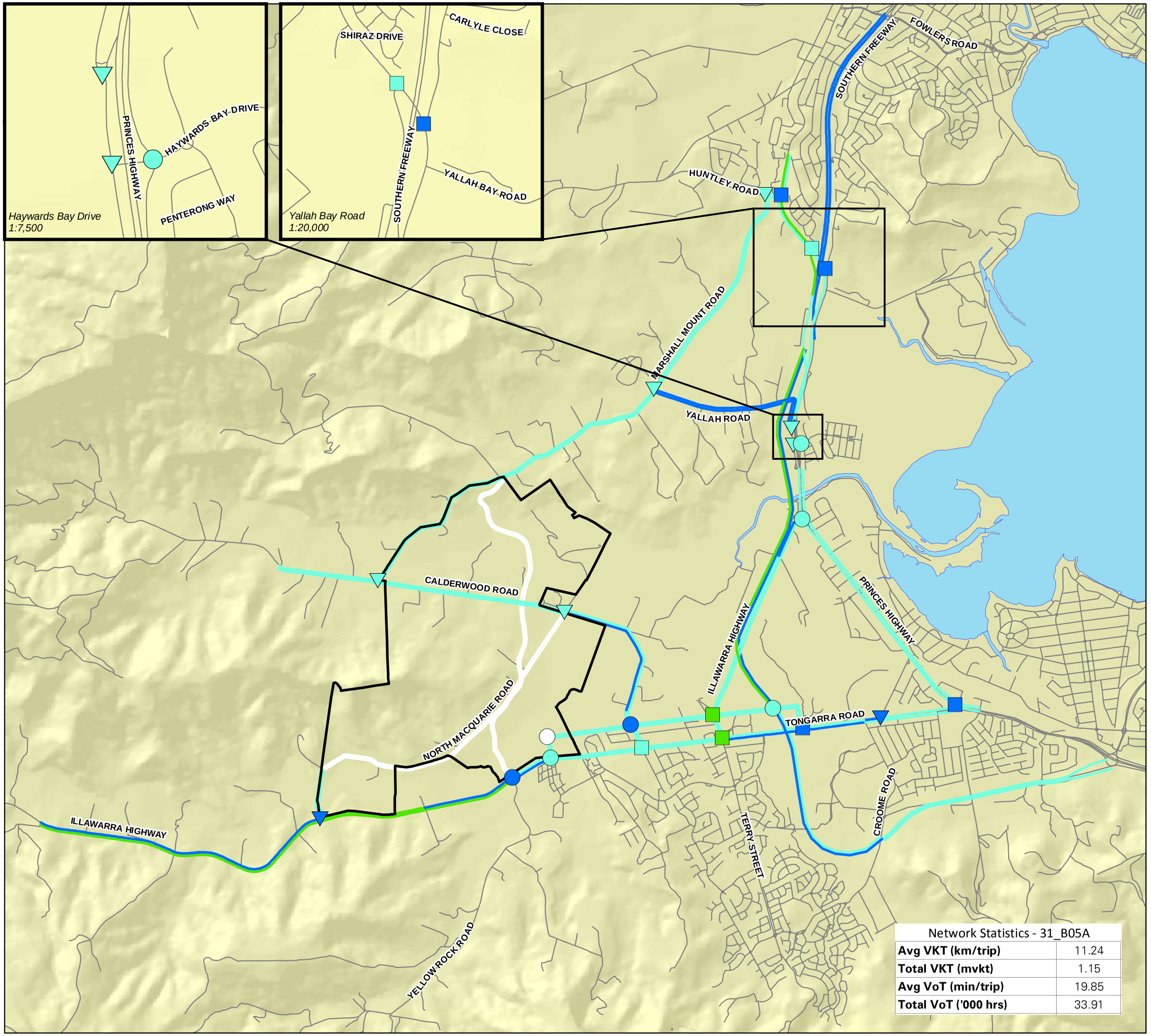

Network Statistics - 31_B05A	
Avg VKT (km/trip)	11.24
Total VKT (mvkt)	1.15
Avg VoT (min/trip)	19.85
Total VoT ('000 hrs)	33.91

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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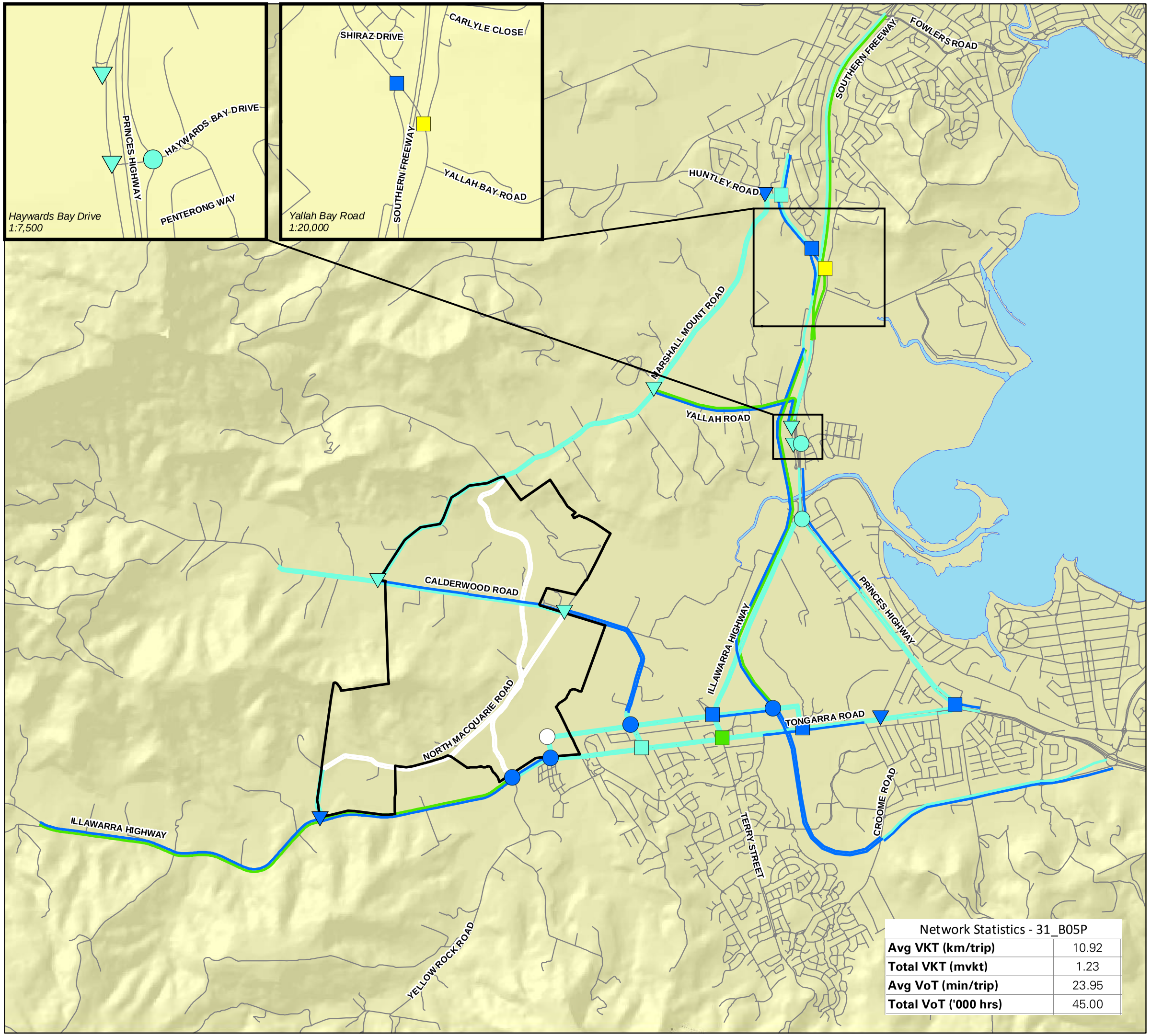
Coordinate System: Zone 56 MGA/GDA 94
GIS MAP REF: 110026-01_58028_KeyRoutes_LevelOfService_31_B05A.mxd 04



Network Statistics - 31_B05P	
Avg VKT (km/trip)	10.92
Total VKT (mvkt)	1.23
Avg VoT (min/trip)	23.95
Total VoT ('000 hrs)	45.00

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.

