Alkimos Eglinton District Structure Plan. Appendix 4 Transport & Access.

ALKIMOS EGLINTON

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Alkimos Eglinton Structure Plan Transport and Access Supplementary report

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Contents

1. Introduction and background 1
1.1 Purpose of this report 1
1.2 Summary of main differences 1
2. Internal and external road network 2
2.1 Overview 2
2.2 Analysis process 2
2.3 Estimated traffic volumes 2
2.4 Functional road hierarchy 4
2.5 Mitchell Freeway 6
2.6 Marmion Avenue 6
2.7 Romeo Road 7
2.8 Alkimos Drive 9
2.9 Eglinton Avenue 10
2.10 Alkimos EW Coastal Village Distributor 10
2.11 Neighbourhood connector (A) 11
2.12 Neighbourhood connector (B) 11
2.13 Access Streets 12
2.14 Controls at major intersections 12
2.14.1 Mitchell Freeway interchanges 12
2.14.2 Marmion Avenue/ Romeo Road 14
2.14.3 Marmion Avenue/ Alkimos regional centre EW distributor 14
2.14.4 Marmion Avenue/ Alkimos Drive 14
2.14.5 Marmion Avenue/ Central EW connector 14
2.14.6 Marmion Avenue/ Eglinton Avenue 15
2.14.7 Marmion Avenue/ Eglinton district centre 15
2.14.8 Marmion Avenue/ Northern EW Connector 15
2.14.9 Romeo Road/ Alkimos Regional Centre NS distributor 15
2.14.10 Alkimos Drive/ Alkimos Regional Centre NS distributor 15
2.14.11 Eglinton Avenue/ Eastern NS connector/ Eastern District Centre NS Connector 16
2.14.12 Minor intersections within Alkimos Eglinton 16
2.15 Summary 16
Appendix A Traffic model 17
A.1 Transport modelling package 17
A.2 Modelled road network 17
A.3 Model structure 17
A.4 Model share 18

A.5 Modelling of motorised traffic 18
A.5.1 Trip production 18
A.5.2 Trip attractions 19
A.5.3 Employment data 20
A.5.4 Trip generation of Alkimos-Eglinton study region 20
A.5.5 External and through trips 21
A.5.6 Trip distribution 22
A.5.7 Assignment 22

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1. Introduction and background

1.1 Purpose of this report

This transport and access report has been prepared by Sinclair Knight Merz for LandCorp, Eglinton Estates and W.R. Carpenter Landholdings Ltd as part of the Alkimos Eglinton Structure Plan.

It is a supplementary report to *Alkimos Eglinton Structure Plan – Transport and Access*, SKM, March 2007 (Transport 07 report)

This supplementary report includes an update to section 5 (*Internal and external road network*) and Appendix A (*Traffic model)* of the Transport 07 report.

1.2 Summary of main differences

The main differences between the information provided in this supplementary report and the information provided in the Transport 07 report are described in more detail in a later section of this report. In summary they are:

- Reconfiguration of road network between Eglinton Marina and Eglinton District Centre
- Reconfiguration of the coastal NS (neighbourhood) connector (renamed from western NS connector)
- Introduction of a new north-south neighbourhood connector to the west of Marmion Avenue (named the western NS connector).
- Increase in designation and road width for the eastern NS connector to the west of the rail line from a 2-lane undivided neighbourhood connector to a 2-lane or 4-lane divided integrator arterial (B).
- Increase in employment within the Alkimos Eglinton area.

2. Internal and external road network

2.1 Overview

This section of the report provides details about the analysis process, the forecast traffic volumes and the proposed road types and cross sections for both the ultimate and interim road networks. It has been updated from section 5 of the Transport 07 report,

2.2 Analysis process

Analysis of the proposed road network was undertaken as an iterative process in which the desired integrated land use/ transport plan was subjected to traffic modelling to understand the estimated future traffic volumes on each link. Where there was a conflict between the desired urban environment and the estimated traffic volumes, options were developed to change the transport network so that traffic volumes and land uses were compatible.

The transport modelling package Emme/2 was used to estimate future traffic volumes on the road network. Details of the traffic model, the model inputs, trip rates, distribution split and assignment assumptions are detailed in **Appendix A**.

The assessment year for ultimate development was taken as 2031. The external traffic volumes, that is, traffic volumes having neither an origin nor a destination in the Alkimos Eglinton structure plan area, were provided by Main Roads from their 2031 Regional Operations Model (ROM).

All estimated traffic volumes were average 24-hour weekday traffic volumes.

2.3 Estimated traffic volumes

The estimated traffic volumes for the proposed Alkimos Eglinton road network are shown in **Figure 2.1**.

- **Figure 2.1 Ultimate daily traffic volumes at full build out**

2.4 Functional road hierarchy

The functional hierarchy, based on *Liveable Neighbourhoods Ed 3* (2004), is shown in **Figure 2.2**, and includes:

- Mitchell Freeway - Primary Distributor
- Marmion Avenue - Integrator Arterial (A)
- Romeo Road - Integrator Arterial (A)
- Alkimos Drive - Integrator Arterial (A)/ Integrator Arterial (B)
- Eglinton Avenue - Integrator Arterial (A)/ Integrator Arterial (B)
- Alkimos regional centre NS distributor - Integrator Arterial (B)
- Alkimos regional centre EW distributor - Integrator Arterial (B)
- Alkimos coastal village EW distributor - Integrator Arterial (B)
- Eglinton district centre EW distributor - Integrator Arterial (B)
- Eglinton district centre NS distributor - Integrator Arterial (B) – south section only
- Eastern NS distributor - Integrator arterial (B)
- Southern NS connector - Neighbourhood connector (A)
- Southern EW connector - Neighbourhood connector (A)
- Western NS connector - Neighbourhood connector (A)
- Coastal NS connector - Neighbourhood connector (A)
- Central EW connector - Neighbourhood connector (A)
- Park and Ride connector - Neighbourhood connector (A)
- Pipidinny Road - Neighbourhood connector (A)
- Eglinton district centre NS connector - Neighbourhood connector (A) -north section
- Northern EW connector - Neighbourhood connector (A)

All other subdivision roads within the development would be classified as access streets and neighbourhood connectors (B).

