

APPENDIX A
ACOUSTIC ASSESSMENT
(HERRING STORER, MAY 2020)





LENDLEASE

**PRECINCT 1 SUBDIVISION
CENTRAL ALKIMOS**

SPP 5.4 NOISE ASSESSMENT

MAY 2020

OUR REFERENCE: 24064-2-17018-02



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NOISE ASSESSMENT
PRECINCT 1 CENTRAL ALKIMOS

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LENLEASE

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1. INTRODUCTION

Herring Storer Acoustics was commissioned by Lendlease to undertake a road traffic noise assessment for the proposed development of Precinct 1 in Central Alkimos.

The purpose of this assessment was to assess noise received within the development from vehicles travelling along the Marmion Avenue for the future and passenger rail associated with the northern suburbs passenger railway line. Previously, an acoustic assessment, (reference *HSA 14882-2-12067 and 21437-5-17018*) was conducted for the overall development, including the proposed Precinct 1 in Central Alkimos. The purpose of this current acoustic assessment is to provide additional, detailed acoustic advice for individual lots, now that the final subdivision layout is known and to update the information contained within the study to reference the latest version of State Planning Policy 5.4, with was released in September 2019.

The traffic noise assessment has been carried out in accordance with the WAPC State Planning Policy 5.4 "*Road and Rail Noise*".

For information, the development plan is attached in Appendix A.

2. SUMMARY

Under the Western Australian Planning Commission (WAPC) Planning Policy 5.4 "*Road and Rail Noise*" (SPP5.4), the appropriate criteria for assessment for this development are as listed below for "Noise Limits".

EXTERNAL

$L_{Aeq(Day)}$ of 55 dB(A); and
 $L_{Aeq(Night)}$ of 50 dB(A).

INTERNAL

$L_{Aeq(Day)}$ of 40 dB(A) in living and work areas; and
 $L_{Aeq(Night)}$ of 35 dB(A) in bedrooms.

Noise received at an outdoor area should also be reduced as far as practicable, with an aim of achieving an L_{Aeq} (night) of 50 dB(A).

From the modelling undertaken for the future Marmion Avenue, noise received at the development would exceed the above criteria. As the inclusion of a noise wall for the entire length of the development is not practical as future residential lots face the roadway, to comply with the requirements of SPP 5.4 "Quiet House" design is required. For side facing lots (two lots at the southern end of the development) a wall has been included at 1.8m high, hence provide amelioration to the outdoor living areas.

Appendix C details the Quiet House Design Packages required for each individual Lot with Appendix D containing the deemed to satisfy construction methods.

Due to the orientation of the lots, the outdoor living area is situated behind the house, away from the Marmion Avenue, therefore providing a barrier to noise level, hence compliance is achieved with the L_{Aeq} (night) of 50 dB(A).

Additionally, noise modelling indicates that noise received at the closest residence to the extension of the Northern Suburbs Passenger Railway Line would comply with the above criteria.

Therefore, no acoustic amelioration, or notifications are required for those residential lots located adjacent to the Railway Line.

3. ACOUSTIC CRITERIA

3.1 ROAD AND RAIL TRAFFIC NOISE

The Western Australian Planning Commission (WAPC) released on 6th September 2019 State Planning Policy 5.4 “Road and Rail Noise”. The requirements of State Planning Policy 5.4 are outlined below.

POLICY APPLICATION (Section 4)

When and where it applies (Section 4.1)

SPP 5.4 applies to the preparation and assessment of planning instruments, including region and local planning schemes; planning strategies, structure plans; subdivision and development proposals in Western Australia, where there is proposed:

- a) *noise-sensitive land-use within the policy’s trigger distance of a transport corridor as specified in **Table 1**;*
- b) *New or major upgrades of roads as specified in **Table 1** and maps (**Schedule 1, 2 and 3**); or*
- c) *New railways or major upgrades of railways as specified in maps (**Schedule 1, 2 and 3**); or any other works that increase capacity for rail vehicle storage or movement and will result in an increased level of noise.*

Policy trigger distances (Section 4.1.2)

Table 1 identifies the State’s transport corridors and the trigger distances to which the policy applies.

*The designation of land within the trigger distances outlined in **Table 1** should not be interpreted to imply that land is affected by noise and/or that areas outside the trigger distances are un-affected by noise.*

*Where any part of the lot is within the specified trigger distance, an assessment against the policy is required to determine the likely level of transport noise and management/mitigation required. An initial screening assessment (**guidelines: Table 2: noise exposure forecast**) will determine if the lot is affected and to what extent.”*

TABLE 1: TRANSPORT CORRIDOR CLASSIFICATION AND TRIGGER DISTANCES

Transport corridor classification	Trigger distance	Distance measured from
Roads		
Strategic freight and major traffic routes Roads as defined by Perth and Peel Planning Frameworks and/or roads with either 500 or more Class 7 to 12 Austroads vehicles per day, and/or 50,000 per day traffic volume	300 metres	Road carriageway edge
Other significant freight/traffic routes These are generally any State administered road and/or local government road identified as being a future State administered road (red road) and other roads that meet the criteria of either >=23,000 daily traffic count (averaged equivalent to 25,000 vehicles passenger car units under region schemes)	200 metres	Road carriageway edge
Passenger railways		
	100 metres	Centreline of the closest track
Freight railways		
	200 metres	Centreline of the closest track

Proponents are advised to consult with the decision making authority as site specific conditions (significant differences in ground levels, extreme noise levels) may influence the noise mitigation measures required, that may extend beyond the trigger distance.

POLICY MEASURES (Section 6)

The policy applies a performance-based approach to the management and mitigation of transport noise. The policy measures and resultant noise mitigation will be influenced by the function of the transport corridor and the type and intensity of the land-use proposed. Where there is risk of future land-use conflict in close proximity to strategic freight routes, a precautionary approach should be applied. Planning should also consider other broader planning policies. This is to ensure a balanced approach takes into consideration reasonable and practical considerations.

Noise Targets (Section 6.1)

Table 2 sets out noise targets that are to be achieved by proposals under which the policy applies. Where exceeded, an assessment is required to determine the likely level of transport noise and management/mitigation required.

In the application of the noise targets the objective is to achieve:

- indoor noise levels as specified in **Table 2** in noise sensitive areas (for example, bedrooms and living rooms of houses, and school classrooms); and
- a reasonable degree of acoustic amenity for outdoor living areas on each residential lot. For non-residential noise-sensitive developments, for example schools and child care centres the design of outdoor areas should take into consideration the noise target.

It is recognised that in some instances, it may not be reasonable and/or practicable to meet the outdoor noise targets. Where transport noise is above the noise targets, measures are expected to be implemented that balance reasonable and practicable considerations with the need to achieve acceptable noise protection outcomes.

TABLE 2: NOISE TARGETS

Proposals	New/Upgrade	Noise Targets		
		Outdoor		Indoor
		Day ($L_{Aeq}(\text{Day})$ dB) (6 am-10 pm)	Night ($L_{Aeq}(\text{Night})$ dB) (10 pm-6 am)	(L_{Aeq} dB)
Noise-sensitive land-use and/or development	New noise sensitive land use and/or development within the trigger distance of an existing/proposed transport corridor	55	50	L_{Aeq} (Day) 40(Living and work areas) L_{Aeq} (Night) 35 (bedrooms)
Roads	New	55	50	N/A
	Upgrade	60	55	N/A
Railways	New	55	50	N/A
	Upgrade	60	55	N/A

Notes:

- The noise target is to be measured at one metre from the most exposed, habitable façade of the proposed building, which has the greatest exposure to the noise-source. A habitable room has the same meaning as defined in State Planning Policy 3.1 Residential Design Codes.
- For all noise-sensitive land-use and/or development, indoor noise targets for other room usages may be reasonably drawn from Table 1 of Australian Standard/New Zealand Standard AS/NZS 2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors (as amended) for each relevant time period.
- The 5dB difference in the criteria between new and upgrade infrastructure proposals acknowledges the challenges in achieving noise level reduction where existing infrastructure is surrounded by existing noise-sensitive development.
- Outdoor targets are to be met at all outdoor areas as far as is reasonable and practical to do so using the various noise mitigation measures outlined in the guidelines. For example, it is likely unreasonable for a transport infrastructure provider to achieve the outdoor targets at more than 1 or 2 floors of an adjacent development with direct line of sight to the traffic.

Noise Exposure Forecast (Section 6.2)

When it is determined that SPP 5.4 applies to a planning proposal as outlined in Section 4, proponents and/or decision makers are required to undertake a preliminary assessment using **Table 2**: noise exposure forecast in the guidelines. This will provide an estimate of the potential noise impacts on noise-sensitive land-use and/ or development within the trigger distance of a specified transport corridor. The outcomes of the initial assessment will determine whether:

- no further measures is required;
- noise-sensitive land-use and/or development is acceptable subject to deemed-to-comply mitigation measures; or
- noise-sensitive land-use and/or development is not recommended. Any noise-sensitive land-use and/ or development is subject to mitigation measures outlined in a noise management plan.”

4. MODELLING

Modelling of noise received within the development from the Marmion Avenue was carried out using SoundPlan, using the Calculation of Road Traffic Noise (CoRTN) algorithms. The input data for the model included:

- Increased traffic volume, assuming 2% growth over 20 years.
- Other traffic data as listed in Table 4.1.
- A +2.5 dB adjustment to allow for façade reflection.

The traffic data is as listed in Table 4.1.

TABLE 4.1 - SUMMARY OF TRAFFIC DATA

Parameter	Marmion Avenue
Future Traffic Flow (vpd)	35,000
Percentage Heavy Vehicles (%)	3%
Speed (km/hr)	70

For this project, with reference to the DEFRA publication and as for the original assessment, the difference between the $L_{A10,18h}$ and the $L_{Aeq,8hr}$ and the $L_{Aeq,16hr}$ has been taken to be 10 and 2.5 dB(A) respectively. It was assumed that these differences would apply in the year 2031.

Notes:

1. As noise monitoring of existing road traffic noise emanating from Marmion Avenue is not possible at this time, as outlined in the Implementation Guidelines, the standard correction of -1.7 dB has been applied to the noise model.
2. We also note that with the difference between the $L_{Aeq,8hr}$ and the $L_{Aeq,16hr}$ being greater than 5 dB(A), achieving compliance with the day period criteria will also achieve compliance with the night period criteria. Therefore, noise modelling was only undertaken for the day period and the results are shown graphically in Appendix B.

Noise modelling for road noise was undertaken for the following scenarios:

- S1 Noise emissions from Marmion Avenue (Future) without noise amelioration for front facing lots and a 1.8m wall for side facing lots, but with future residential buildings.

The 1.8m wall for the side facing lots has been assumed to be a minimum of 15kg/m² in density.

For the noise modelling of future traffic, it has been assumed that the percentage of future heavy vehicles remains the same as for the current traffic flows. In this case, we believe that this is a conservative approach, as we believe that the percentage of heavy vehicles would fall over time.

The noise modelling was carried out based on the number of train movements as summarised in Table 4.2. We understand that these movements were used to model noise emissions from other section of the Northern Suburbs Passenger Railway Line.

TABLE 4.2 – TRAIN MOVEMENTS

Parameter	Train Movements (per hour)	
	Day	Night
North Bound		
3 Car Set (75 metres long)	5.0	0.75
4 Car Set (100 metres long)	0.5	0
6 Car Set (150 metres long)	0.4	0
South Bound		
3 Car Set (75 metres long)	5.4	0.9
4 Car Set (100 metres long)	0.5	0
6 Car Set (150 metres long)	0.4	0

Based on the above number of train movements, once again if compliance is achieved with the day period criteria, compliance will also be achieved with the night period criteria. Therefore, noise modelling was only undertaken for the day period.

Noise modelling for rail was undertaken for the following scenario:

- R1 Noise emissions from proposed northern suburbs railway, without noise amelioration.

5. ASSESSMENT

In accordance with the WAPC Planning Policy 5.4, an assessment of the noise that would be received within the development located at Precinct 1 from vehicles travelling on the Marmion Avenue has been undertaken.

In accordance with the Policy, the following would be the acoustic criteria applicable to this project:

External	
Day	Maximum of 55 dB(A) L_{Aeq}
Night	Maximum of 50 dB(A) L_{Aeq}
Outdoor Living Areas (Night)	Maximum of 50 dB(A) L_{Aeq}
Internal	
Sleeping Areas	35 dB(A) $L_{Aeq(night)}$
Living Areas	40 dB(A) $L_{Aeq(day)}$

Noise received at an outdoor area should also be reduced as far as practicable with an aim of achieving an $L_{Aeq(night)}$ of 50 dB(A).

From the modelling undertaken for the future Marmion Avenue, noise received at the development would exceed the above criteria. As the inclusion of a noise wall for the entire length of the development is not practical as future residential lots face the roadway, to comply with the requirements of SPP 5.4 "Quiet House" design is required. For side facing lots (two lots at the southern end of the development) a wall has been included at 1.8m high, hence provide amelioration to the outdoor living areas.

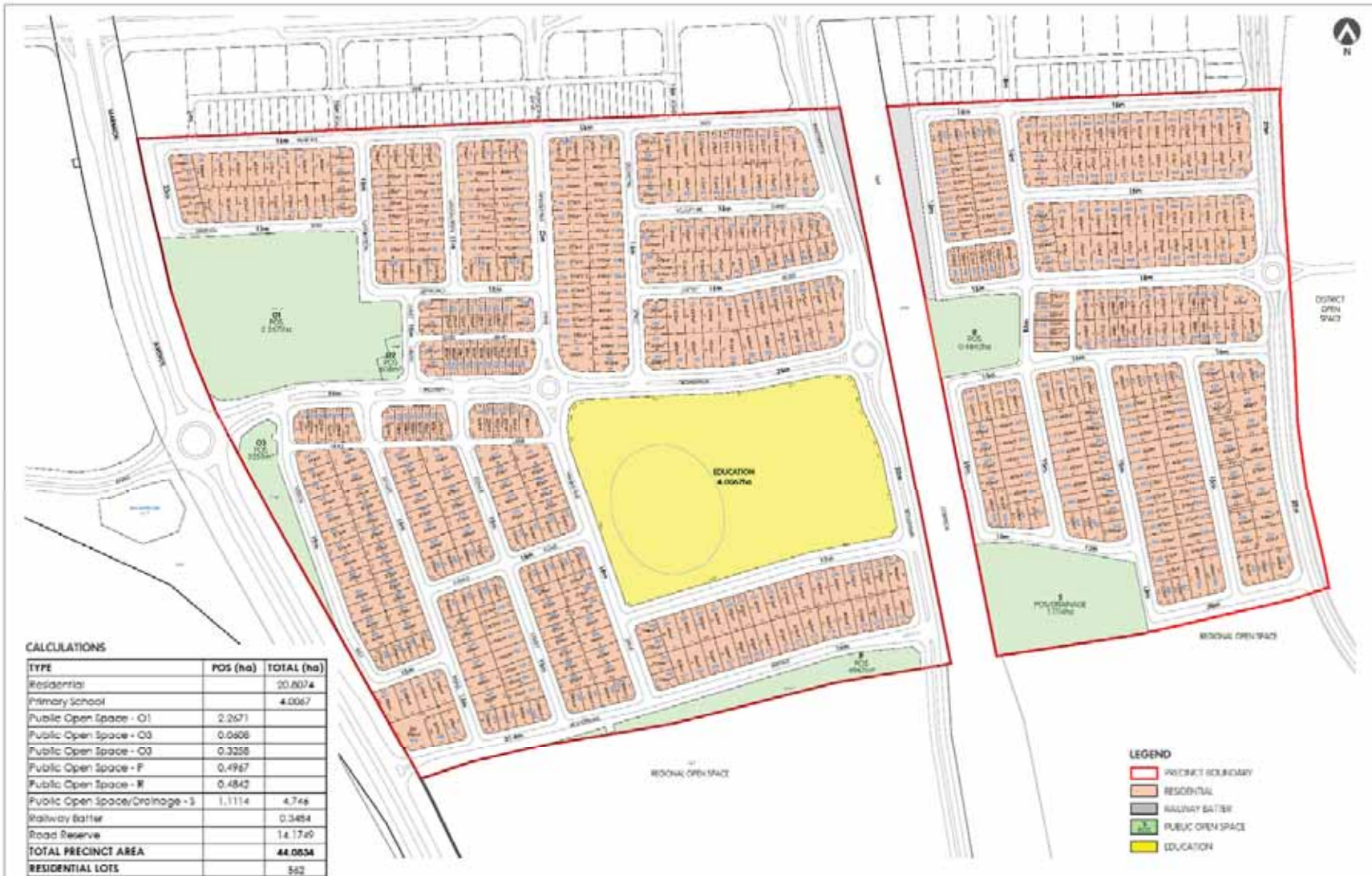
Appendix C details the Quiet House Design Packages required for each individual Lot with Appendix D containing the deemed to satisfy construction methods. We note that alternative constructions as to those listed in Appendix D, are acceptable, provided they are supported by an assessment undertaken by a suitably qualified acoustic consultant.

Due to the orientation of the lots, the outdoor living area is situated behind the house, away from the Marmion Avenue, therefore providing a barrier to noise level, hence compliance is achieved with the L_{Aeq} (night) of 50 dB(A).

Additionally, noise modelling indicates that noise received at the closest residence to the extension of the Northern Suburbs Passenger Railway Line would comply with the above criteria. Therefore, no acoustic amelioration, or notifications are required for those residential lots located adjacent to the Railway Line.

APPENDIX A

PRECINCT 1 DEVELOPMENT PLAN



CALCULATIONS

TYPE	POS (ha)	TOTAL (ha)
Residential		20.8074
Primary School		4.0067
Public Open Space - O1	2.2671	
Public Open Space - O3	0.0906	
Public Open Space - O3	0.3258	
Public Open Space - F	0.4967	
Public Open Space - W	0.4842	
Public Open Space/Drainage - S	1.1114	4.7749
Railway Barrier		0.3484
Road Reserve		14.1749
TOTAL PRECINCT AREA		44.0834
RESIDENTIAL LOTS		552

- LEGEND**
- PRECINCT BOUNDARY
 - RESIDENTIAL
 - RAILWAY BARRIER
 - PUBLIC OPEN SPACE
 - EDUCATION



CADASTRAL INFORMATION
 SOURCE: 1882
 TOWNSHIP: 36785
 DIST: RP: 2/10/08 (REVISED)
 PROJECTION: PCMA

AERIAL PHOTOGRAPHY
 SOURCE: 1882
 TOWNSHIP: 36785



COMMERCIAL ASSESSMENT PLAN (APRIL 2020) (NORTHERN LOTS EXCLUDED)

A	UPDATE POS NUMBER ON TABLE	20/02/21	SR	SR/PT
B	UPDATE POS NUMBER ON TABLE	20/02/21	SR	SR/PT
C	REVISOR SIGNATURES	18/02/21	SR	SR
REV	DESCRIPTION	TOWNSHIP: 36785	APPROV	

Alkimos Vista
 City of Wanneroo

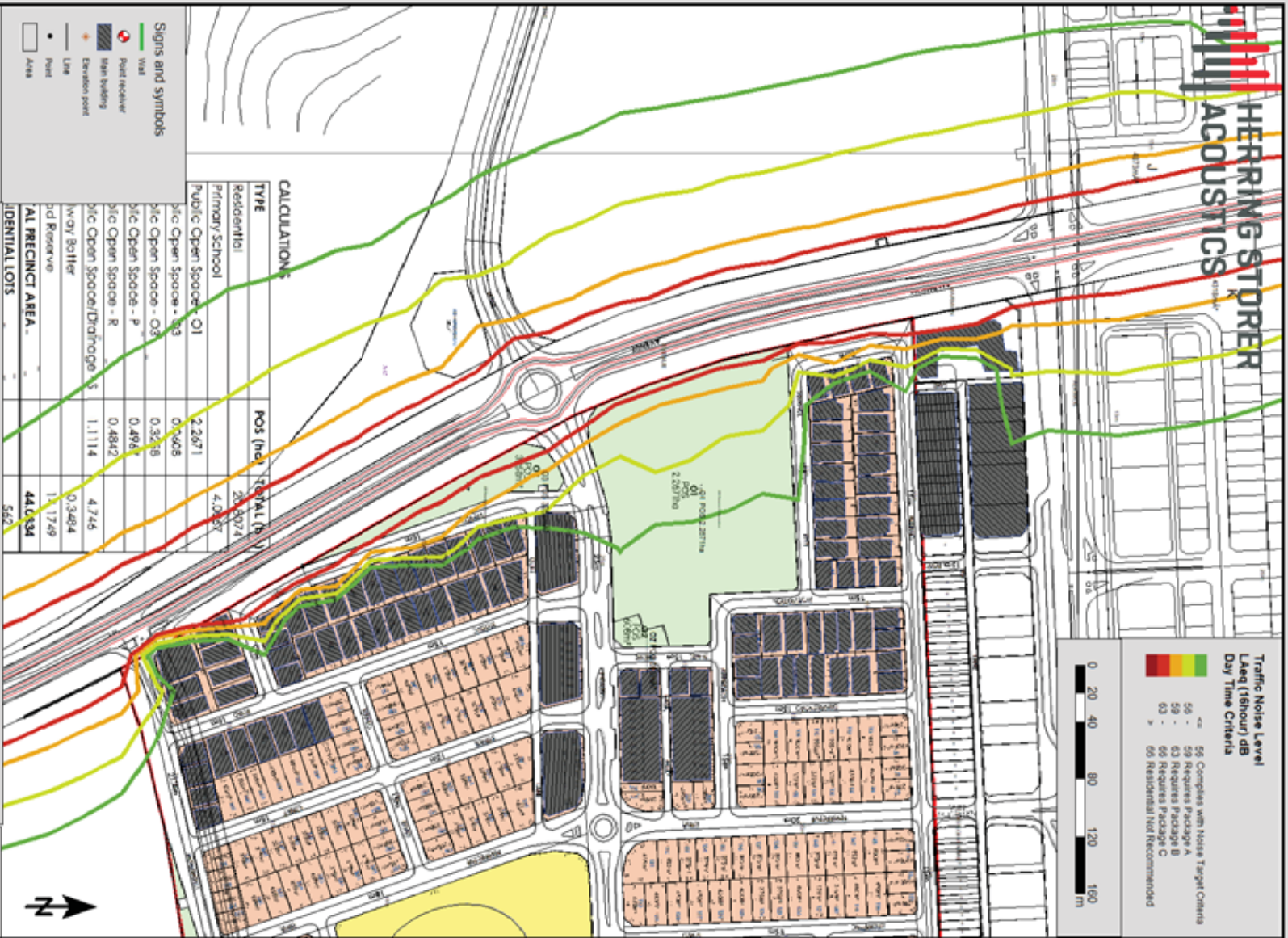
REF NO: **DLL CEN**
 DRAW NO: **RD1 102**
 REV: **F**

DEVELOPER SHOULD FOR DESIGN INTENT ONLY. ALL AREAS AND DIMENSIONS ARE SUBJECT TO FINAL DESIGN AND SURVEY.

APPENDIX B

NOISE CONTOUR PLOT

Traffic Noise Level
Laeq (15hour) dB
Day Time Criteria



- Signs and symbols**
- Wall
 - Point receiver
 - Site building
 - Elevation point
 - Line
 - Point
 - Axis

CALCULATIONS

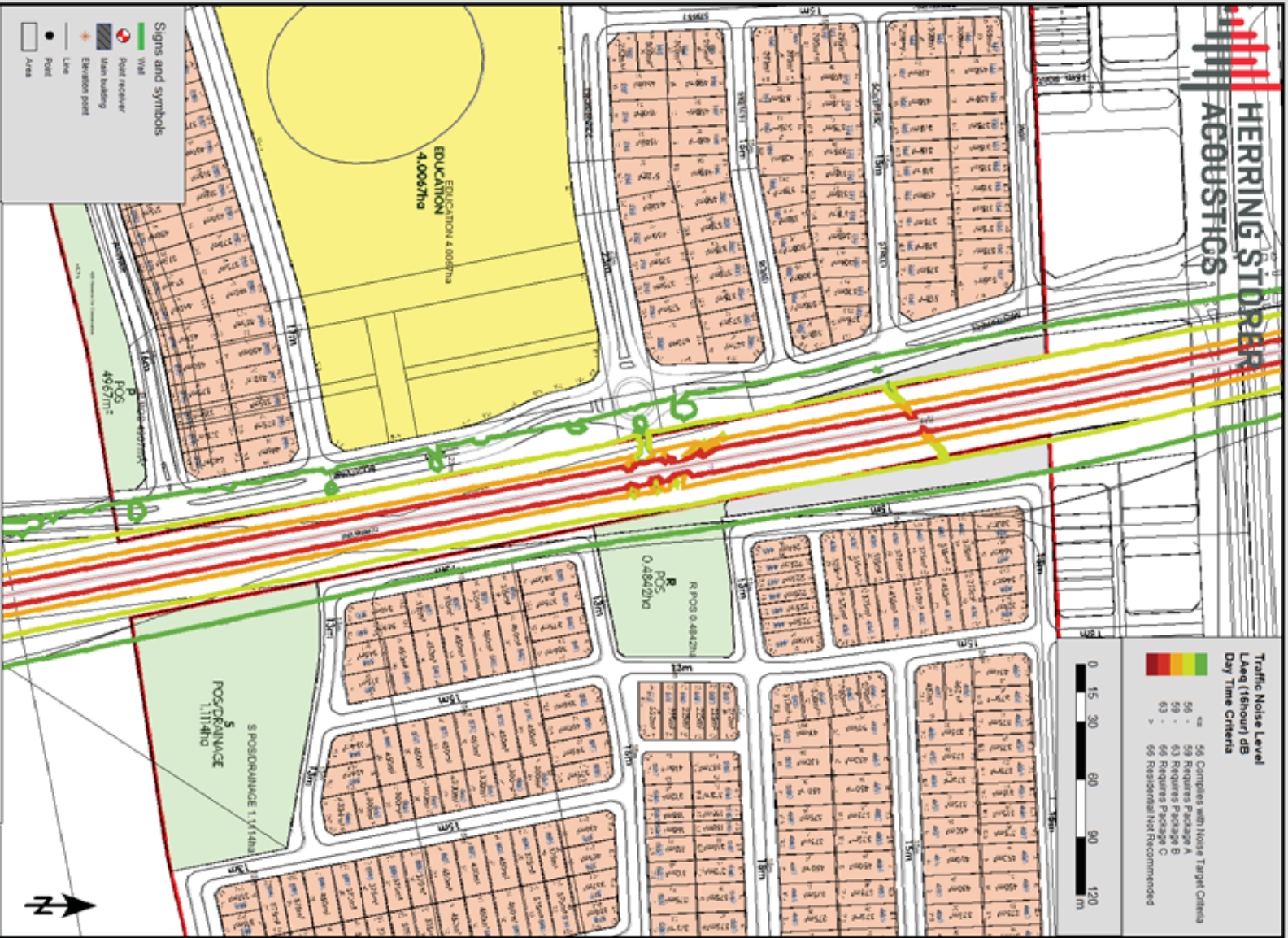
TYPE	POS (m)	TOTAL (m)
Residential	2,307.2	2,307.2
Primary School	4,028.7	4,028.7
Public Open Space - OI	2,287.1	2,287.1
Public Open Space - S3	0.7608	0.7608
Public Open Space - O3	0.3236	0.3236
Public Open Space - P	0.496	0.496
Public Open Space - R	0.4842	0.4842
Public Open Spaces/Drainage	1,111.4	4,746
Way/Boiler	0.3484	1,174.9
Pod Reserve	1,174.9	1,174.9
AL PRECINCT AREA		44,034
IDENTICAL LOTS		5,67

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 Job No - 17018-02

ALKINOS PRECINCT 1
 Marston Ave With Future Housing
 Laeq (15hour) Day Noise Level Contour

Figure B1
 Ref # 2015





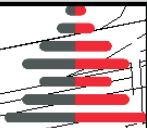
Herring Storer Acoustics
Job No - 17018-02

ALKIMOS PRECINCT 1
Passenger Rail With Future Housing
Laeq (15hour) Day Noise Level Contour

Figure B2
Ref # 2014

APPENDIX C

Quiet House Design – Individual Lot Requirements



HERRING STORER ACOUSTICS

Note: Alternative constructions to those listed for are acceptable, provided they are assessed and a report is submitted by a suitably qualified acoustic consultant.



- No Acoustic Requirement
- Requires "Package A" Quiet House Design and Notification on Titles
- Requires "Package B" Quiet House Design and Notification on Titles
- Requires "Package C" Quiet House Design and Notification on Titles



Herring Storer Acoustics
 428 No. 17/18/22

CENTRAL ALKIMOS
 Precinct 1 Road Noise Influence
 Individual Lot Requirements - Quiet House Design

Figure C1

Note: Alternative constructions to those listed for are acceptable, provided they are assessed and a report is submitted by a suitably qualified acoustic consultant.



- No Acoustic Requirement
- Requires Notification on Titles
- Requires "Package A" Quiet House Design and Notification on Titles
- Requires "Package B" Quiet House Design and Notification on Titles
- Requires "Package C" Quiet House Design and Notification on Titles

Scale 1:2584

Herring Storer Acoustics
200 No. 178/82

CENTRAL ALUMINO'S
Precinct 1 Rail Noise Influence
Individual Lot Requirements - Quiet House Design

Figure C2

APPENDIX D

QUIET HOUSE DESIGN GUIDELINES

**Road Traffic and Passenger Rail
Quiet House Requirements
(Based on Table 3 of State Planning Policy 5.4 2019)**

Exposure Category	Orientation to corridor	Acoustic rating and example constructions					Mechanical ventilation/air conditioning considerations
		Walls	External doors	Windows	Roofs and ceilings of highest floors	Outdoor Living areas	
A Quiet House A	Facing	<p>Bedroom and Indoor Living and work areas to $R_w + C_{tr}$ 45dB</p> <p>Stud Frame Walls</p> <ul style="list-style-type: none"> ➤ One row of 92mm studs at 60mm centres with: ➤ Resilient steel channels fixed to the outside of the studs; and ➤ 9.5mm hardboard or 9mm fibre cement weatherboards or one layer of 19mm board cladding fixed to the outside of the channels; and ➤ 75mm glass wool (11kg/m³) or 75mm polyester (14kg/m³) insulation, positioned between the studs; and ➤ -Two layers of 16mm fire-protective grade plasterboard fixed to the inside face of the studs. <p>Brick Walls</p>	<p>Bedrooms:</p> <ul style="list-style-type: none"> ➤ Fully glazed hinged door with certified R_w+C_{tr} 28dB rated door and frame including seals and 6mm glass <p>Indoor Living and work areas:</p> <ul style="list-style-type: none"> ➤ 35mm solid core timber hinged door and frame system certified to R_w 28dB including seals: OR ➤ Glazed sliding door with 10 mm glass and weather seals 	<p>Bedrooms:</p> <ul style="list-style-type: none"> ➤ Total external door and window system area up to 40% of room floor area: Sliding or double hung with minimum 10 mm single or 6mm-12mm-10mm double insulated glazing (R_w+C_{tr} 28 dB). Sealed awning or casement windows may use 6 mm glazing instead: OR ➤ Up to 60% floor area: as per above but must be sealed awning or casement type windows (R_w+C_{tr} 31dB). <p>Indoor Living and work areas</p> <ul style="list-style-type: none"> ➤ Up to 40% floor area: Sliding, awning, casement or double hung with minimum 6mm single pane or 6mm-12mm-6mm double insulated glazing (R_w+C_{tr} 25dB): OR ➤ Up to 60% floor area: As per Bedrooms at up to 40% area (R_w+C_{tr} 28 dB : OR ➤ Up to 80% floor area: As per Bedrooms at up to 60% area (R_w+C_{tr} 31 dB). 	<p>To R_w+C_{tr} 35dB</p> <ul style="list-style-type: none"> ➤ Concrete or terracotta tile or metal sheet roof with sarking and at least 10mm plasterboard ceiling 	<ul style="list-style-type: none"> ➤ At least one outdoor living area located on the opposite side of the building from the transport corridor and/or at least one ground level outdoor living area screened using a solid continuous fence or other structure of minimum 2 metres height above ground level 	<ul style="list-style-type: none"> ➤ Acoustically rated openings and ductwork to provide a minimum sound reduction performance of Rw 40dB into sensitive spaces ➤ Evaporative systems require attenuated ceiling air vents to allow closed windows ➤ Refrigerant-based systems need to be designed to achieve National Construction Code fresh air ventilation requirements ➤ Openings such as eaves, vents and air inlets must be acoustically treated, closed or relocated to building sides facing away from the corridor where practicable
	Side On	<ul style="list-style-type: none"> ➤ Single leaf of 150mm brick masonry with 13mm cement render on each face: OR 	<p>As per "Facing" above, except R_w+C_{tr} values may be 3dB less, e.g. glazed sliding door with 10 mm glass and weather seals for bedrooms</p>	<p>As above, except R_w+C_{tr} values may be 3dB less, or max % area increased by 20%</p>			
	Opposite	<ul style="list-style-type: none"> ➤ Double brick: two leaves of 90 mm clay brick masonry with a 20mm cavity between leaves. 	<p>No specific requirements</p>	<p>No specific requirements</p>			

**Road Traffic and Passenger Rail
Quiet House Requirements
(Based on Table 3 of State Planning Policy 5.4 2019)**

Exposure Category	Orientation to corridor	Acoustic rating and example constructions					Mechanical ventilation/air conditioning considerations
		Walls	External doors	Windows	Roofs and ceilings of highest floors	Outdoor Living areas	
B Quiet House B	Facing	<p>Bedroom and indoor living and work areas to R_w+C_{tr} 50dB</p> <p>Single leaf of 90 mm clay brick masonry with:</p> <ul style="list-style-type: none"> ➤ A row of 70 mm x 35 mm timber studs or 64 mm steel studs at 600 mm centres; ➤ A cavity of 25 mm between leaves; ➤ 50 mm glass wool or polyester cavity insulation (R2.0+) insulation between studs; and ➤ One layer of 10mm plasterboard fixed to the inside face ➤ Single leaf of 220mm brick masonry with 13mm cement render on each face ➤ 150mm thick unlined concrete panel or 200mm thick concrete panel with one layer of 13mm plasterboard or 13mm cement render on each face 	<p>Bedrooms</p> <ul style="list-style-type: none"> ➤ Fully glazed hinged door with certified R_w+C_{tr} 31dB rated door and frame including seals and 10mm glass <p>Indoor Living and work areas</p> <ul style="list-style-type: none"> ➤ 35mm solid core timber hinged door and frame system certified to Rw 28dB including seals: OR ➤ Glazed sliding door with 10 mm glass and weather seals 	<p>Bedrooms:</p> <ul style="list-style-type: none"> ➤ Total external door and window system area up to 40% of room floor areas: Fixed sash, awning or casement with minimum 6mm single or 6mm-12mm-6mm double insulated glazing (Rw+Ctr 31dB). ➤ Up to 60% floor area: as per above but must be minimum 10mm single or 6mm-12mm-10mm double insulated glazing (Rw+Ctr 34dB) <p>Indoor Living and work areas</p> <ul style="list-style-type: none"> ➤ Up to 40% floor area; Sliding or double hung with minimum 6mm single pane or 6mm-12mm-6mm double insulated glazing (R_w+C_{tr} 28dB). Sealed awning or casement windows may use 6mm glazing instead. : OR ➤ Up to 60% floor area: As per Bedrooms at up to 40% area (R_w+C_{tr} 31dB). : OR ➤ Up to 80% floor area: As per Bedrooms at up to 60% area (R_w+C_{tr} 34dB). 	<p>To R_w+C_{tr} 35dB</p> <ul style="list-style-type: none"> ➤ Concrete or terracotta tile sarking and at least 10mm plasterboard ceiling, R3.0+ insulation OR ➤ Metal sheet roof, sarking and at least 10mm plasterboard ceiling, R3.0+ insulation 	<ul style="list-style-type: none"> ➤ At least one outdoor living area located on the opposite side of the building from the corridor and/or at least one ground level outdoor living area screened using a solid continuous fence or other structure of minimum 2.4 metres height above ground level 	<ul style="list-style-type: none"> ➤ Acoustically rated openings and ductwork to provide a minimum sound reduction performance of Rw 40dB into sensitive spaces ➤ Evaporative systems require attenuated ceiling air vents to allow closed windows ➤ Refrigerant-based systems need to be designed to achieve National Construction Code fresh air ventilation requirements ➤ Openings such as eaves, vents and air inlets must be acoustically treated, closed or relocated to building sides facing away from the corridor where practicable
	Side-On	<p>Double brick: two leaves of 90mm clay brick masonry with:</p> <ul style="list-style-type: none"> ➤ A 50mm cavity between leaves ➤ 50mm glass wool or polyester cavity insulation (R2.0+) ➤ Resilient ties where required to connect leaves <p>Double brick: two leaves of 110mm clay brick masonry with</p> <ul style="list-style-type: none"> ➤ 50mm cavity between leaves and R2.0+ cavity insulation 	<p>Bedrooms:</p> <ul style="list-style-type: none"> ➤ Fully glazed hinged door with certified R_w+C_{tr} 28dB rated door and frame including seals and 6mm glass <p>Indoor Living and work areas:</p> <ul style="list-style-type: none"> ➤ 35mm solid core timber hinged door and frame system certified to Rw 28dB including seals: OR ➤ Glazed sliding door with 10 mm glass and weather seals 	<p>Bedrooms:</p> <ul style="list-style-type: none"> ➤ Total external door and window system area up to 40% of room floor area: Sliding or double hung with minimum 10 mm single or 6mm-12mm-10mm double insulated glazing (R_w+C_{tr} 28 dB). Sealed awning or casement windows may use 6 mm glazing instead. : OR ➤ Up to 60% floor area: as per above but must be sealed awning or casement type windows (R_w+C_{tr} 31dB). <p>Indoor Living and work areas</p> <ul style="list-style-type: none"> ➤ Up to 40% floor area: Sliding, awning, casement or double hung with minimum 6mm single pane or 6mm-12mm-6mm double insulated glazing (R_w+C_{tr} 25dB). : OR ➤ Up to 60% floor area: As per Bedrooms at up to 40% area (R_w+C_{tr} 28 dB) : OR ➤ Up to 80% floor area: As per Bedrooms at up to 60% area (R_w+C_{tr} 31 dB). 			
	Opposite		As above, except R_w+C_{tr} values may be 3dB less, or max % area increased by 20%	As above, except R_w+C_{tr} values may be 3dB less, or max % area increased by 20%			

**Road Traffic and Passenger Rail
Quiet House Requirements
(Based on Table 3 of State Planning Policy 5.4 2019)**

Exposure Category	Orientation to corridor	Acoustic rating and example constructions					Mechanical ventilation/air conditioning considerations
		Walls	External doors	Windows	Roofs and ceilings of highest floors	Outdoor Living areas	
C Quiet House C	Facing	<p>Bedroom and indoor living and work areas to R_w+C_{tr} 50dB</p> <p>Single leaf of 90 mm clay brick masonry with:</p> <ul style="list-style-type: none"> ➤ A row of 70 mm x 35 mm timber studs or 64 mm steel studs at 600 mm centres; ➤ A cavity of 25 mm between leaves; ➤ 50 mm glass wool or polyester cavity insulation (R2.0+) insulation between studs; and 	<p>Bedrooms</p> <ul style="list-style-type: none"> ➤ External doors to bedrooms facing the corridor are not recommended. <p>Indoor Living and work areas</p> <ul style="list-style-type: none"> ➤ Fully glazed hinged door with certified R_w+C_{tr} 31dB rated door and frame including seals and 10mm glass: OR <p>40mm solid core timber frame and door (without glass or with glass inserts not less than 6mm), side hinged with certified Rw 32dB acoustically rated door and frame system including seals</p>	<p>Bedrooms:</p> <ul style="list-style-type: none"> ➤ Total external door and window system area up to 20% of room floor area: Fixed sash, awning or casement with minimum 6mm single or 6mm-12mm-6mm double insulated glazing (R_w+C_{tr} 31dB): OR ➤ Up to 40% floor area; as per above but must be minimum 10mm single or 6mm-12mm-10mm double insulated glazing (R_w+C_{tr} 34dB). <p>Indoor Living and work areas</p> <ul style="list-style-type: none"> ➤ Up to 40% floor area: Sliding or double hung with minimum 6mm single pane or 6mm-12mm-6mm double insulated glazing (R_w+C_{tr} 31dB). Sealed awning or casement windows may use 6mm glazing instead: OR ➤ Up to 60% floor area: As per Bedrooms at up to 40% area (R_w+C_{tr} 34dB) 	<p>To R_w+C_{tr} 40dB</p> <ul style="list-style-type: none"> ➤ To all bedrooms, 2 layers of 10mm plasterboard, or one layer 13mm high density sealed plasterboard (minimum surface density of 12.5 kg/m²), affixed using steel furring channels beneath ceiling rafters/supports: and ➤ R3.0+ insulation batts laid in cavity : and ➤ Concrete or terracotta tile roof with sarking, or metal sheet roof with foil backed R2.0+ fibre insulation between steel sheeting and roof battens 	<ul style="list-style-type: none"> ➤ At least one outdoor living area located on the opposite side of the building from the corridor and/or at least one ground level outdoor living area screened using a solid continuous fence or other structure of minimum 2.4 metres height above ground level 	<ul style="list-style-type: none"> ➤ Acoustically rated openings and ductwork to provide a minimum sound reduction performance of Rw 40dB into sensitive spaces. ➤ Evaporative systems require attenuated ceiling air cents to allow closed windows. ➤ Refrigerant-based systems need to be designed to achieve National Construction Code fresh air ventilation requirements
	Side-on	<ul style="list-style-type: none"> ➤ One layer of 10mm plasterboard fixed to the inside face ➤ Single leaf of 220mm brick masonry with 13mm cement render on each face ➤ 150mm thick unlined concrete panel or 200mm thick concrete panel with one layer of 13mm plasterboard or 13mm cement render on each face <p>Double brick: two leaves of 90mm clay brick masonry with:</p>	<p>Bedrooms</p> <ul style="list-style-type: none"> ➤ Fully glazed hinged door with certified R_w+C_{tr} 31dB rated door and frame including seals and 10mm glass <p>Indoor Living and work areas</p> <ul style="list-style-type: none"> ➤ 35mm solid core timber hinged door and frame system certified to Rw 28dB including seals: OR ➤ Glazed sliding door with 10 mm glass and weather seals 	<p>Bedrooms:</p> <ul style="list-style-type: none"> ➤ Total external door and window system area up to 40% of room floor area: Sliding or double hung with minimum 10 mm single or 6mm-12mm-10mm double insulated glazing (R_w+C_{tr} 28 dB). Sealed awning or casement windows may use 6 mm glazing instead: OR ➤ Up to 60% floor area: as per above but must be sealed awning or casement type windows (R_w+C_{tr} 31dB). <p>Indoor Living and work areas</p> <ul style="list-style-type: none"> ➤ Up to 40% floor area: Sliding, awning, casement or double hung with minimum 6mm single pane or 6mm-12mm-6mm double insulated glazing (R_w+C_{tr} 25dB): OR ➤ Up to 60% floor area: As per Bedrooms at up to 40% area (R_w+C_{tr} 28 dB) : OR ➤ Up to 80% floor area: As per Bedrooms at up to 60% area (R_w+C_{tr} 31 dB). 	<p>To R_w+C_{tr} 40dB</p> <ul style="list-style-type: none"> ➤ Concrete or terracotta tile roof with sarking, or metal sheet roof with foil backed R2.0+ fibre insulation between steel sheeting and roof battens 	<ul style="list-style-type: none"> ➤ At least one outdoor living area located on the opposite side of the building from the corridor and/or at least one ground level outdoor living area screened using a solid continuous fence or other structure of minimum 2.4 metres height above ground level 	<ul style="list-style-type: none"> ➤ Acoustically rated openings and ductwork to provide a minimum sound reduction performance of Rw 40dB into sensitive spaces. ➤ Evaporative systems require attenuated ceiling air cents to allow closed windows. ➤ Refrigerant-based systems need to be designed to achieve National Construction Code fresh air ventilation requirements
	Opposite	<ul style="list-style-type: none"> ➤ A 50mm cavity between leaves ➤ 50mm glass wool or polyester cavity insulation (R2.0+) ➤ Resilient ties where required to connect leaves <p>Double brick: two leaves of 110mm clay brick masonry with</p> <ul style="list-style-type: none"> ➤ 50mm cavity between leaves and R2.0+ cavity insulation 	<p>Bedrooms:</p> <ul style="list-style-type: none"> ➤ Fully glazed hinged door with certified R_w+C_{tr} 28dB rated door and frame including seals and 6mm glass <p>Indoor Living and work areas:</p> <ul style="list-style-type: none"> ➤ 35mm solid core timber hinged door and frame system certified to Rw 28dB including seals: OR ➤ Glazed sliding door with 10 mm glass and weather seals 	<p>Bedrooms:</p> <ul style="list-style-type: none"> ➤ Total external door and window system area up to 40% of room floor area: Sliding or double hung with minimum 10 mm single or 6mm-12mm-10mm double insulated glazing (R_w+C_{tr} 28 dB). Sealed awning or casement windows may use 6 mm glazing instead: OR ➤ Up to 60% floor area: as per above but must be sealed awning or casement type windows (R_w+C_{tr} 31dB). <p>Indoor Living and work areas</p> <ul style="list-style-type: none"> ➤ Up to 40% floor area: Sliding, awning, casement or double hung with minimum 6mm single pane or 6mm-12mm-6mm double insulated glazing (R_w+C_{tr} 25dB): OR ➤ Up to 60% floor area: As per Bedrooms at up to 40% area (R_w+C_{tr} 28 dB) : OR ➤ Up to 80% floor area: As per Bedrooms at up to 60% area (R_w+C_{tr} 31 dB). 	<p>To R_w+C_{tr} 40dB</p> <ul style="list-style-type: none"> ➤ Concrete or terracotta tile roof with sarking, or metal sheet roof with foil backed R2.0+ fibre insulation between steel sheeting and roof battens 	<ul style="list-style-type: none"> ➤ At least one outdoor living area located on the opposite side of the building from the corridor and/or at least one ground level outdoor living area screened using a solid continuous fence or other structure of minimum 2.4 metres height above ground level 	<ul style="list-style-type: none"> ➤ Acoustically rated openings and ductwork to provide a minimum sound reduction performance of Rw 40dB into sensitive spaces. ➤ Evaporative systems require attenuated ceiling air cents to allow closed windows. ➤ Refrigerant-based systems need to be designed to achieve National Construction Code fresh air ventilation requirements

Note: The above treatments are a deemed to satisfy construction. Alternative designs are acceptable, provided they are certified by a suitable qualified acoustic consultant.



APPENDIX B
ENVIRONMENTAL ASSESSMENT
AND JUSTIFICATION REPORT

(EMERGE, AUGUST 2013)



ENVIRONMENTAL ASSESSMENT AND JUSTIFICATION REPORT

CENTRAL ALKIMOS

Project Number EP11-065

**Prepared for Lend Lease Communities (Alkimos) Pty
Ltd
August 2013**

ENVIRONMENTAL ASSESSMENT AND JUSTIFICATION REPORT
 CENTRAL ALKIMOS

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Executive Summary

Emerge Associates was engaged by Lend Lease Communities (Alkimos) Pty Ltd to provide environmental consulting services to support the design and documentation of the Central Alkimos Local Structure Plan (LSP) for Part Lot 9002 and Part Lot 9003 Marmion Avenue, Alkimos (the site).

The site is identified as “Urban” and “Parks and Recreation” within the Alkimos-Eglinton District Structure Plan (DSP). The planning for the Alkimos-Eglinton DSP was conducted in conjunction with an amendment to the Metropolitan Region Scheme (MRS) to reflect the land uses planned for within the DSP. This MRS amendment (MRS Amendment 1029/33) was formally assessed by the Environmental Protection Authority (EPA), who assessed the regional values of the DSP area and made recommendations that specific areas were reserved for “Parks and Recreation” as areas of regional significance (EPA Bulletin 1207). These recommendations were significantly different to that which was proposed in the original MRS amendment by the Western Australian Planning Commission (WAPC) and resulted in an additional 138 ha of Parks and Recreation Reserve being reserved within the DSP area. The site contains areas that were recommended by the EPA for retention due to the presence of regionally significant values, and an east-west ecological linkage through the DSP area.

The planning of the *Alkimos Eglinton District Structure Plan* (DSP) was prepared using extensive background studies over a full range of relevant environmental considerations which were completed prior to or as part of the Metropolitan Region Scheme (MRS) Amendment 1029/33 (MRS 2005). Environmental investigations and assessments conducted over the site (and wider area) includes:

- *Metropolitan Scheme Amendment 1029/33 Alkimos Eglinton Environmental Review* (ATA Environmental 2003).
- *Metropolitan Scheme Amendment 1029/33 Alkimos Eglinton Flora, Vegetation and Fauna Baseline Information* (ATA Environmental 2005).
- *Alkimos Eglinton District Structure Plan, Environmental Assessment* (RPS 2006).
- *District Water Management Strategy Alkimos Eglinton* (GHD 2011).

This report outlines the environmental attributes and values within the site and summarises an assessment that has supported the preparation of the LSP. The information has been drawn from existing sources and site-specific assessments conducted within the site and include:

- *Desktop Geotechnical Study* (Douglas Partners 2012) (**Appendix A**).
- *Graceful Sun Moth Survey* (Ecological Australia, 2011) (**Appendix B**).
- *Local Water Management Strategy* (Emerge Associates 2012a).
- *Bushfire Management Plan* (Don Spriggins Forestry Consultants 2012) (**Appendix D**).
- *Acoustic Assessment* (Herring Storer Acoustics 2012) (**Appendix E**).
- *Black Cockatoo Habitat Assessment* (Emerge Associates 2012c).
- *Vegetation Community and Condition Mapping Update* (Emerge Associates 2012c).
- *Graceful Sun Moth Habitat Assessment* (Emerge Associates 2012d).

All of the above information was used to conduct the environmental assessment of the site as documented in this report. From this, the following environmental attributes and values were identified:

- A parabolic dune with geoheritage significance is located within the site.
- Two Priority Ecological Communities (PECs) were inferred to be present within the site, being FCT No. 24: Northern Spearwood shrublands and woodlands, and FCT No. 29b: Acacia shrublands on taller dunes.

ENVIRONMENTAL ASSESSMENT AND JUSTIFICATION REPORT
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- One potential Threatened Ecological Community (TEC) was inferred to be present within the site, being FCT 26a: *Melaleuca huegelii*- *Melaleuca acerosa* shrublands on Limestone ridges. This TEC has not been confirmed by WA Department of Environment and Conservation (DEC).
- Remnant vegetation occurs extensively across the site with condition ranging from “Degraded” to “Excellent” in accordance with Bush Forever vegetation condition scale (2000).
- Plant species known to be Carnaby’s black cockatoo foraging species and evidence of foraging by Carnaby’s black cockatoo.
- Groundwater is greater than 3 metres below the ground surface and there are no surface water features.
- No known risk of Acid Sulfate Soils (ASS) occurs within 3 m of the natural soil surface.

The LSP has responded to the environmental values and attributes within the site by providing the opportunity to:

- Retain the parabolic dune landform feature within the Regional Open Space (ROS) reserved for “Parks and Recreation” under the MRS. This includes the conservation of the parabolic dune and ROS vegetation which ranges from “Degraded” to “Excellent” condition vegetation within the north east corner of the site.
- Retain Bush Forever Site 397 in the western corner of the site with “Very Good” condition vegetation.
- Designate ROS over areas of the Threatened Ecological Community (TEC) and Priority Ecological Communities (PECs) (inferred by ATA Environmental 2005) included in the ROS, which correspond to the areas of remnant vegetation in the best condition.
- Enable adequate bushfire suppression access and providing for setbacks to satisfy the requirements of *Planning for Bushfire Protection* (WAPC 2010) for areas adjacent to vegetation.
- Understand potential noise impacts from Marmion Avenue, Mitchell Freeway and the Northern Suburbs Railway and the requirements for noise mitigation measures.

This document also identifies the following studies and management plans are likely to be as part of subdivision or the subdivision approval process:

- An Urban Water Management Plan (UWMP) for each stage of subdivision.
- Vegetation and Fauna Management Plan.
- Karst Investigation and Management Plan.
- Landscape Concept Plan.
- Open Space Strategy.
- A detailed acoustic assessment incorporating final lot levels and other details and the preparation of a Noise Management Plan.
- EMPs for impacts on ROS.

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Desktop Geotechnical Study

Appendix B

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Appendix C

Regionally Significant Bushland within the Alkimos Eglinton Area

Appendix D

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Alkimos Beach Concept Plan

1 Introduction

1.1 Background

Lend Lease Communities (Alkimos) Pty Ltd (Lend Lease) in partnership with LandCorp are delivering the Local Structure Plan for Central Alkimos (Part Lot 9003 and Part Lot 9002, Marmion, Avenue Alkimos).

The Central Alkimos Local Structure Plan (LSP) area (referred to collectively herein as the 'site'), is located approximately 17 km north of Joondalup Strategic Metropolitan Centre and 40 km north of the Perth City Business District. The site is proposed to be developed for residential housing, and the site is bound to the east by the future Mitchell Freeway and is dissected by Marmion Avenue and the proposed Northern Suburbs Railway Line which extends through the site to the proposed new train station centre immediately south of the site located in the Alkimos City Centre. The location of the site is shown in **Figure 1**.

The Central Alkimos LSP design has been prepared in conjunction with the Alkimos City Centre LSP. The Alkimos City Centre is located south of the site and provides provide a diverse, multi-functional and mixed use centre, which will be a focal point for the local and wider community. Central Alkimos on the other hand supports residential use and large areas of Regional Open Space (ROS).

1.2 Purpose of the report

Lend Lease engaged Emerge Associates to provide environmental consultancy services to support the preparation of the LSP for the Central Alkimos. The purpose of this report is to support the lodgment of the LSP with City of Wanneroo, its review and subsequent advertising and referral to state government agencies.

This report provides a synthesis of information regarding the environmental values and attributes of the site utilising a range of information sources including local and regional reports, databases, mapping and where applicable, site specific investigations. This report assesses the potential environmental impacts that could arise from implementation of the plan and provides a framework for the future environmental management requirements to be progressed through the future subdivision and detailed development stages.

1.3 Scope of work undertaken

In addition to a review of existing information, and input into the LSP design process, Emerge Associates also undertook a number of site specific investigations.

In October 2012, Emerge Associates updated the vegetation community and condition mapping based on the *Alkimos-Eglinton Flora, Vegetation and Fauna Baseline Information – Interpretation Report* by ATA Environmental (2005). Emerge Associates also undertook a Graceful Sun Moth habitat assessment and Carnaby's black cockatoo habitat assessment. The findings of these investigations (Emerge Associates 2012b, Emerge Associates 2012d) have been included in this report.

In addition, Emerge Associates have prepared a Local Water Management Strategy (LWMS) (Emerge Associates 2012a) to support the LSP for the site.

1.4 Extent of current and historical investigations

A Metropolitan Region Scheme (MRS) amendment has previously been completed for the wider Alkimos-Eglinton area in 2006, which covers the site. MRS Amendment 1029/33 was formally assessed by the Environmental Protection Authority (EPA) by Environmental Review under Section 48A of the *Environmental Protection Act 1986*. The EPA released its report and recommendations for MRS Amendment 1029/33 in November 2005 (EPA Bulletin 1207). This is discussed further in **Section 3.3**.

In addition, the site is located within the *Alkimos Eglinton District Structure Plan (DSP)* area shown in **Figure 2**. The DSP was approved by the City of Wanneroo (CoW) in July 2008 and the Western Australian Planning Commission (WAPC) in June 2010. These planning processes were supported by a large amount of technical environmental investigations appropriate for the level of planning.

Recent investigations were undertaken to determine key environmental values for the site and surrounding area. A Graceful Sun Moth Survey (Ecological 2011) was completed for the site and Lot 1003 over 2010 and 2011 (**Appendix B**). Emerge Associates (2012) recently undertook *Lomandra maritima* density mapping to determine the densities of Graceful Sun Moth habitat over the site. Since these investigations were undertaken, the Graceful Sun Moth has been removed from Schedule 1 of the *Wildlife Conservation Act 1950 (WC Act)* and is no longer listed as Endangered under the *Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act 1999)*.

A Desktop Geotechnical Study was conducted by Douglas Partners (Douglas Partners 2012) for the proposed site and Alkimos City Centre LSP area in July 2012 (**Appendix A**). The purpose of the investigation was to review available geological information to identify the likelihood of karstic features being present. This Geotechnical Study provides a desktop analysis of the site which is the required level of assessment to support the lodgment of the LSP in accordance with the City of Wanneroo *Draft Local Planning Policy 4.13: Caves and Karstic features (LPP 4.13)* (July 2012).

A Bushfire Management Plan for the site was prepared by Don Spriggins Forestry Consultants in December 2012 (Forestry Consultants 2012) (**Appendix D**). The plan provides principles and general commitments for bushfire management to support the lodgment and review of the LSP.

Herring Storer Acoustics prepared an Acoustic Assessment of Central Alkimos and Regional Centre Residential Development for Lend Lease in July 2012 (Herring Storer Acoustics 2012) (**Appendix E**). This provides a summary of the noise limits affecting the site and the criteria to follow for the development of noise sensitive areas, in accordance with *State Planning Policy 5.4- Road and Rail Transport Noise and Freight Considerations in Land Use Planning (SPP 5.4)*.

Updated and site specific vegetation condition and community mapping was prepared by Emerge Associates following field investigations in October 2012, which followed the flora and vegetation mapping conducted by ATA Environmental (2005) for the entire DSP area. The vegetation condition mapping was altered to more accurately reflect the current condition found throughout the site. The findings of this field investigation have been included in this report (Emerge Associates 2012c).

A habitat assessment for black cockatoo species with a focus on Carnaby's black cockatoo was undertaken by Emerge Associates in October 2012. This survey recorded identified Carnaby's black cockatoo foraging evidence and identified potential habitat trees over the site (Emerge Associates 2012b).

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A Local Water Management Strategy (LWMS) has been prepared by Emerge Associates (Emerge Associates 2012a). It outlines the integrated water management requirements which support the overall design of the LSP.

This document provides a summary of the findings and outcomes arising from these environmental investigations and assessments.

2 Existing Environment and Site Specific Investigations

2.1 The local context

The site is located in the locality of Alkimos within the City of Wanneroo approximately 17 km north of Joondalup Strategic Metropolitan Centre and approximately 40 km north of the Perth Central Business District. The site is zoned “Urban” and “Parks and Recreation” reserve under the MRS and “Urban Development” and “Parks and Recreation” under the *City of Wanneroo’s Town Planning Scheme No. 2* (TPS No. 2). The site also contains a strip of land zoned “Railways” and “Other Regional Roads” under the MRS and TPS No. 2. The “Other Regional Roads” reservation is associated with Marmion Avenue which runs north-south through the middle of the site, and a distributor road which connects Marmion Avenue to the future Mitchell Freeway extension to the east. The site is immediately north of Alkimos City Centre zoned “Central City Area”, which is a regional centre for the local and wider community. The site is bound by the “Urban” zoned Shorehaven residential development to the north and “Parks and Recreation” reserved Bush Forever Site 397 to the east. The Alkimos WWTP “Public Purposes” reservation land is located south and west of the site adjacent to Marmion Avenue.

The location of the site is shown in **Figure 1** with aerial photography indicating the physical conditions within the site and the MRS zones and reservations for the site and surrounding areas is shown in **Figure 3**.

2.2 Climate

The climate of the site (which applies to the wider Perth metropolitan region) is described as a Mediterranean climate, with hot, dry summers and moderately wet, mild winters.

The majority of rainfall within the region occurs between May and October each year, and on average is between 600 to 1000 millimetres per year. However, in the last 40 years there has been a marked decrease in rainfall (approximately 11 per cent decrease), with a noticeable shift to a drier climate across the south-west of Western Australia (Water Corporation 2009). 2010 was one of the lowest years of rainfall on record, with only 503.8 millimetres recorded in Perth, compared to the long-term average of 852.6 millimetres per annum.

The closest weather station to the site which records rainfall is at Tamala Park in Mindarie, situated approximately 12 kilometres south of the site. The annual rainfall at Tamala Park for 2009 and 2010 was 551.4 millimetres and 501.4 millimetres respectively which is lower than the annual average (2004-2012) of 614.4 millimetres per annum. The monthly rainfall data for 2009 and 2010 and the monthly average (2004-2012) has been summarised below in **Table 1**.

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Table 1: Summary of rainfall for 2009 and 2010 and average (2004-2012) at Tamala Park weather station

YEAR	RAINFALL IN MILLIMETRES (MM)												
	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
2009	1.6	6.2	6.4	5.0	40.8	118.0	137.6	107.4	101.4	5.0	22.0	0.0	551.4
2010	0.0	1.2	48.0	44.6	78.2	59.2	98.4	79.8	46.6	9.2	12.0	24.2	501.4
Average (2004-2012)	12.2	9.9	16.8	56.9	80.4	109.9	113.9	95.2	69.1	34.0	22.4	11.8	614.4

2.3 Topography

The site has highly undulating topography due to the parabolic dunal system on which it lies. The north eastern portion of the site is situated on a parabolic dune which runs along the southern boundary of the site. The site ranges in height from 50m AHD in the south east (associated with the northern arm of the parabolic dune) to 15 m AHD in the centre, rising again to 40 m AHD in the west. A low corridor runs north-south through this portion of the site, associated with Marmion Avenue. The site has predominantly a northeasterly aspect.

Topographic contours over the site are shown in **Figure 4**.

2.4 Soils and landforms

The site is located on the Swan Coastal Plain, which forms the central portion of the Perth basin. The Perth basin extends from the Darling Fault in the east to the continental slope west of Rottnest Island, and from the Murchison River in the north and the Southern Ocean in the south. The Perth basin is sedimentary in origin and is marginal to the west of the Australian Shield (Seddon 2004).

The Swan Coastal Plain is generally flat and is approximately 20 – 30 kilometres wide, consisting of a series of geomorphic entities running parallel to the coastline. The youngest and most western of these geomorphic entities is the Quindalup Dunes, followed by the Spearwood Dunes and at the most eastern extent the Bassendean Dunes.

The site is situated within the coastal belt of the Swan Coastal Plain, within the Quindalup and Spearwood Dunes geomorphological units. A description of the soil-landform units present over the site is provided below in **Table 2** and shown in **Figure 5**.

Table 2: Soil Landform Units (Churchward and McArthur 1980).

SOIL LANDFORM UNIT	DESCRIPTION
Karrakatta Shallow Soils Phase (KIs)	Bare rock, yellow/brown shallow sands and stony soils
Karrakatta Sand Yellow Phase (Ky)	Yellow deep sands
Quindalup Oldest Dune Phase (Q1)	Calcareous sands with organic staining to about 30 cm, overlying pale brown sand with definite cementation below 1 m

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SOIL LANDFORM UNIT	DESCRIPTION
Quindalup Second Dune Phase (Q2)	Calcareous sands with organic staining to about 20 cm, passing into pale brown sand; some cementation below 1m
Quindalup Youngest Dune Phase (Q4)	Loose pale brown calcareous sand with no soil profile development
Quindalup Deep Sand Flat Phase (Qp)	Dark grey brown sand to about 50 cm and then pale brown sand

The dominant landform units for the site are the Karrakatta Shallow Soils Phase, Karrakatta Sand Yellow Phase and the Quindalup Second Dune Phase.

2.5 Geoheritage

The Australian Geological Society defines Geoheritage as “global to local features of geology that are intrinsically important sites or culturally important sites that provide information into the formation and evolution of the earth” (Brocx 2008).

The site contains a part of the Alkimos dune system. This dune system is a parabolic feature approximately 2 km wide which extends inland for 4 km. The Alkimos dune system was described by the Geological Society of Australia as an excellent example of a complex system of parabolic dunes of Holocene age belonging to the Quindalup system with national and international significance (Seminuik 2004, Lemmon *et al.* 1979, EPA 2005). The system involves four Quindalup dune phases (Q1-Q4) which have been defined on the basis of profile maturity, soil development and vegetation cover. The site contains the Q2 dune phase which is the second oldest Quindalup system phase.

2.6 Geology

2.6.1 Environmental geology mapping

Environmental geology for the site has been mapped by the Geological Survey of Western Australia, Gozzard (1985). The site consists of limestone, sand and calcareous sand with the geological units listed in **Table 3** and shown in **Figure 6**.

Table 3: Environmental Geology (Gozzard 1985).

GEOLOGICAL UNIT	EQUIVALENT ON GEOLOGICAL MAPS	DESCRIPTION
LS1 - Limestone	Tamala limestone	Light yellowish brown, fine to coarse-grained, sub-angular to well rounded, quartz, trace of feldspar, shell debris, variable lithified, surface kankar, of eolian origin
LS4 – Limestone	Safety Bay Sand	Pale yellowish brown weakly cemented, friable, medium-grained, sub-rounded, quartz and shell debris, of eolian origin
S2 - Calcareous sand	Safety Bay Sand	White fine to medium grained, sub-rounded quartz and shell debris, of eolian origin
S3 – Calcareous sand	Safety Bay Sand	As S2, occurs as relatively thick covering over LS1
S7 - Sand	Sand derived from Tamala limestone	Pale and olive yellow, medium to coarse-grained, sub-angular quartz with a trace of feldspar, moderately sorted, of residual origin

2.6.2 Karstic features

Karst features are known to generally occur within Tamala limestone. The CoW has produced the Draft LPP4.13 (July 2012), which has been prepared under the provisions of Section 8.11 of the CoW *District Planning Scheme No.2*. (CoW 2012). The purpose of the policy is to outline the information requirements required for investigation and management of caves and karstic features to assist in design, assessment and determination of structure plans, subdivision applications and development applications.

The karst assessment and risk map associated with this policy identifies areas of low and medium karst risk within the site. The management requirements for these karst risk levels at LSP planning stage include a "Desktop Karst Survey" and a "Geotechnical Report".

2.6.3 Desktop Geotechnical Study

A desktop geotechnical study was completed by Douglas Partners for the site in July 2012 (see **Appendix A**). This geotechnical study reviewed the environmental geology mapping discussed above (the Yanchepp 1:50,000 Environmental Geology Sheet) for the site.

The results of the desktop geotechnical study indicate the ground conditions underlying the development site have a geological unit which has "common solution cavities and fissures" but is not known to have large karst features such as caves. Based on this information, Douglas Partners concluded that there was a very low susceptibility for development of large karst structures within the site and that the likelihood of karst formations impacting the proposed development is low.

2.7 Acid sulfate soils

Acid Sulfate Soils (ASS) is the name commonly given to naturally occurring soils and sediment containing iron sulphide (iron pyrite) materials. In their natural state ASS are generally present in waterlogged anoxic conditions and do not present any risk to the environment. ASS can present issues when oxidised, producing sulphuric acid, which can impart a range of impacts on the surrounding environment, infrastructure and human health. ASS that have been oxidised and resulted in the creation of acidic conditions are commonly termed "Actual ASS" (AASS) and those that have acid generating potential but remain in their naturally anaerobic state are termed "Potential ASS (PASS)".

Mapping prepared by the WA Department of Environment and Conservation (DEC) to support the Western Australian Planning Commission's Planning Bulletin No. 64: Acid Sulfate Soils (WAPC, 2007) provides broad-scale mapping indicating areas of potential ASS risk. The mapping indicates that the site has been classified as predominantly having no known risk of ASS occurring within three metres of the ground surface.

2.8 Hydrology

2.8.1 Groundwater

The *Perth Groundwater Atlas* (DoW 2004) shows that groundwater levels across the site range from between 5 m AHD in the east to <1 m AHD in the west before dropping to sea level at the coastal interface.

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Groundwater monitoring has been carried out across the Alkimos-Eglinton DSP area with six rounds of monitoring undertaken between July 2010 and November 2011 including groundwater levels, as well as nutrient and metal analysis. The depth to groundwater ranged between 13 m to 40 m below the ground surface. Further information on groundwater levels and groundwater quality can be found in the LWMS prepared for the site (Emerge 2012a).

2.8.2 Surface water

There is no known surface water features associated with the site. The soils have a high infiltration capacity and there would be little to no surface run off except during extreme rainfall events.

2.8.3 Public drinking water sources

Public Drinking Water Source Areas (PDWSAs) are proclaimed by the Department of Water (DoW) to protect the quality of identified drinking water sources, which can be surface water or groundwater sources (DoW 2009b). They are proclaimed under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* or the *Country Areas Water Supply Act 1947* as Water Reserves, Catchment Areas or Underground Water Pollution Areas (DoW 2009b). PDWSA provide the community of Western Australia with the majority of its drinking water supplies and can be vulnerable to contamination from a range of land uses and water based activities (DoW 2009b). Once an area is identified as a PDWSA consideration needs to be given to the intended land use and associated activities to ensure that they are appropriate in meeting the water protection quality objectives of the area.

The majority of the site is located within a Priority 3 PDWSA as part of the Perth Coastal Underground Water Pollution Control area.

Priority 3 PDWSA's areas are defined to *manage the risk of pollution* to the water source from catchment activities. Under the DoW policy (DoW 2009b) it is expected that protection of P3 areas is achieved through guided or regulated environmental risk management for land use activities. Land uses considered to have significant pollution potential are generally opposed or constrained (Department of Environment 2004).

The site also contains proposed Well Head Protection Zones (WHPZ) associated with drinking water and monitoring bores which are subject to restricted land uses in order to protect the water quality immediately surrounding extraction bores. WHPZ are circular with a radius of 300 m in P3 areas and are subject to special protection measures (Department of Environment 2004).

The extent of the Priority 3 PDWSA and the WHPZ within the site are shown in **Figure 7**.

2.9 Wetlands

A review of the *Geomorphic Wetlands on the Swan Coastal Plain dataset* (DEC 2012) indicates that there are no geomorphic wetlands within the site. Site investigations have confirmed that there are no wetland features on the site or wetland dependent vegetation types.

2.10 Flora and vegetation

2.10.1 Regional context

The site lies within the Swan Coastal Plain Interim Biogeographic Regionalisation for Australia (IBRA) region (Thackway and Cresswell 1995). The Swan Coastal Plain IBRA region is broadly compatible with the Swan Coastal Plain (Drummond Botanical Subdistrict) Phytogeographical Subregion as described by Beard (1990). This region is characterised by banksia low woodlands on leached sands, woodlands of tuart (*Eucalyptus gomphocephala*), jarrah (*Eucalyptus marginata*) and marri (*Corymbia calophylla*) on less leached soils and *Melaleuca* swamps.

Vegetation complex mapping for the Swan Coastal Plain undertaken by Heddle *et al.* (1980) indicates that two vegetation complexes occur within the site:

- Quindalup complex – Coastal dune complex consisting mainly of two alliances – the strand and fore dune alliance and the mobile and stable dune alliance. Local variations including the low closed forest of *Melaleuca lanceolata* – *Callitris preissii* and the closed scrub of *Acacia rostellifera*.
- Cottesloe complex Central and South – mosaic of woodland of *E. gomphocephala* and open forest of *E. gomphocephala* – *E. marginata* – *Corymbia calophylla*; closed heath on the limestone outcrops.

Based on EPA (2006) approximately 47.1% of the Quindalup complex and 41.1% of the Cottesloe Central and South complex remains compared to the pre-European settlement. A more recent assessment undertaken by the Perth Biodiversity Project (PBP 2011) indicates that approximately 55.43% of the Quindalup complex and 23.92% of the Cottesloe Central and South complex remains on the Swan Coastal Plain (south of Moore River) compared to pre-European settlement. The figure for Cottesloe Central and South is slightly lower than the generally accepted (best practice) 30% complex retention targets (Commonwealth of Australia 2001 and EPA 2006). However it is greater than the 10% target which is the objective for “constrained areas” such as the Swan Coastal Plain portion of the Perth Metropolitan Region (the Bush Forever study area) in accordance with EPA *Guidance Statement No. 10 Levels of Assessment for Proposals Affecting Natural Areas within System 6 Region and Swan Coastal Plain Portion of the System 1 Region* (EPA 2006). Furthermore, both complexes have over 10% formally protected through DEC conservation estate and Bush Forever sites (PBP 2011). The vegetation complexes of the site are shown in **Figure 8**.

Within the City of Wanneroo, 13% of the pre-European extent of the Quindalup complex is protected and 24% of the Cottesloe Central and South complex (City of Wanneroo 2011).

2.10.2 Flora and vegetation survey

Flora and vegetation over the Alkimos – Eglinton DSP area has been surveyed numerous times including Trudgen and Keighery in 1990, Armstrong 1996, ATA Environmental in 2002 and later Bennett in 2004 (ATA 2005). The report entitled *Alkimos-Eglinton Flora, Vegetation and Fauna Baseline Information – Interpretation Report* (ATA Environmental 2005) provided detailed information to support the EPA assessment of the MRS amendment 1029/33. This was the only survey that covered the entire Alkimos – Eglinton amendment area.

A detailed field survey was conducted by Emerge Associates in October 2012 to verify the previously prepared vegetation association and vegetation condition mapping for the site. The survey involved visiting particular vegetation communities in varying vegetation condition and walking transects over

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the majority of the site to map changes in the vegetation associations and condition and determine the accuracy of the previously prepared mapping and also to update at a finer mapping resolution that was specific for the site. The vegetation condition scale developed by Keighery (1994) and used in Bush Forever (2000) was used for this assessment.

The flora and vegetation information described in this report is primarily sourced from the ATA Environmental (2005) with additional information from the recently undertaken Emerge Associates 2012 survey.

2.10.2.1 Vegetation associations

Over 23 vegetation associations were identified over the site in the ATA Environmental (2005), consisting of two broad groups *Melaleuca* spp, *Lomandra maritima*, *Xanthorrhoea preissii*, *Acacia* spp heath on dune systems or *Eucalyptus* spp, *Banksia* spp woodlands in lower lying areas and limestone. A site visit by Emerge Associates in October 2012 confirmed and updated the spatial extent of these vegetation associations. The vegetation associations mapped by ATA Environmental (2005) and updated by Emerge Associates in 2012 are shown in **Figure 8**.

2.10.2.2 Vegetation condition

Vegetation condition over the site was recorded by ATA Environmental (2005) using the Bush Forever Vegetation Condition Scale (2007). Emerge Associates visited the site in 2011 and 2012 and confirmed that the vegetation condition is generally consistent with that mapped by ATA Environmental (2005). The vegetation condition of the site is shown in **Figure 10**.

Vegetation condition is variable over the site and the majority of the site is “Very Good” with remnant patches of “Excellent” condition vegetation throughout the site. The site has not been subject to heavy grazing or vehicle pressures and therefore large parts are relatively intact. The parabolic dune formation in the south east portion of the site ranges from “Degraded” to “Very Good”.

2.10.3 Significant flora

Species of flora acquire Declared Rare Flora (DRF) or Priority Flora (PF) conservation status where populations are restricted geographically or threatened by local processes. The Department of Environment and Conservation (DEC) recognises these threats and subsequently applies regulations towards population protection and species conservation. The DEC enforces regulations under the *Wildlife Conservation Act 1950* (WC Act) to conserve DRF species and protect significant populations. PF are described as potentially rare or threatened species and are classified in order of threat. DRF and PF category definitions are listed below in **Table 4**.

Table 4: Definition of Rare and Priority Flora species (Atkins 2008)

CONSERVATION CODE	CATEGORY
R	Declared Rare Flora – Extant Taxa. Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.
X	Declared Rare Flora – Presumed Extinct Taxa Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such.

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CONSERVATION CODE	CATEGORY
P1	Priority One – Poorly Known Taxa Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat e.g. road verges, urban areas, farmland, active mineral leases etc., or the plants are under threat, e.g. from disease, grazing by feral animals etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as "rare flora", but are in urgent need of further survey.
P2	Priority Two – Poorly Known Taxa Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as "are flora", but urgently need further survey.
P3	Priority Three – Poorly Known Taxa Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as "rare flora" but need further survey.
P4	Priority Four – Rare Taxa Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

The Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) promotes the conservation of biodiversity by providing statutory protection for plants at a species level. Some DRF species listed under the WC Act are also listed at a Federal level. Section 178 and 179 of the EPBC Act provides for the lists and categories of threatened species under the Act and is summarised in **Table 5**.

Table 5: Categories of Threatened Species (EPBC Act, Section 178 & 179, 1999)

(Only categories marked with an * are matters of national environmental significance under the EPBC Act 1999)

CONSERVATION CODE	CATEGORY
E	Extinct Taxa which is known only to survive in cultivation, in captivity or as a naturalized population, well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
CE*	Critically Endangered Taxa which is facing a very high risk of extinction in the wild in the immediate or near future, as determined in accordance with the prescribed criteria.
E*	Endangered Taxa which are not critically endangered and is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
V*	Vulnerable Taxa which is not endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
CD	Conservation Dependent A species that is the focus of a specific conservation program; the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

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To assess the potential for the site to contain specifically protected flora species, searches of the DEC's NatureMap Database and the Department of Sustainability, Environment, Water, Population, Arts and Community (SEWPAC) Protected Matters database were undertaken. It is important to note that these do not take into account the specific vegetation condition of the site in question, but are based on the proximity of the site to known occurrences of significant species. These database search results were combined with the listed protected flora identified by ATA Environmental (2005) to form a comprehensive list of protected flora species which may occur over the site are listed in **Table 6**.

Table 6: Conservation coded flora known to occur within the vicinity of the site based upon database searches and ATA Environmental survey (2005).

SPECIES		CONSERVATION CODE	
SCIENTIFIC NAME	COMMON NAME	FEDERAL	STATE
<i>Acacia benthamii</i>	-		P2
<i>Calectasia cyanea</i>	Blue Tinsel Lily	CE	R
<i>Centrolepis caespitosa</i>	-	E	P4
<i>Conostylis pauciflora subsp. euryrhipis</i>	-		P4
<i>Conostylis pauciflora subsp. pauciflora</i>	-		P4
<i>Crassula colorata subsp. miriamae</i>	-		P2
<i>Eucalyptus argutifolia</i>	Wabbling Hill Mallee	V	R
<i>Fabronia hampeana</i>	-		P2
<i>Hibbertia spicata subsp. leptotheca</i>	-		P3
<i>Isopogon uncinatus</i>	Hook-leaf Isopogon	E	R
<i>Jacksonia sericea (Waldjumi)</i>	Waldjumi		P4
<i>Lecania turicensis var. turicensis</i>	-		P2
<i>Leucopogon maritimus</i>	-		P1
<i>Leucopogon sp. Yanchep (M. Hislop 1986)</i>	-		P3
<i>Lepidosperma rostratum</i>	Beaked Lepidosperma	E	R
<i>Melaleuca sp. Wanneroo (G.J. Keighery 16705)</i>	-		P1
<i>Pimelea calcicola</i>	-		P3
<i>Sarcozona bicarinata</i>	-		P3
<i>Stylidium maritimum</i>	-		P3

In addition, ATA Environmental identified a number of locally significant flora species. Many of these species were found to occur widely over the Alkimos-Eglinton area. Based on vegetation associations, the following species may occur within the site

- *Petrophile serruriae*.
- *Leptorhynchos scaber* (Lanky Buttons).
- *Lechenaultia linarioides* (Yellow Leschenaultia).
- *Grevillea preissii*.

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- *Crassula colorata* (Dense Stonecrop) (P2).
- *Persoonia comate*.
- *Melaleuca cardiophylla* (Tangling Melaleuca).
- *Diplopeltis huegelii*.
- *Eucalyptus decipiens* (mallee).
- *Conospermum triplinervium* (Tree Smokebush).
- *Eucalyptus foecunda* (mallee) (Narrow-leaved Red Mallee).
- *Stylidium maritimum* (P3).
- *Pimelea calcicola* (P3).
- *Sarcosoma bicarinata* (P3).
- *Hibbertia spicata*.
- *Hibbertia spicata* subsp. *Leptotheca* (P3).
- *Thyridium ledifolium* subsp. *Ledifolium*.
- *Eucalyptus gomphocephala* (tuart) mallee.

A number of these species are recognized in Bush Forever (Government of Western Australia 2000) as significant flora of the Perth Metropolitan Region as they were either poorly reserved, significant populations or populations at the northern or southern limit of their known geographical range.

2.10.4 Threatened Ecological Communities

In Western Australia, Threatened Ecological Communities (TECs) are defined by the Western Australian Threatened Ecological Communities Scientific Advisory Committee (within the DEC). Generally these can be described as vegetation communities that are assemblages of species that occur together in a particular type of habitat. They are the sum of species within an ecosystem and, as a whole provide many of the processes which support a specific ecosystem.

TECs are not afforded direct statutory protection at a State level but their significance is acknowledged through other State environmental approval processes (i.e. environmental impact assessment pursuant to Part IV of the *Environmental Protection Act 1986* (EP Act)). Under the State process the DEC has been identifying and informally listing TECs since 1994, using a range of definitions to indicate the level of threat to the TEC in question. These definitions are outlined below in **Table 7**.

Table 7: Categories of Threatened Ecological Communities utilised by the DEC (DEC 2010)

CODE	CATEGORY
PD	<p>Presumed Totally Destroyed</p> <p>An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.</p>
CR	<p>Critically Endangered</p> <p>An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated. Generally it has been found to be facing an extremely high risk of total destruction in the immediate future.</p>
EN	<p>Endangered</p> <p>An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future. An</p>

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CODE	CATEGORY
	ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future.
VU	<p>Vulnerable</p> <p>An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range. An ecological community is considered Vulnerable when it is facing a high risk of total destruction or significant modification in the medium to long-term future</p>

Specific communities are also afforded statutory protection at a Federal level pursuant to the EPBC Act. TECs are listed under Section 181 of the EPBC Act, and are defined as “Critically Endangered”, “Endangered” or “Vulnerable” under Section 182, with most TECs listed as “Critically Endangered” under the State process also recognised at the Federal level.

Possible threatened ecological communities that do not meet survey criteria are added to a list maintained by DEC for Priority Ecological Communities (PEC) under Priorities 1, 2 and 3. Ecological communities that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation dependent ecological communities are placed in Priority 5 (DEC 2010). On the southern Swan Coastal Plain TECs are generally related to Floristic Community Types (FCT) based upon survey work undertaken by Gibson *et al.* (1994).

FCT for the vegetation associations occurring over the site were inferred by ATA Environmental (2005) with reference to FCT descriptions in Gibson *et al.* (1994) and Bush Forever (Government of Western Australia 2000). The following FCTs were inferred over the site:

- FCT No. 24: Northern Spearwood shrublands and woodlands.
- FCT No. 28: Spearwood *Banksia attenuata* or *B. attenuata* – Eucalyptus woodlands.
- FCT No. 29b: Acacia shrublands on taller dunes.
- FCT No. S11: Northern *Acacia rostellifera* – *Melaleuca systema* shrublands.
- FCT No. 26a: *Melaleuca huegelii*- *Melaleuca acerosa* shrublands on Limestone ridges.

Floristic community type 26a: *Melaleuca huegelii*- *Melaleuca acerosa* shrublands on Limestone ridges is a listed TEC, and was recorded within three small areas within the western portion of the site (within Bush Forever Site 349). It is important to note that this TEC has never been confirmed by the DEC. Further vegetation and flora surveys were undertaken since the *Alkimos Eglinton DSP Environmental Assessment Report* (RPS 2006), and findings of these surveys regarding Floristic Community 26a (FCT 26a) were inconclusive as to the presence of FCT 26a within the site.

Both FCT 29b and FCT 24 are recognised by the DEC as PEC's, specifically Priority 3(i) ecological communities. In accordance with DEC definition Priority 3 (i) PECs are those “that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation” (DEC 2010).

2.10.5 Bush Forever

The Government of Western Australia's *Bush Forever Policy* (2000) is a strategic plan for conserving regionally significant bushland within the Swan Coastal Plain portion of the Perth Metropolitan Region. The objective of Bush Forever is to protect comprehensive representations of all the original ecological communities by targeting a minimum of 10% of each vegetation complex for long term and secure protection (Government of Western Australia 2000). Bush Forever Sites are representative of regional ecosystems and habitat and have a key role in the conservation of Perth's biodiversity.

The western portion of the site forms part of Bush Forever Site No. 397. This Bush Forever Site "Coastal Strip from Wilbinga to Mindarie" is part of a large coastal foreshore reserve, extending from Mindarie to Eglinton.

Bush Forever Site 397 was included in the original Bush Forever Assessment in 2000, and the area was proposed to be re-zoned to "Parks and Recreation" in the MRS Amendment 1029/33. The EPA's formal assessment of the site determined that area 5b of Bush Forever Site 397 (the most eastern portion of Bush Forever Site 397) was no longer considered regionally significant as its desirable values were protected elsewhere over the MRS Amendment area (EPA Bulletin 1207). Therefore the EPA recommended that areas 5b and 5c not be reserved "Parks and Recreation". On this basis this area was removed from the final "Parks and Recreation" boundary and was zoned "Urban". This represents the area of Bush Forever within the western portion of the site which is currently zoned "Urban".