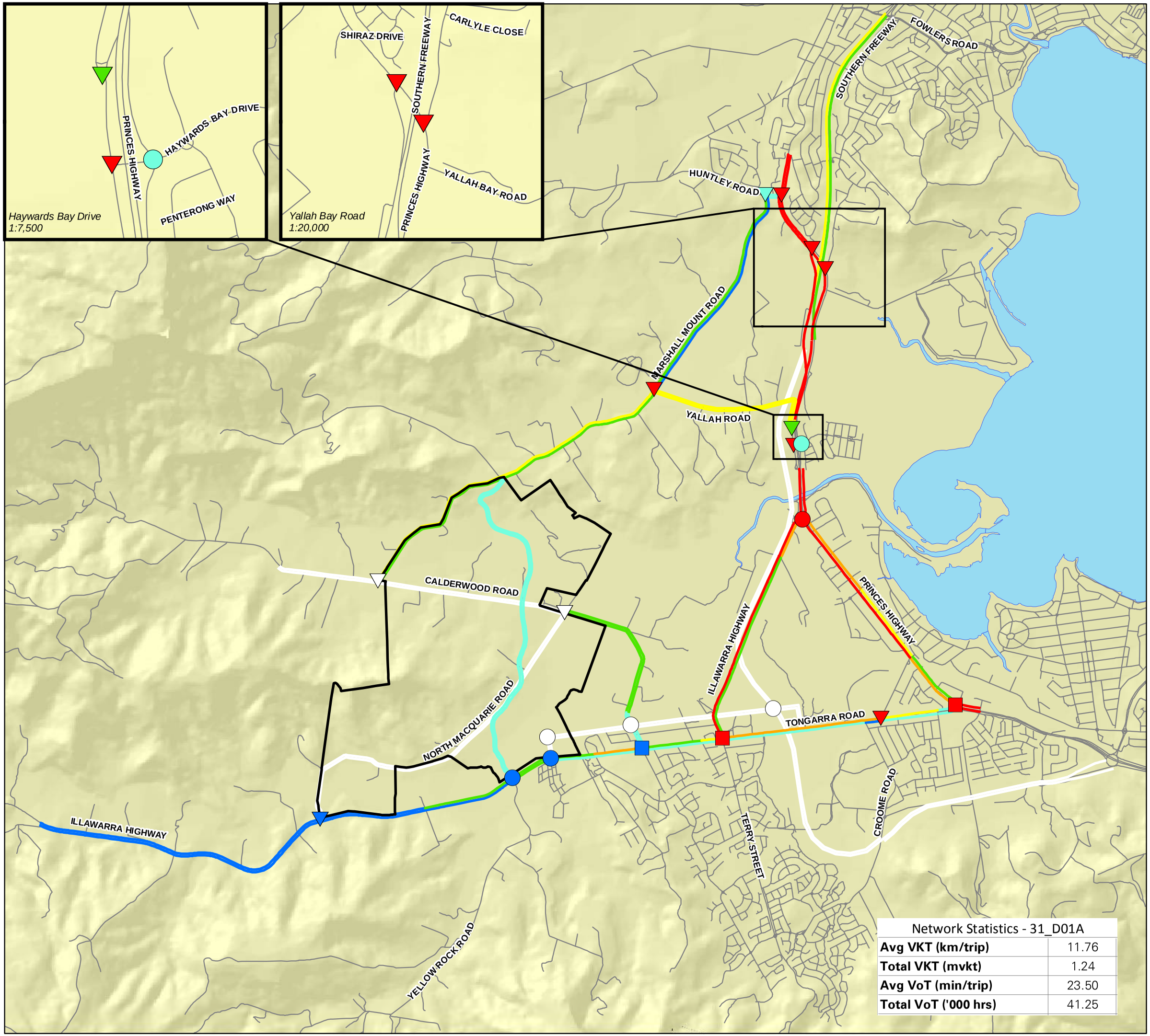
Table 7.2 provides an overview of the CUDP model scenarios, detailing the scenario description and key outcomes for the scenario. Results of each scenario are then summarised in the figures in this chapter with detailed results presented in a series of appendices as identified in Table 7.2.

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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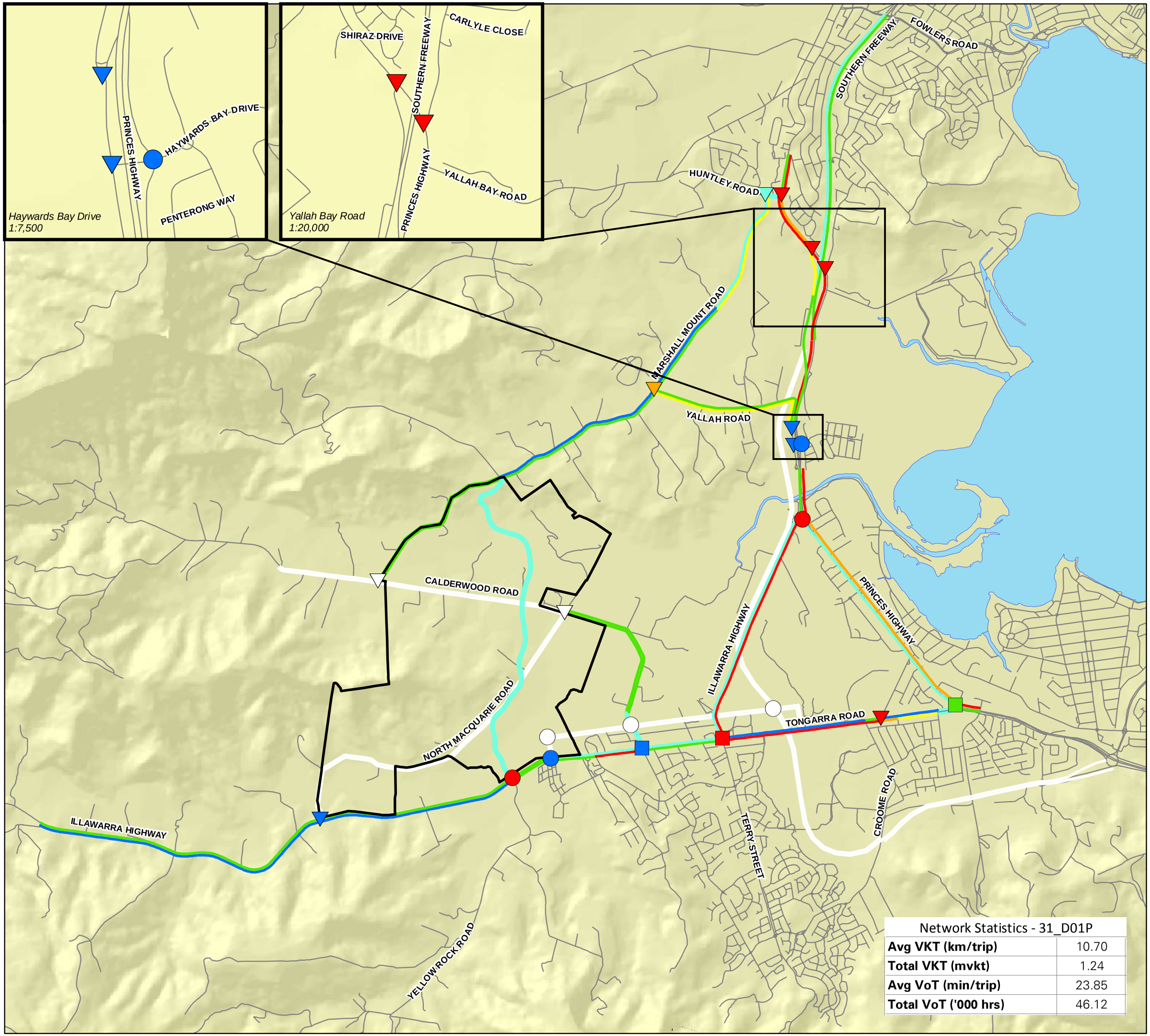

Network Statistics - 31_D01P	
Avg VKT (km/trip)	10.70
Total VKT (mvkt)	1.24
Avg VoT (min/trip)	23.85
Total VoT ('000 hrs)	46.12