- **Figure 2.2 Functional road hierarchy**

2.5 Mitchell Freeway

The Mitchell Freeway is estimated to carry about 40,000 to 52,000 vpd (alongside Alkimos Eglinton) and has been planned to accommodate this traffic volume.

2.6 Marmion Avenue

Marmion Avenue is proposed as a district distributor integrator (A) with a maximum traffic speed of 60 kph within the Alkimos Eglinton urban area. It is estimated to carry 28,000 to 48,000 vpd within the Alkimos Eglinton structure plan area. Marmion Avenue would not have frontage access to individual developments.

Marmion Avenue would have different cross sections for: (a) town centre environments (within Alkimos Regional Centre and Eglinton District Centre), (b) urban environments, and (c) non-urban environments.

Figure 2.3 illustrates the proposed cross section of Marmion Avenue as a 4-lane dual carriageway in a town centre environment. The minimum road reserve would be 37 m, comprising 6.0 m median, two 8.5 m traffic lanes (including cycle lanes) and two 6.5 m verges. This minimum width assumes that earthworks are incorporated into the surrounding land forms and not required to be accommodated within the road reserve.

- **Figure 2.3 Indicative cross section for Marmion Avenue in a town centre environment**

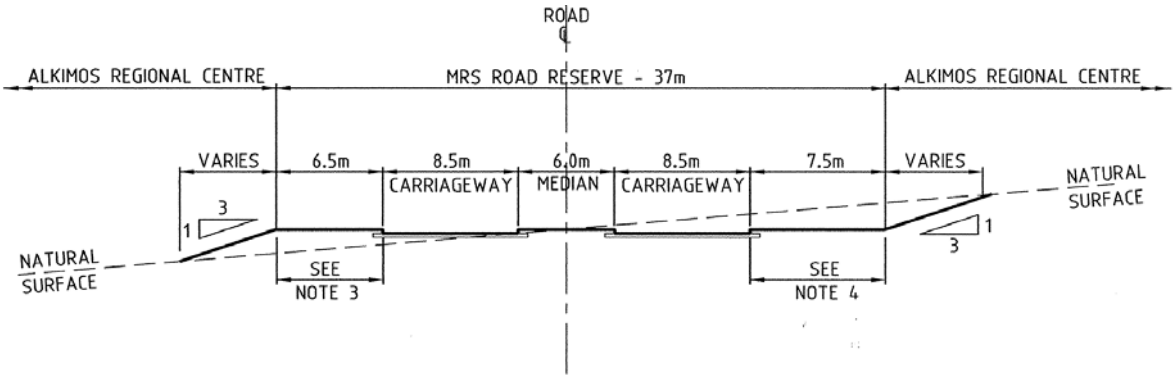


Figure 2.4 illustrates the cross section of Marmion Avenue as a 4-lane dual carriageway in an urban environment. The minimum road reserve would be 53 m, comprising 6.0 m median, two 8.5 m carriageways (including cycle lanes), plus service roads and verges as shown. The minimum width assumes that earthworks are incorporated into the road reserve.

- **Figure 2.4 Indicative cross section for Marmion Avenue, urban environment**

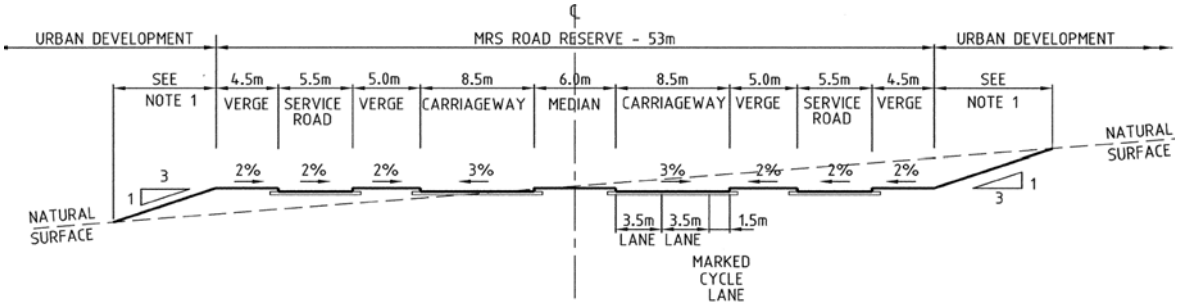
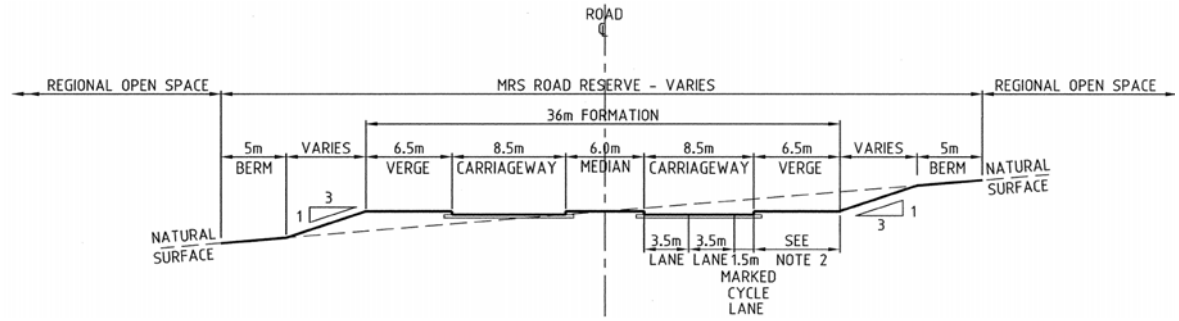


Figure 2.5 illustrates the cross section of Marmion Avenue as a 4-lane dual carriageway within regional open space. The minimum road formation would be 36 m, comprising 6.0 m median, two 8.5 m carriageways (including cycle lanes), plus two 6.5 m verges as shown. The minimum road reserve would depend on the surrounding environment and land form.