The Department of Planning (DoP) has recently confirmed that area 5b can support urban development uses and although still delegated under the MRS as Bush Forever, there is recognition of the anomaly by the DoP (**Appendix G**). The DoP have confirmed that Bush Forever boundaries will be updated at a later date to be consistent with the "Parks and Recreation" reservation which is further discussed in **Section 3.1**.

The north eastern corner of the site is also part of Bush Forever Site 139 which is part of a larger Bush Forever Site known as "State Forest 65 – Pinjar Plantation South Bushland Nowergup/ Yanchep/ Neerabup". This Bush Forever Site is accommodated with the "Parks and Recreation" Reserve. The Bush Forever Sites over the site are shown in **Figure 11**.

2.10.6 Biodiversity linkages

The *Perth Biodiversity Project Local Government Biodiversity Planning Guidelines for the Perth Metropolitan Region* (2004) identified Regional Ecological Linkages for the Perth Metropolitan Region. These 500 m corridors link protected natural areas with other areas of native vegetation within the Perth Metropolitan Region and are intended to provide best practice guidance for biodiversity planning for local government. These regional linkages are shown in **Figure 11**.

In addition, the City of Wanneroo's *Biodiversity Strategy 2011-2016* (2011) identifies local ecological linkages. In areas yet to be urbanised, the CoW suggests that these local linkages are somewhat flexible and may be added or amended through the land development process. A local biodiversity linkage has been located along the southern boundary of the site which is associated with the ROS that runs east – west through the site.

Both biodiversity documents provide a guide to assist local governments in planning for biodiversity and conservation. These are discretionary planning tools and have no strategic, statutory or policy

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context. These guidance documents should be considered in conjunction with and in balance with other state and local government policy.

2.11 Terrestrial fauna

2.11.1 Historical fauna surveys

A vertebrate fauna survey of the Alkimos – Eglinton area was undertaken in October 1996 by Alan Tingay and Associates (Alan Tingay and Associates 1996). This survey included a trapping program using Elliott, pit-fall and cage traps as well as bird transect surveys, active searching and opportunistic observations. This survey recorded one amphibian, 18 species of reptile, 49 bird species and three native and three introduced mammal species across the entire Alkimos – Eglinton area. It was considered that the Alkimos - Eglinton area could support at least three frog species, more than 40 reptiles, over 80 birds and about 14 mammals, many of which are bat species.

Additional surveys were undertaken for the Alkimos WWTP in 2005, which is located west of Marmion Avenue, south of the site. This survey suggested that the WWTP site could support five frog species, 51 reptile species, 105 bird species and 22 mammal species.

More recently, Ecological Australia were engaged to undertake a Graceful Sun Moth Survey of the site in 2010 and 2011. The Graceful Sun Moth survey examined areas that could potentially provide habitat for the Graceful Sun Moth based upon vegetation associations containing the host plant species *Lomandra maritima* (from ATA Environmental 2005). This included the northern arm of the parabolic dune within the site, as well as the southern arm of the parabolic dune (located within the Alkimos City Centre LSP area) south of the site. This Graceful Sun Moth survey recorded the locations of the moth but did not include any *Lomandra* density mapping in accordance with the DEC Survey Guidelines for Graceful Sun Moth (*Synemon gratiosa*) and site habitat assessments (Ecological 2011).

Therefore, in order to understand and quantify the Graceful Sun Moth habitat over the site (and the habitat of the adjacent Central Alkimos LSP area) Emerge Associates (2012d) recently undertook *Lomandra maritima* density mapping over areas of the site and the broader area to quantify the Graceful Sun Moth habitat (**Appendix B**). Since these surveys have been conducted, the Graceful Sun Moth has been removed from Schedule 1 of the WC Act and is no longer listed as Endangered under the EPBC Act 1999.

A survey of the site (and Alkimos City Centre LSP area) was also undertaken by Emerge Associates (2012b) to accurately determine the nature and extent of Carnaby's black cockatoo (*Calyptorhynchus latirostris*) foraging habitat and potential habitat trees. The site was systematically searched for foraging evidence and habitat trees (with a diameter at breast height of greater than 50 cm) of suitable species for Carnaby's black cockatoo. Evidence of foraging and nesting were recorded within the site. Observations were also made on the potential use of these trees by Carnaby's black cockatoo for nesting and/or roosting.

2.11.2 Fauna habitat types

The 1996 survey identified three broad habitat types within the Alkimos-Eglinton area being:

- Old Quindalup heath.
- Limestone heath.
- Banksia woodland.

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ATA Environmental (2005) undertook a detailed fauna survey of the Alkimos-Eglinton area and identified several fauna habitats over the site. The habitats were classified based on the habitat type and condition. The site is predominantly vegetated and provides a range of fauna habitats. The parabolic dune is classified as low open heath in “Good” condition while dense vegetation in the northern portion of the site provides “Very Good” condition low woodland habitat.

2.11.3 Significant fauna

The conservation status of fauna species in Western Australia is assessed under the state administered WC Act. The WC Act utilises a set of schedules described in **Table 8**. In addition to this, the DEC also produces a list of priority species which while not considered threatened under the WC Act; however there is concern over their long-term survival. These categories are outlined below in **Table 9**.

As well as those species protected under the WC Act, the Federal government also maintains a list of protected species under the EPBC Act. Species are listed in accordance with the categories described in **Table 6** and **Section 2.10.3**.

Table 8: Categories of DEC Threatened Fauna

CATEGORY	CODE	DESCRIPTION
Schedule 1	S1	Fauna which is rare or likely to become extinct
Schedule 2	S2	Fauna which is presumed extinct
Schedule 3	S3	Birds which are subject to an international agreement between the governments of Australia and other countries relating to the protection of migratory birds and birds in danger of extinction
Schedule 4	S4	Fauna that is otherwise in need of special protection

Table 9: DEC Priority Fauna Categories

CATEGORY	CODE	DESCRIPTION
Priority 1	P1	Taxa with few, poorly known populations on threatened lands.
Priority 2	P2	Taxa with few, poorly known populations on conservation lands.
Priority 3	P3	Taxa with several, poorly known populations, some on conservation lands.
Priority 4	P4	Taxa in need of monitoring (Not currently threatened or in need of special protection but could be if present circumstances change) .
Priority 5	P5	Taxa in need of monitoring (Not considered threatened but are subject to specific conservation program, the cessation of which would result in the species becoming threatened within five years).

To assess the potential for the site to contain specifically protected fauna species, the DEC’s NatureMap Database and the SEWPAC Protected Matters database were searched. It is important to note that these searches do not take into account the condition of the vegetation occurring on the site, but are based on the proximity of the site to known occurrences of significant species. In addition, based on fauna surveys by Alan Tingay and Associates (1996) and ATA Environmental (2005), a number of species of conservation significance may occur within or potentially use the site. These significant species are listed below in **Table 10**.

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Table 10: Species which may potentially use the site (based on SEWPAC Protected Matters search tool, DEC Naturemap database, Alan Tingay and Associates 1996 and Bamford and Davies 2005)

SPECIES		CONSERVATION SIGNIFICANCE		
COMMON NAME	SCIENTIFIC NAME	DEC	WAWC	EPBC
Mammals				
Western Brush Wallaby	<i>Macropus irma</i>	P4		
Quenda	<i>Isoodon obesulus fusiventer</i>	P5		
Chuditch	<i>Dasyurus geoffroii</i>		S1	EN
Birds				
Forest Red-tailed Black Cockatoo	<i>Calyptorhynchus banksii naso</i>		S1	VU
Carnaby's black cockatoo	<i>Calyptorhynchus latirostris</i>		S1	EN
Peregrine Falcon	<i>Falco peregrinus</i>		S4	
Rainbow Bee Eater	<i>Merops ornatus</i>			MIG
Reptiles				
Carpet Python (south-western spp.)	<i>Morella spilota imbricata</i>		S4	
Black striped-snake	<i>Neelaps calontus</i>	P3		

Indicative habitat mapping for Carnaby's black cockatoo has been prepared by DEC and released by WAPC (WAPC 2011), and recently updated vegetation mapping by Emerge Associates (2012c) suggests that there is potential Carnaby's black cockatoo foraging habitat within areas of banksia woodland.

The mapping provided by the WAPC (2011) has used available data to map likely habitat of the Carnaby's black cockatoo used for feeding, night roosts and breeding in the Swan Coastal Plain and Jarrah Forest IBRA regions, at a regional scale (DEC 2010). This mapping indicates that, in addition to potential foraging habitat, the site is 2.3 km west of a "confirmed roost" site. A confirmed roost site is a site where Carnaby's black cockatoo were recorded roosting as part of a formal roost survey, such as the Great Cocky Count (DEC 2011).

The site is also 7 km south of a "confirmed breeding" area. Breeding data was made available by a range of sources and projects (DEC 2011). The Carnaby's black cockatoo "confirmed" breeding areas indicate records of eggs or chicks were recorded within allocated area. This "confirmed breeding" area is associated with Yanchep National Park. It was determined that feeding areas within a 12 km radius are important for successfully raising chicks (DEC 2011). Therefore a 12 km buffer is applied to "confirmed breeding" areas.

Due to the resolution of the WAPC current mapping, when a subject area is identified as potential Carnaby's black cockatoo habitat, additional detailed site mapping and field examination for actual Carnaby's black cockatoo resources or use by Carnaby's black cockatoo will be required (DEC 2011). This detailed field survey of the site was undertaken by Emerge Associates (Emerge Associates 2012b) in October 2012.

The field survey undertaken by Emerge Associates (2012) recorded evidence of foraging by Carnaby's black cockatoo over the site. Foraging was recorded over a majority of the site and in areas north of the parabolic dune (**Figure 13**). These areas contain open forests of *Banksia attenuata* and *Banksia menziesii* with *Eucalyptus marginata* and *E. totiana* (which are also used for roosting) and areas of dense shrublands of *Banksia sessilis* and *Xanthorrhoea preissii*.

A number of habitat trees (with a diameter at breast height greater than 50 cm) were also recorded at the site, particularly within the south eastern corner and along a small section of the northern boundary (**Figure 13**). This included trees of Coastal Blackbutt (*Eucalyptus totiana* and Tuart (*E. gomphocephala*). From the 31 habitat trees that were recorded, three of these trees appear to have possible hollows suitable for use by Carnaby's black cockatoo, although there was no evidence of any habitat trees being used for roosting or breeding.

2.12 Areas of regional conservation significance

The Alkimos parabolic dune system which runs along the southern boundary of the site has been described by Geological Society of Australia in 1979 (Lemmon *et al.* 1979) as an excellent example of a complex system of parabolic dunes of Holocene age, belonging to the Quindalup dune system (EPA Bulletin 2005). The northern arm of the parabolic dune is located within the land reserved as "Parks and Recreation" in the site. The EPA considers this area a unique bushland linkage of regional and local importance. It provides a cross section of vegetation, habitats and landforms including the northern arm of parabolic dune which is the largest of the Alkimos dunes (EPA 2005). Therefore, this geoheritage site has been reserved as ROS.

Bush Forever Site 397 located within the western portion of the site forms part of the north south coastal ecological linkage, as well as part of the east west regional ecological linkage which runs through the site and the adjacent WWTP. This east-west linkage was a key recommendation of the EPA and is discussed further in **Section 3.1**. These corridors have been reserved as ROS to allow ecological processes and natural systems to persist and to provide a corridor for fauna movement and dispersion through the landscape.

2.13 Existing and historical land uses

Parts of the site, particularly along the southern boundary have been historically grazed over a number of years prior to the purchase of the site by LandCorp. The majority of the site remains in relatively good vegetation condition, although currently the site is accessed illegally by recreation vehicles for off-road use, including four wheel drives, quad bikes and trail bikes. Historical images provided by Landgate indicate the southern boundary of the site adjacent to Marmion Avenue has already been extensively cleared in 1974 (Landgate 2012). The rest of the site remains in good condition, except for the area used for the construction of the Marmion Avenue extension through the centre of the site in 2008 (Landgate 2012). From 2010 surrounding development and the construction of the WWTP west of the site is visible.

The site is also identified by the Department of Defence (DoD) mapping ("Where is UXO" map) available on the DoD website as having "Other" Unexploded Ordnance potential. The definition of "Other" potential is: "*Defence records do not confirm that the site was used for live firing. UXO or explosive ordnance fragments have not been recovered from that site. Defence opinion is that it would be inappropriate to assess as either slight or substantial*". "Other" UXO potential is recorded through the Butler-Jindalee and Alkimos-Eglinton area (DoD 2012).

2.14 Potential site contamination

The State government, through DEC has the overall responsibility for developing, administering and enforcing the *Contaminated Sites Act 2003* and its associated procedures. Part of this responsibility includes maintenance of the Contaminated Sites Database and Register. The Contaminated Sites Database and Register holds information on known, previously or potentially contaminated sites within Western Australia. A search of this database and register indicated that the site is not listed. A review of aerial photography suggests that the previous land uses of the site are unlikely to have resulted in significant site contamination.

2.15 Surrounding land uses

The site is surrounded by land largely zoned “Urban” to the north and “Central City Area” to the south (**Figure 3**). Land uses to the east of the site include, the future Mitchell Freeway extension, a long “Parks and Recreation” reservation running north to south associated with Bush Forever Site No. 139 and “Rural” zoned land primarily used for market gardens and turf farms.

A future groundwater treatment plant (GWTP) is located to the east of the site (**Figure 2**). The future GWTP has not been included within the site boundary. The site will be owned and operated by the Water Corporation. This treatment plant has a 300m chlorine buffer and the whole area (including the buffer) is reserved for “Public Purposes”. An additional 200 m wide buffer (total of 500m from the GWTP) has been reserved as “Parks and Recreation” areas under the MRS.

West and south of the site across Mamion Avenue is the Alkimos WWTP reserved for “Public Purposes” under the MRS. A buffer of 450 to 600 m (based on specific odour modelling) has been accommodated for the Alkimos WWTP and is included within the “Public Purposes” reservation and “Urban Deferred” zoning.

2.16 Heritage

2.16.1 Indigenous heritage

An online search for relevant Aboriginal heritage information was undertaken using the Department of Indigenous Affairs (DIA) Aboriginal Heritage Inquiry System (AHIS) that incorporates both the heritage site register and the heritage survey database (DIA 2009). The Aboriginal Heritage Site Register is maintained pursuant to Section 38 of the *Aboriginal Heritage Act 1972* (AHA) and contains information on over 22,000 listed Aboriginal sites throughout Western Australia.

This search did not locate any Aboriginal Heritage sites or heritage places within the site. However the AHIS search did show that an archaeological and ethnographic survey of the Proposed Clarkson, Eglinton and Alkimos Housing Developments, North West Corridor had been conducted for LandCorp in 1990 (DIA 1990).

Ethnoscience was engaged by Lend Lease to review ethnographic consultation and archaeological research in relation to the potential Aboriginal heritage values of the Central Alkimos LSP area (Ethnoscience 2010). An Aboriginal Heritage Management Plan (AHMP) was prepared for the site to ensure that there are procedures in place for dealing with the potential for subsurface archeological material in accordance with Lend Lease and LandCorp company principles and legal requirements. The AHMP also confirmed that there are no known aboriginal heritage sites located within the site.

2.16.2 Non-indigenous heritage

In order to determine the actual or potential presence of sites or features of non-indigenous heritage significance within the site, a review of readily available information at a federal, state and local government level was undertaken to determine if there were any of the following within the site:

- World Heritage Sites.
- National Heritage Sites.
- Commonwealth Heritage Sites.
- Sites on the Heritage Council of WA heritage register.
- Sites listed in the Local Municipal Inventory List.

Based on this review, there are no recorded non-indigenous heritage sites found within the site.

3 The Proposal and the Planning Approval Framework

3.1 Consideration by the Environmental Protection Authority

The site (and the wider Alkimos Eglinton District) was subject to MRS Amendment 1029/33 which was assessed by Environmental Review under the *Environmental Protection Act 1986* by the Environmental Protection Authority (EPA).

The EPA assessed a range of relevant environmental factors during the assessment of MRS Amendment 1029/33 including:

- Vegetation.
- Fauna.
- Odour.
- Geoheritage.
- Aboriginal heritage.
- Risk.

The EPA's assessment of Amendment 1029/33 considered the environmental values across the entire Alkimos Eglinton area. Environmental surveys were conducted by ATA Environmental (2005) to support the EPA's assessment. The EPA used this information to outline areas of regionally significant environmental value. This assessment was largely independent of the proposed reservations and zonings considered as part of the MRS amendment and resulted in areas being identified by the EPA as being "regionally significant" which were not accounted for within the original MRS amendment. The differences between the EPA's assessment and the original MRS amendment is shown as **Appendix C**.

In relation to the site, the EPA considered the parabolic dune a significant landscape/vegetation linkage. The environmental investigations undertaken as part of the Environmental Review determined the northern arm of the parabolic dune located within the site has a high biodiversity and natural value as well as geoheritage significance. With this advice from the EPA, the northern arm of the dune was reserved for "Parks and Recreation" and referred to as Regional Open Space (ROS).

Overall, the EPA's assessment resulted in changes to areas proposed to be reserved "Parks and Recreation" within the Alkimos - Eglinton area to that which was originally proposed by the WAPC. As a result of the EPA's recommendations areas of environmental significance were reserved for "Parks and Recreation".

The MRS amendment was supported by the Minister for the Environment in 2006 through Ministerial Statement 722 (**Appendix F**). Ministerial Statement 722 outlines environmental management conditions for the areas of "Parks and Recreation" Reserve and "Public Purposes" Reserve (**Appendix F**). In accordance with Condition 2 of the Minister for the Environment's Statement 722, certain proposals will require the preparation of an Environmental Management Plan (EMP). These proposals include:

- Roads and rail that cross ROS (including Marmion Avenue, the railway, the secondary transit system and other required roads).
- The construction of infrastructure including Dual Use Paths and car parks in ROS.
- Urban development proposals adjacent to ROS that may have an adverse impact on the values of the ROS.

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Condition 5 of Ministerial Statement 722 allows a maximum of 25% of the area of land reserved “Parks and Recreation” identified as areas 6a and 6b in **Appendix F**, to be developed for parks and recreation purposes in accordance with an EMP (EPA 2006). The EMP for this land use needs to be prepared to the requirements of the EPA.

An EMP for proposals within or adjacent to the ROS and the development of parks and recreation uses within the ROS should include (EPA 2006):

- A description of existing environmental values, and the identification of the environmental outcome to be achieved through the implementation of this plan.
- Clear delineation of boundaries or significant areas to be protected.
- Management of construction, access and rehabilitation.
- Vegetation mitigation strategies.
- Allocation of responsibilities and identification of timing and duration of implementation.
- Provision for routine monitoring and environmental values.
- Provision of details of contingency plans in the event that the monitoring surveys indicate that the development is having or has had an adverse impact upon environmental values.

An EMP will need to be completed to the satisfaction of the WAPC or the Local Authority prior to the commencement of any site works that could impact on ROS.

3.2 Alkimos - Eglinton District Structure Plan (DSP)

The Alkimos – Eglinton DSP provides the broad district level land use strategy for the area, and critically, over the site includes:

- Urban development.
- Regional Open Space.
- Playing fields.
- A high school.
- Opportunities for business, commercial and mixed use development within the site.

The Alkimos – Eglinton DSP outlined a number of requirements relevant to be addressed at the Local Structure Planning stage including:

- LSPs to include a Local Water Management Strategy that incorporates best practice water sensitive urban design principles and which is in line with the district water management design objectives and standards in the DSP.
- LSPs to conserve and enhance local biodiversity through design facilitating the retention of significant natural features in POS areas, road reserves, social/pedestrian/cycle linkages or provide suitable justification otherwise.
- LSPs to identify significant landscape features, such as ridge lines and dunal formations, and significant natural features, such as locally significant vegetation and fauna habitat and integrate these either within POS or with a suitably controlled and managed, highly landscape responsive form of development or provide suitable justification otherwise.
- LSPs to investigate and facilitate interlinking recreational areas, environmental reserves, landscaped streetscapes and local POS to provide “stepping stones” from hinterland to the coast generally in accordance with the social/pedestrian/cycle linkages shown on the DSP.

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- LSPs to identify conservation areas, such as conservation POS, or passive open space with conservation function, and design these in such a way, so they remain viable.

The DSP also recommended the preparation of a number of environmental strategies to be prepared in conjunction with the LSP including:

- Vegetation and Fauna Management Strategy.
- Local Water Management Strategy.
- Landscape Concept Plan.
- Open Space Strategy.
- Sustainability Strategy (in conjunction with LSP).

The project team has acknowledged these strategies, and a number of these have been undertaken to support the LSP. However, some of these studies require a greater level of detail than is available at the LSP stage. Therefore these will be prepared at future planning stages such as subdivision. This is discussed further in **Section 5**.

3.3 Alkimos Beach Concept Plan

A Concept Plan has been developed for South Alkimos, Alkimos City Centre and Central Alkimos. The strategic framework of the Concept Plan responds to the natural dunal landform and environment, and reflects the existing coastal character of the site. The vision of the Concept Plan reflects the development intentions of the LSP in more detail, although unlike the LSP the Concept Plan has no statutory basis. The Concept Plan for Alkimos has been included in **Appendix G**.

The Central Alkimos LSP outlines the areas of ROS reserved “Parks and Recreation” which will retain a majority of the environmental and ecological value of the site. The Alkimos Beach Concept Plan provides further detail of the retained dune within the ROS and the intended locations of POS and ovals within the site.

3.4 Central Alkimos Local Structure Plan

The Central Alkimos LSP has been designed as a coastal community incorporating suburban residential housing and schools. The LSP area includes a total land area of 266 hectares and proposed land uses include:

- High School and Primary School.
- Regional Open Space (ROS).
- Residential Use
- Commercial use
- Mixed use
- Business
- Road network.
- Railway network.

The Central Alkimos LSP is shown in **Figure 14**.

The Central Alkimos LSP design incorporates mixed used residential living as well as maintaining the natural environment and providing ecological linkages from the coast to inland bushland.

4 Planning, Design and Management Response to Environmental Values and Attributes

This section discusses in detail the spatial response of the LSP and supporting Concept Plan to the environmental values and attributes associated with the site, and also outlines future environmental management considerations that will be required for certain environmental factors as part of future subdivision and development within the LSP area. This section discusses only those environmental values and attributes that require specific consideration based on their presence within the site, and/or applicable legislation and policy requirements associated with the site.

4.1 Topography

Due to the steep slopes of portions of the site, landform modification will be required for the developed portions of the site in order to accommodate buildings, roads and drainage. Where possible the development will aim to maximise landform retention opportunities, although this is not always possible.

The area of ROS over the site has included the parabolic with the intention of retaining this geoheritage feature. It is expected that this would allow landform retention, except where infrastructure is required to cross these areas. In accordance with Condition 2 of Ministerial Statement 722 (**Appendix F**) an EMP will need to be prepared and implemented for any proposed infrastructure that dissects the ROS within the site to manage and minimise the potential impacts of the proposed subdivision and development.

The EMP will be required to demonstrate that environmental impacts associated with infrastructure can be managed and will include information on the treatment of topography, including the requirement for any batters, plus the stabilisation and management of those batters.

4.2 Soils and landforms

As discussed above, modification to the landforms within the site will be necessary to facilitate development. The ROS over the site has included the northern arm of the parabolic dune with the intention of retaining this as a landform feature for the site.

4.2.1 LSP considerations for landform

While the development intention is to retain the parabolic dune, there are a number of roads and the future railway reserve which will need to intersect the dune system. The LSP design has located these pieces of infrastructure perpendicular to the orientation of the dune, in order to minimize impacts to landform.

Modification of the dune will be required in order to ensure the engineering levels for the road and drainage link into the dune formation. There are a number of options for this including battering with revegetation, retaining walls or a combination of the two. Any infrastructure or development within the ROS will require an EMP to support development as outlined in Ministerial Statement 722 and discussed in **Section 3.1** and **Section 4.1**. This EMP will be required to be approved by the local government or the WAPC.

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The detailed treatment of the dune will be considered as part of future design and it is the intention to minimise disturbance and retain a stable dune landform, while providing adequate grade and width for the roads/railway through the dune formation.

4.2.2 LSP considerations for karstic features

The City of Wanneroo's *Draft Local Planning Policy Caves and Karstic Features* (2012) (Draft LPP 4.13) outlines the CoW information requirements for the investigation and management of caves and karstic features at the different planning stages. The site is within a low and medium Karst Risk area, and in accordance with the Draft LPP 4.13 the minimum requirements to support an LSP are a Geotechnical Study and associated mapping showing the extent and severity of karst risk.

A desktop Geotechnical Assessment by Coffey Geosciences (2006) has been completed for the Alkimos-Eglinton DSP area. A site specific Desktop Geotechnical Study was prepared by Douglas Partners for the site (**Appendix A**).

The Desktop Geotechnical Study concluded that based on the available information that there is a low risk of large karstic features within the site.

The Desktop Geotechnical Study (2012) recommends that a site specific assessment of possible karst features is undertaken as part of ongoing geotechnical investigation over the site. This would involve:

- Walk-over inspection by experienced professionals.
- Test pit and cone penetration tests as part of geotechnical investigations.
- Observations during bulk earthworks phase of the construction of the development.

Furthermore, this site-specific assessment is likely to be required as a condition of subdivision in accordance with Draft LPP 4.13 (CoW 2012).

4.3 Public Drinking Water Source Areas

A majority of the site is located within a Priority 3 PDWSA, as shown in **Figure 7**. The land uses proposed within the site are compatible with Priority 3 areas in accordance with the land use capability table as outlined in *Water Quality Protection Note: Landuse Compatibility in Public Drinking Water Source Areas* (DoE 2004).

The current policy framework requires that development in Priority 3 PDWSA must be connected to deep sewerage and additional conditions may apply to the fertiliser and pesticide application of irrigated ovals (DEC 2004). This does not pose a constraint for the site, or the design of the LSP.

Within the areas identified as WHPZ, by-laws pursuant to the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* may prohibit, restrict or approve defined land uses to prevent water source pollution and contamination. The broad landuses identified in the LSP are compatible with these WHPZ.

4.4 Flora and vegetation

Based on flora and vegetation surveys undertaken within the site, the key findings were:

- No listed communities or flora species pursuant to the EPBC Act occur within the site.

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- FCT 26a was inferred to occur within the site (ATA Environmental 2005) and is a state listed TEC.
- FCT 29b and FCT 24 were inferred by ATA Environmental (2005) to occur within the site and are state listed PECs (Priority 3).
- Vegetation condition over the site ranged from “Completely Degraded” to “Excellent”.

4.4.1 LSP considerations for flora and vegetation

The LSP considerations for flora and vegetation are consistent with those outlined in the Alkimos Eglinton DSP (2010). The DSP recognises that approximately 20% of Alkimos-Eglinton will be retained for conservation purposes in ROS, and many areas of POS are likely to be created to provide the necessary active recreation opportunities for the future residents of the area.

The large area of the site (104 ha) identified as ROS in the LSP is reserved “Parks and Recreation Reserve” within the *MRS Amendment 1029/33* (2006). The majority of this ROS is required to be retained as remnant native vegetation in accordance with the Minister for Environment’s Ministerial Statement No. 722 (**Appendix F**).

Since the recent listing of FCT 24 as a PEC, and in addition to FCT 29, there are areas of the site which may represent a PEC. FCT26a, a state listed TEC was also inferred as occurring within the site. Areas of ROS associated with the parabolic dune and Bush Forever Site 397 include some areas of the vegetation communities which represent FCT24 (PEC), FCT29b (PEC) and FCT26a (TEC) (**Figure 15**). On this basis, the LSP (and existing zoning) provides the opportunity to retain these vegetation communities. The detail and treatment of these vegetation communities will be assessed as part of detailed subdivision design and as part of any EMPs which are required to be prepared for impacts on ROS.

Given the large area of remnant vegetation proposed to be retained within ROS, the LSP design has looked to maximize the active Public Open Space, as well as retain native vegetation where possible. The areas where native vegetation can be retained within POS will be defined during the detailed subdivision design process.

4.4.2 Regional open space management

Broad principles have been outlined in the *Alkimos Eglinton DSP Environmental Assessment* prepared by RPS (2006) to guide the management of the Alkimos-Eglinton ROS. These principles include:

- Provide adequate and appropriate public access to ROS for sustainable passive recreation and protect the values of the ROS from uncontrolled pedestrian access by providing Dual Use Paths (DUP) in and through the ROS that connect to the DUP network in the adjacent areas.
- Erect appropriate fencing to discourage uncontrolled access.
- Create a clear boundary between the ROS and private land.
- Design edges between ROS and adjacent urban areas to minimise disturbance to the ecological values of the ROS.
- Protect the linkage values and biodiversity values of the ROS.

These principles provide the basic requirement for ROS management of the Alkimos-Eglinton area, which is outlined in detail by Ministerial Statement 722 and have influenced the LSP design. It is the intention of the proponent that the ROS fulfills some of the functions of Conservation POS, with some areas being accessible to the public through walk trails, boardwalks and similar. The preparation of an EMP will address site specific management concerns and measures to be implemented to retain the

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ecological values of the ROS. Ministerial Statement No. 722 identified that these areas “*shall be managed to protect the integrity, function and environmental values of the bushland and landforms to the requirements of the Western Australian Planning Commission on the advice from the Environmental Protection Authority and shall only be used for conservation, landscape and complimentary purposes*”.

Ministerial Statement No. 722 also identifies that a maximum of 25% of the “Parks and Recreation” reserve within the north eastern portion of the site can be developed for parks and recreation purposes in accordance with an EMP prepared to the requirements of the EPA (**Appendix F**). This area has been identified within the LSP design, as the location of local sporting fields (consistent with the Alkimos-Eglinton DSP).

The area of ROS is significant over the site and will be retained largely for conservation. As outlined previously in **Section 3.1**, Ministerial Statement No. 722 requires an EMP to be prepared and implemented for any infrastructure that crosses an area of ROS and for any impacts of adjacent development and subdivision. Therefore, the proponent will be required to produce an EMP for the areas of ROS within the site which will be affected through the implementation of the LSP.

4.4.3 Conservation open space and local biodiversity strategy

The *City of Wanneroo Local Planning Policy 4.3 Public Open Space* (October 2010) requires a minimum of three percent (3%) of the gross sub-divisible area to be provided as POS for the purposes of conservation and passive recreation. The Conservation POS is required to fill a viability assessment (as detailed within the *City of Wanneroo Public Open Space Policy* and the *City of Wanneroo Local Biodiversity Strategy*) to ensure that the size, shape and vegetation condition of the POS area will support the long-term retention of conservation values.

Viable conservation areas ensure long term survival at minimum maintenance costs. They are determined based on a viability factor table and are scored based on a number of categories. These factors include size, shape, and perimeter to area ratio, vegetation condition and connectivity. A minimum score of 14 is required for a conservation POS to be considered viable.

The ROS outlined in the LSP has significant ecological value associated with it including:

- Geoheritage significance associated with the parabolic dune.
- Part of Bush Forever Site 397.
- Carnaby’s black cockatoo habitat.
- Two potential PECs (FCT 24 and FCT 29b).
- One potential TEC (FCT 26a).

It is the intention of the LSP and supporting Concept Plan to retain a large portion of these areas for conservation purposes. The biodiversity and natural assets of the site and the overall Concept Plan design of the development is shown in **Figure 15**.

A viability assessment is not required for the site due to the large area of ROS that will be provided, which will fulfill the CoW POS Conservation Requirements within the LSP area. POS areas accommodated for within the Concept plan are likely to fill an active POS role to balance the large area of conservation and passive recreation provided for through the ROS. The requirement for the management of ROS within the site is discussed in **section 4.4.2**.

4.5 Fauna

The fauna habitats within the site are highly variable and are largely dependent on vegetation type and its condition. A majority of the site provides high quality fauna habitat, although some areas of the site have been degraded through historical land uses and provide minimal habitat values for fauna.

Fauna surveys and habitat mapping conducted in 2010-2012 confirmed the presence of Carnaby's black cockatoo (and associated supporting habitat) within the site.

This species is listed as a Matter of National Environmental Significance (MNES) pursuant to the Commonwealth EPBC Act. EPBC Act considerations in relation to the implementation of the LSP and the impacts on matters of MNES are discussed further in **Section 4.5.2**.

4.5.1 LSP considerations for fauna habitat

The majority of the site is covered by remnant vegetation and provides a range of vegetation and habitat types. The site also contains known foraging habitat and potential habitat trees for the Carnaby's black cockatoo which are largely associated with the south eastern corner of the site and parts of the northern boundary (**Figure 13**) (Emerge 2012b). There was evidence of foraging by Carnaby's black cockatoo over the site, and several trees had one or more hollows suitable for Carnaby's black cockatoo for roosting or nesting. Some areas of foraging habitat have been included within areas designated as ROS on the Concept Plan and these areas are shown in **Figure 15**. The proposed environmental values to be retained will be managed through the EMP for ROS within the site. The retention of vegetation (including foraging habitat) outside of the ROS (such as in areas of POS) may be explored in more detail as part of subdivision design and may be retained in areas of POS.

The Vegetation and Fauna Management Plan will be prepared for subdivision as a DSP commitment. The Vegetation and Fauna Management Plan will provide detail as to how the fauna values retained within the POS (and ROS) areas of the site will be managed for the long term. This may include Banksia woodland that is retained for Carnaby's black cockatoo.

The retention of the eastern ROS (incorporating parabolic dune and Banksia woodland) and Bush Forever Site 397 will provide a local fauna linkage through the site. On a district scale, these ROS areas in conjunction with the WWTP "Public Purposes" reserve provides the opportunity for an ecological connection from the coast and Bush Forever Site 397 through to Bush Forever Site No.130, immediately east of the site. As outlined in **Section 3.1**, this area of ROS was recommended by the EPA for retention through *EPA Bulletin 1207* as a key ecological linkage and was subsequently reserved for "Parks and Recreation".

4.5.2 Likely considerations under the *Environment Protection and Biodiversity Conservation Act 1999*

The Carnaby's black cockatoo is a highly mobile species with a large range extending from Esperance to the lower Murchison River. There are extensive areas of foraging habitat associated with coastal banksia woodland in the north west portion of the Perth Metropolitan Region and this area is recognised as an important area for Carnaby's black cockatoo with a resident breeding population at Yanchep National Park, approximately 7 km north. The northern corridor of the Perth Metropolitan Region also includes large areas of protected habitat associated with Yanchep National Park and Bush Forever sites.

There are large areas of ROS adjacent to and within the site, which have been assessed by the EPA as being “regionally significant”. It is the intention that these provide ecological corridors and linkages through the locality and parts of these areas would be used by Carnaby’s black cockatoo. The ROS within the site provides the opportunity for an ecological connection from the coast through to Bush Forever Site No.139. This ROS contains a large area of banksia woodland and foraging by Carnaby’s black cockatoo was observed within this ROS (Emerge 2012b) as well as other areas of the site.

The implementation of the LSP will result in the clearing of Black Cockatoo habitat and future development will require referral on this basis. A number of similar developments within the northern corridor of the Perth Metropolitan Region have submitted referrals pursuant to the EPBC Act and received approvals requiring onsite mitigation (retention and creation of habitat) and offsite offsets.

The Vegetation and Fauna Management Plan (produced as part of subdivision) will also identify areas of Carnaby’s black cockatoo habitat retained over the site and may form part of the EPBC Act referral/approval process.

4.6 Presence of Unexploded Ordnances

As outlined in Section 2.12, the site is listed by the Department of Defence (DoD) as having “Other” Unexploded Ordnance potential. UXOs in Western Australia are commonly dealt with by the Fire and Emergency Services Authority of Western Australia (FESA) and it is expected that a UXO search will be required over the site as part of subdivision planning and development or possibly as a condition of subdivision. It is the intention that a detailed UXO search is undertaken prior to subdivision to reduce the risk of UXO potential to an acceptable level. This is consistent with a number of adjacent developments within the Alkimos Eglinton area, including Trinity to the south.

4.7 Surrounding land uses

Areas of bushland within and surrounding the site have the potential to carry a severe fire risk. The significant bushfire hazard features which are relevant for the site include the ROS, the large area of bushland north east of the site which is the proposed location of the Water Corporation Groundwater Treatment Plant, and the “Public Purposes” reserve around the Alkimos WWTP to the west and south of the site. Fire management is a requirement in accordance with the Western Australian Planning Commission’s (WAPC) *Planning for Bush Fire Protection Guidelines* (2010) and has been considered as part of the LSP design.

The site is also bound by the future extension of the Mitchell Freeway to the east, Marmion Avenue through the centre and the future Northern Suburbs Railway Line through the eastern portion of the site. The noise impacts of this infrastructure require consideration for the future development of the site. The impact of these surrounding landuses is discussed further below.

4.7.1 Bush Fire management

Planning for Bush Fire Protection (WAPC 2010) is a guideline for various stages of the planning process to avoid inappropriately located or designed land uses, subdivision and development on land where a bush fire risk is identified and to ensure that an appropriate level of protection to life and property from bushfires is provided. As the site is surrounded by remnant vegetation, a Bushfire Management Plan (BMP) was prepared for the site by Roger Underwood of York Gum Services,

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working for Don Spriggins Forestry Consultants. The BMP was undertaken to support the LSP and is provided in **Appendix D**.

The BMP preparation process has considered the bushfire hazard level when the LSP is implemented and the area is developed. As part of development, the site will be cleared for roads, road reserves and housing, and as such the bushfire risk within these areas would be reduced from "Medium" to "Low" as remnant vegetation is removed. Any retained vegetation within the ROS would retain a "Medium" bushfire risk as vegetation would be retained over this area. Following development, properties will not carry a running fire, although they are vulnerable to ember attacks from any fires on adjoining bushland.

A bushfire hazard management zone was determined to be 100 m from the perimeter of remaining vegetation at the time of construction. Development within this zone should be built to a construction standard able to withstand a bushfire attack depending on a combination of vegetation type (i.e. fuel type, fuel load and structure) and the distance and slope from the predominant vegetation. Construction standards will be determined in accordance with *Australian Standard AS 3959: Construction of Buildings in Bushfire-Prone Areas* (AS 3959-2009) (SA 2009).

The BMP provides an indication of the setback distances required between dwellings and bushfire hazards (remnant vegetation). Lots adjacent to retained bushland which are separated by a 13 metre road reserve should ensure dwellings are setback five metres from the lot boundary (nearest the vegetation) to achieve a Bushfire Attack Level (BAL) of 19. Lots separated by bushland with a 22 metre cleared road reserve are to be set back five metres from the lot boundary so as to achieve a BAL of 12.5. Both BAL 12.5 and BAL 19 provide acceptable outcomes as the risk to dwellings will be reduced by increased construction standards in accordance with the *Australian Standard (AS3959-2009 Construction of buildings in bushfire prone areas)*.

The BMP demonstrates that the bushfire risk over the site can be managed, through dwelling setbacks and construction standards (if required) and the WAPC/FESA's "Planning for Bushfire Protection Guidelines". Furthermore, the BMP is based on the City of Wanneroo's *Specification D10 Bushfire Protection* and Part 3 of the City's *Bushfire Protection Requirements for Subdivision and Development* (BMP 2012).

This BMP details the required construction standards for dwellings based on road reserve widths and the extent of areas of remnant vegetation outside the site (such as that within the future GWTP or Mitchell Freeway reserve). In addition the BMP outlines the bushfire management measures that must be implemented by the developer. As outlined above, this BMP satisfies the required bushfire management for subdivision.

4.7.1.1 LSP considerations for bushfire management

Based on the BMP (Forestry Consultants, 2012), BAL12.5 can be achieved for most residences within the proposed bushfire hazard management zone. BAL 19 will be achieved for residences along south western boundary of the site adjacent to the ROS and Alkimos WWTP (**Appendix D**).

The LSP has provided a road adjacent to the majority of the areas of remnant vegetation with the intention of providing access for fire appliances. The BMP demonstrates that the fire risk can be managed.

4.7.1.2 Future bushfire management

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The current BMP will be updated with more detail regarding interface treatments for future planning stages. The measures to minimise bushfire threat to the site outlined in the BMP should be implemented at subdivision.

4.7.2 Noise from transport infrastructure

Statement of Planning Policy 5.4 *Road and Rail Transport Noise and Freight Considerations in Land Use Planning* (SPP 5.4) (WAPC 2009) guides the process to determine compliance of noise sensitive developments when located near a major road and/or rail infrastructure.

The outdoor noise criteria are shown below (**Table 11**). These criteria apply at any point 1-metre from a habitable facade of a noise sensitive premise (residential, school and aged care) and in one outdoor living area. These levels are separated into a “target” and a “limit” for both day and night. The “target” provides an objective noise level for the site, whereas the “limit” is the noise level that cannot be exceeded.

Table 11: Outdoor Noise Criteria in accordance with State Planning Policy 5.4 (WAPC 2009)

PERIOD	NOISE CRITERIA TARGET	NOISE CRITERIA LIMIT
Day (6am – 10pm)	55 dB L_{Aeq} (day)	60dB L_{Aeq} (day)
Night (10pm – 6am)	50 dB L_{Aeq} (night)	55dB L_{Aeq} (night)

Noise levels above the “limit” are generally considered unacceptable for residential uses. Where the “target” can be achieved, no further controls are required. Where noise levels are between the “limit” and “target”, further noise controls are necessary.

An acoustic assessment was conducted by Herring Storer Acoustics in July 2012 to determine the expected noise impacts from Marmion Avenue, Mitchell Freeway and the Northern Suburbs Railway (refer to **Appendix E**).

The acoustic assessment conducted for the portion of the site adjacent to Marmion Avenue (Herring Storer Acoustics 2012) found that, without any noise mitigation:

- The future road noise levels would exceed the “target” criteria at all proposed lots adjacent to Marmion Ave.
- The future road noise levels would exceed the “limit” criteria at majority of the proposed lots adjacent to Marmion Avenue.

The acoustic assessment conducted for the site adjacent to Mitchell Freeway (Herring Storer Acoustics 2012) found that, without any noise mitigation:

- The future road noise levels would not exceed the “target” criteria at any proposed lots adjacent to Mitchell Freeway.
- The future road noise levels would not exceed the “limit” criteria at majority of the proposed lots adjacent to Marmion Avenue.

Results from the acoustic impact assessment adjacent to Northern Suburbs Railway found that without any noise mitigation:

- The future rail noise levels would exceed the “target” criteria for the closest proposed lots adjacent to the Northern Suburbs Railway.

- The future rail noise levels would not exceed the “limit” criteria for proposed lots adjacent to the Northern Suburbs Railway.

4.7.2.1 LSP considerations for noise

The acoustic assessment concluded that the most significant noise impacts over the site are from Marmion Avenue as noise levels exceed the “target” criteria as well as the “limit” criteria. The Mitchell Freeway has the least noise impact as the “target” and “limit” criteria were not exceeded at the majority of locations. The noise impacts from Marmion Ave, Mitchell Freeway and the Northern Suburbs Railway could be managed through the implementation of a range of noise mitigation measures and approaches.

The mitigation options considered appropriate include a potential noise barrier along part of the development boundary adjacent to Marmion Avenue, and/or treatments to the facade of properties exceeding the “target” criteria. Noise mitigation options will be determined at the detailed design stage prior to subdivision. Marmion Avenue and Mitchell Freeway are likely to require the implementation of “Quiet Noise” design guidelines for dwellings which outline noise insulation measures designed to ensure the noise standards in the policy are achieved where outdoor noise levels exceed the “target” criteria by up to 8dB(A) (Herring Storer Acoustics, 2012).

In summary, the noise acoustic assessments indicate that future noise emissions can be accommodated for in the current layout of the LSP and that further noise management and mitigation will be required as discussed below.

4.7.2.2 Future noise management requirements

A detailed Noise Management Plan for areas adjacent to Marmion Ave, Mitchell Freeway and the Northern Suburbs Railway will be prepared at the subdivision stage. As part of the Noise Management Plan, more detailed noise modelling for these areas will be conducted. This modelling will be undertaken as detailed site specific information (ie. finalised lot levels) is available. The Noise Management Plan will also provide details on proposed noise mitigation measures, refined as part of detailed design. The Noise Management Plan will also identify which lots are likely to require a notification on titles to advise future residents of road/rail noise.

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5 Implementation

A summary of the LSP and Concept Plan response to the environmental values and attributes within the site are described below in outlined in **Table 12**. The table shows the proposed future management required as part of the subdivision and development process.

Table 12: Summary of environmental factors, LSP response and future management at the subdivision and development stage.

FACTOR	LOCAL STRUCTURE PLAN AND CONCEPT PLAN	SUBDIVISION	DEVELOPMENT
Topography, Soils and Landform	<ul style="list-style-type: none"> ROS to retain parabolic dune landform values. 	<ul style="list-style-type: none"> Prepare detailed information on dune treatment (batters, retaining walls). Geotechnical Investigations to respond to potential karst features. Prepare EMPs for any impacts through ROS (parabolic dune). 	<ul style="list-style-type: none"> Implementation of EMP.
Hydrology	<ul style="list-style-type: none"> Local Water Management Strategy has been prepared to support the LSP. 	<ul style="list-style-type: none"> Prepare Urban Water Management Plans to support subdivision applications. 	<ul style="list-style-type: none"> Implementation of UWMP.
Flora and Vegetation	<ul style="list-style-type: none"> The Concept Plan design allows for retention of the significant PEC vegetation along the ROS. Ecological linkage retained as ROS. 	<ul style="list-style-type: none"> Vegetation and Fauna Management Plan to respond to remnant vegetation and fauna habitat. Prepare EMPs for any impacts through ROS. 	<ul style="list-style-type: none"> Implementation of Vegetation and Fauna Management Plan to manage vegetation and flora habitat. Implementation of EMP.
Fauna	<ul style="list-style-type: none"> The Concept Plan design allows for retention of fauna habitat along the ROS including habitat for Carnaby's black cockatoo. 	<ul style="list-style-type: none"> Vegetation and Fauna Management Plan to respond to remnant vegetation and fauna habitat. Prepare EMPs for any impacts through ROS 	<ul style="list-style-type: none"> Implementation of Vegetation and Fauna Management Plan to manage vegetation and flora habitat. Implementation of EMP.
Fire Management	<ul style="list-style-type: none"> Bushfire Management Plan to determine the overall level of risk presented by the development. Assessment of design in accordance with Planning for Bush Fire Protection and based on the City of Wanneroo's specification D10 "Bushfire Protection", Part 3 of the City's "Bushfire Protection Requirements for Subdivision and Development", and the WAPC/FESA's "Planning 	<ul style="list-style-type: none"> Implementation of the Bushfire Management Plan prepared at the Local Structure Planning stage. 	<ul style="list-style-type: none"> Dwellings to demonstrate compliance with AS3959 as per Bushfire Management Plan.

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FACTOR	LOCAL STRUCTURE PLAN AND CONCEPT PLAN	SUBDIVISION	DEVELOPMENT
	for Bushfire Protection Guidelines'		
Acoustic	<ul style="list-style-type: none">Identify areas for future implementation of mitigation measures.	<ul style="list-style-type: none">Noise Modelling and Noise Management Plan.	<ul style="list-style-type: none">Implementation of noise mitigation measures as determined by Noise Management Plan.

6 Summary and Conclusion

Emerge Associates was engaged by Lend Lease Communities to provide environmental consulting services to inform the preparation and design of the LSP for Central Alkimos (the site). The LSP area is intended to be developed for residential uses.

This report forms a key supporting document for the LSP providing detail on the environmental values and attributes of the site, the spatial response of the LSP to these values and attributes and any required environmental management as a part of the future subdivision and development processes.

The environmental attributes and values identified within the site have been outlined in **Section 2** and summarised below:

- A parabolic dune with geoheritage significance is located within the site.
- Part of Bush Forever Site 397 is located within the site.
- Acid Sulfate Soils and hydrology do not pose major environmental issues for the site.
- There are no recorded Rare or Priority listed flora species over the site.
- There are two potential Priority Ecological Communities (PECs) recorded over the site. These include FCT No. 24: Northern Spearwood shrublands and woodlands, and FCT No. 29b: Acacia shrublands on taller dunes.
- One potential Threatened Ecological Community (TEC) FCT 26a: *Melaleuca huegeli*-*Melaleuca acerosa* shrublands on Limestone ridges. Although this TEC has not been confirmed by WA Department of Environment and Conservation (DEC).
- The site contains Carnaby's black cockatoo foraging habitat corresponding with areas of Banksia woodland.

The environmental values and attributes of the site have been considered during the preparation of the LSP, and include a number of specific design responses, such as the retention of flora, vegetation and habitat values have been considered.

The key considerations of the environmental values and attributes have been outlined in **Section 4** and summarised below:

- Opportunities for retention of potential Priority Ecological Communities (PECs) and potential Threatened Ecological Communities (TEC) within the ROS.
- A road reserve adjacent to some areas of POS and ROS incorporating retained remnant vegetation to provide for bush fire suppression access to satisfy the requirements of *Planning for Bushfire Protection* (WAPC 2010).

The key environmental values and attributes on a regional scale within the Alkimos Eglinton area have been considered in detail through the planning process at the MRS Amendment and DSP stage, including a formal EPA assessment. The majority of significant environmental values were captured by the EPA in their formal assessment of the MRS Amendment, which resulted in a large area of the site being reserved for "Parks and Recreation". As such, the key environmental values were reserved and the LSP has built upon this with an environmental management framework for future planning and development stages.

The site is proposed to be developed for residential development, incorporating mixed uses, a Northern Suburbs Railway line connection and a large area of ROS. The LSP (and existing zoning)

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has provided for the retention of values associated with the parabolic dune, significant vegetation communities and habitat for conservation significant fauna species. The form and treatment of these areas will be examined in detail at future planning stages.

This report, in conjunction with the LSP documentation also sets up an environmental management framework to outline the ongoing and future requirements to respond to environmental attributes and values through the planning process. Therefore, at the subdivision stage, the following studies and management plans will be required:

- An Urban Water Management Plan (UWMP) for each stage of subdivision.
- Vegetation and Fauna Management Plan.
- Karst Investigation and Management Plan.
- Landscape Concept Plan.
- Open Space Strategy.
- Detailed noise modeling based on final lot levels and other details and the preparation of a Noise Management Plan.
- EMPs for impacts on ROS.

Finally, the removal of foraging habitat for Carnaby's black cockatoo habitat associated with the implementation of the LSP will require a referral pursuant to the EPBC Act. This will be considered as part of future planning and development.

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ENVIRONMENTAL ASSESSMENT AND JUSTIFICATION REPORT
CENTRAL ALKIMOS

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FIGURES

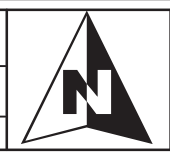
- Figure 1: Locality Plan
- Figure 2: Alkimos Eglinton District Structure Plan (DSP)
- Figure 3: Metropolitan Region Scheme- 2011
- Figure 4: Topography
- Figure 5: Landforms and Soils
- Figure 6: Environmental Geology
- Figure 7: Public Drinking Water Source Areas
- Figure 8: Vegetation Complexes
- Figure 9: Vegetation Communities
- Figure 10: Vegetation Condition
- Figure 11: Inferred Floristic Community Types.
- Figure 12: Bush Forever Sites and Regional Ecological Linkages
- Figure 13: Carnaby's black cockatoo habitat mapping.
- Figure 14: Proposed Local Structure Plan
- Figure 15: Proposed Concept Plan over Environmental Values



Figure 1: Locality Plan

Project: Environmental Assessment and Justification Report
Central Alkimos

Client: Lend Lease Communities (Alkimos) Pty Ltd



Legend

Site boundary

Plan Number: EP11-065(10)-F56	
Drawn: GRO	Date: 03/10/12
Approved: CKK	Date: 20/11/12
Checked: CH	Scale: 1:33,000@A4



While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used.

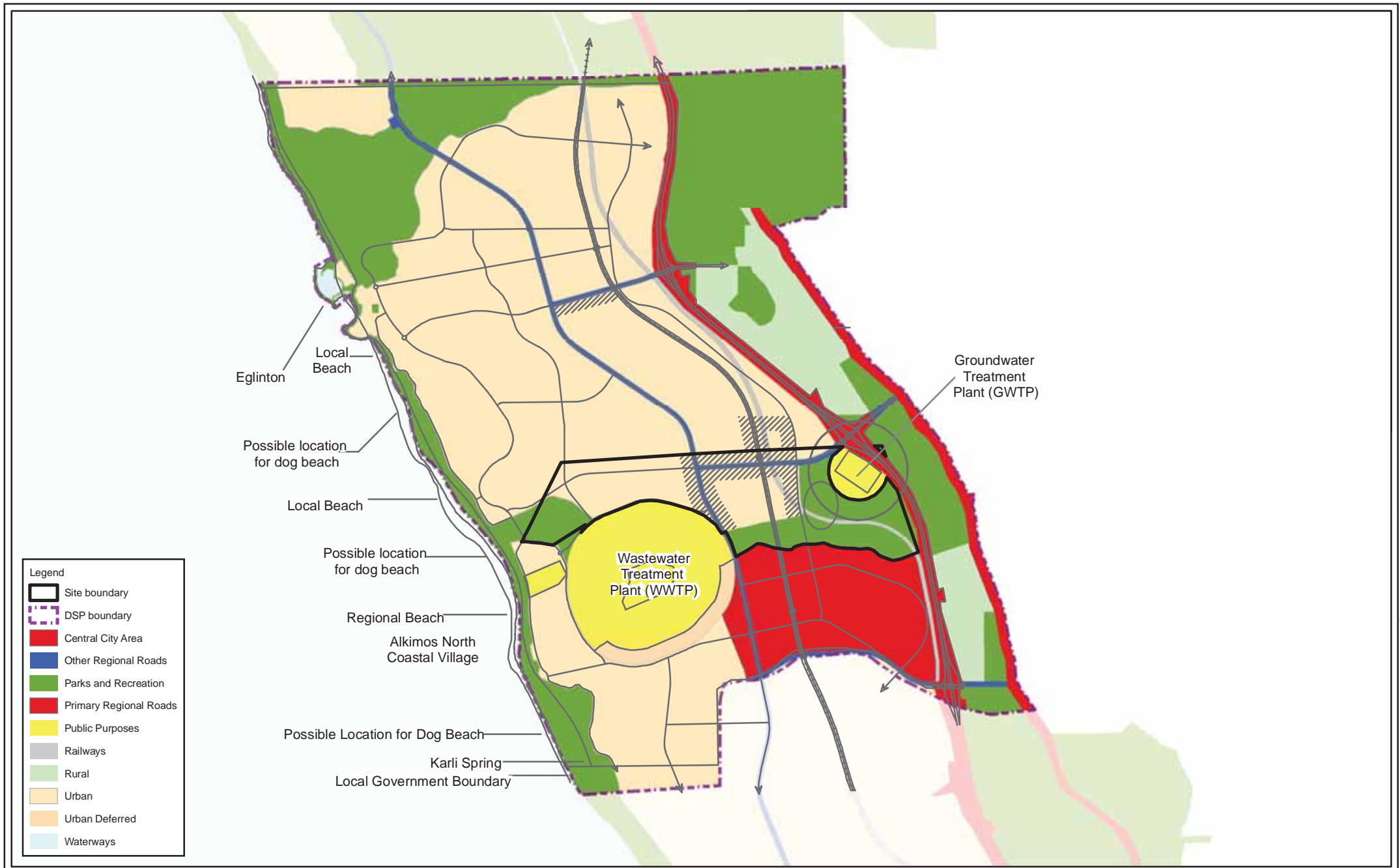


Figure 2: Alkimos Eglinton District Structure Plan

Project: Environmental Assessment and Justification Report
Central Alkimos

Client: Lend Lease Communities (Alkimos) Pty Ltd

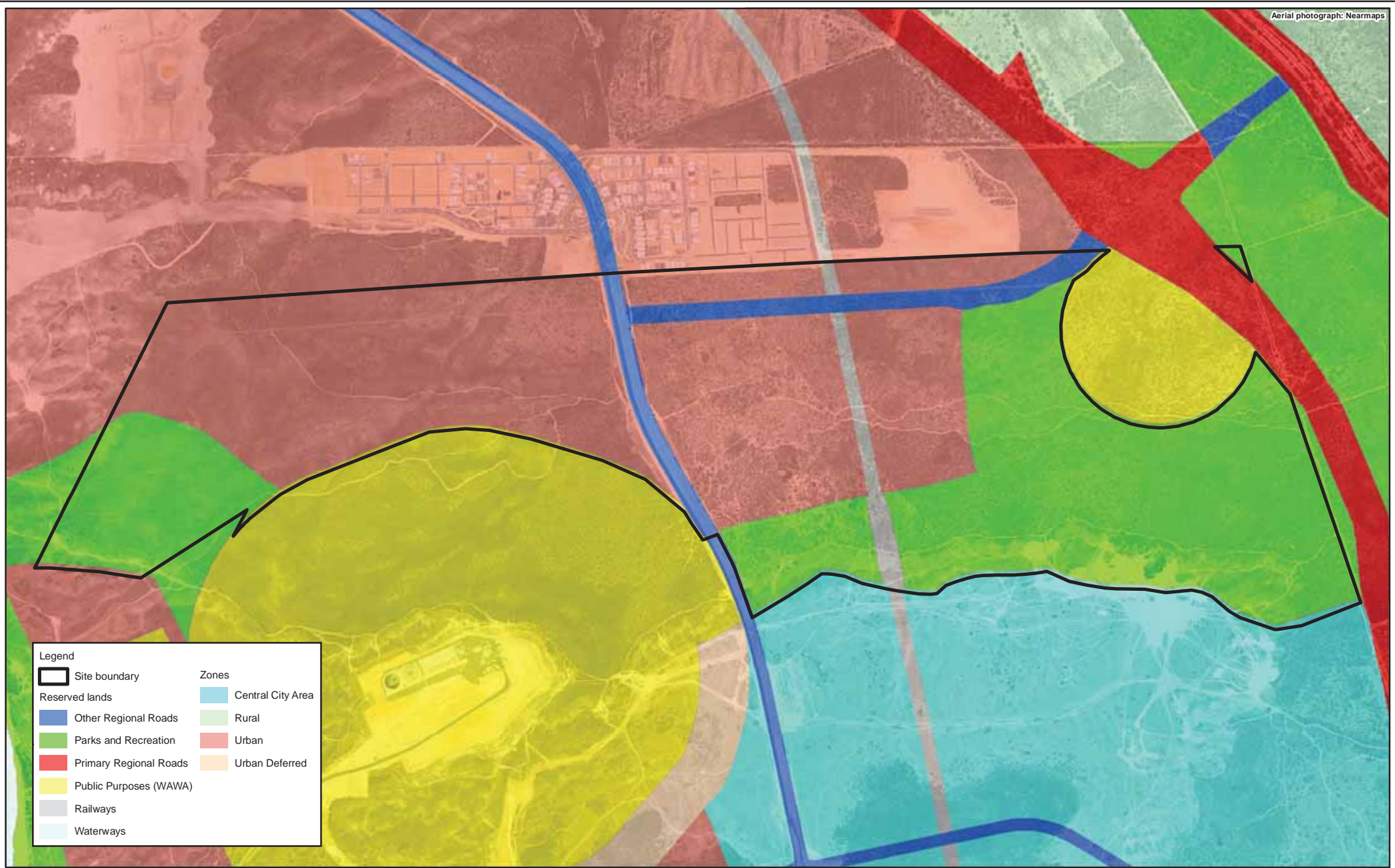


Plan Number: EP11-065(10)-F68

Drawn: GRO	Date: 11/10/12
Approved: CKK	Date: 20/11/12
Checked: CH	Scale: 1:50,000@A4

0 500 1,000 2,000 Metres





Legend

Site boundary	Zones
Reserved lands	Central City Area
Other Regional Roads	Rural
Parks and Recreation	Urban
Primary Regional Roads	Urban Deferred
Public Purposes (WAWA)	
Railways	
Waterways	

Figure 3: Metropolitan Region Scheme - 2013

Project: Environmental Assessment and Justification Report
Central Alkimos

Client: Lend Lease Communities (Alkimos) Pty Ltd



Plan Number: EP11-065(10)--F57a

Drawn: GRO	Date: 17/04/13
Approved: CKK	Date: 17/04/13
Checked: CH	Scale: 1:15,000@A4

0 150 300 600 Metres



Sources: The following datasets were used in the production of this map: Metropolitan Region Scheme - DoP (2013)





Figure 4: Topography

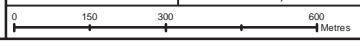
Project: Environmental Assessment and Justification Report
Central Alkimos

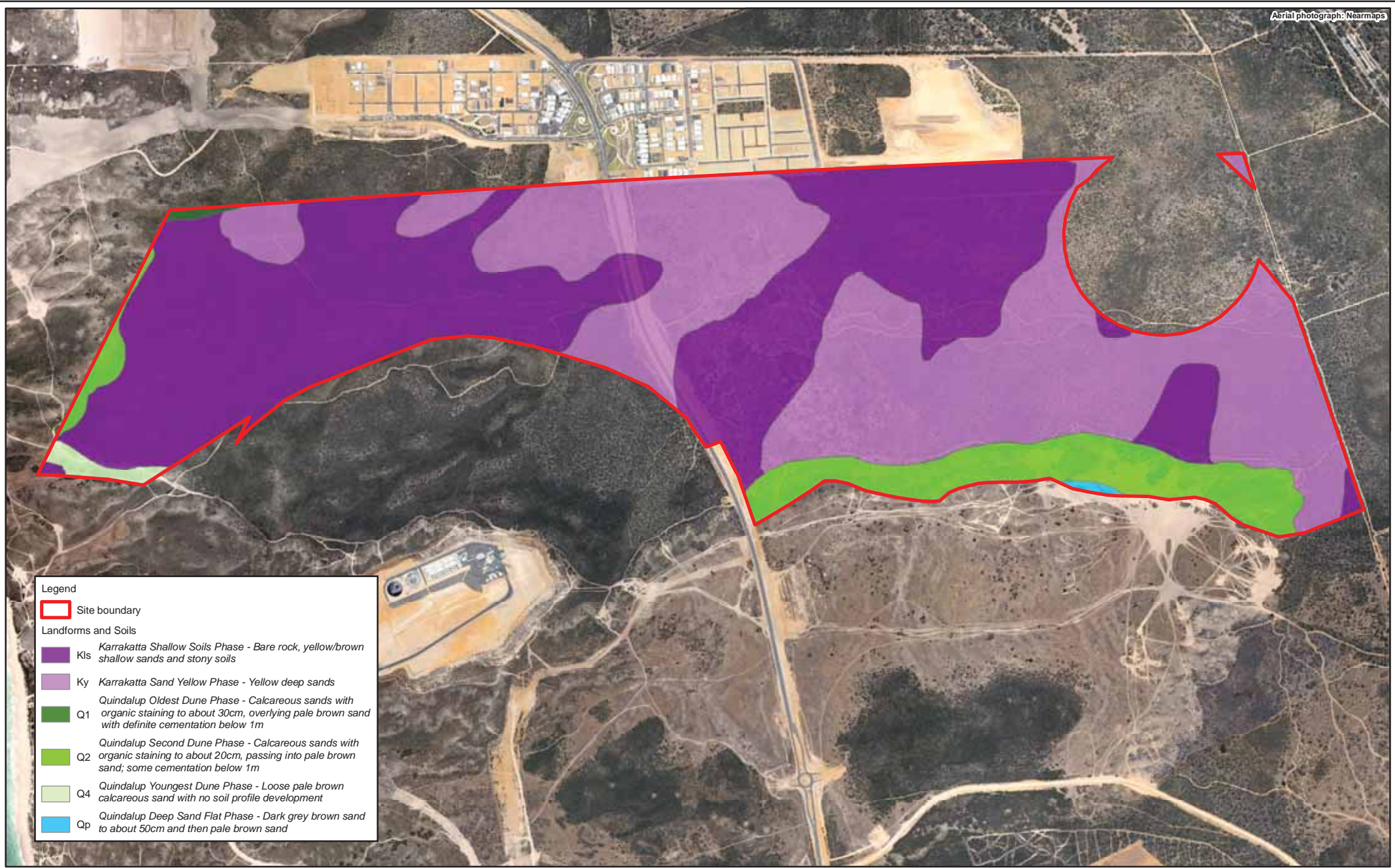
Client: Lend Lease Communities (Alkimos) Pty Ltd



Legend	
	Site boundary
	5m Contours (mAHD)

Plan Number: EP11-065(10)-F58	
Drawn: GRO	Date: 03/10/12
Approved: CKK	Date: 20/11/12
Checked: CH	Scale: 1:15,000@A4





Legend

Site boundary

Landforms and Soils

- Kls *Karrakatta Shallow Soils Phase - Bare rock, yellow/brown shallow sands and stony soils*
- Ky *Karrakatta Sand Yellow Phase - Yellow deep sands*
- Q1 *Quindalup Oldest Dune Phase - Calcareous sands with organic staining to about 30cm, overlying pale brown sand with definite cementation below 1m*
- Q2 *Quindalup Second Dune Phase - Calcareous sands with organic staining to about 20cm, passing into pale brown sand; some cementation below 1m*
- Q4 *Quindalup Youngest Dune Phase - Loose pale brown calcareous sand with no soil profile development*
- Qp *Quindalup Deep Sand Flat Phase - Dark grey brown sand to about 50cm and then pale brown sand*

Figure 5: Landforms and Soils

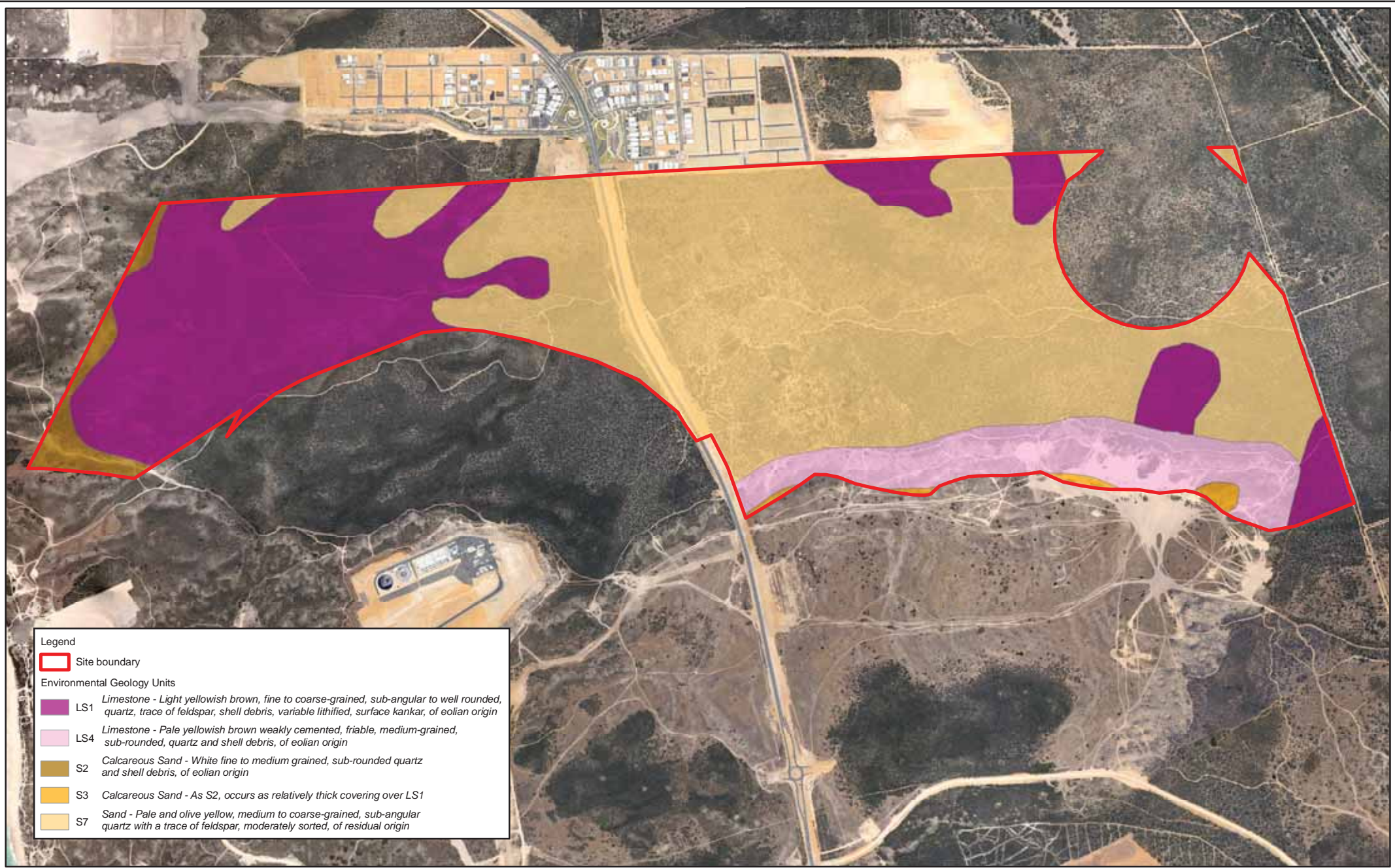
Project:	Environmental Assessment and Justification Report Central Alkimos
Client:	Lend Lease Communities (Alkimos) Pty Ltd



Plan Number: EP11-065(10)-F59	
Drawn: GRO	Date: 03/10/12
Approved: CKK	Date: 20/11/12
Checked: CH	Scale: 1:15,000@A4



Sources: The following datasets were used in the production of this map: Landforms and Soils - Churchward and McArthur (1980)



Legend

Site boundary

Environmental Geology Units

- LS1 *Limestone - Light yellowish brown, fine to coarse-grained, sub-angular to well rounded, quartz, trace of feldspar, shell debris, variable lithified, surface kankar, of eolian origin*
- LS4 *Limestone - Pale yellowish brown weakly cemented, friable, medium-grained, sub-rounded, quartz and shell debris, of eolian origin*
- S2 *Calcareous Sand - White fine to medium grained, sub-rounded quartz and shell debris, of eolian origin*
- S3 *Calcareous Sand - As S2, occurs as relatively thick covering over LS1*
- S7 *Sand - Pale and olive yellow, medium to coarse-grained, sub-angular quartz with a trace of feldspar, moderately sorted, of residual origin*

Figure 6: Environmental Geology

Project: Environmental Assessment and Justification Report
Central Alkimos

Client: Lend Lease Communities (Alkimos) Pty Ltd

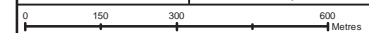


Plan Number: EP11-065(10)-F60

Drawn: GRO Date: 03/10/12

Approved: CKK Date: 20/11/12

Checked: CH Scale: 1:15,000@A4



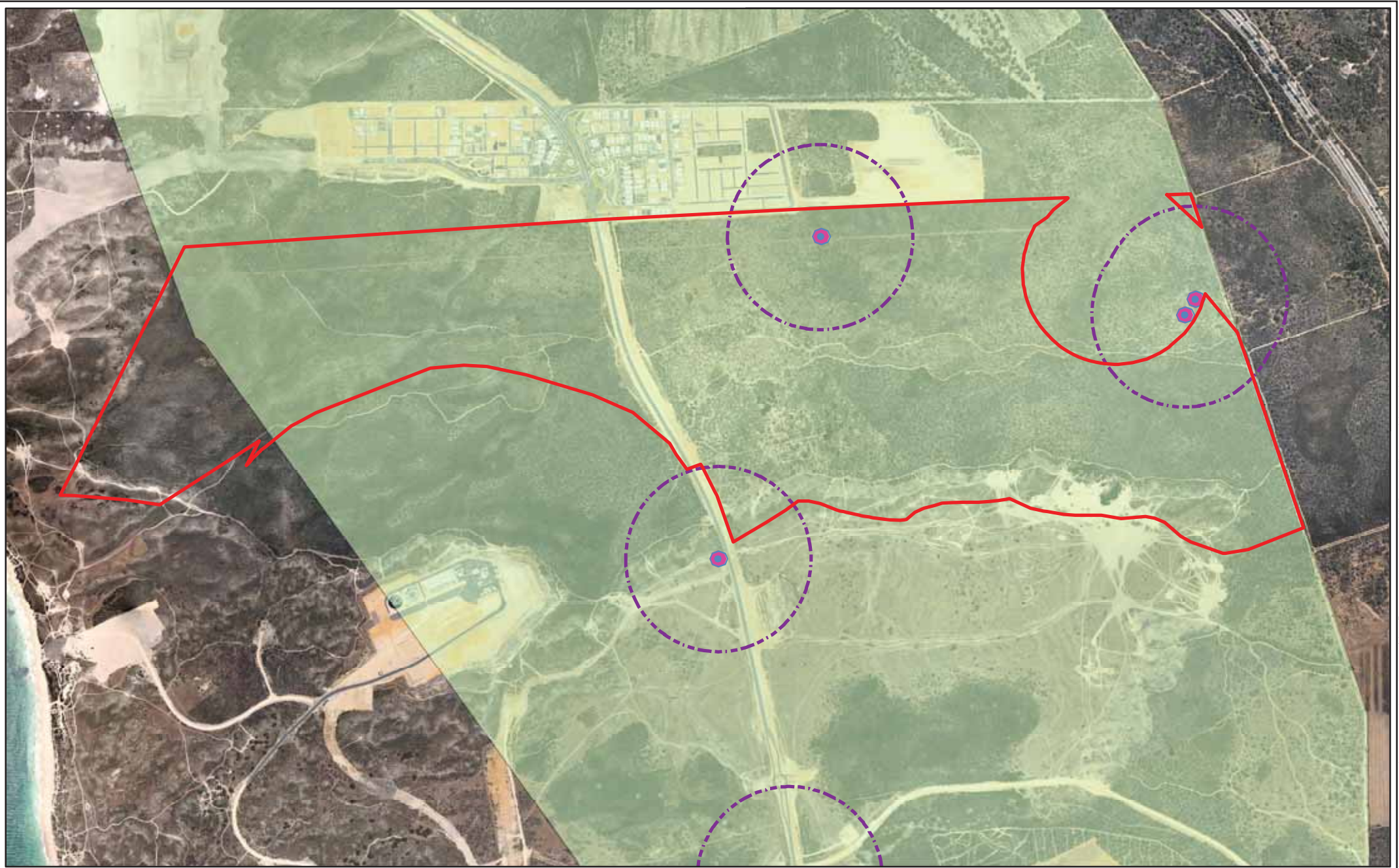


Figure 7: Public Drinking Water Source Areas

Project: Environmental Assessment and Justification Report
Central Alkimos

Client: Lend Lease Communities (Alkimos) Pty Ltd



Legend

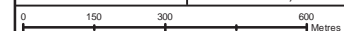
- Public Drinking Water Source Area - Priority 3
- Site boundary
- Estimated wellhead location
- 300m wellhead protection zone

Plan Number: EP11-065(10)-F61

Drawn: GRO Date: 03/10/12

Approved: CKK Date: 20/11/12

Checked: CH Scale: 1:16,000@A4



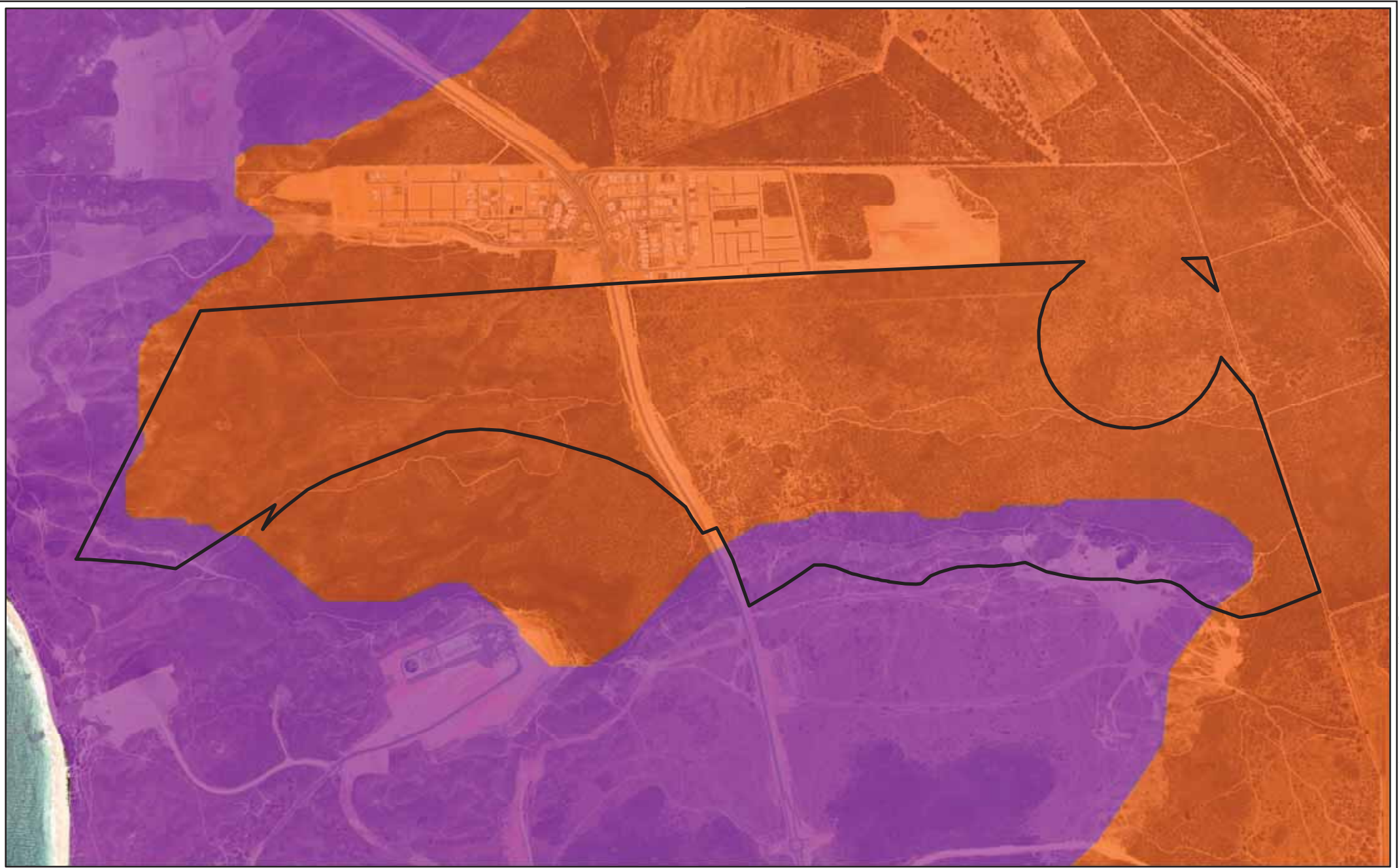






Figure 8: Vegetation Complexes

Project: Environmental Assessment and Justification Report
Central Alkimos

Client: Lend Lease Communities (Alkimos) Pty Ltd



- Legend
-  Site boundary
 -  Cottesloe complex - central and south
 -  Quindalup complex

Plan Number: EP11-065(10)-F86	
Drawn: GRO	Date: 03/10/12
Approved: CKK	Date: 20/11/12
Checked: CH	Scale: 1:16,000@A4
	



Sources: The following datasets were used in the production of this map: Vegetation Complexes - Heddlie et al (1980)

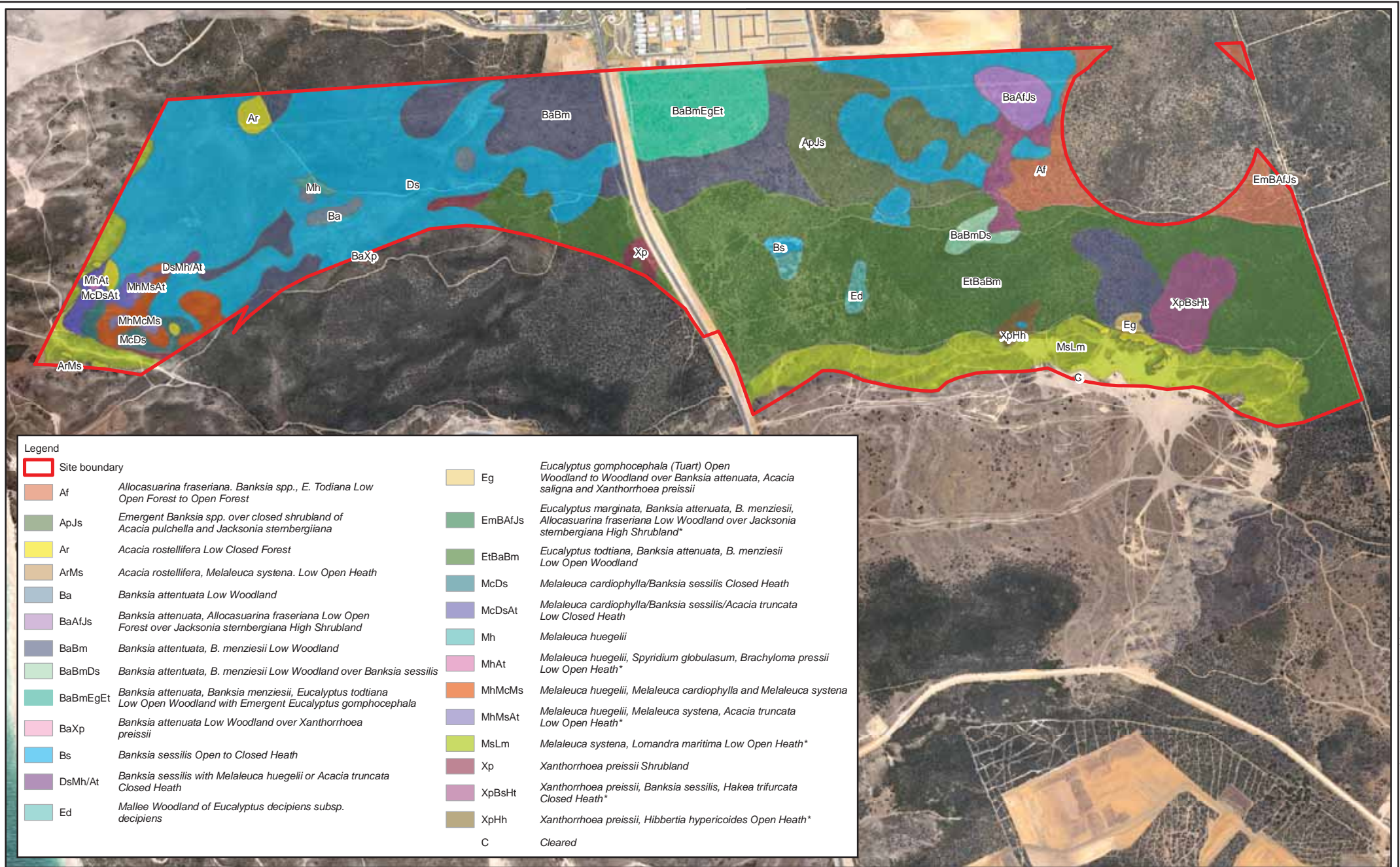


Figure 9: Vegetation Communities

Project: Environmental Assessment and Justification Report
Central Alkimos

Client: Lend Lease Communities (Alkimos) Pty Ltd



Plan Number: EP11-065(10)-F78

Drawn: GRO	Date: 18/10/12
Approved: CKK	Date: 20/11/12
Checked: CH	Scale: 1:15,000@A4

0 150 300 600 Metres





Legend

- Site boundary
- Vegetation Condition**
- Exellent
- Very Good
- Good
- Degraded
- Completely Degraded