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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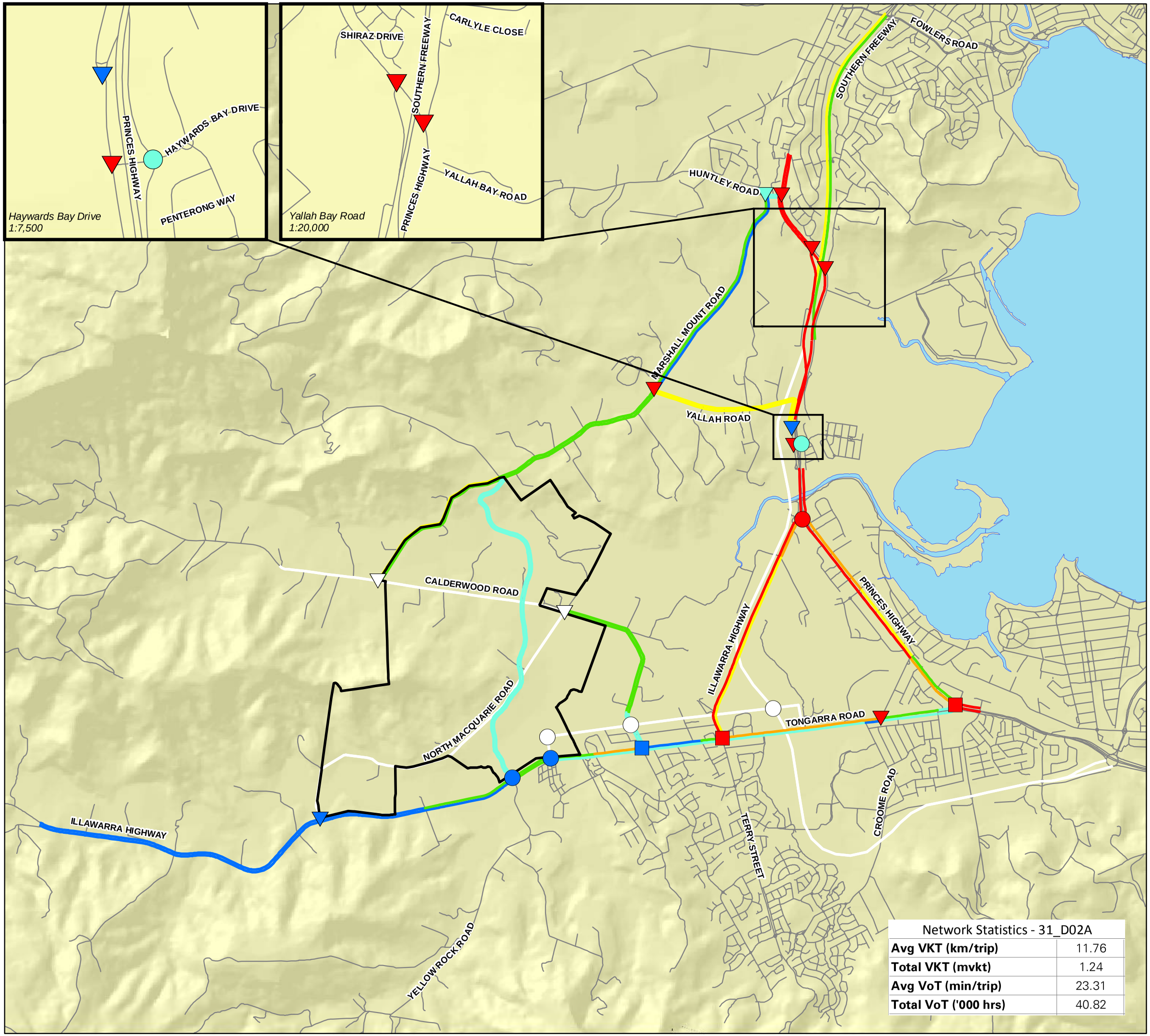

Network Statistics - 31_D02A	
Avg VKT (km/trip)	11.76
Total VKT (mvkt)	1.24
Avg VoT (min/trip)	23.31
Total VoT ('000 hrs)	40.82

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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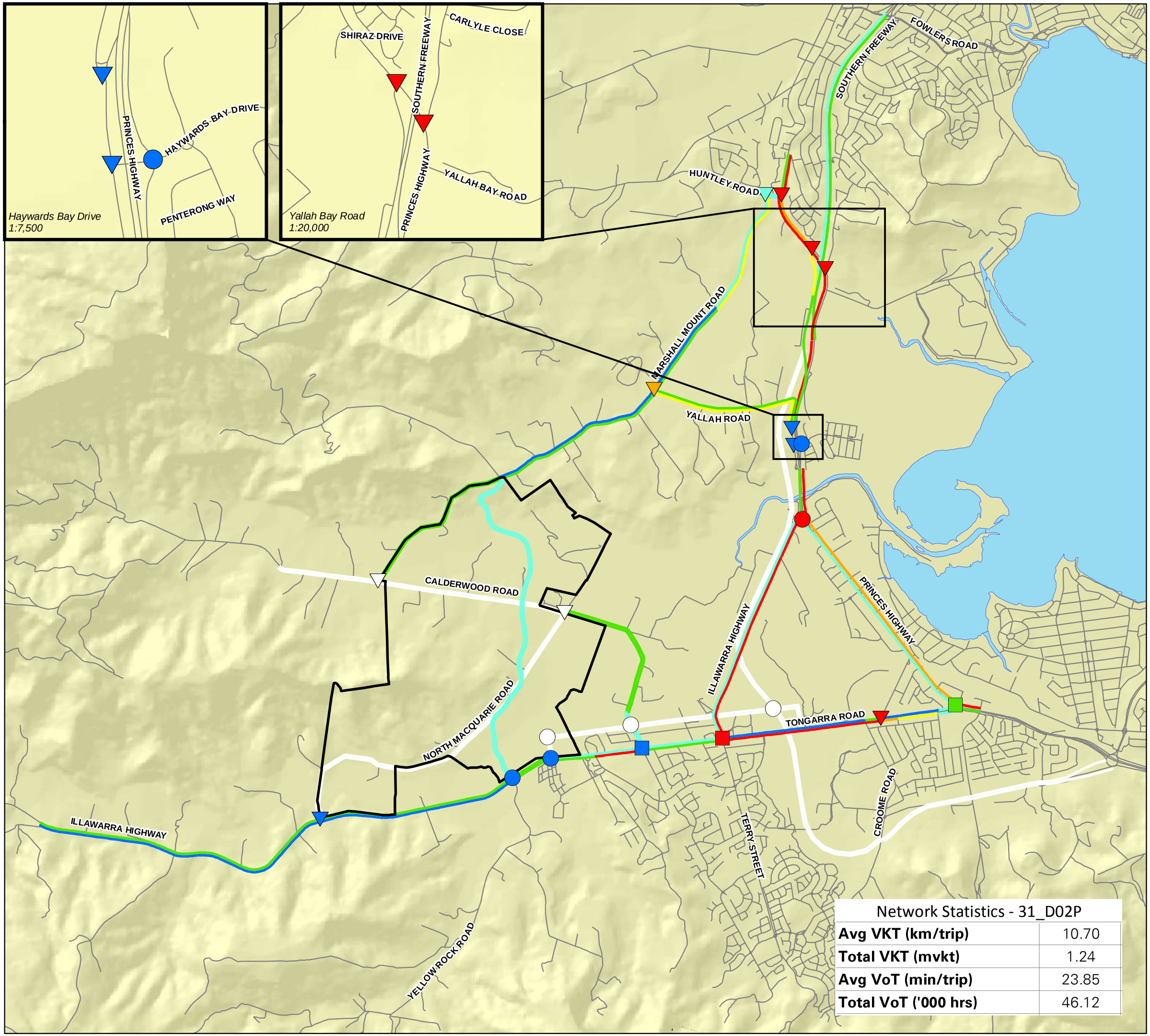

Network Statistics - 31_D02P	
Avg VKT (km/trip)	10.70
Total VKT (mvkt)	1.24
Avg VoT (min/trip)	23.85
Total VoT ('000 hrs)	46.12