- **Figure 2.5 Indicative cross section for Marmion Avenue in regional open space**



Environments that have regional open space on one side and an urban environment on the other would have a road formation partly comprising urban environment cross section (Figure 2.4) and partly comprising regional open space formation (Figure 2.5).

2.7 Romeo Road

Romeo Road is proposed as a district distributor integrator arterial (A) with an indicative maximum traffic speed of 60 kph. It is estimated to carry 14,500 to 30,000vpd.

Romeo Road would have two different cross sections: one for the section within Alkimos Regional Centre and the other for the section between the regional centre and the Mitchell Freeway.

Figure 2.6 illustrates the proposed cross section of Romeo Road as a 4-lane dual carriageway within Alkimos Regional Centre. The minimum road reserve would be 37 m, comprising 6.0m median, two 8.5 m traffic lanes (including cycle lanes) and two 6.5 m verges. This minimum width assumes that earthworks are incorporated into the surrounding land forms and not required to be accommodated within the road reserve.

- **Figure 2.6 Indicative cross section for Romeo Road within Alkimos Regional Centre**

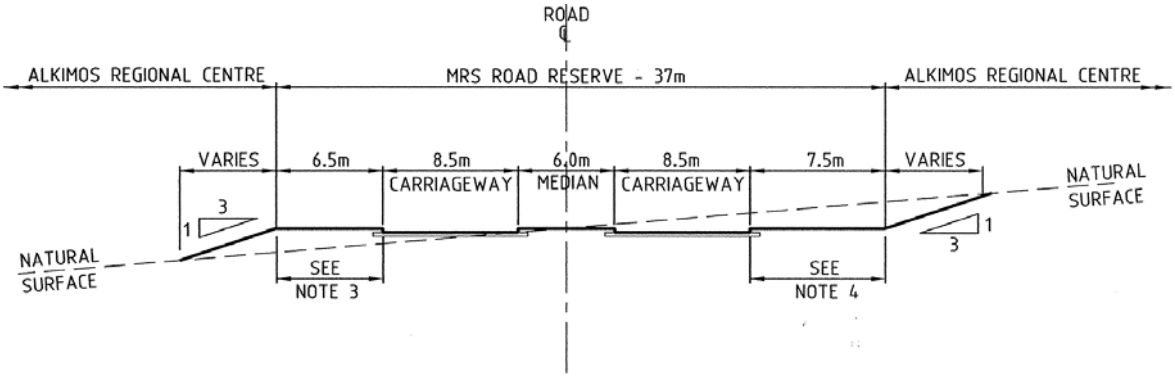
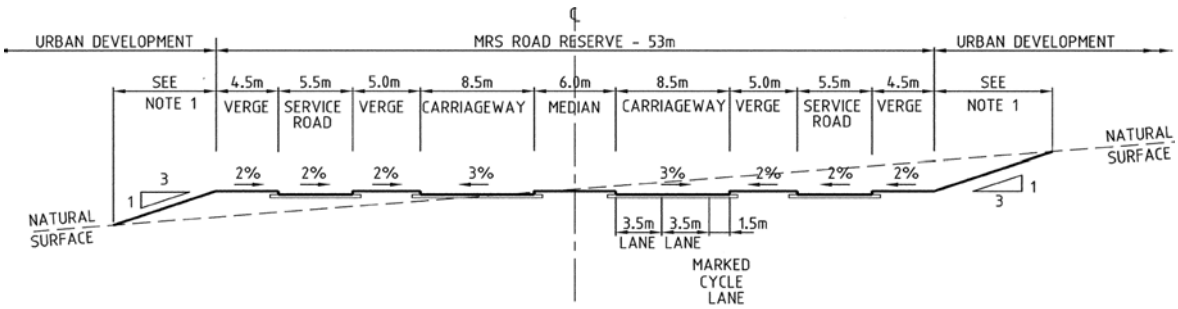


Figure 2.7 illustrates the cross section of Romeo Road as a 4-lane dual carriageway between Alkimos Regional Centre and the Mitchell Freeway. The minimum road reserve would be 53 m, comprising 6.0 m median, two 8.5 m carriageways (including cycle lanes), plus service roads and verges as shown. This minimum width assumes that earthworks are incorporated into the road reserve.

The illustrated cross section is based on service roads fronting Romeo Road. If the detailed design of the urban environment either side of Romeo Road does not require service roads, then the road reserve would be correspondingly reduced.

- **Figure 2.7 Indicative cross section for Romeo Road between Alkimos Regional Centre and the Mitchell Freeway**



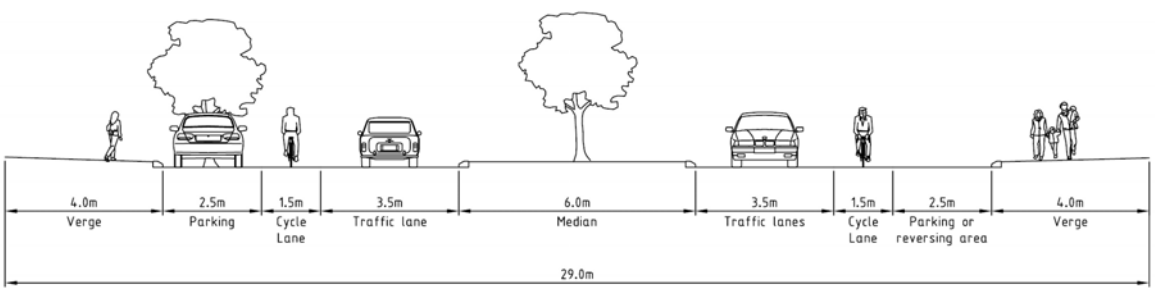
2.8 Alkimos Drive

Alkimos Drive, east of Marmion Avenue, is proposed as a district distributor integrator arterial (A) with an indicative maximum traffic speed of 60 kph. It is estimated to carry 8,000 to 16,000vpd.