Figure 10: Vegetation Condition

Project: Environmental Assessment and Justification Report
Central Alkimos

Client: Lend Lease Communities (Alkimos) Pty Ltd



Plan Number: EP11-065(10)-F63

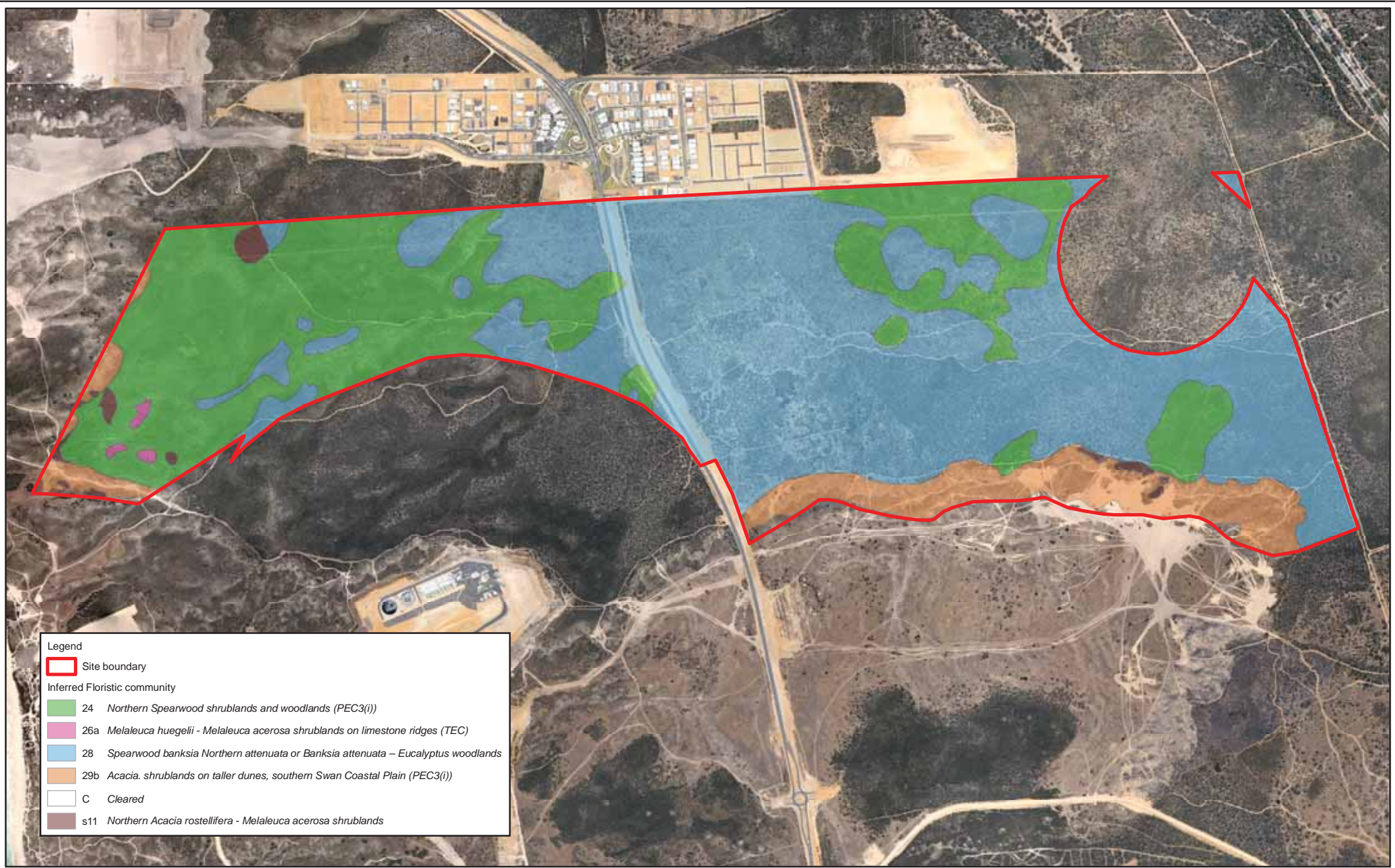
Drawn: GRO	Date: 18/10/12
Approved: CKK	Date: 20/11/12
Checked: CH	Scale: 1:15,000@A4

0 150 300 600 Metres



Sources: The following datasets were used in the production of this map: Vegetation Condition - Emerge Associates (2012)

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used



Legend	
	Site boundary
Inferred Floristic community	
	24 Northern Spearwood shrublands and woodlands (PEC3(i))
	26a <i>Melaleuca huegellii</i> - <i>Melaleuca acerosa</i> shrublands on limestone ridges (TEC)
	28 Spearwood banksia Northern attenuata or <i>Banksia attenuata</i> – <i>Eucalyptus</i> woodlands
	29b <i>Acacia</i> . shrublands on taller dunes, southern Swan Coastal Plain (PEC3(i))
	C Cleared
	s11 Northern <i>Acacia rostellifera</i> - <i>Melaleuca acerosa</i> shrublands

Figure 11: Inferred Floristic Community Types

Project: Environmental Assessment and Justification Report
Alkimos City Centre and Central Alkimos

Client: Lend Lease Communities (Alkimos) Pty Ltd



Plan Number: EP11-065(10)-F69	
Drawn: GRO	Date: 06/02/12
Approved: CKK	Date: 20/11/12
Checked: CH	Scale: 1:15,000@A4



Sources: The following datasets were used in the production of this map: Inferred Floristic Community - ATA (2005)

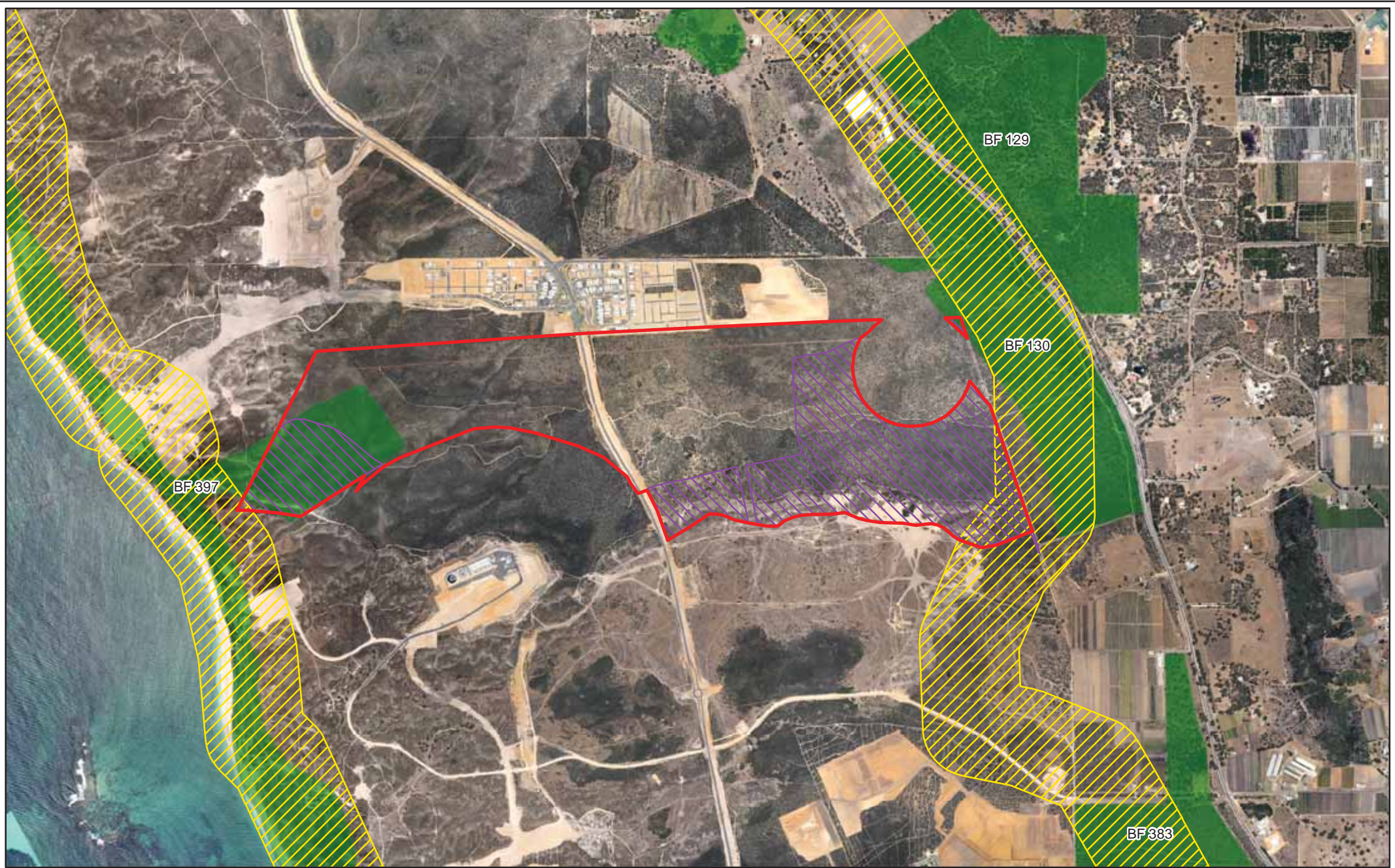


Figure 12: Bush Forever Sites and Regional Ecological Linkages

Project: Environmental Assessment and Justification Report
Central Alkimos
Client: Lend Lease Communities (Alkimos) Pty Ltd

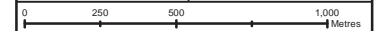


Legend

- Site boundary
- Bush Forever Sites
- Regional Open Space
- Regional Ecological Linkages

Plan Number: EP11-065(10)-F64a

Drawn: GRO	Date: 17/04/13
Approved: CKK	Date: 17/04/13
Checked: CH	Scale: 1:25,000@A4



Sources: The following datasets were used in the production of this map: Bush Forever Sites - DoP (2007), Regional Ecological Linkages - Perth Biodiversity Project (2007), Regional Open Space - MRS Amendment 1029/33, EPA (2006)



Legend

- Site boundary
- Potential Carnaby's Black Cockatoo foraging habitat

Habitat trees

- Coastal Blackbutt >50cm DBH, no hollows
- Coastal Blackbutt >50cm DBH, one or more hollows observed
- Tuart >50cm DBH, no hollows
- Tuart >50cm DBH, one or more hollows observed
- Species unknown >50cm DBH, no hollows
- Species unknown >50cm DBH, one or more hollows observed
- One or more hollows suitable for a Black Cockatoo

Figure 13: Carnaby's Black Cockatoo Habitat Mapping

Project: Environmental Assessment and Justification Report
Central Alkimos

Client: Lend Lease Communities (Alkimos) Pty Ltd



Plan Number: EP11-065(10)--F77a

Drawn: GRO Date: 20/08/13

Approved: JDH Date: 20/08/13

Checked: CKK Scale: 1:15,000@A4

0 150 300 600 Metres





Figure 14: Proposed Local Structure Plan

Project: Environmental Assessment and Justification Report
Central Alkimos
Client: Lend Lease Communities (Alkimos) Pty Ltd



Plan Number: EP11-065(10)--F88c

Drawn: GRO Date: 20/08/13

Approved: JDH Date: 22/08/13

Checked: CKK Scale: NTS@A4

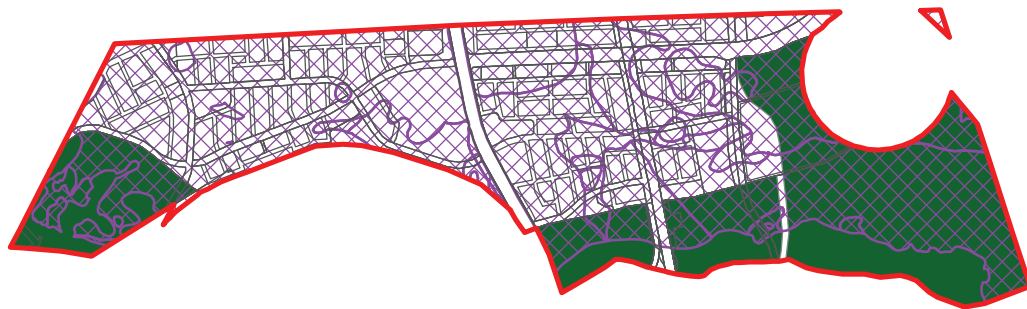





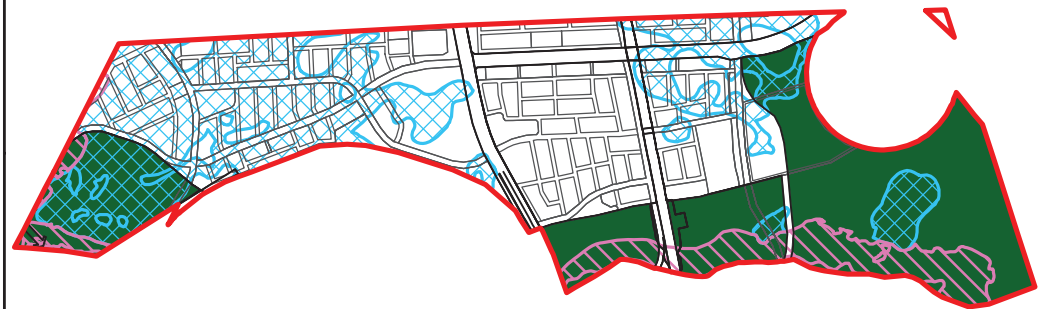
 Parabolic dune (Q2)



 GSM habitat (MsLm vegetation community)



 Potential Carnaby's Black Cockatoo foraging habitat








Inferred Floristic Community
 24 Northern Spearwood shrublands and woodlands (PEC3(i))
 29b Acacia shrublands on taller dunes, southern Swan Coastal Plain (PEC3(i))

Figure 15: Proposed Concept Plan over Environmental Values

Project: Environmental Assessment and Justification Report
Central Alkimos

Client: Lend Lease Communities (Alkimos) Pty Ltd



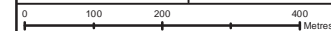
Legend
 Site boundary
 ROS
 LSP

Plan Number: EP11-065(10)-F87b

Drawn: GRO Date: 20/08/13

Approved: JDH Date: 22/08/13

Checked: CKK Scale: 1:35,000@A4



APPENDIX A



DESKTOP GEOTECHNICAL STUDY

Proposed Central Alkimos Development, Alkimos WA
Douglas Partners 2012

Lend Lease Communities (Alkimos) Pty Ltd
Level 2, 10 Ord Street
WEST PERTH WA 6005

Project 76396.00
11 July 2012
MOW:DR

Attention: Mr Peter Dockett

Dear Sirs

Desktop Geotechnical Study
Proposed Central Alkimos Development, Alkimos, WA

1. Introduction

This letter presents the results of a geotechnical desktop study undertaken by Douglas Partners Pty Ltd (DP) for the proposed Central Alkimos development site, located in Alkimos, Western Australia (WA). This report was commissioned by Lend Lease Communities (Alkimos) Pty Ltd (Lend Lease) by way of a Professional Services Agreement dated 6 June 2012.

The purpose of this desktop study is to review available geological information in order to identify the likelihood of karst formations being present within the site, and provide comments on potential risks for the development associated with such landforms. As directed by Lend Lease, this report is limited to desktop analysis of available information only. No site inspections or testing were undertaken as part of this assessment.

A plan provided by Lend Lease indicates that the subject area comprises approximately 530 ha of coastal land on Marmion Avenue in Alkimos (refer to Drawing 1, attached), located to the north of the Perth Metropolitan Area. It is understood that the development will include both residential and commercial land use.

2. Background on Karst

Karst features are erosional landforms occurring within calcareous rock, and in particular include caves, dolines and swallow holes. They form over long periods of time by the dissolution of the rock's carbonate minerals by groundwater movement and percolation. Major cavities are thought to generally form at or near the water table level (which may have varied over geological time).

Karst features exist within the coastal area of south-western WA, however only a small number are known to result in a subsidence risk to structures or personnel. Phenomena such as caves and dolines have been mapped within a belt of karsts, which generally occurs with the geological unit

described as Limestone (LS₂) on Drawing 1. The Central Alkimos development site does not lie within this belt, and is situated to its west.

It is understood that no fatalities have occurred from cave roof collapses in WA. Fatalities have, however, occurred as a result of collapsed open overhangs in marine cliffs.

3. Review of Available Geological Information

The Yanchep 1:50,000 Environmental Geology Sheet (Ref 1) indicates that the Central Alkimos development site (refer to Drawing 1) is underlain by the following soil and rock units:

- **Calcareous Sand (S₂ and S₃)** – fine to medium grained, sub-rounded quartz and shell debris forming part of the Safety Bay Sand Unit;
- **Sand (S₇)** - medium to coarse grained, sub-angular quartz sand, derived from Tamala Limestone Unit;
- **Limestone (LS₁)** – fine to coarse grained, quartz and shell debris, variably lithified and with common solution cavities and fissures, forming part of the Tamala Limestone Unit;
- **Limestone (LS₄)** – medium grained, quartz and shell debris, weakly cemented, friable, no karst features noted, forming part of the Safety Bay Sand Unit.

There are no known karst features identified on the geology map sheet as lying within the boundary of the site. The nearest known karst feature identified on the sheet is a doline (collapsed cave) located 1.25 km east of the site. The closest cave is marked 1.4 km north-east of the site. A number of caves and dolines are known to be in the wider area and are marked on the geological sheet within the geological unit identified as Limestone (LS₂). Extensive cave systems and other large scale karstic phenomena are known to occur within this unit. The closest mapped occurrence of Limestone (LS₂) to the site is approximately 150 m east of the site.

The Perth Groundwater Atlas (Ref 2) indicates that the level of the regional near surface groundwater aquifer beneath the site was between RL 0 m and RL 3 m relative to Australian Height Datum (AHD) in May 2003. These levels correspond to depths below the existing surface level of between 0 m to 50 m across the site.

4. Comments

The results of the desktop geotechnical study indicate that the ground conditions underlying the development site contain a geological unit which has “common solution cavities and fissures” but is not known to have large karst features such as caves. Based on this desktop information, it is considered that there is only a very low susceptibility for development of large karst structures within the site and that, following detailed investigation, the likelihood of karst landforms impacting the proposed development is rare. An extract (Appendix C) of the Practice Note Guidelines for Landslide Risk Management (Ref 3) defining terminology is attached.

Necessarily, these comments are provided based on the analysis of desktop information only, and site based identification of possible karst features has not been undertaken. It is therefore considered prudent that consideration to potential karst phenomena are given during the subsequent site based elements of ongoing geotechnical testing for the development at the site, including:

- Walk-over inspections by experienced professionals;
- Test pit and cone penetration tests as part of geotechnical investigations; and
- Observations during the bulk earthworks phase of the construction of the development.

In the event that features indicating the presence of karst landforms are identified at the site, specific testing will be warranted to assess the likelihood and consequence of failure, and impact (risk) on the development.

5. References

1. Geological Survey of Western Australia (1986), Geology of Yanchep 1:50,000 Environmental Geology Sheet.
2. Department of Environment, Perth Groundwater Atlas, Second Edition, December 2004.
3. Australian Geomechanics Society. "Practice Note Guidelines for Landslide Risk Management", Australian Geomechanics, Vol. 42 No. 1 (2007c).

6. Limitations

DP has prepared this desktop geotechnical study for the proposed Central Alkimos development, WA in accordance with DP's fee proposal dated 3 May 2012 and commissioned by Lend Lease Communities (Alkimos) Pty Ltd by way of a Professional Services Agreement dated 6 June 2012. This report is provided for the exclusive use of Lend Lease Communities (Alkimos) Pty Ltd for this project only and for the purposes described in the report. It should not be used for other projects or by a third party. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

This report must be read in conjunction with all of the attached notes and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion given in this report.

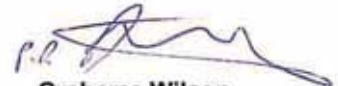
This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

Yours faithfully
Douglas Partners Pty Ltd



Dan Reaveley
Senior Associate

Reviewed by



Grahame Wilson
Senior Consultant

Attachments:

About this Report

Drawing 1 - Site Boundary and Geology

Appendix C of the Practice Note Guidelines for Landslide Risk Management

About this Report

Douglas Partners



Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;

- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT 2007

APPENDIX C: LANDSLIDE RISK ASSESSMENT

QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY

QUALITATIVE MEASURES OF LIKELIHOOD

Approximate Annual Probability		Implied Indicative Landslide Recurrence Interval		Description	Descriptor	Level
Indicative Value	Notional Boundary					
10 ⁻¹	5x10 ⁻²	10 years	20 years	The event is expected to occur over the design life.	ALMOST CERTAIN	A
10 ⁻²		100 years		The event will probably occur under adverse conditions over the design life.	LIKELY	B
10 ⁻³	5x10 ⁻³	1000 years	2000 years	The event could occur under adverse conditions over the design life.	POSSIBLE	C
10 ⁻⁴	5x10 ⁻⁴	10,000 years		The event might occur under very adverse circumstances over the design life.	UNLIKELY	D
10 ⁻⁵	5x10 ⁻⁵	100,000 years	20,000 years	The event is conceivable but only under exceptional circumstances over the design life.	RARE	E
10 ⁻⁶	5x10 ⁻⁶	1,000,000 years	200,000 years	The event is inconceivable or fanciful over the design life.	BARELY CREDIBLE	F

Note: (1) The table should be used from left to right; use Approximate Annual Probability or Description to assign Descriptor, not *vice versa*.

QUALITATIVE MEASURES OF CONSEQUENCES TO PROPERTY

Approximate Cost of Damage		Description	Descriptor	Level
Indicative Value	Notional Boundary			
200%	100%	Structure(s) completely destroyed and/or large scale damage requiring major engineering works for stabilisation. Could cause at least one adjacent property major consequence damage.	CATASTROPHIC	1
60%		Extensive damage to most of structure, and/or extending beyond site boundaries requiring significant stabilisation works. Could cause at least one adjacent property medium consequence damage.	MAJOR	2
20%	40%	Moderate damage to some of structure, and/or significant part of site requiring large stabilisation works. Could cause at least one adjacent property minor consequence damage.	MEDIUM	3
5%	10%	Limited damage to part of structure, and/or part of site requiring some reinstatement stabilisation works.	MINOR	4
0.5%	1%	Little damage. (Note for high probability event (Almost Certain), this category may be subdivided at a notional boundary of 0.1%. See Risk Matrix.)	INSIGNIFICANT	5

Notes: (2) The Approximate Cost of Damage is expressed as a percentage of market value, being the cost of the improved value of the unaffected property which includes the land plus the unaffected structures.

(3) The Approximate Cost is to be an estimate of the direct cost of the damage, such as the cost of reinstatement of the damaged portion of the property (land plus structures), stabilisation works required to render the site to tolerable risk level for the landslide which has occurred and professional design fees, and consequential costs such as legal fees, temporary accommodation. It does not include additional stabilisation works to address other landslides which may affect the property.

(4) The table should be used from left to right; use Approximate Cost of Damage or Description to assign Descriptor, not *vice versa*

PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT 2007

APPENDIX C: – QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY (CONTINUED)

QUALITATIVE RISK ANALYSIS MATRIX – LEVEL OF RISK TO PROPERTY

LIKELIHOOD		CONSEQUENCES TO PROPERTY (With Indicative Approximate Cost of Damage)				
	Indicative Value of Approximate Annual Probability	1: CATASTROPHIC 200%	2: MAJOR 60%	3: MEDIUM 20%	4: MINOR 5%	5: INSIGNIFICANT 0.5%
A - ALMOST CERTAIN	10 ⁻¹	VH	VH	VH	H	M or L (5)
B - LIKELY	10 ⁻²	VH	VH	H	M	L
C - POSSIBLE	10 ⁻³	VH	H	M	M	VL
D - UNLIKELY	10 ⁻⁴	H	M	L	L	VL
E - RARE	10 ⁻⁵	M	L	L	VL	VL
F - BARELY CREDIBLE	10 ⁻⁶	L	VL	VL	VL	VL

Notes: (5) For Cell A5, may be subdivided such that a consequence of less than 0.1% is Low Risk.

(6) When considering a risk assessment it must be clearly stated whether it is for existing conditions or with risk control measures which may not be implemented at the current time.

RISK LEVEL IMPLICATIONS

Risk Level	Example Implications (7)
VH VERY HIGH RISK	Unacceptable without treatment. Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to Low; may be too expensive and not practical. Work likely to cost more than value of the property.
H HIGH RISK	Unacceptable without treatment. Detailed investigation, planning and implementation of treatment options required to reduce risk to Low. Work would cost a substantial sum in relation to the value of the property.
M MODERATE RISK	May be tolerated in certain circumstances (subject to regulator's approval) but requires investigation, planning and implementation of treatment options to reduce the risk to Low. Treatment options to reduce to Low risk should be implemented as soon as practicable.
L LOW RISK	Usually acceptable to regulators. Where treatment has been required to reduce the risk to this level, ongoing maintenance is required.
VL VERY LOW RISK	Acceptable. Manage by normal slope maintenance procedures.

Note: (7) The implications for a particular situation are to be determined by all parties to the risk assessment and may depend on the nature of the property at risk; these are only given as a general guide.

APPENDIX B



GRACEFUL SUN MOTH SURVEY

Part of Lot 1003 Alkimos

Ecological 2011



Graceful Sun Moth Survey

Part of Lot 1003, Alkimos

Prepared for
Lend Lease

June 2011





Graceful Sun-moth survey

Part of Lot 1003, Alkimos

PREPARED FOR	Lend Lease
PROJECT NO	11PERECO-0005
DATE	21 June 2011

DOCUMENT TRACKING

ITEM	DETAIL
Project Name	Lot 1003 Alkimos Graceful Sun-moth Survey
Project Number	11PERECO-0005
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Prepared by	KZ, RBC
Approved by	BD, WM
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Cover photo	Looking out over Alkimos Lot 1003 site. Inset: Graceful Sun-moth specimen, 15 March 2011, Eco Logical Australia

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1 Introduction

Lend Lease commissioned Eco Logical Australia (ELA) to undertake a targeted survey of Graceful Sun-moth (*Synemon gratiosa*) and its occurrence within its Alkimos part Lot 1003 site (the site). The survey was undertaken due to the attention by State and Federal agencies on the species, particularly concerning its occurrence on this portion of the Northern Swan Coastal Plain. The site was previously surveyed in 2010 at which time the species was confirmed to occur within the site.

The survey also aims to increase scientific knowledge on the species (in consultation with the WA Department of Environment and Conservation) both within the site and surrounding habitat. Study efforts have been aimed at interpreting the number and size of local populations as well as the assessment of habitat characteristics to assist in determining minimum habitat patch sizes and specimen numbers required for minimum viable populations.

Surveys for Graceful Sun-moths are required to progress referrals and assessment under the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) for areas supporting *Lomandra* habitat suitable for the species. This survey is required to provide sufficient detail about the occurrence of this species and its breeding habitat within the site. The survey has been carried out according to methodology endorsed by the Department of Environment and Conservation (DEC) and provides reliable evidence of presence or absence of Graceful Sun-moth within the proposed development site boundary. The targeted survey was undertaken within the period of known flight, which occurs predominately throughout March, as required by DEC. Accordingly, this survey will enable the extent of potential local impact on the species resulting from the proposed development to be determined.

1.1 STUDY AREA

The site is situated 45km north of Perth CBD at Alkimos (Figure 1). It is approximately 517 ha in size and covers part of Lot 1003 (excluding Lots 101 and 1004). The proposed Lend Lease development will involve works pertaining to urban housing, coastal villages, schools, major roads and transport routes and areas for conservation in Regional Open Space (ROS) and Public Open Space (POS). The development is to be referred to the Federal Department of Sustainability, Environment, Water, Populations and Communities (SEWPaC) for consideration of whether it constitutes a Controlled Action, and therefore requires formal assessment, under the EPBC Act.

1.2 GRACEFUL SUN-MOTH

This species is a federally listed threatened species, listed as Endangered under the EPBC Act. The *WA Wildlife Conservation Act 1950* also lists this species under Schedule 1 as rare or likely to become extinct. Federal and state conservation categories are described in Appendix A.

The Graceful Sun-moth occurs on the Swan Coastal Plain where its current known distribution is confined roughly to between Leeman in the north, to Binningup in the south (Bishop *et al.* 2010b). This distribution represents a linear range of over 440 km covering an area of approximately 2015 km², of which the area of occupancy within this distribution is less than 10%. These figures are substantially larger than previously recorded values of 90 km and 234 km² (Bishop *et al.* 2010b). Within this distribution, the Graceful Sun-moth occurs in subpopulations in remnant bushland, including some conservation and DEC managed reserves. It is understood that DEC has undertaken surveys in

potential *Lomandra* habitat further north of Leeman, as far north as Useless Loop, to ascertain the full range and occurrence of this species. The work is being supported by some genetic studies to confirm it is the same species occurring over this range.

The Graceful Sun-moth is a medium sized diurnal Castniid moth species that superficially resembles a butterfly (DEC 2011). This species is active in autumn with peak activity in March. The generation length of the Graceful Sun-moth is unknown; however, closely related species of sun-moth live for approximately four to ten days in adult form (Douglas and Marriot 2003). The Graceful Sun-moth is recorded to breed only once each year, between February and April (DEC 2011, Bishop *et al.* 2010b). Breeding tends to occur on mat-rushes and the juvenile larval stages exist underground (Bishop *et al.* 2010b). Surveys for the species are limited to the flying season, generally throughout March.

The Graceful Sun-moth is thought to breed exclusively on *Lomandra* species. *Lomandra hermaphrodita* and *L. maritima* are two known host plant species, although other *Lomandra* species are potentially also used. Recent research suggests that Graceful Sun-moth may have a stronger association with *L. maritima* than previously thought (Bishop *et al.* 2010a). This discovery means additional habitat and populations of Graceful Sun-moth may be found in coastal vegetation where *L. maritima* is abundant. Within a given area of bushland, these host plants must occur in sufficient number and density to sustain a viable population. Figures for the minimum required number and density of host plants are yet to be determined.

1.3 PREVIOUS SURVEY RESULTS

The site and its surrounds were previously surveyed in 2010 by ELA for Graceful Sun-moth. This followed a desktop assessment by ELA for Graceful Sun-moth habitat to ascertain suitable areas for a targeted survey within the project area. This habitat assessment was based on a literature review of information on habitat preference and distribution from previous studies of Graceful Sun-moth, including *Lomandra* habitat mapping of the area by ATA Environmental in 2005. A map of potential habitat areas was produced to aid in determining transect locations for the survey.

In 2010, approximately 133 Graceful Sun-moths were recorded within the Lot 1003 site throughout the survey period (Figure 2). Graceful Sun-moth observations increased over the four search days. The fewest number of individuals were recorded on the first search day, and the highest number of moths observed were recorded on the last search day. Graceful Sun-moths were recorded over a range of weather conditions including zero cloud cover to 90% cloud cover, temperatures between 24°C and 38°C, and wind speeds between four and 35 km/h. Although moth activity was observed on cooler days, a higher number of moths were observed on warmer days when temperatures exceeded 34°C and cloud cover was on average 80%. The survey was undertaken over a period of ten days from the 2nd March to the 12th March 2010, with each search day evenly spaced throughout this time. A total length of approximately 20 km was traversed over the four survey days.

Most observations were within mapped *Lomandra* habitat but several sightings occurred on the edges or outside the predetermined preferred habitat (Figure 2). Based on the locations of majority of moths observed, the distribution within the site appeared to be relatively consistent with the occurrence of known suitable breeding habitat, specifically *Lomandra maritima*. No *L. hermaphrodita* was recorded within the site.

2 Survey methods

2.1 APPROACH AND OBJECTIVES

The Graceful Sun-moth survey methodology was developed in consideration of the DEC prescribed method (Bishop *et al.* 2010a). Due to the current relative paucity of ecological information on this species, the DEC method has been formulated to gather information on species distribution, abundance and habitat requirements. The method has also been developed to enable confident assessment of presence or absence of the Graceful Sun-moth within a given survey area on the Swan Coastal Plain.

Lead field ecologists undertook DEC Graceful Sun-moth training courses. All other field ecologists were given DEC approved training on the identification and survey methodology as per DEC's prescribed methods prior to undertaking field surveys. All field ecologists are familiar with diagnostic characteristics to accurately and confidently identify Graceful Sun-moths in the field.

2.1.1 Government Agency requirements

A Regulation 17 Licence to Take Fauna for Scientific Purposes under the *Wildlife Conservation Act 1950* is required to perform Graceful Sun-moth surveys, and was obtained from DEC (licence number SF007258). State Government Authorities including the Environmental Protection Authority (EPA) and the DEC provide guidance to consultants on the minimum standards required to achieve appropriate levels of fauna survey. To this end, the methodology used to carry out this survey has been done in close consultation with DEC Science Division Staff, and in accordance with specific DEC methodology requirements outlined in Appendix B (Bishop *et al.* 2010a).

The DEC are the principle authority for WA state fauna of conservation significance, therefore the Commonwealth Government may seek advice from the DEC in relation to the Federal Approvals process for the Graceful Sun-moth.

2.1.2 Transects

The survey method involved four repeated transect searches undertaken during optimum weather conditions for Graceful Sun-moth breeding activity throughout March and early April 2011. Each search followed a pre-determined transect based on the distribution and density of *Lomandra maritima* within the site. The transect location was also based on floristic composition, vegetation condition, disturbance, tracks and other clearings, topography, and fire history.

Based on breeding biology, this species is known to occupy coastal areas where one of the main plants required for breeding, *Lomandra maritima*, is present or abundant. Habitat mapping in the area was undertaken previously by ATA Environmental (2005) and refined by ELA in the field. This data enabled a transect path to be defined through areas mapped as having *L. maritima* as a dominant ground stratum species. The use of previous extensive vegetation mapping provided sufficient detail to plan the transect route, as per DEC requirements to use *Lomandra* density and abundance in choosing transect routes.

2.1.3 Survey effort

The survey effort required for the site was based on the DEC requirements for transect length depending on the size of the project area (Appendix B). The area of habitat mapped as dominated by *L. maritima* within the site is approximately 40 ha; accordingly the survey search transect length required was approximately 4.5 km. This length is considered adequate for the given habitat area,

therefore based on survey results, conclusions of presence or absence of the Graceful Sun-moth can be made with a high degree of confidence.

2.1.4 Timing and weather

The timing for searches was critical as it needed to coincide with the brief but seasonal breeding period in which the species is active and therefore visible. Outside this period, the Graceful Sun-moth is relatively undetectable. Accordingly the prescribed DEC methodology was taken into account and the survey was undertaken during the month of March and the beginning of April.

The four replicate transect searches were conducted on suitable, evenly spaced, separate days over the site. The four survey dates were the 9th, 15th, 22nd March, and the 1st April 2011. The searches were carried out based upon DEC method requirements for optimum weather conditions in terms of wind, sunlight, ambient temperature and time of day with all searches carried out between the hours of 10:00 and 15:00. Graceful Sun-moths may not fly if the weather is cool, overcast or windy (DEC 2011). Weather conditions were monitored at approximately half hour intervals.

2.1.5 Data collected

During each transect search the following data was recorded:

- GPS location of all Graceful Sun-moth specimens and time observed;
- Transect location via GPS track logger;
- Weather data including wind speed, ambient temperature, and cloud cover;
- Habitat data including vegetation community, and habitat disturbance history; and
- Topography.

2.1.6 DEC consultation

The Graceful Sun-moth survey required close liaison with DEC as per requirements of the prescribed survey methodology. Key field ecologists from ELA met with DEC officers prior to undertaking the surveys to discuss transects, vegetation mapping to be used and appropriate protocols. Liaison with DEC during the survey included obtaining advice on survey design, vegetation community and habitat preference for Graceful Sun-moth, and notification to DEC when Graceful Sun-moth specimens were recorded. It also involved the provision of data, moth specimens and plant samples to the Department, as per DEC licence conditions. This was done to aid current DEC research into the species distribution and genetic composition.

3 Survey results

3.1 GRACEFUL SUN-MOTH ACTIVITY

Graceful Sun-moths were recorded within the Lot 1003 site on all four search days. The number of individual moths recorded along the survey transects varied over the four search days; 80 individuals were observed on the first day while only one individual was recorded on the last day (Table 1). A total of 161 moths were observed within the site (Figure 1). Approximately 23 km of transect length was traversed over the four search days.

The locations of all moths recorded are presented in Figure 1 and can be compared to results from 2010 (Figure 2). The highest concentrations of moth activity was observed in and around *Lomandra* breeding habitat on the western side of the site. Graceful Sun-moths appeared to be present throughout most of the mapped breeding habitat identified within the site, and based on the location of individuals, the distribution of Graceful Sun-moths appears to be consistent with the occurrence of known suitable breeding habitat (Section 3.2).

Table 1: Number of Graceful Sun-moth individuals recorded on each search day within the site

SURVEY DATE	NUMBER OF GRACEFUL SUN-MOTHS
9/03/2011	80
15/03/2011	55
22/03/2011	25
1/04/2011	1
Total	161

3.2 HABITAT CHARACTERISTICS AND OBSERVATIONS

The site lies on the Quindalup Dunes, which are characterised by distinctly undulating topography of pale sandy dune ridges, swales and inter-dunal basins. The vegetation present is representative predominantly of the Quindalup vegetation complex, characterised by extensive areas with a low ground stratum dominated by *Lomandra maritima* (Figure 4). The site disturbance history is evident with extensive vehicular tracks and large cleared areas throughout, and variations in density and condition of *L. maritima*. Some areas, such as the vegetation west of Marmion Avenue, support patches of low open shrubs including *Xanthorrhoea*, *Hakea*, *Acacia* and *Melaleuca* species. No *L. hermaphrodita* was recorded within the site.

Approximately 40 ha out of the 517 ha of Lot 1003 was previously identified as potential Graceful Sun-moth habitat by ELA (desktop habitat mapping exercise) and by ATA Environmental (2005). Some slight inconsistencies in *Lomandra* habitat mapping was observed on site by ELA field staff during the course of the 2011 survey. In these instances, transects were altered slightly in order to maximise the amount

of potential Graceful Sun-moth habitat being traversed. A large number of moths were observed flying outside of the current mapped *Lomandra* habitat (Figure 1). Many of these observations were in areas of vegetation that had been extensively cleared or disturbed, but were adjacent to suitable *Lomandra* habitat. Walking through patches of unsuitable habitat within the site enabled field ecologists to confirm presence or absence of Graceful Sun-moths in areas where *L. maritima* was not observed, and to verify the findings of the literature review.

Within the site Graceful Sun-moths were consistently recorded in areas with low strata vegetation dominated by *Lomandra maritima* with little to no mid or upper strata. The highest densities of moths were found in the north west of the site in low strata vegetation dominated by *L. maritima* (Figure 1). The percentage ground cover for recorded Graceful Sun-moth locations was found to be variable, however most recorded locations had a high percentage ground cover of *L. maritima*, mixed with other less dominant low strata plants including *Xanthorrhoea*, *Melaleuca* and *Acacia* species.

Topographic data recorded indicates that moths were observed over a range of locations within the dune profile including mid and upper slopes, dune crests and saddles, but indicated a preference for upper slopes and dune ridges.

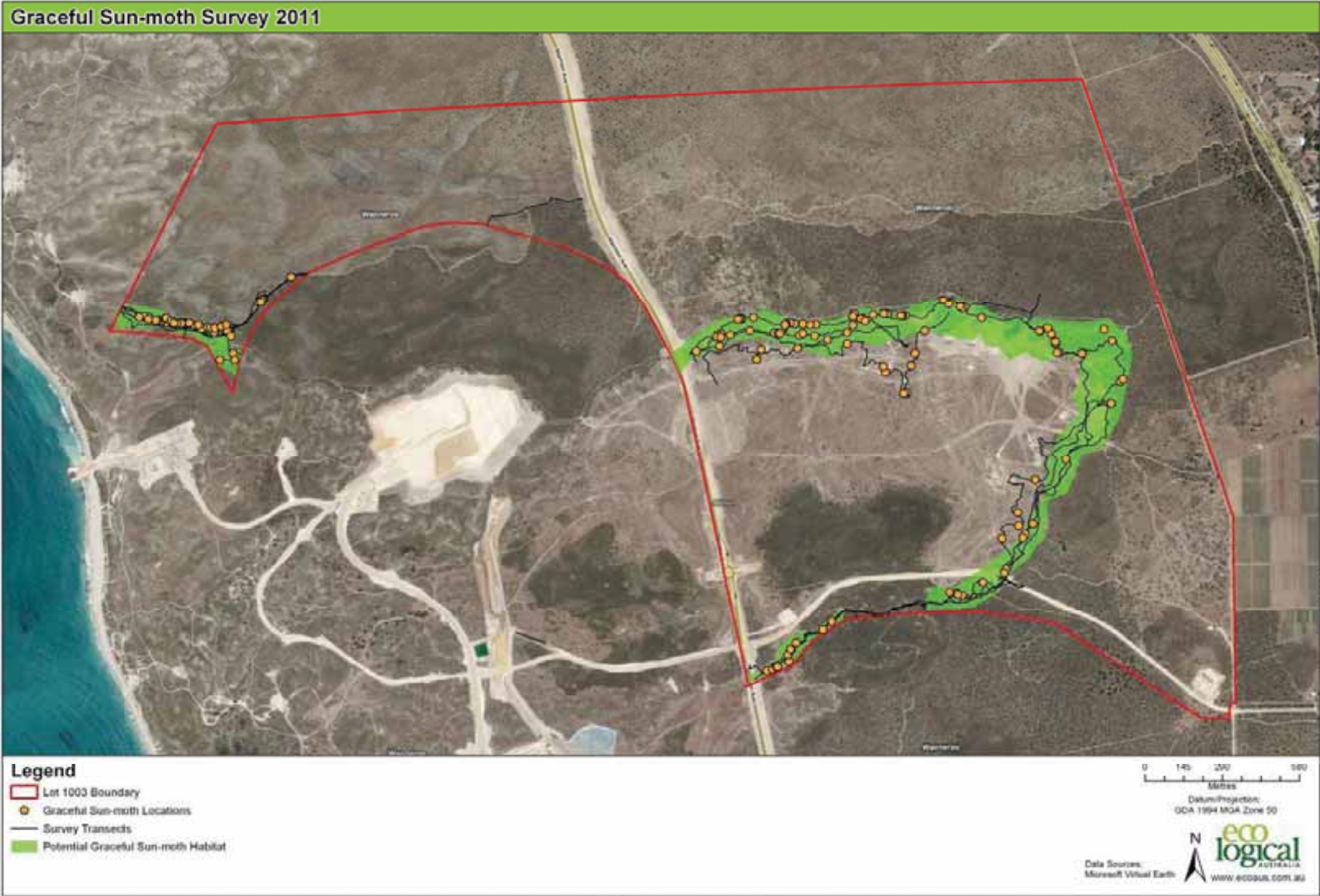


Figure 1: Mapped locations of all Graceful Sun-moths recorded and transects walked within the site in relation to *Lomandra maritima* habitat



Figure 2: Mapped locations of Graceful Sun-moths recorded in 2010 within the site in relation to potential habitat



Figure 3: Graceful Sun-moth captured within the site

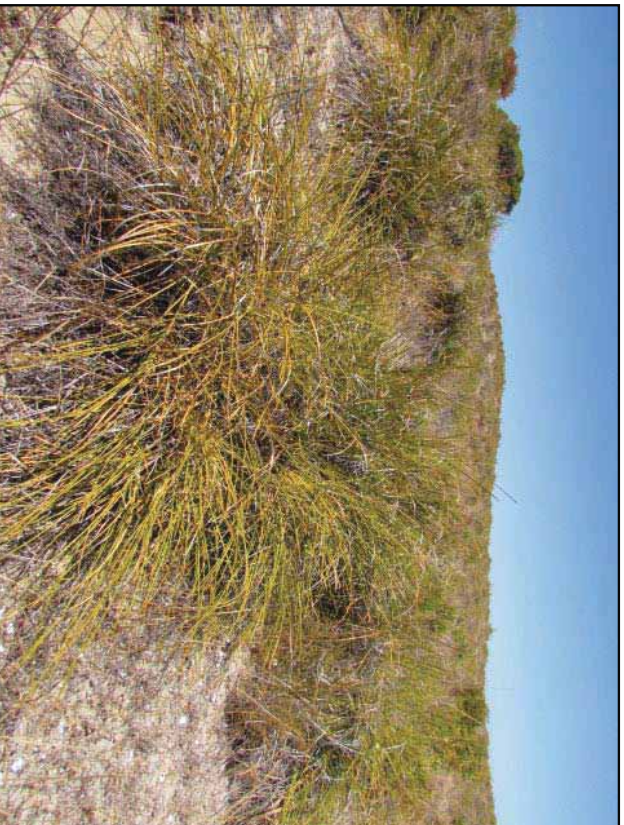


Figure 4: Observation site of a Graceful Sun-moth at Lot 1003, showing typical habitat within a dune saddle with a dominance of *Lomandra maritima* in the lower strata and some bare ground

3.3 WEATHER CONDITIONS

Weather data monitored during the four search days indicates that Graceful Sun-moths are active and detectable over a range of weather conditions in terms of wind speed and ambient temperature.

The range of wind conditions over which moths were recorded included very light sea breezes (4 km/h) to moderate breezes with gusts up to 23 km/h (Table 2). Cloud cover ranged from being zero to approximately 25% on the third search day. All four search days experienced ambient temperatures of over 30°C, ranging from a minimum of 27°C to a maximum of 36°C.

On the first search day when 80 moths were observed, the air temperature reached a maximum of 32°C and cloud cover was zero. Temperature dropped down to 27°C when the wind picked up to 23 km/h in the afternoon, however moths were still observed flying in these conditions.

On the second search day zero cloud cover was recorded, wind speeds fluctuated between 4.5 km/h to 20.5 km/h, and the temperature rose from 32°C to 36°C degrees throughout the day. A total of 55 individual moths were observed.

The third search day was the cloudiest of all four search days, with cloud cover varying between five and 25%. Air temperatures consistently stayed above 30°C and average wind speeds were quite low between 3.2 km/h and 9 km/h. A total of 25 moths were recorded.

On the last search day only one moth was observed within the site. Temperatures ranged between 30°C and 32°C, average wind speed was again quite low (4.5 – 8 km/h), and cloud cover was zero.

Table 2: Weather data monitored during each of the four search days

1st search: 9/03/2011						
Time	10:30	11:00	11:30	12:00	13:00	13:30
Av Wind Speed (km/h)	4	9	16.7	12	4.5	23
Air Temperature (°C)	31	32	28	28.6	28.6	27
Cloud Cover (%)	0	0	0	0	0	0
2nd search: 15/03/2011						
Time	10:30	11:00	11:30	12:30	14:00	15:00
Av Wind Speed (km/h)	20.5	10	10	4.5	6	8
Air Temperature (°C)	32	33	34	34	34	36
Cloud Cover (%)	0	0	0	0	0	0
3rd search: 22/03/2011						
Time	10:00	11:00	11:30	12:00	12:30	13:00
Av Wind Speed (km/h)	9	4	4.8	7.6	3.2	3.5
Air Temperature (°C)	33	33.5	34	32	31.4	31.5
Cloud Cover (%)	20	5	5	15	20	25
4th search: 1/04/2011						
Time	10:30	11:00	12:00	13:00		
Av Wind Speed (km/h)	8	8	6.3	4.5		
Air Temperature (°C)	32	31	30	30		
Cloud Cover (%)	0	0	0	0		

4 Discussion

4.1 GRACEFUL SUN-MOTH ACTIVITY

One hundred and sixty one Graceful Sun-moth observations were made within the Lot 1003 site over the March – April 2011 survey period. The number of individual moths recorded daily varied over the four survey days, with the highest number of individuals (80 moths) observed on the first search day in early March. Compared with results from the 2010 Graceful Sun-moth survey, a slightly higher number of individuals were recorded within the site in 2011. A total of 133 moths were recorded within the site in 2010 with the highest number of individuals recorded on the last search day on the 12th March 2010.

A distance of approximately 23 km was traversed over the course of the four search days in 2011. By comparison, in 2010 approximately 20 km was walked within the site during the four search days. The survey transect length in 2010 and 2011 was considered adequate to draw confident conclusions regarding the presence or absence of Graceful Sun-moths in potential suitable habitat within the site. Although transect lengths were similar in length over both survey years, the areas of suitable habitat that were traversed differed slightly. The patch of suitable breeding habitat identified in the north west corner of the site contained a great deal more individuals in 2011 than was recorded in 2010. The increase in numbers recorded in this area is likely due to the increase in level of survey effort in this patch of suitable breeding habitat in 2011 compared to 2010. In 2010 only a small portion of this area was surveyed due to time and staff constraints.

Peak Graceful Sun-moth activity for 2011 appeared to be the first two weeks of March, and in 2010 peak activity was also observed in the second week of March. The DEC recommends that surveys are conducted between late February and early April, based on previous surveys of Graceful Sun-moth activity and behaviour (Bishop *et al.* 2010b). Few studies have been carried out focusing on Graceful Sun-moth activity which means there is a lot of room for error in predicting when peak activity will occur, however based on current knowledge of the species' it appears that Graceful Sun-moth abundance is higher in the first half of the flying season and therefore it is likely that more moths will be detected during this period (Bishop *et al.* 2010a). Peak activity times can vary from year to year, however, can be anywhere between one to two weeks (Bishop *et al.* 2010a). In addition, species activity may be influenced by variations in weather and climatic conditions, which adds to the difficulty of predicting Graceful Sun-moth activity from year to year (Bishop *et al.* 2010a). Based on this year's observations, it would appear that peak Graceful Sun-moth activity in 2011 was consistent with DEC's findings, however due to the fact that the survey period in 2010 only lasted two weeks, it is difficult to determine when peak activity occurred in 2010.

Differences in Graceful Sun-moth individuals observed within the site between 2010 and 2011 could be accounted to the spacing of search days throughout the survey periods. In 2011, the four search days were placed on suitable, evenly spaced days over a period of four weeks. By comparison, in 2010 surveys were conducted within a much shorter timeframe, beginning on the 2nd of March and finishing on the 12th of March. Given that Graceful Sun-moths are estimated to live for between four to ten days (Bishop *et al.* 2010a), it is unlikely that the majority of individuals observed in 2011 would be recaptures from the week before. Instead, the number of moths observed in 2011 is likely to be an approximate representation of the abundance of moths at the site. It is possible that some individuals observed in 2010 were recaptures if less than five days had lapsed since the previous search day.

4.2 HABITAT CHARACTERISTICS AND OBSERVATIONS

Recorded locations of Graceful Sun-moth activity in 2011 were very similar to observations made during the 2010 survey but densities observed varied between the two survey years. In 2011, the highest densities of moths were found in the north west of the site in low strata vegetation dominated by *Lomandra maritima*, however in 2010 only three moths were observed in this area of habitat. A large number of moths were observed flying outside of the current mapped *Lomandra* habitat. Many of these observations were in areas of vegetation that had been extensively cleared or disturbed, however were adjacent to *L. maritima* habitat, which is consistent with DEC habitat data noting that Graceful Sun-moths are often associated with areas of disturbance (Bishop *et al.* 2010b).

Graceful Sun-moths were absent or in lower numbers in some areas of *L. maritima* on site, while occurring in higher numbers and density in others. The recorded locations of Graceful Sun-moths over the past two years indicate a habitat preference for dune ridges and upper slopes, with fewer moths observed within dune swales. A large proportion of moths were observed in more open areas of habitat, such as along vehicular and kangaroo tracks, which is consistent with the DEC's interim report findings (Bishop *et al.* 2010b).

4.3 WEATHER CONDITIONS

Weather conditions in both 2011 and 2010 were quite variable on each search day and over the survey periods. In 2011 wind speeds ranged from slight sea breezes to moderate easterly breezes of up to 23 km/h. In 2010 wind speeds were higher over the four search days than in 2011, the windiest day recording wind speeds of up to 35 km/h. In 2010 the highest numbers of moths were observed on the last search day, with a maximum wind speed of 14 km/h recorded. The largest number of individuals (80 moths) was observed on the first search day in 2011, with wind speeds reaching up to 23 km/h. In 2010, the least windy day was the last search day when the highest numbers of moths were observed flying. In 2011, the least windy day was also the last search day but only one moth was recorded. Findings from the DEC observed that less windy days were optimum for observing Graceful Sun-moths when compared to windy days (Bishop *et al.* 2010a, Bishop *et al.* 2010b). Windy conditions can cause constant movement of vegetation which can reduce the visibility of Graceful Sun-moth activity to a degree. Results from 2010 surveys are consistent with DEC's interim report findings, however based on wind speeds recorded in 2011, results are inconclusive as to whether wind had an effect on the number of Graceful Sun-moths observed within the Lot 1003 site.

All four search days in 2011 experienced warm, sunny conditions of over 30°C, the agreed optimum temperature for Graceful Sun-moth detection. The ambient air temperature recorded during the four search days did not appear to influence Graceful Sun-moth activity, as observations ranged from one moth to 80 moths on any one search day. In 2010, air temperatures only exceeded 30°C on the third and fourth search days, with almost 75% of Graceful Sun-moth records for the site being made on these last two days. Based on previous studies, the DEC found that warm sunny days were optimum for observing Graceful Sun-moth activity (Bishop *et al.* 2010b, DEC 2011), which is now a pre-requisite for choosing appropriate survey times and is reflected in the DEC methodology (Bishop *et al.* 2010a). Based on ELA's findings in 2011, it is unclear if ambient air temperatures affected the number of Graceful Sun-moths observed within Lot 1003. However, it would appear that temperature was a contributing factor to the number of Graceful Sun-moth observations made in 2010.

Cloud cover was nonexistent on three of the four search days in 2011. On the third search day, a maximum of 25% cloud cover was recorded and 25 moths were observed. Interestingly, in 2010 the highest number of moths was recorded on the fourth search day when cloud cover was on average 80%, the highest level of cloud cover recorded during the 2010 survey period. DEC methodology

recommends that Graceful Sun-moth surveys be conducted on cloudless days in order to observe a maximum number of moths flying (Bishop *et al.* 2010a). Based on the fact that no cloud cover was recorded on three out of four search days, and that cloud cover was insignificant on the third search day during the 2011 surveys, it is difficult to tell if cloud cover influenced Graceful Sun-moth activity at the site in 2011.

5 Conclusions

Graceful Sun-moth surveys of Lot 1003 over 2010 and 2011 indicate that Graceful Sun-moths are active over most of the 40 ha that has been identified as suitable Graceful Sun-moth habitat within the site (Figure 1 and Figure 2). Graceful Sun-moths occur in large, dense populations throughout the suitable habitat identified at Lot 1003. Edge effects should be considered in areas of key Graceful Sun-moth habitat.

The completion of two consecutive years of surveys on site provides a comprehensive basis for assessing the potential local impact of development of Lot 1003, and the potential value of areas of habitat to be retained in POS and ROS, to support a referral under the EPBC Act.

6 References

ATA Environmental. 2005. *Metropolitan Regional Scheme Amendments 1029/33*. Alkimos Eglinton Flora, Vegetation and Fauna Baseline Information. Unpublished Report for LandCorp, Eglinton Estates and WR Carpenter.

Bureau of Meteorology (BOM). 2011. *Summary Statistics Monthly Rainfall - Tamala Park Research Station*. Bureau of Meteorology, Perth, Western Australia. <http://www.bom.gov.au/index.shtml> [Accessed 1 April 2011].

Bishop, C., Williams, M., Mitchell, D., and Gamblin, T. 2010a. *Survey Guidelines for the Graceful Sun-moth (*Synemon gratiosa*) & Site Habitat Assessments*. Version 1.2, Department of Environment and Conservation, Western Australia.

Bishop, C., Williams, M., Mitchell, D., Williams, A., Fissioli, J. and Gamblin, T. 2010b. *Conservation of the Graceful Sun-moth (*Synemon gratiosa*) Interim Report*. Department of Environment and Conservation, Western Australia.

Department of Environment and Conservation (DEC). 2011. *Conservation Advice for *Synemon gratiosa* (Graceful Sun-moth) – January 2011*. Department of Environment and Conservation, Western Australia.

Douglas, F. & Marriott, P. 2003. *Some notes on the sun-moths, Lepidoptera: Castniidae*. Victorian Entomologist **33**: 90-97.

Appendix A: Fauna conservation status categories

State and Federal categories used in the assessment conservation status. IUCN categories (based on review by Mace and Stuart 1994) as used for the Environmental Protection and Biodiversity Conservation (EPBC) Act and the WA Wildlife Conservation Act.

<p>Extinct. Taxa not definitely located in the wild during the past 50 years.</p> <p>Extinct in the Wild. Taxa known to survive only in captivity.</p> <p>Critically Endangered. Taxa facing an extremely high risk of extinction in the wild in the immediate future.</p> <p>Endangered. Taxa facing a very high risk of extinction in the wild in the near future.</p> <p>Vulnerable. Taxa facing a high risk of extinction in the wild in the medium-term future.</p> <p>Near Threatened. Taxa that risk becoming Vulnerable in the wild.</p> <p>Conservation Dependent. Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classed as Vulnerable or more severely threatened.</p> <p>Data Deficient (Insufficiently Known). Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.</p> <p>Least Concern. Taxa that are not Threatened.</p>
--

Schedules used in the WA Wildlife Conservation Act.

<p>Schedule 1. Rare and Likely to become Extinct.</p> <p>Schedule 2. Extinct.</p> <p>Schedule 3. Migratory species listed under international treaties.</p> <p>Schedule 4. Other Specially Protected Fauna.</p>

WA Department of Environment and Conservation Priority species (species not listed under the Wildlife Conservation Act, but for which there is some concern).

<p>Priority 1. Taxa with few, poorly known populations on threatened lands.</p> <p>Priority 2. Taxa with few, poorly known populations on conservation lands; or taxa with several, poorly known populations not on conservation lands.</p> <p>Priority 3. Taxa with several, poorly known populations, some on conservation lands.</p> <p>Priority 4. Taxa in need of monitoring. Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change.</p> <p>Priority 5. Taxa in need of monitoring. Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years (IUCN Conservation Dependent).</p>

Appendix B: DEC prescribed methodology for the survey of Graceful Sun-moth

Table 1: Fraction of site to be sampled and transect lengths required based on site area to satisfy Graceful Sun-moth survey methodology

SITE AREA	SAMPLING FRACTION	TRANSECT LENGTH
5ha or less	30 – 70%	0.7 – 1.6 km
6 – 10 ha	20 – 30%	1.7 – 2.2 km
11 – 20 ha	15 – 20%	2.3 – 3.1 km
21 – 50 ha	10 – 15%	3.2 – 5.0 km
51 – 100 ha	7 – 10%	5.0 – 7.0 km
101 – 200 ha	5 – 7%	7.0 – 10.0 km
201 ha or more	5%	10 km

Source: Bishop *et al.* 2010a



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HUNTER

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Newcastle NSW 2300
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Narooma NSW 2546
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F 02 4476 1161

COFFS HARBOUR

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Coffs Harbour Jetty NSW 2450
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F 02 6651 6890

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F 02 6772 1279

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WESTERN AUSTRALIA

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West Perth WA 6005
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F 08 9324 3538

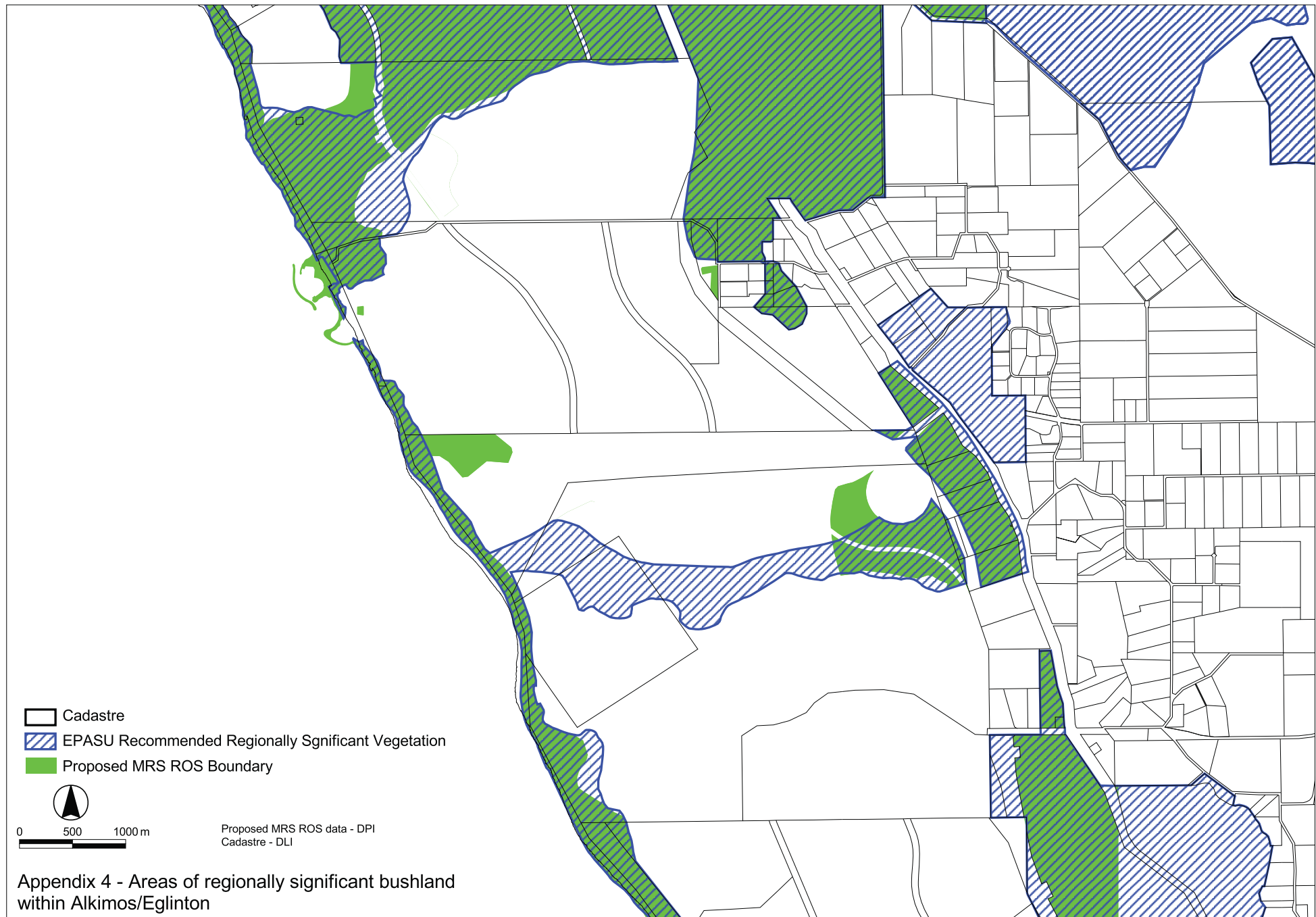
APPENDIX C



REGIONALLY SIGNIFICANT BUSHLAND WITHIN THE ALKIMOS EGLINTON AREA

Appendix 4

Areas of regionally significant bushland within Alkimos - Eglinton



Appendix 4 - Areas of regionally significant bushland within Alkimos/Eglinton

APPENDIX D



BUSHFIRE MANAGEMENT PLAN

Central Alkimos

Don Spriggons, Forestry Consultants 2012

Bushfire Management Plan

Central Alkimos

Prepared by Don Spriggins Forestry Consultants

December 2012

1. Introduction

1.1 *The purpose of this plan*

This Bushfire Management Plan sets out the background, principles and general commitments for bushfire management at the proposed residential and commercial development known as Alkimos City Centre and Central Alkimos (“the property”) by LandCorp Lend Lease (“the developer”).

The purpose of this plan is to provide supporting information for the approval of the Local Structure Plan for the property.

The plan is prepared by Roger Underwood of York Gum Services, working for Don Spriggins Forestry Consultants (“The Principal Consultant”).

1.2 *General description of the site and its local context*

The property subject of this management plan has an area of approximately 487 hectares.

The property adjoins land to the north, which is being developed for urban purposes. The land to the east is vacant but is reserved for a Water Corporation groundwater treatment plant and Mitchell Freeway extension. The land on the eastern side of Marmion Avenue is currently vacant but is the site of the Alkimos Secondary Centre. The foreshore reserve and Indian Ocean is located to the west of the site

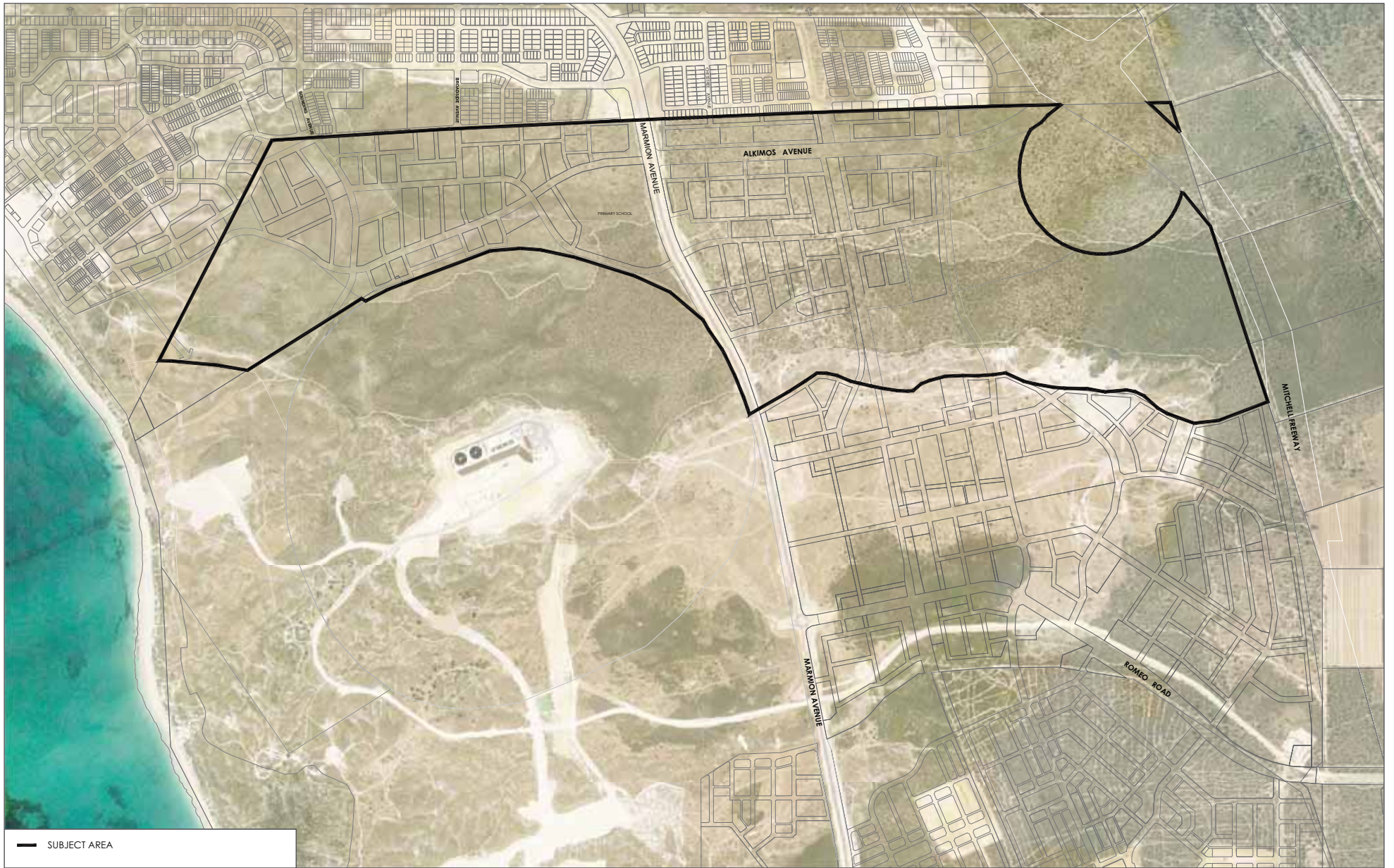
A proposed railway will also bisect the area running south/north parallel to Marmion Ave with a train station located within the City Centre.

The general geography of the area is shown in Figure 1.

1.3 *Bushfire significance*

The native vegetation on the property will be completely cleared before development, with the exception of the Regional Open Space area, which traverses the site in an east-west direction.

The most significant bushfire features is the strip of Regional Open Space (ROS) which runs from west-east through the middle of the development, which is to be managed for conservation and the buffer zone around the Alkimos Waste Water Treatment Plant. These areas carry coastal shrubland, balgas and



— SUBJECT AREA

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C	CITY CENTRE	121129	SJ	DD
REV	DESCRIPTION	YYMMDD	DRAWN	APPRVD

CLIENT
LEND LEASE
PROJECT
CENTRAL & CITY

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 INTENT ONLY. ALL AREAS AND
 DIMENSIONS ARE SUBJECT TO
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FIGURE 1 - Location Plan
Alkimos Central
City of Wanneroo

0 metres 100 200 300 400 500
 SCALE 1:10,000 SHEET A3

REFERENCE NUMBER	DRAWING NUMBER	ISSUE
DLL CEN	RD1 009	A

scattered eucalypt trees and grass. This bushland is flammable and if left long unburnt will carry a severe fire.

The climate of the region is conducive to bushfire occurrence and spread every summer. There are strong winds most summer days, especially from the west and south-west in the afternoon. Strong northerly winds occur on occasions during every summer, associated with the inland movement of low pressure troughs.

Bushfires have occurred in the area in the past, lit by lightning, accident or arsonists, and are certain to occur in the future.

Residential and commercial development of this area must be based on the assumption that bushfires will occur on and near the site in the future and that their impact on key values of the property must be minimised.

1.4 The proposed development

A Local Structure Plan has been prepared for the property to facilitate:

- Approximately 2429 dwellings;
- A neighbourhood centre;
- A Secondary School and Primary School;
- All lots will be serviced by sealed roads.

2. Principles underpinning bushfire management at the site

The developer has adopted the following principles to underpin bushfire management at this site:

- Bushfire threats will be identified in advance of development;
- Development planning will be undertaken in the light of an understanding of bushfire threats to human, economic and environmental values.
- A checklist will be provided showing compliance with the requirements set out in *Planning for Bushfire Protection Guidelines* –see appendix to this Management Plan.

The developer recognises that the following values will be potentially threatened by bushfires at this site:

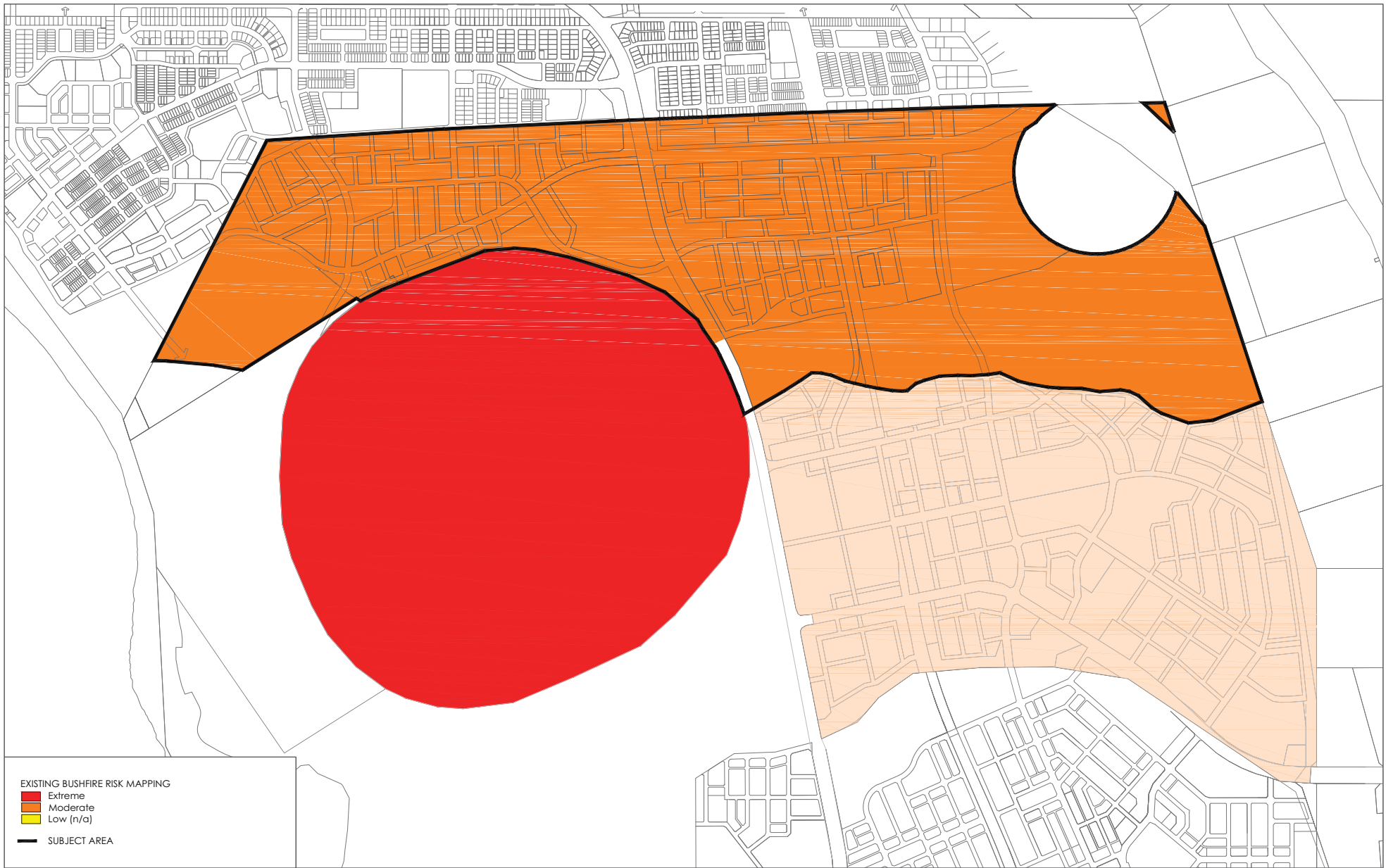
- **Human lives:** Approximately 1200 people could be resident on the site
- **Assets:** The development will contain houses, sheds, equipment, house contents and equipment and commercial premises.
- **Environmental values:** The site will have retained remnant bushland on the sand dunes system running through the property.

3. Bushfire Hazard Assessment

Sections of the property on which development will occur will be fully cleared of native bushland and therefore will have a zero bushfire hazard when the project commences. The parabolic sand dune system on which vegetation will be retained is assessed as having a Moderate bushfire hazard assessment.

The designated ROS is assessed as having a Moderate bushfire hazard.

The large buffer zone surrounding the Alkimos Waste Water Treatment Plant is vested with the Water Corporation. A separate environmental and bushfire management plan has been prepared by Water



EXISTING BUSHFIRE RISK MAPPING

- Extreme
- Moderate
- Low (n/a)

— SUBJECT AREA

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C ALKIMOS CENTRAL 121128 SJ DD
REV DESCRIPTION YMMDDDRAWN APPRVD

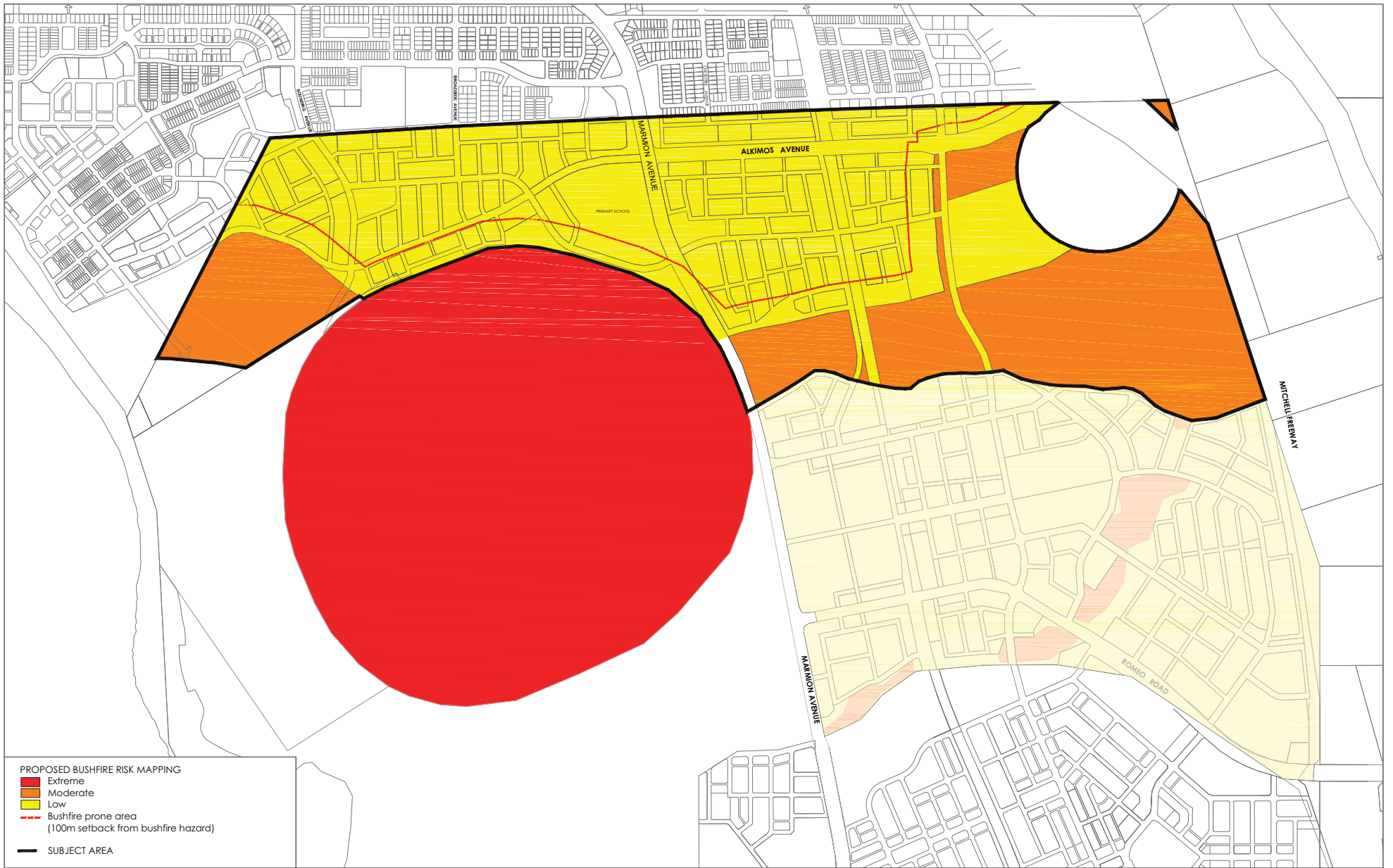
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**FIGURE 2 - Fire Management Risk Pre - Subdivision
Alkimos Central
City of Wanneroo**

0 metres 100 200 300 400 500
SCALE 1:10,000 SHEET A3

REFERENCE NUMBER DRAWING NUMBER ISSUE
DLL CEN RD1 009 A



PROPOSED BUSHFIRE RISK MAPPING

- Extreme
- Moderate
- Low
- Bushfire prone area (100m setback from bushfire hazard)
- SUBJECT AREA

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A ALKIMOS CENTRAL 121128 SJ DD
REV DESCRIPTION YYMMDD DRAWN APPROV

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FIGURE 3 - Fire Management Risk Post - Subdivision Alkimos Central City of Wanneroo

0 100 200 300 400 500
SCALE 1:10,000 SHEET A3

REFERENCE NUMBER
DRAWING NUMBER
ISSUE

DLL CEN RD1 009 A

Corporation for this area which, if implemented will minimise the risk of fires starting in the buffer zone and spreading into surrounding suburbia. This area is assessed as having an Extreme bushfire hazard.

Climatic/weather conditions at the site will be conducive for a bushfire during most days in summer, and autumn, with high temperatures and strong winds. The most serious fire winds will be the strong northeasterly and northwesterly winds, which occur during unstable atmospheric conditions every summer, and the strong westerly “sea-breezes” common on most summer afternoons.

The property gently undulates (>10 degrees).

Conclusion: *Following development the bulk of the property will not carry a running fire. Vegetation on the dune system or the retained bushland corridor will burn, and other areas will be vulnerable to ember attack from fires in adjoining bushland. Bushfires have occurred in this region in the past and will undoubtedly occur in the future.*

4. Bushfire attack level (BAL)

All lots within 100 metres are assessed according to Table 2.4.3 of AS 3959-2009.

- The vegetation in this area is classified as “scrub”;
- Lots adjoining bushland will be level with or downhill of retained bushland;
- A BAL of 19 is prescribed for all lots setback from bushland between 13 and 19 metres from retained bushland;
- A BAL of 12.5 is prescribed for all lots between 19 and 100 metres of retained bushland.

5. Fire detection and attack capability in the area

Rapid bushfire detection can be expected at this site due to the high resident and neighbouring populations, high vehicular use of Marmion Avenue and the freeway.

Firefighters will be available from the local Bush Fire Brigade and DEC. It is expected that a uniformed FESA fire brigade will be established in the area following progressive urban development along Marmion Avenue currently underway.

6. Measures to minimise the fire threat at the site

The developer undertakes to consider, and if practical to incorporate the following bushfire management measures at this site.

6.1 Compliance with planning requirements

This Bushfire Management Plan is based on the City of Wanneroo’s specification D10 “Bushfire Protection”, Part 3 of the City’s “Bushfire Protection Requirements for Subdivision and Development”, and the WAPC/FESA’s “Planning for Bushfire Protection Guidelines”.

6.2 Protection of human lives and property

The following measures will be adopted to protect, as far as is possible, the lives of residents and their assets from bushfire damage in this development:

(i) BAL 19

For all lots identified as having a BAL of 19 (shown on Figure 4), a notification in the form of a section 70A notification, pursuant to the Transfer of Land Act 1893 (as amended) is to be placed on the Certificates of Title.

The notification will advise of the existence of this Bushfire Management Plan and will require: (i) the dwelling on the lot to be 13 metres from the edge of the bushland; and (ii) houses constructed on these lots must comply with Section 3 and 6 of Australian Standards AS 3959-2009 (“Construction of Houses in Bushfire-prone Areas”).

(ii) BAL 12.5

For all lots identified as having a BAL of 12.5 (shown on Figure 4), a notification in the form of a section 70A notification, pursuant to the Transfer of Land Act 1893 (as amended) is to be placed on the Certificates of Title.

The notification will advise of the existence of this Bushfire Management Plan and will require houses constructed on these lots to comply with Section 3 and 5 of Australian Standards AS 3959-2009 (“Construction of Houses in Bushfire-prone Areas”).

- (iii) In addition to the requirements identified Sections 3, 5 and 6 of AS 3959-2009 the developer will advise all lot owners for lots that are located within 100 metres of retained bushland or the Alkimos Wastewater Treatment Site Buffer, that houses on these lots should have enclosed eaves and no gaps between rafters; that rotary roof ventilators be fitted with metal gauze spark screens with a maximum aperture size of 1.8 mm; and roof-mounted evaporative air conditioners have the openings to the cooling unit fitted with metal gauze spark guards.
- (iv) The developer will provide a copy of the Bushfire Management Plan and a copy of the document “Homeowners Bushfire Survival Manual Guidelines” to each initial lot purchaser for the lots adjacent to bushland.

6.3 Hazard management

The developer will fully clear all lots in advance of development, and undertakes to control weeds or regrowth on unsold lots during the development phase.

6.4 Access and egress

There will be high quality access/egress on sealed roads provided to every lot, thus permitting two-way movement of vehicles in an emergency, and rapid ingress for fire appliances. Every lot owner will have egress on sealed roads to Marmion Avenue, the freeway and Wanneroo Road, and linkages to the Trinity suburb to the south.

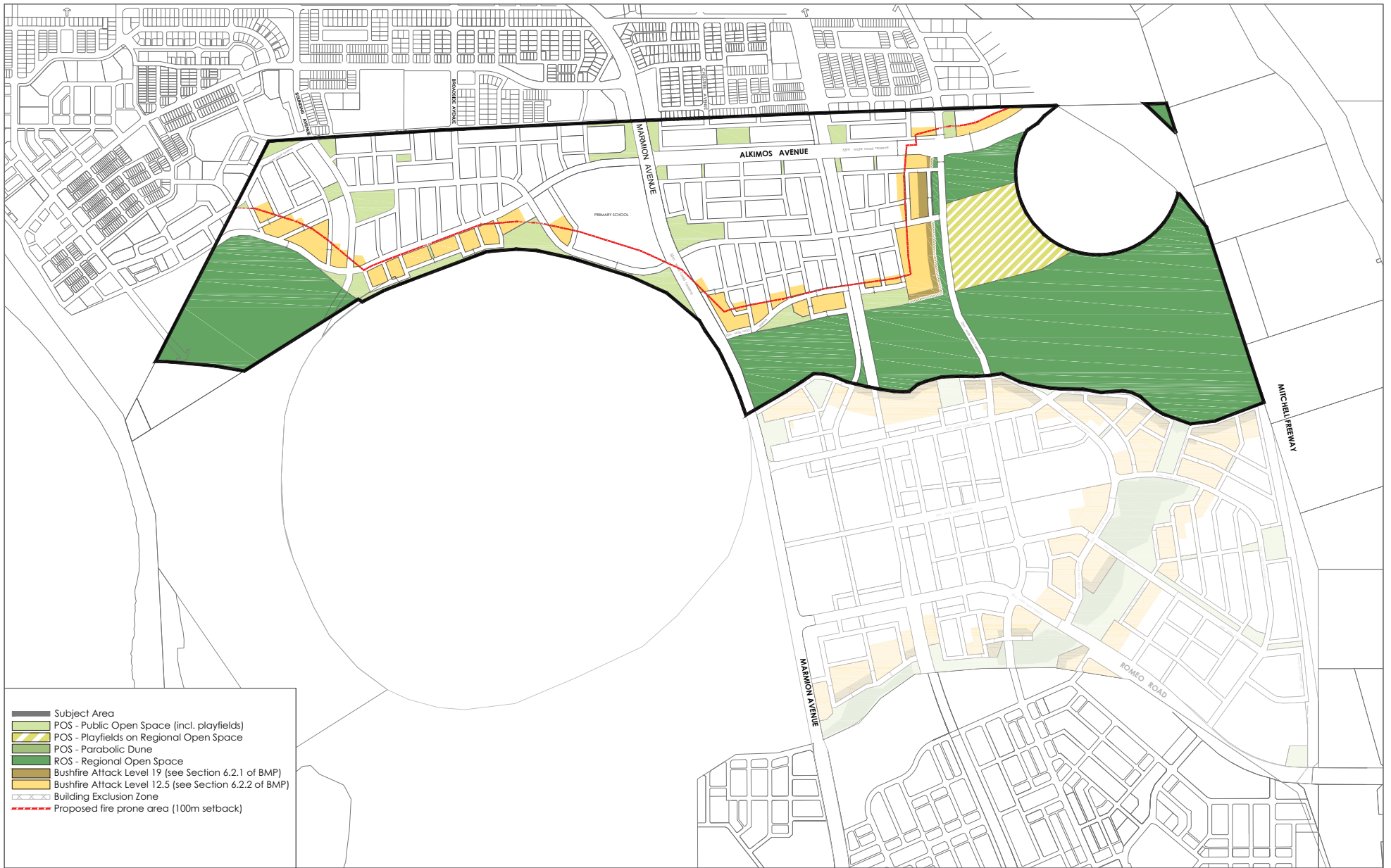
6.5 Firebreaks










There will be a sealed road separating lots from retained bushland.

