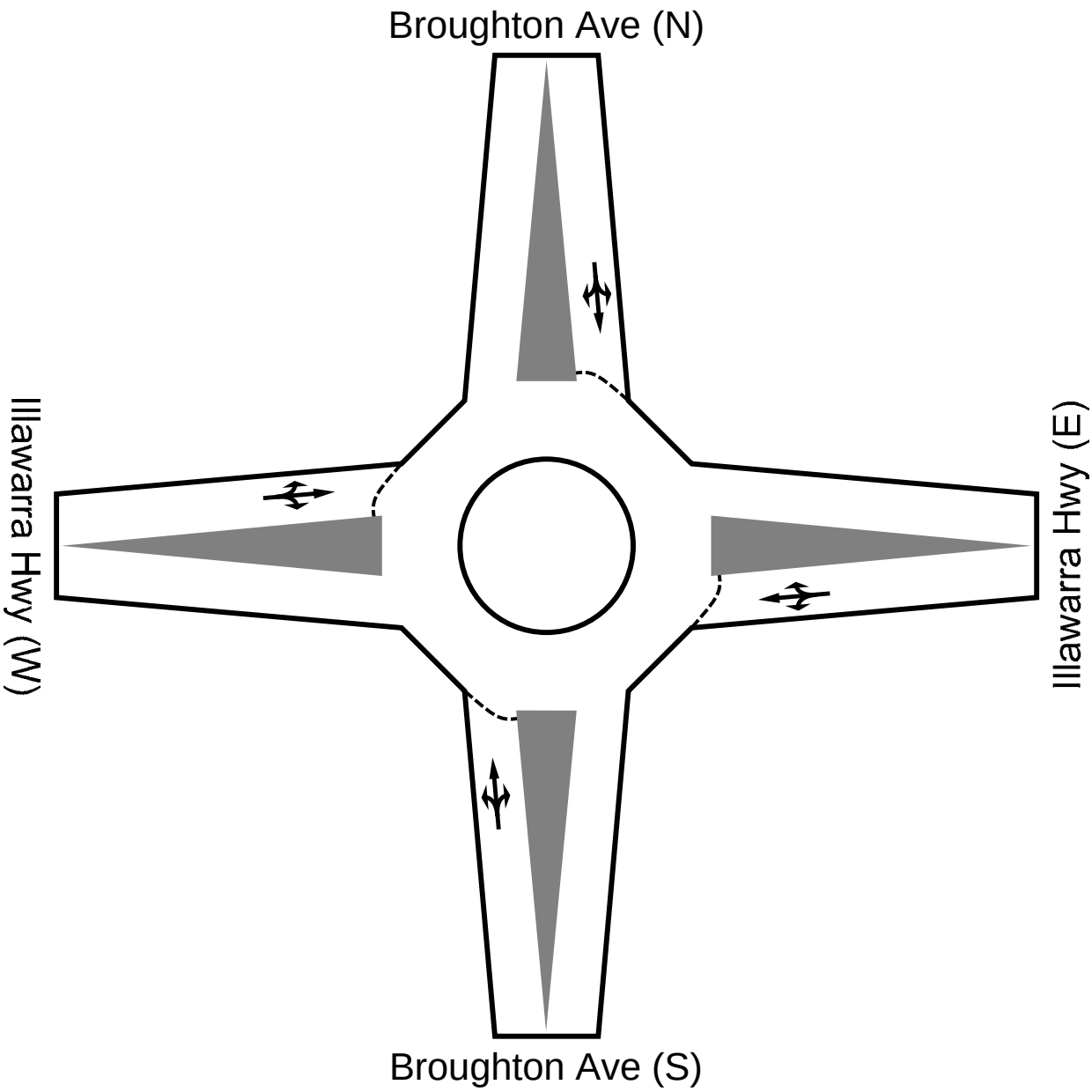


Figure 10A-5 Proposed Conceptual