The proposed cross sections for Alkimos Drive, east of Marmion Avenue, are similar to those proposed for Romeo Road, and illustrated in **Figure 2.6** and **Figure 2.7**.

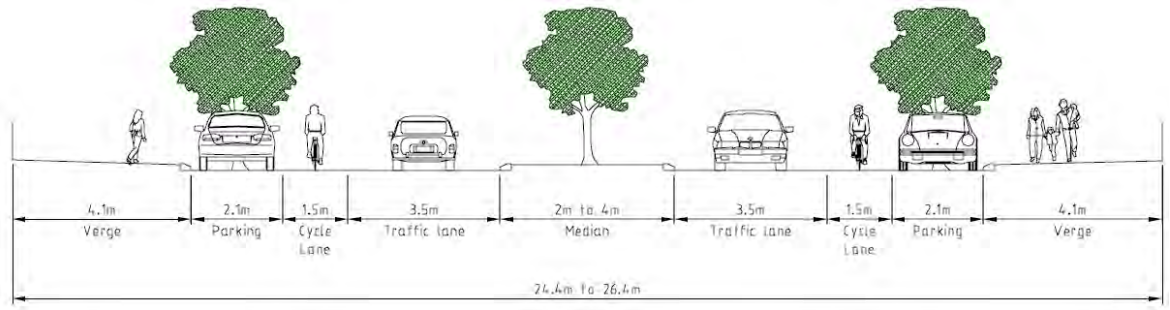
West of Marmion Avenue, Alkimos Drive is proposed as a district distributor integrator arterial (B) and estimated to carry 5,000 vpd to 10,000 vpd at full development. Immediately west of Marmion Avenue, Alkimos Drive is proposed as a boulevard with one traffic lane in each direction, a central median and kerbside parking lanes (as appropriate), as illustrated in **Figure 2.8**. The minimum road reserve would be 29 m, comprising 6.0 m median, two 7.5 m carriageways including 1.5 m cycle lanes and 2.5 m parking lanes, and two 4.0 m verges. Parking lanes could be deleted near intersections to provide for additional traffic/ turning lanes, as required.

- **Figure 2.8 Indicative cross section for Alkimos Drive, immediately west of Marmion Avenue**



Further to the west, Alkimos Drive is proposed as a single carriageway with median zones, cycle lanes and parking lanes, as illustrated in **Figure 2.9**. The road reserve would vary, depending on the width of the median and whether or not parking was provided.

- **Figure 2.9 Indicative cross section for Alkimos Drive, western section**



2.9 Eglinton Avenue

Eglinton Avenue, east of Marmion Avenue is proposed as a district distributor integrator arterial (A) with an indicative maximum traffic speed of 60 kph. It is estimated to carry 15,500 to 17,500vpd.

The proposed cross sections for Eglinton Avenue are similar to those proposed for Romeo Road, and illustrated in **Figure 2.6** and **Figure 2.7**.

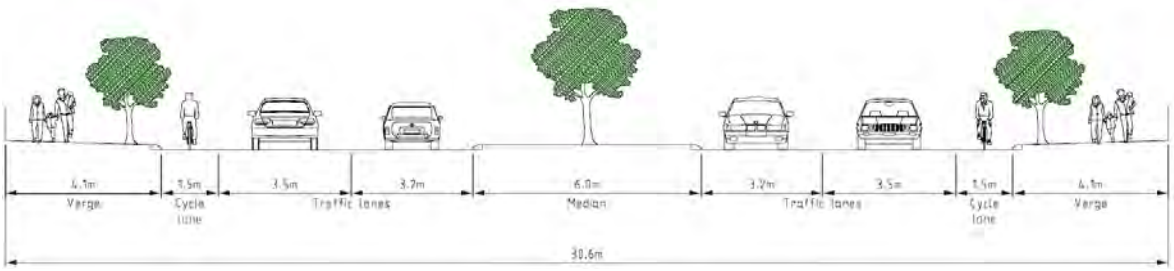
West of Marmion Avenue, Eglinton Avenue is proposed as a district distributor integrator arterial (B) and estimated to carry 4,000 vpd to 13,500 vpd at full development. The proposed cross sections are similar to Alkimos Drive, as illustrated in **Figure 2.8** and **Figure 2.9**. The minimum road reserve in the areas with higher traffic volumes would be 29 m, comprising 6.0 m median, two 7.5 m carriageways including 1.5 m cycle lanes and 2.5 m parking lanes. Parking lanes can be deleted near intersections to provide an additional traffic/ turning lane, as required. In the low traffic volume sections, the road reserve would be 24.4 m to 26.4 m, depending on the width of the median and whether or not parking was provided.

2.10 Alkimos EW Coastal Village Distributor

The Alkimos EW Coastal Village Distributor (between Marmion Avenue and the Alkimos Coastal Village) is proposed as a district distributor integrator arterial (B) with an indicative maximum traffic speed of 60 kph. It is estimated to carry 5,000 to 21,000vpd.

The eastern section of this road is likely to require four traffic lanes, as illustrated in **Figure 2.10**. The minimum road reserve would be 30.6 m, comprising 6.0 m median, two 8.5 m carriageways including 1.5 m cycle lanes and two traffic lanes (3.5 m and 3.2 m).