6.6 Water supply

Reticulated scheme water will be available to every lot on the site.

Fire hydrants meeting FESA specifications will be installed every 200 m along the internal road system, and designated by standard markings.



-  Subject Area
-  POS - Public Open Space (incl. playfields)
-  POS - Playfields on Regional Open Space
-  POS - Parabolic Dune
-  ROS - Regional Open Space
-  Bushfire Attack Level 19 (see Section 6.2.1 of BMP)
-  Bushfire Attack Level 12.5 (see Section 6.2.2 of BMP)
-  Building Exclusion Zone
-  Proposed fire prone area (100m setback)



6.7 Power supply

The developer will arrange for all lots to be supplied with electric power. All powerlines within the site will be underground.

6.8 Fire refuge area

The developer will designate the primary school football oval (an open irrigated grass area) as a “fire refuge area”, and will erect signs to this effect within the development area. Lot owners will be advised that in the event of a large, regional bushfire impacting on the site, they should gather at the fire refuge site, where it will be possible to activate the sprinkler system, thus providing a high degree of safety.

6.9 Fire protection during stages of development

As development proceeds, the developer will ensure each completed development sector is protected from fires running through yet-to-be-developed bushland on the site. This will be done by periodic winter burning of bushland to reduce bushfire fuels or by slashing/mowing grassy fuels.

6.10 Home Owners Association/Bushfire Ready Group

The developer will recommend to residents that they form, and will assist in the setting up of a “Bushfire Ready Group”. This will comprise residents who will:

- Promote high standards of bushfire preparedness at the site, including implementation of the Bushfire Management Plan; and
- Liaise with the Water Corporation to ensure Water Corporation maintains a responsible program of bushfire management on the bushland of the buffer to the Alkimos Water Treatment Plant.

7. Disclaimer

The Consultant preparing this Preliminary Bushfire Management Plan takes no responsibility for the impacts of a future bushfire on any values at the Alkimos-City Centre residential subdivision. He has done his best in this strategy to alert residents to the threat of bushfires, and to suggest measures to minimise these threats and potential bushfire damage, but there may occur an unusual combination of events or human actions or lack of actions which could not reasonably have been expected at the time of preparing the Plan. The Consultant takes no responsibility for the standard of bushfire preparedness or damage mitigation undertaken by lot owners in the future

Appendix

Compliance checklist for performance criteria and acceptable solutions for bushfire management at Alkimos City Central

Based on Appendix 4 from *Planning for Bushfire Protection*

Element 1: Location

Does the proposal comply with the performance criteria by applying acceptable solution A1.1?

Yes The land on which houses will be constructed will be fully cleared of vegetation and replaced by houses and urban gardens, schools or commercial developments. A small proportion of the area will be bushland retained on the dune system and in regional open space within the property.

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P1 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Element 2: Vehicular access

Does the proposal comply with the performance criteria by applying acceptable solution A2.1?

Yes There will be multiple points of access and egress on fully engineered surfaced roads

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A2.2?

Yes **Not applicable**

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A2.3?

Yes **Not applicable**

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A2.4?

Yes **Not applicable**

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A2.5?

Yes **Not applicable**

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A2.6?

Yes **Not applicable**

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A2.7?

Yes **Not applicable**

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A2.8?

Yes **Not applicable**

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A2.9?

Yes **Not applicable**

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A2.10?

Yes **Not applicable**

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Element 3: Water

Does the proposal comply with the performance criteria by applying acceptable solution A3.1?

Yes **The development will be fully serviced with reticulated pressurised water**

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P3 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A3.2?

Yes **Not applicable**

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P3 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A3.3?

Yes **Not applicable**

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P3 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Element 4: Siting of development

Does the proposal comply with the performance criteria by applying acceptable solution A4.1?

No There will be no dwellings on lots on which the native bushland is retained. Some dwellings will be within 100 m of the bushland on the water treatment areas, and appropriate specifications are prescribed for these areas.

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P4 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A4.2?

As no bushland will be retained on the lots, no building protection zones will be required

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P4 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A4.3?

Yes BPZ and hazard reduction zones are not required

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P4 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Note: Please indicate the extent of the building protection zone on the plans submitted.

Does the proposal comply with the performance criteria by applying acceptable solution A4.4?

Not Applicable.

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P4 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Note: Please indicate the extent of the hazard separation zone on the plans.

Does the proposal comply with the performance criteria by applying acceptable solution A4.5?

Yes Not applicable

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P4 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Note: Please provide details of the proposed shielding to be implemented as part of the development.

Element 5: Design of development

Does the proposal comply with the performance criteria by applying acceptable solution A5.1?

Yes **The design is compliant with Elements 1-4.**

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P5 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A5.2?

Yes **Not applicable**

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P5 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Applicant Declaration

I declare that the information provided is true and correct to the best of my knowledge.

Full name: **Roger John Underwood**

Applicant signature:

A handwritten signature in blue ink that reads "Roger John Underwood". The signature is written in a cursive style with a large initial 'R'.

Date: November 15th 2012

APPENDIX E



ACOUSTIC ASSESSMENT

Acoustic Assessment Alkimos Central and Regional Centre Residential Development
Lend Lease 2012

Rochdale Holdings Pty Ltd A.B.N. 85 009 049 067 trading as:

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LEND LEASE

ALKIMOS CENTRAL and REGIONAL CENTRE RESIDENTIAL DEVELOPMENT

ACOUSTIC ASSESSMENT

JULY 2012

OUR REFERENCE: 14882-2-12067



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**ACOUSTIC ASSESSMENT
ALKIMOS**

Job No: 12067

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FOR

LEND LEASE

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C	Rail $L_{Aeq(16hr)}$ Noise Contours
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1. INTRODUCTION

Herring Storer Acoustics was commissioned by Lend Lease to undertake an acoustic study relating to the noise that would be received at proposed residences within the Alkimos Central and Alkimos Regional Centre proposed residential developments. As part of the study, the following was carried out:

- Determine by noise modelling the noise that would be received at residences within the development from vehicles travelling on the future extensions of Marmion Avenue and Mitchell Freeway.
- Determine by noise modelling the noise that would be received at residences within the development from trains travelling on the extension of the Northern Suburbs passenger railway line.
- Assess the predicted noise levels for compliance with the appropriate criteria.
- If exceedances are predicted, comment on possible noise amelioration options for compliance with the appropriate criteria.

For information, a locality plan is attached in Appendix A.

2. SUMMARY

Under the Western Australian Planning Commission (WAPC) Planning Policy 5.4 *“Road and Rail Transport Noise and Freight Considerations in Land Use Planning”* (SPP5.4), we believe that the appropriate criteria for assessment for this development are as listed below for “Noise Limits”.

EXTERNAL

$L_{Aeq(Day)}$ of 60 dB(A);
and
 $L_{Aeq(Night)}$ of 55 dB(A).

INTERNAL

$L_{Aeq(Day)}$ of 40 dB(A) in living and work areas;
and
 $L_{Aeq(Night)}$ of 35 dB(A) in bedrooms.

Firstly, we note that the noise modelling indicates that noise received at the closest residence to the extension of the Northern Suburbs Passenger Railway Line would comply with the above criteria. However, as the noise received at the first row of residence would exceed the “Noise Targets” as outlined in the policy. Therefore, Notification on Titles is required for those residential lots located adjacent to the Railway Line.

With regards to the Freeway, the noise modelling indicates that noise received at the closest residences located adjacent to the Freeway would, for the majority of locations, comply with the “Noise Limits” and in the majority of location also comply with the “Noise Target”. Based on the results of the modelling the residence requiring “Quiet House” design and Notification on Titles are shown on Figure E1 attached in Appendix E.

The results of the acoustic assessment indicate that noise received at the ground floor level of residences located adjacent to Marmion Avenue could exceed the above acoustic criteria, with the level of exceedence in the worst case location being 8 dB(A). Thus for these residences, noise received at residences would exceed the “Noise Limits” criteria and notifications on Titles and a “Quiet House” design would be required for at least the first row of residence.

For residences located adjacent to Marmion Avenue, we do not believe that for the entire length of the development it would be practicable or desirable to construct noise barriers at the edge of the Marmion Avenue road reserve. This will be addressed at the detailed design stage at subdivision level. Potential solutions to the noise constraints along Marmion Avenue include:

1. Where lots back on to Marmion Avenue, the construction of a 2.2 metre barrier wall is recommended. Locations are shown on Figure D1 attached in Appendix D. However this will be resolved at the detailed design stage.
2. Where possible, minor access streets be located between these roads and residential premises. This then allows the front of the residence to face the major roads and ensuring that the residence themselves provide a barrier to an outdoor living area located at the rear of the residence. Noise received at the outdoor living areas would then comply with the "Noise Target" as required under SPP5.4.

The design requirements in accordance with "Quiet House" design will be determined at subdivision level based on the outcomes of the detailed design.

Information regarding "Quiet House" design Packages, as outlined in the Implementation Guidelines, is contained in Appendix E.

For the first row of residences adjacent to Marmion Avenue, notification of vehicle noise is to be stated on the Titles.

3. CRITERIA

The Western Australian Planning Commission (WAPC) released on 22 September 2009 State Planning Policy 5.4 "Road and Rail Transport Noise and Freight Considerations In Land Use Planning" (SPP 5.4). Section 5.3 – Noise Criteria, outlines the acoustic criteria and states:

"5.3 - NOISE CRITERIA

Table 1 sets out the outdoor noise criteria that apply to proposals for new noise-sensitive development or new major roads and railways assessed under this policy.

These criteria do not apply to—

- *proposals for redevelopment of existing major roads or railways, which are dealt with by a separate approach as described in section 5.4.1; and*
- *proposals for new freight handling facilities, for which a separate approach is described in section 5.4.2.*
- *The outdoor noise criteria set out in Table 1 apply to the emission of road and rail transport noise as received at a noise-sensitive land use. These noise levels apply at the following locations—*
 - *for new road or rail infrastructure proposals, at 1m from the most exposed, habitable façade of the building receiving the noise, at ground floor level only; and*
 - *for new noise-sensitive development proposals, at 1m from the most exposed, habitable façade of the proposed building, at each floor level, and within at least one outdoor living area on each residential lot.*

Further information is provided in the guidelines.

Table 1: Outdoor Noise Criteria

Time of day	Noise Target	Noise Limit
Day (6 am–10 pm)	$L_{Aeq(Day)} = 55 \text{ dB(A)}$	$L_{Aeq(Day)} = 60 \text{ dB(A)}$
Night (10 pm–6 am)	$L_{Aeq(Night)} = 50 \text{ dB(A)}$	$L_{Aeq(Night)} = 55 \text{ dB(A)}$

The 5 dB difference between the outdoor noise target and the outdoor noise limit, as prescribed in Table 1, represents an acceptable margin for compliance. In most situations in which either the noise-sensitive land use or the major road or railway already exists, it should be practicable to achieve outdoor noise levels within this acceptable margin. In relation to greenfield sites, however, there is an expectation that the design of the proposal will be consistent with the target ultimately being achieved.

Because the range of noise amelioration measures available for implementation is dependent upon the type of proposal being considered, the application of the noise criteria will vary slightly for each different type. Policy interpretation of the criteria for each type of proposal is outlined in sections 5.3.1 and 5.3.2.

The noise criteria were developed after consideration of road and rail transport noise criteria in Australia and overseas, and after a series of case studies to assess whether the levels were practicable. The noise criteria take into account the considerable body of research into the effects of noise on humans, particularly community annoyance, sleep disturbance, long-term effects on cardiovascular health, effects on children’s learning performance, and impacts on vulnerable groups such as children and the elderly. Reference is made to the World Health Organization (WHO) recommendations for noise policies in their publications on community noise and the Night Noise Guidelines for Europe. See the policy guidelines for suggested further reading.

5.3.1 Interpretation and application for noise-sensitive development proposals

In the application of these outdoor noise criteria to new noise-sensitive developments, the objective of this policy is to achieve –

- acceptable indoor noise levels in noise-sensitive areas (for example, bedrooms and living rooms of houses, and school classrooms); and
- a reasonable degree of acoustic amenity in at least one outdoor living area on each residential lot¹.

If a noise-sensitive development takes place in an area where outdoor noise levels will meet the noise target, no further measures are required under this policy.

In areas where the noise target is likely to be exceeded, but noise levels are likely to be within the 5dB margin, mitigation measures should be implemented by the developer with a view to achieving the target levels in a least one outdoor living area on each residential lot¹. Where indoor spaces are planned to be facing any outdoor area in the margin, noise mitigation measures should be implemented to achieve acceptable indoor noise levels in those spaces. In this case, compliance with this policy can be achieved for residential buildings through implementation of the deemed-to-comply measures detailed in the guidelines.

¹ For non residential noise-sensitive developments, (e.g. schools and child care centres) consideration should be given to providing a suitable outdoor area that achieves the noise target, where this is appropriate to the type of use.

In areas where the outdoor noise limit is likely to be exceeded (i.e. above $L_{Aeq(Day)}$ of 60 dB(A) or $L_{Aeq(Night)}$ of 55 dB(A)), a detailed noise assessment in accordance with the guidelines should be undertaken by the developer. Customised noise mitigation measures should be implemented with a view to achieving the noise target in at least one outdoor living or recreation area on each noise-sensitive lot or, if this is not practicable, within the margin. Where indoor spaces will face outdoor areas that are above the noise limit, mitigation measures should be implemented to achieve acceptable indoor noise levels in those spaces, as specified in the following paragraphs.

For residential buildings, acceptable indoor noise levels are $L_{Aeq(Day)}$ of 40 dB(A) in living and work areas and $L_{Aeq(Night)}$ of 35 dB(A) in bedrooms². For all other noise-sensitive buildings, acceptable indoor noise levels under this policy comprise noise levels that meet the recommended design sound levels in Table 1 of Australian Standard AS 2107:2000 Acoustics—Recommended design sound levels and reverberation times for building interiors.

These requirements also apply in the case of new noise-sensitive developments in the vicinity of a major transport corridor where there is no existing railway or major road (bearing in mind the policy's 15-20 year planning horizon). In these instances, the developer should engage in dialogue with the relevant infrastructure provider to develop a noise management plan to ascertain individual responsibilities, cost sharing arrangements and construction time frame.

If the policy objectives for noise-sensitive developments are not achievable, best practicable measures should be implemented, having regard to section 5.8 and the guidelines.”

The Policy, under Section 5.7, also provides the following information regarding “Notifications on Titles”:

“5.7 - NOTIFICATION ON TITLE

If the measures outlined previously cannot practicably achieve the target noise levels for new noise-sensitive developments, this should be notified on the certificate of title.

Notifications on certificates of title and/or advice to prospective purchasers advising of the potential for noise impacts from major road and rail corridors can be effective in warning people who are sensitive to the potential impacts of transport noise. Such advice can also bring to the attention of prospective developers the need to reduce the impact of noise through sensitive design and construction of buildings and the location of outdoor living areas.

² For residential buildings, indoor noise levels are not set for utility spaces such as bathrooms. This policy encourages effective “quiet house” design, which positions these non-sensitive spaces to shield the more sensitive spaces from transport noise (see guidelines for further information).

The notification is to ensure that prospective purchasers are advised of –

- the potential for transport noise impacts; and
- the potential for quiet house design requirements to minimise noise intrusion through house layout and noise insulation (see the guidelines).

Notification should be provided to prospective purchasers and be required as a condition of subdivision (including strata subdivision) for the purposes of noise-sensitive development as well as planning approval involving noise-sensitive development, where noise levels are forecast or estimated to exceed the target outdoor noise criteria, regardless of proposed noise attenuation measures. The requirement for notification as a condition of subdivision and the land area over which the notification requirement applies, should be identified in the noise management plan in accordance with the guidelines.

An example of a standard form of wording for notifications is presented in the guidelines.”

4. MODELLING

4.1 ROAD TRAFFIC

To determine the noise received within the subdivision from the extension of Marmion Avenue and the Mitchell Freeway, acoustic modelling was carried out using SoundPlan, using the Calculation of Road Traffic Noise (CoRTN) algorithms. Noise modelling was undertaken in accordance with the “Implementation Guidelines” for the State Planning Policy 5.4.

The input data for the model included:

- Ground contours as provided, modified to suit road profiles.
- Other traffic data as listed in Table 4.1.
- A +2.5 dB adjustment to allow for façade reflection.

Table 4.1 - Noise Modelling Input Data

Parameter	Mitchell Freeway	Marmion Avenue
Traffic flows for 2031	39000	35000 vpd
Speed (km/hr)	100	70
Heavy Vehicles (%)	1	3
Percentage traffic 0600 – 2400 hours	94	94
Other		
Receiver Level (m)	+1.5 above ground	
Façade Correction	+ 2.5 dB(A)	
Road Surface	Dense Graded Asphalt	

For this project, with reference to the DEFRA publication and as for the original assessment, the difference between the $L_{A10,18hr}$ and the $L_{Aeq,8hr}$ and the $L_{Aeq,16hr}$ has been taken to be 10 and 2.5 dB(A) respectively. It was assumed that these differences would apply in the year 2031.

Note: As noise monitoring of existing road traffic noise emanating from Marmion Avenue and the Freeway are not possible at this time, as outlined in the Implementation Guidelines, the standard correction of - 1.7 dB has been applied to the noise model.

We note that with the difference between the $L_{Aeq,8hr}$ and the $L_{Aeq,16hr}$ being 5 dB(A), achieving compliance with the day period criteria will also achieve compliance with the night period criteria. Therefore, noise modelling was only undertaken for the day period and the results are shown graphically in Appendix B.

Noise modelling for road noise was undertaken for the following scenarios:

- R1 Noise emissions from both Marmion Avenue and the Mitchell Freeway without noise amelioration.
- R2 Noise emissions from both Marmion Avenue and the Mitchell Freeway, with 2.2m high walls, as shown on Figure D1 in Appendix D.

4.2 RAIL NOISE

The noise modelling was carried out based on the number of train movements as summarised in Table 4.2. We understand that these movements were used to model noise emissions from other section of the Northern Suburbs Passenger Railway Line.

TABLE 4.2 – TRAIN MOVEMENTS

Parameter	Train Movements (per hour)	
	Day	Night
North Bound		
3 Car Set (75 metres long)	5.0	0.75
4 Car Set (100 metres long)	0.5	0
6 Car Set (150 metres long)	0.4	0
South Bound		
3 Car Set (75 metres long)	5.4	0.9
4 Car Set (100 metres long)	0.5	0
6 Car Set (150 metres long)	0.4	0

Based on the above number of train movements, once again if compliance is achieved with the day period criteria, compliance will also be achieved with the night period criteria. Therefore, noise modelling was only undertaken for the day period and the results are shown graphically in Appendix C.

Noise modelling for rail was undertaken for the following scenario:

- R1 Noise emissions from proposed northern suburbs railway, without noise amelioration.

5. DISCUSSION / RECOMMENDATIONS

Under the Western Australian Planning Commission (WAPC) Planning Policy 5.4 *“Road and Rail Transport Noise and Freight Considerations in Land Use Planning”* the following external criteria are listed:

“Noise Target”

$L_{Aeq(Day)}$ of 55 dB(A); and
 $L_{Aeq(Night)}$ of 50 dB(A).

and

“Noise Limits”

$L_{Aeq(Day)}$ of 60 dB(A); and
 $L_{Aeq(Night)}$ of 55 dB(A).

Under the SPP 5.4 for a “greenfield” site there is an expectation that the design of the development be consistent with achieving the “Noise Target” levels. However, in areas where the “Noise Target” levels will be exceeded, mitigation measures should be implemented by the development with a view to achieving the “Noise Target” levels in at least one outdoor living area on each residential lot. Additionally, where noise levels are likely to exceed the “Noise Limits” then customised noise mitigation measures should be undertaken by the developer.

Given the size and type of development and that the extension of Marmion Avenue and the Mitchell Freeway have been planned for some time, we do not believe that this development should be considered as a “greenfields” site. Therefore, the “Noise Limits” as outlined in the Western Australian Planning Commission (WAPC) Planning Policy 5.4 *“Road and Rail Transport Noise and Freight Considerations in Land Use Planning”* would be the appropriate criteria for assessment. The noise limits as set out in the Planning Policy are:

EXTERNAL

$L_{Aeq(Day)}$ of 60 dB(A); and
 $L_{Aeq(Night)}$ of 55 dB(A).

We also note that under the SPP5.4, noise mitigation measure should be implemented with a view to achieve, in at least one outdoor area, the L_{Aeq} of 50 dB(A) noise level for the night period. As external noise levels exceed the “Noise Target” noise levels, then the residential premises should be designed to comply with the following internal noise levels:

INTERNAL

$L_{Aeq(Day)}$ of 40 dB(A) in living and work areas; and
 $L_{Aeq(Night)}$ of 35 dB(A) in bedrooms.

5.1 ROAD TRAFFIC

Firstly, the noise modelling of noise emissions from the Mitchell Freeway indicate that noise received at the residences located adjacent to the Freeway would, for the majority of locations, comply with the “Noise Limits”. For those locations where noise received from the Freeway would exceed the “Noise Limits”, “Quiet House” design would by way of Package B, as outlined in the implementation guidelines, be required. For the other residences adjacent to the Freeway, Package A “Quiet House” guidelines as outlined in the SPP 5.4 Implementation Guidelines would be required.

Based on the results of the modelling the residence requiring “Quiet House” design and Notification on Titles are shown on Figure D1 attached in Appendix D.

The results of the acoustic assessment indicate that noise received at the ground floor level of residences located adjacent to Marmion Avenue could exceed the above acoustic criteria, with the level of exceedence in the worst case location being 8 dB(A). Thus for these residence, noise received at residences would exceed the “Noise Limits” criteria and notifications on titles and a “Quiet House” design would be required for at least the first row of residence.

For residences located adjacent to Marmion Avenue, we do not believe that for the entire length of the development it would be practicable or desirable to construct noise barriers at the edge of the Marmion Avenue road reserve. This will be addressed at the detailed design stage at subdivision level. Potential solutions to the noise constraints along Marmion Avenue include:

1. Where lots back on to Marmion Avenue, the construction of a 2.2 metre barrier wall is recommended. Locations are shown on Figure D1 attached in Appendix D. However this will be resolved at the detailed design stage.
2. Where possible, minor access streets be located between these roads and residential premises. This then allows the front of the residence to face the major roads and ensuring that the residence themselves provide a barrier to an outdoor living area located at the rear of the residence. Noise received at the outdoor living areas would then comply with the “Noise Target” as required under SPP5.4.

The design requirements in accordance with “Quiet House” design will be determined at subdivision level based on the outcomes of the detailed design.

Information regarding “Quiet House” design Packages, as outlined in the Implementation Guidelines, is contained in Appendix E.

Notes:

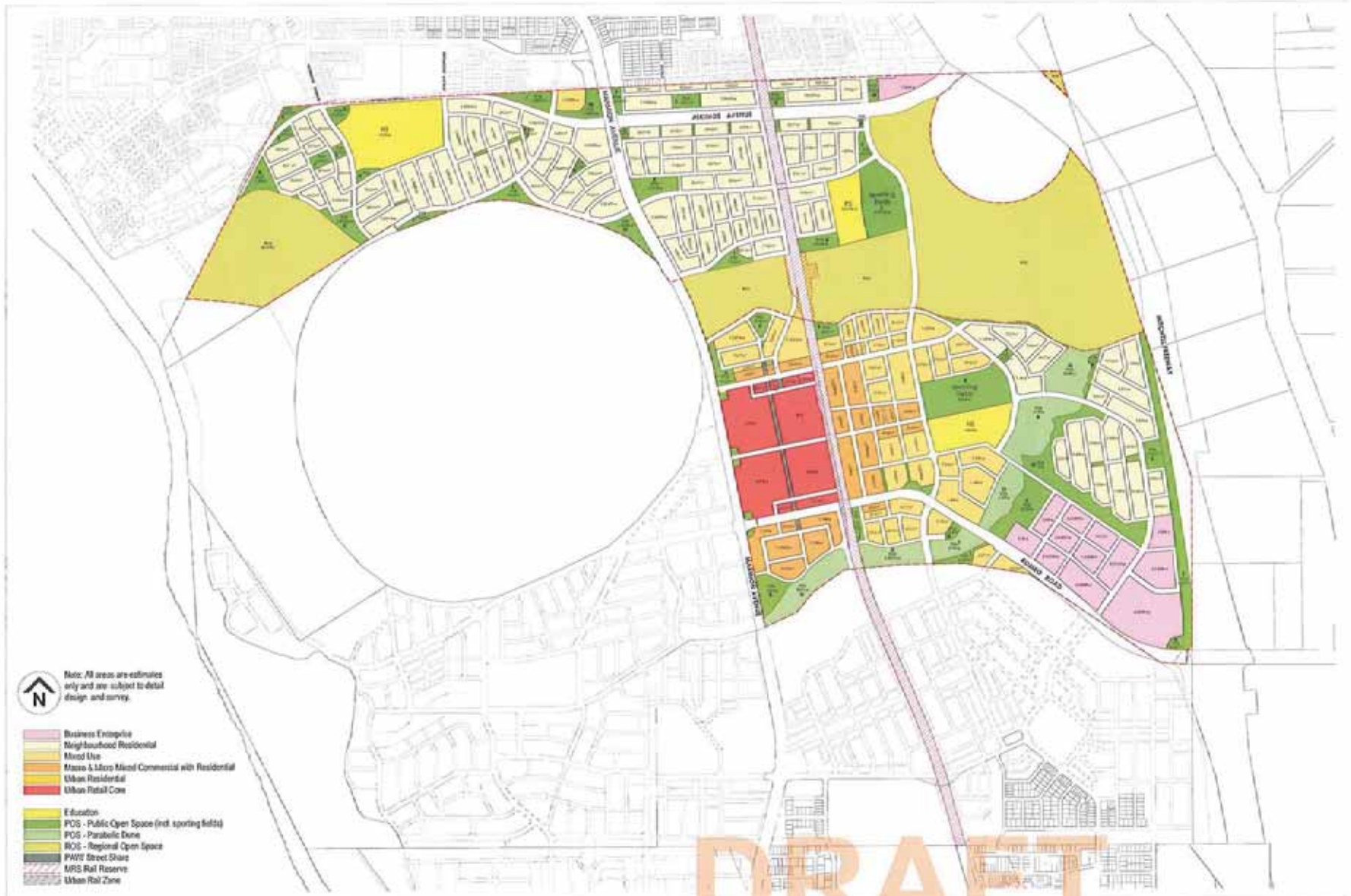
1. The noise amelioration is normally only required to the first row of residences, as these houses provide an adequate barrier between the road and the other residences.
2. If required following detailed design, the barrier can be either a solid wall of minimum density of 17 kg/m³; an earthen bund or a combination of both wall and bund.
3. Packages A and B are as per the Implementation Guidelines for SPP5.4 (Contained in Appendix E).
4. Package B+ is as for Package B but with reduced window areas (Maximum of 2m²).

5.2 RAIL NOISE

The noise modelling indicates that noise received at the closest residence to the extension of the Northern Suburbs Passenger Railway Line would comply with the above criteria. However, as the noise received at the first row of residence would exceed the “Noise Targets” as outlined in the policy. Therefore, Notification on Titles are required for those residential lots located adjacent to the Railway Line.

APPENDIX A

DEVELOPMENT PLAN



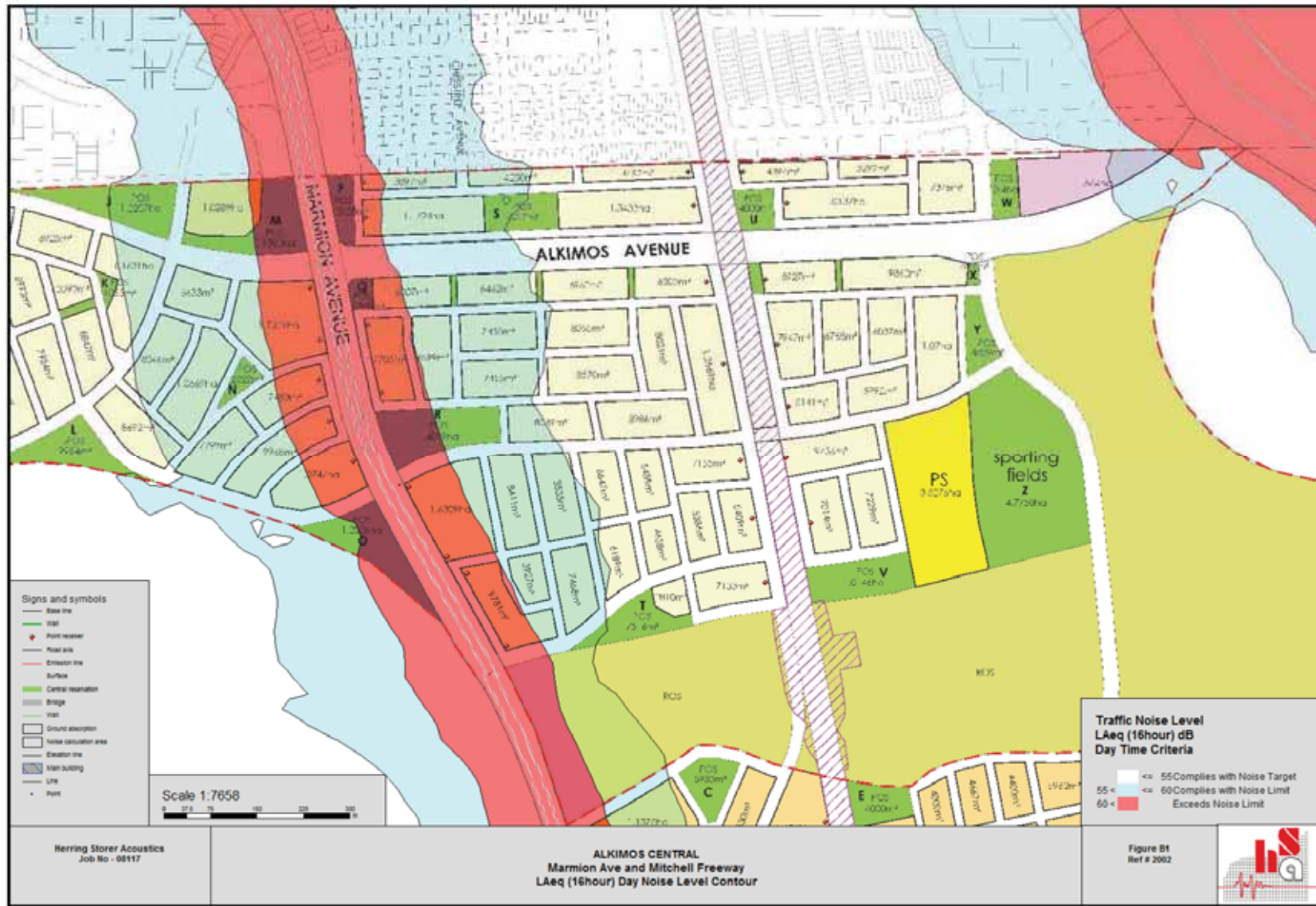
Note: All areas are estimates only and are subject to detail design and survey.

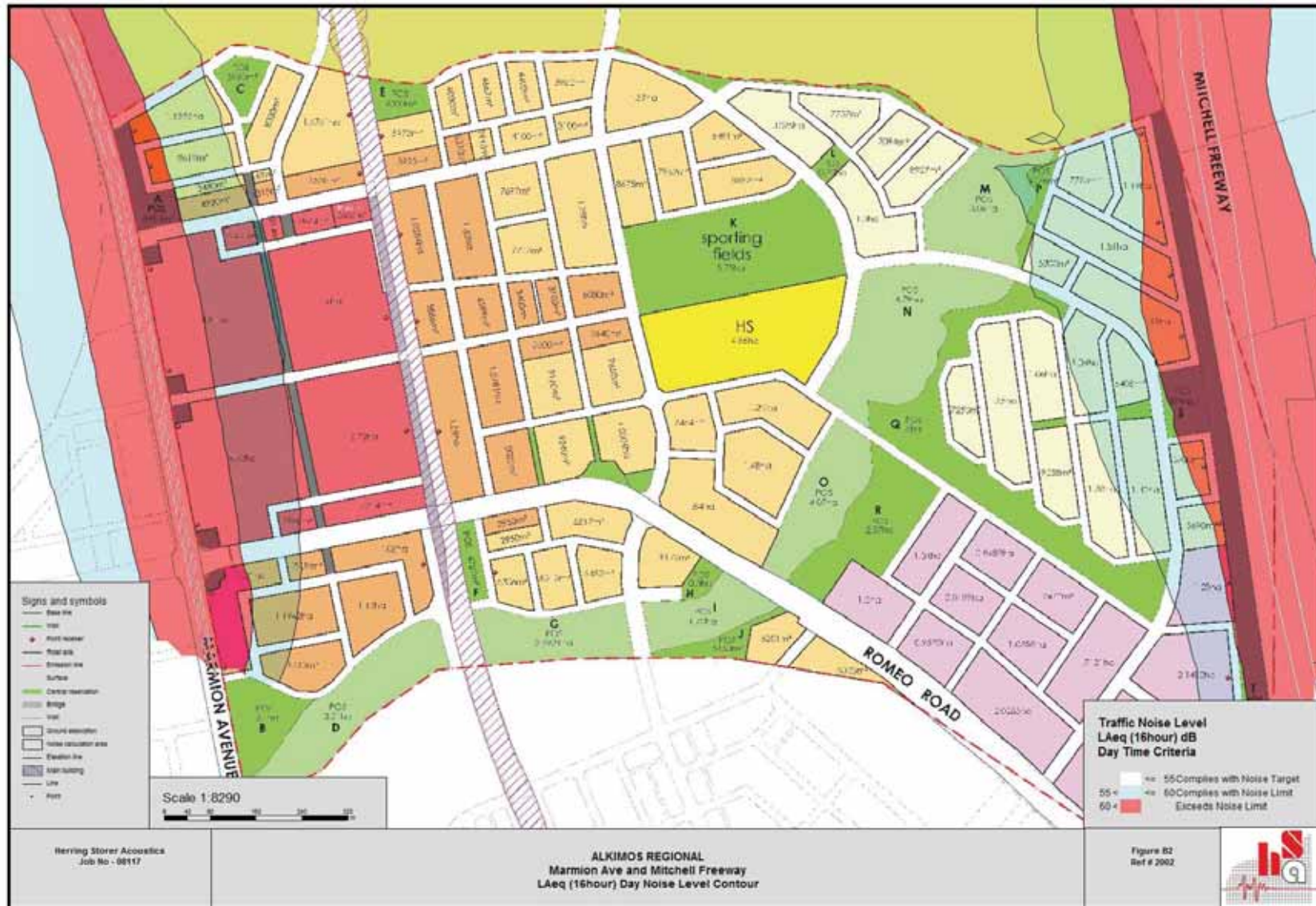
- Business Enterprise
- Neighborhood Residential
- Mixed Use
- Massive & Large Mixed Commercial with Residential
- Urban Residential
- Urban Retail Core
- Education
- POS - Public Open Space (incl. sporting fields)
- POS - Parklike Open Space
- ROS - Regional Open Space
- PWS Street Share
- MRS Rail Reserve
- Urban Rail Zone

DRAFT

APPENDIX B

ROAD TRAFFIC $L_{Aeq(16hr)}$ NOISE CONTOURS





APPENDIX C

RAIL $L_{Aeq(16hr)}$ NOISE CONTOURS





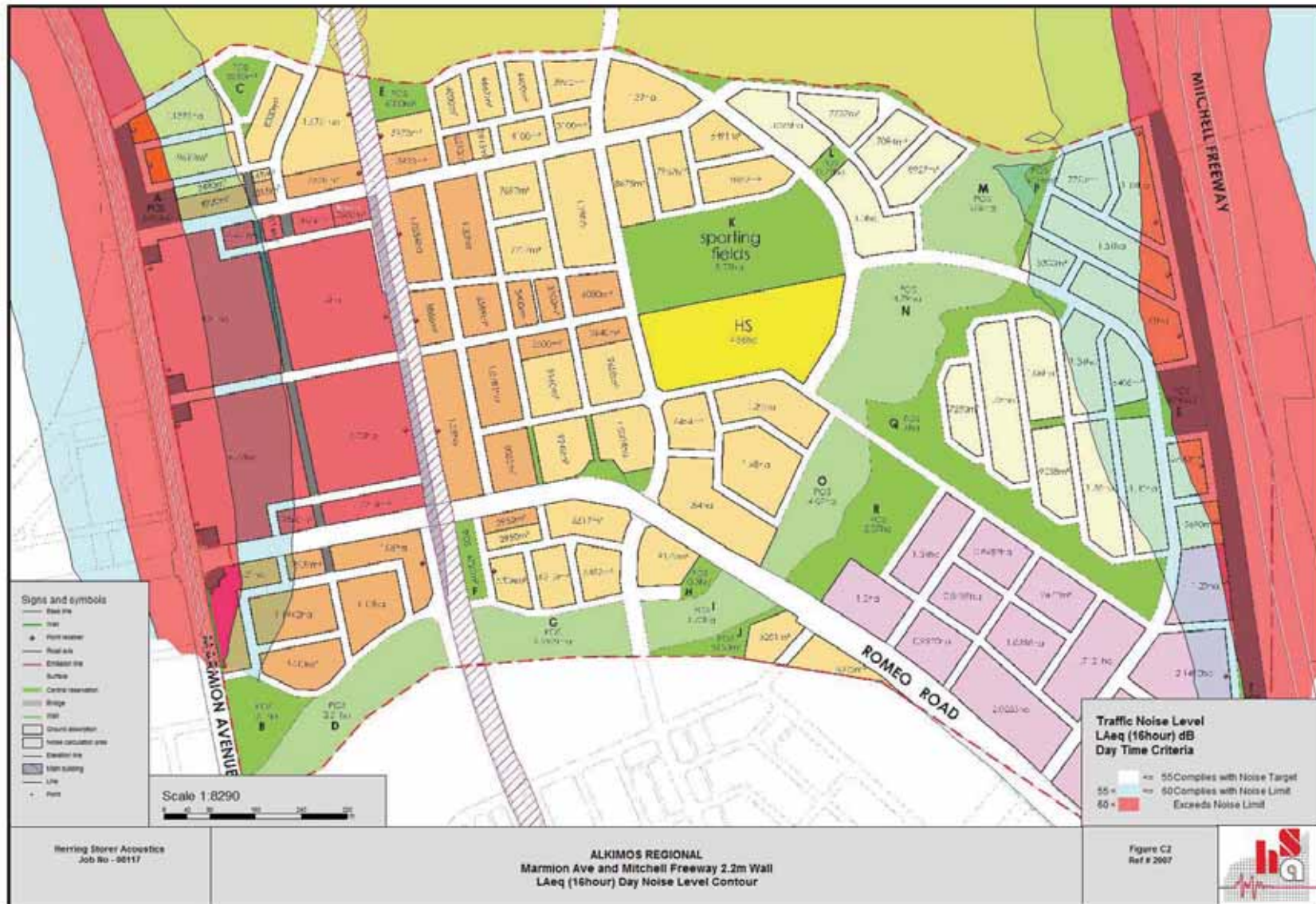
Herring Storer Acoustics
 Job No - 08117



APPENDIX D

BARRIER WALLS





APPENDIX E

“QUIET HOUSE” DESIGN – GENERAL INFORMATION

4.4.2 Other design considerations

Care needs to be taken with the integration of the foregoing measures with other design requirements to ensure that safety, functionality and energy efficiency are not compromised in the pursuit of noise reduction. For example, designs with climate requirements may suggest a need for the location of living areas and/or orientation of openings that are not conducive to noise amelioration. In such circumstances, additional measures may be necessary to provide a satisfactory level of noise reduction, or it may be necessary to accept some compromise in relation to either or both of the conflicting design requirements.

In cases in which new living and sleeping areas are to be located in close proximity to a railway or major road, consideration also needs to be given to reducing the maximum passby noise levels, in addition to the "average" L_{Aeq} noise levels, to acceptable levels. This may be done in consultation with the Department of Environment and Conservation.

4.5 Noise insulation – "deemed to comply" packages for residential development

The following "deemed-to-comply" packages outline noise insulation measures designed to ensure that the indoor noise standards in the policy are achieved for residential developments in areas where outdoor noise levels will exceed the "target" noise levels by up to 8dB(A). These packages have been designed for developments adjacent to major roads and passenger railways, where noise levels are likely to be higher during the day than at night. In the case of freight rail, where noise levels are likely to be fairly constant over the 24-hour period, these packages can be adapted. See section 4.8 of the guidelines for guidance on developments adjacent to freight railways.

The deemed-to-comply specifications are intended to simplify compliance with the noise criteria, and the relevant package should be required as a condition of development. However, this should not remove the option to pursue alternative measures or designs. Departures from the deemed-to-comply specifications need to be accompanied by acoustic certification from a competent person, to the effect that the development will achieve the requirements of the policy.

Superior construction standards, such as those specified in the deemed-to-comply packages, are now becoming more prevalent in residential buildings; and they do not significantly increase the cost of building. A similar standard of construction has been recommended by the Western Australian Planning Commission for new housing in areas forecast to be seriously affected by aircraft noise.⁴ That recommendation followed a comprehensive assessment of the efficacy and costs of noise attenuation measures, taking into account the recent changes in industry building standards as well as changes to the *Building Code of Australia*.

Where transport noise levels are more than 8dB above the noise "target", i.e. 3dB above the noise "limit", or where noise-sensitive development other than residential is proposed, a detailed assessment should be prepared by a competent person. The report should specify the level of noise reduction required and the noise insulation measures needed to comply with the policy. The approval may require that the construction drawings be checked for compliance with the detailed assessment, and that follow-up verification be carried out to certify compliance.

⁴ Statement of Planning Policy No 5.1, *Land Use Planning in the Vicinity of Perth Airport* and the accompanying report on *Aircraft Noise Insulation for Residential Development in the Vicinity of Perth Airport*, February 2004.

4.5.1 Package A: noise levels within the "margin"

The following noise insulation package (Table 8) is designed to meet the indoor noise standards for residential developments in areas adjacent to major roads or passenger railways where noise levels exceed the noise "target" but are within the "limit".

Table 8

Area type	Orientation	Package A measures
Indoors		
Bedrooms	Facing road/rail corridor	<ul style="list-style-type: none"> • 6 mm laminated glazing • Casement or awning windows • No external doors • Closed eaves • No vents to outside walls/eaves • Mechanical ventilation/airconditioning (see 4.5.3)
	Side-on to corridor	<ul style="list-style-type: none"> • 6 mm laminated glazing • Closed eaves • Mechanical ventilation/airconditioning
	Away from corridor	No requirements
Living and work areas ⁵	Facing corridor	<ul style="list-style-type: none"> • 6 mm laminated glazing • Casement or awning windows • 35 mm (minimum) solid core external doors with acoustic seals⁶ • Sliding doors must be fitted with acoustic seals • Closed eaves • No vents to outside walls/eaves • Mechanical ventilation/airconditioning
	Side-on to corridor	<ul style="list-style-type: none"> • 6 mm glazing • Closed eaves • Mechanical ventilation/airconditioning
	Away from corridor	No requirements
Other indoor areas	Any	No requirements
Outdoors		

⁵ These deemed-to-comply guidelines adopt the definitions of indoor spaces used in AS 2107-2000. A comparable description for bedrooms, living and work areas is that defined by the Building Guide of Australia as a "habitable room". The Building Guide of Australia may be referenced if greater clarity is needed. A living or work area can be taken to mean any "habitable room" other than a bedroom. Note that there are no noise insulation requirements for utility areas such as bathrooms. The Building Guide of Australia describes these utility spaces as "non-habitable rooms".

⁶ Glazing panels are acceptable in external doors facing the transport corridor. However these must meet the minimum glazing requirements.

Outdoor living area ⁷	Facing corridor	<ul style="list-style-type: none"> • Minimum 2.0 m high solid fence (e.g. Hardifence, pinelap, or Colorbond) • Picket fences are not acceptable
	Side-on to corridor	
	Away from corridor	No requirements

4.5.2 Package B: noise within 3dB above the "limit"

The following noise insulation package (Table 9) is designed to meet the indoor noise standards for residential developments in areas adjacent to major roads or passenger railways where transport noise levels exceed the noise "limit" but by no more than 3dB (See Table 1 in policy).

Table 9

Area type	Orientation	Package B measures
Indoors		
Bedrooms	Facing road/rail corridor	<ul style="list-style-type: none"> • 10 mm laminated glazing • Casement or awning windows • No external doors • Closed eaves • No vents to outside walls/eaves • Mechanical ventilation/airconditioning (see 4.5.3)
	Side-on to corridor	<ul style="list-style-type: none"> • 6 mm laminated glazing • Casement or awning windows • Closed eaves • Mechanical ventilation/airconditioning
	Away from corridor	No requirements
Living and work areas ⁸	Facing corridor	<ul style="list-style-type: none"> • 10 mm laminated glazing • Casement or awning windows • 40 mm (minimum) solid core external doors with acoustic seals⁹ • Sliding doors must be fitted with acoustic seals • Closed eaves • No vents to outside walls/eaves • Mechanical ventilation/airconditioning

⁷ The Policy requires that at least one outdoor living area be reasonably protected from transport noise. The protected area should meet the minimum space requirements for outdoor living areas, as defined in the Residential Design Codes of Western Australia.

⁸ These deemed-to-comply guidelines adopt the definitions of indoor spaces used in AS 2107-2000. A comparable description for bedrooms, living and work areas is that defined by the Building Guide of Australia as a "habitable room". The Building Guide of Australia may be referenced if greater clarity is needed. A living or work area can be taken to mean any "habitable room" other than a bedroom. Note that there are no noise insulation requirements for utility areas such as bathrooms. The Building Guide of Australia describes these utility spaces as "non-habitable rooms".

⁹ Glazing panels are acceptable in external doors facing the transport corridor. However these must meet the minimum glazing requirements.

Outdoor living area ⁷	Facing corridor	<ul style="list-style-type: none"> • Minimum 2.0 m high solid fence (e.g. Hardifence, pinelap, or Colorbond) • Picket fences are not acceptable
	Side-on to corridor	
	Away from corridor	No requirements

4.5.2 Package B: noise within 3dB above the "limit"

The following noise insulation package (Table 9) is designed to meet the indoor noise standards for residential developments in areas adjacent to major roads or passenger railways where transport noise levels exceed the noise "limit" but by no more than 3dB (See Table 1 in policy).

Table 9

Area type	Orientation	Package B measures
Indoors		
Bedrooms	Facing road/rail corridor	<ul style="list-style-type: none"> • 10 mm laminated glazing • Casement or awning windows • No external doors • Closed eaves • No vents to outside walls/eaves • Mechanical ventilation/airconditioning (see 4.5.3)
	Side-on to corridor	<ul style="list-style-type: none"> • 6 mm laminated glazing • Casement or awning windows • Closed eaves • Mechanical ventilation/airconditioning
	Away from corridor	No requirements
Living and work areas ⁸	Facing corridor	<ul style="list-style-type: none"> • 10 mm laminated glazing • Casement or awning windows • 40 mm (minimum) solid core external doors with acoustic seals⁹ • Sliding doors must be fitted with acoustic seals • Closed eaves • No vents to outside walls/eaves • Mechanical ventilation/airconditioning

⁷ The Policy requires that at least one outdoor living area be reasonably protected from transport noise. The protected area should meet the minimum space requirements for outdoor living areas, as defined in the Residential Design Codes of Western Australia.

⁸ These deemed-to-comply guidelines adopt the definitions of indoor spaces used in AS 2107-2000. A comparable description for bedrooms, living and work areas is that defined by the Building Guide of Australia as a "habitable room". The Building Guide of Australia may be referenced if greater clarity is needed. A living or work area can be taken to mean any "habitable room" other than a bedroom. Note that there are no noise insulation requirements for utility areas such as bathrooms. The Building Guide of Australia describes these utility spaces as "non-habitable rooms".

⁹ Glazing panels are acceptable in external doors facing the transport corridor. However these must meet the minimum glazing requirements.

	Side-on to corridor	<ul style="list-style-type: none"> • 6 mm laminated glazing • Casement or awning windows • Closed eaves • Mechanical ventilation/airconditioning
	Away from corridor	No requirements
Other indoor areas	Any	No requirements
Outdoors		
Outdoor living area ¹⁰	Facing corridor	<ul style="list-style-type: none"> • Minimum 2.4 m solid fence (e.g. brick, limestone or Hardifence)
	Side-on to corridor	<ul style="list-style-type: none"> • Colorbond and picket fences are not acceptable
	Away from corridor	No requirements

4.5.3 Mechanical ventilation/airconditioning

Where outdoor noise levels are above the "target", both packages A and B require mechanical ventilation or airconditioning to ensure that windows can remain closed in order to achieve the indoor noise standards.

In implementing packages A and B, the following need to be observed:

- Evaporative airconditioning systems will meet the requirements for packages A and B provided attenuated air vents are provided in the ceiling space. Without such vents, these systems require windows to remain open.
- Refrigerative airconditioning systems need to be designed to achieve fresh air ventilation requirements.
- Air inlets need to be positioned facing away from the corridor where practicable.
- Ductwork needs to be provided with adequate silencing, particularly in higher noise areas, to prevent noise intrusion.

4.6 Reasonable and practicable considerations

The policy requires consideration and implementation of all "reasonable" and "practicable" noise mitigation measures to achieve the noise target and acceptable indoor noise levels. Where it can be demonstrated that it is neither practicable nor reasonable to reduce noise levels to the noise target, then higher noise levels may be acceptable, but longer term noise management strategies may need to be considered.

"Practicable" considerations for the purposes of the policy normally relate to the engineering aspects of the noise mitigation measures under evaluation. These may include:

- limitations of the different mitigation measures to reduce transport noise;
- safety issues (such as impact on crash zones or restrictions on road vision);

¹⁰ The Policy requires that at least one outdoor living area be reasonably protected from transport noise. The protected area should meet the minimum space requirements for outdoor living areas, as defined in the Residential Design Codes of Western Australia.

- topography and site constraints (such as space limitations);
- drainage requirements;
- access requirements (for driveways, pedestrian access etc);
- maintenance requirements; and
- suitability of the building for acoustic treatments.

For example, if there is insufficient space between a road and a residence then it would not be practicable to build an earth bund as a noise mitigation measure, given the technical requirements for the bund to be built at a certain slope.

See also the definition of "practicable" in the *Environmental Protection Act 1986*¹¹.

"Reasonableness" considerations, for the purposes of the policy, would be based on understanding and balancing a range of factors, and then agreeing on the best overall outcome, taking a triple bottom line approach to the assessment of these factors.

A judgment about whether a noise mitigation measure is reasonable might include a consideration of:

- the noise reduction benefit provided;
- the number of people protected;
- the cost of mitigation;
- existing and future noise levels, including changes in noise levels;
- community views and impacts;
- aesthetic and visual impacts;
- compatibility with other planning policies;
- differences between metropolitan and regional situations; and
- the benefits arising from the proposed development.

The purpose of considering "reasonableness" concerns is to achieve the best balanced outcome with respect to noise abatement. Assessment should involve careful and thorough consideration of a wide range of factors, not just one criterion. The assessment should identify the social, economic and environmental aspects of the benefits, and the disbenefits of implementing the noise mitigation measure. In some cases it may be helpful to quantify performance against each factor, thereby enabling a more objective decision to be made.

An assessment of reasonableness should also clearly demonstrate that efforts have been made to resolve conflicts, without compromising on the need to protect noise amenity. For example, if residents are concerned about the height of a transport noise barrier, have reasonable efforts been made to design, relocate or vegetate the barrier to address these concerns?

It is preferable that reasonableness arguments be presented in triple bottom line terms. For instance, rather than arguing that a transport noise barrier should not be built because residents want their views to be retained, "reasonableness" considerations would cause an investigation into the cost of building a transparent barrier, which would enable residents' views to be retained and their noise

¹¹ "Practicable" is defined in the *Environmental Protection Act 1986* to mean "reasonably practicable having regard to, among other things, local conditions and circumstances (including costs) and to the current state of technical knowledge".

amenity to be protected. In another case, the benefits of differing noise mitigation options could be compared by calculating the cost per unit of noise reduction provided by the barrier (\$/dB), or the cost per residence (\$/residence), or a combination of these (\$/dB/residence).

Effective community consultation is critical in noise mitigation planning, and should be considered a vital element in any reasonableness assessment where it is proposed that residual noise impacts will remain even after the application of appropriate noise mitigation measures. This principle applies to developers, who should consult with local government, existing residents and road/rail authorities, and to new transport infrastructure providers, with a responsibility to engage with impacted residents and the local government. Stakeholders should be able to participate in the selection of the most appropriate noise mitigation option in an open, equitable and effective way.

Any case outlining reasonable and practicable considerations must be justifiable and so should be well documented. A submission outlining the reasonable and practicable considerations should help to facilitate a determination on the matter and should assist in communicating that decision to the community in a transparent way.

Example of rural highway project:

A new highway is being constructed to link two large regional centres. A detailed assessment indicates that noise levels will exceed the noise "limit" at distances of up to 100 m from the road, and that noise amelioration measures will be needed at existing residences.

Where the road passes alongside a built-up area on the outskirts of one of the centres, the infrastructure provider decides to use an open graded asphalt road surface instead of chip seal, as a practicable measure to achieve an initial noise reduction. A noise barrier is identified as a further practicable measure. To achieve the noise "limit" will require a barrier of height 1.5 m, while achieving the "target" will require a barrier height of 4.5 m. A "reasonable" barrier height of 3 m is negotiated through consultation with the stakeholders. This barrier is predicted to achieve a noise level $L_{Aeq}(Day)$ of 57dB(A), which is accepted as being within the "margin", while preserving some views.

As the road passes out from the built-up areas into semi-rural areas, the economics of the quieter road surface and noise barrier are less attractive, and the infrastructure provider considers alternatives. In this area there are about 10 houses per kilometre. Based on a cost of about \$0.5m per kilometre for a limestone blockwork wall, the cost per house for the barrier option is \$50 000 per house. By comparison, the cost of noise insulation of the individual houses is \$15 000 per house, for upgrading of the window glazing and some doors; providing ducted evaporative airconditioning; and erecting some local outdoor privacy walls around the entertaining areas. Following consultation, the residents accept the offer of noise insulation.

The infrastructure provider documents the various noise amelioration measures for the built-up area and the semi-rural area in the noise management plan for the project.

4.7 Noise management plan

Having received a detailed noise assessment report and considered reasonable and practicable mitigation measures, the developer or infrastructure provider would normally prepare a comprehensive noise management plan to outline their commitments in relation to noise mitigation and management.

APPENDIX F



MINISTERIAL STATEMENT NO. 722

Minister for Environment 2006

Hon Mark McGowan MLC
Minister for the Environment,
Raving and Gaming

101 St George's Terrace, Perth WESTERN AUSTRALIA 6000
Telephone: (08) 9222 9111, Facsimile: (08) 9222 9410
Internet: <http://www.wa.gov.au> Website: www.mta.wa.gov.au

Statement No.

STATEMENT THAT A SCHEME MAY BE IMPLEMENTED
(PURSUANT TO THE PROVISIONS OF DIVISION 3 OF PART IV OF THE
ENVIRONMENTAL PROTECTION ACT 1986)

010722

ALKIMOS-EGLINTON
METROPOLITAN REGION SCHEME
AMENDMENT 1029/33

Scheme Purpose: To amend reservations and zonings in the Metropolitan Region Scheme consistent with the Alkimos-Eglinton Structure Plan.

Responsible Authority: Western Australian Planning Commission

Responsible Authority Address: 469 Wellington Street, PERTH WA 6000

Assessment Number: 1365

Report of the Environmental Protection Authority: Bulletin 1207

Subject to the following conditions, there is no known environmental reason why the amendment to the Metropolitan Region Scheme to which the above report of the Environmental Protection Authority relates should not be implemented:

1 Additional Land to be Reserved

1-1 All or portions of the following sites shall be reserved, in accordance with the requirements set out in Attachment 1 of the Minister for the Environment's "Statement that a Scheme may be Implemented" No. (insert number) published on (date):

- 1) Public Purpose reserve surrounding the Wastewater Treatment Plant;
- 2) Parks and Recreation Reserve north of Ningana Bushland;
- 3) Parks and Recreation Reserves south of Ningana Bushland;

Published on

24 APR 2006

- 4) Parks and Recreation Reserve north of the Waste Water Treatment Plant;
- 5) Town park immediately north of the Alkimos Regional Centre;
- 6) Rationalisation and reductions to the coastal foreshore Regional Open Space reservation; and,
- 7) East-west parabolic dune linkage.

2 Environmental Management Plans

2-1 Prior to approving subdivision or development applications (whichever is sooner) for infrastructure proposals, the Western Australian Planning Commission or local government, as the case requires, may require an Environmental Management Plan to be prepared and implemented to achieve the objective of managing the potential impacts of the proposed subdivision, development or infrastructure on the following:

- 1) land which is reserved as Regional Open Space in the Scheme; and,
- 2) bushland or land that may be part of an ecological linkage.

The Environmental Management Plan shall include:

- 1) a description of existing environmental values, and the identification of the environmental outcome to be achieved through the implementation of this plan;
- 2) clear delineation of boundaries or significant areas to be protected;
- 3) management of construction, access and rehabilitation;
- 4) vegetation mitigation strategies;
- 5) allocation of responsibilities and identification of timing and duration of implementation;
- 6) provision for routine monitoring and environmental values; and
- 7) provision of details of contingency plans in the event that the monitoring surveys indicate that the development is having or has had an adverse impact upon environmental values.

2-2 An Environmental Management Plan prepared pursuant to condition 2-1 shall be prepared to the satisfaction of the WAPC or the local authority as required, having due regard for advice from relevant government agencies and shall be implemented in accordance with a program defined in the Environmental Management Plan.

- 3 Areas of Public Purpose Reservation to be protected for conservation purposes
- 3-1 Portions of the Public Purpose reservation for the Wastewater Treatment Plant shall be set aside and managed for conservation purposes in accordance with the requirements set out in Attachment 1 of the Minister for the Environment's "Statement that a Scheme may be implemented" No. (insert number) published on (date):
- 4 Lifting of Urban Deferment – Wastewater Treatment Plant Buffer
- 4-1 Lifting of Urban Deferment within the southern portion of the Wastewater Treatment Plant Buffer shall not occur unless it is demonstrated to the requirements of the Environmental Protection Authority that the area within which Urban Deferment is to be lifted is not subject to odour at a level likely to cause adverse impacts on the amenity of odour sensitive land uses.
- 5 **Development within areas reserved for Parks and Recreation**
- 5-1 With the exception of the areas specified in condition 5-2, all land reserved for Parks and Recreation shall be managed to protect the integrity, function and environmental values of the bushland and landforms to the requirements of the Western Australian Planning Commission on the advice of the Environmental Protection Authority and shall only be used for conservation, landscape and complimentary purposes.
- 5-2 A maximum of 25 percent of the area of the land to be reserved for Parks and Recreation identified as Areas 6a and 6b on the attached Figure may be developed for Parks and Recreation purposes in accordance with an Environmental Management Plan prepared to the requirements of the Environmental Protection Authority.

**HON MARK MCGOWAN MLA
MINISTER FOR THE ENVIRONMENT;
RACING AND GAMING**

24 APR 2006

STATEMENT THAT A SCHEME MAY BE IMPLEMENTED –
METROPOLITAN REGION SCHEME AMENDMENT 1029/33

SPECIFICATIONS FOR RESERVATION FOR THE WASTE WATER
TREATMENT PLANT AND ADDITIONAL LAND TO BE RESERVED

I Additional Land to be Reserved

Prior to finalisation of the scheme the following land shall be reserved:

1-1 Public Purpose Reserve surrounding the Wastewater Treatment Plant

Land surrounding the Wastewater Treatment Plant as detailed in the attached Figure shall be reserved for Public Purposes to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for complementary purposes.

1-2 Parks and Recreation Reserve north of Ningana Bushland

A portion of Lot M1503 (Area 1b as detailed in the attached Figure), Eglinton shall be reserved for conservation purposes to protect the integrity, function and environmental value of the bushland to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation, landscape and complementary purposes.

1-3 Parks and Recreation Reserve south of Ningana Bushland

A portion of Lot M1503, Eglinton (Area 2b as detailed in the attached Figure) shall be reserved for conservation purposes to protect the integrity, function and environmental value of the bushland to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation, landscape and complementary purposes.

1-4 Parks and Recreation Reserve south of Ningana Bushland

A portion of Lots M1503 and 11, Eglinton (Area 3a as detailed in attached Figure) shall be reserved for conservation purposes to protect the integrity, function and environmental value of the bushland to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation, landscape and complementary purposes.

1-5 Parks and Recreation Reserve north of the Waste Water Treatment Plant

A portion of Lots M1482 and 102, Alkimos (Areas 5a and 5d as detailed in attached Figure) shall be reserved for conservation purposes to protect the integrity, function and environmental value of the bushland to the requirements of the Western Australian Planning Commission on advice of the

Environmental Protection Authority, and shall only be used for conservation, landscape and complementary purposes.

1-6 Town Park immediately north of the Alkimos Regional Centre

A portion of Lot 102, Alkimos (Areas 6b and 6c as detailed in attached Figure) shall be reserved for conservation purposes to protect the integrity, function and environmental value of the bushland to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation, landscape and complementary purposes.

1-7 Rationalisation and reductions to the coastal foreshore Regional Open Space reservation

A portion of Lot 102, Alkimos (Area 7c as detailed in attached Figure) shall be reserved for conservation purposes to protect the integrity, function and environmental value of the bushland to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation, landscape and complementary purposes.

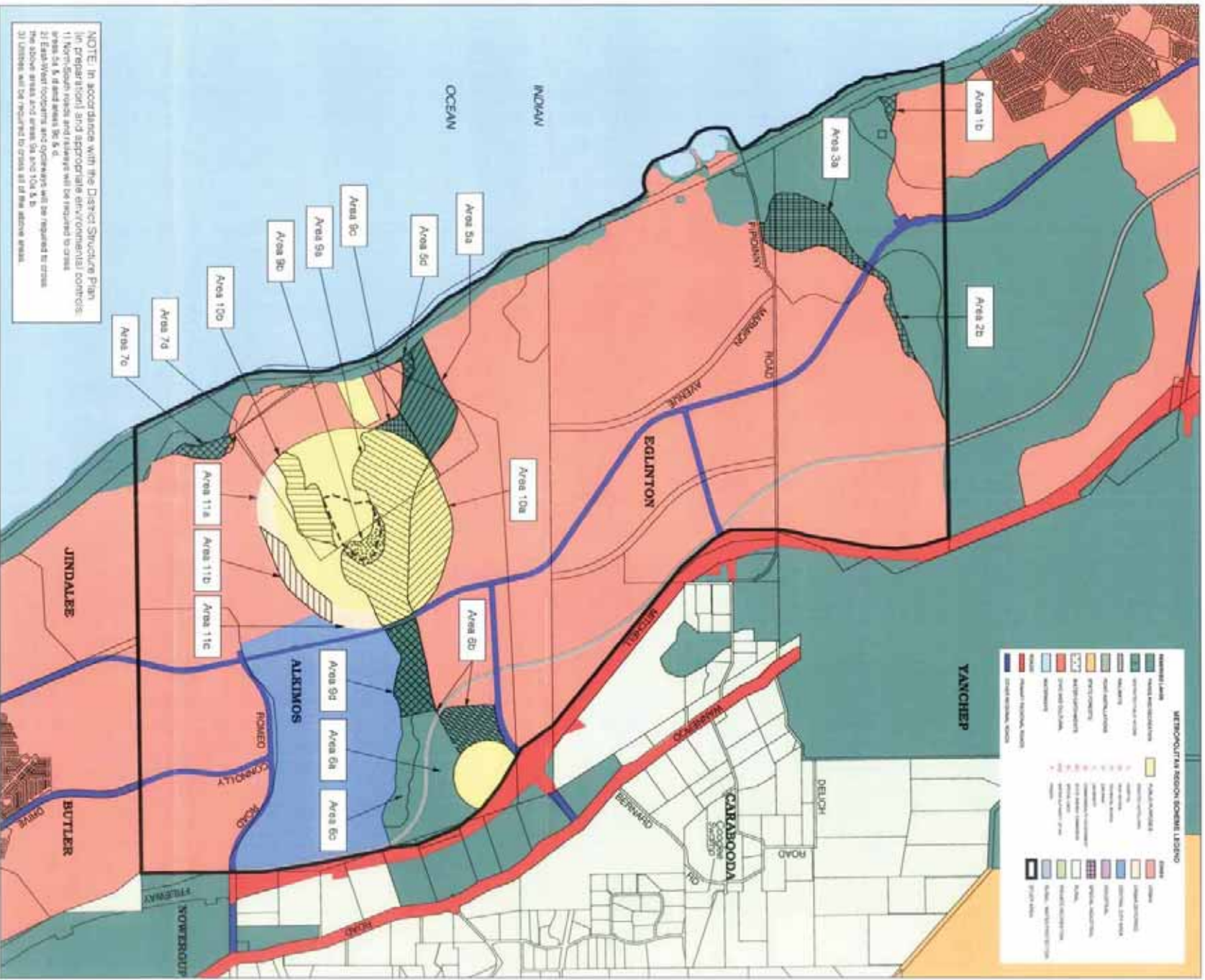
1-8 East-west parabolic dune linkage

A portion of Lots 101 and 102, Alkimos (Areas 9c and 9d as detailed in attached Figure) shall be reserved for conservation purposes to protect the integrity, function and environmental value of the bushland to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation, landscape and complementary purposes.

2 Areas of Public Purpose reservation to be protected for conservation purposes

2-1 Portions of Lots 101 & 102, Alkimos to be reserved for Public Purposes

(Areas 9a, 10a and 10b in the attached Figure) shall be protected and managed for conservation purposes to protect the integrity, function and environmental value of the bushland to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation, landscape and complementary purposes. Minor infrastructure may be installed within these areas, providing the work is undertaken in accordance with a Management Plan approved by the Environmental Protection Authority



NOTE: In accordance with the District Structure Plan (in preparation), and appropriate environmental controls areas 5A, 5B and areas 9C, 9D, 21 East West corridors and corridors will be required to cross the above areas and areas 9A and 10A, 5A, 21 Corridors will be required to cross all of the above areas.



Data information supplied by DLP FA 23, 2003
 Prepared by Strategic Planning Section, Spatial Information & Research - Mapping & Geospatial Data
 Distributed by Planning and Infrastructure, Strategic Information & Research - Mapping & Geospatial Data

MRS AMENDMENT 1029/33 ALKIMOS- EGLINTON
As determined by Minister for the Environment



APPENDIX G



DEPARTMENT OF PLANNING BUSH FOREVER DELEGATION

Tracey Scroop, Senior planning Officer
Department of Planning, May 2012

Chrystal King

From: Scroop, Tracey <Tracey.Scroop@planning.wa.gov.au>
Sent: Wednesday, 9 May 2012 4:08 PM
To: Chrystal King
Cc: Vyner, Carolyn
Subject: RE: Bush Forever Site 397 - Alkimos
Attachments: 000722.pdf; Metro_Region_Scheme_text.pdf; Pages from 2156_B1207.pdf; ATT00001.txt; ATT00002.htm

Hi Chrystal

I apologise for not getting back to you sooner. I note your query relates predominately to the section of land north of the Alkimos waste water treatment plant (WWTP), Lot 9002 Marmion Avenue, Alkimos, as you are working on the local structure plan (LSP) for this area. A small portion of Lot 9002 also falls to the west of the WWTP within the South Alkimos LSP. Your query is if the Bush Forever area within this subject area will be aligned to the parks and recreation reservation, as currently on the Metropolitan Region Scheme (MRS) the Bush Forever overlay does not correlate with the current parks and recreation reservation. As shown on this map from the Western Australian Planning Commission website http://www.planning.wa.gov.au/dop_pub_pdf/mrs_3.pdf

Please note this advice is given in regard to Bush Forever only and other environmental and planning policies and legislation may affect the parks and recreation reservation and / or the urban area, such as State Planning Policy 2.6 – State Coastal Planning Policy (SPP 2.6) which is currently under review, or the federal *Environment Protection and Biodiversity Conservation Act 1999* . Any issues will be resolved during the LSP process.

Attached is the Environmental Protection Authority (EPA) environmental conditions associated with MRS amendment 1029/33, which is the amendment that resulted in the current MRS alignment. This correlates with the MRS text (page 29) that I was referring too on the phone, which is also attached.

As part of the EPA assessment for the MRS amendment 1029/33, the EPA identified bushland as regionally significant which differs to the Bush Forever 2000 layer for Bush Forever area 397 – Coastal Strip from Wilbinga to Mindarie and for Bush Forever area 289 – Ningana Bushland Eglinton (attached).

As such, it would be acceptable to treat the urban zoned areas within the Bush Forever 2000 layer, that were rezoned from parks and recreation to urban on the recommendations from the EPA under MRS amendment 1029/33, as land with urban development potential, noting subject to other environmental and planning assessment and approvals. The boundaries of the current Bush Forever areas shown on the MRS that are zoned urban within this area associated with MRS amendment 1029/33, will be adjusted to correlate with the parks and recreation reservation through a MRS amendment some time in the future, likely to be after the LSP process.

Further to the above, as the MRS amendment 1029/33 resulted in a loss of Bush Forever vegetation, it is expected that all the areas reserved for parks and recreation will be transferred to the Bush Forever delegation. This would include the areas on the coastal strip within or adjacent to Bush Forever area 397, the areas abutting the WWTP and the east - west link between the WWTP and the freeway reservation. It would appear the addition and deletion of

Bush Forever area 289 and the parks and recreation reservation has already been done for the Eglinton area associated with MRS amendment 1029/33.

It should be noted that an environmental management plan is to be prepared for both the land reserved for parks and recreation (regional open space) in the MRS and for areas of bushland that may be part of an ecological linkage. As part of the local structure planning for the Alkimos - Eglinton area, it could be potentially identified that areas not reserved for parks and recreation (regional open space) are found to be part of an ecological linkage or further prove to be of regional significance.

It is further noted that in May 2010 the WAPC adopted a position statement on sea level rise which increased the S3 value in Schedule One of SPP 2.6 from 0.38 to 0.90 metres. This has the potential to affect setbacks for development requirements, over and above the designated parks and recreation / foreshore reservation. For further information on this and the LSP process you are advised to contact the Statutory Planners in the Metropolitan North West Team at the Department of Planning.

I hope this information is of assistance. Please contact me if you require any further information on Bush Forever matters.

Kind Regards

Tracey

Tracey Scroop
Senior Planning Officer
Policy Coordination and Development
Department of Planning
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From: Chrystal King [mailto:Chrystal.King@emergeassociates.com.au]
Sent: Monday, 23 April 2012 4:37 PM
To: Scroop, Tracey
Subject: FW: Bush Forever Site 397 - Alkimos

Hi Tracey,

Please find below the email I sent through to Helen.

I don't have a copy of the WAPC Amendment Report – however the EPA prepared the attached figure within their report. This “EPASU Recommended Regionally Significant Vegetation” represents the current ROS boundaries (over Lot 102). This has excluded area 5c and 5b (see attached figure), which are part of Bush Forever – but not current ROS. The EPA report (Bulletin 1207 page 25) states that:

The EPA recommends modifying the boundary to include Areas 5a and 5d and exclude Areas 5b and 5c, on the basis that:

- *the current boundary bisects the parabolic dune landform at Area 5c;*
- *the boundary of the regional linkage should be widened at Area 5d; and*
- *values within Areas 5b and 5c, while significant and desirable to retain if possible are protected elsewhere on the site.*

The District Structure Plan for Alkimos-Eglinton states the following:

The consultant team undertook an assessment of the environmental values of the entire district and have proposed a number of changes to the boundaries of Bush Forever Sites 289 and 397. The proposed changes to the Bush Forever boundaries mirror the proposed changes to the Parks and Recreation reserve boundaries as reflected in the approved MRS and are embodied in the DSP.

See page 183 here: http://www.wanneroo.wa.gov.au/files/d17e20f0-3cb6-49e6-805b-9eb70092ed6a/FINAL_Alkimos-Eglinton_DSP_Part_2.pdf

However, I can't seem to locate if there was any engagement with DoP.

Any historical information you are able to provide on the site, would be helpful.

Also – if publicly available, are you able to provide me with a copy of the MRS amendment text which you were referring to on the phone?

Thanks for your assistance Tracey.

Kind Regards
Chrystal King



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From: Chrystal King
Sent: Wednesday, 11 April 2012 8:59 AM
To: Helen Griffiths (helen.griffiths@planning.wa.gov.au)
Subject: Bush Forever Site 397 - Alkimos

Hi Helen,

Apologies on taking a bit of time to email you about the above Bush Forever Site.

We are working on the a structure plan for the Alkimos development, which includes a portion of Bush Forever Site 397 ([within the northern portion of Lot 102](#)).

The planning for this site has been extensive, including a formal assessment of the MRS amendment by the EPA in 2006. This resulted in the creation of a number of areas of Regional Open Space (ROS) zoned Parks and Recreation Reservation under the MRS. The location of the ROS and Bush Forever Site 397 are shown in the attached figure (F14). As you can see the ROS covers only a part of BF 397.

I am interested in the historical Bush Forever planning that may have occurred for the above site. I have assumed that the area of Regional Open Space represents an agreed outcome which defines the area required to be protected for conservation, however any information you may have will be useful.

Please contact me if you have any questions or require further information.

Kind Regards
Chrystal

WESTERN AUSTRALIAN PLANNING COMMISSION

METROPOLITAN REGION SCHEME TEXT

This document is a working paper for use as a reference by officers of the Department for Planning and Infrastructure.

It is based on the 1 APRIL 1984 consolidation of The Scheme published in the *Government Gazette* of 29 NOVEMBER 1985 (pp 4470 - 4474) and includes subsequent amendments made to the text and reference notes up to and including those introduced by the *Swan and Canning Rivers (Consequential and Transitional Provisions) Act 2006*.

The text is retained in the Department's networked computer directory (G:\Legis\Metro Region Scheme Text) and is corrected and updated by the WAPC Secretariat as required. (Paper copies may be printed from this source). Text errors or other problems experienced in using the document should be brought to the notice of the Team Leader - Regional Schemes or Manager - WAPC Secretariat.

Notes have been placed into this working paper that do not form part of the 'official' text. Notes are in italics and marked 'Note'.

This Working Paper is for reference/technical use and in cases of dispute or litigation it is recommended that the published text and amendments be used.

This document is available on the WAPC website www.wapc.wa.gov.au or from -

Department for Planning and Infrastructure
Albert Facey House
469 - 489 Wellington Street (cnr Forrest Place)
PERTH WA 6000

NOTE -

PREPARATORY PUBLICATIONS

*First published in GOVERNMENT GAZETTE of 09/08/63, pp. 3218-2325;
- to come into effect from and after 30 October 1963 (Government Gazette 1/11/63,
p.3340)*

*Amended by consolidation (at 01/04/80); in Government Gazette of 06/03/81, pp. 908-09.
Amended by Amendment No. 283/31; in Government Gazette of 22/05/81, p. 1566.
Amended by Amendment No. 386/33A; in Government Gazette of 14/08/81, p. 3337.
Amended by Amendment No. 273/31; in Government Gazette of 11/09/81, p. 3936.
Amended by Amendment No. 452/33A; in Government Gazette of 22/10/82, p. 4150.
Amended by Amendment No. 503/33A; in Government Gazette of 09/12/83, p. 4822.*

*Consolidated and reprinted in GOVERNMENT GAZETTE of 29/11/85 pp. 4470-4474
- Corrigendum to Notice Government Gazette 13/12/85 p. 4783.*

*Amended by Amendment No. 699/33A; in Government Gazette of 03/06/88, p. 1876.
Amended by Acts Amendment (Swan River Trust) Act No. 21 of 1988; Part 7; assented to
05/10/88.*

*Amended by Amendment No. 721/33A; in Government Gazette of 25/11/88, p. 4721.
Amended by Amendment No. 737/33A; in Government Gazette of 02/11/90, pp. 5472-5473.
Amended by consolidation (at 31/12/91); in Government Gazette of 17/11/92, pp. 5614-
5615.*

*Amended by Swan Valley Planning Act No 31 of 1995; assented to 18/09/95 and proclaimed
25/11/95; Government Gazette of 24/11/95, p. 5389.*

Amended by Amendment No. 983/33A; in Government Gazette of 01/07/97, p. 3268.

Amended by Amendment No. 981/33; in Government Gazette of 17/04/98, p. 2055.

*Amended by Amendment No. 1000/33A; in Government Gazette of 30/06/98, p. 3540;
(see also corrigendum in GG 21/08/98, p. 4675-4676).*

Amended by Amendment No. 998/33; in Government Gazette of 29/06/99, p. 2851.

Amended by Amendment No. 1014/33A; in Government Gazette of 30/06/00, p. 3450.

Amended by Amendment No. 1009/33A; in Government Gazette of 12/04/02, pp. 1924-1925.

*Amended by the Planning and Development (Consequential) Regulations 2006; assented to
12/12/05 and proclaimed 09/04/06; Government Gazette of 05/05/06, pp. 1731-1733.*

*Amended by the Swan Valley Planning Legislation Amendment Act No. 7 of 2006; assented
to 19/04/06 and proclaimed 18/06/06; Government Gazette of 16/06/06, p. 2109.*

*Amended by the Swan and Canning Rivers (Consequential and Transitional Provisions) Act
2006; assented to 06/10/06 and proclaimed 25/09/07; Government Gazette of 25/09/07, p.
4835.*

NOTE -

ENVIRONMENTAL CONDITIONS INCORPORATED IN SCHEDULE 1

[Where the Minister for the Environment places conditions upon an Amendment to the Scheme, reference to those conditions is added to Schedule 1. This is a list of such additions. The full detail of any conditions so placed in Schedule 1 are available for perusal at the office of the Department for Planning and Infrastructure in Wellington Street, Perth.]

- *Amendment No. 984/33; Effective Date: 21/10/1999*
- *Amendment No. 999/33A; Effective Date: 14/04/2000*
- *Amendment No. 991/33; Effective Date: 24/11/2000*
- *Amendment No. 1008/33; Effective Date: 12/12/2001*
- *Amendment No. 992/33; Effective Date: 13/12/2003*
- *Amendment No. 1010/33; Effective Date: 24/09/2004*
- *Amendment No. 1029/33; Effective Date: 23/06/2006*

METROPOLITAN REGION SCHEME

PART I – PRELIMINARY

1. The Scheme may be cited as the Metropolitan Region Scheme.
2. The Scheme is divided into Parts and Divisions as follows:
 - Part I - Preliminary
 - Part II - Reserved Land
 - Division 1 - Reservation of Land and Development thereof
 - Division 2 - Reserved Land Owned by or Vested in a Public Authority
 - Division 3 - Reserved Land not Owned by or Vested in a Public Authority
 - Part III - Zones, Development of Land in Zones
 - Part IV - Development
 - Division 1 - Approval of Responsible Authority to Commence Development
 - Division 2 - Appeals against Decision of Authority or Local Authority
 - Division 3 - Non-conforming Use of Land
 - Part V - Finance and Administration
3. (1) In this Scheme, unless the contrary intention appears -
 - "reserved land" means land reserved for a purpose under the Scheme;
 - "Scheme Act" means the Metropolitan Region Town Planning Scheme Act 1959, as amended from time to time;
 - "Swan development control area" has the meaning given to "development control area" in the Swan and Canning Rivers Management Act.
 - Words importing the singular shall be deemed to include the plural and the plural the singular.

[Note: Metropolitan Region Town Planning Scheme Act 1959 repealed by the Planning and Development (Consequential and Transitional Provisions) Act 2005, No. 38 of 2005, 21/03/06 p. 1078]

 - (2) A word or expression used in this scheme has the same meaning as it has in the

Planning and Development Act 2005 unless –

- (a) this Scheme gives it another meaning; or
- (b) the contrary intention appears in some other way.

4. The Authority shall publish in the *Government Gazette* the day on which this Scheme has effect as though its provisions were enacted by the Scheme Act as provided in section 32 of that Act.

[Note: *the Scheme has effect from and after 30 October 1963; GG 01/11/63; p. 3340*]

5. The Authority responsible for the carrying out of this Scheme is the Western Australian Planning Commission [*see Note - Metropolitan Region Planning Authority*] but in relation to any particular part of the Scheme the responsible authority shall be such other authority as the Authority delegates to be the responsible authority under section 16 of the *Planning and Development Act 2005*.

[Note: *the Metropolitan Region Planning Authority was superseded by the State Planning Commission from 6 December 1985 - refer Acts Amendment (State Planning Commission) Act 1985 and the State Planning Commission Act 1985.*]

[Note: *the State Planning Commission was superseded by the Western Australian Planning Commission from 1 March 1995 - refer Planning Legislation Amendment Act (No 2) 1994.*]

[Note: *section 19 of the Scheme Act was repealed by Acts Amendment (SPC) Act No. 92 of 1985. The WAPC Act No 91 of 1985 has separate provisions for delegation.*]

[Note: *the Metropolitan Region Town Planning Scheme Act 1959, Town Planning and Development Act 1928 and Western Australian Planning Commission Act 1985 were repealed by the Planning and Development Act 2005 from 9 April 2006.*]

6. This Scheme shall apply to all land within the metropolitan region.
7. This Scheme comprises this text setting out the provisions of the Scheme together with the Scheme map, comprising 38 sheets and the descriptive legend of the map, and colouring or markings thereon together with all Amendments to the Scheme made in accordance with the provisions of Clauses 15 and 27 of the Scheme, and the provisions of the *Planning and Development Act 2005*.
8. (1) Claims for compensation for injurious affection to land or property in accordance with the Scheme Act other than claims in respect of land reserved under part 2 of this Scheme, must be lodged with the Authority not later than six months from the

date on which the Scheme has the force of law.

- (2) Claims for compensation shall be in the form set out in Form 4 of this Scheme.
9. (1) a) Any development carried out between 7 September 1956, and the date of the Scheme having the force of law, other than development in accordance with the provisions of the Metropolitan Region (Perth and Fremantle) Interim Development Order No. 1, that does not conform with the provisions of this Scheme, shall be deemed to be in contravention of this Scheme.
- b) The failure or omission to carry out any development in accordance with the conditions subject to which the development was permitted under that Interim Development order, shall be deemed to be a contravention of the Scheme.
- (2) Where any development that is so deemed to be in contravention of this Scheme, has taken place on land and the land is subsequently purchased or otherwise acquired by the Authority that development shall not be taken into account in assessing the purchase price or compensation but the Authority may, if it thinks fit, make an additional payment of purchase monies or compensation in respect of that development.
10. Except as otherwise provided in this Scheme, no development of any land within the metropolitan region shall be commenced or continued without the written approval of the responsible authority in addition to any other permission or approval that may otherwise be required by law.
- [Note: Clause 10A inserted by Acts Amendment (Swan River Trust) Act, No. 21 of 1988, 01/03/89 p. 6]
- [Note: Swan River Trust Act 1988 repealed by Swan and Canning Rivers (Consequential and Transitional Provisions) Act 2006, No. 52 of 2006, 25/00/07 p. 4835]
- 10A. Clauses 13, 16 (2), 18, 24 and 28 do not apply to a development to which Part 5 of the *Swan and Canning Rivers Management Act 2006* applies.
11. (1) Objections to the Scheme may be made at any time within three months from the date the notice required to be published under section 31 of the Scheme Act is first published in the *Government Gazette*.
- (2) Such objections shall be made in the Form 6 to this Scheme and be addressed to the Secretary, Metropolitan Region Planning Authority.

PART II - RESERVED LAND

Division 1 - Reservation of Land and Development Thereof

12. (1) Land that is coloured and delineated on the Scheme Map in the manner set out in Column 1 of Table 1 to this clause is deemed to be reserved under the Scheme for the Purposes set forth opposite thereto in Column 2 of that table.