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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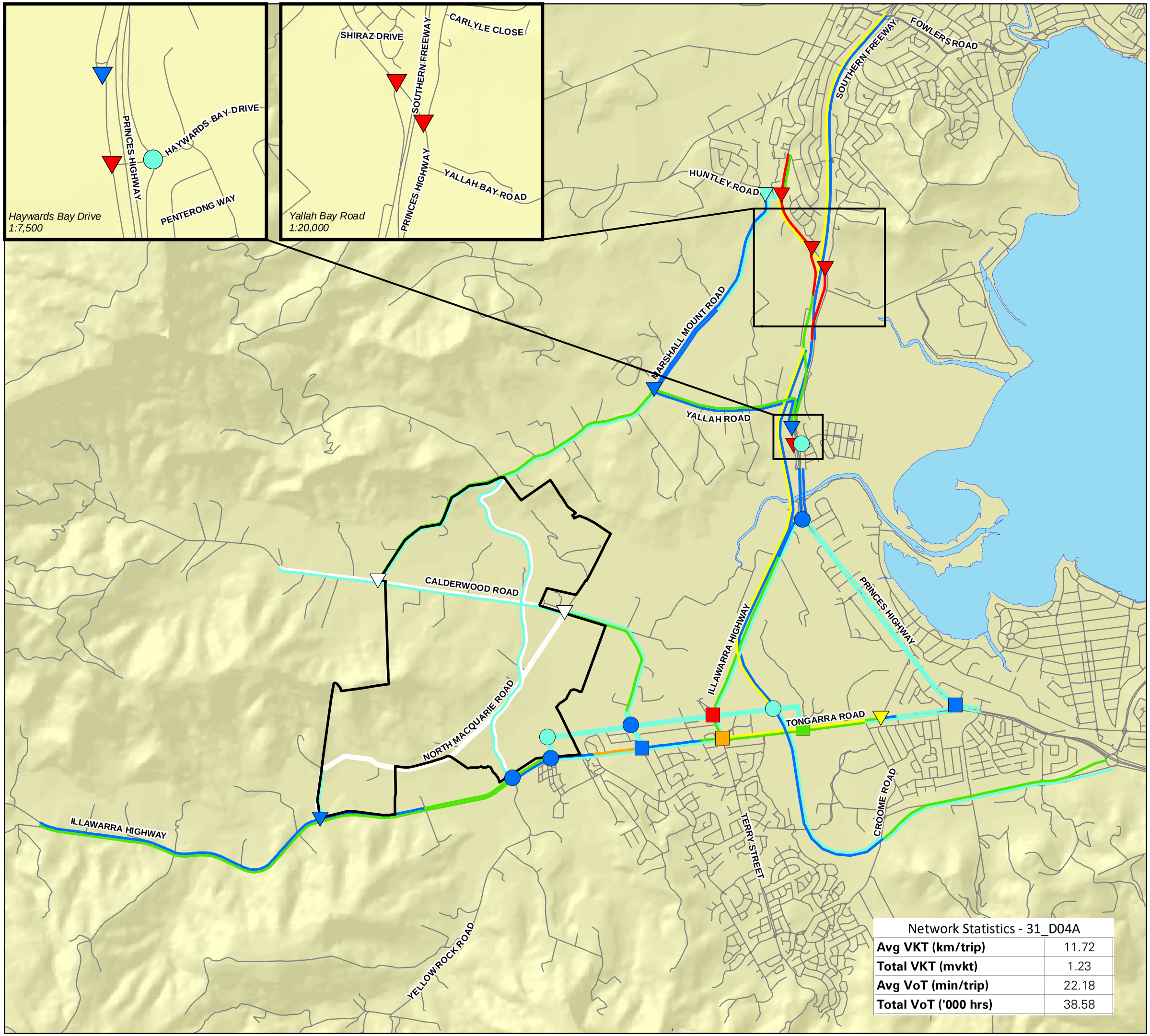

Network Statistics - 31_D04A	
Avg VKT (km/trip)	11.72
Total VKT (mvkt)	1.23
Avg VoT (min/trip)	22.18
Total VoT ('000 hrs)	38.58

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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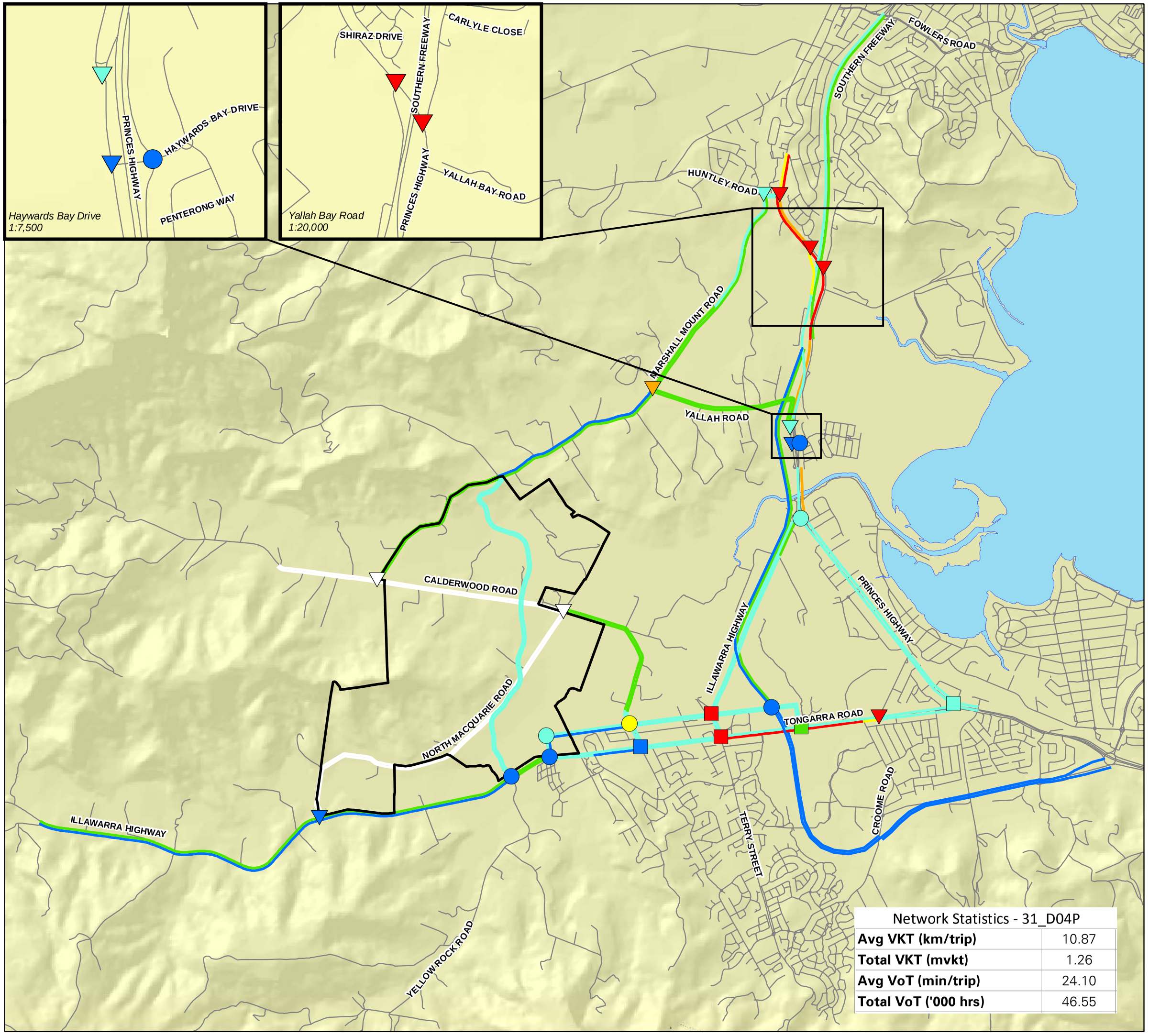

Network Statistics - 31_D04P	
Avg VKT (km/trip)	10.87
Total VKT (mvkt)	1.26
Avg VoT (min/trip)	24.10
Total VoT ('000 hrs)	46.55