- **Figure 2.10 Indicative cross section for Alkimos EW Coastal Village Distributor**

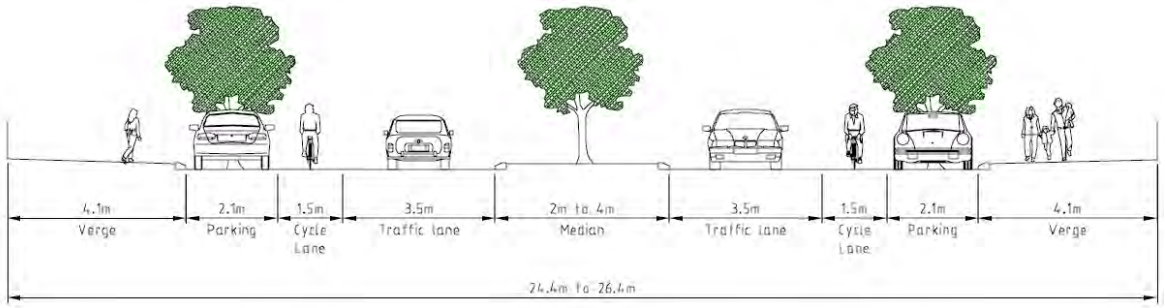


On the western section, the proposed cross section is similar to Alkimos Drive, as illustrated in **Figure 2.8**. The minimum road reserve would be 29 m, comprising 6.0 m median, two 7.5 m carriageways including 1.5 m cycle lanes and 2.5 m parking lanes. Parking lanes can be deleted near intersections to provide an additional traffic/ turning lane, as required.

2.11 Neighbourhood connector (A)

Figure 2.11 illustrates an indicative cross section for neighbourhood connectors (A), up to 7,000 vpd. The road reserve would be 24.4 to 26.4 m, comprising a 2.0m to 4.0 m median (depending on the tree species selected), two 7.5 m carriageways (including cycle lanes and parking lanes) and two 4.1 m verges.

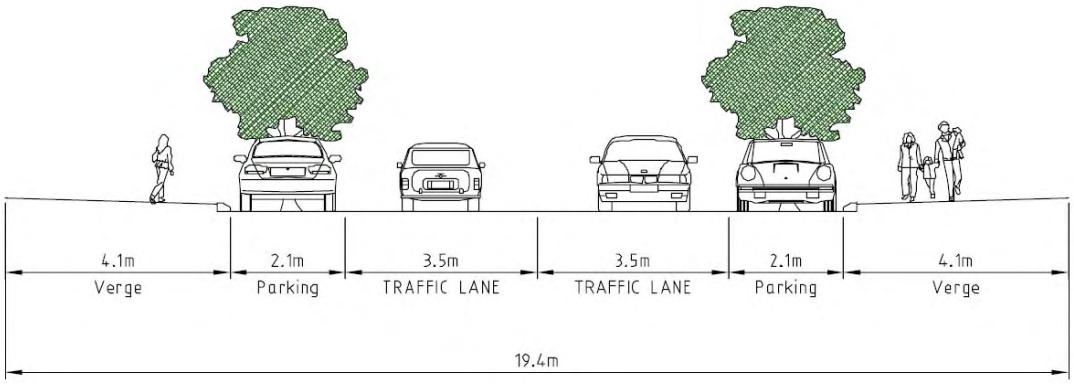
- **Figure 2.11 Indicative cross section, neighbourhood connector (A)**



2.12 Neighbourhood connector (B)

Figure 2.12 illustrates an indicative cross section for neighbourhood connectors (B), up to 3,000 vpd. The minimum road reserve would be 19.4 m, comprising two 3.5 m traffic lanes, two 2.1 m parking lanes and two 4.1 m verges. This minimum width assumes that earthworks are incorporated into the surrounding land forms and not required to be accommodated within the road reserve.

- **Figure 2.12 Indicative cross section, neighbourhood connector (B)**



2.13 Access Streets

Access Street would have an indicative maximum traffic speed of 50 kph and expect to carry less than 3,000 vpd. *Liveable Neighbourhoods* includes four indicative cross sections for different local street environments. Access streets have not been specified at this structure plan level.

2.14 Controls at major intersections

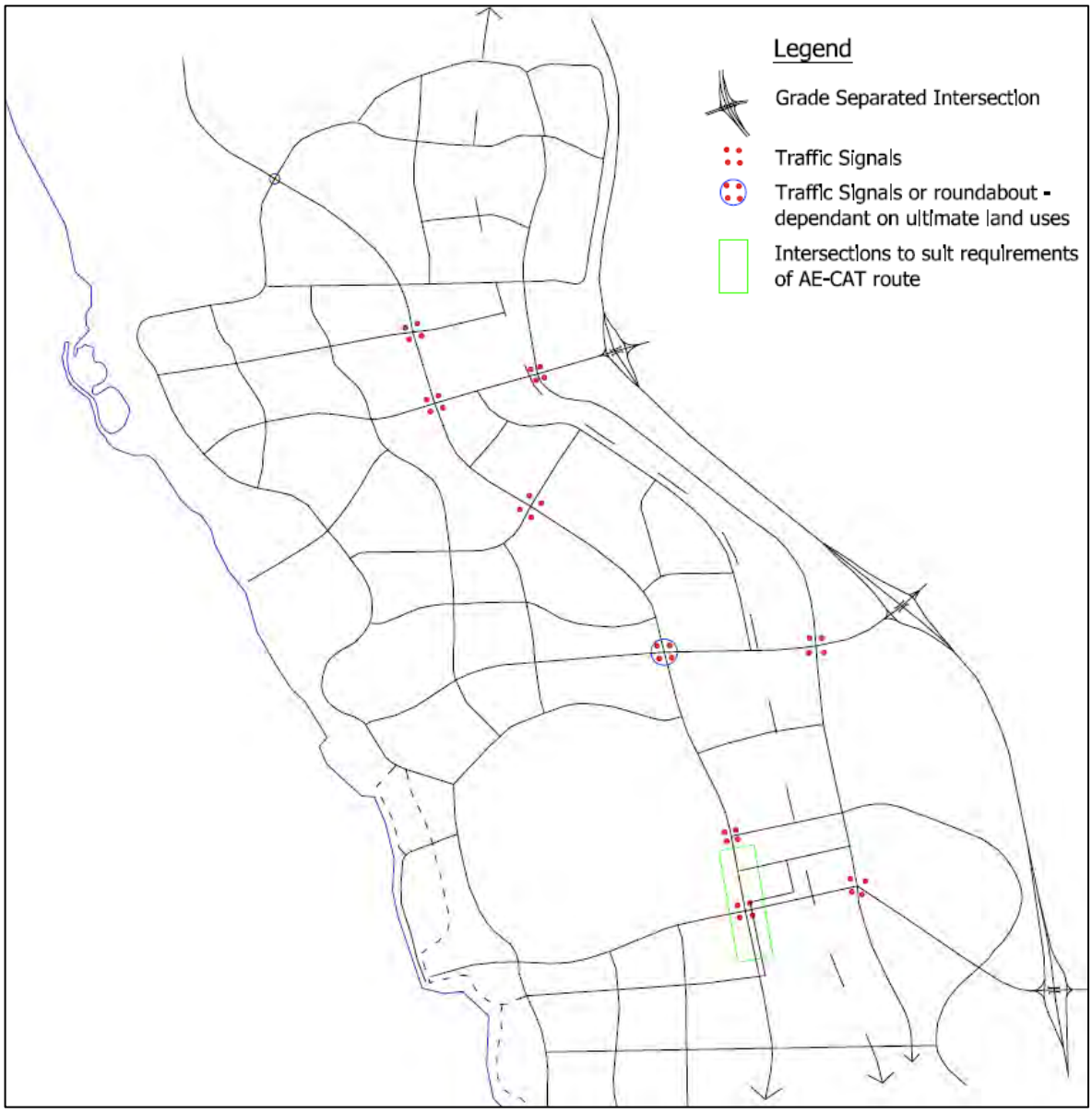
The recommended controls at major intersections are illustrated in **Figure 2.13**.