[Note: Table 1, Column 1, (e) and (j) amended by way of consolidation [s.33D(3)] effective GG 17/11/92. pp]

[Note: Table 1, Columns 1 & 2, (i), (j), (k) and (l) amended by the reduction of road reservations from 3 to 2 classifications; effective 23 June 1999; GG 29/6/99, p. 2851]

- (2) Table 1:-

Column 1 Legend on Scheme Map	Column 2 Purpose of which Land is Reserved
(a) All land coloured dark green	Parks and Recreation area
(b) All land coloured dark green with letter "R" - superimposed	Parks and Recreation area - restricted public access
(c) All land coloured grey	Railways
(d) All land coloured grey with black diagonal hatch	Port Installation
(e) All land coloured mustard yellow	State Forests
(f) All land coloured blue dots	Water Catchments
(g) All land coloured orange	Civic and Cultural
(h) All land coloured pale blue	Waterways
(i) All land coloured red	Primary Regional Roads
(j) All land coloured dark blue	Other Regional Roads
(k) All land coloured yellow - superimposed letters indicate the purpose for which land may be used as set out in Column 2	Public Purposes Hospital - H High School - H.S. Technical School - T.S. Car Park - C.P. University - U Commonwealth Government - C.G. State Energy Commission - S.E.C. Special Uses - S.U. Water Authority of Western Australia (formerly Metropolitan Water Supply Sewerage and Drainage Board) - W.S.D. Prison - P

13. Except as provided in Division 2 of this Part no person shall commence or carry out any development on reserved land, other than the erection of a boundary fence, without first applying for and obtaining the written approval of the Commission to do so.

14. No provisions of this Part shall prevent the continued use of land for the purpose for which it was being lawfully used immediately before the Scheme has the force of law.

[Note: Clause 15 deleted by Government Gazette effective 06/05/81, p. 1566]

Division 2 - Reserved Land Owned by or Vested in a Public Authority

[Note: Clause 16 amended by Government Gazette effective 12/04/2002, pp. 1924-1925]

- 16 (1) Reserved land owned by or vested in a public authority may be used without the written approval of the Commission referred to in Clause 13 if the land is used:
- (a) for the purpose for which it is reserved under the Scheme;
 - (b) for any purpose for which it was lawfully used before the coming into force of the Scheme; or
 - (c) for any purpose for which the land may be lawfully used by the public authority.
- (1a) Development on reserved land owned by or vested in a public authority may be commenced or carried out without the written approval of the Commission if the development is –
- (a) permitted development that does not involve the clearing of regionally significant vegetation on a site specified as a *Bush Forever* site in the *Bush Forever Final Report* published by the Commission in December 2000; or
 - (b) expressly authorized under an Act to be commenced or carried out without the approval of the Commission.
- (2) Reserved land owned by or vested in a public authority may be used or developed for any other purpose approved by the Commission with or without conditions.
- (3) In this clause –
- “permitted development”** means –
- (a) works on land reserved for Primary Regional Roads or Other Regional Roads for the purpose of or in connection with a road within the meaning of the *Main Roads Acts 1930*;
 - (b) works on land reserved for Port Installations for the purpose of or in connection with a port;
 - (c) works for the purpose of or in connection with the supply of water, electricity or gas, or the drainage or treatment of waste, water or sewerage;

- (d) works on land reserved for Railways for the purpose of or in connection with a railway, but this does not include the construction or alteration of a railway station or any related car parks, public transport interchange facilities, or associated means of pedestrian or vehicular access;
- (e) works on land reserved for Parks and Recreation where the works are in accordance with a management plan endorsed by the Commission;
- (f) works on land reserved for Public Purposes - High School for the purpose of or incidental to a high school; and
- (g) operational works on land reserved for State Forests for the purpose of or incidental to a State Forest;

“reserved land owned by or vested in a public authority” includes reserved land in relation to which a public authority has an easement, right of way, right of occupation, or any other interest or right, privilege or concession”.

17. Where it is desired to develop reserved land within a State Forest or Water Catchment Area for a purpose other than that for which the land is reserved under the Scheme the land shall be subject to the Scheme in the same way as if the land were within a Rural zone.

Division 3 - Reserved Land not Owned by or Vested in a Public Authority

[Note: Clause 18 amended by Government Gazette effective 12/04/2002, pp. 1924-1925]

18. Except as provided in Clauses 13 and 16 no person shall commence or carry out any development on reserved land that is not owned by or vested in a public authority without the written approval of the Commission to do so.
19. The approval of the Commission given under this Division may be subject to such conditions as the Commission considers necessary having regard to the purpose for which the land is reserved under the Scheme and may without limiting the generality of the foregoing include conditions limiting the period of the approval and relating to the type of buildings that may be built on the land and the removal of buildings from the land.
20. (1) Where the Commission refuses approval for the development of reserved land on the ground that the land is reserved for public purposes or approves subject to conditions that are unacceptable to the applicant if the land is injuriously affected thereby the owner may claim compensation for such injurious affection in accordance with the *Planning and Development Act 2005*.
- (2) Claims for such compensation shall be in the Form 4 to this Scheme and shall be lodged at the office of the Commission not later than six months after the date of the decision of the Commission refusing approval or granting it subject to conditions

that are unacceptable to the applicant.

- (3) In lieu of paying compensation, the Commission may in accordance with the *Planning and Development Act 2005* purchase the land affected by such decision of the Commission at a price not exceeding the value of the land at the time of refusal of approval or of the grant of approval subject to conditions that are unacceptable to the applicant.

PART III - ZONES

Development of Land in Zones

21. Where any provision of a local planning scheme of a local authority that has been duly made subsequent to this Scheme having the force of law, and which has been approved by the Minister and published in the *Government Gazette*, is at variance with any provision of this Part, the provision of the local planning scheme of the local authority shall prevail.
22. Pending approval of the town planning scheme of a local authority as required by section 35 of the Scheme Act, applications for the approval to commence and carry out development on land zoned under Part III of this Scheme shall be determined by the local authority in accordance with its current town planning scheme or its zoning or other bylaws, if any.
23. (1) Land, other than land reserved under Part II of this Scheme, is classified into zones as set out in Column 2 of Table 2 of this clause and shown coloured on the Scheme Map in the manner described in Column 1 of that Table.

[Note: Table 2, columns 1 and 2 amended by addition of zone numbered 8; effective 1 April 1998; *Government Gazette* 17/04/98, p. 2055

- (2) Table 2:

Column 1 Legend on Scheme Map	Column 2 Zone
1. All land coloured red brown	Urban
2. All land coloured light red brown	Urban Deferred
3. All land coloured light blue	Central City Area
4. All land coloured purple	Industrial
5. All land coloured purple with horizontal and vertical hatching	Special Industrial
6. All land coloured light green	Rural
7. All land coloured yellow green	Private Recreational
8. All land coloured smokey green	Rural - Water Protection

[Note: *Clause 24 amended by Government Gazettes 11/09/81 p. 3936 and 30/06/2000, p. 3450.*]

24. (1) Subject to sub-clause (2) of this clause approval of the responsible authority under this scheme is required for the development of land within areas zoned under this Part.
- (2) Approval under this Part is not required for the development of land if:
- a) that land is not subject of a notice under Clause 32 of this Scheme or declaration under section 112 of the *Planning and Development Act 2005*; and
 - b) that development consists of:
 - (i) the erection on a lot of a single dwelling house which will be the only building on the lot, no part of which lot is within the Swan development control area or abuts any part of the Swan development control area; or
 - (ii) the carrying out of any works on, in, over or under a street or road by a public authority acting pursuant to the provisions of any Act.

Approval under this Part does not exempt the person to whom the approval is granted from the requirement, if any, to obtain permission or approval for development on the land under any other law.

25. Subject to section 7 of the Town Planning Act, when making or amending a Town Planning Scheme in accordance with section 35 of the Scheme Act, a local authority shall have regard to the primary use for which the land to which the Town Planning Scheme relates is zoned under the Scheme as indicated by the descriptive title in column two of table two of the Scheme, but nothing in the Scheme prevents a local authority from making proper provision for that land or portion to be otherwise used or zoned for some other use and, when required by the Minister so to do, the local authority shall make such provision.

[Note: *Clause 26 amended by Government Gazettes 22/10/82 p. 4150 and 03/06/88 p. 1876, and by Swan Valley Planning Legislation Amendment Act 2006, 16/06/06 p.2109*]

26. (1) Except as provided in subclause (2) or (3) of this clause or sub-clauses (1)(b) and (1)(c) of Clause 29 of this Scheme where a local authority -
- (a) has prepared a Town Planning Scheme in accordance with section 35 of the Scheme Act that has been approved and published in the *Government Gazette*; or
 - (b) has amended a Town Planning Scheme in accordance with section 35 of the Scheme Act so that it conforms to the provisions of this Scheme,

an approval given by the local authority to develop land comprised in the Scheme which has been zoned under this Part shall be deemed to be an approval under this Scheme.

- (2) In respect of applications for approval to develop land in the Swan Valley, where the advice of the Swan Valley Planning Committee is accepted by the City of Swan, the determination of the City of Swan under the local planning scheme is taken to be a determination under this Scheme.
 - (3) In respect of applications for approval to develop land in the Swan Valley, where the advice of the Committee is not accepted by the City of Swan, the City of Swan is to refer the application, together with any recommendations provided by all bodies consulted, and the reasons why the advice of the Committee was not accepted by the City of Swan, to the Commission for determination.
 - (4) In this clause “**Committee**”, “**Swan Valley**”, and “**Swan Valley Planning Committee**” have the same meanings as they have in the *Swan Valley Planning Act 1995*.
27. By resolution of the Commission notified in the *Government Gazette* land may be transferred from the Urban Deferred Zone to the Urban Zone.

PART IV - DEVELOPMENT

Division 1 - Approval of Responsible Authority to Commence Development

28. An application for the approval of the responsible authority to commence and carry out development shall be made in the form set out in Form 1 of this Scheme, and shall be submitted in duplicate to the local authority in whose district the land the subject of the application is situate, together with such plans and other information as the responsible authority may reasonably require.

[Note: *Clause 29 amended by Government Gazettes 22/10/82 p. 4150 and 03/06/88 p. 1876, and by Swan River Trust Act 1988, 01/03/89 p. 6]*

29. (1) The local authority to which such an application is duly submitted shall, within seven days of that application, forward it to the Commission for determination where -
- a) the application is for the development of land -
 - (i) reserved under Part II of this Scheme;
 - (ii) part of which is in the Swan development control area; or

- (iii) which abuts that any part of the Swan development control area, [*see Note on Swan River Trust area, at conclusion of MRS text*] or
 - b) the application is for the development of land zoned under Part III of the Scheme and the subject of a notice under Clause 32 of the Scheme or a declaration under section 112 of the *Planning and Development Act 2005*, or
 - c) the application is for development of land (nor coming under paragraph (a) (iii)) abutting reserved land and is not of a type which may be determined by that local authority under delegated powers conferred by the Commission pursuant to section 16 of the *Planning and Development Act 2005*.
 - (2) In the case of any application for the development of land zoned under Part III of the Scheme and not required by the terms of sub-clause (1) to be determined by the Commission, the local authority shall determine the application in accordance with the power delegated by the Commission under the *Planning and Development Act 2005*.
 - (3) Where under sub-clause (1) a local authority forwards an application to the Commission, the local authority may, within 42 days of the date of receipt of the application by local authority (or such further period as the Commission may allow) make recommendations for consideration by the Commission in respect of the application.
- 30.
 - (1) The Commission or a local authority exercising the powers of the Commission so delegated to it under the *Planning and Development Act 2005* may consult with any authority that in the circumstances it thinks appropriate; and having regard to the purpose for which the land is zoned or reserved under the Scheme, the orderly and proper planning of the locality and the preservation of the amenities of the locality may, in respect of any application for approval to commence development, refuse its approval or may grant its approval subject to such conditions if any as it may deem fit.
 - (2) Where approval is granted subject to conditions if the conditions are not complied with the approval may be revoked by the Commission or local authority that gave the approval.
 - (3) The Commission or a local authority may in respect of any such application limit the time for which the approval granted on the application, remains valid.
 - (4) Where a building or land is used or a proposed building is designed for more than one use it shall be regarded for the purposes of this scheme as being used or designated partially for each of those uses.

[Note: Clause 30A inserted by Acts Amendment (Swan River Trust) Act 1988, 01/03/89 p. 6-7]

30A. (1) In this clause -

"Minister for Planning" means the Minister to whom the administration of the *Planning and Development Act 2006* is committed;

"SCRM Minister" means the Minister to whom the administration of the *Swan and Canning Rivers Management Act 2006* is committed;

"Trust" means the Swan River Trust established by the *Swan and Canning Rivers Management Act 2006* section 16.

(2) Without limiting clause 30, if an application for approval relates to -

(a) a development on land comprised in a lot -

- (i) any part of which is within the Swan development control area; or
- (ii) that is not in the Swan development control area but abuts waters that are in the Swan development control area;

or

(b) a development -

- (i) of land that abuts the Swan development control area; or
- (ii) that in the opinion of the Commission is likely to affect waters in the Swan development control area,

other than a development to which paragraph (a) applies,

then, unless subclause (9) applies, the Commission is to give full particulars of the application to the Trust.

- (3) The Trust, within 42 days after the day on which it receives particulars of the application or within such longer period as the Commission allows, is to give to the Commission its advice in writing on how the application should be determined, including any conditions to which any approval should be made subject.
- (4) If the Trust fails to give its advice within the time allowed under subclause (3), it is taken to have no advice to give on the application.
- (5) Subject to any direction under subclause (7), the Commission is to determine an application referred to in subclause (2)(a) in a manner that is consistent with the advice of the Trust on the application.

- (6) The Commission is to have regard to the advice of the Trust when determining an application referred to in subclause (2)(b) but is not required to make a determination that is consistent with that advice.
- (7) If the Commission does not agree with part or all of the advice of the Swan River Trust on an application referred to in subclause (2)(a) -
 - (a) the matter on which there is not agreement is to be resolved in the manner determined by the SCRM Minister and the Minister for Planning;
 - (b) the Minister for Planning is to direct the Commission accordingly; and
 - (c) the Commission is to determine the application in accordance with the direction.
- (8) Nothing in subclause (7) is to be read as limiting the *Planning and Development Act 2005* section 17.
- (9) The Trust may determine that any particular class or description of application need not be referred to it for advice under this clause and is to notify the Commission of any such determination.

[Note: *Clause 30B inserted by Swan Valley Planning Act 1995, 24/11/95 p. 5389 (does not apply to any application for approval under the Scheme made before the commencement of the Swan Valley Act 1995); and amended by Swan Valley Planning Legislation Amendment Act 2006, 16/06/06 p.2109]*

- 30B
- (1) Without limiting clause 30 of this Scheme where an application for approval relates to a development of land in the Swan Valley the responsible authority shall, unless subclause (6) applies to the application, give full particulars of the application to the Swan Valley Planning Committee.
 - (2) The Committee shall, within 42 days after the day on which it receives particulars of an application, or within such longer period as the responsible authority allows, give to the responsible authority its advice in writing on how the application should be determined, including any conditions to which any approval should be made subject.
 - (3) If the Committee fails to give its advice within the time allowed under subclause (2), it shall be taken to have no advice to give on the application.
 - (4) Where the responsible authority is the Commission, the Commission is required to have due regard to the advice of the Committee, but may determine the application otherwise than in accordance with that advice.
 - (5) Where the responsible authority is the City of Swan, the City is to have due regard to the advice of the Committee but if the City of Swan does not accept that advice, the City of Swan is to refer the application, together with any recommendations

provided by all bodies consulted, and the reasons why the advice of the Committee was not accepted by the City of Swan, to the Commission for determination.

- (6) The Committee may determine that any particular class or description of applications for approval need not be referred to the Committee for advice under this section and is to notify the Commission and the City of Swan of any such determination.
- (7) In this clause "**Swan Valley**", "**Swan Valley Planning Committee**" and "**Committee**" have the same meanings as they have in the *Swan Valley Planning Act 1995*.

[Note: *Clause 31 amended by Government Gazette 09/12/83 p. 4822; and Form 2 amended by Government Gazette 02/11/90 pp. 5472 - 5473*]

- 31. (1) The Commission or a local authority shall issue its decision in respect of any application for approval to commence development in the form set out in form 2 to this Scheme.
 - (2) An application shall be deemed to have been refused where a decision is not conveyed to the applicant by the local authority or the Commission, as the case required, within 60 days of the receipt of this application -
 - a) by the local authority, if the application can be determined by the local authority; or
 - b) by the Commission, if the application is required by this Scheme to be determined by the Commission,or within such further time as may be agreed in writing between the applicant and the local authority or the Commission, as the case requires, within that period of 60 days.
- 32. The Commission may by resolution, a notice of which shall be published in the *Government Gazette* and a copy served on the responsible authority as soon as practicable after the resolution is passed by the Commission -
 - (1) define areas in respect of which the proposals contained in this Scheme which relate to the areas are to be reviewed by the Commission and require that applications for all or certain classes of development on land in those areas shall be referred to the Commission for determination;
 - (2) require that a local authority forward any such particular application or application in respect of a specified class of development on land in the area, to the Commission for its determination.

[Note: *Clause 32A inserted by Swan River Trust Act 1988, 01/03/89 p. 8]*

[Note: *Swan River Trust Act 1988 repealed by Swan and Canning Rivers Management Act 2006, 12/09/07]*

32A. The power in clause 32 of this Scheme shall not be exercised in respect of any land comprised in a lot that is wholly, or waters that are, within the Swan development control area.

Division 2 - Appeals Against Decision of the Commission or Local Authority

[Note: *Clause 33 hereunder amended by Government Gazette 09/12/83 p. 4822]*

33. (1) An applicant for approval to commence development on land zoned under Part III of this Scheme whose application has been refused by the Commission or local authority exercising the power duly delegated to it by the Commission or approved subject to conditions that are unacceptable to the applicant may, except where the refusal or conditional approval is in accordance with the provisions of a local planning scheme, appeal to the Minister against such refusal or conditional approval.
- (2) Part 14 of the *Planning and Development Act 2005* applies to an appeal under subclause (1).

[Note: *Clause 34 deleted by Government Gazette 22/05/81, p. 1566]*

[Note: *Clause 35 amended by Government Gazette 01/12/83 p. 4822]*

35. A person who feels aggrieved by a decision of the Commission not to transfer land from the Urban Deferred Zone to the Urban Zone may, within the time and in the manner prescribed by the Metropolitan Region Scheme (Appeals) Regulations 1964, appeal to the Minister.

[Note: *Clause 36 amended by Government Gazette 01/12/83 p. 4822]*

36. The decision of the Minister on an appeal shall be final.

[Note: *Clause 37 deleted by Government Gazette 09/12/83, p. 4822]*

Division 3 - Non-Conforming Use of Land

38. No provision of this Scheme shall prevent -
- (a) the continued use of any land or building for the purpose for which it was being lawfully used at the time of coming into force of this Scheme; or
 - (b) the carrying out of any development thereon for which, immediately prior to that time a permit or permits required under the Town Planning Act and any other law authorising the development to be carried out had been duly obtained and was current.
39. Where a non-conforming use exists or was authorised as mentioned in Clause 38 of this Scheme on land -
- (1) reserved under Part II of this Scheme - all or any erection, alteration or extension of the buildings thereon or use thereof shall not be carried out or continued unless the approval of the Commission has been obtained in writing;
 - (2) zoned under Part III of this Scheme - such use or building thereon or both may be extended to the limits prescribed by the Uniform Building Bylaws or such other bylaw made under the *Local Government Act 1960*, and amendments for the purpose of limiting the size, location and distance from boundaries and other matters required by law for that class of use within the boundary of the lot or lots on which the use was carried on immediately prior to the coming into force of this Scheme.

PART V - FINANCE AND ADMINISTRATION

40. The Commission may at any time after the coming into force of this Scheme purchase, resume or otherwise acquire in accordance with the *Planning and Development Act 2005* any land reserved under Part II of this Scheme and such other land as may be required for the carrying out of this Scheme.
41. Land so acquired by the Commission may be disposed of or alienated to the public or other authority responsible for carrying out the development on the land or where the land is not required for the purpose of the Scheme then in accordance with the provisions of section 196 of the *Planning and Development Act 2005*.

[Note: Clause 42 hereunder amended by Government Gazettes 14/08/81 p. 3337, 25/11/88 p. 4721 and 1 July 1997 p. 3268]

42. The Commission may on payment of the sum of twenty five dollars issue a certificate in the form set out in Form 5 to this Scheme in respect of any land stating the manner in which it is affected by the Scheme and the purpose if any for which the land is reserved under the Scheme.

[Note: *Clause 43 hereunder, and Schedule 1, added by Government Gazette 30 June 1998, p. 3540*]

43. Pursuant to sections 50 and 61 of the *Planning and Development Act 2005*, conditions under Section 48F(2) or Section 48G(3) of the *Environmental Protection Act 1986* are set out in Schedule 1.

SCHEDULE 1
ENVIRONMENTAL CONDITIONS

AMENDMENT No. AND GAZETTAL DATE	LOCATION	ENVIRONMENTAL CONDITIONS
<p>METROPOLITAN REGION SCHEME AMENDMENT No. 984/33 (FORRESTFIELD MARSHALLING YARDS)</p> <p>Effective Date: 21-10-1999</p> <p>Gazettal Date: 29-10-1999</p>	<p>Forrestfield Marshalling Yards, generally bounded by Dundas Road to the east, Tonkin Highway to the south, and the Perth International Airport to the west, as per MRS Amendment No. 984/33.</p>	<p>Environmental Management Plans shall be prepared in accordance with the specifications set out in the Minister for the Environment's "Statement that a Scheme may be Implemented" No. 000510 published on 4 June 1999, for:</p> <ul style="list-style-type: none"> • Drainage and Nutrient Management Plans; • Soil Contamination Remediation Plans; • Groundwater Contamination Remediation Plans; and • Groundwater Abstraction Plan. <p>These Environmental Management Plans shall be prepared and implemented in accordance with the provisions of the Plans, to the requirements of the Western Australian Planning Commission, with the concurrence of the Department of Environmental Protection and the Water and Rivers Commission, where required by the "Statement that a Scheme may be Implemented" No. 000510.</p>

SCHEDULE 1
 ENVIRONMENTAL CONDITIONS

AMENDMENT No. AND GAZETTAL DATE	LOCATION	ENVIRONMENTAL CONDITIONS
<p>METROPOLITAN REGION SCHEME AMENDMENT No. 999/33A (NORTHBRIDGE URBAN RENEWAL)</p> <p>Effective Date: 14 - 4 - 2000 Gazettal Date: 14 - 4 - 2000</p>	<p>Northbridge Urban Renewal Area, generally bounded by Lord Street to the east, Aberdeen Street to the south, Newcastle Street to the north and Fitzgerald Street to the west, as per MRS Amendment No. 999/33A.</p>	<p>Environmental Management Plans and requirements shall be prepared in accordance with the specifications set out in the Minister for the Environment's "Statement that a Scheme may be Implemented" No. 000542 published on 7 April 2000, for:</p> <ul style="list-style-type: none"> • Soil Contamination Management Plan(s); • Soil Remediation Validation Report(s); • Groundwater Contamination Investigations; • Contaminated Groundwater Management; and • Contaminated Site Schedule. <p>These Environmental Management Plans and requirements shall be prepared and implemented in accordance with the provisions of the Plans, to the requirements of the Western Australian Planning Commission, with the concurrence of the Department of Environmental Protection and the Water and Rivers Commission, where required by the "Statement that a Scheme may be Implemented" No. 000542.</p>

SCHEDULE 1
 ENVIRONMENTAL CONDITIONS

AMENDMENT No. AND GAZETTAL DATE	LOCATION	ENVIRONMENTAL CONDITIONS
<p>METROPOLITAN REGION SCHEME AMENDMENT No. 991/33 (SOUTH WEST DISTRICTS OMNIBUS No.3B)</p> <p>Effective Date: 24-11-2000</p> <p>Gazettal Date: 15-12-2000</p>	<p>Marine Industry Technology Park, Munster: land bounded by Fawcett Road, Coogee Road, Frobisher Avenue, Rockingham Road and Russell Road, and adjacent to Lake Coogee, Munster</p> <p>Realignment of “Controlled Access Highway” reservation, Baldvis: between Lightbody Road and the future Kwinana Freeway interchange at Baldvis</p>	<p>Environmental Management Plans and requirements shall be prepared in accordance with the specifications set out in the Minister for Environment’s “Statement that a Scheme may be Implemented” No. 000546 published on 30 May 2000, for:</p> <ul style="list-style-type: none"> • Environmental Management Plan for the Marine Technology Park; • Drainage and Nutrient Management Plan for the Marine Technology Park; • Site Contamination Management Plan; and • Environmental Management Plan for the Realignment of “Controlled Access Highway” reservation, Baldvis. <p>These Environmental Management Plans and requirements shall be prepared and implemented in accordance with the provisions of the plans, to the requirements of the Western Australian Planning Commission, with the concurrence of the Department of Environmental Protection and the Water and Rivers Commission, in consultation with the City of Cockburn and Land Management, where required by the “Statement that a Scheme may be Implemented” No. 000546</p>

SCHEDULE 1
ENVIRONMENTAL CONDITIONS

AMENDMENT No. AND GAZETTAL DATE	LOCATION	ENVIRONMENTAL CONDITIONS
<p>METROPOLITAN REGION SCHEME AMENDMENT No. 1008/33 (SOUTH FREMANTLE / HAMILTON HILL)</p> <p>Effective Date: 12-12-2001</p> <p>Gazettal Date: 21-12-2001</p>	<p>As Shown on Figure 1 of the Minister for Environment's "Statement that a Scheme may be Implemented" No.000560</p>	<p>Prior to application for subdivision or development approval, the potential for land use conflict between sensitive land uses and industrial premises shall be identified and buffers established where necessary to the satisfaction of the Western Australian Planning Commission on advice of the Department of Environmental Protection, City of Fremantle and City of Cockburn.</p> <p>Environmental Management Plans and requirements shall be prepared in accordance with the specifications set out in the Minister for the Environment's "Statement that a Scheme may be Implemented" No. 000560 published on 22 December 2000, for:</p> <ul style="list-style-type: none"> • Noise Management Plan; • Site Investigation and Management Plan; and • Site Remediation and Validation Report. <p>These Environmental Management Plans and requirements shall be prepared and implemented in accordance with the provisions of the plans, to the requirements of the Western Australian Planning Commission, with the concurrence of the Department of Environmental Protection, in consultation with the Health Department of WA, Water and Rivers Commission, City of</p>

		Fremantle and City of Cockburn, where required by the "Statement that a Scheme may be Implemented" No. 000560
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SCHEDULE 1
ENVIRONMENTAL CONDITIONS

AMENDMENT No. AND GAZETTAL DATE	PROPOSAL/LOCATION	ENVIRONMENTAL CONDITIONS
<p>METROPOLITAN REGION SCHEME AMENDMENT No. 992/33 (CLARKSON-BUTLER)</p> <p>Effective Date: 13-12-2003 Gazettal Date: 23-01-2004</p>	<p>Urban Deferred Zone, Clarkson: land bounded by Marmion Avenue, Neerabup Road, the Mitchell Freeway transportation corridor, and the Parks and Recreation reservation surrounding the Tamala Park Landfill (Portion Lot 118), Clarkson</p> <p>East-West Roads (Hester Avenue and Neerabup Road): two district distributor roads between Wanneroo Road and Mitchell Freeway transportation corridor, through Neerabup National Park</p> <p>Adjustments to Wanneroo Road Reservation: minor adjustments (reduction or widening) of sections of Wanneroo Road reservation</p> <p>Mitchell Freeway and part of Northern Suburbs Rail System: alignment of the Mitchell Freeway and Northern Suburbs Rail System north of Hester Avenue, Butler</p>	<p>Management Plans and requirements shall be prepared in accordance with the specifications set out in the Minister for the Environment’s “Statement that a Scheme may be Implemented” No. 000629 published on 8 July 2003 as follows:</p> <ul style="list-style-type: none"> • Environmental Management Plan and Stygofauna and Troglobitic Fauna Management Plan for the Urban Deferred Zone, Clarkson; • Vegetation and Fauna Management Plan and Construction Management Plan for the East-West Roads; • Vegetation and Fauna Management Plan and Construction Management Plan for the Adjustments to the Wanneroo Road Reservation; and • Vegetation and Fauna Management Plan, Construction Management Plan and Noise, Vibration and Light Management Plan for the Mitchell Freeway and part of the Northern Suburbs Railway System. <p>These Management Plans and requirements shall be prepared and implemented in accordance with the provisions of the Plans, to the requirements of the Western Australian Planning Commission, with the concurrence of the Environmental Protection</p>

	<p>Tamala Park Landfill, Clarkson: Land within 500 metres of the Tamala Park Landfill on the Public Purposes reservation (Portion Lot 118), Clarkson</p>	<p>Authority, in consultation with the Department of Environmental Protection, Water and Rivers Commission, the Department of Conservation and Land Management, the Western Australian Museum, the University of Western Australia (Department of Zoology) and conservation groups (including Quinn’s Rock Environmental Group), where required by the “Statement that a Scheme may be Implemented” No. 000629.</p> <p>Provisions shall be included in the City of Wanneroo District Planning Scheme No. 2 to preclude residential uses from within 500 metres of the active face of any existing or proposed putrescible wastes filling area unless it is demonstrated to the Environmental Protection Authority, through appropriate studies and investigations, that odour, noise, landfill gas and dust will not adversely impact on future residents.</p>
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SCHEDULE 1
ENVIRONMENTAL CONDITIONS

AMENDMENT No. AND GAZETTAL DATE	LOCATION	ENVIRONMENTAL CONDITIONS
<p>METROPOLITAN REGION SCHEME AMENDMENT No. 1010/33 (PORT CATHERINE)</p> <p>Effective Date: 24-09-04 Gazettal Date: 26-10-2004</p>	<p>South Coogee: land bounded by the South Fremantle Power station and the freight line in the north, the limestone ridge within the Coogee Open Space area to the east, the Coogee Beach Reserve and northern edge of the Cockburn Waters residential estate to the south, and the western extent of the proposed ocean marina to the west.</p>	<p>1. Management Programs and Management Plan</p> <p>The following Management Programs and Management Plan are to be prepared in accordance with the specifications set out in Attachment 1 in the Minister for the Environment’s “Statement that a Scheme may be Implemented” No. 000636 published on 20 October 2003, and shall be subsequently implemented in accordance with the provisions of those Management Programs and Management Plan:</p> <ul style="list-style-type: none"> • Remedial Works Management Program; • Construction Management Program; • Waterways Environmental Management Program; and • Noise and Vibration Management Plan <p>2. Responsibilities for On-going Management</p> <p>Prior to the finalisation of a Town Planning Scheme Amendment for the land within the Metropolitan Region Scheme amendment area, or the consideration of an application for subdivision or development within the amendment area (other than an application for consolidation or minor modification to existing boundaries), whichever occurs first, the Responsible Authority shall resolve responsibilities for on-going environmental management of the proposed</p>

		<p>marina, to the satisfaction of the Environmental protection Authority, such that a suitable entity, or entities, with adequate financial and technical resources and authority, will ensure that the objectives of the Environmental Management Program, as set out in Attachment 1 in the Minister for the Environment's "Statement that a Scheme may be implemented" No.000636 published on 20 October 2003, will be achieved.</p>
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SCHEDULE 1
ENVIRONMENTAL CONDITIONS

AMENDMENT No. AND GAZETTAL DATE	LOCATION	ENVIRONMENTAL CONDITIONS
<p>METROPOLITAN REGION SCHEME AMENDMENT No. 1029/33 (ALKIMOS-EGLINTON)</p> <p>Effective Date: 23-06-06</p> <p>Gazettal Date: 07-07-06</p>	<p>Parks and Recreation and Public Purposes Reservations, Alkimos: within lots 101, 102 and M1482.</p> <p>Railways and Other Regional Roads Reservations, Alkimos: within lots 101, 102 and M1482 and adjoining Parks and Recreation and Public Purposes Reservations</p>	<p>Prior to approving subdivision or development applications (whichever is sooner) for infrastructure proposals, the Western Australian Planning Commission or local government, as the case requires, may require an Environmental Management Plan to be prepared and implemented to achieve the objective of managing the potential impacts of the proposed subdivision or development on the following:</p> <ol style="list-style-type: none"> 1) land which is reserved as Regional Open Space in the Scheme; and, 2) bushland or land that may be part of an ecological linkage. <p>The Environmental Management plan shall include:</p> <ol style="list-style-type: none"> 1) a description of existing environmental values, and the identification of the environmental outcome to be achieved through the implementation of this plan; 2) clear delineation of boundaries or significant areas to be protected; 3) management of construction access and rehabilitation; 4) vegetation mitigation strategies; 5) allocation of responsibilities and identification of timing and duration of implementation; 6) provision of routine monitoring and environmental values; and 7) provision of details of contingency plans in the event

		<p>that the monitoring surveys indicate that the development is having or has had an adverse impact upon environmental values.</p> <p>An Environmental Management Plan prepared pursuant to this condition shall be prepared to the satisfaction of the WAPC or the local authority as required, having due regard for advice from relevant government agencies and shall be implemented in accordance with a program defined in the Environmental Management Plan.</p>
	<p>Public Purposes Reservation (for wastewater treatment purposes), Alkimos: within lots 101 and 102.</p>	<p>Portions of the Public Purposes reservation for the Wastewater Treatment Plant shall be set aside and managed for conservation purposes in accordance with the requirements set out in Attachment 1 of the Minister for the Environment's "Statement that a Scheme may be implemented" No. 722, published on 24 April 2006.</p>
	<p>Urban Deferred Zoning, Alkimos: within lots 101 and 102.</p>	<p>Lifting of Urban Deferment within the southern portion of the Wastewater Treatment Plant Buffer shall not occur unless it is demonstrated to the requirements of the Environmental Protection Authority that the area within which Urban Deferment is to be lifted is not subject to odour at a level likely to cause adverse impacts on the amenity of odour sensitive land uses.</p>
	<p>Parks and Recreation Reservations, Alkimos, Eglinton and Yanchep: within part lot 6, and lots 8, 11, 14, 15, 101, 102, M1482 and M1503</p>	<p>With the exception of the areas specified below, all land reserved for Parks and Recreation shall be managed to protect the integrity, function and environmental values of the bushland and landforms to the requirement of the western Australian Planning Commission on the advice of the</p>

		Environmental Protection Authority and shall only be used for conservation, landscape and complimentary purposes.
	Parks and Recreation Reservation, Alkimos: within lot 102 and adjoining the Public Purposes Reservation for ground water treatment purposes.	A maximum of 25 percent of the area of the land is to be reserved for Parks and Recreation identified as Areas 6a and 6b on the map attached to the Minister for the Environment's "Statement that a Scheme may be implemented" No. 722, published on 24 April 2005, may be developed for Parks and Recreation purposes in accordance with an Environmental Management Plan prepared to the requirements of the Environmental Protection Authority.

[Note: the Metropolitan Region Scheme includes five forms which are NOT reproduced in this document.]

The forms are:

FORM 1 APPLICATION FOR APPROVAL TO COMMENCE DEVELOPMENT

FORM 2 APPROVAL (or) REFUSAL OF APPROVAL TO COMMENCE DEVELOPMENT

FORM 3 APPEAL AGAINST REFUSAL BY THE WESTERN AUSTRALIAN PLANNING COMMISSION / LOCAL GOVERNMENT TO ALLOW DEVELOPMENT

FORM 4 CLAIM FOR COMPENSATION FOR INJURIOUS AFFECTION

FORM 5 CERTIFICATE (see Clause 42)

FORM 6 OBJECTION TO METROPOLITAN REGION SCHEME

[Note: Form 6 renamed Form 41 (for substantial amendments to the Scheme) and Form 57 (for non-substantial amendments to the Scheme) with the introduction of the Planning and Development Act 2005.]

[Note: Several clauses within the MRS text refer to the management area of the Swan River Trust. The definition of that area is contained in Schedules 1-4 to the Swan and Canning Rivers Management Act. Those schedules are printed here for ease of use.

These Schedules are NOT part of the Metropolitan Region Scheme Text.]

EXTRACT FROM THE SWAN AND CANNING RIVERS MANAGEMENT ACT 2006

SCHEDULE 1 - CATCHMENT AREA

All of the land and waters shown on Deposited Plan 47464.

SCHEDULE 2 - SWAN CANNING RIVERPARK

All of the land and waters shown hatched blue on Deposited Plan 47465 version 3.

SCHEDULE 3 - DEVELOPMENT CONTROL AREA

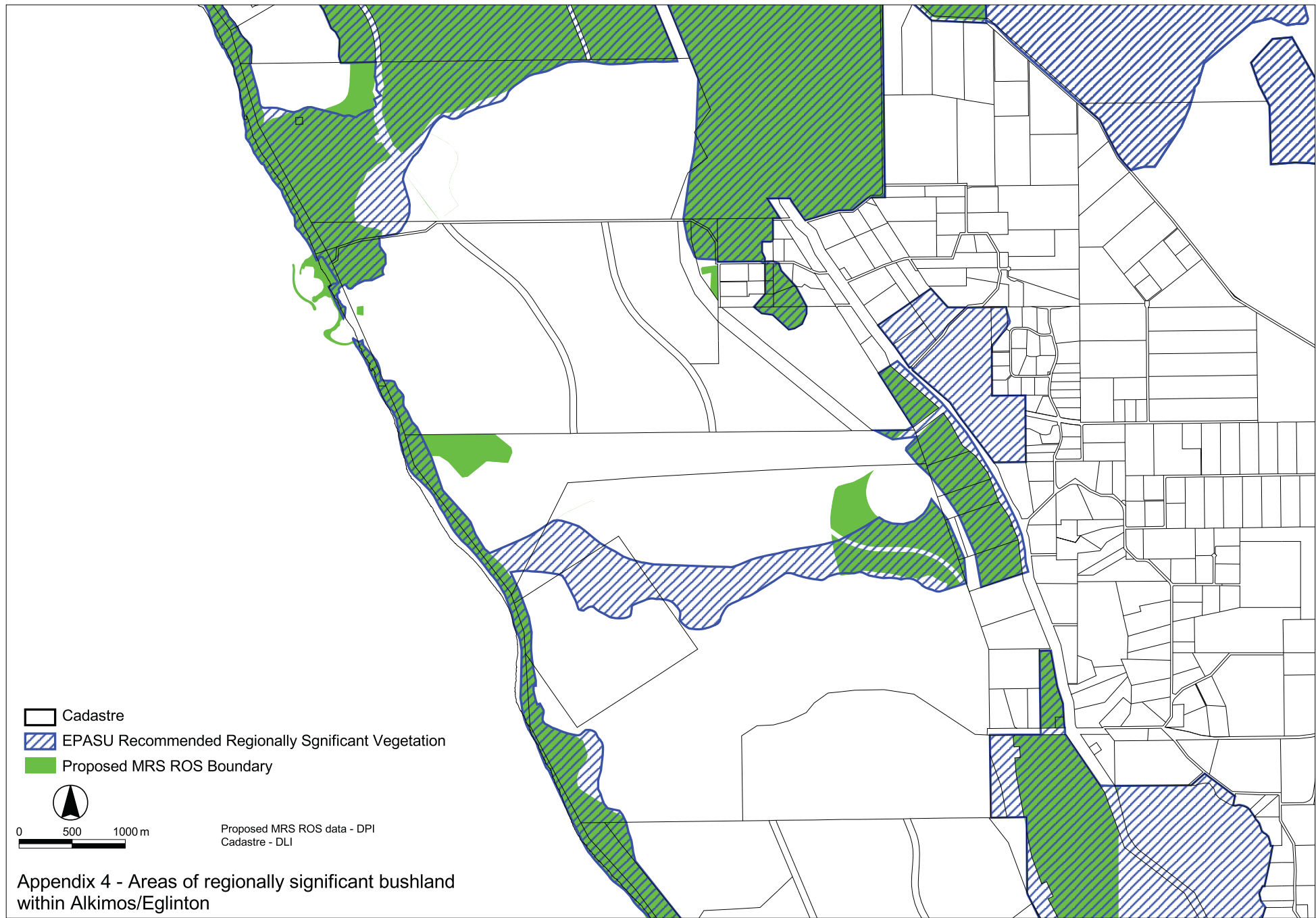
All of the land and waters shown bordered in red on Deposited Plan 47465 version 3.

SCHEDULE 4 - RIVER RESERVE

Reserve 48325, being the land in Lot 300 on Deposited Plan 47450, Lot 301 on Deposited Plan 47451, Lots 302 & 303 on Deposited Plan 47452, Lots 304 - 306 (inclusive) on Deposited Plan 47453, Lot 4893 on Deposited Plan 157903, Lot 11523 on Deposited Plan 189858, Lots 13598 & 13599 on Deposited Plan 220695, Lot 13017 on Deposited Plan 193785, Lot 13690 on Deposited Plan 220927, Lot 13949 on Deposited Plan 27474 and Lot 14082 on Deposited Plan 26651 comprising a total area of about 3002ha.

Reserve 48326, being the land in Lot 320 on Deposited Plan 47467 and Lot 321 on Deposited Plan 47468 comprising a total area of about 36ha.

Reserve 48327, being the land in Lots 310 & 311 on Deposited Plan 47439, Lots 312 & 313 on Deposited Plan 47440, Lots 314 - 316 (inclusive) on Deposited Plan 47441, Lot 4162 on Deposited Plan 93607, Lots 4367 & 4368 on Deposited Plan 194473, Lot 4369 on Deposited Plan 194474, Lot 4280 on Deposited Plan 215572 and Lot 4840 on Deposited Plan 32737 comprising a total area of about 558ha.



Appendix 4 - Areas of regionally significant bushland within Alkimos/Eglinton

Hon Mark McGowan MLA
Minister for the Environment,
Raving and Gaming

101 St George's Terrace, Perth WESTERN AUSTRALIA 6000
Telephone: (08) 9222 9111, Facsimile: (08) 9222 9110
Email: mark.mcgowan@perth.wa.gov.au Website: www.perth.wa.gov.au

Statement No.

STATEMENT THAT A SCHEME MAY BE IMPLEMENTED
(PURSUANT TO THE PROVISIONS OF DIVISION 3 OF PART IV OF THE
ENVIRONMENTAL PROTECTION ACT 1986)

010722

ALKIMOS-EGLINTON
METROPOLITAN REGION SCHEME
AMENDMENT 1029/33

Scheme Purpose: To amend reservations and zonings in the Metropolitan Region Scheme consistent with the Alkimos-Eglinton Structure Plan.

Responsible Authority: Western Australian Planning Commission

Responsible Authority Address: 469 Wellington Street, PERTH WA 6000

Assessment Number: 1365

Report of the Environmental Protection Authority: Bulletin 1207

Subject to the following conditions, there is no known environmental reason why the amendment to the Metropolitan Region Scheme to which the above report of the Environmental Protection Authority relates should not be implemented:

1 Additional Land to be Reserved

1-1 All or portions of the following sites shall be reserved, in accordance with the requirements set out in Attachment 1 of the Minister for the Environment's "Statement that a Scheme may be Implemented" No. (insert number) published on (date):

- 1) Public Purpose reserve surrounding the Wastewater Treatment Plant;
- 2) Parks and Recreation Reserve north of Ningana Bushland;
- 3) Parks and Recreation Reserves south of Ningana Bushland;

Published on

24 APR 2006

- 4) Parks and Recreation Reserve north of the Waste Water Treatment Plant;
- 5) Town park immediately north of the Alkimos Regional Centre;
- 6) Rationalisation and reductions to the coastal foreshore Regional Open Space reservation; and,
- 7) East-west parabolic dune linkage.

2 Environmental Management Plans

2-1 Prior to approving subdivision or development applications (whichever is sooner) for infrastructure proposals, the Western Australian Planning Commission or local government, as the case requires, may require an Environmental Management Plan to be prepared and implemented to achieve the objective of managing the potential impacts of the proposed subdivision, development or infrastructure on the following:

- 1) land which is reserved as Regional Open Space in the Scheme; and,
- 2) bushland or land that may be part of an ecological linkage.

The Environmental Management Plan shall include:

- 1) a description of existing environmental values, and the identification of the environmental outcome to be achieved through the implementation of this plan;
- 2) clear delineation of boundaries or significant areas to be protected;
- 3) management of construction, access and rehabilitation;
- 4) vegetation mitigation strategies;
- 5) allocation of responsibilities and identification of timing and duration of implementation;
- 6) provision for routine monitoring and environmental values; and
- 7) provision of details of contingency plans in the event that the monitoring surveys indicate that the development is having or has had an adverse impact upon environmental values.

2-2 An Environmental Management Plan prepared pursuant to condition 2-1 shall be prepared to the satisfaction of the WAPC or the local authority as required, having due regard for advice from relevant government agencies and shall be implemented in accordance with a program defined in the Environmental Management Plan.

- 3 Areas of Public Purpose Reservation to be protected for conservation purposes
- 3-1 Portions of the Public Purpose reservation for the Wastewater Treatment Plant shall be set aside and managed for conservation purposes in accordance with the requirements set out in Attachment 1 of the Minister for the Environment's "Statement that a Scheme may be implemented" No. (insert number) published on (date):
- 4 Lifting of Urban Deferment – Wastewater Treatment Plant Buffer
- 4-1 Lifting of Urban Deferment within the southern portion of the Wastewater Treatment Plant Buffer shall not occur unless it is demonstrated to the requirements of the Environmental Protection Authority that the area within which Urban Deferment is to be lifted is not subject to odour at a level likely to cause adverse impacts on the amenity of odour sensitive land uses.
- 5 **Development within areas reserved for Parks and Recreation**
- 5-1 With the exception of the areas specified in condition 5-2, all land reserved for Parks and Recreation shall be managed to protect the integrity, function and environmental values of the bushland and landforms to the requirements of the Western Australian Planning Commission on the advice of the Environmental Protection Authority and shall only be used for conservation, landscape and complimentary purposes.
- 5-2 A maximum of 25 percent of the area of the land to be reserved for Parks and Recreation identified as Areas 6a and 6b on the attached Figure may be developed for Parks and Recreation purposes in accordance with an Environmental Management Plan prepared to the requirements of the Environmental Protection Authority.

**HON MARK MCGOWAN MLA
MINISTER FOR THE ENVIRONMENT;
RACING AND GAMING**

24 APR 2006

STATEMENT THAT A SCHEME MAY BE IMPLEMENTED –
METROPOLITAN REGION SCHEME AMENDMENT 1029/33

SPECIFICATIONS FOR RESERVATION FOR THE WASTE WATER
TREATMENT PLANT AND ADDITIONAL LAND TO BE RESERVED

I Additional Land to be Reserved

Prior to finalisation of the scheme the following land shall be reserved:

1-1 Public Purpose Reserve surrounding the Wastewater Treatment Plant

Land surrounding the Wastewater Treatment Plant as detailed in the attached Figure shall be reserved for Public Purposes to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for complementary purposes.

1-2 Parks and Recreation Reserve north of Ningana Bushland

A portion of Lot M1503 (Area 1b as detailed in the attached Figure), Eglinton shall be reserved for conservation purposes to protect the integrity, function and environmental value of the bushland to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation, landscape and complementary purposes.

1-3 Parks and Recreation Reserve south of Ningana Bushland

A portion of Lot M1503, Eglinton (Area 2b as detailed in the attached Figure) shall be reserved for conservation purposes to protect the integrity, function and environmental value of the bushland to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation, landscape and complementary purposes.

1-4 Parks and Recreation Reserve south of Ningana Bushland

A portion of Lots M1503 and 11, Eglinton (Area 3a as detailed in attached Figure) shall be reserved for conservation purposes to protect the integrity, function and environmental value of the bushland to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation, landscape and complementary purposes.

1-5 Parks and Recreation Reserve north of the Waste Water Treatment Plant

A portion of Lots M1482 and 102, Alkimos (Areas 5a and 5d as detailed in attached Figure) shall be reserved for conservation purposes to protect the integrity, function and environmental value of the bushland to the requirements of the Western Australian Planning Commission on advice of the

Environmental Protection Authority, and shall only be used for conservation, landscape and complementary purposes.

1-6 Town Park immediately north of the Alkimos Regional Centre

A portion of Lot 102, Alkimos (Areas 6b and 6c as detailed in attached Figure) shall be reserved for conservation purposes to protect the integrity, function and environmental value of the bushland to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation, landscape and complementary purposes.

1-7 Rationalisation and reductions to the coastal foreshore Regional Open Space reservation

A portion of Lot 102, Alkimos (Area 7c as detailed in attached Figure) shall be reserved for conservation purposes to protect the integrity, function and environmental value of the bushland to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation, landscape and complementary purposes.

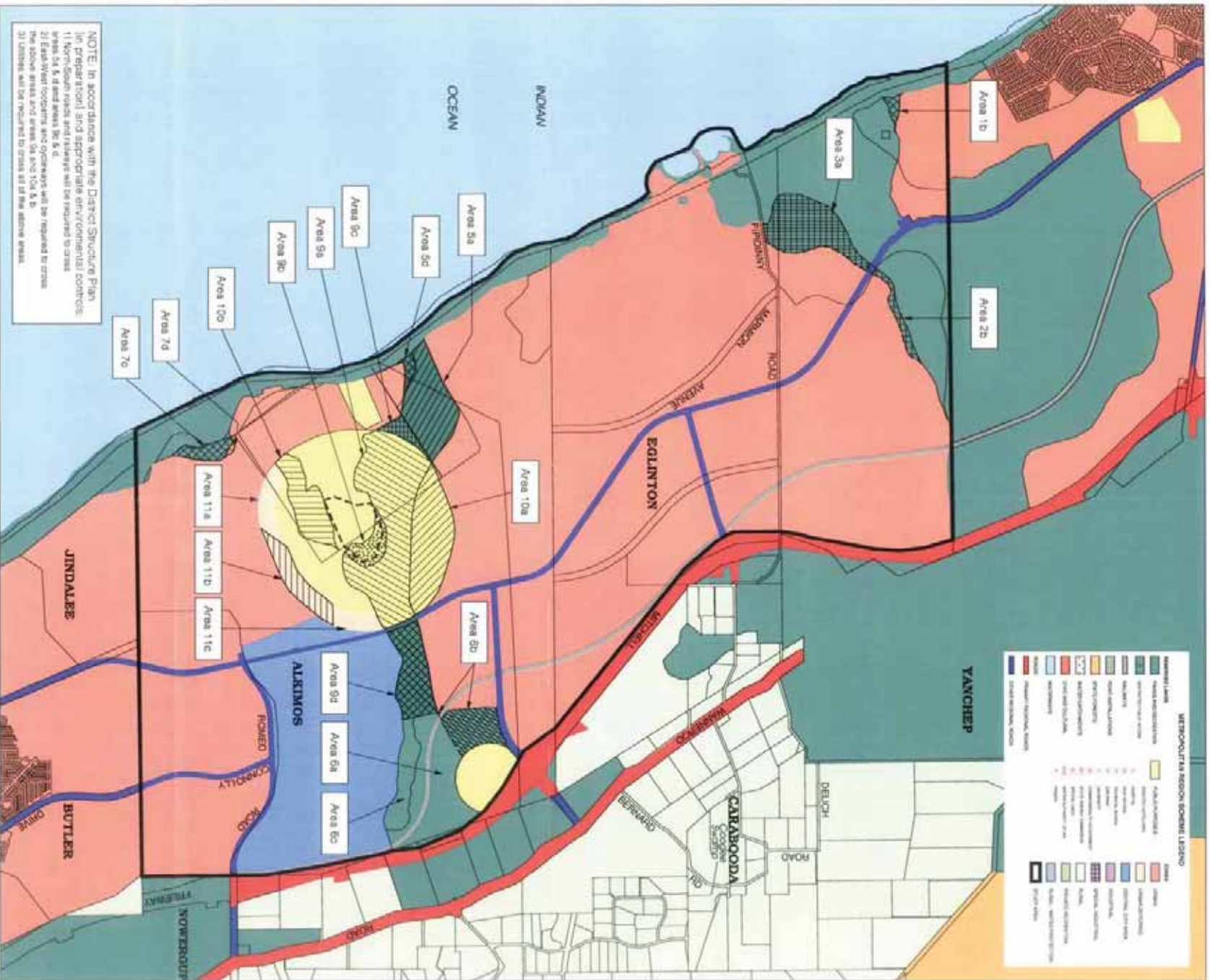
1-8 East-west parabolic dune linkage

A portion of Lots 101 and 102, Alkimos (Areas 9c and 9d as detailed in attached Figure) shall be reserved for conservation purposes to protect the integrity, function and environmental value of the bushland to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation, landscape and complementary purposes.

2 Areas of Public Purpose reservation to be protected for conservation purposes

2-1 Portions of Lots 101 & 102, Alkimos to be reserved for Public Purposes

(Areas 9a, 10a and 10b in the attached Figure) shall be protected and managed for conservation purposes to protect the integrity, function and environmental value of the bushland to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation, landscape and complementary purposes. Minor infrastructure may be installed within these areas, providing the work is undertaken in accordance with a Management Plan approved by the Environmental Protection Authority



NOTE: In accordance with the District Structure Plan (in preparation), and appropriate environmental controls areas 1a, 1b, 2a, 2b, 3a, 3b, 4a, 4b, 4c, 5a, 5b, 5c, 6a, 6b, 6c, 7a, 7b, 7c, 8a, 8b, 8c, 9a, 9b, 9c, 10a, 10b, 10c, 11a, 11b, 11c, the above areas and overlays will be required to cross:

- 1) Northern foreshore and reserve will be required to cross
- 2) East West foreshore and overlays will be required to cross
- 3) The above areas and areas 9a and 10a, 11a, 11b, 11c
- 4) Utilities will be required to cross all of the above areas.

MRS AMENDMENT 1029/33 ALKIMOS- EGLINTON
As determined by Minister for the Environment



Extra information supplied by D/L PA 23/2003
 22 Apr 2008
 Produced by Strategic Planning Section, Spatial Information & Mapping - Mapping & Geographic Data
 Distributed by Planning and Infrastructure, Strategic Planning & Mapping, Western Australian Planning Commission, Perth WA



APPENDIX H



ALKIMOS BEACH CONCEPT PLAN

Lend Lease, 2012



- | | | |
|---|---|--|
| <ul style="list-style-type: none"> 1. Mitchel Freeway and inter-city cycle route. 2. Local employment area with access to major roads and Alkimos City. 3. Alkimos Drive linking to Marmion Avenue and coast. 4. Marion Avenue transit corridor with vehicle, bus, cycle and walk routes. 5. Protected parabolic dune and ecological areas framing Regional Open Space. 6. Rail corridor with vehicle, cycle and pedestrian access to City and Transit interchange. 7. Key vehicle, cycle and walk between Central Alkimos and east end of City Centre . 8. District play fields as part of Regional Open Space. 9. Primary School with access to District play fields. 10. Key east-west street with principle shared path network connecting between schools. 11. Hill top residential area looking down over Regional Open Space. | <ul style="list-style-type: none"> 12. Inner city residential development beside connection to City. 13. Neighbourhood on west facing slope with views to regional parks. 14. Local park in hollow with natural vegetation and active use areas, shelters and kids play areas. 15. Secondary School on landmark site elevated above Marmion Avenue. Ocean view opportunities from western end of site. 16. Local activity centre and mixed use area serving community. 17. Neighbourhood on low saddle ridge with broad views. 18. Preserved limestone hilltop. 19. Waste Water Treatment Plant buffer with ecological areas and potential beach node access path network. 20. Alkimos Drive on limestone ridge with coast view potential. | <ul style="list-style-type: none"> 21. Ridge housing with views over ecological protection zone around Waste Water Treatment Plant. 22. Neighbourhood in hollow behind coastal dunes. 23. Protected escarpment with hill side housing. 24. Escarpment Park. 25. Neighbourhood on elevated plateau with views down dune gullies to ocean. 26. Connection to Alkimos coastal node including regional beach, foreshore parks, coastal village and to proposed marina. 27. Connection to Shorehaven coastal node. 28. Regional Open Space ecologically connection. |
|---|---|--|



ALKIMOS CENTRAL

CONCEPT PLAN



NOTE: This plan is indicative only, and specific site, road alignment, boundaries, setbacks, and building layout shown may vary due to detailed design considerations. © 2013 LandCorp. All rights reserved. Except as permitted by LandCorp, no part of this publication may be reproduced or distributed in any form or by any means, or stored in a database or retrieval system, without the prior permission of LandCorp.



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APPENDIX C

BUSHFIRE MANAGEMENT PLAN

(DON SPRIGGINS, NOVEMBER 2012)



Bushfire Management Plan

Central Alkimos

Prepared by Don Spriggins Forestry Consultants

December 2012

1. Introduction

1.1 *The purpose of this plan*

This Bushfire Management Plan sets out the background, principles and general commitments for bushfire management at the proposed residential and commercial development known as Central Alkimos (“the property”) by LandCorp and Lend Lease (“the developer”).

The purpose of this plan is to provide supporting information for the approval of the Local Structure Plan for the property.

The plan is prepared by Roger Underwood of York Gum Services, working for Don Spriggins Forestry Consultants (“The Principal Consultant”).

1.2 *General description of the site and its local context*

The property subject of this management plan has an area of approximately 200 hectares.

The property adjoins land to the north, which is being developed for urban purposes. The land to the east is vacant but is reserved for a Water Corporation groundwater treatment plant and Mitchell Freeway extension. The land on the eastern side of Marmion Avenue is currently vacant but is the site of the Alkimos Secondary Centre. The foreshore reserve and Indian Ocean is located to the west of the site

A proposed railway will also bisect the area running south/north parallel to Marmion Ave with a train station located within the City Centre.

The general geography of the area is shown in Figure 1.

1.3 *Bushfire significance*

The native vegetation on the property will be completely cleared before development, with the exception of the Regional Open Space area, which traverses the site in an east-west direction.

The most significant bushfire features is the strip of Regional Open Space (ROS) which runs from west-east through the middle of the development, which is to be managed for conservation and the buffer zone around the Alkimos Waste Water Treatment Plant. These areas carry coastal shrubland, balgas and

scattered eucalypt trees and grass. This bushland is flammable and if left long unburnt will carry a severe fire.

The climate of the region is conducive to bushfire occurrence and spread every summer. There are strong winds most summer days, especially from the west and south-west in the afternoon. Strong northerly winds occur on occasions during every summer, associated with the inland movement of low pressure troughs.

Bushfires have occurred in the area in the past, lit by lightning, accident or arsonists, and are certain to occur in the future.

Residential and commercial development of this area must be based on the assumption that bushfires will occur on and near the site in the future and that their impact on key values of the property must be minimised.

1.4 The proposed development

A Local Structure Plan has been prepared for the property to facilitate:

- Approximately 1816 dwellings;
- A neighbourhood centre;
- A Secondary School and Primary School;
- All lots will be serviced by sealed roads.

2. Principles underpinning bushfire management at the site

The developer has adopted the following principles to underpin bushfire management at this site:

- Bushfire threats will be identified in advance of development;
- Development planning will be undertaken in the light of an understanding of bushfire threats to human, economic and environmental values.
- A checklist will be provided showing compliance with the requirements set out in *Planning for Bushfire Protection Guidelines* –see appendix to this Management Plan.

The developer recognises that the following values will be potentially threatened by bushfires at this site:

- **Human lives:** Approximately 4700 people could be resident on the site
- **Assets:** The development will contain houses, sheds, equipment, house contents and equipment, a high school, a primary school and commercial premises.
- **Environmental values:** The site will have retained remnant bushland on the sand dunes system running through the property.

3. Bushfire Hazard Assessment

Sections of the property on which development will occur will be fully cleared of native bushland and therefore will have a zero bushfire hazard when the project commences. The parabolic sand dune system on which vegetation will be retained is assessed as having a Moderate bushfire hazard assessment.

The designated ROS is assessed as having a Moderate bushfire hazard.

The large buffer zone surrounding the Alkimos Waste Water Treatment Plant is vested with the Water Corporation. A separate environmental and bushfire management plan has been prepared by Water

Corporation for this area which, if implemented will minimise the risk of fires starting in the buffer zone and spreading into surrounding suburbia. This area is assessed as having an Extreme bushfire hazard.

Climatic/weather conditions at the site will be conducive for a bushfire during most days in summer, and autumn, with high temperatures and strong winds. The most serious fire winds will be the strong northeasterly and northwesterly winds, which occur during unstable atmospheric conditions every summer, and the strong westerly “sea-breezes” common on most summer afternoons.

The property gently undulates (>10 degrees).

Conclusion: *Following development the bulk of the property will not carry a running fire. Vegetation on the dune system or the retained bushland corridor will burn, and other areas will be vulnerable to ember attack from fires in adjoining bushland. Bushfires have occurred in this region in the past and will undoubtedly occur in the future.*

4. Bushfire attack level (BAL)

All lots within 100 metres are assessed according to Table 2.4.3 of AS 3959-2009.

- The vegetation in this area is classified as “scrub”;
- Lots adjoining bushland will be level with or downhill of retained bushland;
- A BAL of 19 is prescribed for all lots setback from bushland between 13 and 19 metres from retained bushland;
- A BAL of 12.5 is prescribed for all lots between 19 and 100 metres of retained bushland.

5. Fire detection and attack capability in the area

Rapid bushfire detection can be expected at this site due to the high resident and neighbouring populations, high vehicular use of Marmion Avenue and the freeway.

Firefighters will be available from the local Bush Fire Brigade and DEC. It is expected that a uniformed FESA fire brigade will be established in the area following progressive urban development along Marmion Avenue currently underway.

6. Measures to minimise the fire threat at the site

The developer undertakes to consider, and if practical to incorporate the following bushfire management measures at this site.

6.1 Compliance with planning requirements

This Bushfire Management Plan is based on the City of Wanneroo’s specification D10 “Bushfire Protection”, Part 3 of the City’s “Bushfire Protection Requirements for Subdivision and Development”, and the WAPC/FESA’s “Planning for Bushfire Protection Guidelines”.

6.2 Protection of human lives and property

The following measures will be adopted to protect, as far as is possible, the lives of residents and their assets from bushfire damage in this development:

(i) BAL 19

For all lots identified as having a BAL of 19 (shown on Figure 4), a notification in the form of a section 70A notification, pursuant to the Transfer of Land Act 1893 (as amended) is to be placed on the Certificates of Title.

The notification will advise of the existence of this Bushfire Management Plan and will require: (i) the dwelling on the lot to be 13 metres from the edge of the bushland; and (ii) houses constructed on these lots must comply with Section 3 and 6 of Australian Standards AS 3959-2009 (“Construction of Houses in Bushfire-prone Areas”).

(ii) BAL 12.5

For all lots identified as having a BAL of 12.5 (shown on Figure 4), a notification in the form of a section 70A notification, pursuant to the Transfer of Land Act 1893 (as amended) is to be placed on the Certificates of Title.

The notification will advise of the existence of this Bushfire Management Plan and will require houses constructed on these lots to comply with Section 3 and 5 of Australian Standards AS 3959-2009 (“Construction of Houses in Bushfire-prone Areas”).

- (iii) In addition to the requirements identified Sections 3, 5 and 6 of AS 3959-2009 the developer will advise all lot owners for lots that are located within 100 metres of retained bushland or the Alkimos Wastewater Treatment Site Buffer, that houses on these lots should have enclosed eaves and no gaps between rafters; that rotary roof ventilators be fitted with metal gauze spark screens with a maximum aperture size of 1.8 mm; and roof-mounted evaporative air conditioners have the openings to the cooling unit fitted with metal gauze spark guards.
- (iv) The developer will provide a copy of the Bushfire Management Plan and a copy of the document “Homeowners Bushfire Survival Manual Guidelines” to each initial lot purchaser for the lots adjacent to bushland.

6.3 Hazard management

The developer will fully clear all lots in advance of development, and undertakes to control weeds or regrowth on unsold lots during the development phase.

6.4 Access and egress

There will be high quality access/egress on sealed roads provided to every lot, thus permitting two-way movement of vehicles in an emergency, and rapid ingress for fire appliances. Every lot owner will have egress on sealed roads to Marmion Avenue, the freeway and Wanneroo Road, and linkages to the Trinity suburb to the south.

6.5 Firebreaks

There will be a sealed road separating lots from retained bushland.

6.6 Water supply

Reticulated scheme water will be available to every lot on the site.

Fire hydrants meeting FESA specifications will be installed every 200 m along the internal road system, and designated by standard markings.

6.7 Power supply

The developer will arrange for all lots to be supplied with electric power. All powerlines within the site will be underground.

6.8 Fire refuge area

The developer will designate the primary school football oval (an open irrigated grass area) as a “fire refuge area”, and will erect signs to this effect within the development area. Lot owners will be advised that in the event of a large, regional bushfire impacting on the site, they should gather at the fire refuge site, where it will be possible to activate the sprinkler system, thus providing a high degree of safety.

6.9 Fire protection during stages of development

As development proceeds, the developer will ensure each completed development sector is protected from fires running through yet-to-be-developed bushland on the site. This will be done by periodic slashing/mowing of grassy fuels.

6.10 Home Owners Association/Bushfire Ready Group

The developer will recommend to residents that they form, and will assist in the setting up of a “Bushfire Ready Group”. This will comprise residents who will:

- Promote high standards of bushfire preparedness at the site, including implementation of the Bushfire Management Plan; and
- Liaise with the Water Corporation to ensure Water Corporation maintains a responsible program of bushfire management on the bushland of the buffer to the Alkimos Water Treatment Plant.

7. Disclaimer

The Consultant preparing this Preliminary Bushfire Management Plan takes no responsibility for the impacts of a future bushfire on any values at the Alkimos Central residential subdivision. He has done his best in this strategy to alert residents to the threat of bushfires, and to suggest measures to minimise these threats and potential bushfire damage, but there may occur an unusual combination of events or human actions or lack of actions which could not reasonably have been expected at the time of preparing the Plan. The Consultant takes no responsibility for the standard of bushfire preparedness or damage mitigation undertaken by lot owners in the future

Appendix

Compliance checklist for performance criteria and acceptable solutions for bushfire management at Central Alkimos

Based on Appendix 4 from *Planning for Bushfire Protection*

Element 1: Location

Does the proposal comply with the performance criteria by applying acceptable solution A1.1?

Yes The land on which houses will be constructed will be fully cleared of vegetation and replaced by houses and urban gardens, schools or commercial developments. A small proportion of the area will be bushland retained on the dune system and in regional open space within the property.

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P1 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Element 2: Vehicular access

Does the proposal comply with the performance criteria by applying acceptable solution A2.1?

Yes There will be multiple points of access and egress on fully engineered surfaced roads

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A2.2?

Yes **Not applicable**

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A2.3?

Yes **Not applicable**

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A2.4?

Yes **Not applicable**

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A2.5?

Yes **Not applicable**

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A2.6?

Yes **Not applicable**

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A2.7?

Yes **Not applicable**

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A2.8?

Yes **Not applicable**

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A2.9?

Yes **Not applicable**

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A2.10?

Yes **Not applicable**

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Element 3: Water

Does the proposal comply with the performance criteria by applying acceptable solution A3.1?

Yes **The development will be fully serviced with reticulated pressurised water**

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P3 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A3.2?

Yes **Not applicable**

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P3 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A3.3?

Yes **Not applicable**

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P3 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Element 4: Siting of development

Does the proposal comply with the performance criteria by applying acceptable solution A4.1?

No There will be no dwellings on lots on which the native bushland is retained. Some dwellings will be within 100 m of the bushland on the water treatment areas, and appropriate specifications are prescribed for these areas.

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P4 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A4.2?

As no bushland will be retained on the lots, no building protection zones will be required

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P4 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A4.3?

Yes BPZ and hazard reduction zones are not required

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P4 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Note: Please indicate the extent of the building protection zone on the plans submitted.

Does the proposal comply with the performance criteria by applying acceptable solution A4.4?

Not Applicable.

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P4 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Note: Please indicate the extent of the hazard separation zone on the plans.

Does the proposal comply with the performance criteria by applying acceptable solution A4.5?

Yes Not applicable

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P4 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Note: Please provide details of the proposed shielding to be implemented as part of the development.

Element 5: Design of development

Does the proposal comply with the performance criteria by applying acceptable solution A5.1?

Yes **The design is compliant with Elements 1-4.**

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P5 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A5.2?

Yes **Not applicable**

No

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P5 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Applicant Declaration

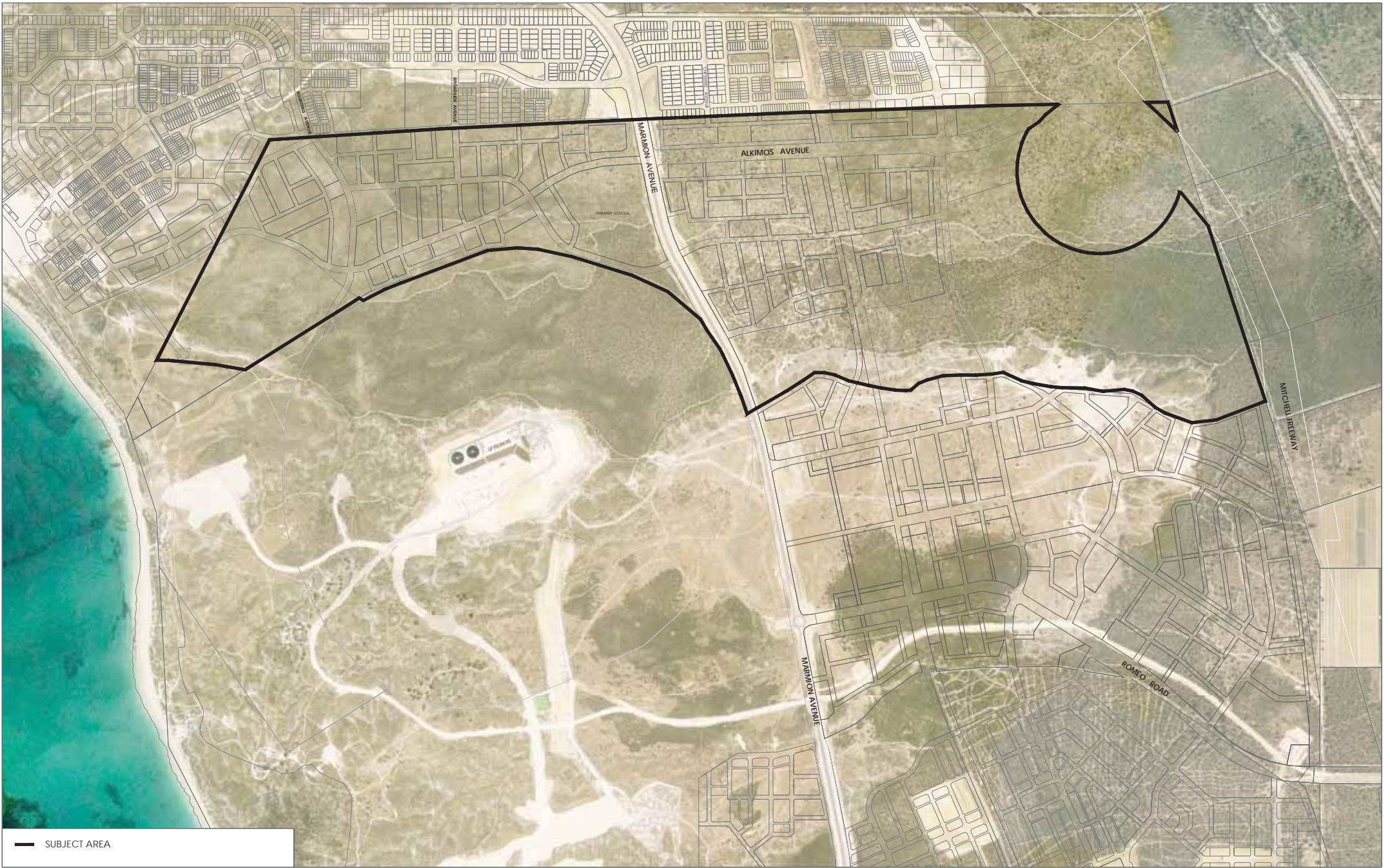
I declare that the information provided is true and correct to the best of my knowledge.

Full name: **Roger John Underwood**

Applicant signature:

A handwritten signature in blue ink that reads "Roger John Underwood". The signature is written in a cursive style with a large initial 'R'.

Date: November 15th 2012



— SUBJECT AREA

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perth | sydney | melbourne

Level 1 | 130 Royal Street East Perth
Western Australia 6004 AUSTRALIA
T: 08 9218 8700 | F: 08 9218 8701
www.robertsday.com.au



C CITY CENTRE
REV DESCRIPTION

121129 SJ DD
YYMMDDDRAWN APPRVD

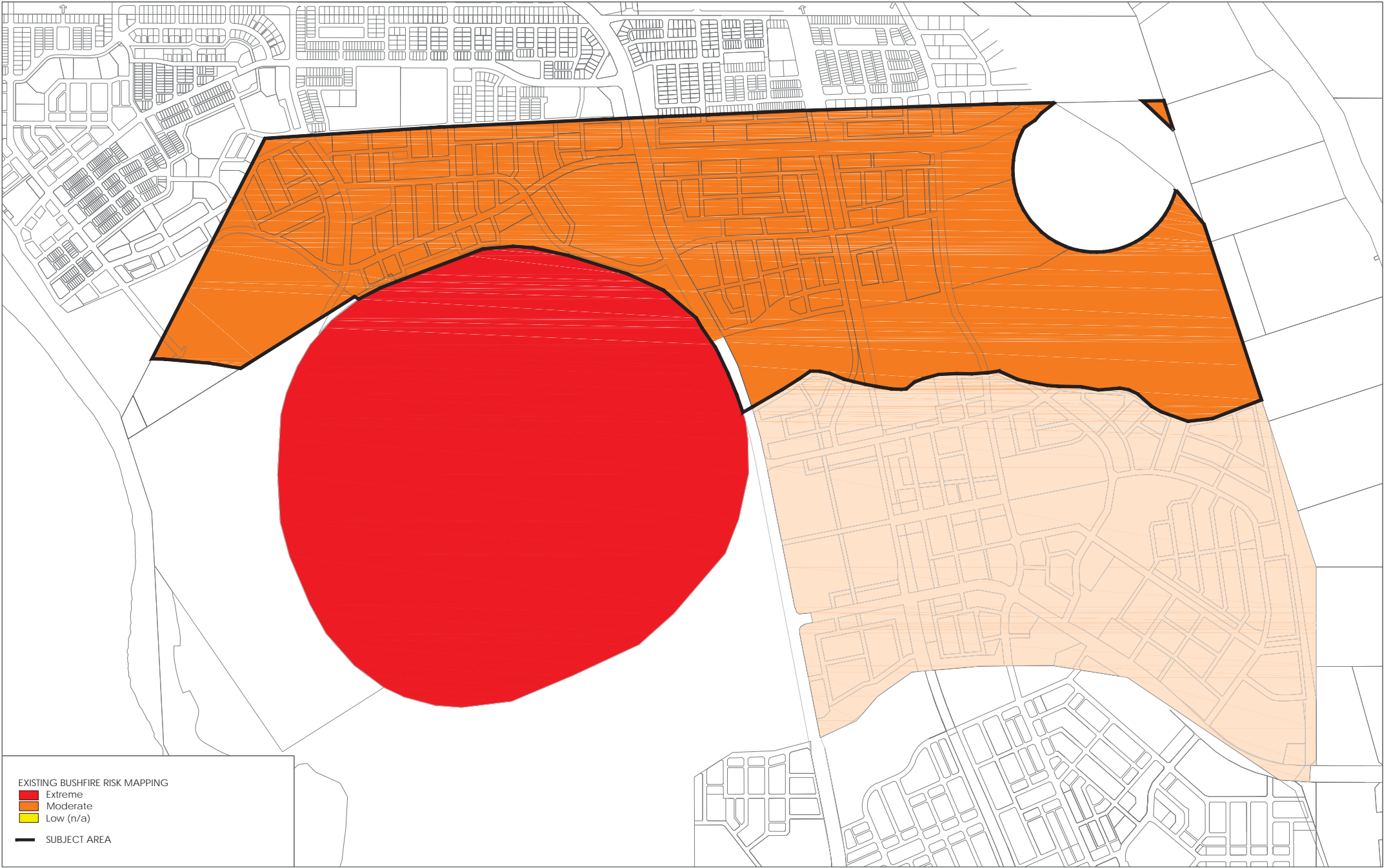
CLIENT
LEND LEASE
PROJECT
CENTRAL & CITY

DISCLAIMER: ISSUED FOR DESIGN
INTENT ONLY. ALL AREAS AND
DIMENSIONS ARE SUBJECT TO
DETAIL DESIGN AND SURVEY.

FIGURE 1 - Location Plan
Alkimos Central
City of Wanneroo

0 metres 100 200 300 400 500
SCALE 1:10,000 SHEET A3

REFERENCE NUMBER
DLL CEN
DRAWING NUMBER
RD1 009
ISSUE
A



EXISTING BUSHFIRE RISK MAPPING

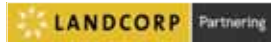
- Extreme
- Moderate
- Low (n/a)

SUBJECT AREA

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C ALKIMOS CENTRAL
REV DESCRIPTION

121128 SJ DD
YYMMDDDRAWN APPRVD

CLIENT
LEND LEASE

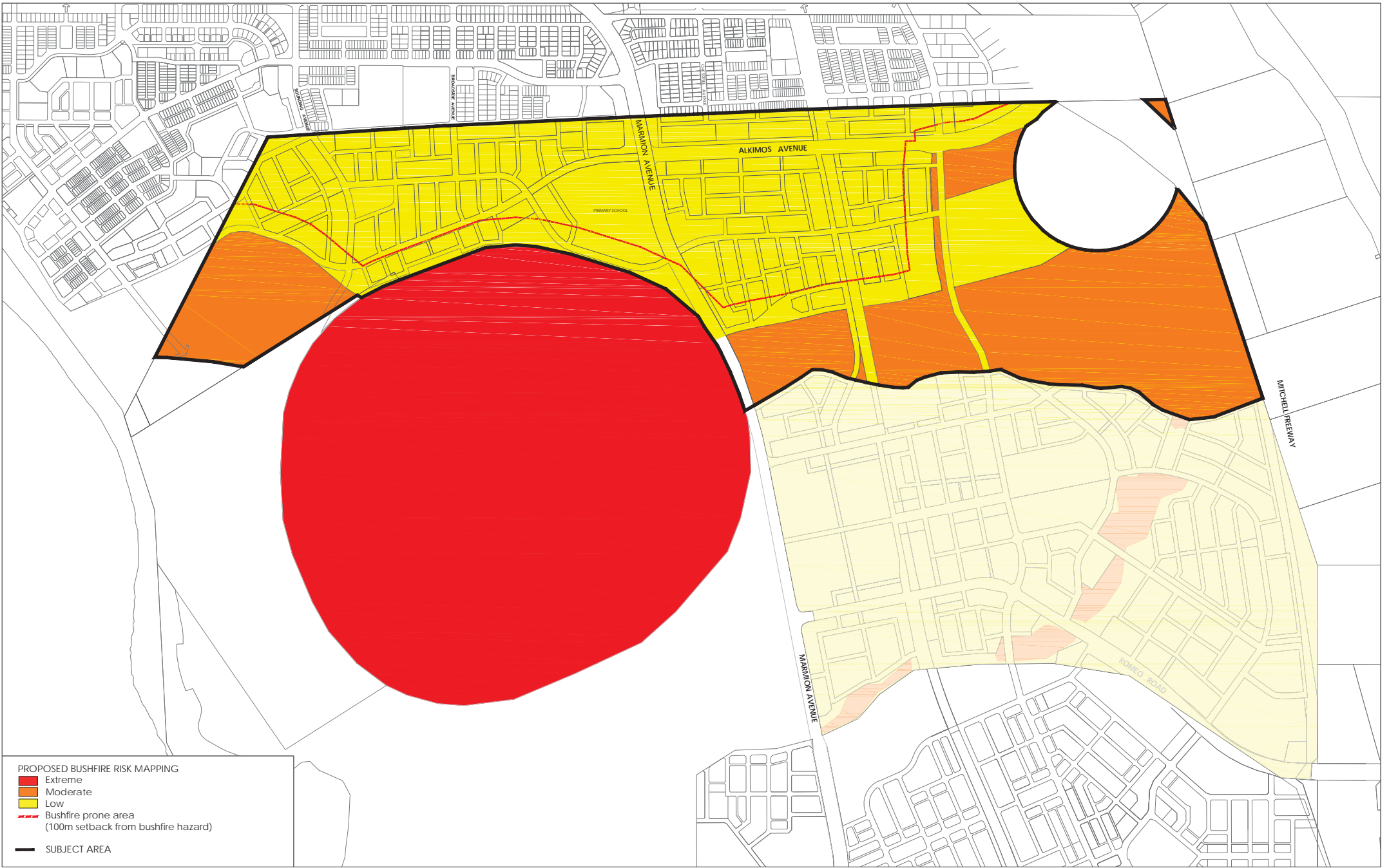
PROJECT
CENTRAL & CITY

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DIMENSIONS ARE SUBJECT TO
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**FIGURE 2 - Fire Management Risk Pre - Subdivision
Alkimos Central
City of Wanneroo**

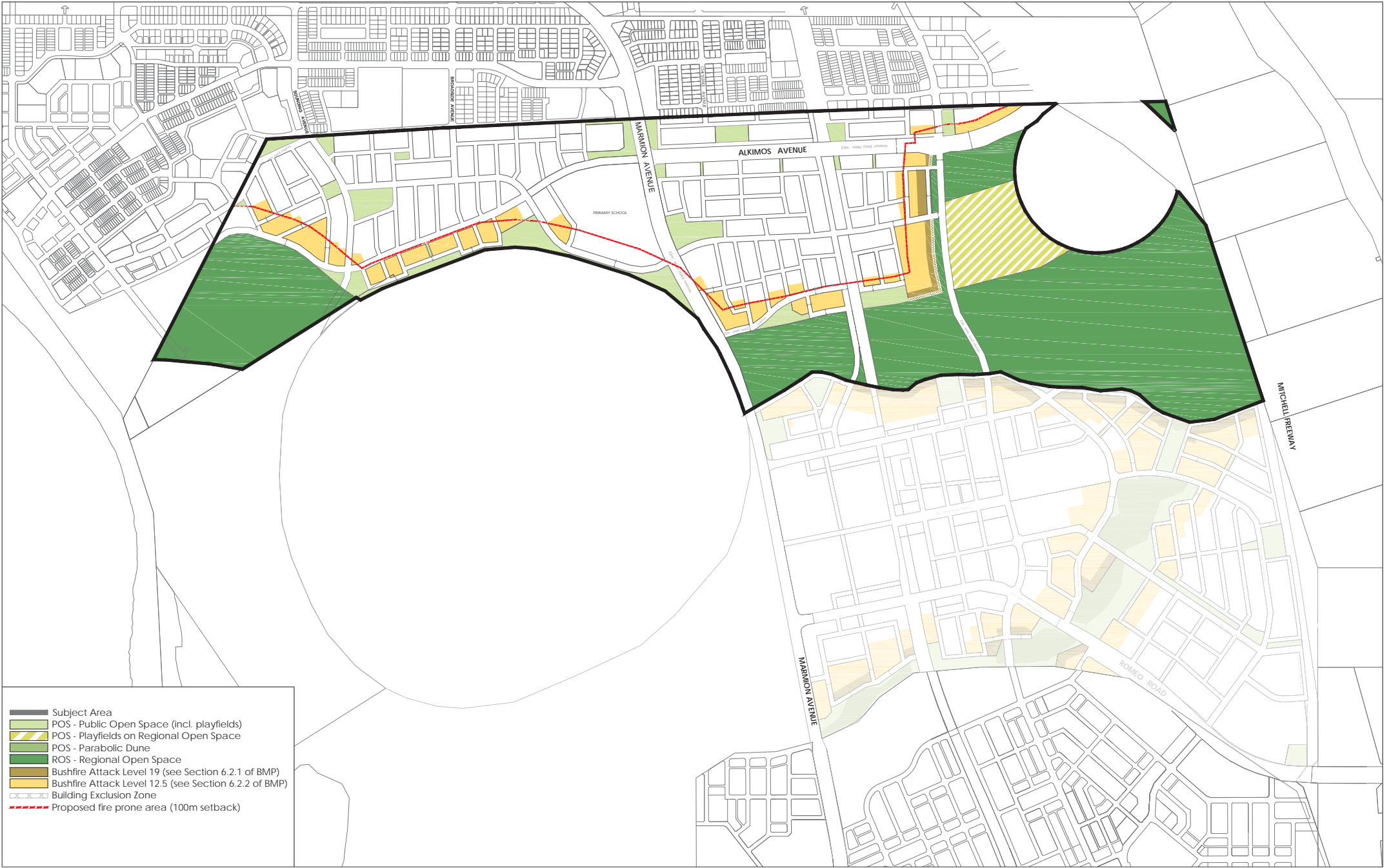
0 metres 100 200 300 400 500
SCALE 1:10,000 SHEET A3

REFERENCE NUMBER DRAWING NUMBER ISSUE
DLL CEN RD1 009 A



- PROPOSED BUSHFIRE RISK MAPPING**
- Extreme
 - Moderate
 - Low
 - Bushfire prone area
(100m setback from bushfire hazard)
 - SUBJECT AREA





- Subject Area
- POS - Public Open Space (incl. playfields)
- POS - Playfields on Regional Open Space
- POS - Parabolic Dune
- ROS - Regional Open Space
- Bushfire Attack Level 19 (see Section 6.2.1 of BMP)
- Bushfire Attack Level 12.5 (see Section 6.2.2 of BMP)
- Building Exclusion Zone
- Proposed fire prone area (100m setback)





APPENDIX D
ABORIGINAL HERITAGE
MANAGEMENT PLAN

(ETHNOSCIENCES, JULY 2012)

*Ethnoscience*s

ABN 47 065 099 228

Aboriginal Heritage

Aboriginal Heritage Management Plan: Central Alkimos Local Structure Plan, Alkimos, Western Australia

*Prepared by Ethnoscience*s for Lend Lease and LandCorp

December 2012

*Ethnoscience*s

ABN 47 065 099 228

Aboriginal Heritage

Disclaimer

The results, conclusions and recommendations contained within this report are based on information available at the time of its preparation. Whilst every effort has been made to ensure that all relevant data has been collated, the authors can take no responsibility for omissions and/or inconsistencies that may result from information becoming available subsequent to the report's completion.