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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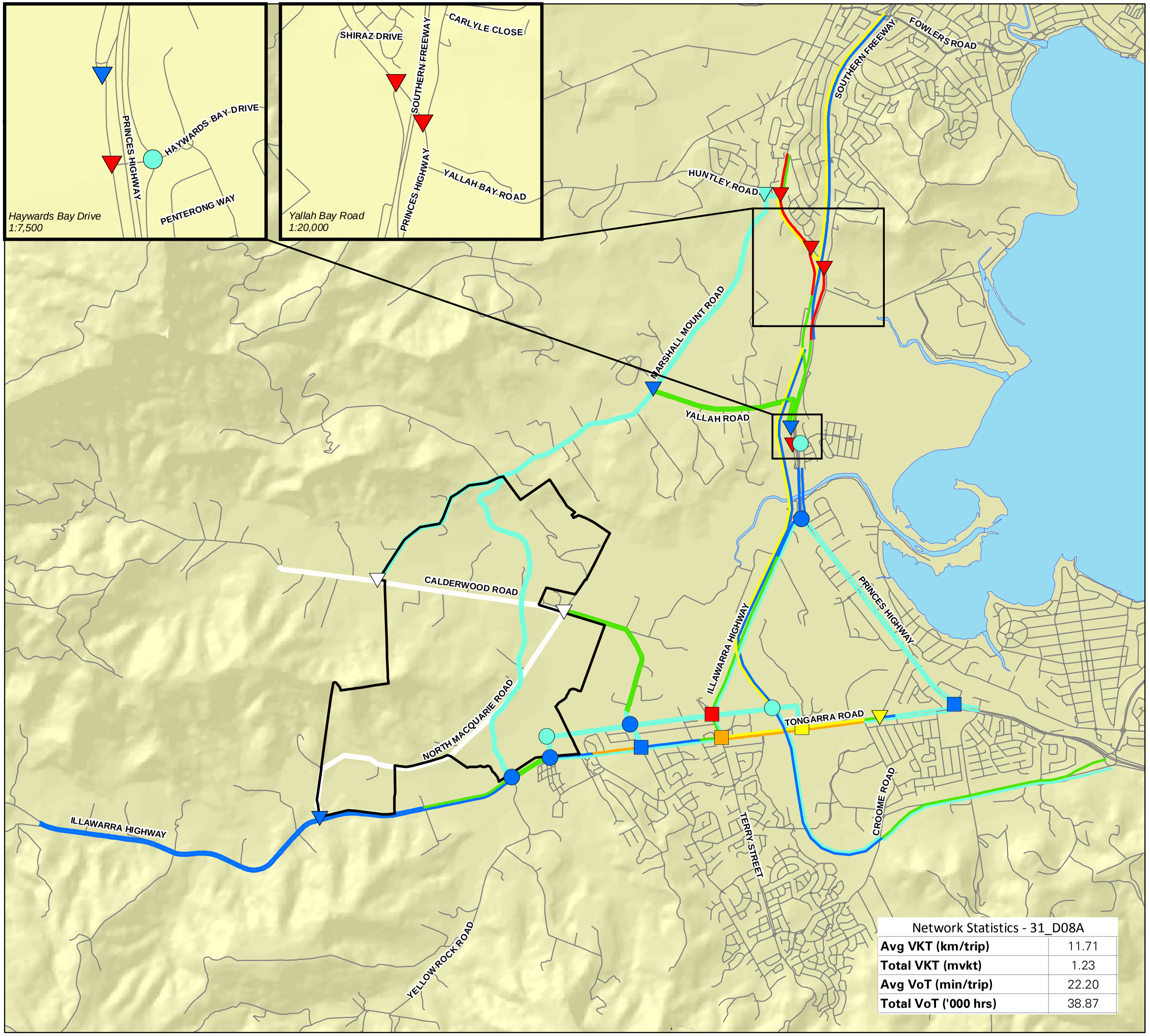
Coordinate System: Zone 56 MGA/GDA 94
GIS MAP REF: 110026-01_58035_KeyRoutes_LevelOfService_31_D04P.mxd 03



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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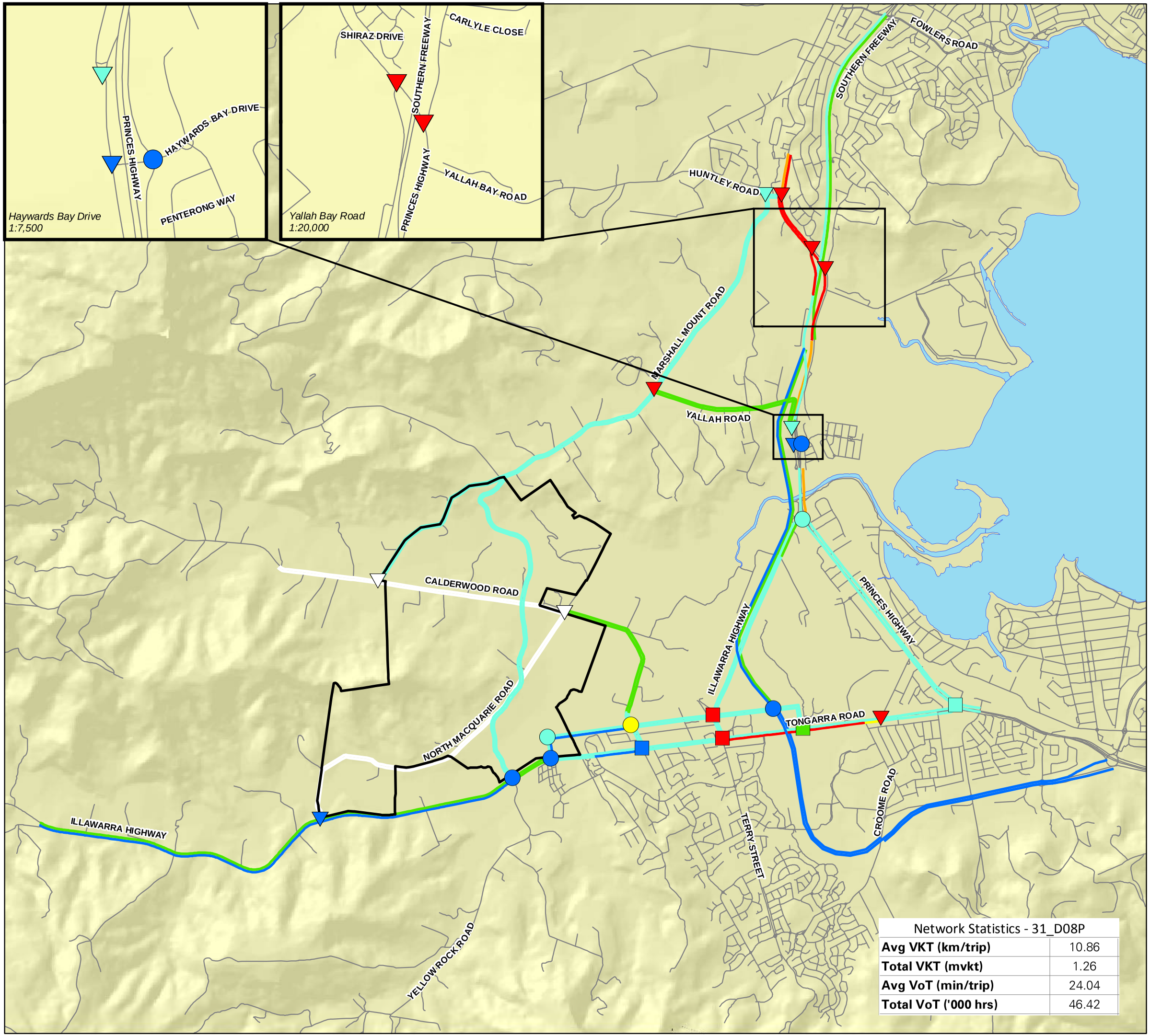

Network Statistics - 31_D08P	
Avg VKT (km/trip)	10.86
Total VKT (mvkt)	1.26
Avg VoT (min/trip)	24.04
Total VoT ('000 hrs)	46.42