2.14.1 Mitchell Freeway interchanges

The intersections of Romeo Road, Alkimos Drive and Eglinton Avenue with the Mitchell Freeway are each planned to be conventional grade-separated diamond interchanges.

To the south of Romeo Road, the interchange of the Mitchell Freeway and Jindalee Boulevard is planned as an unconventional grade separated interchange with frontage roads such that northbound traffic from Jindalee Boulevard to the Mitchell Freeway would pass through the Romeo Road interchange. Similarly, southbound traffic to Jindalee Boulevard would exit the freeway via the Romeo Road exit and use the frontage road to Jindalee Boulevard.

- **Figure 2.13 Recommended controls at major intersections**



2.14.2 Marmion Avenue/ Romeo Road

The four-way intersection at Marmion Avenue and Romeo Road is proposed as a signalised intersection. This location is expected to attract a high number of pedestrians and cyclists moving to and from the Alkimos Regional Centre. Traffic signals offer a greater level of amenity for crossing Marmion Avenue, compared with a roundabout.

In addition, this intersection will have a high percentage of turning traffic and signals are operationally more efficient for managing turning movements.

2.14.3 Marmion Avenue/ Alkimos regional centre EW distributor

The (potential) four-way intersection at Marmion Avenue and the Alkimos Regional Centre EW distributor is proposed as a signalised intersection. This location is expected to attract a high number of pedestrians and cyclists moving to and from the Alkimos Regional Centre. Traffic signals offer a greater level of amenity for crossing Marmion Avenue, compared with a roundabout.

In addition, this intersection will have a high percentage of turning traffic and signals are operationally more efficient for managing turning movements.

2.14.4 Marmion Avenue/ Alkimos Drive

The four way intersection at Marmion Avenue and Alkimos Drive could either be constructed as a signalised intersection or a roundabout, depending on the surrounding land uses. The north-east quadrant of the intersection would incorporate the proposed park and ride station plus associated car parking. If the remaining quadrants were to have high intensity land uses expected to generate high pedestrian movements, then a signalised intersection would be preferred. If on the other hand, the remaining quadrants have standard urban density, then a roundabout could be considered.

The road reserve requirements for roundabouts and traffic signals are similar. Hence the decision about which form of intersection to develop can be made at the detailed development planning stage rather than at the structure plan stage.

2.14.5 Marmion Avenue/ Central EW connector

The (potential) four way intersection at Marmion Avenue and the Central EW Connector is proposed to be constructed as a signalised intersection. This intersection would provide access to the development on the eastern side of the rail line. It is also anticipated that this intersection would become the location for a neighbourhood centre.

2.14.6 Marmion Avenue/ Eglinton Avenue

The four-way intersection at Marmion Avenue and Eglinton Avenue needs to be developed within the context of access to the Eglinton District Centre. It is proposed that this intersection should be planned for traffic signals to facilitate pedestrian movements to and from the district centre and the Eglinton train station.

2.14.7 Marmion Avenue/ Eglinton district centre

The four-way intersection at Marmion Avenue and Eglinton district centre is proposed as traffic signals to facilitate pedestrian movements and the AE-CAT to and from the district centre and the Eglinton train station.

2.14.8 Marmion Avenue/ Northern EW Connector

The four-way intersection at Marmion Avenue and the northern EW connector could be planned as a roundabout intersection since pedestrian movements in this area are likely to be low.

2.14.9 Romeo Road/ Alkimos Regional Centre NS distributor

The intersection of Romeo Road and the Alkimos Regional Centre NS distributor is proposed as a signalised intersection. This location is expected to attract a high number of pedestrians and cyclists moving within the Alkimos Regional Centre, particularly given the proximity to the proposed rail station. Traffic signals offer a greater level of amenity for pedestrians crossing Romeo Road, compared with a roundabout. Signals are also operationally more effective at managing regional centre turning movements.

Depending on the detailed planning for the regional centre, this signalised intersection could be developed as a four-way intersection, providing access to development to the south.

2.14.10 Alkimos Drive/ Alkimos Regional Centre NS distributor

The intersection of Alkimos Drive and the Alkimos Regional Centre NS distributor is proposed as a signalised intersection. This location is expected to attract a high number of turning movements to and from the proposed park and ride station as well as to and from the regional centre (to the south).