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Ethnoscience

ABN 47 065 099 228

Aboriginal Heritage

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1. Introduction

Lend Lease has commissioned Ethnoscience to prepare an Aboriginal Heritage Management Plan (AHMP) for the Central Alkimos Local Structure Plan (LSP) area within Lots 9003 and 9002 Marmion Avenue, Alkimos. The Central Alkimos LSP area lies inside the City of Wanneroo's District Planning Scheme No. 2 and forms part of the development of the wider Alkimos-Eglinton area in accordance with the Alkimos Eglinton District Structure Plan (DSP) (Figure 1 & Figure 2).

The AHMP has been prepared in order to assist landowners, their contractors and the local authority in the ongoing management of any currently unknown Aboriginal sites and cultural heritage materials that in future may be found within the LSP area.

2. Structure of the AHMP

The AHMP, which is based on the Department of Indigenous Affairs' (DIA) template and other relevant documentation, is structured as follows:

- Section 3:** Principles;
- Section 4:** Purpose and objectives;
- Section 5:** Accountabilities;
- Section 6:** Life of plan;
- Section 7:** Relevant legislation;
- Section 8:** Extent of activity area covered by the AHMP;
- Section 9:** Summary of heritage work completed;
- Section 10:** Summary of consultations undertaken;
- Section 11:** Aboriginal heritage values requiring management;
- Section 12:** Activity description including impact assessment;
- Section 13:** Cultural heritage management strategies and commitments;
- Section 14:** Aboriginal heritage protocols; and
- Section 15:** AHMP monitoring and review.

3. Principles

An AHMP is a document that sets out the significant heritage aspects of a place and details the appropriate policies to manage it so that its values are retained for future use and appreciation (Department of the Environment and Heritage 2003). This AHMP is based on the following broad principles:

- ❖ Lend Lease and LandCorp will strive for best practice in relation to managing any Aboriginal heritage values that may be found to be associated with the Central Aikimos LSP area and will work within the provisions of the *Aboriginal Heritage Act 1972 (AHA)*;
- ❖ Lend Lease and LandCorp will avoid and/or minimise impacts on Aboriginal sites that may be located wherever possible;
- ❖ Lend Lease and LandCorp will conduct mitigative work and undertake additional research (e.g. site recording) and community consultation where necessary;
- ❖ Lend Lease and LandCorp will ensure that all contractors and sub-contractors comply with the principles of this AHMP by making it a condition of contract;
- ❖ Lend Lease and LandCorp will establish programs to monitor earthworks in areas that may be determined to be culturally sensitive and in any areas deemed to be of high archaeological potential in order to avoid inadvertent impact on hitherto unrecorded Aboriginal sites; and
- ❖ Lend Lease and LandCorp will establish a mechanism to review and evaluate the implementation and effectiveness of this AHMP.

4. Purpose and Objectives

The purpose of this document is to provide Lend Lease, its staff and contractors with the information and tools necessary to ensure that any Aboriginal site(s) or Aboriginal cultural material (e.g., artefacts and human remains) located within the LSP area are managed in accordance with company principles and legal requirements, and that any potential impacts resulting from development activities are minimised. Specifically, the purpose of the AHMP is to:

- ❖ ensure that Lend Lease and LandCorp meet their statutory obligations with regards to the *Aboriginal Heritage Act 1972 (AHA)*;
- ❖ ensure that Lend Lease and LandCorp appropriately manage any Aboriginal site(s) or cultural material found within the LSP area; and

Aboriginal Heritage

- ❖ allow Lend Lease and LandCorp's personnel and contractors to work within the vicinity of Aboriginal site(s) with the confidence that they are not unlawfully disturbing any sites.

The objectives of this AHMP are to:

- ❖ collate and compile available information and data relating to the known Aboriginal heritage values of the LSP area; and
- ❖ provide protocols and action plans in the event of the discovery of any previously unidentified Aboriginal sites or cultural material, in particular skeletal remains.

5. Accountabilities

The following people are accountable for the implementation of this AHMP:

Lend Lease and LandCorp's Project Managers – accountable for implementing the AHMP and ensuring that all employees and contractors working within the Central Alkimos LSP area understand their obligations under this AHMP and the AHA.

Superintendent Works – responsible for ensuring that all employees, contractors and sub-contractors are inducted with regard to this AHMP and for ensuring compliance with the AHMP by all parties on site.

Site Supervisor – responsible for the execution of the AHMP on a day-to-day basis.

All employees, contractors and sub-contractors – responsible for complying with the relevant protocols, procedures and conditions within this AHMP.

6. Life of Plan

This AHMP will come into effect immediately on the commencement of the project and operate until the completion of the development of the LSP area and the sale of all the land. The AHMP will be reviewed and updated when:

- ❖ significant project variations or changes occur, which may alter the scope of this document;
- ❖ new information comes to light about the Aboriginal heritage values of the land, which means that the basis for the plan has changed and new objectives and strategies are required to protect previously unknown sites;

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- ❖ previously unrecorded Aboriginal cultural material is located within the LSP area;
- ❖ there are changes to any of the relevant legislations; or
- ❖ on an annual basis.

7. Relevant Legislation

All Aboriginal Sites and objects are protected by the *Aboriginal Heritage Act 1972*.

Section 5 of the AHA defines an Aboriginal Site as follows:

5. This Act applies to

- a. *any place of importance and significance where persons of Aboriginal descent have, or appear to have, left any object, natural or artificial, used for, or made or adapted for use for, any purpose connected with the traditional cultural life of Aboriginal people, past or present;*
- b. *any sacred, ritual or ceremonial site, which is of importance and special significance to persons of Aboriginal descent;*
- c. *any place which, in the opinion of the Committee, is or was associated with Aboriginal people and which is of historical, anthropological, archaeological or ethnographic interest and should be preserved because of its importance and significance to the cultural heritage of the State;*
- d. *any place where objects to which this Act applies are traditionally stored, or to which, under the provisions of this Act, such objects have been taken or removed.*

Section 15 of the Act requires anyone with knowledge of an Aboriginal Site to report it:

15. *Any person who has knowledge of the existence of anything in the nature of Aboriginal burial grounds, symbols or objects of sacred, ritual or ceremonial significance, cave or rock paintings or engravings, stone structures or arranged stones, carved trees, or of any other place or thing to which this Act applies or to which this Act might reasonably be suspected to apply shall report its existence to the Registrar, or to a police officer, unless he has reasonable cause to believe the existence of the thing or place in question to be already known to the Registrar.*

Section 17 of the AHA states that damage to a site or cultural material is an offence under the Act:

17. *A person who -*

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- a. *excavates, destroys, damages, conceals or in any way alters any Aboriginal site; or,*
 - b. *in any way alters, damages, removes, destroys, conceals, or who deals with in a manner not sanctioned by relevant custom, or assumes the possession, custody or control of, any object on or under an Aboriginal site,*
- commits an offence unless he is acting with the authorisation of the Registrar under section 16 or the consent of the Minister under section 18.*

Aboriginal heritage is also protected by Commonwealth legislation (*Aboriginal and Torres Strait Islander Heritage Protection Act 1984*) and the *Environmental Protection Act* (EPA 2004).

8. Extent of Activity Area Covered by the Management Plan

This AHMP covers the proposed Central Alkimos Local Structure Plan area, which applies to a portion of Lots 9003 and 9002 Marmion Avenue, Alkimos, and consisting of all land contained within the inner edge of the line denoting the LSP boundary on the LSP map (Figure 2).

The LSP area is situated on the northern edge of the Greater Perth Metropolitan area, approximately 45km northwest of the Perth CBD, in the southwest region of Western Australia. The LSP area is located on the Swan Coastal Plain in the Quindalup and Spearwood dune systems.

The LSP area is bounded broadly to the west and north by Peet's Shorehaven development (North Alkimos Local Structure Plan Area); the proposed Mitchell Freeway Extension to the east; and by the Alkimos Regional Centre, Alkimos Waste Water Treatment Plant and Lot 9001 to the south (Figure 2).

9. Summary of Heritage Work Conducted

The Central Alkimos LSP area itself, in whole or in part, has been the subject of a number of Aboriginal heritage surveys including:

- ❖ O'Connor, Quartermaine and Bodney's ethnographic and archaeological survey of the proposed Clarkson, Eglinton and Alkimos housing developments (O'Connor; Quartermaine and Bodney 1990);
- ❖ Australian Interaction Consultants' ethnographic survey and archaeological inspection of the Alkimos-Eglinton DSP area (AIC 2006); and
- ❖ Ethnoscience's ethnographic and archaeological surveys of the Marmion Avenue extensions (McDonald & Coldrick 2008; Edwards 2008).

In addition, a number of other heritage investigations have been undertaken in the surrounding area, including:

- ❖ MacIntyre Dobson & Associates' ethnographic and archaeological surveys of the proposed Alkimos Wastewater Treatment Plant immediately to the south (MacIntyre Dobson & Associates 2005; O'Reilly 2005);
- ❖ O'Connor and Quartermaine's ethnographic and archaeological surveys of the proposed Mitchell Freeway Extension immediately to the east (O'Connor 1997; Harris 1997);
- ❖ O'Connor's survey of the Quinns Main Sewer route between Butler and the Alkimos Waste Water Treatment Plant (O'Connor 2006);
- ❖ McDonald and Coldrick's survey of the Alkimos-Eglinton (South Alkimos) Local Structure Plan Area to the south (McDonald & Coldrick 2007). McDonald and Coldrick also undertook an archaeological inspection of an area within what has been designated the 'South-west Village' where spoil from the proposed Alkimos Waste Water Treatment Plant will be deposited;
- ❖ Coldrick and McDonald's (2008) ethnographic survey and Thomson's (2008a) archaeological investigation of Lot 3 Romeo Road (Trinity) to the south;
- ❖ Locke, Smith and McDonald's (1990) ethnographic and archaeological survey of the Quinns area which included Lot 9 (Brighton, formerly Jindalee); and
- ❖ AIC's subsequent (2003) ethnographic and archaeological survey of the Brighton Estate (Lots 8 and 9) (Parker, Parker & Lantzke 2003).

The Alkimos area has also been covered by a number of broad-scale heritage surveys including O'Connor, Bodney and Little's survey for areas of Aboriginal significance in the Perth metropolitan and Murray River regions (O'Connor, Bodney and Little

1985); the Ballaruk Site Recording Project (Machin 1994); Kauler's recording of sites in the Wanneroo area (Kauler 1997–98); and more recently by a study of groundwater-related Aboriginal cultural values on the Gnangara Mound (McDonald, Coldrick and Villiers 2005).

In summary, no Aboriginal archaeological sites or Aboriginal cultural material was located on Lots 9003 and 9002 or in the surrounding areas as a result of any of this research. This finding is consistent with archaeological research in the general area. Moreover, the absence of archaeological sites cannot be explained simply by the presence of extensive ground cover (Thomson 2008b and 2011 provide a useful analysis of the archaeological survey results in the Alkimos/Yanchep areas).

10. Summary of Consultations Undertaken

The Aboriginal heritage surveys of the Clarkson, Eglinton and Alkimos housing developments (O'Connor; Quartermaine and Bodney 1990); Alkimos-Eglinton DSP (AIC 2006); and Marmion Avenue and Mitchell Freeway extensions (McDonald & Coldrick 2008; O'Connor 1997), and the other surveys carried out in the area over the past twenty years, have involved consultations with a range of Aboriginal families and groups with knowledge of and expressed interests in the heritage values of the area.

11. Aboriginal Heritage Values Requiring Management

There are no known Aboriginal sites located within the Central Alkimos Local Structure Plan (LSP) area that would require management. The nearest known Aboriginal site is Karli Spring (DIA Site ID 3509).

Karli Spring, which is located in Foreshore Reserve to the south of the LSP area, is listed on the Register of Aboriginal Sites and has been referred to in the course of heritage surveys of the Alkimos area (O'Connor, Quartermaine and Bodney 1990; AIC 2006 and McDonald & Coldrick 2007, for example). Management controls for

this site are discussed in the AHMP for the South Alkimos Local Structure Plan No. 72 (Ethnoscience 2011:7).

However, hitherto unidentified Aboriginal heritage values may exist on the property. For example, Aboriginal cultural material, including burials or skeletal material may be unearthed in the course of earthworks or construction activities. This AHMP makes provisions for dealing with this eventuality (see below for further discussion and advice).

12. LSP Area Activity Description

Description of Works

The main types of activities to be undertaken within the LSP area include (but are not limited to) vegetation clearance and topsoil removal, excavation of soil and sand, construction of surface and subsurface infrastructure including roads, footpaths, future rail alignment, cycle paths, stormwater drains, utilities and telecommunications, construction of retaining walls, construction of public and private buildings, houses, sporting and recreation facilities.

Risk Assessment

The following risks to potential Aboriginal heritage values within the LSP area have been identified (see **Error! Reference source not found.** below). The potential consequences and likelihood are also identified and controls recommended for reducing the risk of impacts.

It should be noted that the identified risks are not exhaustive and that additional risks may potentially be identified in the future. In this case, the table below should be updated and controls developed to minimise or mitigate the risks.

Risk	Consequence(s)	Likelihood	Recommended Controls
1 Mechanical ground disturbances including bulldozing, grading and excavating	Unearthing of previously undetected or sub-surface archaeological material	Low	<ul style="list-style-type: none"> • Earthworks operator inductions • Watching brief • Procedure for discovery of archaeological material
2 Mechanical ground disturbances including bulldozing, grading and excavating	Unearthing of previously undetected or sub-surface human skeletal remains	Low	<ul style="list-style-type: none"> • Earthworks operator inductions • Watching brief • Procedure for discovery of human skeletal remains

Table 1: Identified heritage risks and controls

13. Cultural Heritage Management Strategies and Commitments

Based on the recommendations contained within previous heritage survey reports, Lend Lease will implement a watching brief during ground disturbance works to monitor for any previously obscured Aboriginal cultural material or potential human skeletal material. The procedure for the watching brief is outlined in the Aboriginal Heritage Protocols below.

14. Aboriginal Heritage Protocols

Watching Brief for Aboriginal Cultural and Skeletal Material

When undertaking vegetation clearing and earthworks, project personnel and contractors will need to be on the lookout for two things:

1. **Archaeological sites:** A collection of cultural material (stone tools and artefacts, non-human bones, a collection of shell, etc.) found together in a relatively small area that is the product of human activities. If the site is stratified (i.e. has evidence of layers in the earth), archaeological excavation may need to be undertaken as it is these sites which can give a high level of information concerning the prehistory of Aboriginal people in the area. Isolated artefacts may also be found.

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2. A burial or skeletal material: Burials are of great importance to the Aboriginal community and are specifically protected by State and Commonwealth law. If skeletal material is uncovered, the area becomes a crime scene and the Police must be contacted to check that it is not a suspicious death.

Once the Police identify the skeleton as the remains of a prehistoric Aboriginal person and not a crime scene, an archaeologist will examine the remains and consult with the Aboriginal community and the relevant authorities – the Department of Indigenous Affairs (DIA) and the Western Australian Museum.

Procedure in the event that Aboriginal archaeological material other than human skeletal remains is identified:

The following procedures shall be effected should any person (staff, contractor, sub-contractor) have reason to suspect the presence of any previously unreported non-skeletal archaeological material (see Appendix 2):

- a. If a suspected Aboriginal site is encountered, work must cease immediately within a notional 30m radius of the discovery. The area is to be demarcated with caution tape/flagging material to locate the site and discourage unauthorised entry.
- b. The Site Supervisor (or other designated responsible person on the work site) is to be informed immediately. The Site Supervisor will then contact the Works Superintendent who will notify Lend Lease's Project Manager who in turn will contact the Aboriginal heritage consultant.
- c. The Works Superintendent will ensure that the relevant protocols are in place.
- d. The Project Manager will arrange for the Aboriginal heritage consultant to undertake an inspection and evaluation of the site/feature in consultation, as appropriate, with the relevant Aboriginal community(s). A report of the findings of the evaluation should be prepared in good order and submitted to the Department of Indigenous Affairs (DIA).
- e. Any archaeological mitigation recommended as a result of the evaluation should be undertaken by a suitably qualified archaeologist in consultation, as is deemed necessary, with the relevant local Aboriginal community(s).
- f. No further work at the location should be undertaken until all relevant parties have been consulted and the necessary clearances obtained from the Minister for Indigenous Affairs.

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Procedure in the event that human skeletal remains are identified:

The following procedures shall be effected should any person (staff, contractor, and sub-contractor) have reason to suspect the presence of human skeletal material (see Appendix 2):

- a. If suspected human skeletal material is encountered, work must cease immediately within a notional 150m radius of the discovery, as by law the area becomes a crime scene until otherwise determined. The area is to be demarcated with caution tape/flagging material to locate the site and discourage unauthorised entry.
- b. The Site Supervisor (or other designated responsible person on the work site) is to be informed immediately. The Site Supervisor will then contact the Works Superintendent who will notify Lend Lease's Project Manager who in turn will contact the Aboriginal heritage consultant.
- c. The Works Superintendent will ensure that the relevant protocols are in place.
- d. The Aboriginal heritage consultant will then contact the Police and the relevant section of the DIA at their Head Office in Perth. If the human skeletal material is deemed to be modern, the appropriate law enforcement officials shall assume jurisdiction and the Aboriginal heritage management process shall be concluded.
- e. If the human skeletal material is deemed to be not modern, the Aboriginal heritage consultant will undertake an inspection and evaluation of the skeletal material. A report of the findings of the evaluation should be prepared in good order and submitted to the DIA.
- f. The relevant Aboriginal community(s) should be consulted regarding the management of the skeletal material once the inspection and evaluation has been completed. No further work at the location should be undertaken until all relevant parties have been consulted and an agreement has been reached and the necessary clearances obtained from the Minister of Indigenous Affairs under Section 18 of the AHA.
- g. The location of the skeletal material should be recorded in accordance with DIA's published guidelines.

Should a decision be reached to relocate the skeletal material, the following procedures should be effected:

- a. A data recovery programme, planned in consultation with the relevant local Aboriginal community(s) and the DIA, should be developed and

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implemented. This will include, but not be limited to, recording the location of the skeletal material, compilation of a photographic archive, collection of samples, and recovery and recording of skeletal material and any accompanying cultural material.

- b. Representatives of the relevant local Aboriginal community(s) should be present during the recovery phase of the operation.
- c. The skeletal remains shall be transferred to a suitable keeping-place or re-internment location to be negotiated between the proponent, relevant local Aboriginal community(s) and relevant government agencies.
- d. The proponent shall respect any reasonable request made by the relevant Aboriginal community(s) to undertake appropriate ceremonies.

15. Monitor and Review

Monitoring of this AHMP and its implementation will be undertaken through periodic review and update. The AHMP will be updated in accordance with the findings of the review.

The effectiveness of this AHMP and its implementation can be monitored against the following key performance indicators.

- ❖ no instances of incorrect or no Aboriginal Heritage Protocols being applied in the event of Aboriginal archaeological material being encountered;
- ❖ completion of remedial or proactive actions identified during review and in-field monitoring processes;
- ❖ minimisation of the number or severity of incidents and near misses.

16. Contacts and Addresses

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Appendix 1: Figures

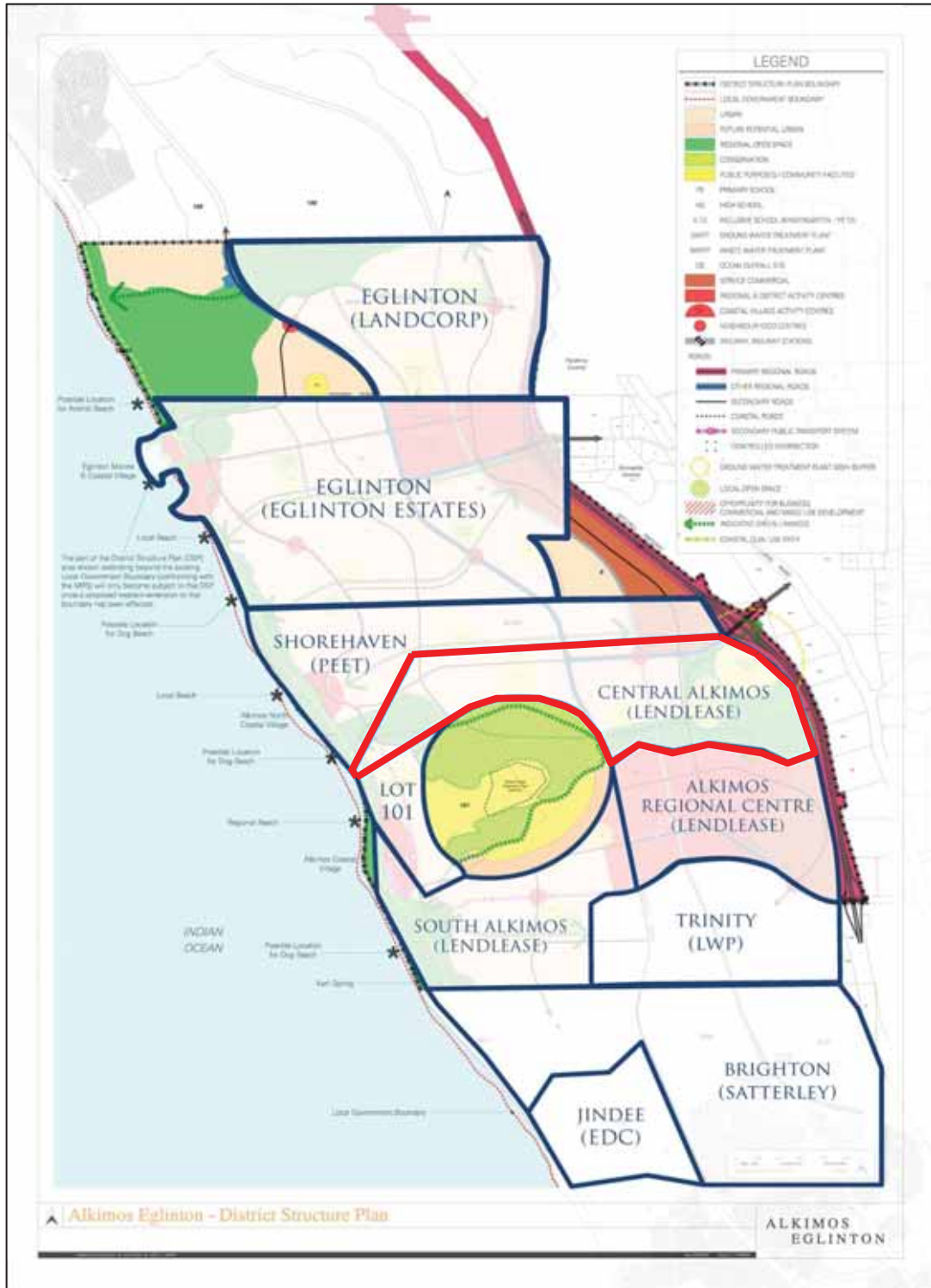


Figure 1: Central Alkimos LSP area (red) in relation to the wider Alkimos-Eglinton District Planning Scheme (Source: Lend Lease)

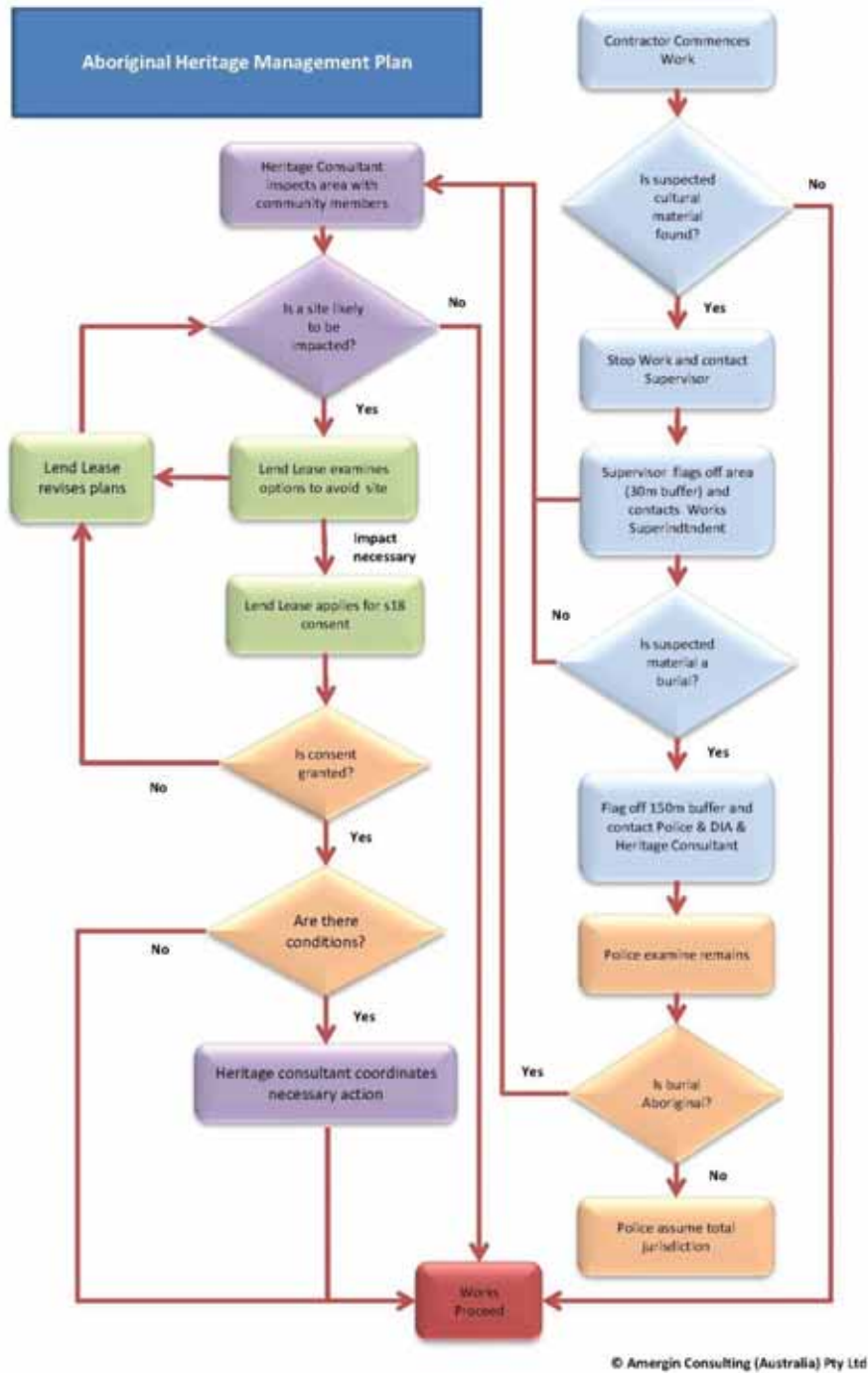
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Figure 2: Central Alkimos Local Structure Plan (Source: Lend Lease)

Lend Lease Aboriginal Heritage Management Plan: Central Alkimos LSP Area

Appendix 2: Aboriginal Heritage Protocol Flowchart ¹



¹ Schematic prepared in association with Amergin Consulting (Australia) Pty Ltd.

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Appendix 3: Section 18 of the Aboriginal Heritage Act 1972

Section 18 of the *Aboriginal Heritage Act 1972* (AHA) provides a mechanism for a landowner or lessee to obtain permission to use the land on which an Aboriginal site is located, as outlined below.

Consent to certain uses

1) For the purposes of this section, the expression “the owner of any land” includes a lessee from the Crown, and the holder of any mining tenement or mining privilege, or of any right or privilege under the Petroleum Act 1967, in relation to the land.

(1a) A person is also included as an owner of land for the purposes of this section if —

(a) the person —

(i) is the holder of rights conferred under section 34 of the Dampier to Bunbury Pipeline Act 1997 in respect of the land or is the holder’s nominee approved under section 34(3) of that Act; or

(ii) has authority under section 7 of the Petroleum Pipelines Act 1969 to enter upon the land;

or

(b) the person is the holder of a distribution licence under Part 2A of the Energy Coordination Act 1994 as a result of which the person has rights or powers in respect of the land.

(2) Where the owner of any land gives to the Committee notice in writing that he requires to use the land for a purpose which, unless the Minister gives his consent under this section, would be likely to result in a breach of section 17 in respect of any Aboriginal site that might be on the land, the Committee shall, as soon as it is reasonably able, form an opinion as to whether there is any Aboriginal site on the land, evaluate the importance and significance of any such site, and submit the notice to the Minister together with its recommendation in writing as to whether or not the Minister should consent to the use of the land for that purpose, and, where applicable, the extent to which and the conditions upon which his consent should be given.

(3) Where the Committee submits a notice to the Minister under subsection (2) he shall consider its recommendation and having regard to the general interest of the community shall either —

(a) consent to the use of the land the subject of the notice, or a specified part of the land, for the purpose required, subject to such conditions, if any, as he may specify; or

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(b) wholly decline to consent to the use of the land the subject of the notice for the purpose required,

and shall forthwith inform the owner in writing of his decision.

(4) Where the owner of any land has given to the Committee notice pursuant to subsection (2) and the Committee has not submitted it with its recommendation to the Minister in accordance with that subsection the Minister may require the Committee to do so within a specified time, or may require the Committee to take such other action as the Minister considers necessary in order to expedite the matter, and the Committee shall comply with any such requirement.

(5) Where the owner of any land is aggrieved by a decision of the Minister made under subsection (3) he may, within the time and in the manner prescribed by rules of court, appeal from the decision of the Minister to the Supreme Court which may hear and determine the appeal.

(6) In determining an appeal under subsection (5) the Judge hearing the appeal may confirm or vary the decision of the Minister against which the appeal is made or quash the decision and substitute his own decision which shall have effect as if it were the decision of the Minister, and may make such order as to the costs of the appeal as he sees fit.

(7) Where the owner of any land gives notice to the Committee under subsection (2), the Committee may, if it is satisfied that it is practicable to do so, direct the removal of any object to which this Act applies from the land to a place of safe custody.

(8) Where consent has been given under this section to a person to use any land for a particular purpose nothing done by or on behalf of that person pursuant to, and in accordance with any conditions attached to, the consent constitutes an offence against this Act.

The Committee comprises, among others, an anthropologist and archaeologist and Indigenous Affairs Departmental and Crown Law representatives along with Aboriginal community representatives. In practice, the Committee's work involves consideration of such applications to disturb land on which Aboriginal sites are known to be located, either by development (governed by Section 18 of the Act) or scientific investigation (governed by Section 16 of the Act).

The Committee is required first to determine whether a place referred to in any such application is indeed an Aboriginal site (under Section 5 of the Act), then assess the relative significance of the place if it is considered to be within the ambit of the Act.

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The legislation is silent, however, on precisely how this significance should be attributed, although a series of guidelines are offered (Section 39[2] and [3]), giving primacy to sites of 'mythological', 'ceremonial and ritual significance'. Dependent upon the degree to which the ACMC believes a site to be of importance, any application can be recommended for consent (i.e. permission is given for disturbance), consent with conditions or refusal.

The listing of conditions on an approval usually mirrors recommendations made by heritage consultants and/or Aboriginal people. Conditions typically listed include further archaeological recording, archaeological monitoring of ground disturbance, the recognition of Aboriginal heritage values through the use of information displays, naming of streets and public open space etc, and/or further consultation.

Any decision made by the Committee is presented to the Minister for Indigenous Affairs in the form of a recommendation and he/she makes the final decision on any matter. Ministerial decisions in general reflect the recommendations of the ACMC except in exceptional circumstances. If aggrieved by Ministerial decisions, a proponent has the right of appeal. Similarly, members of the Aboriginal community have the right to make a common law appeal through the court system.

As a consequence of the Act's drafting, it is only possible for landowners to apply for permission to use land under Section 18 of the Act. However, those who are actually the registered proprietors do not necessarily undertake development. Consequently, there are mechanisms for a limited power of attorney to be provided by landowners to proponents to enable them to act as agents for the purposes of the *Aboriginal Heritage Act (1972 as amended)*. The "authority to act as an agent" pro-forma, which is the only instrument acceptable to the ACMC, specifically limits the scope of the agency to the operation of the Act. As a result, landowners are not in danger of assigning any broader rights or responsibilities to proponents.

All Section 18 notices must include a description of the subject land, Aboriginal sites for which permission is sought and a detail of the land use/activities which are likely to disturb the identified sites. Any permission subsequently granted is phrased in

similarly specific terms, especially the land use envisaged. Thus, a proponent can only obtain consent to use the land for the purposes they request. Should either the purpose or proponent change, then the permission obtained effectively lapses, as does any agency associated with earlier applications. Thus the landowner's proprietary rights are ensured additional protection.

Because consent given under the Act does not run with the land but with the applicant and is specific to the land use/purpose stated in the application, the agent could/should be a person or body corporate that will either control or have a long-term involvement in the development. Under normal circumstances, Section 18 consent functions as though it was granted in perpetuity. However, there have been cases where a radical change in land use from that outlined in a Section 18 submission has resulted in a need to reapply for Ministerial consent (e.g. residential LSP area to industrial use). In addition, consent is not technically given to disturb or destroy an Aboriginal site. As a consequence, once the Committee defines a place as a site, its legal status is not actually altered by the Ministerial consent to use the land. It is important, therefore, that any application is framed as widely as possible (e.g. residential LSP area, commercial and retail and related infrastructure – services, roads and so on) to ensure that it operates under the widest possible parameters.

In the absence of specific conditions, the Section 18 consent allows a proponent to proceed without further reference to the Act. However, there may be circumstances where further action is necessary. For example, new archaeological material may be discovered, the presence of which could not be determined by standard survey techniques (such as a subsurface deposit or an Aboriginal burial which would require further management). However, reports are usually prepared with these contingencies in mind. In other words, a development area is assessed not only on the actual research findings, but also on its potential with regards to burials and subsurface deposits and appropriate recommendations are presented.

Prior to the Committee reviewing an application and supporting documentation, a Departmental officer assesses both and prepares briefing notes. If problems are encountered, they routinely contact the proponent and/or the heritage consultants

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and seek clarification. The key point with regard to an application for Ministerial consent under Section 18 of the Act is that hundreds of such applications are handled annually and without major problems by the Department of Indigenous Affairs and the Aboriginal Cultural Material Committee.

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Appendix 4: Regulation 10 of the Aboriginal Heritage Regulations 1974

Regulation 10 of the *Aboriginal Heritage Regulations* (1974) outlines activities that can and cannot be undertaken on or at an Aboriginal site without Section 18 approval.

Under Regulation 10, a person shall not, without the written consent of the Minister or the Registrar or a person authorised in writing by the Minister or the Registrar,

(a) alter, damage, or destroy any notice, boundary, fence, shelter, grille, cutting, drain, protective work or other thing which the Registrar or any officer of the Department has, or has caused to be, erected, constructed, made or placed thereon or therein;

(b) dig any hole or otherwise disturb the surface of the ground, or remove or disturb any stone, soil, sand, rock or gravel, or any other natural object;

(c) cut, pick, pull, break, remove, take, injure, poison, strip or destroy any tree, shrub, herb, grass or other plant or part thereof whether living or dead;

(d) post, stick, stamp, stencil, paint, draw or otherwise affix or make any mark, symbol, lettering, notice, advertisement poster, sign or document of any description;

(e) except in a place approved or provided for the purpose:

(i) drive, tow, operate or park any vehicle;

(ii) camp, erect tents or shelters, light fires or make fireplaces;

(iii) deposit or leave any refuse, rubbish or litter; or

(iv) take, ride or drive, graze or agist any horse, cattle, sheep, goat, camel, donkey or pig, or allow any such animal to remain;

(f) sell any food, beverage or other article;

(g) unlock, unfasten or leave open any gate unless duly authorised to do so; or

(h) except with the prior written approval of the Minister, or the Registrar, and in accordance with such requirements as he may impose, take any photograph or make any recording for the purpose of commercial reproduction or publication.

Note: It is recommended that clarification be sought from a heritage consultant and/or the Registrar of Aboriginal Sites before undertaking any activities on an Aboriginal site.



APPENDIX E
TRAFFIC AND MOVEMENT NETWORK REPORT
(BRUCE AULABAUGH, NOVEMBER 2012)
+ ADDENDUM - TRAFFIC IMPACT ANALYSIS:
TECHNICAL NOTES
(GTA, MAY 2020)



**CENTRAL ALKIMOS:
TRAFFIC & MOVEMENT NETWORK**
CITY OF WANNEROO
Final Report

For

Lend Lease Pty Ltd

November 2012 (REV1 May 9, 2013)

Bruce Aulabaugh

Traffic Engineering & Transport Planning

Integrated Transport Solutions for Sustainable Communities

FINAL REPORT

**Central Alkimos
Local Structure Plan**

Traffic & Movement Network

For Lend Lease Pty Ltd

Date: November 2012 (REV1 May 9 2013)

Reference: Lend Lease Alkimos Central

Bruce Aulabaugh

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Traffic Engineering & Transport Planning

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This report has been prepared in accordance with the scope of services described in the contract or agreement between Bruce Aulabaugh and the Client. The report relies upon data, surveys, measurements and results taken at or under the particular times and conditions specified herein. Any findings, conclusions or recommendations only apply to the aforementioned circumstances and no greater reliance should be assumed or drawn by the Client. Furthermore, the report has been prepared solely for use by the Client and Bruce Aulabaugh accepts no responsibility for its use by other parties.

Approved by: Bruce Aulabaugh (Traffic/ Transport Engineer)

Signed:



Date: November 14, 2012 (REV1 May 9 2013)

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EXECUTIVE SUMMARY

Road Network and Road Function

Central Alkimos Local Structure Plan (LSP) is to be served by the following key roads, as indicated in the Alkimos Eglinton District Structure Plan and the Perth Metropolitan Region Scheme:

- Mitchell Freeway (ultimate 6 lane freeway, Primary Regional Road in MRS with Primary Distributor function)
- Marmion Avenue (ultimate 4 lane divided arterial, Other Regional Road in MRS with District Distributor Type A function)
- Alkimos Drive (ultimate 4 lane divided arterial, Other Regional Road in MRS with District Distributor Type a function).
- NS2 (2 lane divided minor arterial with District Distributor Type B function)
- NS1 (2 lane Neighbourhood Connector aiding north-south travel to the City Centre and the rail station park n ride facility)

Street Design

The Central Alkimos LSP street design is in accordance with Liveable Neighbourhoods policy. The street types and road reserve characteristics are described below:

- Residential Access Streets: reserve width range is 14m-16m.
- City Centre Access & Circulation Streets reserve width range is 18m-22m.
- Neighbourhood Connectors reserve width range is 20-24m.
- District Distributor Type B reserve width range is 27-30m.
- District Distributor Type A reserve width is 52m (with 7m median and provision for frontage roads).

Arterial Road Access & Traffic Operations Assessment

- Intersections and property access provisions along Marmion Avenue and Alkimos Drive have been determined from City of Wanneroo Local Planning Policy 3.8 and related discussion and agreement with City of Wanneroo (Cow) and Main Roads Western Australia (MRWA).
- Controlled intersection operations (i.e. traffic signal or roundabout control) have been assessed for PM Peak Hour traffic levels at the ultimate development stage. All intersections are forecast to operate at Level of Service D or better, using SIDRA 5.1 computer simulation software.

Local Traffic Treatments

Intersection controls and local traffic management treatments include:

- 50km/ hr default speed limit in built up areas.
- 60-70km/hr speed limit will apply to Alkimos Drive (east of Marmion Ave).

- 70-80km/hr will apply to Marmion Ave.
- Traffic signals or roundabouts at high order intersections;
- Sign controlled (stop or give-way) 4-way intersections;
- Speed control device (i.e. intersection plateau treatment)
- School or Urban Centre Speed Zone

Traffic signals and roundabouts are identified at the busier 4-way intersections and near schools to assist in slowing traffic and managing U-turn demand.

In the Central Alkimos there are numerous 4-way intersections that will need to be reviewed at subdivision stage to confirm the appropriate traffic control and design features. These reviews will be done in consultation with the CoW and MRWA.

Pedestrian/ Cyclist Facilities

Principal Shared Paths (PSP's) are planned along the rail line and along the freeway. These facilities are provided by State Government Agencies. The Alkimos Secondary Regional Centre path network is designed to integrate with the proposed PSP's. The local path and cycle lane planning uses the following guidelines (summarised from Liveable Neighbourhoods):

- Integrator Arterial Type A Roads: Shared paths and cycle lanes are provided on both sides
- Integrator Arterial Type B Roads: Shared path one side, footpath opposite side, cycle lanes both sides.
- Neighbourhood Connectors (traffic > 3000 veh/day): Shared path one side, footpath opposite side, cycle lanes both sides. Neighbourhood Connectors (traffic < 3000 veh/day): Shared path one side and footpath opposite side.
- City Centre Access & Circulation Streets: Urban verge footpath both sides.
- Residential Access Streets: footpath on at least one side.

Pedestrians will cross Marmion Avenue and Alkimos Drive at signalised intersections where pedestrian button signal activation will be available. Most local road crossings will however be unmarked and will have kerb ramps and pedestrian gaps in medians.

Bus Services

Central Alkimos LSP will be served by three bus services operating between Eglinton Station and Alkimos Station. One route will operate on local roads west of Marmion Avenue then join with Marmion Ave at Alkimos Drive. One route will run on Marmion Avenue and the final route will operate on local roads east of the rail line (west of the future Mitchell Freeway).

1. INTRODUCTION

This report presents traffic and transport planning information for the *Central Alkimos LSP Plan* in the City of Wanneroo. The scope of works includes traffic forecasting, road access planning, local street design, local traffic treatments, and pedestrian/cyclist facilities. .

Figure 1 (locality plan) shows the Central Alkimos LSP, located within the Alkimos-Eglinton District Structure Plan area. Please refer to *Appendix A* for copies of both the Alkimos-Eglinton DSP and the Butler-Jindalee DSP.

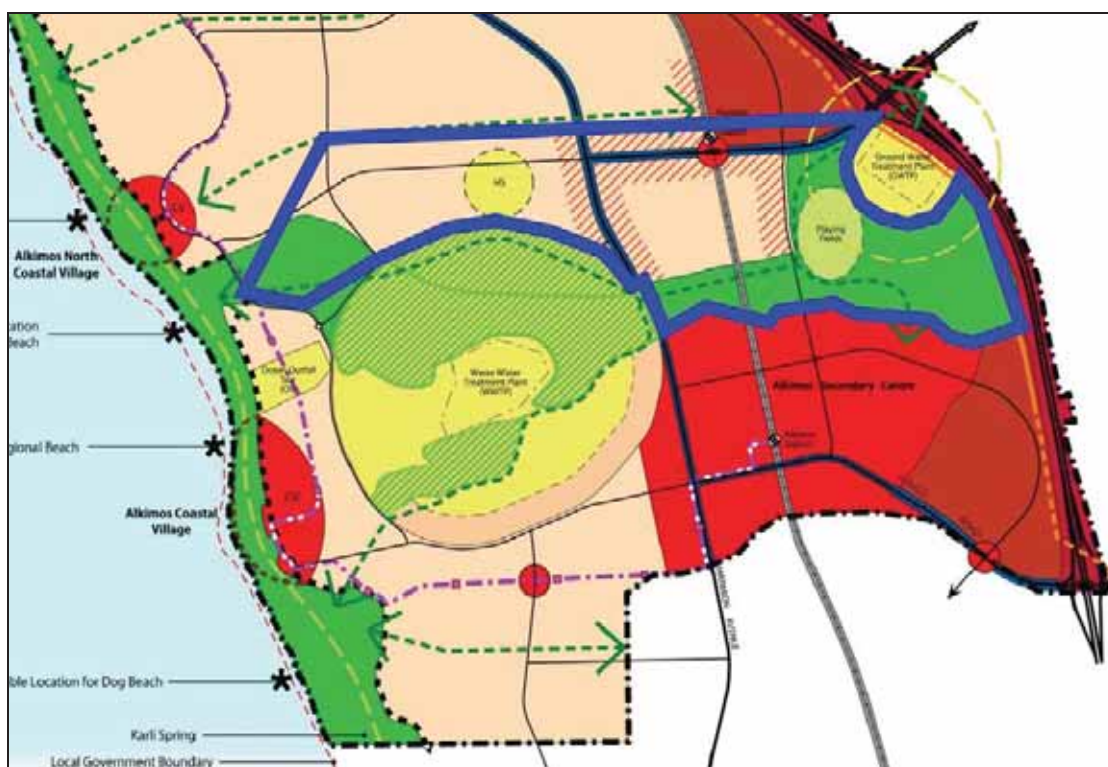


Figure 1: Central Alkimos LSP Locality Plan (shown in context of Alkimos-Eglinton DSP)

2. REGIONAL ROAD NETWORK

The future Mitchell Freeway is identified in the Metropolitan Region Scheme (MRS) as a Primary Regional Road. Marmion Avenue, Romeo Road and Alkimos Drive are identified as an Other Regional Roads. Each of these roads has reserves designed to accommodate 4-lane divided arterials.

Marmion Avenue is currently constructed to Lukin Drive as a 4-lane divided arterial then from Lukin Drive to Yanchep Beach Road as a 2-lane road. It is expected that Marmion Avenue will require upgrading to 4-lane divided arterial by year 2021 or shortly thereafter.

The Mitchell Freeway is currently constructed to Burns Beach Road. There is no indication from state planning authorities when the Mitchell Freeway will be constructed further north to Butler Boulevard.

The transport priority in the North West Corridor is to progress development of the northern suburbs passenger railway (extension to Butler Station by mid 2014). Rail service is expected to reach the Alkimos Town Centre Station by approximately 2020.

3. ROAD HIERARCHY & INTERSECTION CONTROL

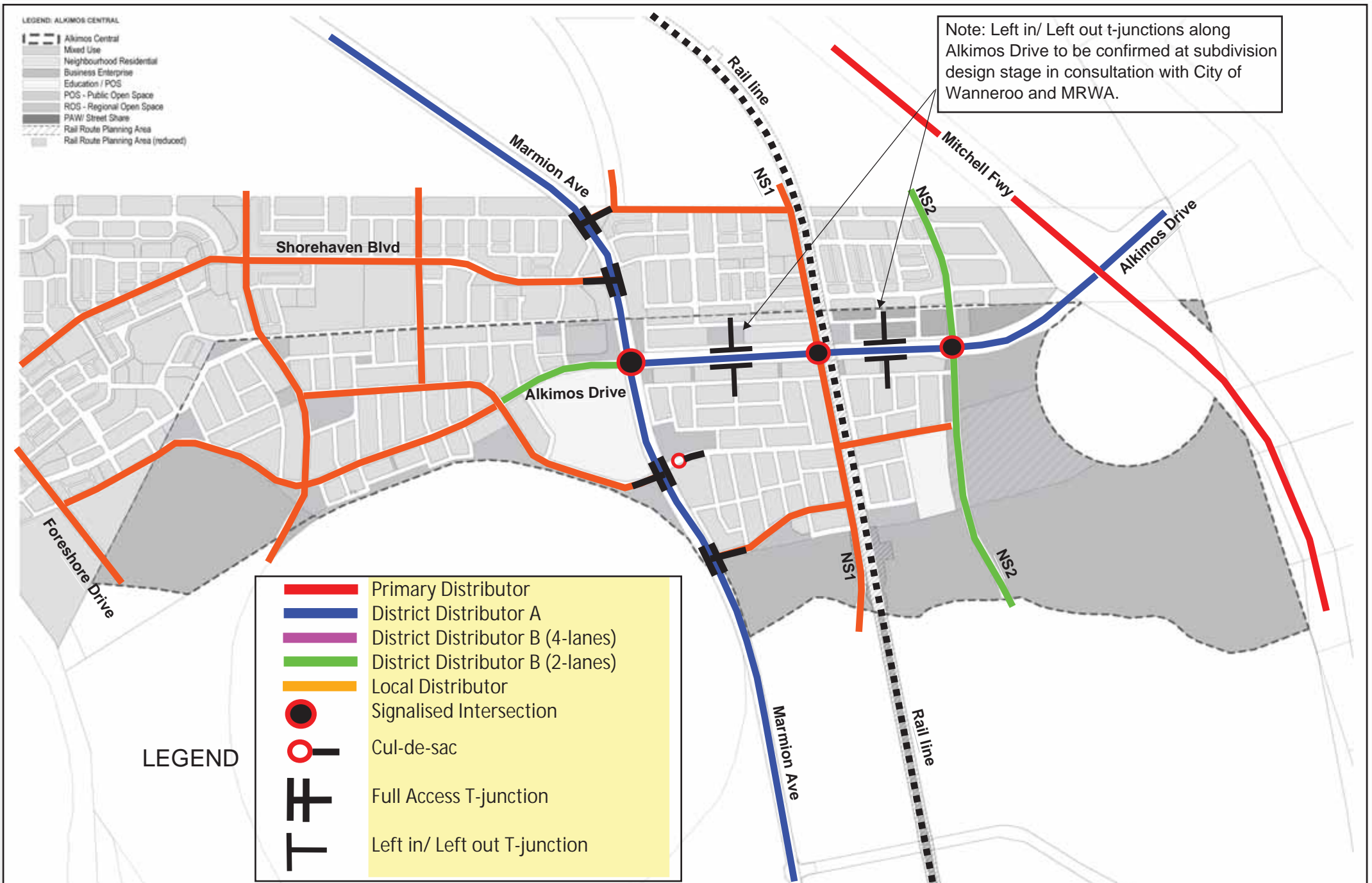
3.1 LPP 3.8 MARMION AVE ACCESS POLICY

An excerpt from City of Wanneroo Local Planning Policy 3.8 (LPP 3.8) is shown in *Figure 2*. Refer to *Appendix B* for a copy of the full document and correspondence with MRWA relating to Central Alkimos access to Marmion Avenue. The road hierarchy and arterial access plan for the Central Alkimos LSP presented in *Figure 3 (overleaf)* is generally consistent with LPP 3.8. Refer to *Section 3.2* for discussion on the addition of Neighbourhood Connector NS1, located on the west side of the rail line.

The Central Alkimos LSP also varies from LPP 3.8 where a signal controlled 4-way on Marmion Avenue (south of Alkimos Drive) has been replaced with a pair of Full Access T-junctions.



Figure 2 Excerpt from LPP 3.8 Marmion Ave Access Policy (City of Wanneroo, 2012).



The 'intersection control' variation to LPP 3.8 is documented in *Appendix B* and the reasons for the change are:

- The location of the signalised 4-way would be undesirably close to the Alkimos Drive intersection (also to be signalised).
- The projected traffic volumes on the Central Alkimos roads are relatively low (not warranting signal control on traffic demand basis).
- The alternative arrangement (i.e. Sign Controlled Full Access T-junctions) should perform adequately during peak periods as a result of gaps in traffic created by nearby signalised intersections to both the north and south.

3.2 NEIGHBOURHOOD CONNECTOR NS1 (REFER FIGURE 3)

NS1 is located at the west side of the proposed rail line within Central Alkimos. NS1 is proposed to be a 2-lane Neighbourhood Connector and will provide access to Alkimos City Centre, including to the Park n Ride facility associated with the Alkimos Rail Station.

Traffic modelling undertaken for the Alkimos City Centre Plan indicates that the Marmion Avenue/ Alkimos Parade intersection would be above capacity without support from another north-south road; and NS1 serves that role. SKM Consultants, in their public transport and strategic transport planning capacities for the Alkimos City Centre Plan, have also recommended the addition of NS1 for the additional network robustness it adds and the improved city centre access.

Please refer to the report titled *Alkimos City Centre Plan: Traffic & Movement Network (Bruce Aulabaugh, REV2 May 9 2013)* for further discussion of traffic forecast and intersection simulation results.

3.3 DESIGN COORDINATION WITH ALKIMOS CITY CENTRE AND SHOREHAVEN STRUCTURE PLANS

The planning of the Central Alkimos LSP road network has occurred in concert with the planning of the Alkimos City Centre Plan and the Shorehaven LSP road networks.

In respect to the Alkimos City Centre Plan, the north-south roads (NS1 and NS2) are key structural elements that have been designed to suit both projects. The same design consultants (engaged by Lend Lease Pty Ltd) worked on both projects and thus coordination was assured.

In respect to coordination with the Shorehaven LSP, the alignment for the extension of Alkimos Drive to the west of Marmion Avenue is the key structural element. The Lend Lease Central Alkimos team liaised with Peet Ltd and their consultants, Taylor Burrell Barnett to agree a mutually acceptable road network.

4. *STREET CROSS-SECTIONS*

Street cross-section drawings (*Appendix D*) have been prepared for the key street types within the Central Alkimos LSP Plan application area. The medians, travel lanes, cycle lanes and footpath/ shared path provisions are consistent with the forecast vehicle traffic and the functional role specified for each road. The road reserve characteristics are described below for each street type (i.e. Access Street, N.Connector, District Distributor Type B, District Distributor Type A).

- Residential Access Streets: reserve width range is 14m-16m.
- City Centre Access & Circulation Streets reserve width range is 18m-22m.
- Neighbourhood Connectors reserve width range is 20-24m.
- District Distributor Type B reserve width range is 27-30m.
- District Distributor Type A reserve width is 52m outside the city core (with 7m median and provision for frontage roads).

The cross-sections are also in conformance with Liveable Neighbourhoods Policy as applied in the City of Wanneroo. Any variations to Liveable Neighbourhoods Policy are agreed with the City of Wanneroo and sanctioned by WAPC at subdivision approval stage.

5. *ULTIMATE DEVELOPMENT TRAFFIC FORECAST*

Ultimate development stage traffic forecasts have been produced using a PM Peak Hour traffic model for the NW Corridor. The traffic model covers an area from Hester Avenue (south boundary) to Wilbinga Reserve (Two Rocks, north boundary) and from the coast (west boundary) to Old Yanchep Road (east boundary, located east of Wanneroo Road). Refer to *Figure 4* showing the extent of the modelled road network.

The traffic model land use information is taken from district and local structure plans and from information provided by the CoW and MRWA. The specific information for the Central Alkimos LSP Plan has been provided by Lend Lease.

The MRWA Regional Operation Model (ROM) provided a 24 hour sub-area vehicle trip matrix for this 'ultimate corridor development scenario'. This ROM vehicle trip matrix provided through trip and internal/ external trip pattern information. The Department of Planning Strategic Transport Evaluation Model (STEM) and provided person trip rate information and the Department of Transport provided guidance on mode splits for use in the model. Refer to *Appendix E* for more information on traffic model inputs/ outputs.



Figure 4. NW Corridor Traffic Model Network (Bruce Aulabaugh)

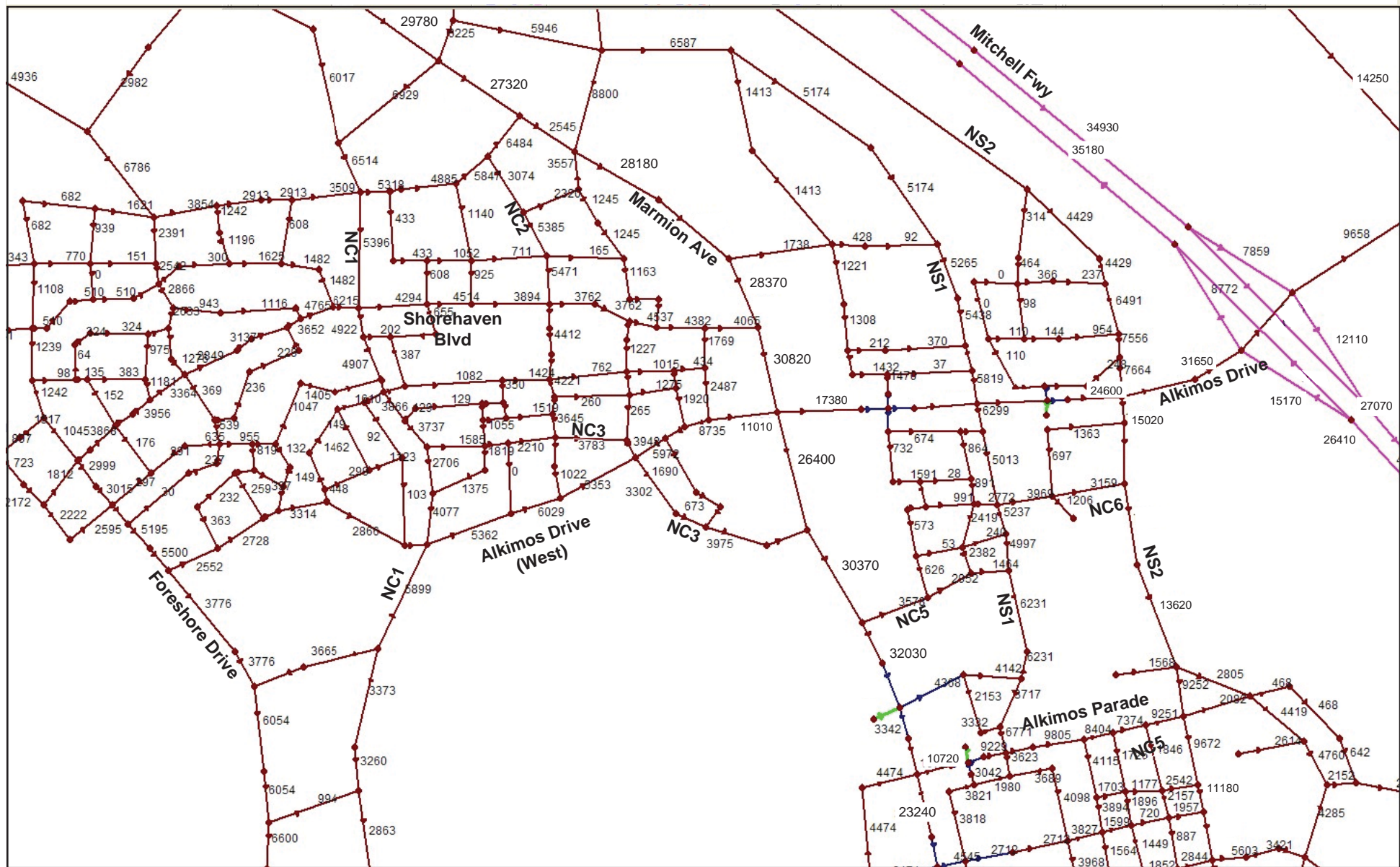
NW Corridor Ultimate Development Traffic Model daily traffic forecast for the ultimate development case is shown in *Figure 5*. The PM peak hour traffic is shown in *Figure 6*.

Summary traffic range forecasts are provided below for key roads in the study area:

- Marmion Avenue (north of Alkimos Drive): 28,000- 31,000 veh/day.
- Marmion Avenue (south of Alkimos Drive): 26,000-33,500 veh/day.
- Alkimos Drive (immediately west of Marmion Ave): 6000-11,000 veh/day
- Alkimos Drive (Marmion to NS1): 17,000-18,000 veh/day
- Alkimos Drive (NS1 to NS2): 24,000-25,000 veh/day
- Alkimos Drive (NS2 to Freeway): 32,000 veh/day
- NS2* (north of Alkimos Drive): 4,000-8,000 veh/day
- NS2* (south of Alkimos Drive): 10,000-15,000 veh/day
- NS1* (north of Alkimos Drive): 5,000-6,000 veh/day
- NS1* (south of Alkimos Drive): 5,000-7,000 veh/day.
- NC1* through NC6: 3,000-7,000 veh/day

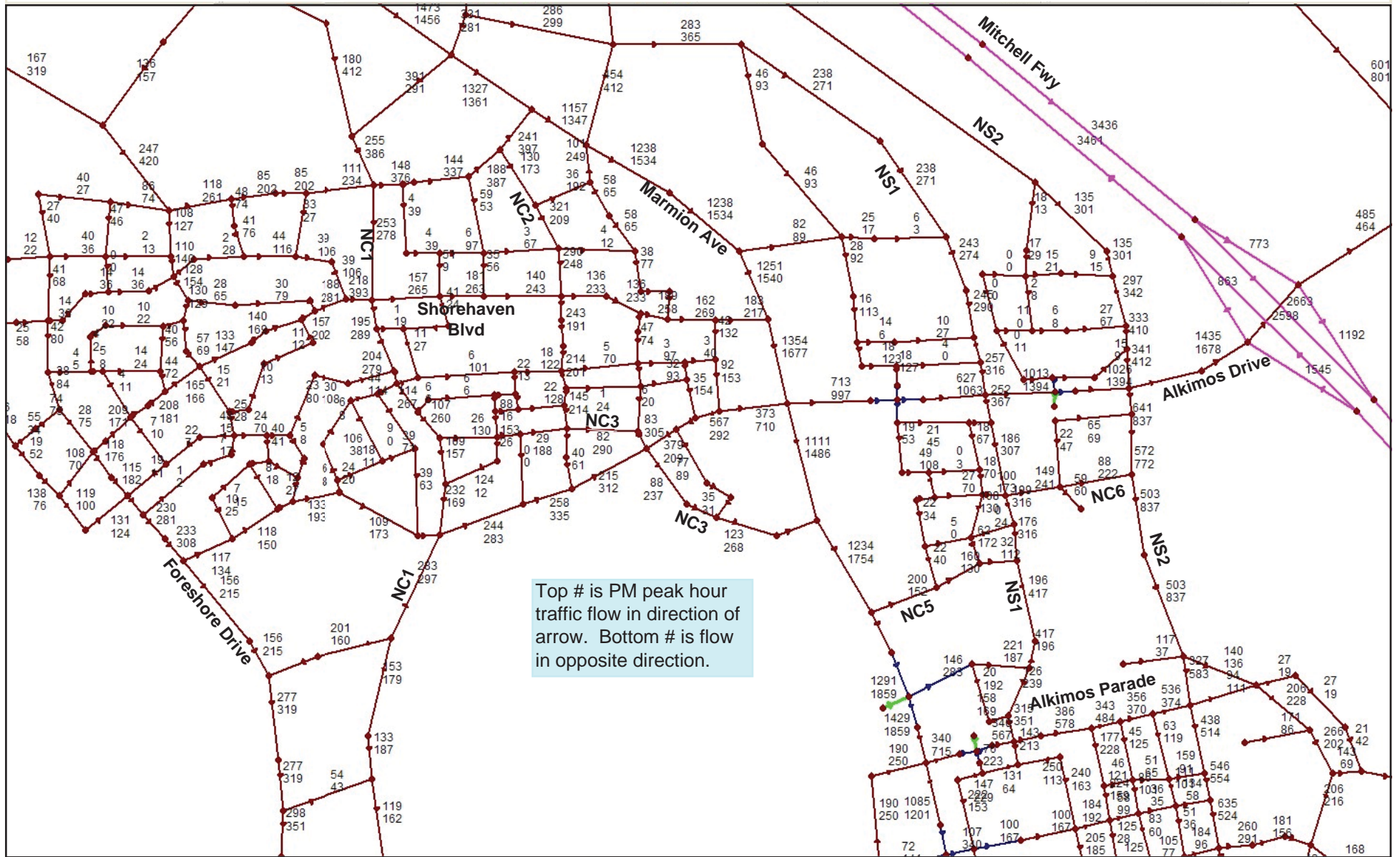
*For consistency, *NS1* and *NS2* roads are named as they are in the *Alkimos City Centre Plan Traffic & Movement Network Report* (Bruce Aulabaugh November 2012)

The forecast traffic levels are within design specifications for the road types indicated in *Figure 3* and are adequately catered for by the proposed street cross-sections (*Section 4*) and intersection designs (*Section 6*).



Central Alkimos Local Structure Plan
 Bruce Aulabaugh Traffic Engineering & Transport Planning

Figure 5 Daily Traffic (veh/day)
 Ultimate Development Scenario



Central Alkimos Local Structure Plan
 Bruce Aulabaugh Traffic Engineering & Transport Planning

Figure 6 PM Peak Traffic (veh/hr)
 Ultimate Development Scenario

6. SIGNALISED INTERSECTION ASSESSMENTS

The PM peak hour traffic conditions that are forecast for ultimate development stage have been tested at the following proposed signalised intersections (using SIDRA 5.1 software):

- Intersection 1 = Marmion Ave/ Alkimos Drive
- Intersection 2 = Alkimos Drive/ NS1
- Intersection 3 = Alkimos Drive/ NS2

Refer to *Figure 7* for the location of the signalised intersections and their summary performance information (i.e. Average Delay, Degree of Saturation and Level of Service). Refer to *Figure 8* for the proposed intersection geometry as input to SIDRA.

SUMMARY RESULTS: SIDRA 5.1 ASSESSMENT FOR SIGNALISED INTERSECTIONS

Summary results for the PM peak hour traffic conditions at ultimate development are provided in Table 1. Refer to *Appendix F, G and H* for additional SIDRA output information.

Table 1: PM Peak Hour Assessment at Ultimate Development

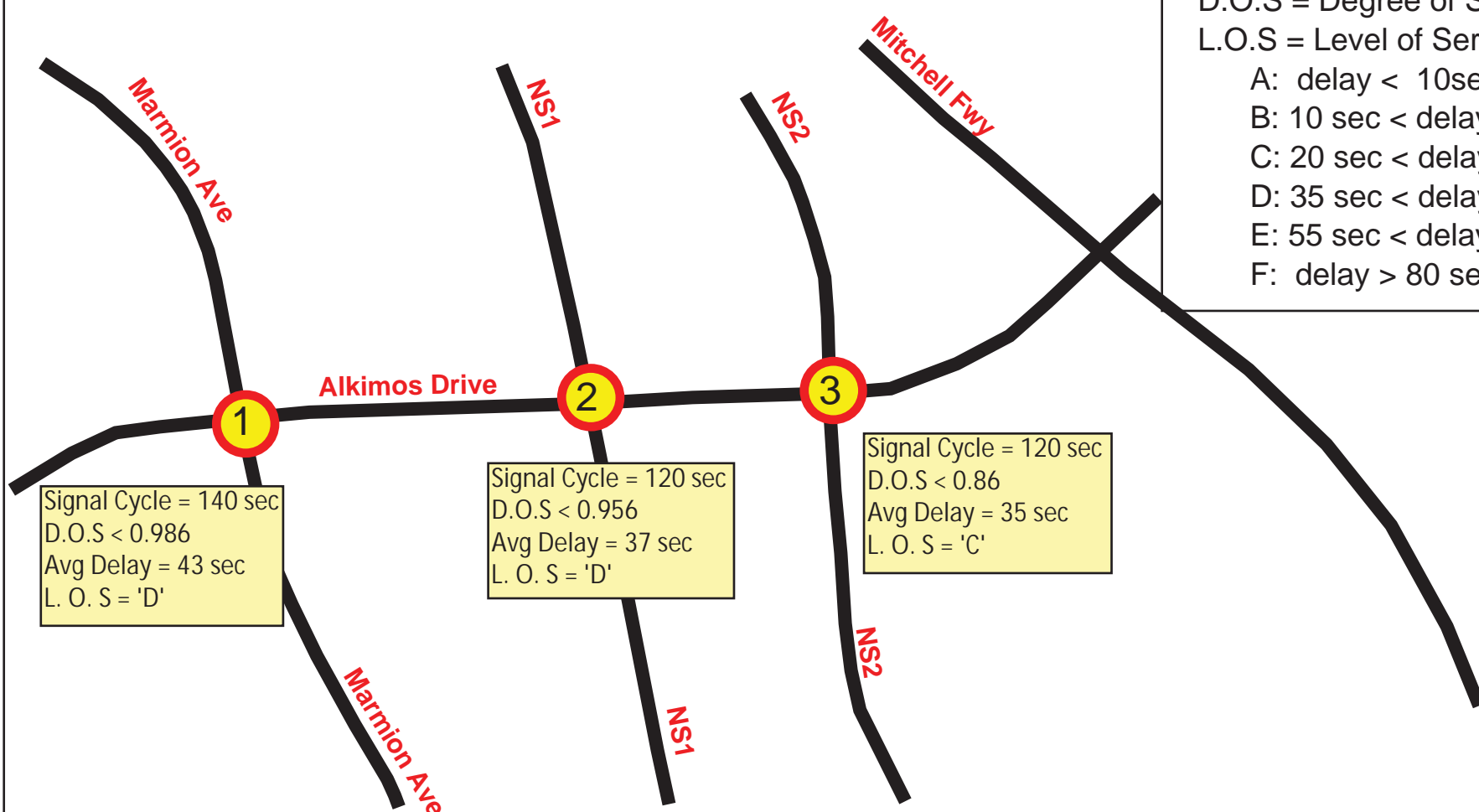
Intersection	Cycle Length	Degree Saturation	Average Delay	Level of Service
1:Marmion/ Alkimos Drive	140	0.99	43 sec	'D'
2:Alkimos Drive/ NS1	120	0.956	37 sec	'D'
3: Alkimos Drive/ NS2	120	0.86	35 sec	'C'

The Central Alkimos LSP generated traffic and district level through traffic give rise to moderately high ultimate development PM peak hour vehicle movements at the proposed signalised intersections. As shown in *Table 1*, the proposed intersection layouts deal reasonably well with the forecast movements (i.e. average delays < 45 sec and D.OS < 1.0).

1 Signalised Intersection #

D.O.S = Degree of Saturation
 L.O.S = Level of Service

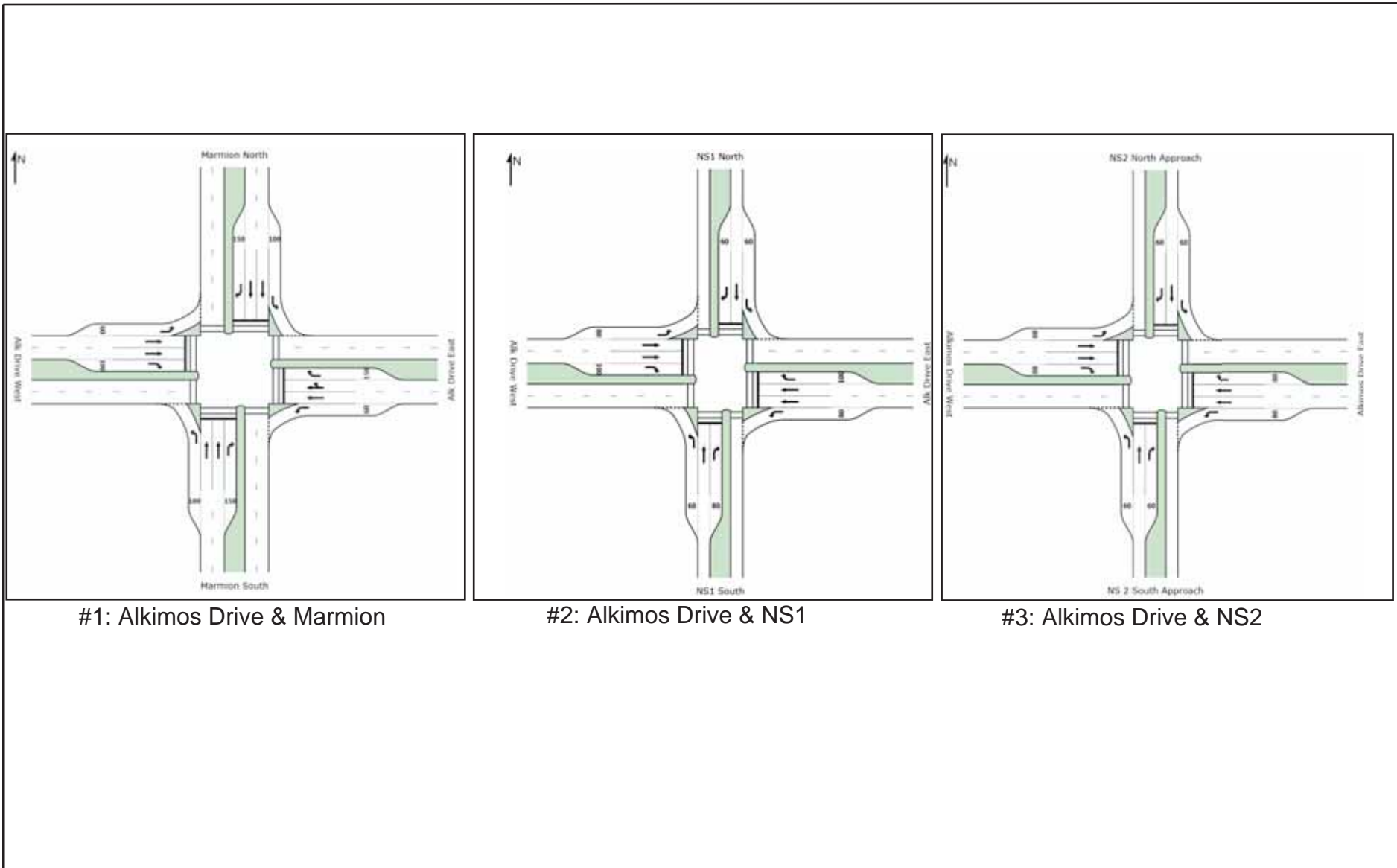
- A: delay < 10sec
- B: 10 sec < delay < 20 sec
- C: 20 sec < delay < 35 sec
- D: 35 sec < delay < 55 sec
- E: 55 sec < delay < 80 sec
- F: delay > 80 sec



Signal Cycle = 140 sec
 D.O.S < 0.986
 Avg Delay = 43 sec
 L. O. S = 'D'

Signal Cycle = 120 sec
 D.O.S < 0.956
 Avg Delay = 37 sec
 L. O. S = 'D'

Signal Cycle = 120 sec
 D.O.S < 0.86
 Avg Delay = 35 sec
 L. O. S = 'C'



#1: Alkimos Drive & Marmion

#2: Alkimos Drive & NS1

#3: Alkimos Drive & NS2

7. ROAD ACCESS: GENERAL POLICY INFORMATION

District Distributor Type A

There is no assumption of or provision for direct individual (private) property access from the District Distributor Type A roads. Only public roads are expected to connect to District Distributor A's. Individual properties on the local roads which connect with District Distributor Type A's (i.e. Integrator Arterial Type A) will require the standard CoW corner clearance of 30m (measured from nearest edge of crossover to the arterial road reserve boundary). This requirement will affect properties located on roads that intersect Marmion Avenue and Alkimos Drive.

District Distributor Type B

There is a general presumption for direct individual (private) property access from those District Distributor Type B roads which meet the required combination of land use and access management design measures as set out in *Liveable Neighbourhoods* policy. It is particularly important that 'forward gear vehicle access' is provided along DDB roads.

On roads which do not meet the design requirements, indirect access via a public street (i.e. a side street or CAP Road) is to be provided. Detailed investigations will be required at subdivision stage to establish the appropriate access design configuration.

Local District Distributors & Access Streets

All Local Distributors and Access Streets are presumed to be suitable to provide direct vehicle access to fronting properties. Those Local Distributors expected to carry traffic exceeding 5,000 veh/day will require a review of access management options at subdivision stage.

8. CITY OF WANNEROO LOCAL PLANNING POLICY 3.8

Local Planning Policy 3.8 Marmion Avenue Arterial Road Access (LPP 3.8) makes reference to property access along Marmion Avenue and Alkimos Drive.

Specifically, provision 1 in 'Part 2 – Policy Provisions' of LPP 3.8 requires the following:

No direct property access will be permitted to the Integrator Arterial roads (A) & (B) – depicted in Figure 1 between Marmion Avenue and the proposed Mitchell Freeway – except where the access meets the requirements of this Policy and is for one of the following:

- a) For the purposes of super lots; or*
- b) Where a commercial development creates rationalised access with the public road with an easement in gross granting reciprocal rights of access.*

Through LPP 3.8 provisions, it will be possible for CoW planning and engineering departments to review and approve structure plan, subdivision plan and design drawings incorporating easements in gross and dedicated crossovers granting reciprocal rights of access along Alkimos Drive.

9. LOCAL TRAFFIC MANAGEMENT

Figure 9 identifies particular intersections and special traffic management treatments for the Central Alkimos LSP street layout design. These include:

- 50km/hr default speed limit in built up areas (this will apply to local streets).
- 60-70km/hr speed limit will apply to Alkimos Drive (east of Marmion Ave).
- 70-80km/hr will apply to Marmion Ave.
- Traffic signals or roundabouts;
- Special 4-way intersection treatment;
- Speed control device (i.e. intersection plateau treatment)
- School Speed Zone at Primary Schools

Speed limits are determined by MRWA and are reflective of road function, road design, the road side environment and user mix. The default speed limit in 'built up' areas (i.e urban areas) is 50km/hr. This speed limit is considered appropriate for most, if not all, of the Central Alkimos LSP road network. Notwithstanding this general design objective, there may be portions of some district distributor roads within the Central Alkimos LSP that are signed 60km/hr on either an interim or final basis.

Traffic signals and roundabouts are identified in *Figure 9* at the busier 4-way intersections and near schools to assist in slowing traffic and managing U-turn demand.

At lower order 4-way junctions (where traffic volumes are light and approach speeds low), stop or give-way signs and brick paved threshold treatment are typically used. Where the 'run up distance' on the minor approach exceeds 200m, a splitter island and second sign are usually recommended. Where appropriate, a raised intersection plateau may be employed to slow traffic and render sign control of the 4-way more effective.

In the Central Alkimos LSP study area there are numerous 4-way Access Street intersections that will need to be reviewed at subdivision stage to confirm whether they are to be treated with sign control or roundabout control. These reviews will be done in consultation with the CoW.

Note: MRWA set speed zones and CoW LPP 3.8 currently indicates 80km/hr speed zone along this portion of Marmion Ave.








It is recommended that this be reviewed with a view to applying 70km/hr speed zone when urban development occurs.

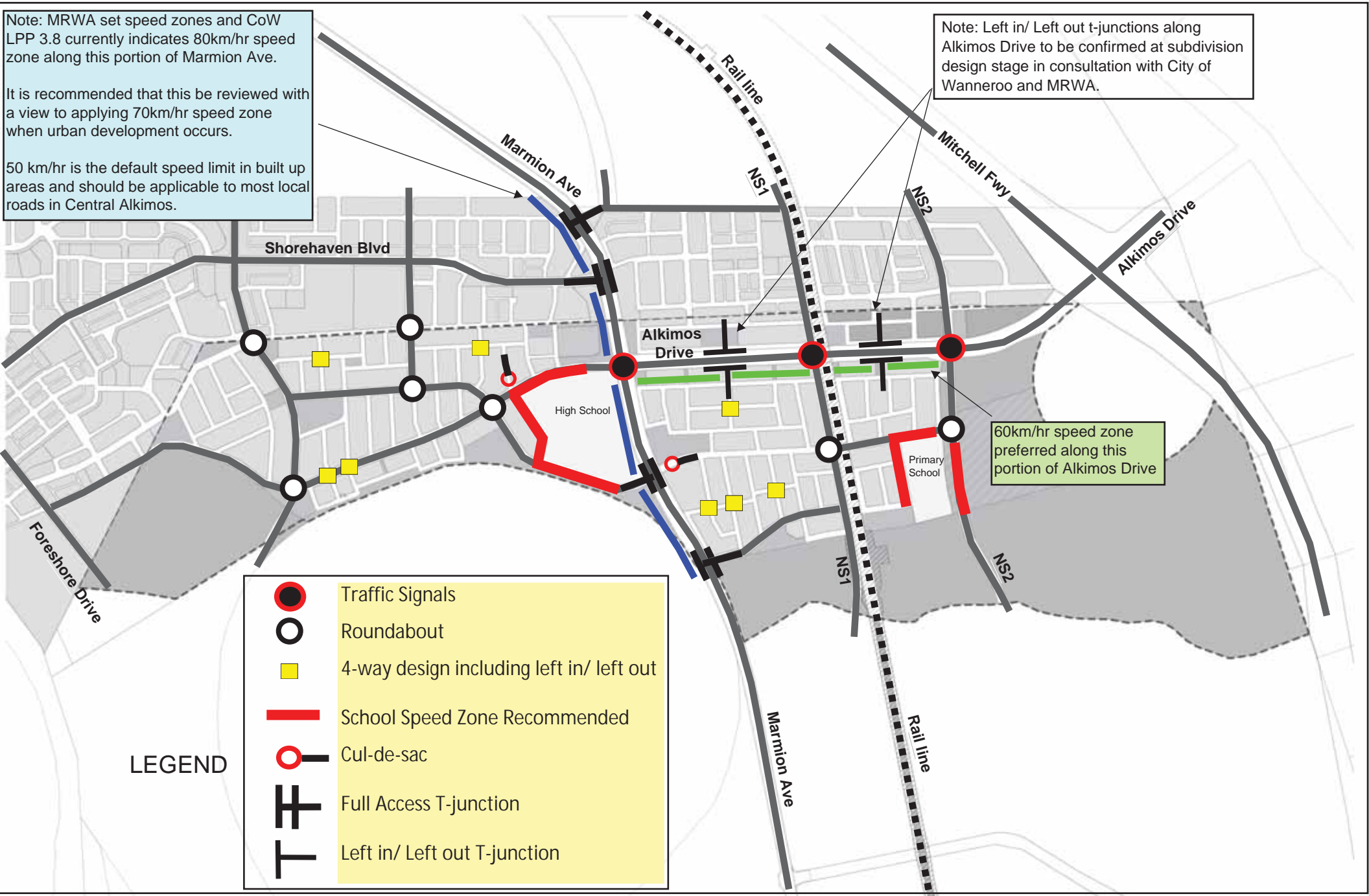
50 km/hr is the default speed limit in built up areas and should be applicable to most local roads in Central Alkimos.

Note: Left in/ Left out t-junctions along Alkimos Drive to be confirmed at subdivision design stage in consultation with City of Wanneroo and MRWA.

60km/hr speed zone preferred along this portion of Alkimos Drive

LEGEND

-  Traffic Signals
-  Roundabout
-  4-way design including left in/ left out
-  School Speed Zone Recommended
-  Cul-de-sac
-  Full Access T-junction
-  Left in/ Left out T-junction



10. PEDESTRIAN & CYCLIST FACILITIES

Shared Paths, Footpaths & Cycle Lanes

The Central Alkimos LSP shared path and cycle lane networks are shown in *Figure 10*. Refer also to the street cross-sections (*Appendix D*). Path and cycle lanes to be provided within road reserves are determined using the following guidelines:

- Integrator Arterial Type A Roads: Shared paths and cycle lanes are provided on both sides
- Integrator Arterial Type B Roads: Shared path one side, footpath opposite side, cycle lanes both sides.
- Local Distributors (i.e. Neighbourhood Connectors) with traffic > 3000 veh/day: Shared path one side and footpath opposite side, cycle lanes both sides.
- Local Distributors (i.e. Neighbourhood Connectors) with traffic < 3000 veh/day: Shared path one side and footpath opposite side.

Principle Shared Paths (PSP's) are also proposed within the rail reserve and the freeway reserve. State government agencies are responsible for the planning and provision of the PSP's.