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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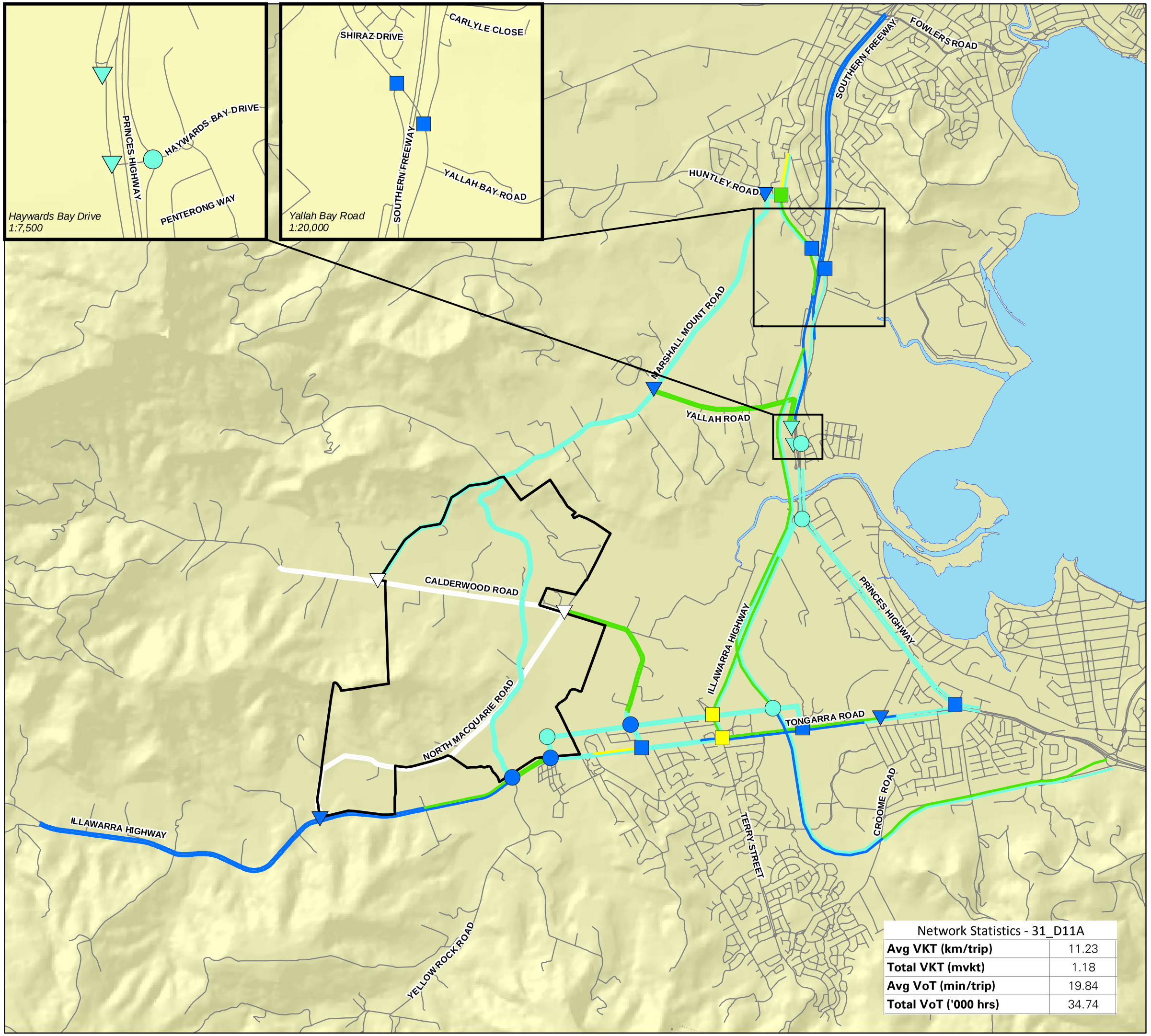

Network Statistics - 31_D11A	
Avg VKT (km/trip)	11.23
Total VKT (mvkt)	1.18
Avg VoT (min/trip)	19.84
Total VoT ('000 hrs)	34.74

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
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Cardno

Map Produced by Cardno Wollongong
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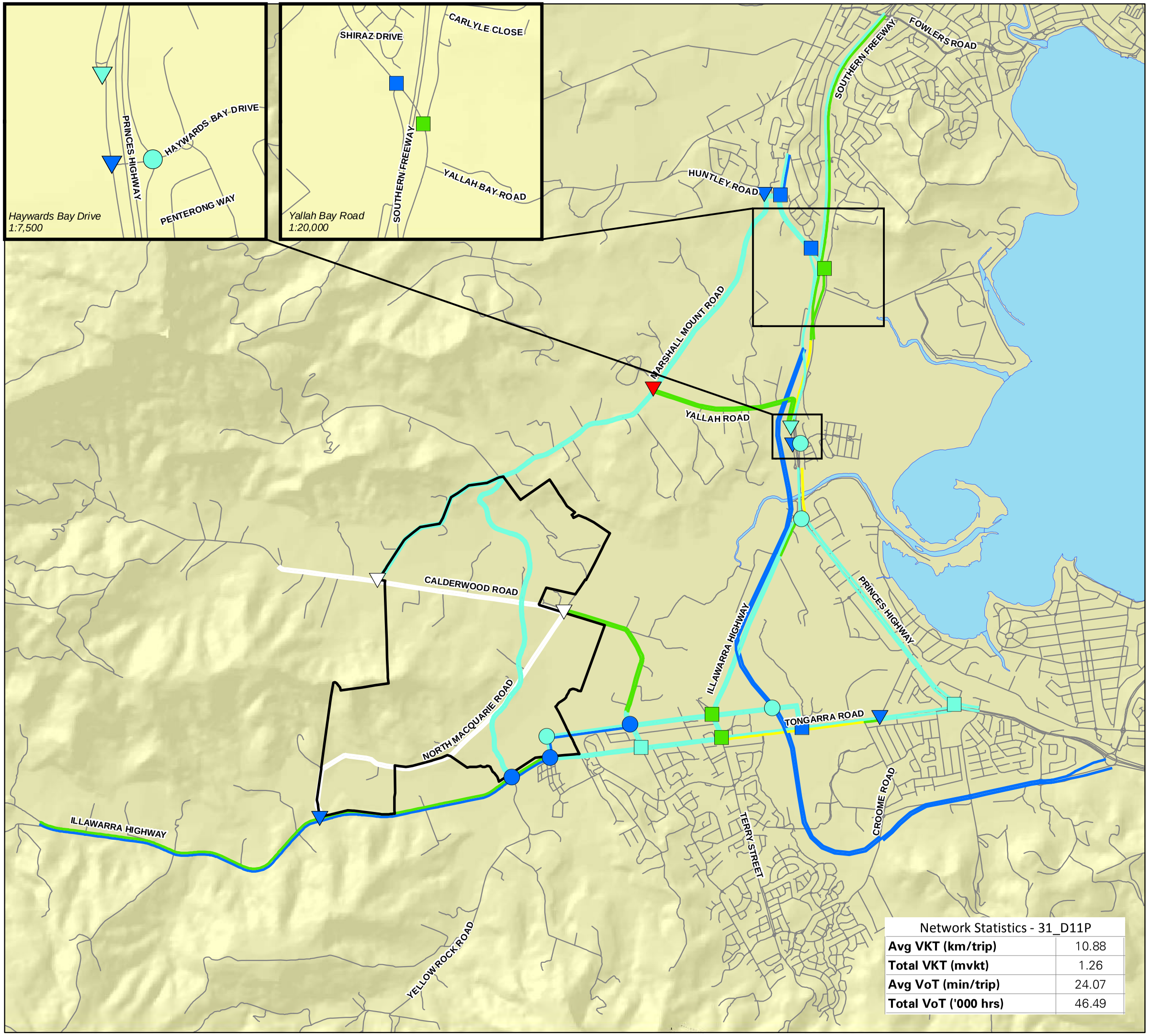

Delfin Lend Lease

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
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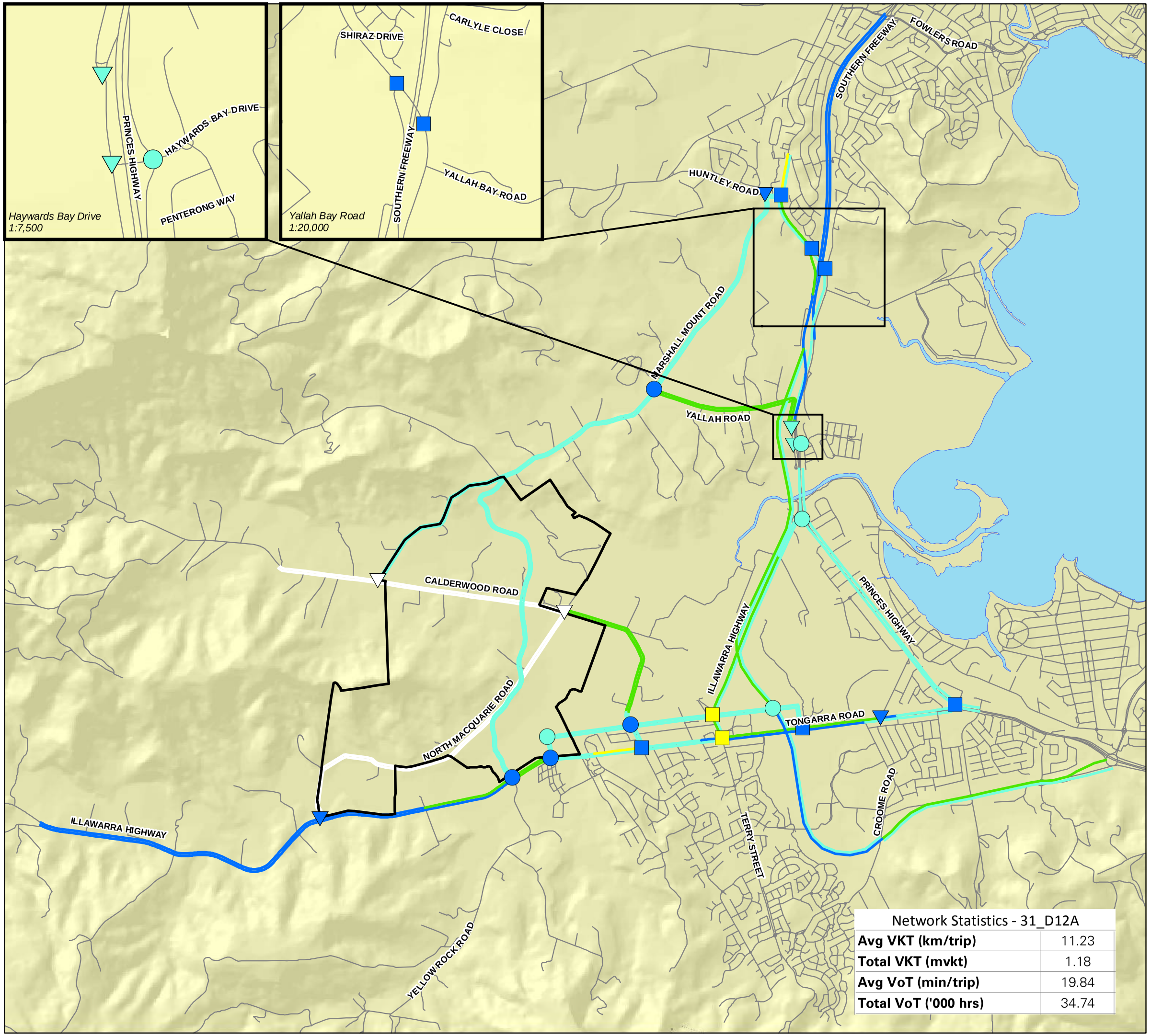