Layout of Tripoli Way/ Calderwood Rd

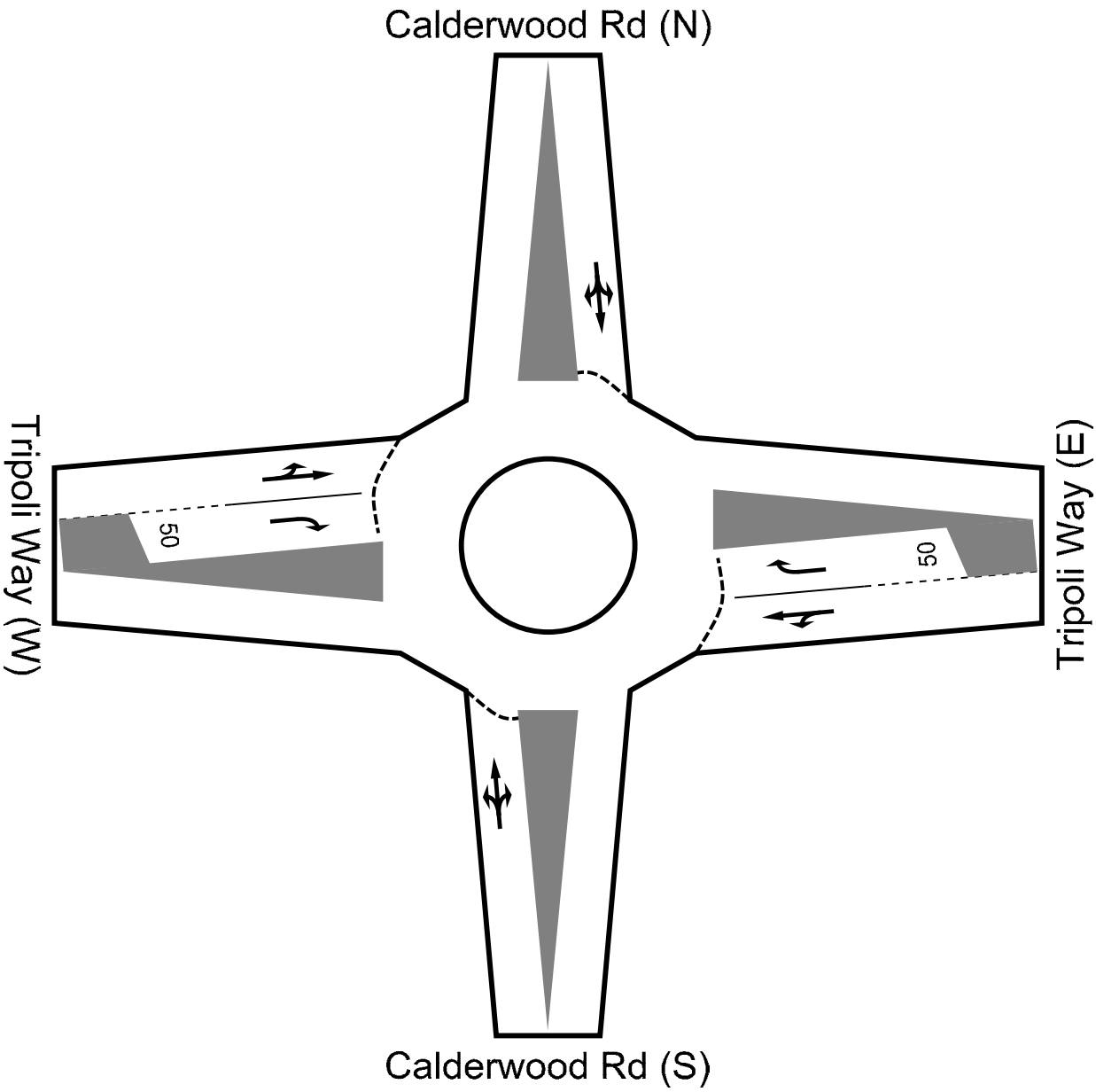