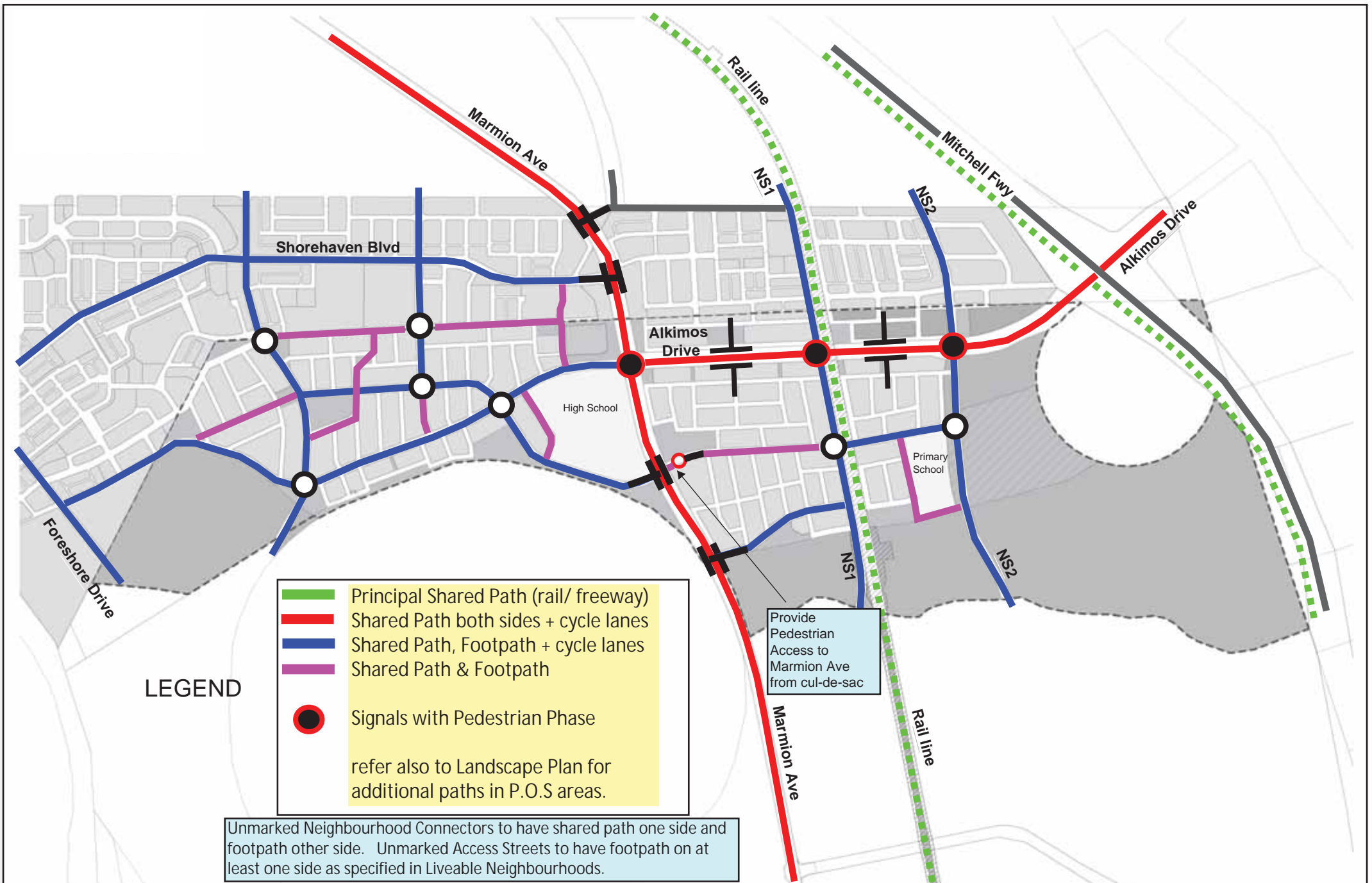
Signalised and Unsignalised At-Grade Crossings

Busier intersections with high pedestrian use will generally have traffic signals. These signals will be fitted with pedestrian activation buttons. Pedestrians will cross Marmion Ave and Alkimos Drive at signalised intersections. All at-grade road crossings (including unsignalised, unmarked crossings) are to have kerb ramps and median gaps or paths for use by pedestrians/ cyclists to access paths on the opposite site of the intersecting road.

Grade-Separated Road Crossings for Pedestrians/ Cyclists

The moderate traffic volumes forecast for most roads in the Central Alkimos LSP and the provision of signalised intersections at higher volume arterial roads should mitigate the need for grade separated pedestrian crossings, and thus, none are proposed in this report.

Primary schools located within Central Alkimos are understood to have catchments that do not span major arterial roads. Notwithstanding this expectation, information is provided below for situations where 'guard controlled at grade crossings' might be warranted.



Guard Controlled School Crossings Guidelines (WA Police):

- Type A crossing: a facility controlled by a warden who is an employee of the WA Police Service. It requires a minimum of 20 student pedestrians and 200 vehicles through traffic per hour.
- Type B crossing: a facility controlled by a warden who has volunteered for unpaid duty or has been engaged by the school's authorised parents association. These are offered where

the Type A warrants are not met but there is strong anticipated future growth in population and/or traffic.

Other forms of 'formalised' supervised pedestrian access include the Walking School Bus Program in which parents accompany a group of children to school. In this situation, although road crossing are not marked/signed as 'warden controlled' crossings and the parents aren't authorised to interrupt traffic to allow the children to cross, there is still adult supervision of the crossing manoeuvre.

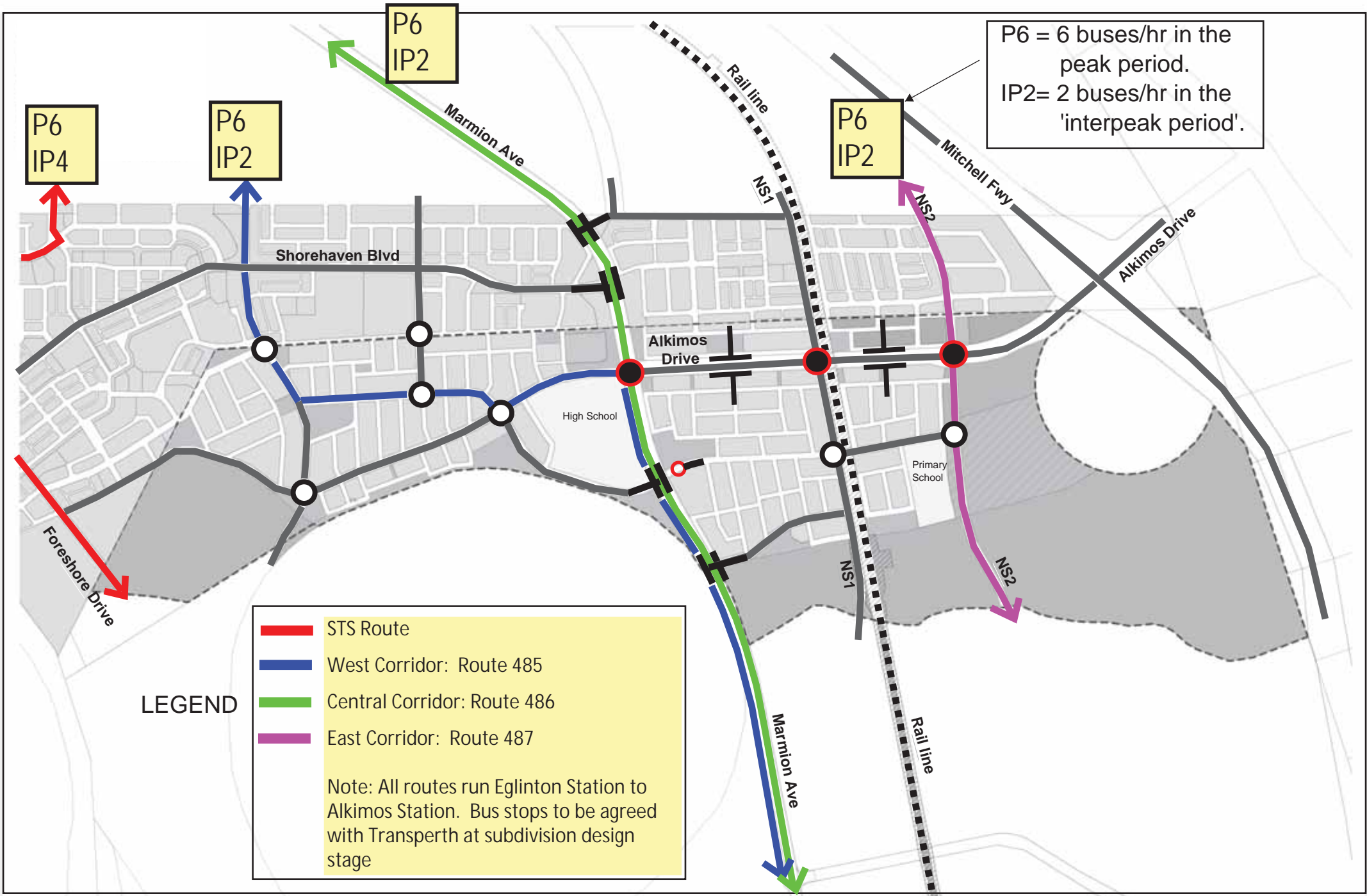
11. BUS SERVICES

Figure 11 shows the proposed Central Alkimos bus routes operating between future Eglinton Station and future Alkimos Station. Train service is expected to reach Alkimos Station by 2020.

The high frequency Secondary Transit System (STS) route is highlighted in red. The STS is expected to operate with buses for the foreseeable future and its operation is referred to here as a high frequency bus route. The STS bus route uses the coastal foreshore roads through Shorehaven and South Alkimos then turns east along Romeo Road (west) to access Alkimos Station.

Figure 11 also shows the ideal bus frequency at specific locations during peak periods and inter-peak periods. For example, 'P12' refers to 12 buses per hour in peak periods and 'IP6' refers to 6 buses per hour during inter-peak periods.

Initially buses will operate at 20min frequency in peak periods. The initial 'inter-peak' frequency will be 30min. Evening and weekend frequency (not shown in *Figure 11*) is likely to be 60 minutes both initially and in the longer term.



Central Alkimos Local Structure Plan
 Bruce Aulabaugh Traffic Engineering & Transport Planning

Figure 11 Bus Route Plan
 Base Plan: Roberts Day

APPENDICES:

- APPENDIX A: DISTRICT STRUCTURE PLAN
- APPENDIX B: COW LPP 3.8 MARMION AVE ACCESS POLICY & MRWA CORRESPONDENCE
- APPENDIX C: SHOREHAVEN AND ALKIMOS CITY CENTRE INFORMATION
- APPENDIX D: STREET CROSS-SECTIONS
- APPENDIX E: NW CORRIDOR TRAFFIC MODELLING INFORMATION
- APPENDIX F: SIDRA SIGNALISED INTERSECTION ASSESSMENTS
- APPENDIX G: DISTRICT BUS ROUTES PLANS
- APPENDIX H: MRWA T-JUNCTION DESIGNS

APPENDIX A

Alkimos-Eglinton DSP

APPENDIX B

***City Wanneroo Local Planning Policy 3.8
Correspondence with MRWA***

Owner	Planning and Sustainability
Implementation	2011
Reviewed	Biannual
Next Review	2013

PART 1 – POLICY OPERATION

Policy Development

This Policy has been prepared under the provisions of Section 8.11 of the City of Wanneroo District Planning Scheme No. 2.

Application and Purpose

This Policy prescribes acceptable standards for the type and location of vehicular access points, provisional standards for cycling infrastructure, and operational procedures for all new planning proposals including:

- structure plans and structure plan amendments;
- detailed area plans;
- applications for planning approval; and
- subdivision applications.

The area to which this Policy applies is bordered by, and inclusive of, Toreopango Avenue to the north, the proposed Mitchell Freeway to the east, Kingsbridge Boulevard to the south, and Marmion Avenue to the west. This area is represented graphically in **Figure 1**.

In the event of any inconsistency between the provisions of this Policy and:

- an agreed structure plan; or
- an application for planning approval that accords with an agreed structure plan; or
- a subdivision application that accords with an agreed structure plan;

then the provisions of that structure plan shall prevail, but only to the extent of that inconsistency.

Objectives

The objectives of this Policy are to:

1. Recognise Marmion Avenue is a major north-south transport route serving the north west corridor, but accept it is a lower classification road than the proposed Mitchell Freeway, which will run parallel, approximately two kilometres to the east;
2. Facilitate adequate pedestrian and bicycle movement (within the road reservation) along and across Marmion Avenue;
3. Strike a balance between the safe movement and flow of traffic on Marmion Avenue and the need for traffic to enter, leave and cross Marmion Avenue; and
4. Create sufficient access opportunities to regional and district centres, which include crossing points for all modes of transport (including pedestrians) and safe access for vehicles accessing the centres.

Structure

This Policy consists of three parts:

Part 1 – Policy Operation: This includes the Policy context and objectives.

Part 2 – Policy Provisions: Sets out Policy provisions for:

- Property access;
- Road design requirements;
- Cycle paths;
- Operating speeds and junction spacing; and
- Seeking amendments to the Policy.

Part 3 – Figure 1: A spatial plan that graphically reflects the following:

- The Policy application area
- Road hierarchy and rail network
- Key vehicular access points
- Ultimate target operating speed zones
- Centre locations

PART 2 – POLICY PROVISIONS

1. No direct property access will be permitted to the Integrator Arterial roads (A) & (B) – depicted in **Figure 1** between Marmion Avenue and the proposed Mitchell Freeway – except where the access meets the requirements of this Policy and is for one of the following:
 - a) For the purposes of super lots; or
 - b) Where a commercial development creates rationalised access with the public road with an easement in gross granting reciprocal rights of access.
2. In the event of any inconsistency between the provisions of this Policy and either, relevant Main Roads WA (MRWA) Guidelines, the Austroads Guide to Road Design or Liveable Neighbourhoods then the provision of those documents shall prevail over the conflicting provision of this Policy but only to the extent of any inconsistency.
3. A safe network of pedestrian and bicycle crossing points will be provided to link communities across major roads and provide safe access to regional and district centres. Major pedestrian crossing points will generally be provided under traffic signal control, but grade separated crossings will also be considered where the geometry is supportive and traffic signals are considered to be inappropriate.

4. Clearly defined cycle paths, at the widths specified below, are required for both sides of the following roads in the applicable area. Acceptable designs will include:
- On-road cycle lanes and physically separated dual use paths; or
 - Physically separated dedicated cycle paths and pedestrian paths.

Table 1: Cycle Path Location and Minimum Widths

Road Type	On-road Cycle Lane	Physically Separated Dedicated Cycle Path	Physically Separated Dual Use Path	Pedestrian Path
Integrator Arterial (A)	2.5 m	2.0 m	2.1 m	1.5 m
Integrator Arterial (B) and Neighbourhood Connector (A)	1.5 m	1.5 m		

5. Ultimate target operating speed and minimum junction spacing are specified in **Table 2** for Marmion Avenue and Integrator Arterial (A) and (B) roads, both;
- Within Town Centre Zones; and
 - Roads outside of Town Centre Zones.

Table 2: Ultimate Target Operating Speeds and Minimum Junction Spacing

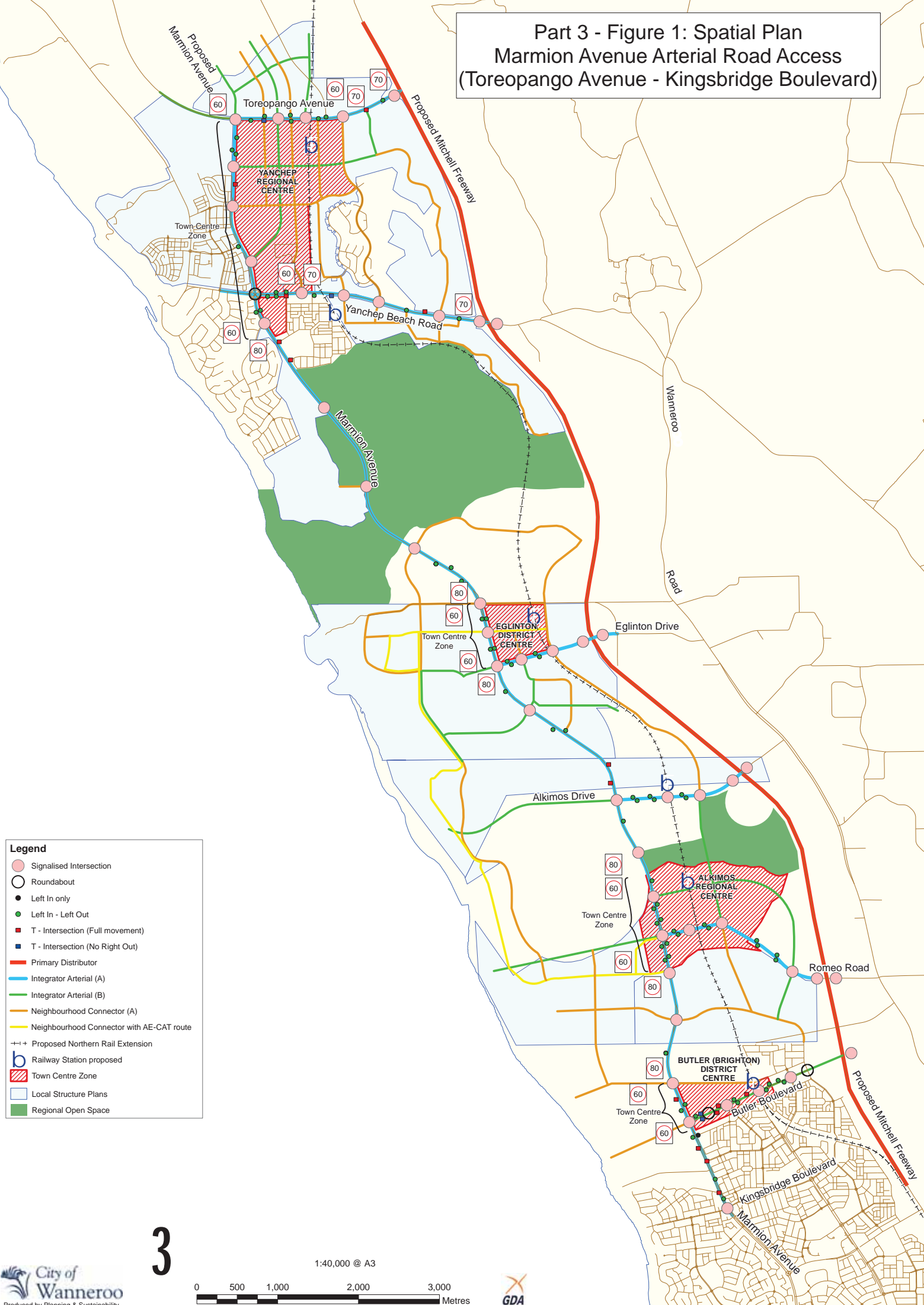
Roads within Town Centre Zones		
Affected Road	Ultimate Target Operating Speed*	Minimum Junction Spacing**
Marmion Avenue	60 km/h	Major: 350 m Minor: 165 m
Other Integrator (A) Roads	60 km/h	Spacing according to Table 5 of Liveable Neighbourhoods
Integrator (B) Roads	60 km/h	
Roads outside of Town Centre Zones		
Affected Road	Ultimate Target Operating Speed*	Minimum Junction Spacing**
Marmion Avenue	80 km/h	Major: 1 km Minor: 500 m
Other Integrator (A) Roads	70 km/h	Spacing according to Table 5 of Liveable Neighbourhoods
Integrator (B) Roads	60 km/h	

*Ultimate target operating speeds are a forecasted requirement only. Future urban growth will dictate whether these speeds are needed or if they require review. Until then, interim speeds will be in effect. Existing roads already have these interim speeds applied by Main Roads WA policy. Future roads' interim speed zoning will be decided by Main Roads WA when required.

**For Marmion Avenue only, 'Major' junctions involve more than two intersecting roads and are controlled by either signals or a roundabout. 'Minor' junctions are T intersections that involve two intersecting roads, controlled by either a 'Stop' or 'Give Way' sign. Within Town Centre Zones, the City may allow right turn manoeuvres. Outside of Town Centre Zones, only left-in left-out intersections will be accepted.

6. Where applications are made to Council seeking to depart from the intersection location, design or any other provision of this Policy, an application must first be made to seek an amendment of this Policy. The application must be supported by a Traffic Assessment, which needs to;
 - be undertaken by a sufficiently qualified and experienced traffic engineer;
 - clearly justify the necessity of the amendment including how it will benefit the road network and address the effect on traffic flow and safety; and
 - be approved by the City of Wanneroo in consultation with MRWA.

Part 3 - Figure 1: Spatial Plan Marmion Avenue Arterial Road Access (Toreopango Avenue - Kingsbridge Boulevard)



- Legend**
- Signalised Intersection
 - Roundabout
 - Left In only
 - Left In - Left Out
 - T - Intersection (Full movement)
 - T - Intersection (No Right Out)
 - Primary Distributor
 - Integrator Arterial (A)
 - Integrator Arterial (B)
 - Neighbourhood Connector (A)
 - Neighbourhood Connector with AE-CAT route
 - ++ Proposed Northern Rail Extension
 - b Railway Station proposed
 - ▨ Town Centre Zone
 - Local Structure Plans
 - Regional Open Space

Bruce Aulabaugh

From: MCKIRDY Justin (URPM) [justin.mckirdy@mainroads.wa.gov.au]
Sent: 14 June 2012 16:38
To: Bruce Aulabaugh
Cc: BROADHURST Lindsay (MRP); HOLMES Rob (RPO)
Subject: RE: Central Alkimos LSP: Preliminary Road Hierarchy & Arterial Access

Thanks Bruce.

I've looked at the plan provided and discussed with Lindsay and can confirm that what you have shown meets the intent of our comments. I also note your comment that the internal road layout may adjust but that this agreement really crystallises the access to Marmion Ave.

Regards

Justin McKirdy
Urban Road Planning Manager



Telephone: (08) 9323 4991 Fax: (08) 9323 4449
Mobile: 0417 173 352
Email: justin.mckirdy@mainroads.wa.gov.au

From: Bruce Aulabaugh [mailto:brucea@iinet.net.au]
Sent: Monday, 11 June 2012 1:24 PM
To: MCKIRDY Justin (URPM)
Cc: BROADHURST Lindsay (MRP)
Subject: FW: Central Alkimos LSP: Preliminary Road Hierarchy & Arterial Access

Justin,

After I received your email of 17 May 2012, I sent a draft reply (addressed to you) firstly to Lend Lease/ Land Corp for review prior to sending on to you. Lend Lease and LandCorp have now come back to me and OK'd it for sending to you. Please see below my email to you (MRWA) in relation to your advice for Marmion Avenue access for the Central Alkimos LSP.

Thanks and regards

Bruce Aulabaugh
Traffic Engineering & Transport Planning
5/18 Fogerthorpe Crescent
Maylands WA 6051
mobile: 0402919933

From: Bruce Aulabaugh [mailto:brucea@iinet.net.au]
Sent: 17 May 2012 12:12
To: 'Jolic, Anne'
Subject: FW: Central Alkimos LSP: Preliminary Road Hierarchy & Arterial Access

Anne,

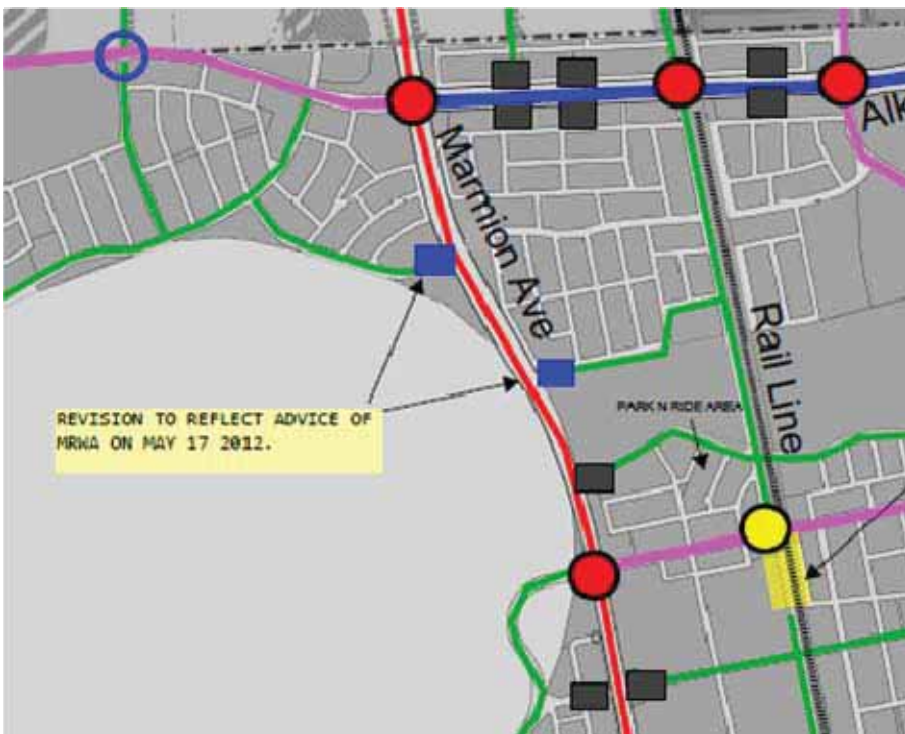
Please discuss with LandCorp the following draft email to MRWA.

Justin,

I've revised the Road Hierarchy & Intersection Control Plan to reflect my understanding of your advice (see attached revision and excerpt of that revision below).

I would appreciate it if you would have a look and confirm that I've amended the draft plan correctly. Please note that the local road network on the east side of Marmion Ave and north of the regional open space is very preliminary but I've duly shifted the notional N.Connector (local distributor) to link to the 'new' Marmion full access sign controlled T junction. As you would imagine, there will be other changes to the local streets in this area to incorporate this change. For purposes of showing arterial road access however, this plan should suffice.

Assuming that this interpretation is correct, I can advise that Lend Lease have considered Main Road's concerns about the original proposal (as contained in your email below) and agree to proceed with LSP planning on the basis of Main Road's alternative approach incorporating staggered full access sign controlled t-junctions for Central Alkimos.



Thanks and regards

Bruce Aulabaugh
Traffic Engineering & Transport Planning
5/18 Fogerthorpe Crescent
Maylands WA 6051
mobile: 0402919933

From: Bruce Aulabaugh [<mailto:brucea@inet.net.au>]

Sent: 17 May 2012 10:44

To: 'MCKIRDY Justin (URPM)'

Cc: 'Brett Wood-Gush'; 'Jolic, Anne'; 'Craig Hansen'; 'BROADHURST Lindsay (MRP)'; 'OSTOIC Jerko (TSC)'; 'KING Bruce (TSC)'

Subject: RE: Central Alkimos LSP: Preliminary Road Hierarchy & Arterial Access

Justin,

Thanks for the advice and your willingness to consider staggered full access sign controlled T-junctions to satisfy the access needs in this area. I will discuss your advice with Lend Lease and get back to you as soon as possible.

regards

Bruce Aulabaugh
Traffic Engineering & Transport Planning
5/18 Fogerthorpe Crescent
Maylands WA 6051
mobile: 0402919933

From: MCKIRDY Justin (URPM) [<mailto:justin.mckirdy@mainroads.wa.gov.au>]
Sent: 17 May 2012 09:41
To: Bruce Aulabaugh
Cc: 'Brett Wood-Gush'; 'Jolic, Anne'; 'Craig Hansen'; BROADHURST Lindsay (MRP); OSTOIC Jerko (TSC); KING Bruce (TSC)
Subject: RE: Central Alkimos LSP: Preliminary Road Hierarchy & Arterial Access

Hi Bruce,

Thanks for the below information and the opportunity to comment. Our position is that we do not support the relocation of the intersection as you have proposed. The original position indicated for a controlled intersection was largely based on the even distribution of controlled intersections along this section of Marmion Ave and the desire to try to change the road environment on the entry to the Alkimos Regional centre. Additionally, the locations shown for controlled intersections on LPP3.8 are intended as a guide and that the need for such control will still need to be demonstrated as appropriate and good practice – and in keeping with maintaining Marmion Ave as the key arterial road through this area. Consideration of the movement task along Marmion Avenue should take precedence over the movement task of the lower order local network. The relocation of the controlled intersection, as you have proposed, is considered to be detrimental to some of these outcomes.

We are of the opinion that Alkimos Dr can adequately cater for the east west demands within this area and that motorists should be making their travel choice within the local road network to ensure their safe and efficient access to the arterial network. Nonetheless, there may be a case to allow full movement connections, in a staggered arrangement, at:

- The original intersection location to cater for the eastern side; and
- The new intersection location to cater for the western side.

This would remove the fourth leg on the eastern side of Marmion Ave from the proposed four way intersection 375m south of Alkimos Dr (refer to Diagram below). Both of the full movement intersections should be able to operate as uncontrolled intersections with sufficient gaps produced by the upstream controlled intersections. The staggered arrangement will also be more consistent with the indicative speed regime proposed in LPP3.8.



Regards

Justin McKirdy
Urban Road Planning Manager



Telephone: (08) 9323 4991 Fax: (08) 9323 4449
Mobile: 0417 173 352
Email: justin.mckirdy@mainroads.wa.gov.au

From: Bruce Aulabaugh [<mailto:brucea@inet.net.au>]
Sent: Wednesday, 16 May 2012 5:08 PM
To: BROADHURST Lindsay (MRP); MCKIRDY Justin (URPM)
Cc: 'Brett Wood-Gush'; 'Jolic, Anne'; 'Craig Hansen'
Subject: Central Alkimos LSP: Preliminary Road Hierarchy & Arterial Access

Lindsay/ Justin,

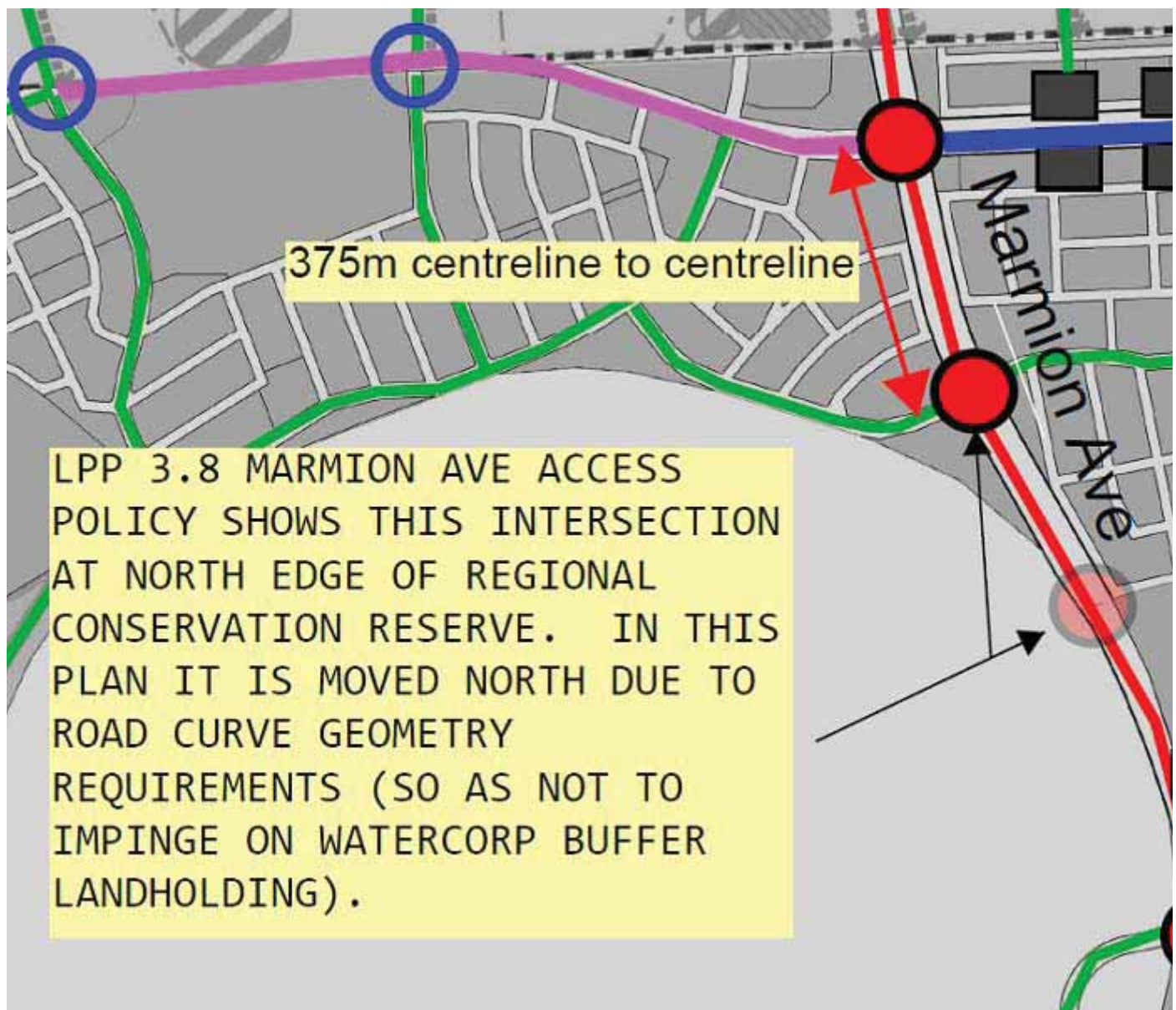
Attached please find a 3 page pdf containing:

1. LPP 3.8 Access Policy Plan excerpt (whole page).
2. LPP 3.8 Access Policy Plan cropped figure (showing Alkimos area).
3. Central Alkimos & Alkimos City preliminary Road Hierarchy & Arterial Access Plan

A portion of item 3 is shown below to highlight the 375m separation between the draft Central Alkimos LSP's proposed 4-way controlled junction on Marmion Ave and the Alkimos Drive/ Marmion Avenue intersection.

The notes on the plan show the original LPP 3.8 three-way controlled intersection 'ghosted' so that you can easily see the northerly shift of the intersection (a move of approximately 350m). We would appreciate your comment on the acceptability of this proposed location which is the furthest south that we believe a 4-way junction can be located without the approach alignments impinging on the WaterCorp Buffer (with regional conservation status).

The 4-way is being proposed to provide better access to/ from the south for the Central Alkimos area as well as to provide better east-west connections.



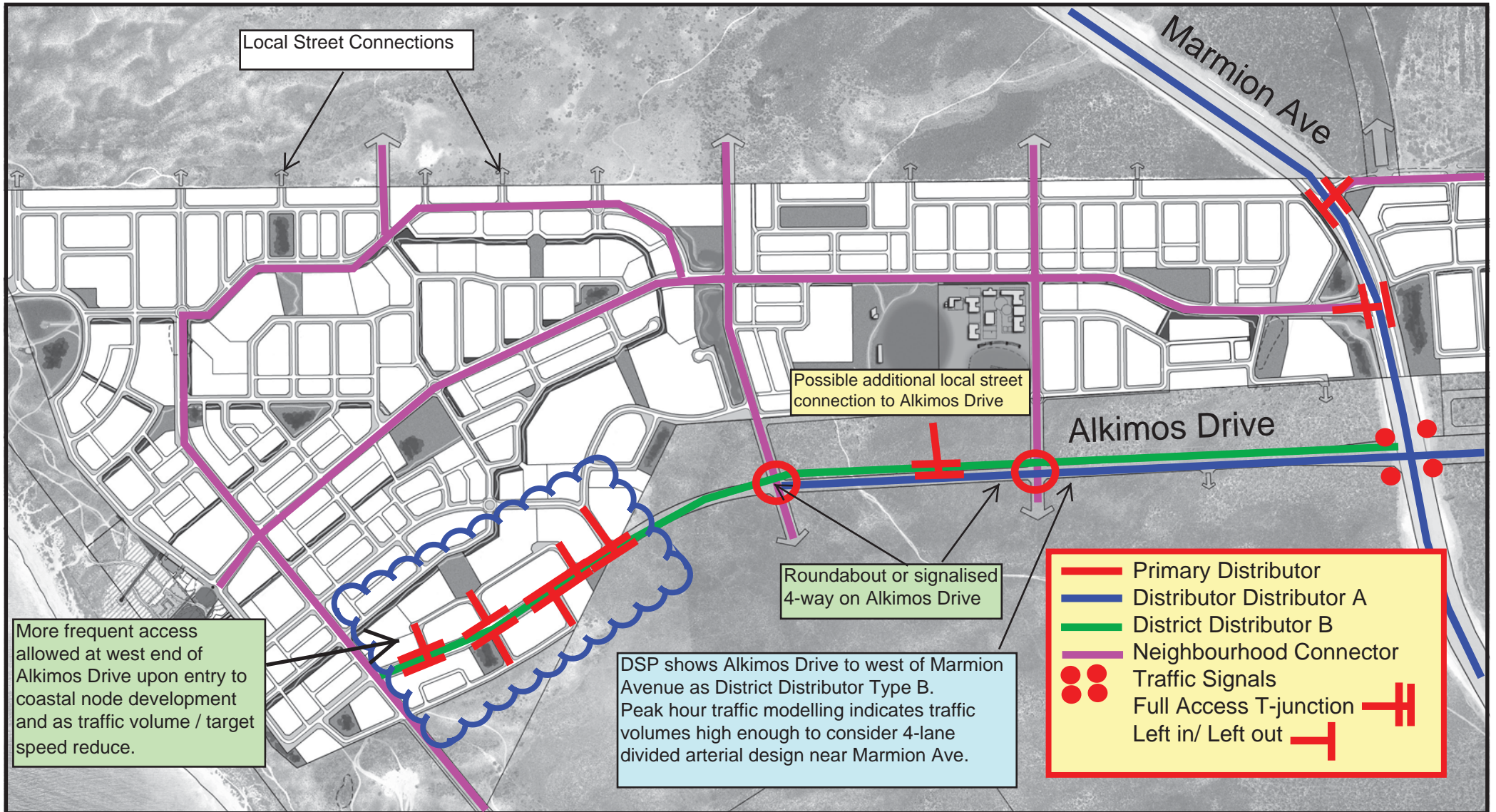
Should you have any questions in this regard, please contact me on 0402 919 933.

Thanks and regards

Bruce Aulabaugh
Traffic Engineering & Transport Planning
5/18 Foggerthorpe Crescent
Maylands WA 6051
mobile: 0402919933

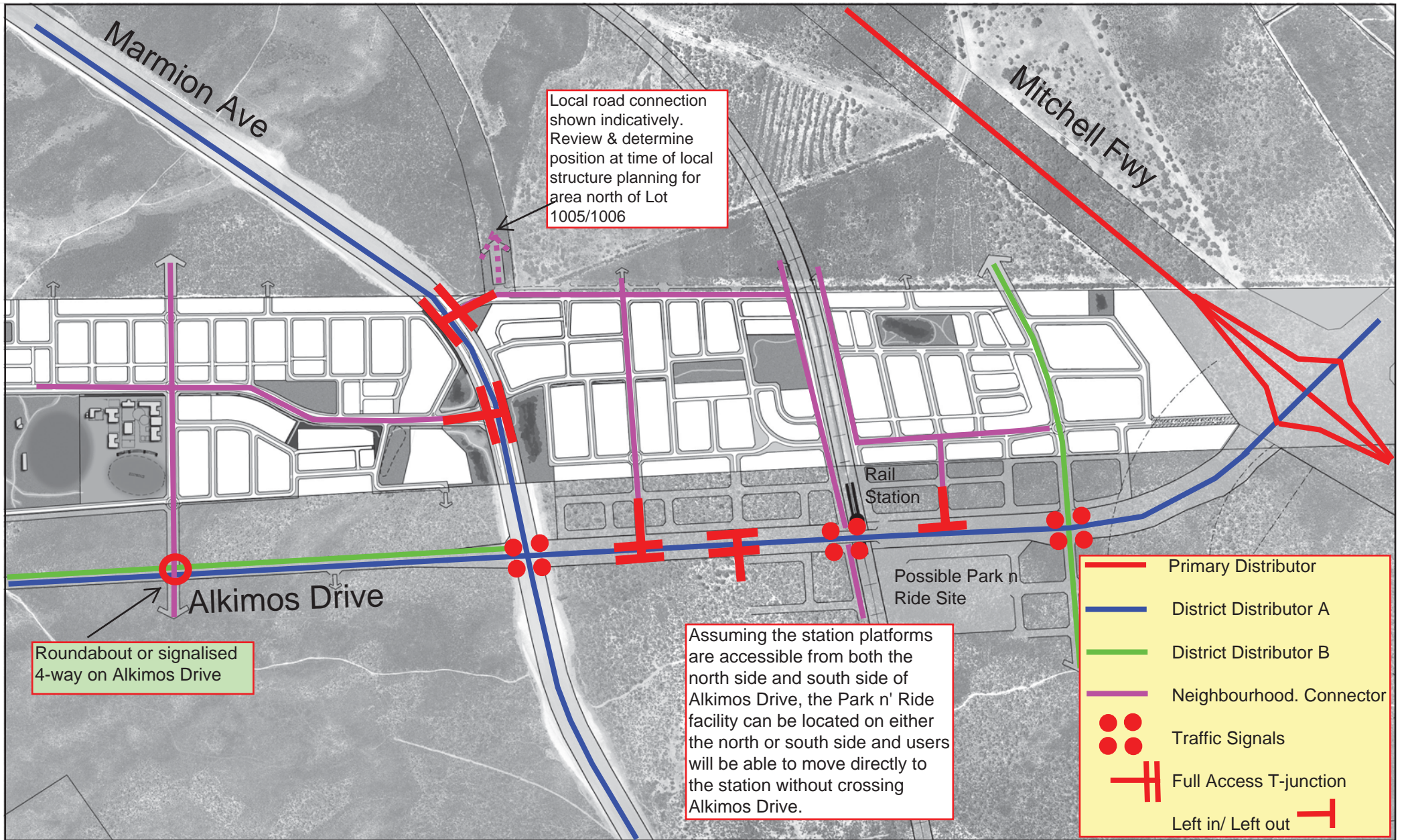
APPENDIX C

Shorehaven LSP and Alkimos City Centre Plan Transport Info



Alkimos Lot 1005/1006 Local Structure Plan
 Bruce Aulabaugh Traffic Engineering & Transport Planning

Figure 5a: Road Hierarchy & Arterial Access Plan



Alkimos Lot 1005/1006 Local Structure Plan
 Bruce Aulabaugh Traffic Engineering & Transport Planning

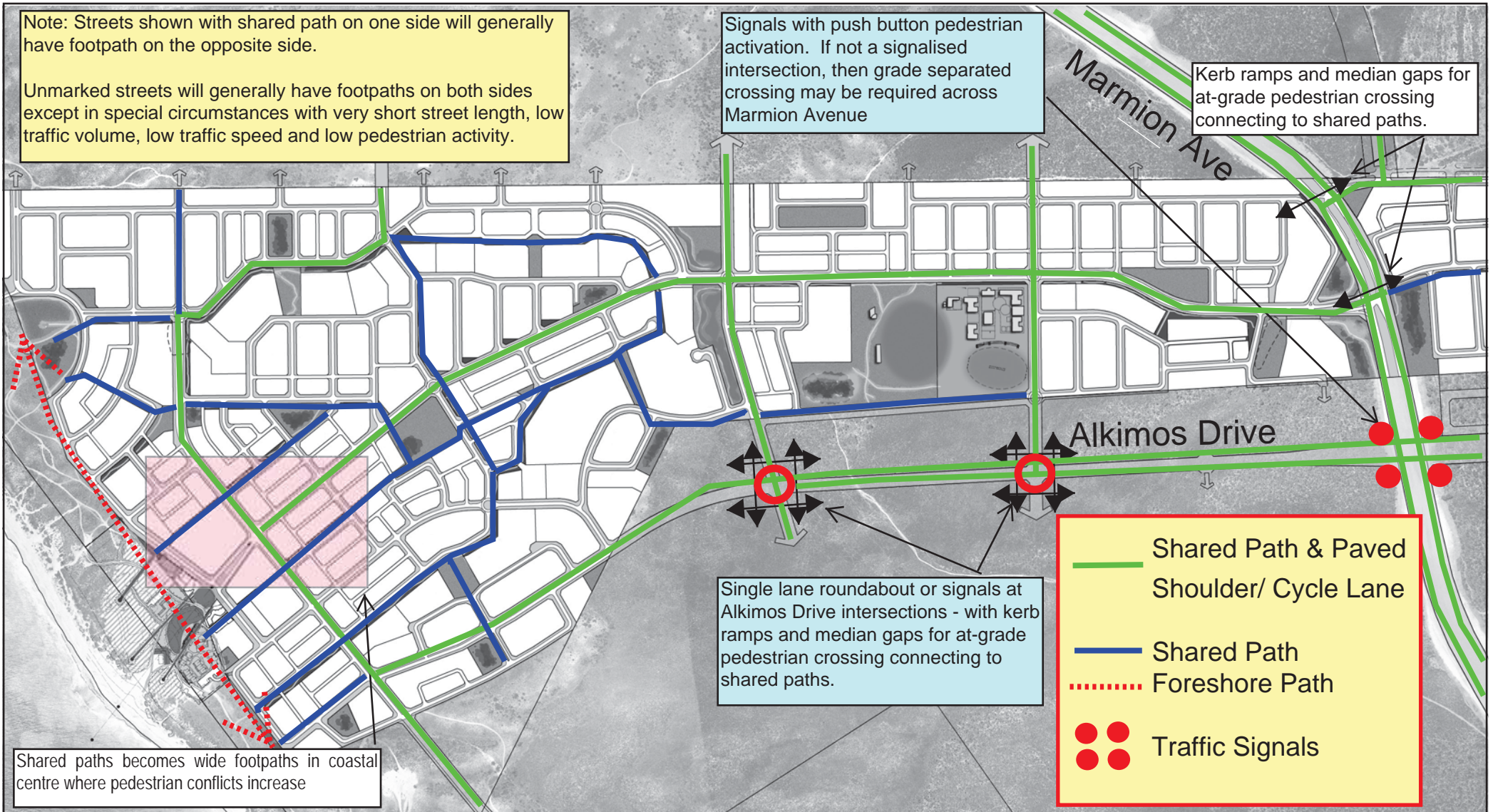
Figure 5b: Road Hierarchy & Arterial Access Plan (east)

Note: Streets shown with shared path on one side will generally have footpath on the opposite side.

Unmarked streets will generally have footpaths on both sides except in special circumstances with very short street length, low traffic volume, low traffic speed and low pedestrian activity.

Signals with push button pedestrian activation. If not a signalised intersection, then grade separated crossing may be required across Marmion Avenue

Kerb ramps and median gaps for at-grade pedestrian crossing connecting to shared paths.



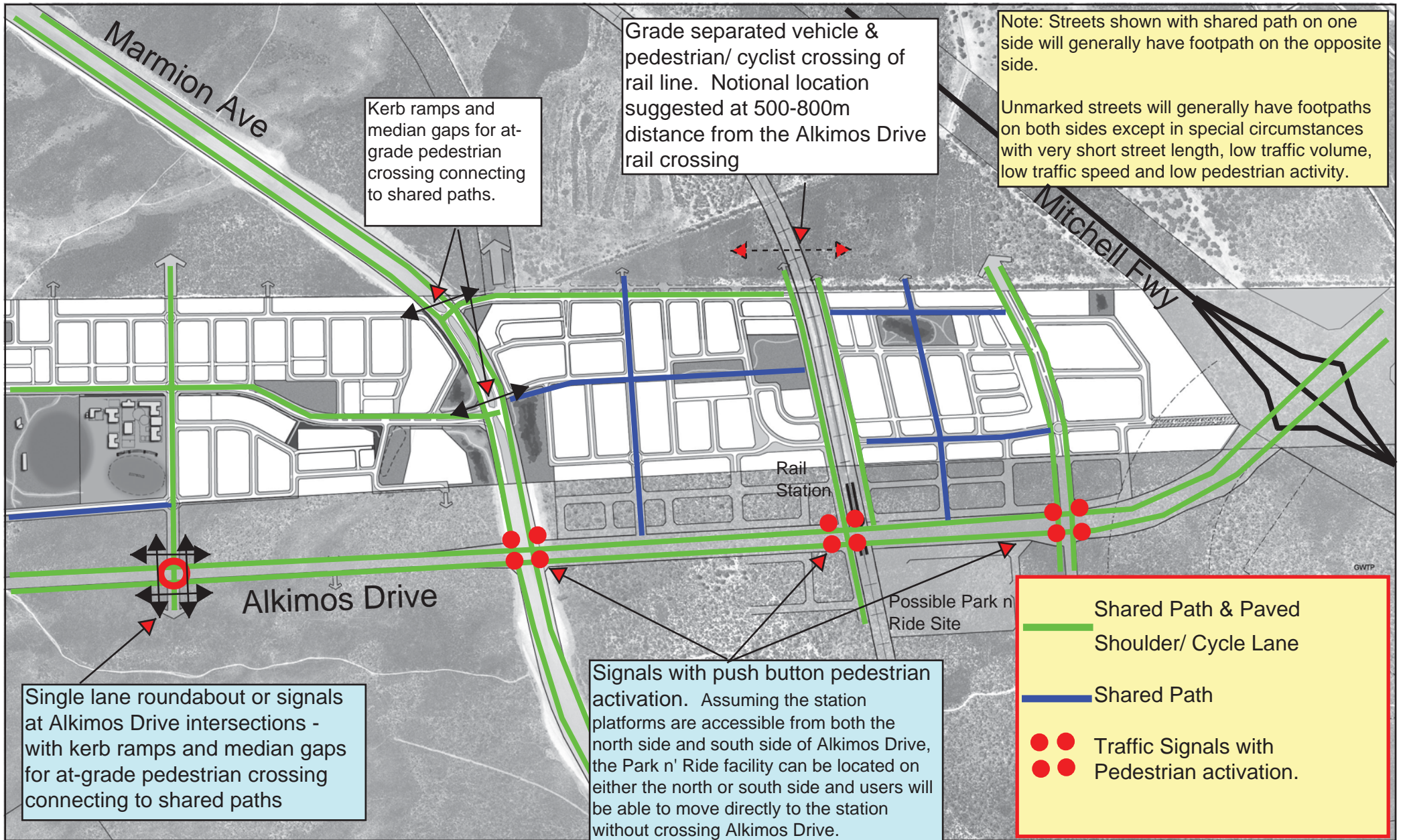
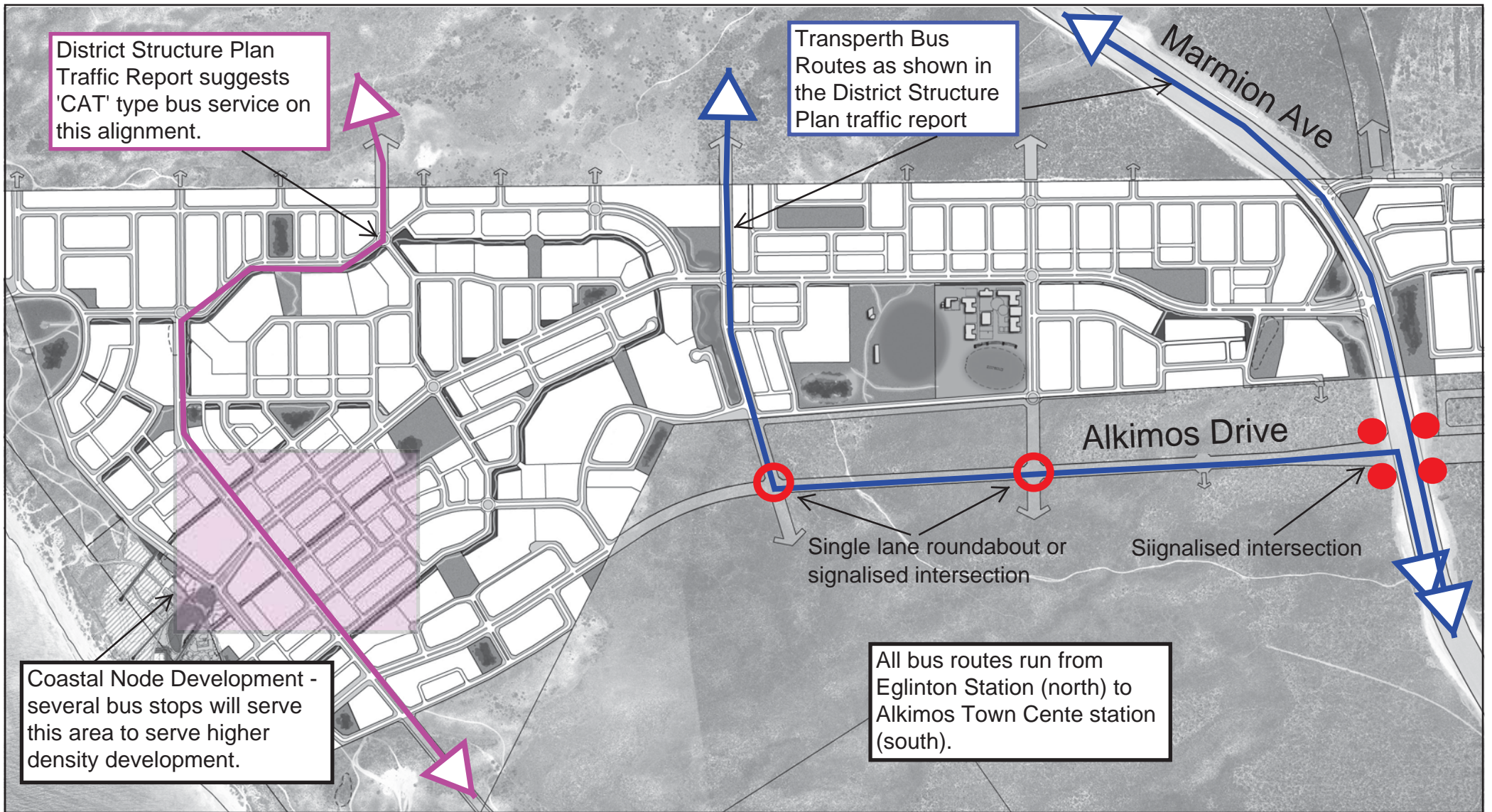
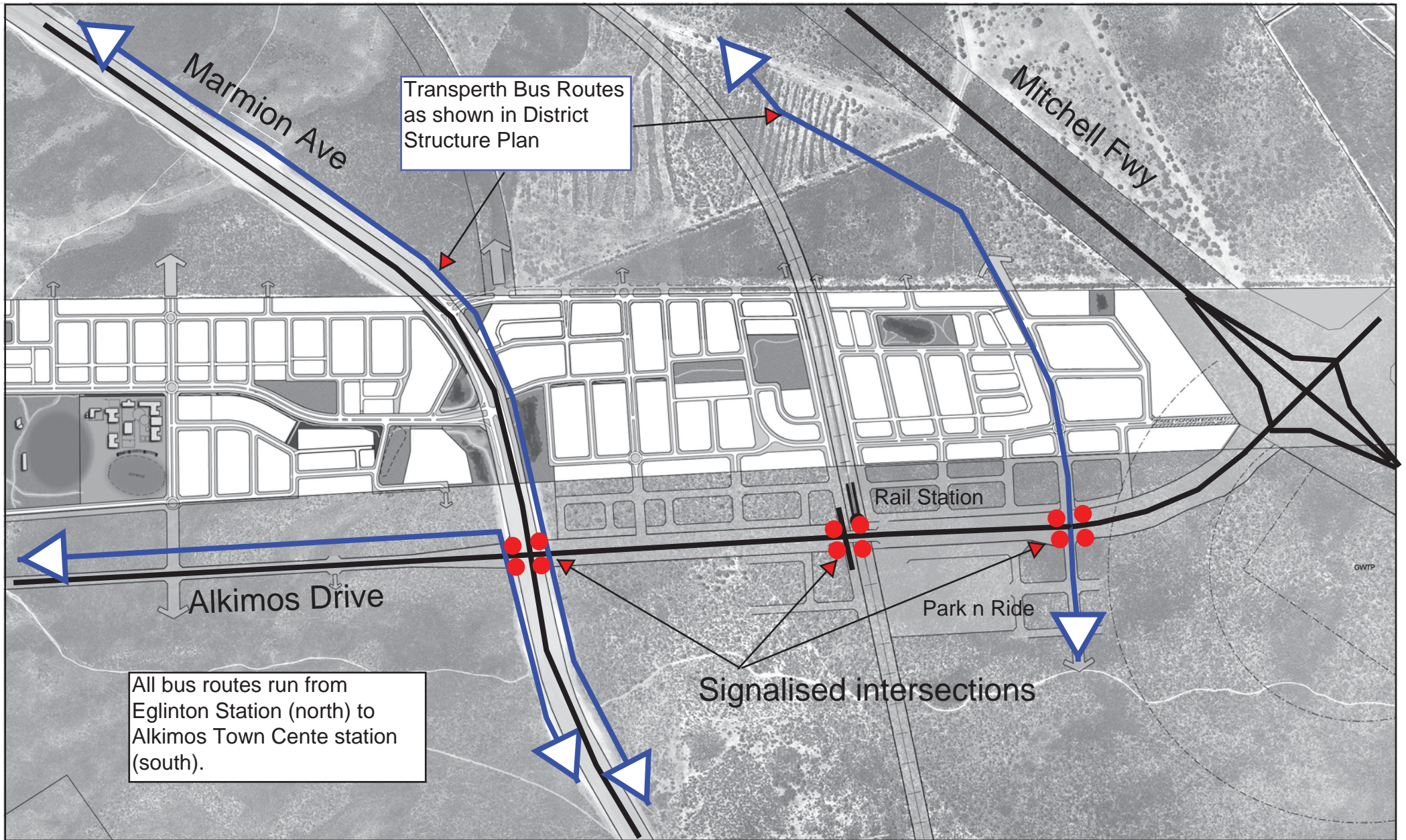


Figure 23b: Pedestrian & Cyclist Facilities (east)



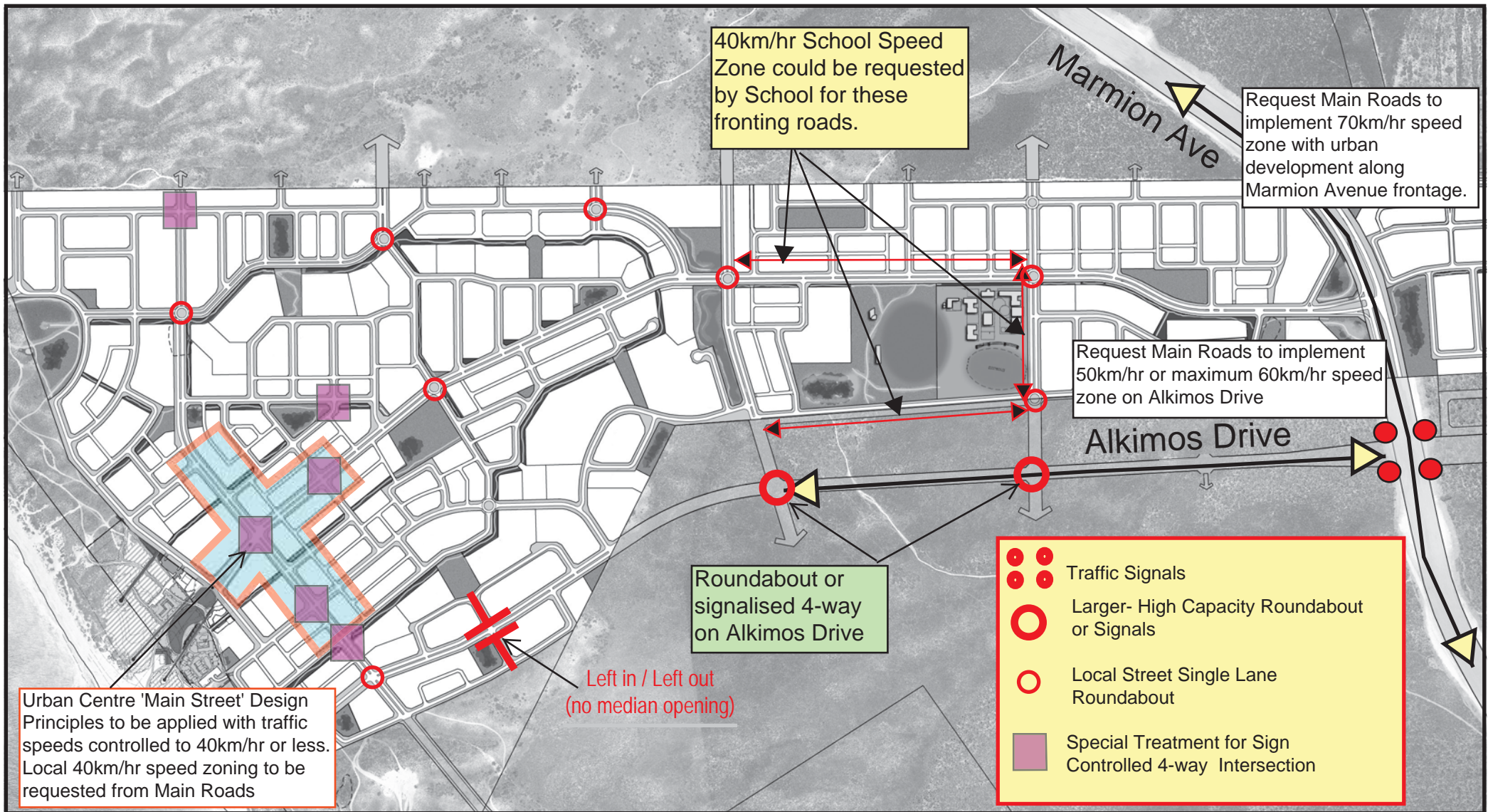
Alkimos Lot 1005/1006 Local Structure Plan
 Bruce Aulabaugh Traffic Engineering & Transport Planning

Figure 25a: Bus Route Plan West



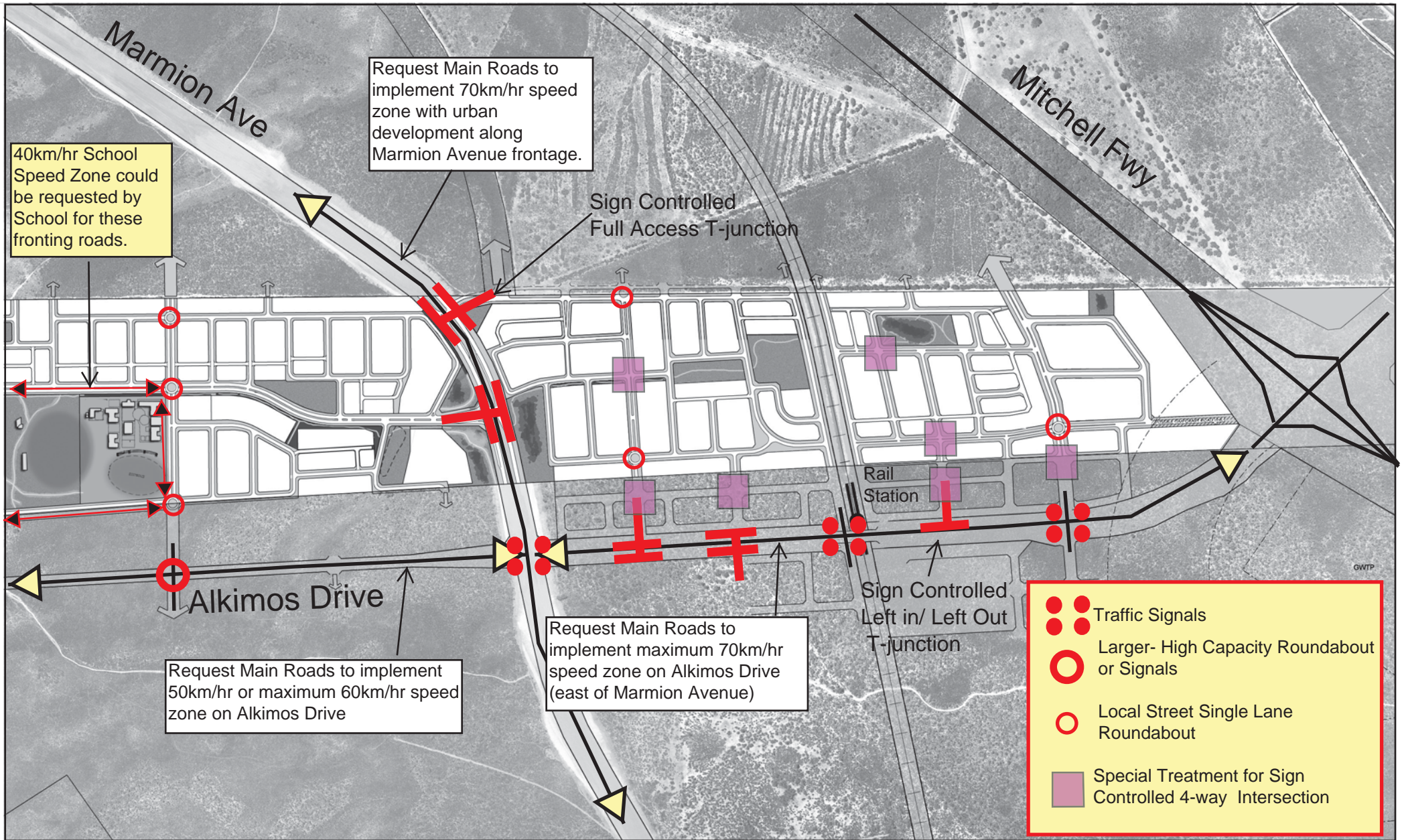
Alkimos Lot 1005/1006 Local Structure Plan
 Bruce Aulabaugh Traffic Engineering & Transport Planning

Figure 25b: Bus Route Plan (east)



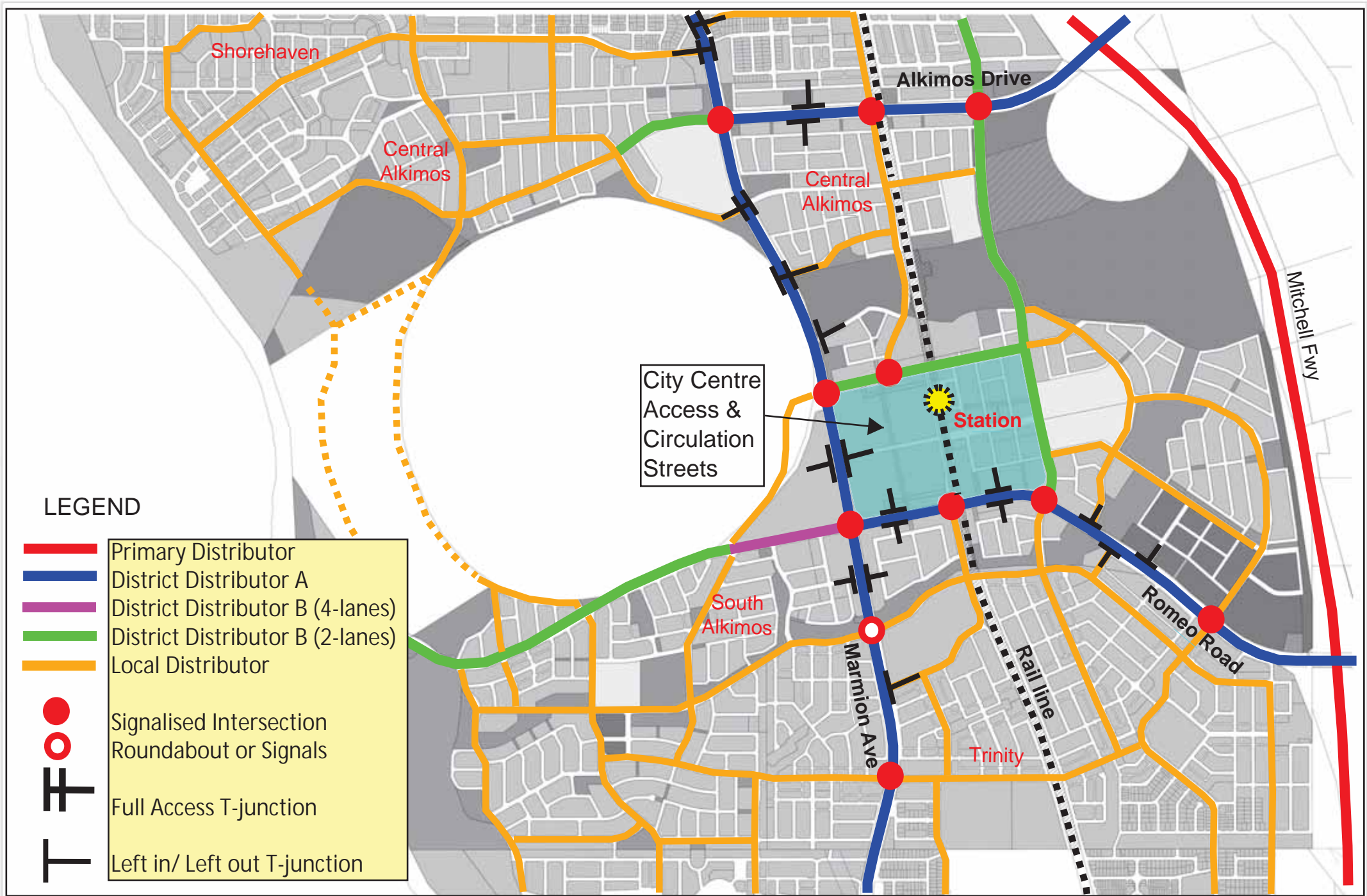
Alkimos Lot 1005/1006 Local Structure Plan
 Bruce Aulabaugh Traffic Engineering & Transport Planning

Figure 27a: Intersection Control Plan West



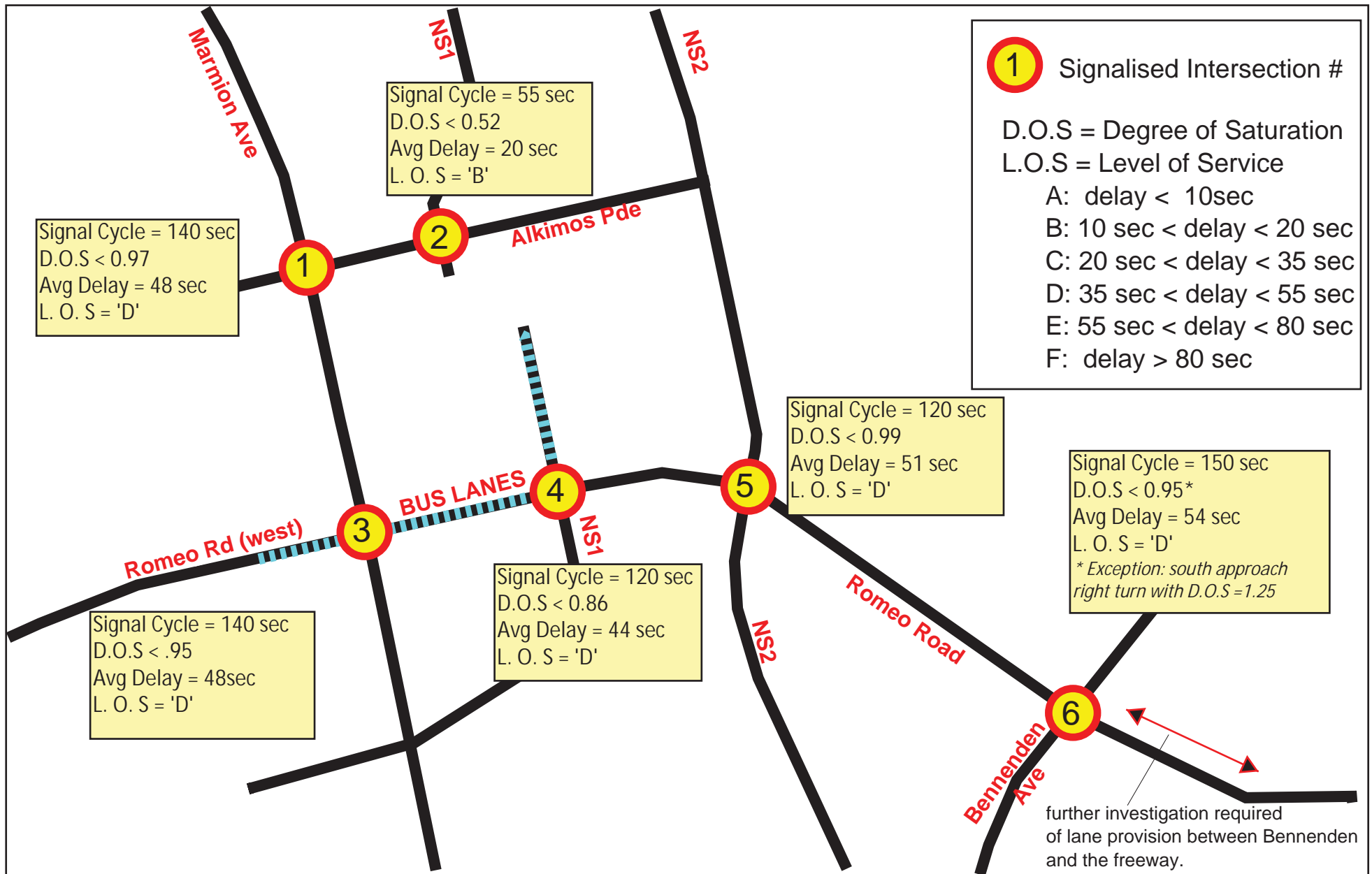
Alkimos Lot 1005/1006 Local Structure Plan
 Bruce Aulabaugh Traffic Engineering & Transport Planning

Figure 27b: Intersection Control Plan (east)



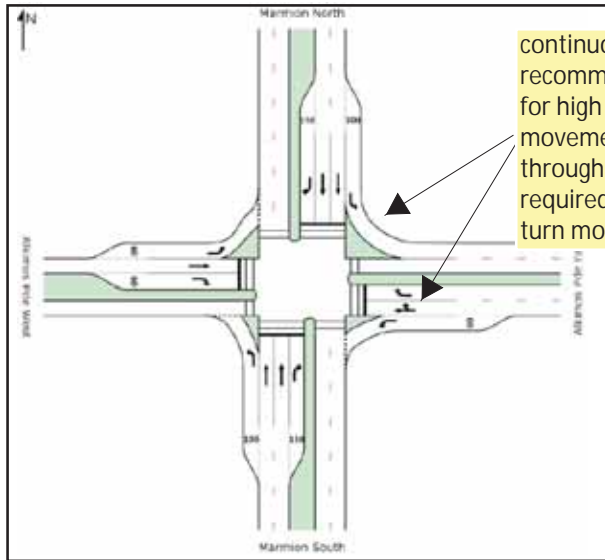
LEGEND

- Primary Distributor
- District Distributor A
- District Distributor B (4-lanes)
- District Distributor B (2-lanes)
- Local Distributor
- Signalled Intersection
- Roundabout or Signals
- Full Access T-junction
- Left in/ Left out T-junction

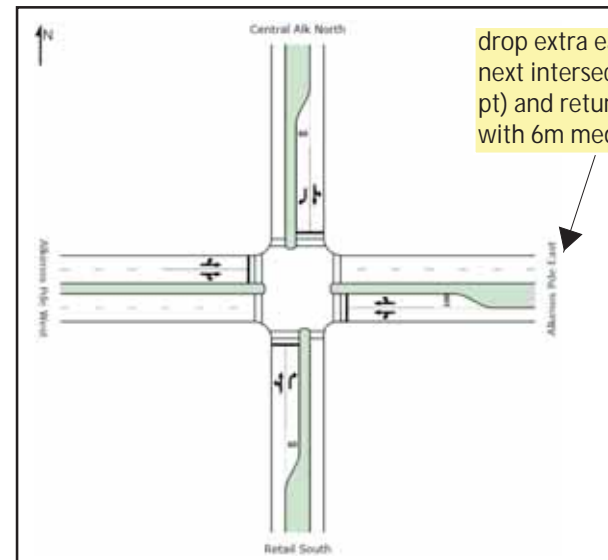


Alkimos City Centre Plan
Bruce Aulabaugh Traffic Engineering & Transport Planning

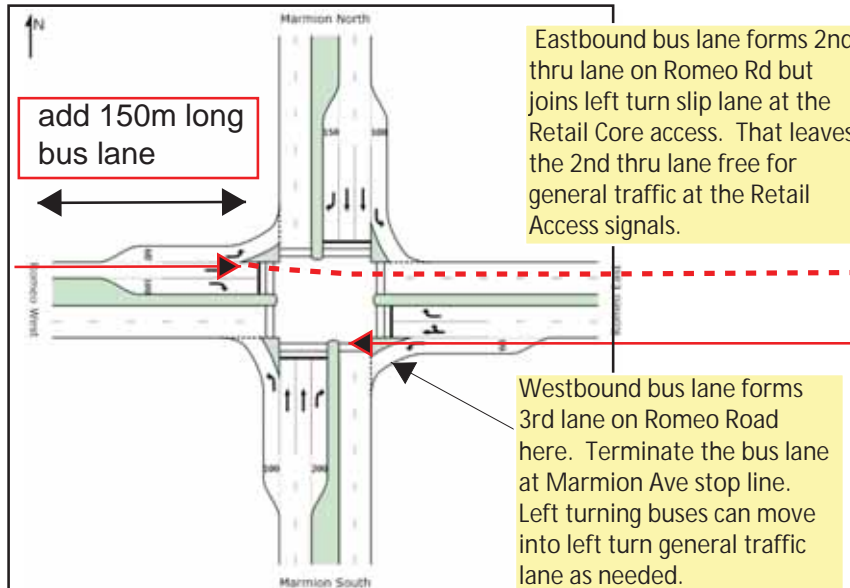
Figure 7 Signalised Intersection Delays



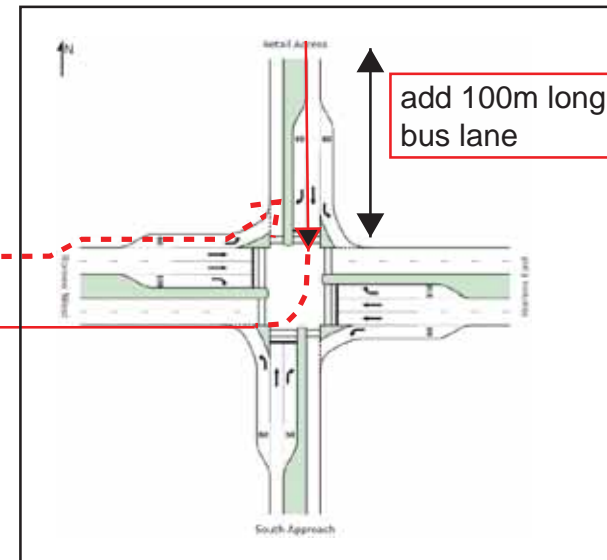
#1: Alkimos Pde & Marmion



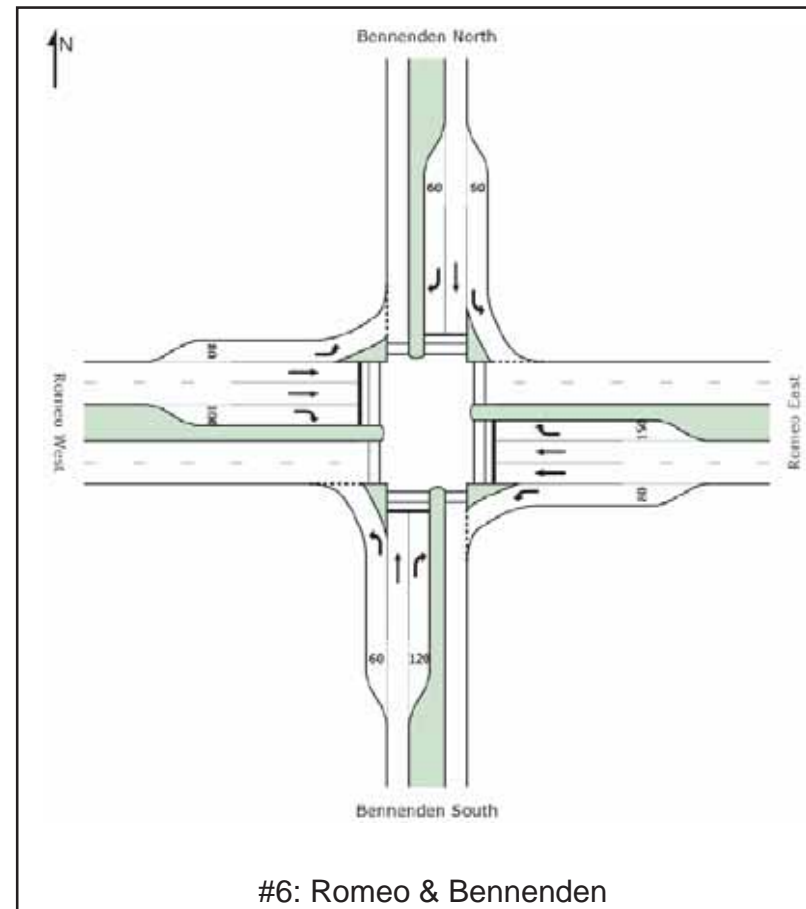
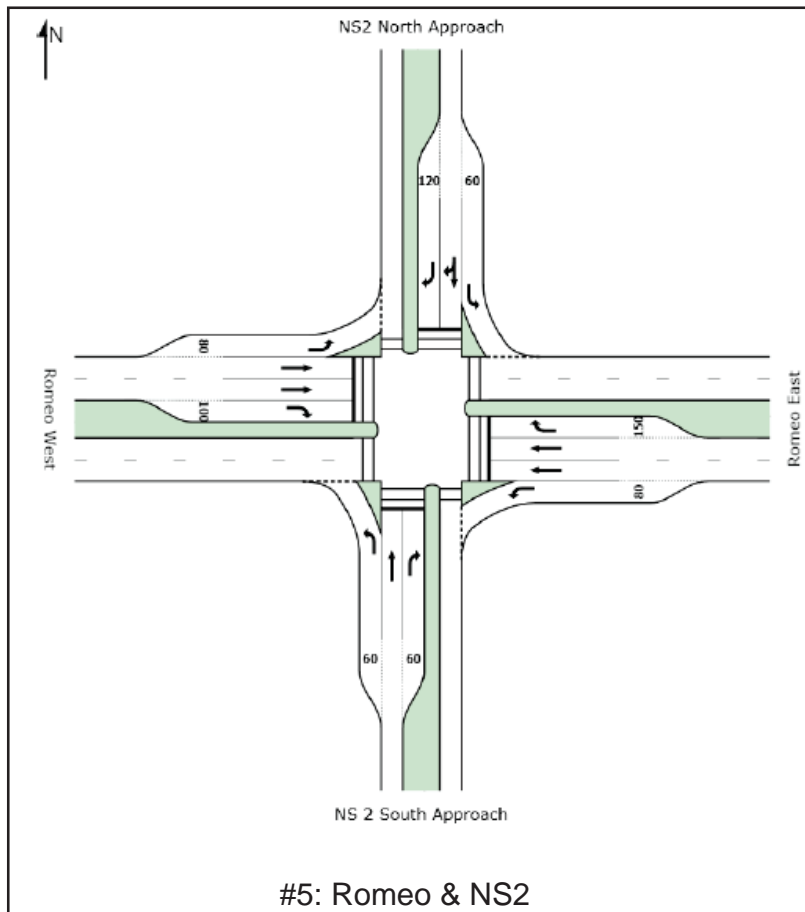
#2: NS1 (north) & Alkimos Pde



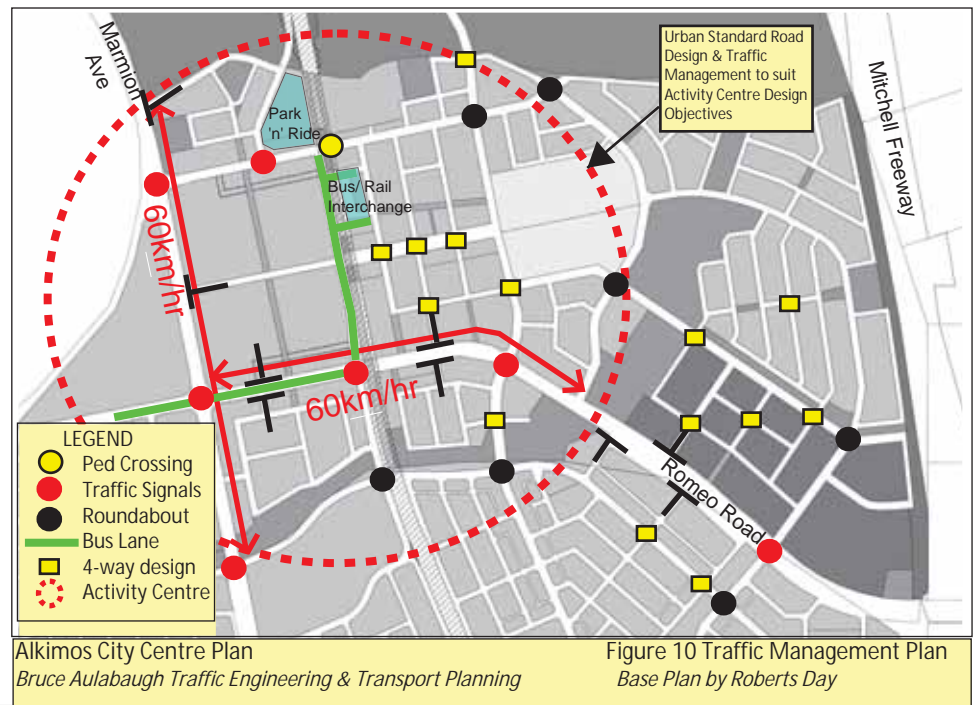
#3: Romeo & Marmion

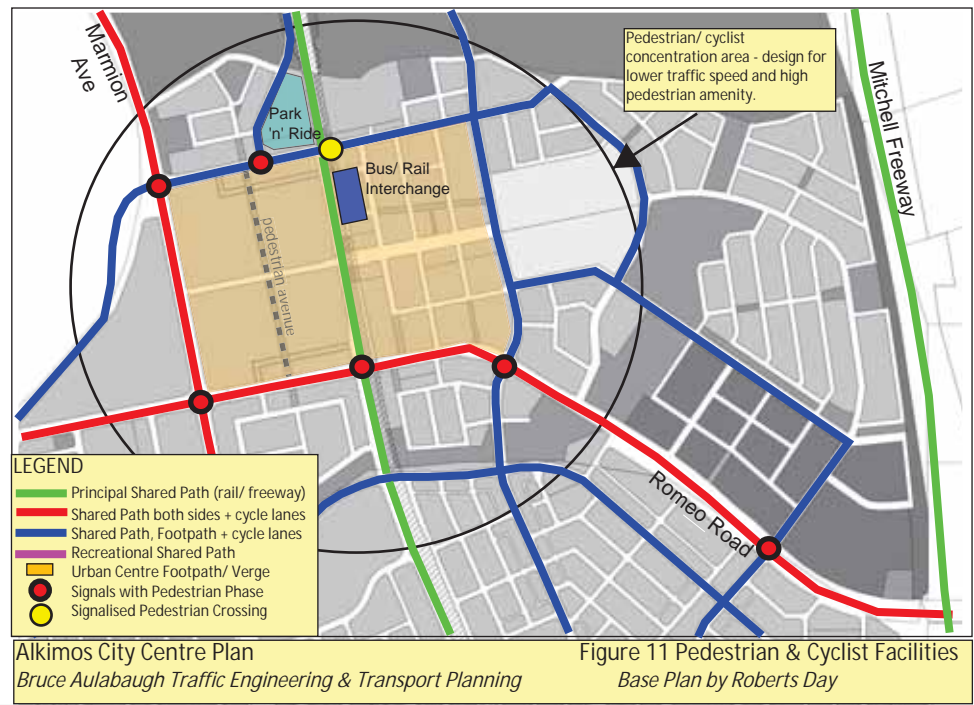


#4: NS1 (south) & Romeo



Refer also to Appendix ?? for alternative geometry with additional through lane on Romeo Road (to freeway)





Alkimos City Centre Plan
 Bruce Aulabaugh Traffic Engineering & Transport Planning

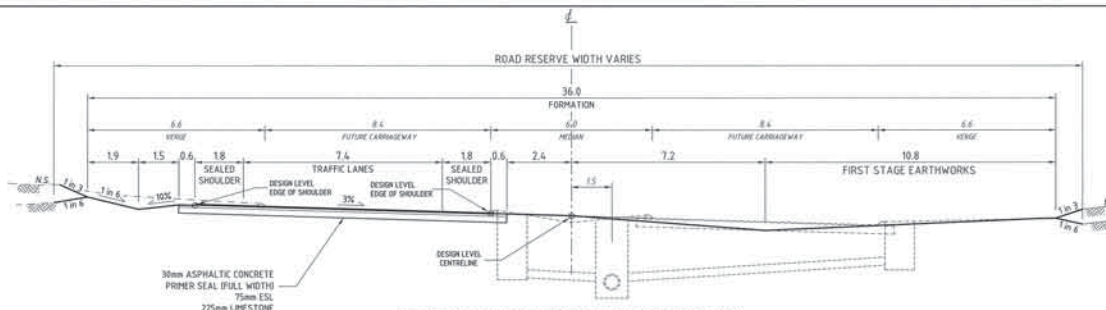
Figure 11 Pedestrian & Cyclist Facilities
 Base Plan by Roberts Day

APPENDIX D

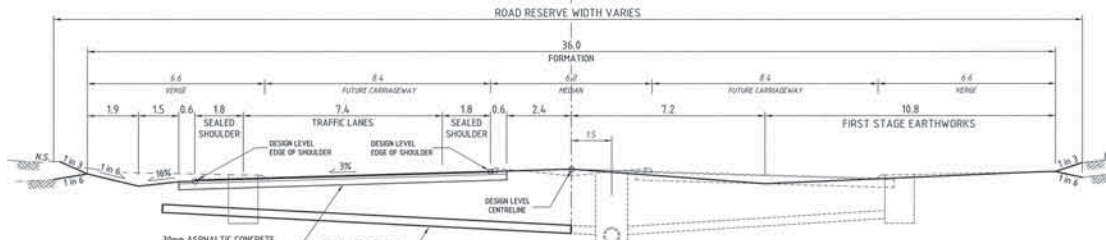
STREET CROSS SECTIONS

(SOURCE: Lend Lease & Roberts Day)

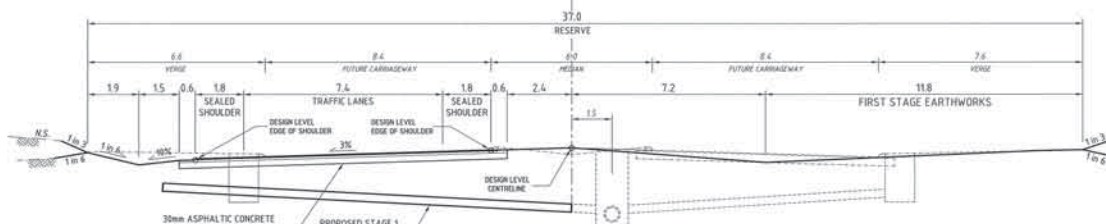
Note: Cossill & Webley provided the Marmion Ave Xsections



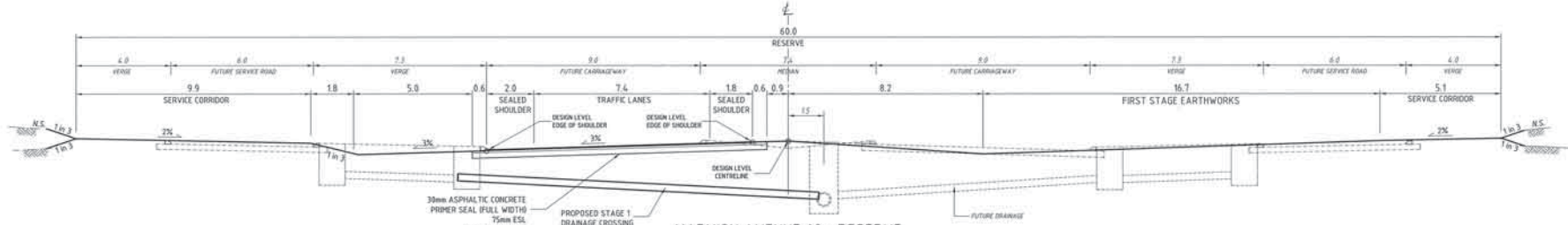
MARMION AVENUE (REGIONAL OPEN SPACE)
TYPICAL CROSS SECTION - FIRST STAGE CONFIGURATION
3% SUPERELEVATION - RIGHT



MARMION AVENUE (REGIONAL OPEN SPACE)
TYPICAL CROSS SECTION - STAGE 1 CONFIGURATION
3% NORMAL CROSSFALL



MARMION AVENUE 37m RESERVE (ALKIMOS REGIONAL CENTRE)
TYPICAL CROSS SECTION - STAGE 1 CONFIGURATION
3% NORMAL CROSSFALL



MARMION AVENUE 60m RESERVE
TYPICAL CROSS SECTION - 1st STAGE CONFIGURATION
3% NORMAL CROSSFALL

NOTES

1. IN THE FUTURE, THE MARMION AVENUE ROAD RESERVE MAY NEED TO BE WIDENED TO ACCOMMODATE THE ROAD EARTHWORKS BATTERS. ALTERNATIVELY, THE ADJACENT DEVELOPMENT MAY INCORPORATE THE ROAD EARTHWORKS INTO THE DEVELOPMENT EARTHWORKS.
2. THROUGH AREAS OF REGIONAL OPEN SPACE, THE ROAD RESERVE WIDTH VARIES TO INCLUDE THE ROAD EARTHWORK BATTERS WITHIN THE MARMION AVENUE ROAD RESERVE.
3. THE ROAD RESERVE THROUGH THE ALKIMOS REGIONAL CENTRE HAS AN OFFSET CENTRELINE TO ALLOW FOR A LEFT TURN LANE INTO ROMEO ROAD.