Delfin Lend Lease

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
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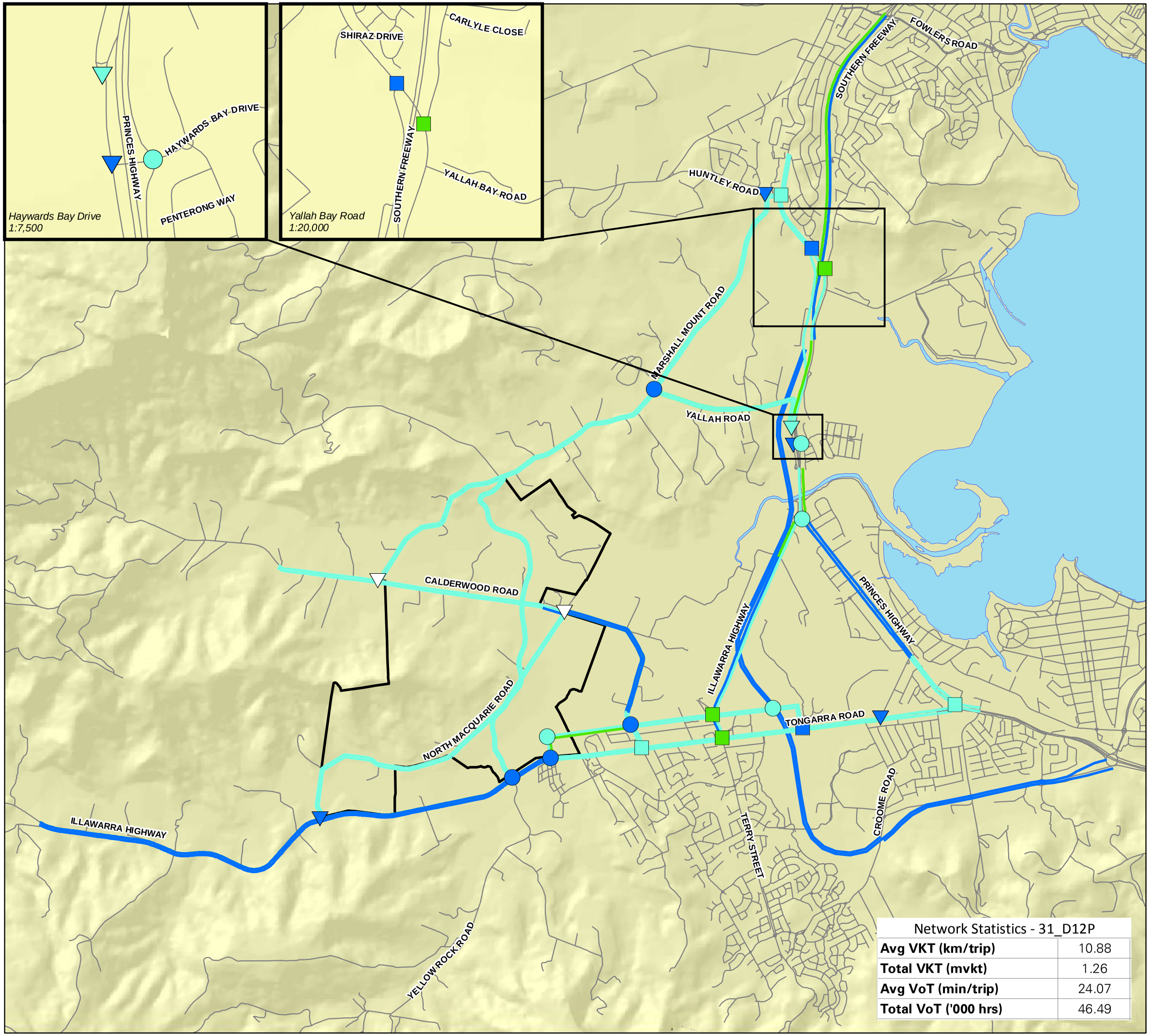


Delfin Lend Lease

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.

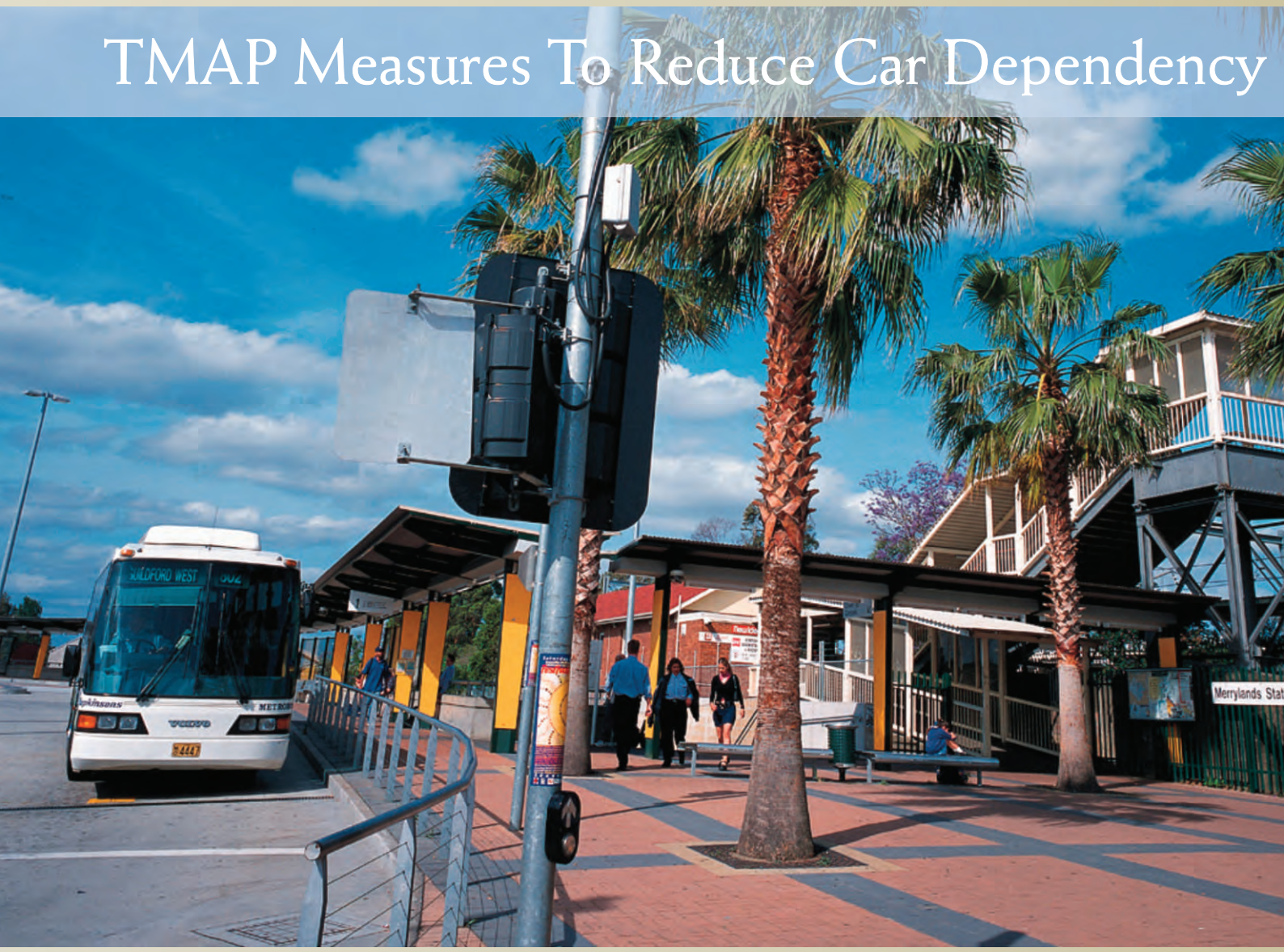
The high activity areas around the village centres will be designed around the fundamentals of:

- 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

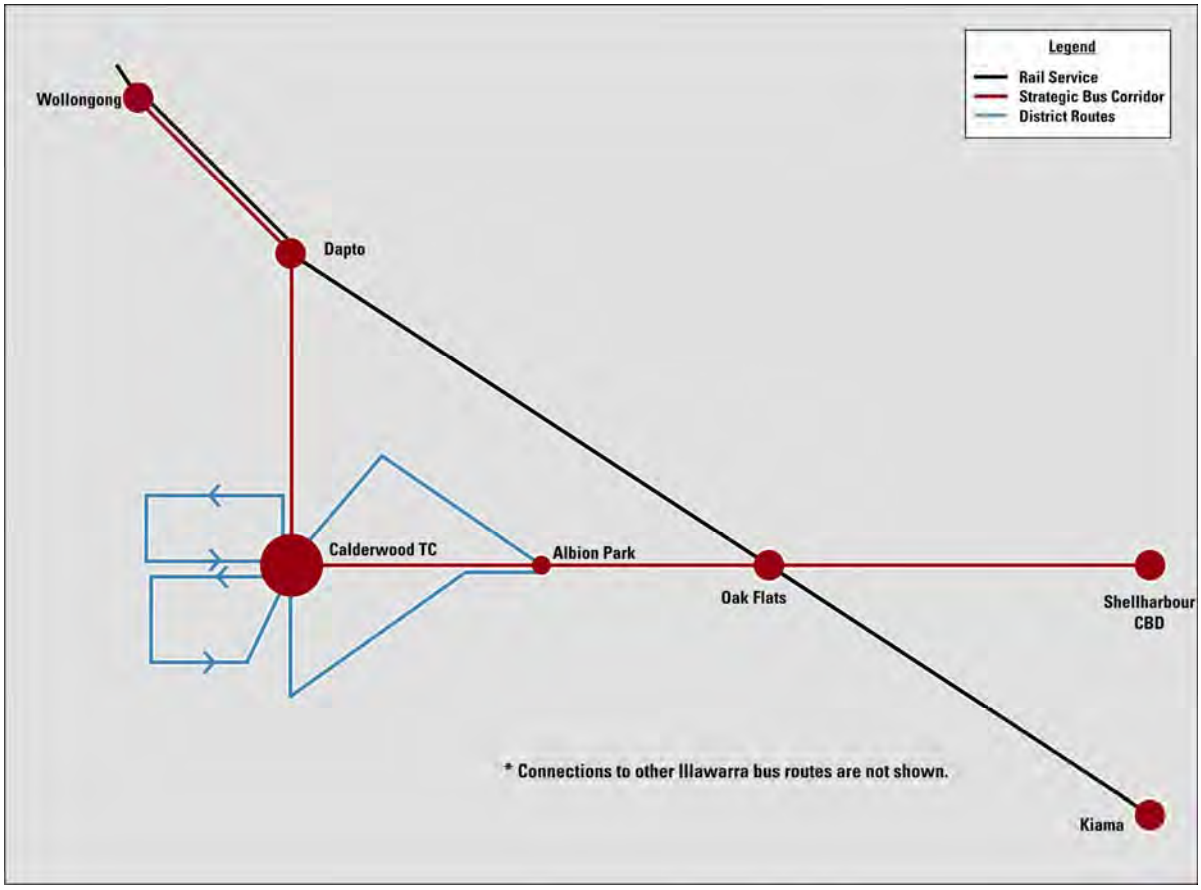


Figure 9.2 presents the proposed bus network relative to the concept plan. Table 9.3 summarises the number of changes required to reach key destinations.

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

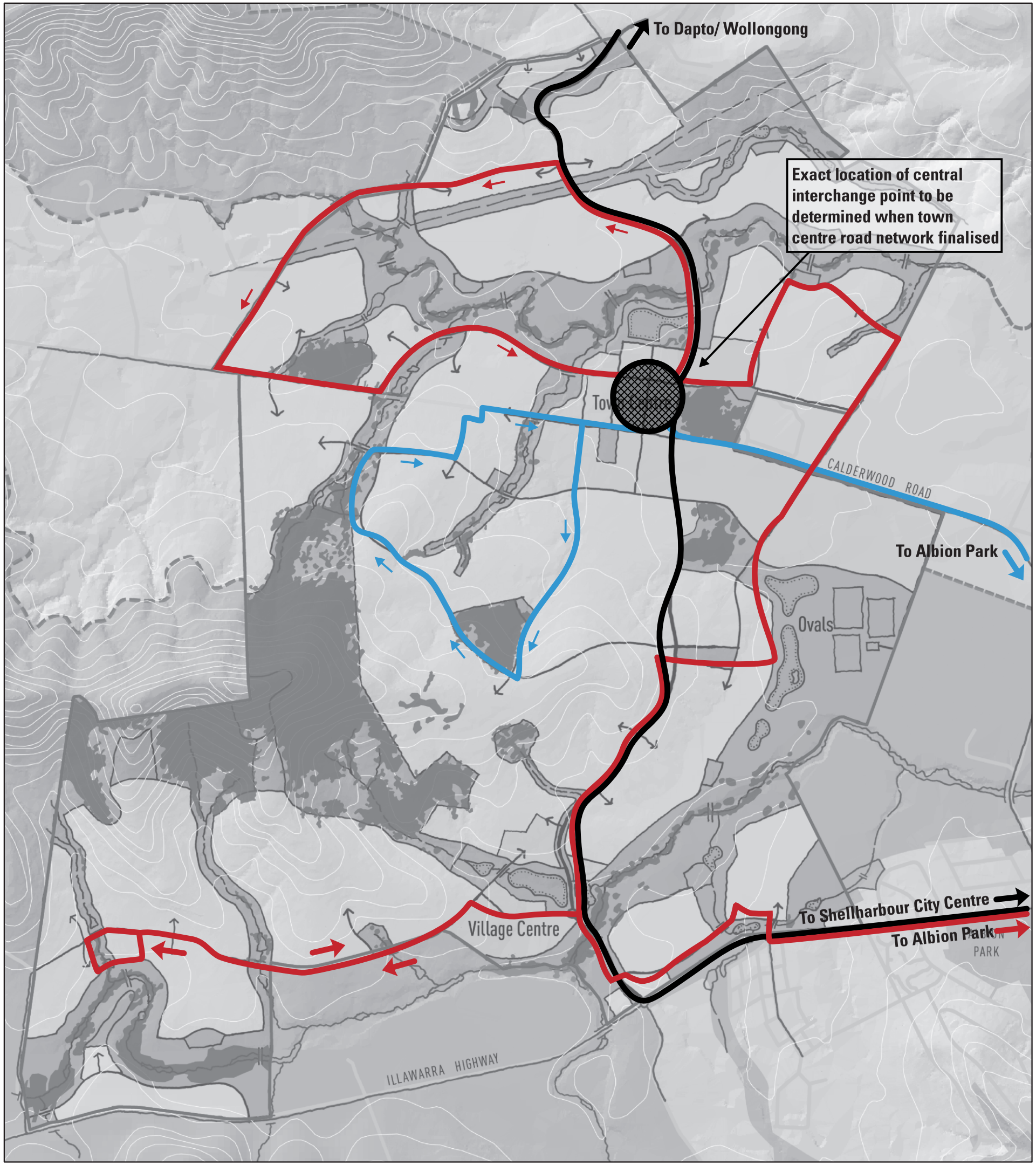


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Figure 9.2

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

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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