Figure 10A-6 **Proposed Conceptual Layout of Tripoli Way/ Illawarra Hwy**

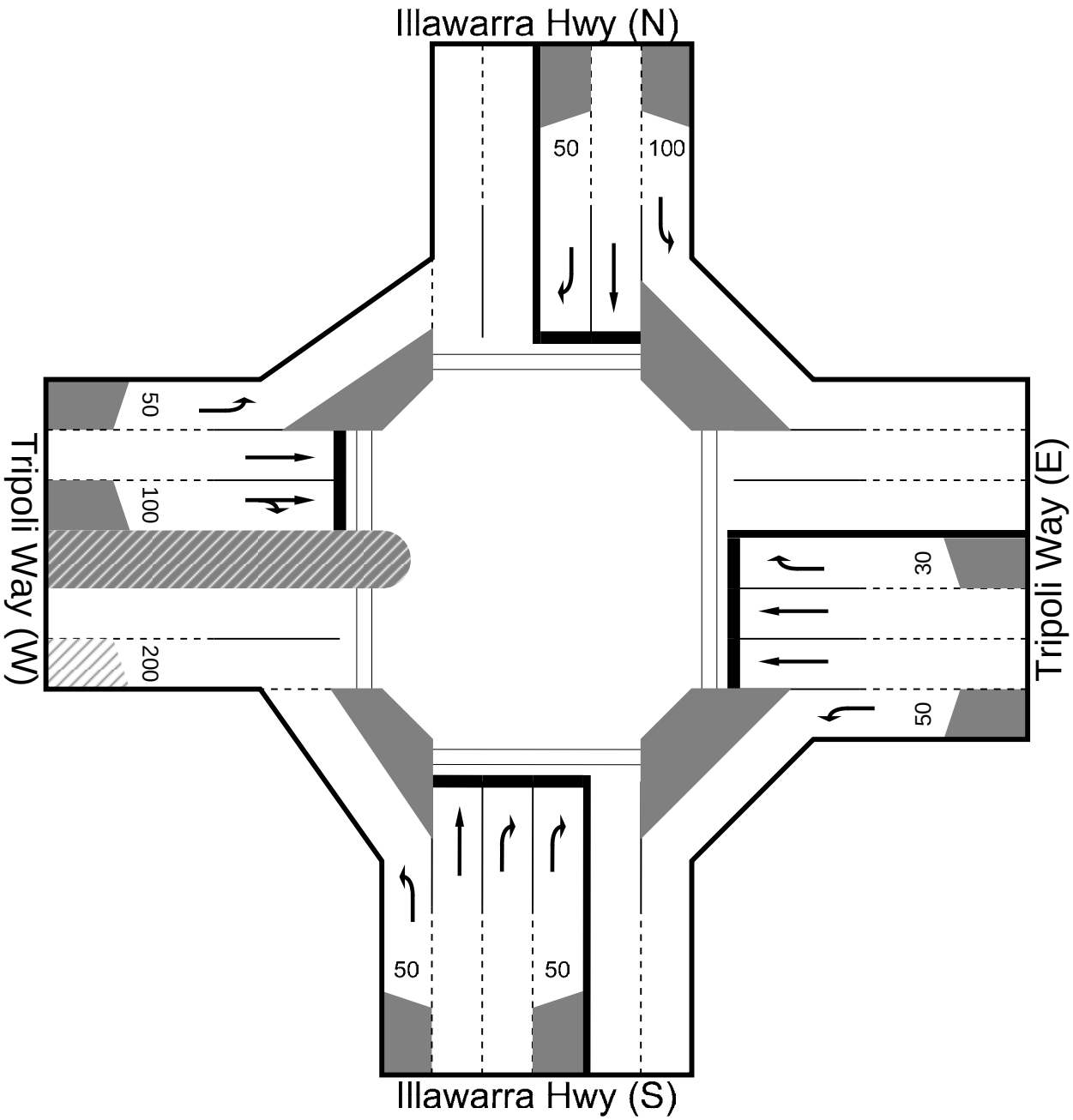
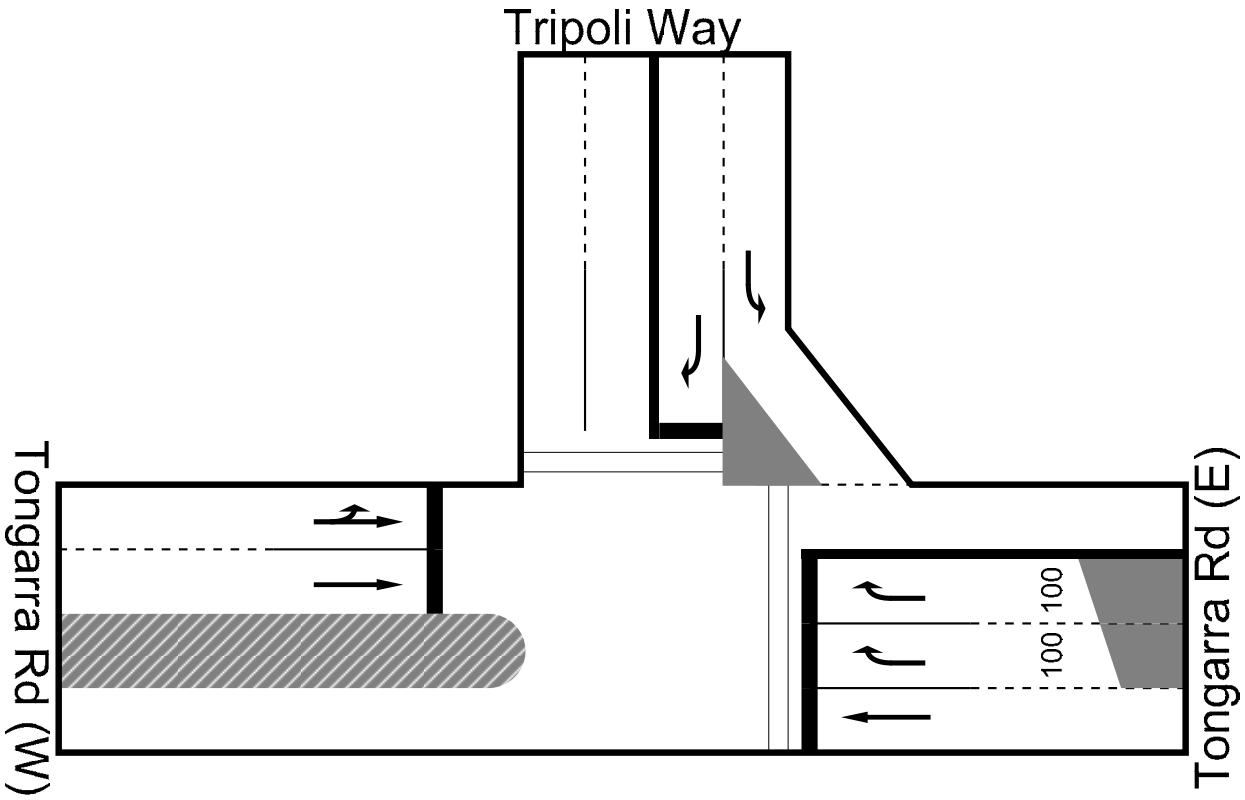