2.14.11 Eglinton Avenue/ Eastern NS connector/ Eastern District Centre NS Connector

The intersection of Eglinton Avenue and the Eastern NS Connector/ Eastern District Centre NS Connector is proposed as a signalised intersection. This location is expected to attract a high number of turning movements to and from the district centre and the proposed commercial/ industrial area, east of the rail line (to the south).

2.14.12 Minor intersections within Alkimos Eglinton

Minor intersections within the development would be appropriately controlled with priority intersections. The treatment of four-way intersections would be consistent with the guidelines in *Liveable Neighbourhoods*.

2.15 Summary

The proposed ultimate road network incorporates the transport framework included in the MRS amendment 1029/33. The key features of the ultimate road network include:

- The Mitchell Freeway, forming the eastern boundary of the Alkimos Eglinton structure plan area;
- Marmion Avenue as the main north-south integrator arterial (A), providing for movement between the south and the Alkimos Regional Centre, between Alkimos and Eglinton, and between Yanchep and the Alkimos Eglinton area.
- Romeo Road connecting Marmion Avenue to the Mitchell Freeway, through Alkimos Regional Centre;
- Alkimos EW Coastal Village Connector, connecting the Alkimos coastal village to Alkimos Regional Centre.
- Alkimos Drive and Eglinton Avenue connecting Marmion Avenue to the Mitchell Freeway and to the coastal suburbs;
- Neighbourhood connectors and other lower order integrator arterial roads throughout Alkimos and Eglinton to form the local road linkages to the district roads.

Appendix A Traffic model

Sinclair Knight Merz has previously developed a traffic model for Alkimos Eglinton using the internationally recognised EMME/2 software platform. EMME/2 is used by the DPI for its Strategic Transport Model (STEM) which has provided forecasts for *Future Perth*, and for the Perth to Mandurah rail link.

A.1 Transport modelling package

EMME/2 represents a road network as a series of links (roads) and nodes (intersections). The traffic generating land uses are represented as a number of zones connected to the network.

For this application, a 24-hour average weekday model was developed. The average weekday was selected as it represents the typical activity on the roads in the area and is suitable for structure planning purposes.

A.2 Modelled road network

The modelled road network comprises all the key routes proposed within the area including important local roads, neighbourhood connectors, district distributors and primary distributors. The road network is shown in **Figure 2.1** and **Figure 2.2**.

The road network coding was based on an estimate of the road hierarchy. Each category of road hierarchy was assigned an appropriate traffic capacity in the form of a volume-delay function. These functions change the travel time based on the volume of traffic uses that particular section of road. Higher-order roads with more traffic lanes have higher capacities and hence vehicle travel times are less affected large traffic volume increases compared with local roads. The EMME/2 model attempts to minimise the journey time and hence tends to concentrate traffic on roads with higher traffic capacities.

A.3 Model structure

A traditional four-step model includes the following processes:

- Trip generation;
- Mode split;
- Trip distribution; and
- Trip assignment.

For Alkimos Eglinton, ‘trip generation’ considers private vehicle motorised trips and transit trips separately; therefore the mode split process is not required. However the influence of

mode split was incorporated in the assumptions adopted for the vehicle trip production rate per household and the percentage of transit trips, as discussed in the following section.

A.4 Model share

For various development densities i.e. R20/R40/R60, the average household size and transport modes used are often different. At higher development densities, the number of trips per household reduces (due to generally lower numbers of persons per dwelling). In addition, high density residential developments close to major activities and public transport corridors generate proportionately higher walk/cycle trips and higher public transport usage (depending on the quality of service offered).

The model assumptions for car trips and transit mode share for various densities within the study area are shown in **Table A.1**.

Table A.1 Car driver and transit mode share assumptions

Density	R60/R100	R40	R25/R20
Car driver	39%	48%	60%
Transit	15%	12%	4%

A.5 Modelling of motorised traffic

The purpose of the trip generation model is to produce 24-hour trip productions and attractions for input into the trip distribution procedure. These trips include:

- Trips originating in the study area to any destination;
- Trips terminating in the study area from any origin;
- Through trips originating and terminating outside the study area but using roads within and around the study area.

A.5.1 Trip production

The 24-hour trip production rates were based on the most recent traffic generation and mode split data, confirmed with the DPI transport modelling section. The trip production rates incorporate the following assumptions for the design year:

- In Perth about 3.5 trips per person per day are generated per head of population
- Car driver trips are 60% of total trips.

Hence, based on an average household size of 2.88 persons per household, the vehicle trip generation rate is approximately 6.0 car driver trips per household.

In Alkimos Structure Plan, residential developments are designed in various densities. As discussed in **Section A.4**, different car driver trip generation rates should apply to different housing densities. The adopted car driver trip rates for various development densities are summarised in **Table A-2.**

- **Table A-2 Daily car driver trip production rates**

Trip purpose	Average vehicle trips/dwelling			
	Average trip rates (Perth)	Assumed trip rates in Alkimos – Eglinton		
		R20/25	R40	R60/100
Work	2.01	2.4	1.5	0.6
Education	0.54	0.6	0.4	0.2
Other	3.45	4.0	2.5	1.1
Total	**6.0**	**7.0**	**4.4**	**1.9**

A.5.2 Trip attractions

While trip productions represent the number of trips associated with each household, trip attractions represent the number of trips to the various destinations within the study area.

Trips are attracted to work places, education facilities, shopping facilities, community facilities and residential areas. The trip attraction rates input to the model are summarised in **Table A.3**.

- **Table A.3 Daily car driver trips attraction rates**

Work Attractions	=		1.365 trips per job
Education Attractions	=		0.8 trips per primary/secondary enrolment
		+	0.897 trips per private school enrolment
Other Attractions	=		0.5 trips per dwelling unit
		+	0.7 trips per m^2 GFA retail floor area
		+	0.2 trips per school enrolment
		+	1.5 trips per 100sqm office/commercial
		+	0.1 trips per 100sqm services/commercial
		+	1.006 trips per tourism job

A.5.3 Employment data

Employment data was taken from the report *Alkimos Eglinton Economic and Employment Strategy*, Syme Marmion and Co, November 2007 (revision 7).

Table 1: Alkimos Eglinton Floor Areas by Centre, and Total Jobs Capacity by Land Use Type based on Scenario 2 for Service Commercial

CENTRE/ACTIVITY	Primary/ Rural	Manufact/ Process/ Fabrication	Storage/ Distrib	Service Industry	Shop/ Retail	Other Retail	Office/ Business	Health/ Welfare/ Community Services	Entertain/ Recreation/ Culture	Residential (Accomm)	Utilities/ Comm	Total (NLA)
Alkimos Regional Centre	0	1,343	2,384	4,500	50,000	15,000	46,121	13,609	6,830	1,346	884	**142,017**
Eglinton District Centre	0	316	1,474	1,673	17,220	2,780	7,399	1,421	3,991	1,530	359	**38,163**
Service/Comm/Indust South	373	33,335	18,994	40,759	6,734	19,378	19,792	2,559	3,588	0	3,854	**149,367**
Service/Comm/Indust North	595	53,160	30,289	64,999	10,739	30,903	31,563	4,081	5,721	0	6,146	**238,196**
Education								27,500				**27,500**
Other Neighbourhood Centres (includes coastal nodes)	0	310	272	2,768	21,000	991	3,939	113	2,244	303	0	**31,939**
TOTAL m^2 (NLA)	**968**	**88,464**	**53,413**	**114,699**	**105,694**	**69,052**	**108,813**	**49,283**	**22,375**	**3,179**	**11,242**	**627,181**
Jobs (Excluding Home Based)	**11**	**1,040**	**288**	**1,731**	**4,005**	**1,356**	**4,050**	**1,165**	**391**	**0**	**57**	**14,094**
Home Based (4%)												**955**
Total Jobs (Incl Home Based)												**15,049**

Source: *Alkimos Eglinton Economic and Employment Strategy*, Syme Marmion and Co, November 2007 (revision 7).

A.5.4 Trip generation of Alkimos-Eglinton study region

The total motorised trips generated within the Alkimos Eglinton areas are summarised in **Table A.4**.

Table A.4 Total vehicle trips generated by Alkimos Eglinton

Trip purpose	Generation		Internal productions		Internal attractions	
	Production	Attraction	Internal destinations	External destinations	Internal origins	External origins
Work	36 040	19 220	13 440	22 600	13 440	5780
Education	9680	9680	9200	480	9200	480
Other	61 520	95 100	43 060	18 460	43 060	52 040
Total	**107 240**	**124 000**	**65 700**	**41 540**	**65 700**	**58 300**

A.5.5 External and through trips

External and through trips were obtained from a sub-area cordon of the MRWA Regional Operations Model version Oct 05. This is a sub area matrix from the 2031 regional traffic model for the extent of the Alkimos Eglinton modelled area. The year 2031 was selected as appropriate for this development. The sub area matrix from MRWA was used to determine:

- the distribution and percentages of traffic travelling to and from the model area to the various external roads; and
- the volume of 'through trips' (i.e. trips originating and terminating outside the model area but using roads within and around the model area).

The percentage of Alkimos Eglinton traffic travelling to and from the external roads is shown in **Table A.5**. The external – external matrix from MRWA Regional model is shown in **Table A.6**.

- **Table A.5 External traffic proportion to and from Alkimos Eglinton**

External gateway	Proportion
Marmion Avenue north	19.1%
Mitchell Freeway north	0.9%
Marmion Avenue south	44.0%
Mitchell Freeway south	23.4%
Wanneroo Road south	8.5%
East of Mitchell Freeway	4.1%
Total	**100%**

- **Table A-6 External – external trip matrix, 2031, 24-hour (rounded)**

External gateway		1	2	3	4	5	6	Total
Marmion Avenue north	1	0	4247	120	8019	1024	1880	**15290**
Marmion Avenue south	2	4165	0	374	9179	896	5358	**19970**
Mitchell Freeway north	3	116	350	0	3798	135	367	**4770**
Mitchell Freeway south	4	7773	8400	3971	0	588	115	**20850**
East of Mitchell Freeway	5	885	862	173	545	0	853	**3320**
Wanneroo Road south	6	1995	5309	446	112	1025	0	**8890**
	Total	**14930**	**19170**	**5080**	**21650**	**3670**	**8570**	**73080**

A.5.6 Trip distribution

Trip distribution is the process whereby two-dimensional matrices of trips are produced from the one-dimensional production and attraction matrices. Internal trips within the study area have been distributed based on the following formula:

$$T_{ij} = f(u_{ij}) * P_i * A_j$$

Where:

P_i: trip production from zone *i*,

A_j: trip attraction to zone *j*,

$f(u_{ij})$: deterrence function of trips from zone *i* to zone *j*,

The deterrence is determined by the following *gamma* function formula:

$$f(u_{ij}) = u_{ij}^{-\alpha} \qquad u_{ij} <= 7 \text{ min}$$

$$= u_{ij}^{-\lambda} e^{-\theta u_{ij}} \qquad u_{ij} > 7 \text{ min}$$

Where:

u_{ij} is travel time from zone *i* to zone *j*,

α, λ, θ *are* model parameters, calibrated to match desired average travel time,

Internal trips and external trips were distributed separately based on the proportions obtained from the MRWA Regional Operations Model.

A.5.7 Assignment

The EMME/2 assignment model uses a linear approximation algorithm to solve the capacity restrained highway assignment.

The trips are distributed around the network by EMME/2 in such a way that their total travel time is minimised. The shortest travel time calculations for the road network take into consideration the road type, average speed and number of lanes along each route. This was done in several iterations to allow the congestion to be included in the travel time calculations.