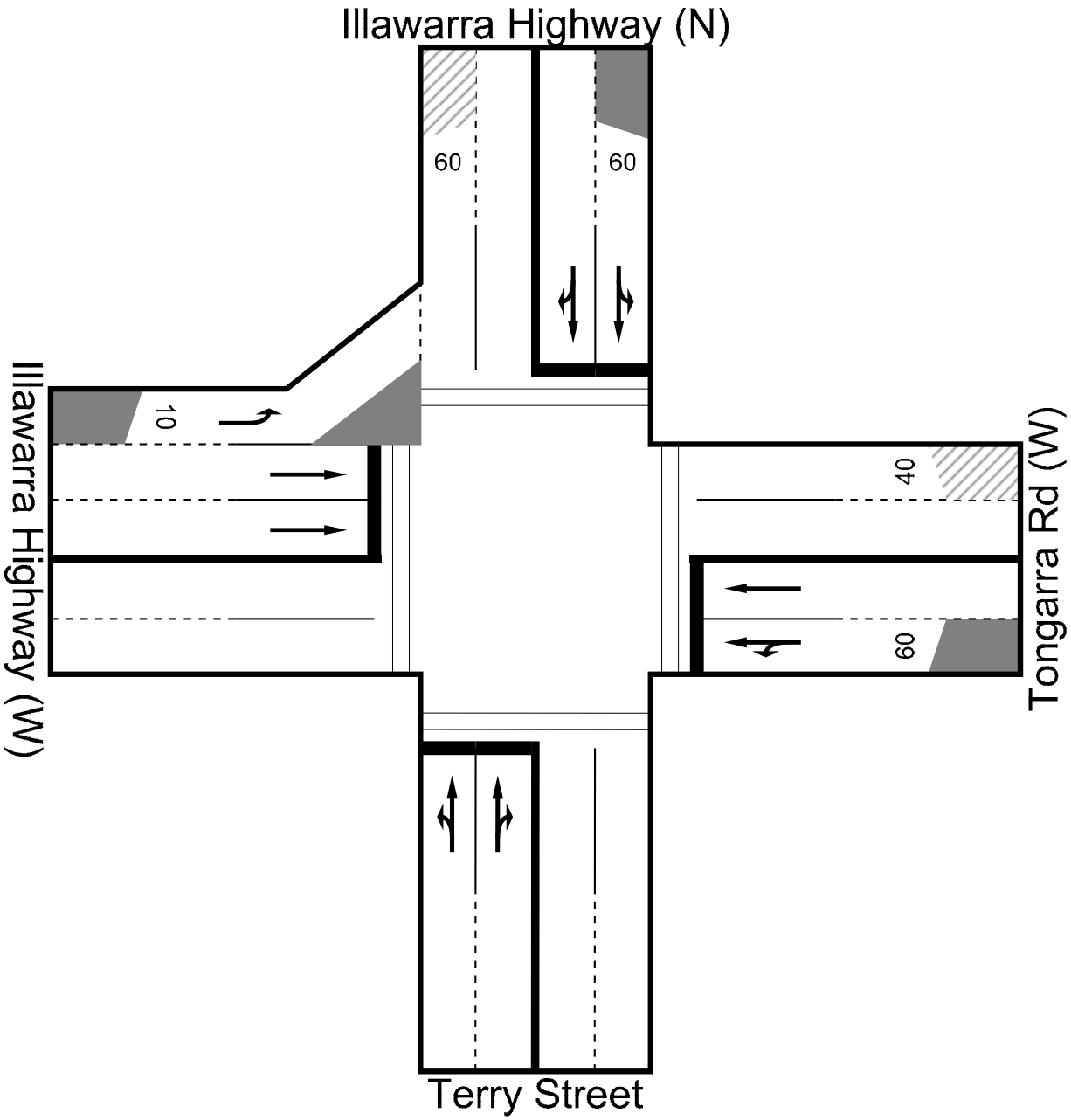
Figure 10A-7 Proposed Conceptual Layout of Tripoli Way/ Tongarra Rd



Illawarra Highway and Tongarra Road/Terry Street

Minor signal alterations - adjustments to timings and install through and right arrow in right turn lane on southern approach. Refer to Figure 10A-8.

Figure 10A-8 Proposed Conceptual Layout of Illawarra Hwy/ Terry St



Appendix 10B

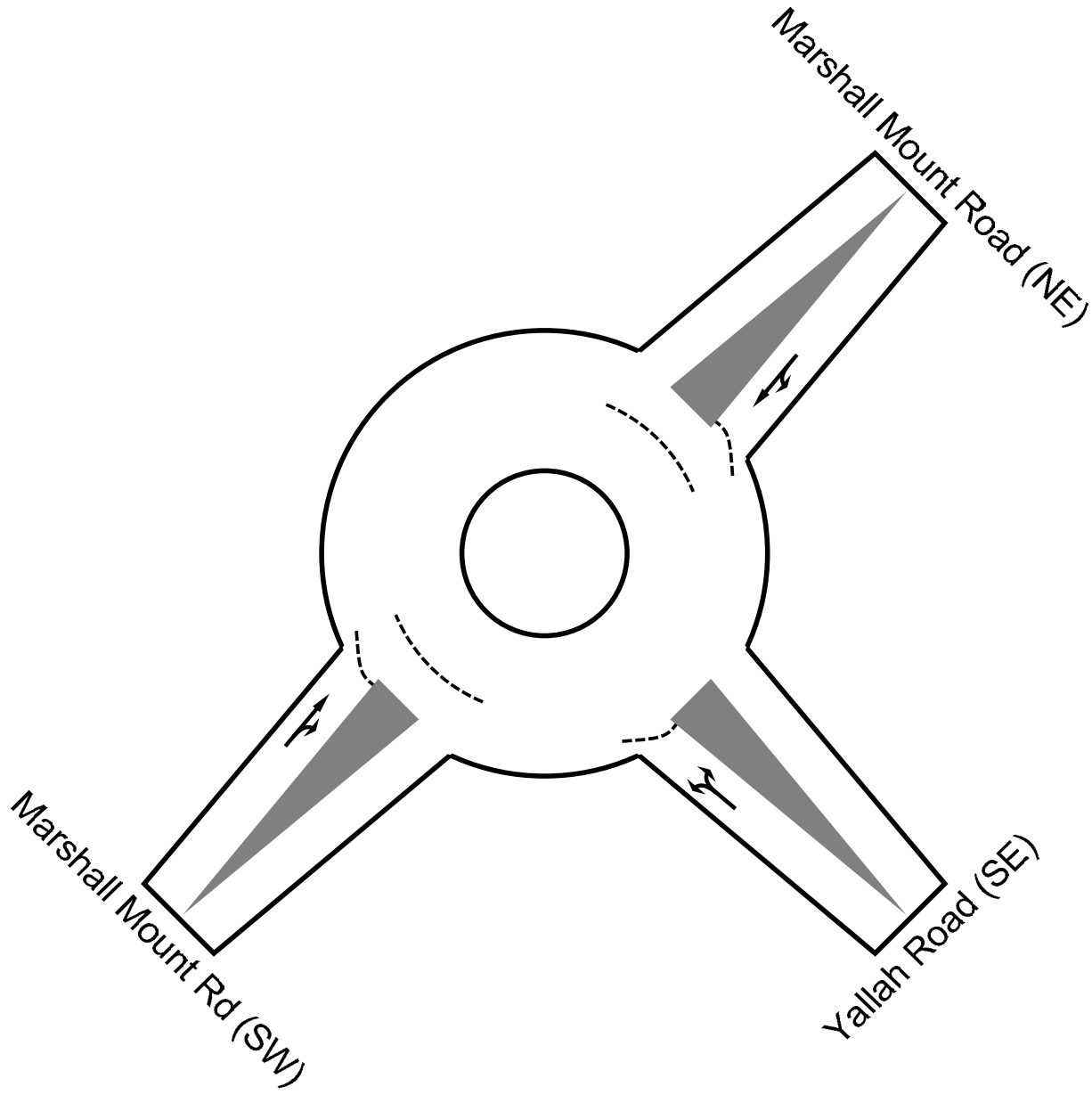
Concept Intersection Layouts – Future Full CUDP Development Upgrades

APPENDIX 10B – Concept Intersection Layouts - Future Full CUDP Development Upgrades

Marshall Mount Road and Yallah Road

Upgrade existing T-intersection to 30 metre ICD single lane roundabout. Refer to Figure 10B-1.

Figure 10B-1 Proposed Conceptual Layout of Marshall Mount Road/ Yallah Road



Illawarra Highway and Yellow Rock Road

Convert existing priority control intersection to 4 arm roundabout with additional northern leg for Calderwood North-South Route. Refer to Figure 10B-2.

Figure 10B-2 Proposed Conceptual Layout of Illawarra Hwy/ Yellow Rock Road