REV	DATE	BY	CHECKED	DESCRIPTION
C	31.08.07	JV	JA	RE-ISSUED FOR APPROVAL FOLLOWING MRWA & CDW COMMENTS
B	9.05.07	JV		ISSUED FOR APPROVAL
A	26.04.07	J.P.	C.H.	ISSUED FOR TENDER

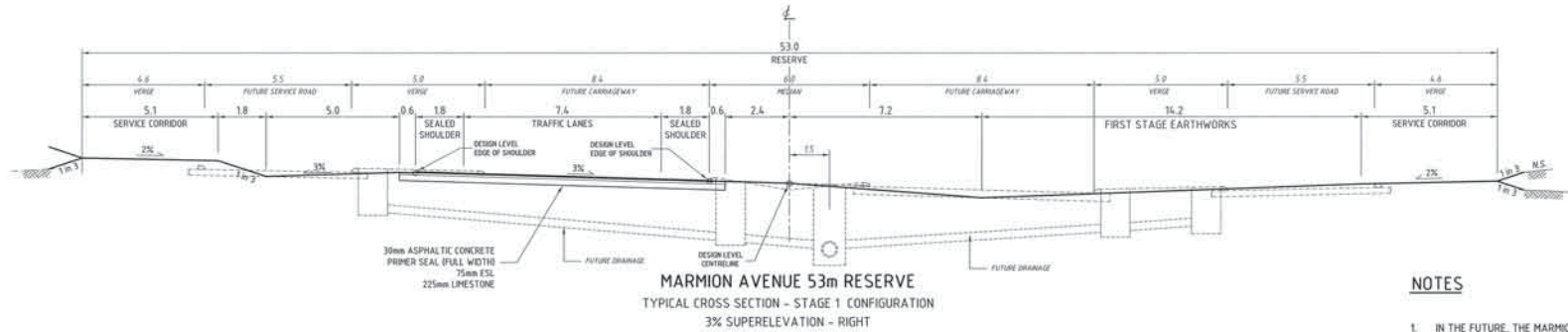
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DESIGNED J.P.	CHECKED JA	APPROVED Sung Nam 2/10/07	
DRAWN J.P.	CHECKED		

Cosill & Webley
CONSULTING ENGINEERS

Level 2
431 Roberts Road
Gubaloo WA 6008

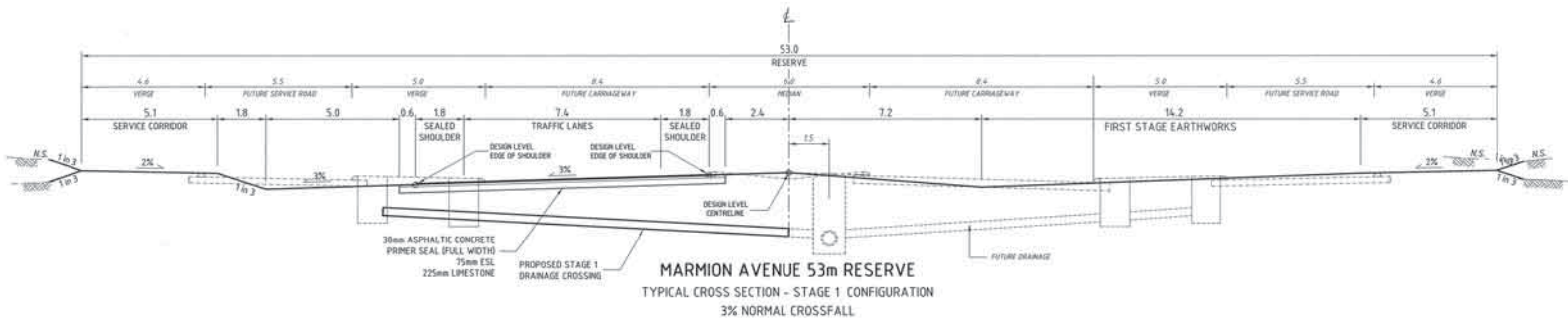
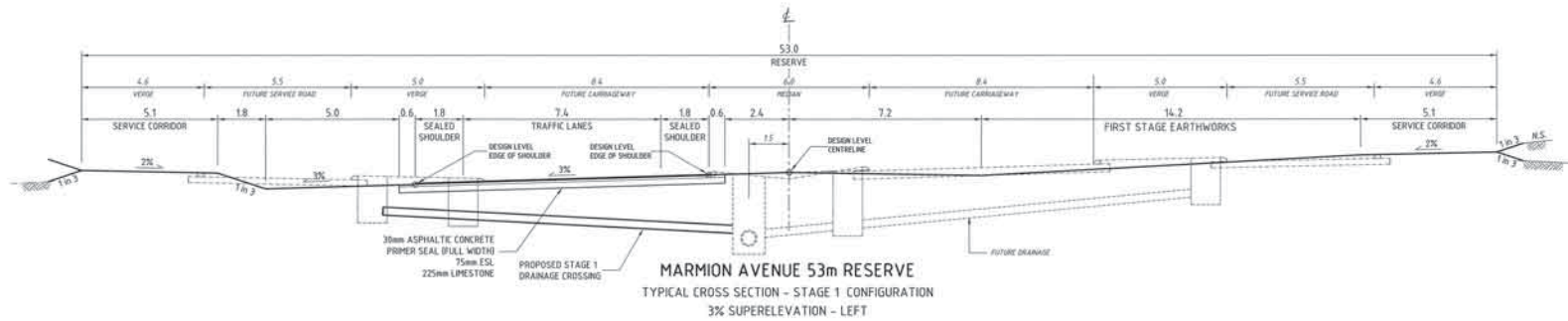
T: (08) 9422 6800
F: (08) 9422 6801
E: admin@cosill.com.au

PROJECT MARMION AVENUE - STAGE 1 (BUTLER - YANCHUP)	TITLE TYPICAL CROSS SECTIONS - SHEET 1 OF 2 FIRST STAGE CONSTRUCTION	SCALE 1:100	DRAWING NUMBER 5711-01-302	ISSUE C
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NOTES

1. IN THE FUTURE, THE MARMION AVENUE ROAD RESERVE MAY NEED TO BE WIDENED TO ACCOMMODATE THE ROAD EARTHWORKS BATTERS. ALTERNATIVELY, THE ADJACENT DEVELOPMENT MAY INCORPORATE THE ROAD EARTHWORKS INTO THE DEVELOPMENT EARTHWORKS.
2. THROUGH AREAS OF REGIONAL OPEN SPACE, THE ROAD RESERVE WIDTH VARIES TO INCLUDE THE ROAD EARTHWORK BATTERS WITHIN THE MARMION AVENUE ROAD RESERVE.
3. THE ROAD RESERVE THROUGH THE ALKIMOS REGIONAL CENTRE HAS AN OFFSET CENTRELINE TO ALLOW FOR A LEFT TURN LANE INTO ROMEO ROAD.



REV	DATE	DRAWN	CHECKED	DESCRIPTION	AMENDMENT	NO.	DATE	DRAWN	CHECKED	DESCRIPTION	AMENDMENT
C	31.08.07	JV	/JH	RE-ISSUED FOR APPROVAL FOLLOWING MRWA & COW COMMENTS							
B	9.05.07	JV		ISSUED FOR APPROVAL							
A	26.04.07	J.P.	C.H.	ISSUED FOR TENDER							

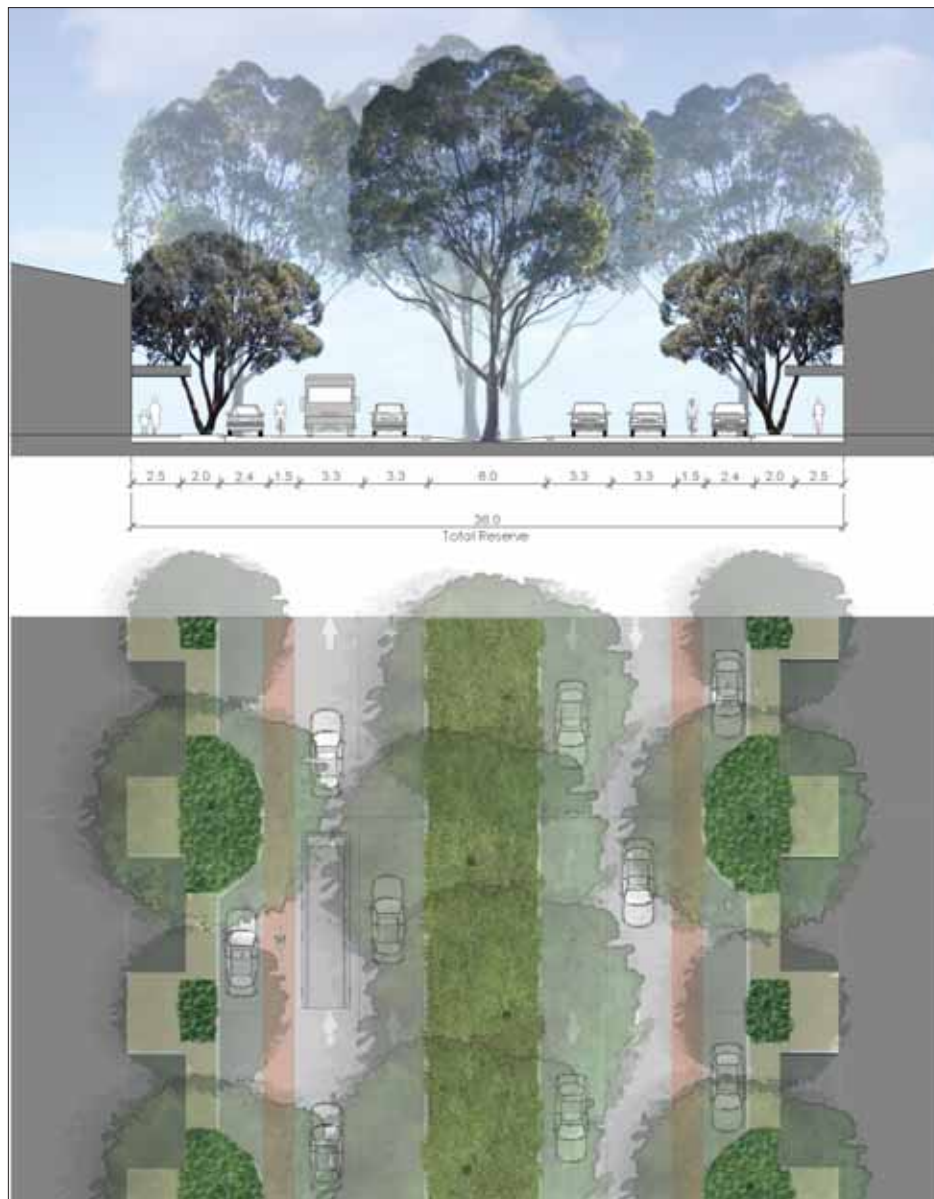
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<p>DESIGNED J.P.</p>	<p>CHECKED [Signature]</p>	<p>APPROVED [Signature] 2/10/07</p>
<p>DRAWN J.P.</p>	<p>CHECKED</p>	

CW Cassill & Webley
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F (08) 9422 0801
E enquiries@cassill.com.au

PROJECT	MARMION AVENUE - STAGE 1 (BUTLER - YANCHEP)		
TITLE	TYPICAL CROSS SECTIONS - SHEET 2 OF 2 FIRST STAGE CONSTRUCTION		
SCALE	1:100	DRAWING NUMBER	5711-01-303
ISSUE	C		



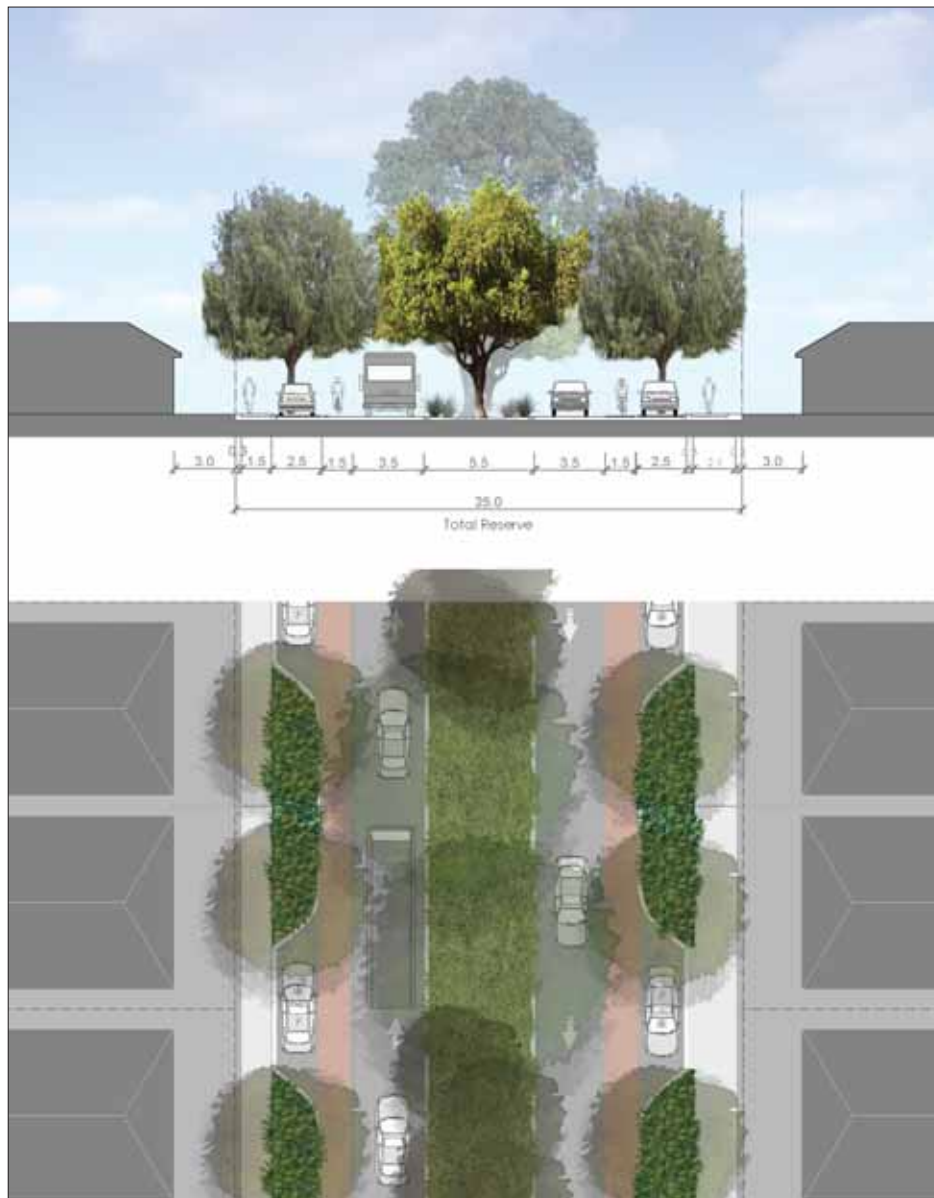
THOROUGHFARE TYPE – INTEGRATOR A		
THOROUGHFARE SUMMARY		
ROAD RESERVE/PAVEMENT	36.0M	21M
DESIGN SPEED/MOVEMENT	50 KPH	TWO-WAY
TRAFFIC LANE ASSEMBLY		
TRAFFIC LANES	FOUR	
CYCLE LANE	TWO	
MEDIAN/TYPE	YES 6.0M	INTERSECTION - RAISED STREET - SWALE
KERB TYPE/RADIUS	COMBINATION	I/I – 12M I/NC – 12M I/AS – 9M
PUBLIC STREETSCAPE		
VERGE WIDTH	6.9M	
PARKING EMBAYMENTS	TWO @ 2.4M	
FOOTPATH WIDTH/LOCATION	2.5M	ABUTS PROPERTY
STREET TREE PLANTING	INFORMAL	
FENCING TYPE/HEIGHT	NIL	NA

Integrator A



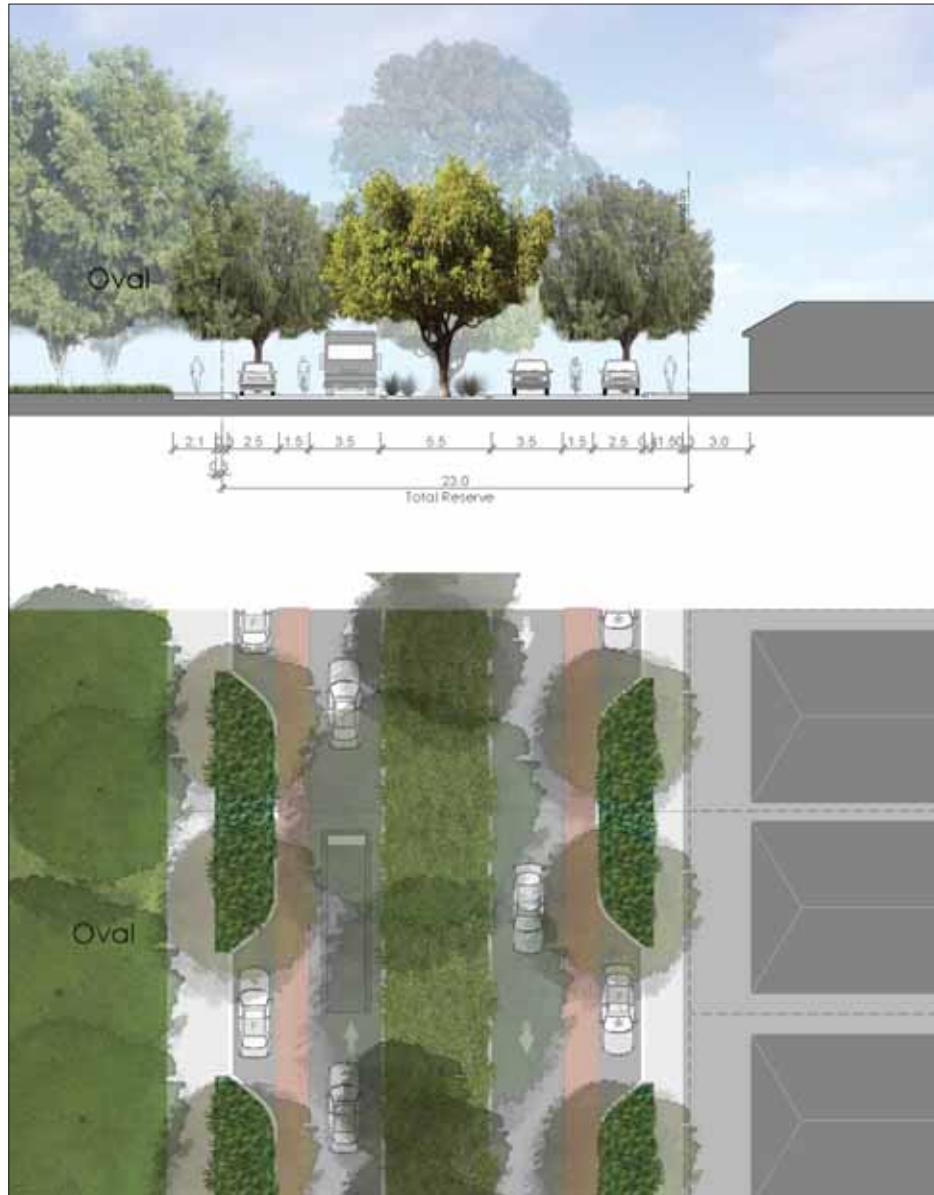
THOROUGHFARE TYPE – INTEGRATOR B		
THOROUGHFARE SUMMARY		
ROAD RESERVE/PAVEMENT	27.0M	15.5M
DESIGN SPEED/MOVEMENT	60 KPH	TWO-WAY
TRAFFIC LANE ASSEMBLY		
TRAFFIC LANES	TWO	
CYCLE LANE	TWO	
MEDIAN/TYPE	YES 5.5M	INTERSECTION - RAISED STREET - FLAT
KERB TYPE/RADIUS	RAISED	I/I – 12M I/NC – 12M I/AS – 9M
PUBLIC STREETSCAPE		
VERGE WIDTH	5.4M (NORTH)/6.1M (SOUTH)	
PARKING EMBAYMENTS	TWO @ 2.4 - 2.5M	
FOOTPATH WIDTH/LOCATION	2.1 - 3M (NORTH)/1.5M (SOUTH)	0.3M OFFSET TO BOUNDARY
STREET TREE PLANTING	INFORMAL	
FENCING TYPE/HEIGHT	SOLID + PERMEABLE	SOLID TO 1.2M

Integrator B



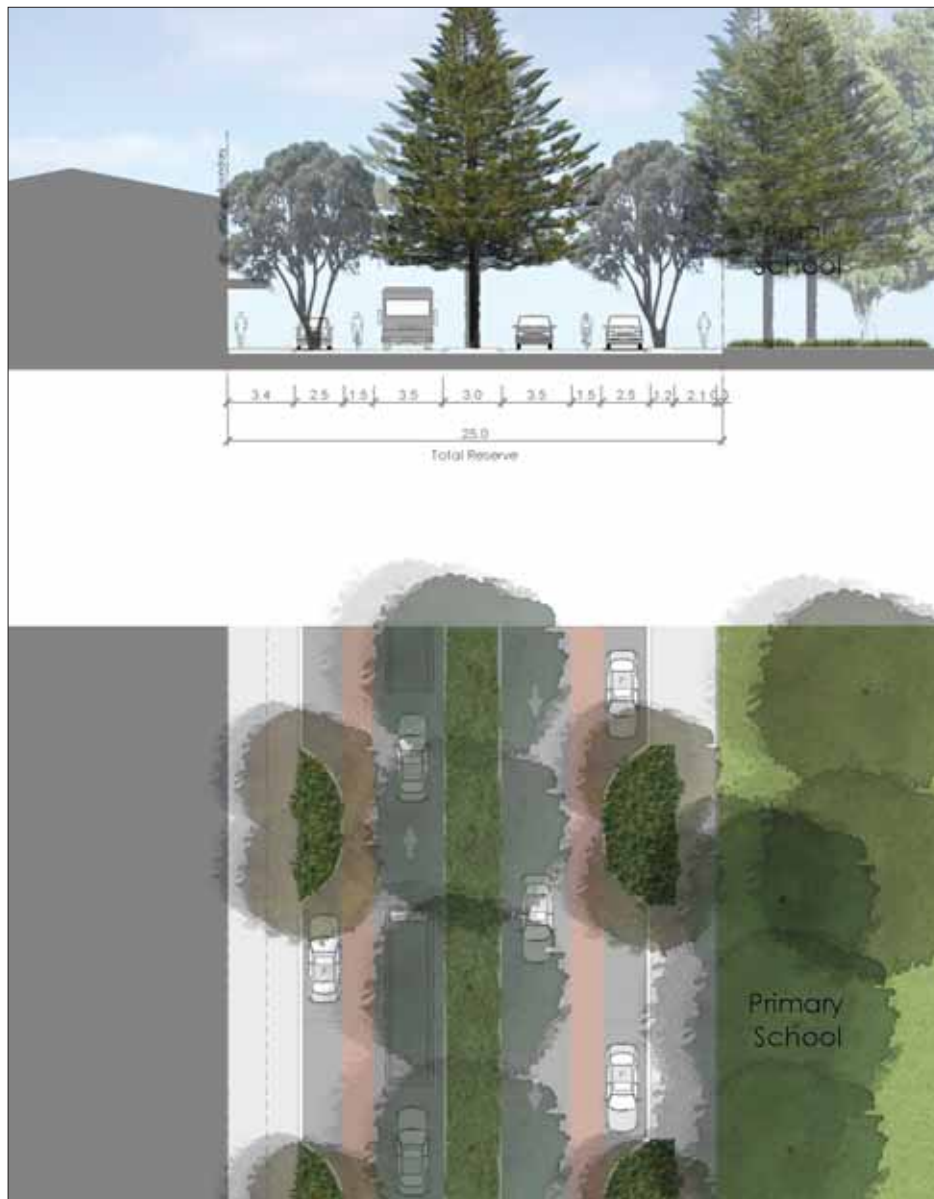
THOROUGHFARE TYPE - INTEGRATOR C		
THOROUGHFARE SUMMARY		
ROAD RESERVE/PAVEMENT	25.0M	15.5M
DESIGN SPEED/MOVEMENT	50 KPH	TWO-WAY
TRAFFIC LANE ASSEMBLY		
TRAFFIC LANES	TWO	
CYCLE LANE	TWO	
MEDIAN/TYPE	YES 5.5M	INTERSECTION - RAISED STREET - FLAT
KERB TYPE/RADIUS	RAISED	I/I - 12M I/NC - 12M I/AS - 9M
PUBLIC STREETScape		
VERGE WIDTH	4.3M (EAST)/5.2M (WEST)	
PARKING EMBAYMENTS	TWO @ 2.5M	
FOOTPATH WIDTH/LOCATION	2.1M (EAST)/1.5M (WEST)	0.3M OFFSET TO B/DARY
STREET TREE PLANTING	INFORMAL	
FENCING TYPE/HEIGHT	PERMEABLE	1.0M MAX

Integrator C



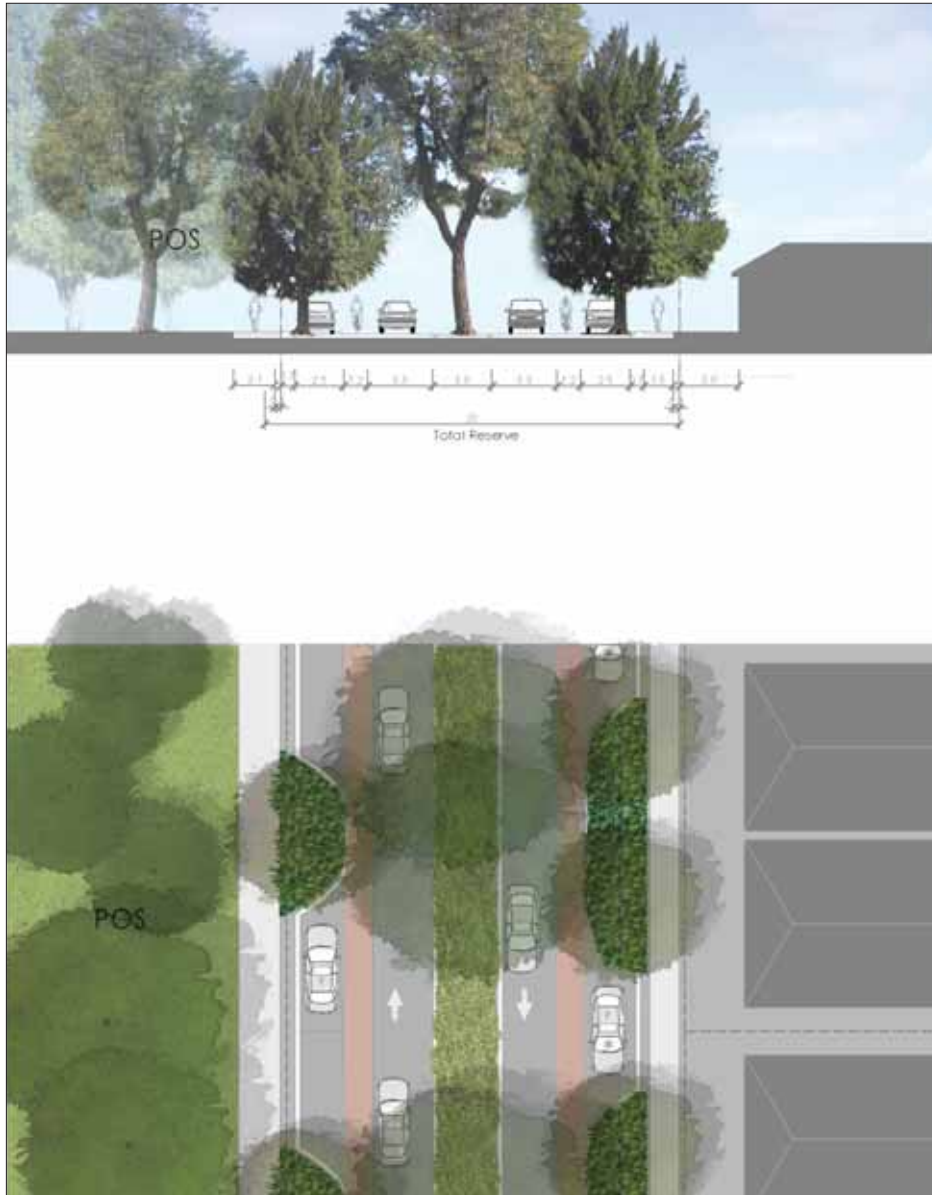
THOROUGHFARE TYPE – INTEGRATOR D		
THOROUGHFARE SUMMARY		
ROAD RESERVE/PAVEMENT	23.0M	14.6M
DESIGN SPEED/MOVEMENT	50 KPH	TWO-WAY
TRAFFIC LANE ASSEMBLY		
TRAFFIC LANES	TWO	
CYCLE LANE	TWO	
MEDIAN/TYPE	YES 5.5M	INTERSECTION - RAISED STREET - FLAT
KERB TYPE/RADIUS	RAISED	I/I – 12M I/NC – 12M I/AS – 9M
PUBLIC STREETScape		
VERGE WIDTH	2.8M (WEST)/4.7M (EAST)	
PARKING EMBAYMENTS	TWO @ 2.5M	
FOOTPATH WIDTH/LOCATION	2.1M SHARED PATH IN POS/ 1.5M FOOTPATH	0.3M OFFSET TO B/ARY
STREET TREE PLANTING	INFORMAL	
FENCING TYPE/HEIGHT	PERMEABLE	1.0M MAX

Integrator D



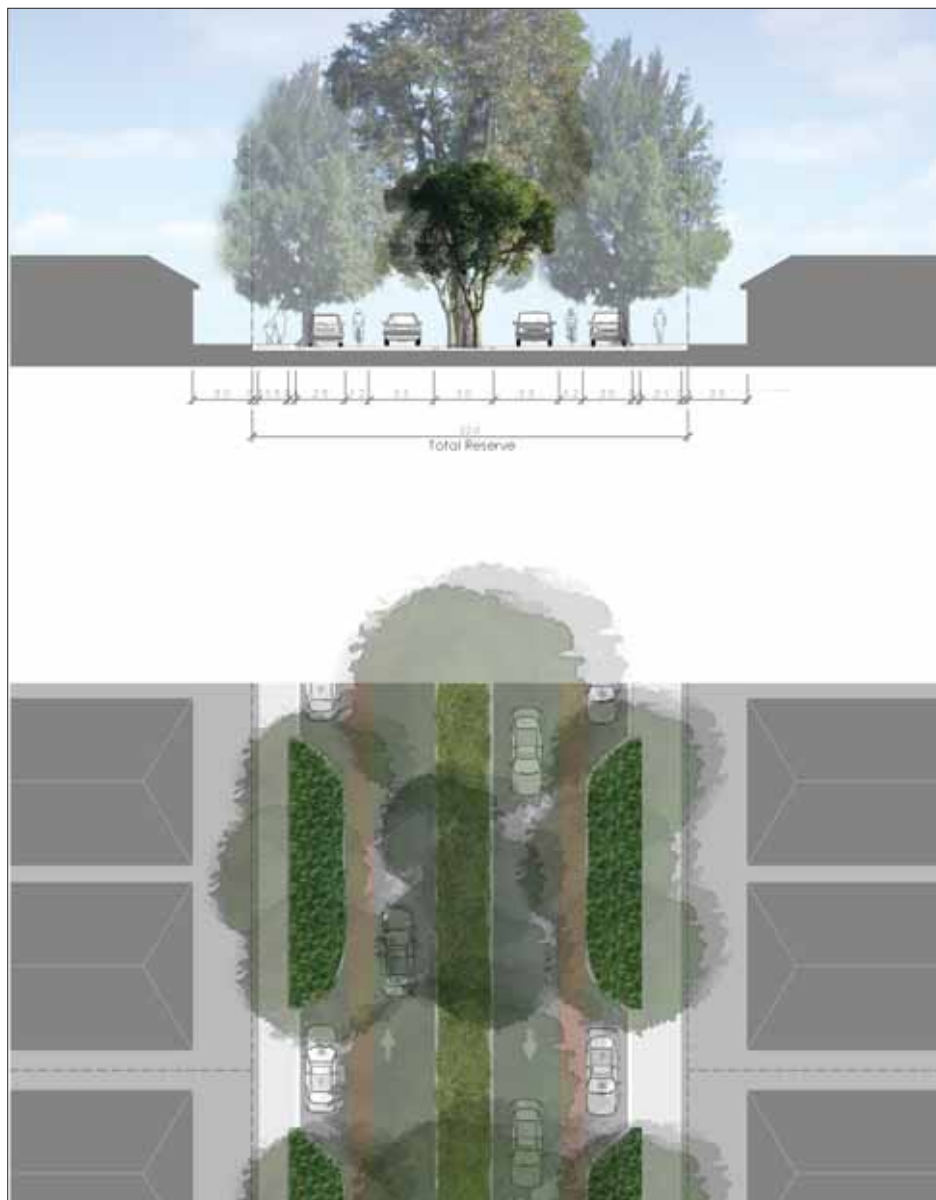
THOROUGHFARE TYPE - INTEGRATOR E		
THOROUGHFARE SUMMARY		
ROAD RESERVE/PAVEMENT	25M	15.5M
DESIGN SPEED/MOVEMENT	50 KPH (40KPH ADJOINING PRIMARY SCHOOL)	TWO-WAY
TRAFFIC LANE ASSEMBLY		
TRAFFIC LANES	TWO	
CYCLE LANE	TWO	
MEDIAN/TYPE	YES 3.0M	INTERSECTION + ADJACENT TO SCHOOL - RAISED STREET - FLAT
KERB TYPE/RADIUS	RAISED	I/I - 12M I/NC - 12M I/AS - 9M
PUBLIC STREETSCAPE		
VERGE WIDTH	5.9M/3.6M	
PARKING EMBAYMENTS	TWO @ 2.5M	
FOOTPATH WIDTH/LOCATION	2.1M	0.3M OFFSET TO BOUNDARY (ADJACENT TO PRIMARY SCHOOL)
STREET TREE PLANTING	FORMAL	
FENCING TYPE/HEIGHT	PERMEABLE	1.0M MAX

Integrator E



THOROUGHFARE TYPE – NEIGHBOURHOOD CONNECTOR A		
THOROUGHFARE SUMMARY		
ROAD RESERVE/PAVEMENT	20.0M	12M
DESIGN SPEED/MOVEMENT	50 KPH	TWO-WAY
TRAFFIC LANE ASSEMBLY		
TRAFFIC LANES	TWO	
CYCLE LANE	TWO	
MEDIAN/TYPE	YES 3.0M	INTERSECTION - RAISED STREET - FLAT
KERB TYPE/RADIUS	RAISED	I/NC – 12M NC/NC – 12M NC/AS – 9M
PUBLIC STREETSCAPE		
VERGE WIDTH	3.2M/5.0M	
PARKING EMBAYMENTS	TWO @ 2.5M	
FOOTPATH WIDTH/LOCATION	2.1M SHARED PATH IN POS/ 1.5M FOOTPATH	0.3M OFFSET TO BOUNDARY
STREET TREE PLANTING	INFORMAL/INFORMAL CENTRE TO CENTRE SPACINGS	
FENCING TYPE/HEIGHT	PERMEABLE	1.0M MAXIMUM

Neighbourhood Connector A



THOROUGHFARE TYPE – NEIGHBOURHOOD CONNECTOR B		
THOROUGHFARE SUMMARY		
ROAD RESERVE/PAVEMENT	22.0M	12M
DESIGN SPEED/MOVEMENT	50 KPH	TWO-WAY
TRAFFIC LANE ASSEMBLY		
TRAFFIC LANES	TWO	
CYCLE LANE	TWO	
MEDIAN/TYPE	YES 3.0M	INTERSECTION - RAISED
		STREET - FLAT
KERB TYPE/RADIUS	RAISED	I/NC – 12M
		NC/NC – 12M
		NC/AS – 9M
PUBLIC STREETScape		
VERGE WIDTH	4.7M / 5.3M	
PARKING EMBAYMENTS	TWO @ 2.5M	
FOOTPATH WIDTH/LOCATION	2.1M (EAST) / 1.5M (WEST)	0.3M OFFSET TO BOUNDARY
STREET TREE PLANTING	INFORMAL/INFORMAL CENTRE TO CENTRE SPACINGS	
FENCING TYPE/HEIGHT	PERMEABLE	1.0M MAX

Neighbourhood Connector B



THOROUGHFARE TYPE – 20M LOCAL ACCESS STREET A		
THOROUGHFARE SUMMARY		
ROAD RESERVE/PAVEMENT	20.0M	10.5M
DESIGN SPEED/MOVEMENT	40 KPH	TWO-WAY
TRAFFIC LANE ASSEMBLY		
TRAFFIC LANES	TWO	
CYCLE LANE	NIL	
MEDIAN/TYPE	YES 2.5M	RAISED OR FLAT
KERB TYPE/RADIUS	RAISED OR FLAT SPOON	I/AS – 9M
		NC/AS – 9M
		AS/AS – 6M
PUBLIC STREETSCAPE		
VERGE WIDTH	4.5M / 5.0M	
PARKING EMBAYMENTS	ONE @ 2.3M (SCHOOL FRONTAGE)	
FOOTPATH WIDTH/LOCATION	1.5M/2.1M	0.3M OFFSET TO BOUNDARY
STREET TREE PLANTING	FORMAL/INFORMAL CENTRE TO CENTRE SPACINGS	
FENCING TYPE/HEIGHT	PERMEABLE	1.0M MAX

20m Local Access Street A



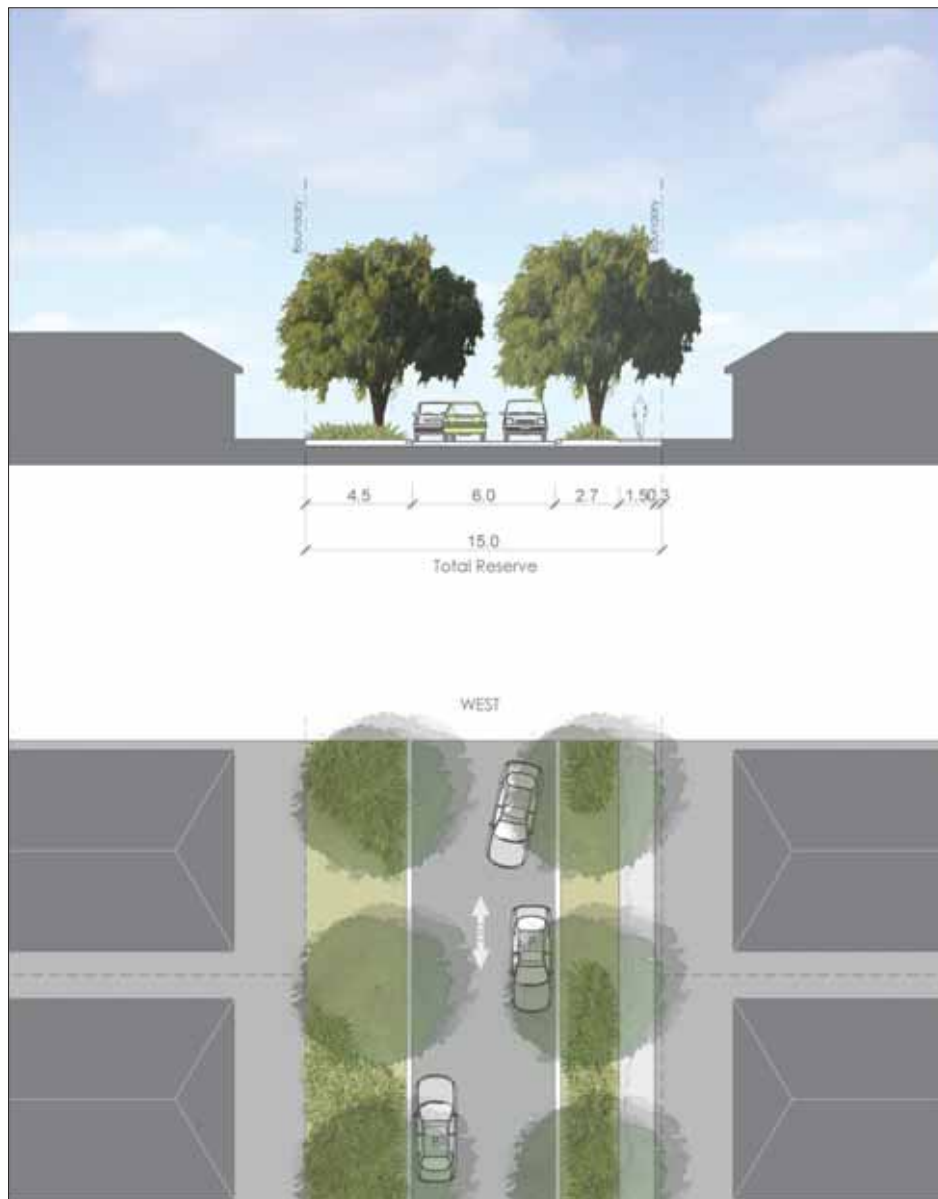
THOROUGHFARE TYPE – 20M LOCAL ACCESS STREET B		
THOROUGHFARE SUMMARY		
ROAD RESERVE/PAVEMENT	20.0M	5.5M - 6.0M
DESIGN SPEED/MOVEMENT	30-40 KPH	YIELD
TRAFFIC LANE ASSEMBLY		
TRAFFIC LANES	TWO WAY YIELD STREET	
CYCLE LANE	NIL	
MEDIAN/TYPE	NO	NA
KERB TYPE/RADIUS	RAISED OR FLAT SPOON	I/AS – 9M
		NC/AS – 9M
		AS/AS – 6M
PUBLIC STREETSCAPE		
VERGE WIDTH	9.2M/4.8M	
PARKING EMBAYMENTS	NIL	
FOOTPATH WIDTH/LOCATION	2.5M/1.5M	VARIES/0.3M OFFSET TO BOUNDARY
STREET TREE PLANTING	INFORMAL/INFORMAL CENTRE TO CENTRE SPACINGS	
FENCING TYPE/HEIGHT	PERMEABLE	1.0M MAX

20m Local Access Street B



15m Local Access Street A

THOROUGHFARE TYPE – 15M LOCAL ACCESS STREET A		
THOROUGHFARE SUMMARY		
ROAD RESERVE/PAVEMENT	15.0M	5.5M - 6.0M
DESIGN SPEED/MOVEMENT	30-40 KPH	YIELD
TRAFFIC LANE ASSEMBLY		
TRAFFIC LANES	TWO WAY YIELD STREET	
CYCLE LANE	NIL	
MEDIAN/TYPE	NO	NA
KERB TYPE/RADIUS	RAISED OR FLAT SPOON	I/AS – 9M
		NC/AS – 9M
		AS/AS – 6M
PUBLIC STREETSCAPE		
VERGE WIDTH	4.5M	
PARKING EMBAYMENTS	NIL	
FOOTPATH WIDTH/LOCATION	1.5M	0.3M OFFSET TO BOUNDARY
STREET TREE PLANTING	FORMAL/INFORMAL CENTRE TO CENTRE SPACINGS	
FENCING TYPE/HEIGHT	PERMEABLE	1.0M MAX



THOROUGHFARE TYPE – 15M LOCAL ACCESS STREET B		
THOROUGHFARE SUMMARY		
ROAD RESERVE/PAVEMENT	15.0M	5.5M - 6.0M
DESIGN SPEED/MOVEMENT	30-40 KPH	YIELD
TRAFFIC LANE ASSEMBLY		
TRAFFIC LANES	TWO WAY YIELD STREET	
CYCLE LANE	NIL	
MEDIAN/TYPE	NO	NA
KERB TYPE/RADIUS	RAISED OR FLAT SPOON	I/AS – 9M
		NC/AS – 9M
		AS/AS – 6M
PUBLIC STREETSCAPE		
VERGE WIDTH	4.5M	
PARKING EMBAYMENTS	NIL	
FOOTPATH WIDTH/LOCATION	1.5M (ONE SIDE ONLY)	0.3M OFFSET TO BOUNDARY
STREET TREE PLANTING	FORMAL/INFORMAL CENTRE TO CENTRE SPACINGS	
FENCING TYPE/HEIGHT	PERMEABLE	1.0M MAX

15m Local Access Street B



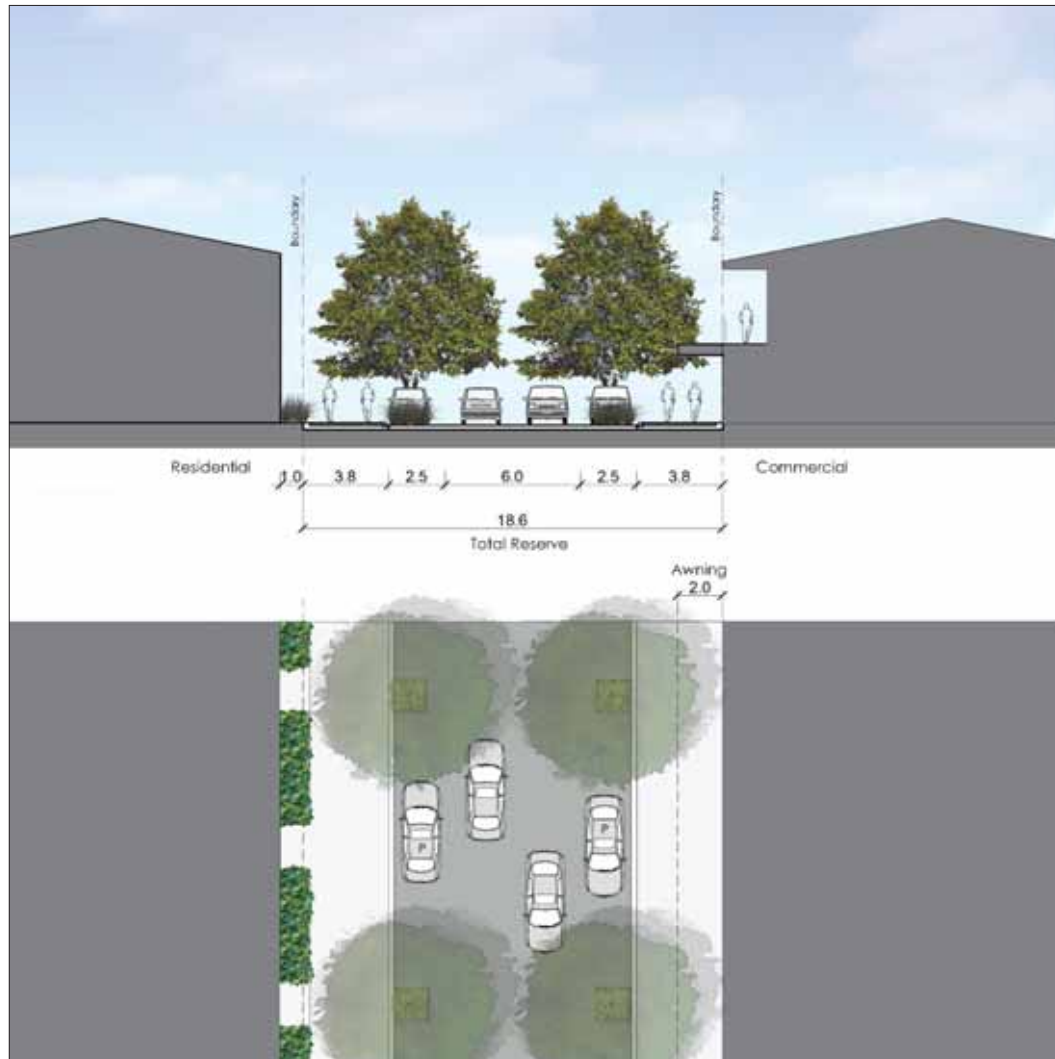
13m Local Access Street A

THOROUGHFARE TYPE – 13M LOCAL ACCESS STREET A		
THOROUGHFARE SUMMARY		
ROAD RESERVE/PAVEMENT	13.0M	5.5M - 6.0M
DESIGN SPEED/MOVEMENT	30-40 KPH	YIELD
TRAFFIC LANE ASSEMBLY		
TRAFFIC LANES	TWO WAY YIELD STREET	
CYCLE LANE	NIL	
MEDIAN/TYPE	NO	NA
KERB TYPE/RADIUS	RAISED OR FLAT SPOON	I/AS – 9M
		NC/AS – 9M
		AS/AS – 6M
PUBLIC STREETSCAPE		
VERGE WIDTH	2.5M/4.3M	
PARKING EMBAYMENTS	ONE @ 2.3M (ADJACENT TO POS)	
FOOTPATH WIDTH/LOCATION	1.8M	0.3M OFFSET TO BOUNDARY
STREET TREE PLANTING	FORMAL/INFORMAL CENTRE TO CENTRE SPACINGS	
FENCING TYPE/HEIGHT	PERMEABLE or SOLID	1.0M MAX



15m Local Access Street (Urban)

THOROUGHFARE TYPE – 15M LOCAL ACCESS STREET (URBAN)		
THOROUGHFARE SUMMARY		
ROAD RESERVE/PAVEMENT	15M	5.5M – 6.0M
DESIGN SPEED/MOVEMENT	30-40 KPH	TWO-WAY
TRAFFIC LANE ASSEMBLY		
TRAFFIC LANES	TWO	
CYCLE LANE	NIL	
MEDIAN/TYPE	NIL	NA
KERB TYPE/RADIUS	RAISED OR FLAT SPOON	I/AS – 9M
		NC/AS – 9M
		AS/AS – 6M
PUBLIC STREETSCAPE		
VERGE WIDTH	4.75M	
PARKING EMBAYMENTS	TWO @ 2.5M	
FOOTPATH WIDTH/LOCATION	1.95M	RESIDENTIAL USE - 0.3M OFFSET TO BOUNDARY
		COMMERCIAL USE - ABUTS BOUNDARY
STREET TREE PLANTING	FORMAL/INFORMAL CENTRE TO CENTRE SPACINGS	
FENCING TYPE/HEIGHT	PERMEABLE	1.0M MAX



18.2m Street (Urban)

THOROUGHFARE TYPE – 18.2M STREET (URBAN)		
THOROUGHFARE SUMMARY		
ROAD RESERVE/PAVEMENT	18.2M	5.5M - 6.0M
DESIGN SPEED/MOVEMENT	30-40 KPH	TWO-WAY
TRAFFIC LANE ASSEMBLY		
TRAFFIC LANES	TWO	
CYCLE LANE	NIL	
MEDIAN/TYPE	NIL	NA
KERB TYPE/RADIUS	RAISED OR FLAT SPOON	I/AS – 9M
		NC/AS – 9M
		AS/AS – 6M
PUBLIC STREETSCAPE		
VERGE WIDTH	6.3M	
PARKING EMBAYMENTS	TWO @ 2.5M	
FOOTPATH WIDTH/LOCATION	3.3M	RESIDENTIAL USE - 0.3M OFFSET TO BOUNDARY
		COMMERCIAL USE - ABUTS BOUNDARY
STREET TREE PLANTING	FORMAL/INFORMAL CENTRE TO CENTRE SPACINGS	
FENCING TYPE/HEIGHT	PERMEABLE	1.0M MAX

APPENDIX E

NW CORRIDOR TRAFFIC MODELLING INFORMATION

TRAFFIC MODEL LAND USE ASSUMPTIONS

The land use data provided by Lend Lease for the portion of the NW Corridor Model covering the Central Alkimos LSP includes:

- Approximately 2429 residential dwellings (approximately 6000 persons);
- Approximately 483 commercial, service commercial and education jobs, plus 267 home based jobs;
- 1 public high school and 1 primary school.

TRAFFIC MODEL TRIP GENERATION

Trip Productions

The Department of Transport provided guidance on mode share assumptions for use in this Ultimate Development NW Corridor traffic model. The guidance takes account of current travel behaviour and expected changes over time. The email from Department of Transport dated 21 March 2012 is attached at the end of this Appendix.

Table 1 compares the NW Corridor Traffic Model average daily person trip production rates and vehicle trip rates (after applying the DoT suggested mode split %) with the 2006 STEM Model.

<i>Table 1: Daily Person and Vehicle Trip Production Rates</i>					
	Home Based	Non-home based	HB + NHB	Car Driver Mode Split	Daily Veh-trip/person
NW Corridor Model	2.92	0.69	3.61	0.55	1.98
*STEM 2006 calibration	2.86	0.67	3.53	0.568	2.02

**Strategic Transport Evaluation Model 2006 calibration metro average person trip rates and car driver mode split. (Peter Lawrence of DoP, August 201).*

Trip Attractions

Vehicle trip attractions were calculated using the following rates:

- *Retail: 14.5 veh-trips/day per employee. Café’s and restaurants are included in this category. This rate is slightly higher than the 13 veh-trips/ day per employee derived using the STEM model attraction coefficients and 70% car driver mode share.
- *Non retail: 3.2 veh-trips/day per employee. This rate is slightly higher than the weighted average of 2.53 veh-trips/ day per non-retail employee derived using Perth Commercial Complex and Industrial Complex employee data and STEM model attraction coefficients. Commercial vehicle fleet trips are accounted separately in the STEM model and are not included in this rate.

- Education: 1.2 veh-trips/ day per student
- Dwelling: 1.2 veh-trips/ day per dwelling

**The NW Corridor traffic model rates listed above include commercial vehicle trips, whereas the STEM model rates quoted for comparison do not. The STEM commercial fleet trips are accounted for through a separate commercial vehicle sub-model.*

PM Peak Hour trip productions/ attractions from the model are given in Table 2, below:

<i>Table 2: PM Peak Hour: Vehicle Trip Productions/ Attractions by Trip Purpose</i>			
Productions		Attractions	
HBW (home based work):	20764	HBW (home based work):	20764
HBO (home based other):	23433	HBO (home based other):	23443
HBS (home based shopping):	13560	HBS (home based shopping):	13560
NHB (non home based):	17479	NHB (non home based):	17479
TOTAL	75246	TOTAL	75246

VEHICLE TRIP PRODUCTIONS & ATTRACTIONS (INTERNAL & EXTERNAL)

Table 3 shows that 'Internal-Internal' trips constitute approximately 77% of the forecast vehicle trips in the NW Corridor Model. 'Internal-External/ External-Internal' trips make up the remaining 23% of the forecast traffic. This corresponds well with the ROM model outputs for this ultimate development scenario (i.e. 78% ii and 23% ie+ei).

<i>Table 3: PM Peak Hour Prod/ Attraction Trip Distribution Table (Internal & External)</i>		
Distribution Category	Vehicle Trips	Percentage
Internal - Internal	57998	77%
Internal – External/ External - Internal	17248 (i.e. 7556 +9692)	23%
Total	75246	100%

INTERNAL – EXTERNAL TRIP PATTERN

The ROM traffic model data, referred to in Section 5, was used to guide the directional distribution of external trips (Table 4, overleaf).

External Station Name/ Direction	External Attraction/ Productions %
Mitchell Fwy/ Wanneroo Road (North)	0.6%
Old Yanchep Road and local roads (south)	10.1%
Wanneroo Road (south)	14.9%
Mitchell Fwy (South)	43.2%
Connolly Drive and local roads (south)	8.7%
Marmion Avenue and local roads (South)	22.5%
TOTAL	100%

VEHICLE TRIPS – FRICTION FACTOR

The NW Corridor Model uses an Exponential Friction Factor Function in its vehicle trip distribution step (where origins and destinations are paired).

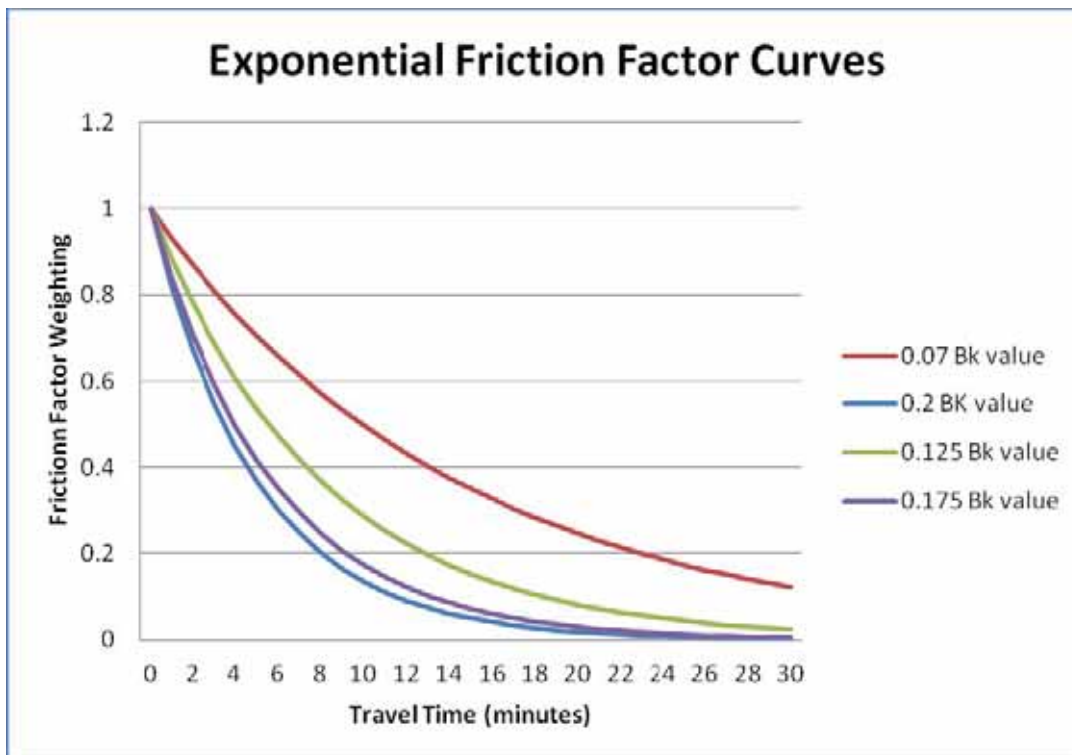


Figure 1: Exponential Friction Factor Curves

The Exponential function is given below:

$$F_k(t_{ij}) = \exp(-B_k \cdot t_{ij})$$

Where:

- k = trip purpose
- B_k = exponential parameter for purpose k
- t_{ij} = travel time between zone i and j in minutes

The chart above (Figure 1) shows the friction factor weighting curves resulting from the Exponential Function with a range of B_k values.

In the NW Corridor Model the exponential parameters (B_k) are as follows:

B_k for HBW = 0.1

B_k for HBO, HBS, & NHB = 0.2

The relatively 'higher value' of 0.2 for HBO, HBS & NHB based trips means that origin-destination pairing is more sensitive to travel time than for HBW trips.

Special Note: Friction Factor curves are not the same as modeled travel time distribution curves. Travel time distribution curves show the effects of the friction factor equations as applied to the model's origin and destination opportunities. As a result, travel time distribution curves may show an increase in trips with increasing travel time as more destinations are within reach (before dropping off due to time cost effects).

BPR SPEED VOLUME FUNCTIONS

The NW Corridor Model calculates travel times with the BPR speed/ volume function:

$$t = t_0 + t_0 A (V/C)^N$$

Where:

- O = step size parameter
- A = volume/ capacity multiplier, can vary by functional class
- N = Volume/ capacity exponent, can vary by functional class
- t = travel time on a link
- t_0 = free travel time on a link
- V = sum of the base volume (times the base traffic multiplier) and the calculated volume
- C = 'capacity' for one hour on a link

The NW Corridor Traffic Model's BPR function parameter values are given in Table 5 (overleaf).

Table 5: NW Corridor BPR V/C Multiplier and Exponent Values

Link Type	Capacity	V/C multiplier	V/C exponent
Freeway/ Expressway	2000 vph per lane	1.2	5.5
Major Arterial (DDA)	875 vph per lane	1.3	5.0
Minor Arterial (DDB)	750 vph per lane	1.35	4.25
Collector (N.Connector)	400 vph per lane	1.5	3.5
Local (Access Streets)	250 vph per lane	1.6	3.5

Bruce Aulabaugh

From: Piotrowski, Steven [Steven.Piotrowski@transport.wa.gov.au]
Sent: 21 March 2012 11:32
To: Richardson, Emmerson (SKM); Bruce Aulabaugh
Cc: Beyer, Steve; Han, Renlong
Subject: FW: Mode share and STEM - NW Corridor

Emmerson & Bruce,

After a considerable amount of investigation and discussion, we suggest using mode splits somewhere within the following ranges for the Alkimos zones in 2031 for Bruce's modelling:

Car Driver 54-56%
Car Pass 20-22%
PT 7-9%
Cyc 2-4%
Walk 12-14%

Kind regards,

Steven Piotrowski

Consultant | Integrated Transport Planning | Department of Transport

Level 8, 140 William St, Perth, WA 6000

Tel: 6551 6270 Fax: (08) 6552 4417 Mob: 0402 222 611| Steven.Piotrowski@transport.wa.gov.au



From: Richardson, Emmerson (SKM)
Sent: Sunday, 26 February 2012 3:21 PM
To: 'Beyer, Steve'
Cc: 'Bruce Aulabaugh'
Subject: FW: Mode share and STEM - NW Corridor

Steve,

Further to the email I sent you last week, Lend lease are keen to have DOT express a position on this which can be the basis for transport planning in the corridor and in Alkimos more particularly. There are a number of people who would be interested in attending any meeting that is held.

Would you be interested in convening a meeting with the following people attending:

- Steve Beyer (convenor)
- Renlong Han –DOP
- Chris Watts – PTA
- Bruce Aulabaugh
- Emmerson Richardson.

Regards, Emmerson.

Regards

Emmerson Richardson

Senior Executive Transport Planning

Sinclair Knight Merz

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www.globalskm.com

From: Richardson, Emmerson (SKM)
Sent: Wednesday, 22 February 2012 8:46 AM
To: 'Beyer, Steve'
Cc: Bruce Aulabaugh
Subject: Mode share and STEM - NW Corridor

Steve,

I refer to our brief telephone discussion yesterday. As I mentioned Bruce Aulabaugh and I are involved in various strategic transport planning studies for Alkimos, Yanchep and Two Rocks. We are finding that some of the STEM outputs being provided by the DOP do not seem to be consistent with the STEM modelling being undertaken as part of the long term PT study. Our suspicion is that these outputs may predate the long term PT plan STEM outputs. As discussed there is a need for consistent modelling outputs to be used for development planning.

The car driver mode share for the entire NW corridor from the PARTS study 1n 2005/ 06 was 59%. This includes the area east of the freeway where car driver mode share is likely to be slightly greater than to the west of the freeway, which is closer to the railway. The 2002, TravelSmart survey for the City of Joondalup showed a 57% car driver mode share.

As the railway is constructed northwards in accordance with the long term PT plan recommendations and congestion on the freeway increases it is likely that car driver mode share will decrease by 2031. My recollection is that we were looking at about 51% car driver mode share across Perth and Peel on average in 2031 in the modelling undertaken as part of the long term PT planning. It may be slightly higher in the NW corridor, but would most likely be in the range 51% to 53% range. Your thoughts on this would be appreciated.

We are currently undertaking detailed traffic modelling for a number of areas and the car driver mode share is of critical importance in getting the quantum right. I am going to suggest that we use 52% car driver mode share for Alkimos, Yanchep, and Two Rocks for 2031 as being broadly consistent with the latest STEM modelling. I would appreciate it if you could liaise with the DOP and agree on a single latest series of STEM modelling outputs for the area.

Regards, Emmerson.

Regards

Emmerson Richardson

Senior Executive Transport Planning

Sinclair Knight Merz

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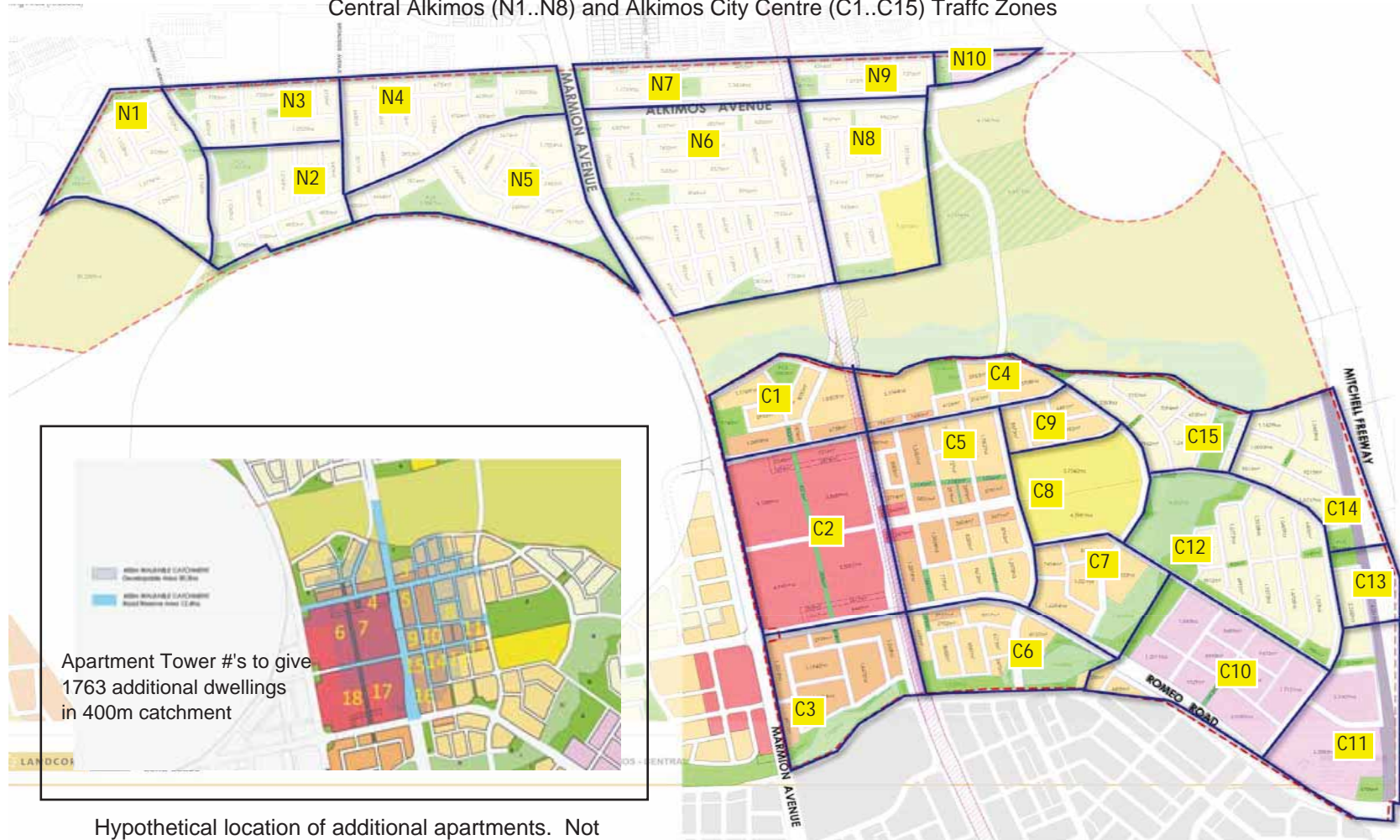
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Central Alkimos (N1..N8) and Alkimos City Centre (C1..C15) Traffic Zones



Apartment Tower #'s to give 1763 additional dwellings in 400m catchment

Hypothetical location of additional apartments. Not input to ultimate development traffic model.

Updated Nov 3

CENTRAL ALKIMOS

Cell	Type	Position	Res Area	DU Av	Dwellings
N1	Coastal Sub	High	8.5679	202.1275	424
N2	West M	Mid	6.7070	352.5	190
N3	West M	Mid	5.5580	352.5	158
N4	West M	Mid	8.0630	352.5	229
N5	West M	Mid	3.3300	352.5	94
N6 SOUTH	Urb East	Entry	9.9413	229	434
N6 NORTH	Sub East	Entry	9.9413	308	323
N6 RAIL	Rail Surr	Entry	2.2092	131	169
N7	Urb East	Entry	3.7752	229	165
N8	Sub East	Mid	8.2053	337.5	243
N9	Urb East	Entry	0.0000	229	0
N10			0.0000		
			Central Dwellings		2429

ALKIMOS CITY CENTRE

C1 WEST	Mixed Use	Mid	2.3026	183	126
C1 EAST	Rail Surr	Entry	1.5351	131	117
C2	Rail Surr	Entry	0.0000	131	0
C3	Mixed Use	Mid	1.5883	183	87
C4 EAST	Mixed Use	Mid	1.8480	183	101
C4 WEST	Rail Surr	Entry	1.2320	131	94
C5	Rail Surr	Entry	3.9173	131	299
C6	Mixed Use	Mid	1.3793	183	75
C7	Mixed Use	Mid	1.4007	183	77
C8			0.0000		
C9	Mixed Use	Mid	1.9128	183	105
C10			0.0000		
C11			0.0000		
C12	Sub East M	Mid	10.1970	337.5	302
C13	Sub East M	Entry	2.2580	308	73
C14	Sub East M	Mid	6.8723	337.5	204
C15	Urb East M	Entry	5.4000	229	236
			City Dwellings		1895

Total Dwellings		4324
-----------------	--	------

CENTRAL ALKIMOS LAND USE

Retail & Showroom	Non Retail	HBB outside empl		
	incl mixed use			
0	0	12	N1	None
0	0	5	N2	None
0	0	4	N3	None
0	48	6	N4	Commercial
0	134	3	N5	High School
0	0	12	N6 SOUTH	None
0	25	9	N6 NORTH	None
0	0	5	N6 RAIL	None
0	10	5	N7	None
0	65	7	N8	Education
0	101	0	N9	Service Commercaill/ Employment
0	101	0	N10	Service Commercaill/ Employment
0	483	67	Total Central Jobs	

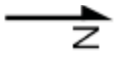
ALKIMOS CITY CENTRE LAND USE

Retail & Showroom	Non Retail	HBB outside empl		
	637	0	C1 WEST	Commercial
	425	0	C1 EAST	Commercial
2030		0	C2	Retail
	712	0		Commercial
87		0	C3	Retail
317		0		Showroom
	240	0	C4 EAST	Retirement Res
	1279	0	C4 WEST	Commercial
43		0	C5	Retail
	2667	0		Commercial
	89	0		Education
	95	0		Civic
	1031	0	C6	Commercial
94		0	C6	Showroom
239		0	C7	Showroom
	179	0	C8	Education
	529	0	C9	Commercial
	513	0	C10	Employment
	387	0	C11	Employment
	0	8	C12	none
	0	8	C13	
	0	8	C14	
	0	8	C15	
2810	8782	32	Total City Jobs	
11592		11624		

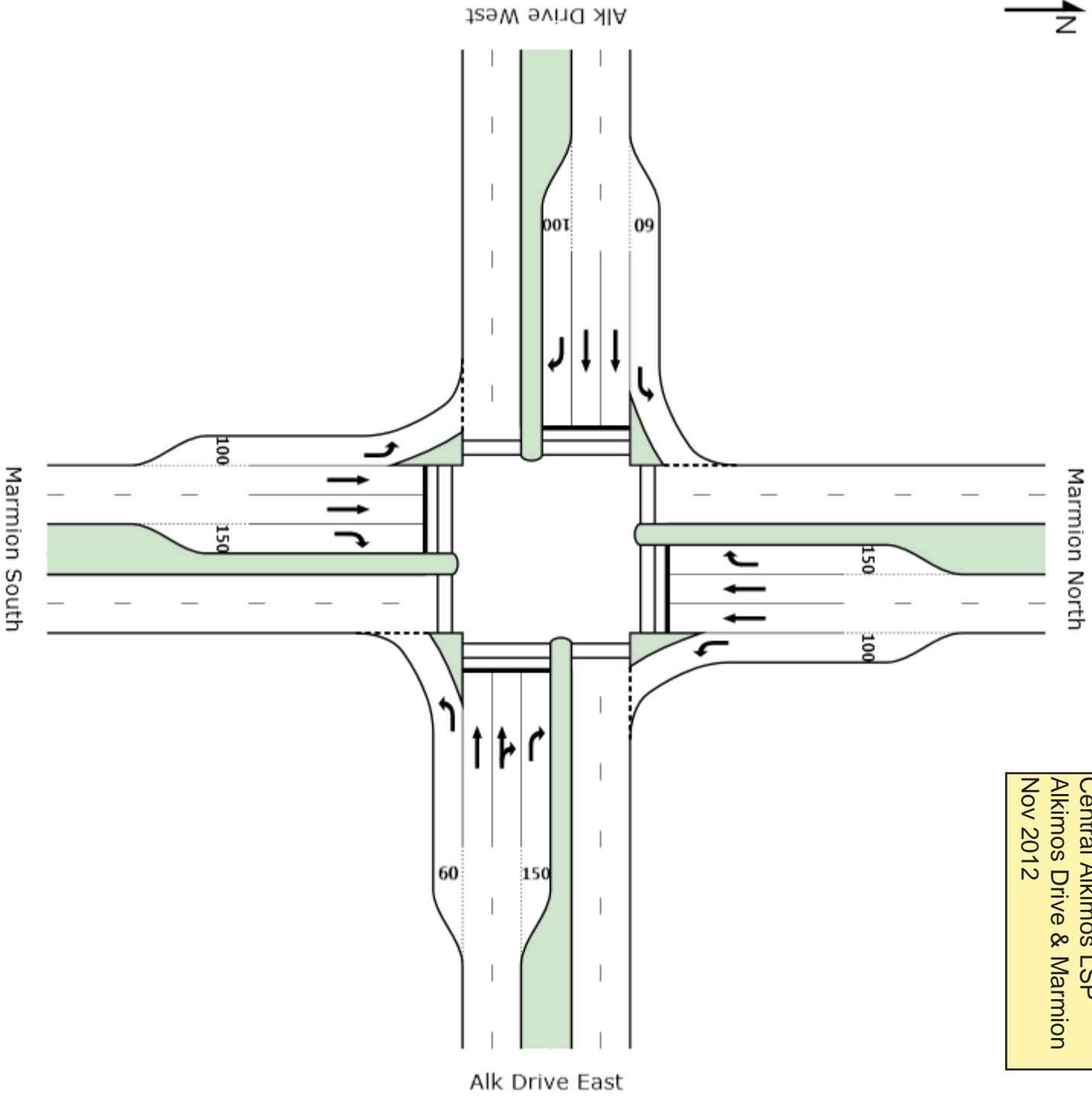
APPENDIX F

SIDRA INTERSECTION ASSESSMENTS

- Marmion Ave/ Alkimos Drive
- Alkimos Drive/ NS1
- Alkimos Drive/ NS2



Central Alkimos LSP
Alkimos Drive & Marmion
Nov 2012



MOVEMENT SUMMARY

Central Alkimos LSP
Alkimos Drive & Marmion
Nov 2012

Standard Network with
LILO added at Trinity, LL & TBB Alkimos Pde changes in Central Alk
Alk Drive & Marmion Intersection
Nov 11 2012 using new NW Corridor traffic model.
HBW = 0.1, HBO = 0.2, HBS = 0.2, NHB = 0.2
RPS city centre employment info as of Nov 5 2012
Four-way intersection with slip lanes (Signals)
Scenario with Hschool Link added
4% heavies on arterial movements
3% heavies on local road movements
95% phf
Signals - Actuated Cycle Time = 140 seconds

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h	
South: Marmion South												
1	L	175	3.0	0.156	9.0	LOS A	0.6	4.2	0.06	0.63	59.4	
2	T	1311	4.0	0.986	45.7	LOS D	48.5	351.3	1.00	0.98	37.9	
3	R	133	4.0	0.509	64.9	LOS E	8.0	57.9	0.89	0.79	32.6	
Approach		1618	3.9	0.986	43.3	LOS D	48.5	351.3	0.89	0.92	38.9	
East: Alk Drive East												
4	L	74	4.0	0.088	11.2	LOS B	0.5	3.8	0.13	0.65	47.7	
5	T	546	4.0	0.760	57.9	LOS E	20.7	149.9	0.94	0.81	21.8	
6	R	432	4.0	0.760	65.5	LOS E	20.3	147.3	0.94	0.85	22.6	
Approach		1052	4.0	0.760	57.7	LOS E	20.7	149.9	0.88	0.81	23.1	
North: Marmion North												
7	L	384	4.0	0.386	9.5	LOS A	1.5	11.2	0.07	0.65	53.0	
8	T	1015	4.0	0.763	32.5	LOS C	27.0	195.6	0.82	0.73	43.5	
9	R	53	3.0	0.201	61.3	LOS E	2.9	20.9	0.81	0.74	22.8	
Approach		1452	4.0	0.763	27.4	LOS C	27.0	195.6	0.62	0.71	44.0	
West: Alk Drive West												
10	L	53	3.0	0.157	31.1	LOS C	2.1	15.2	0.61	0.70	30.9	
11	T	286	3.0	0.576	65.4	LOS E	9.4	67.5	0.96	0.78	19.4	
12	R	84	3.0	0.357	70.6	LOS E	5.4	38.4	0.93	0.77	20.2	
Approach		423	3.0	0.576	62.2	LOS E	9.4	67.5	0.91	0.77	20.6	
All Vehicles		4544	3.9	0.986	43.3	LOS D	48.5	351.3	0.81	0.81	34.7	

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	64.1	LOS F	0.2	0.2	0.96	0.96
P3	Across E approach	53	64.1	LOS F	0.2	0.2	0.96	0.96
P5	Across N approach	53	66.1	LOS F	0.2	0.2	0.96	0.96
P7	Across W approach	53	64.1	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		212	64.6	LOS F			0.96	0.96

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

PHASING SUMMARY

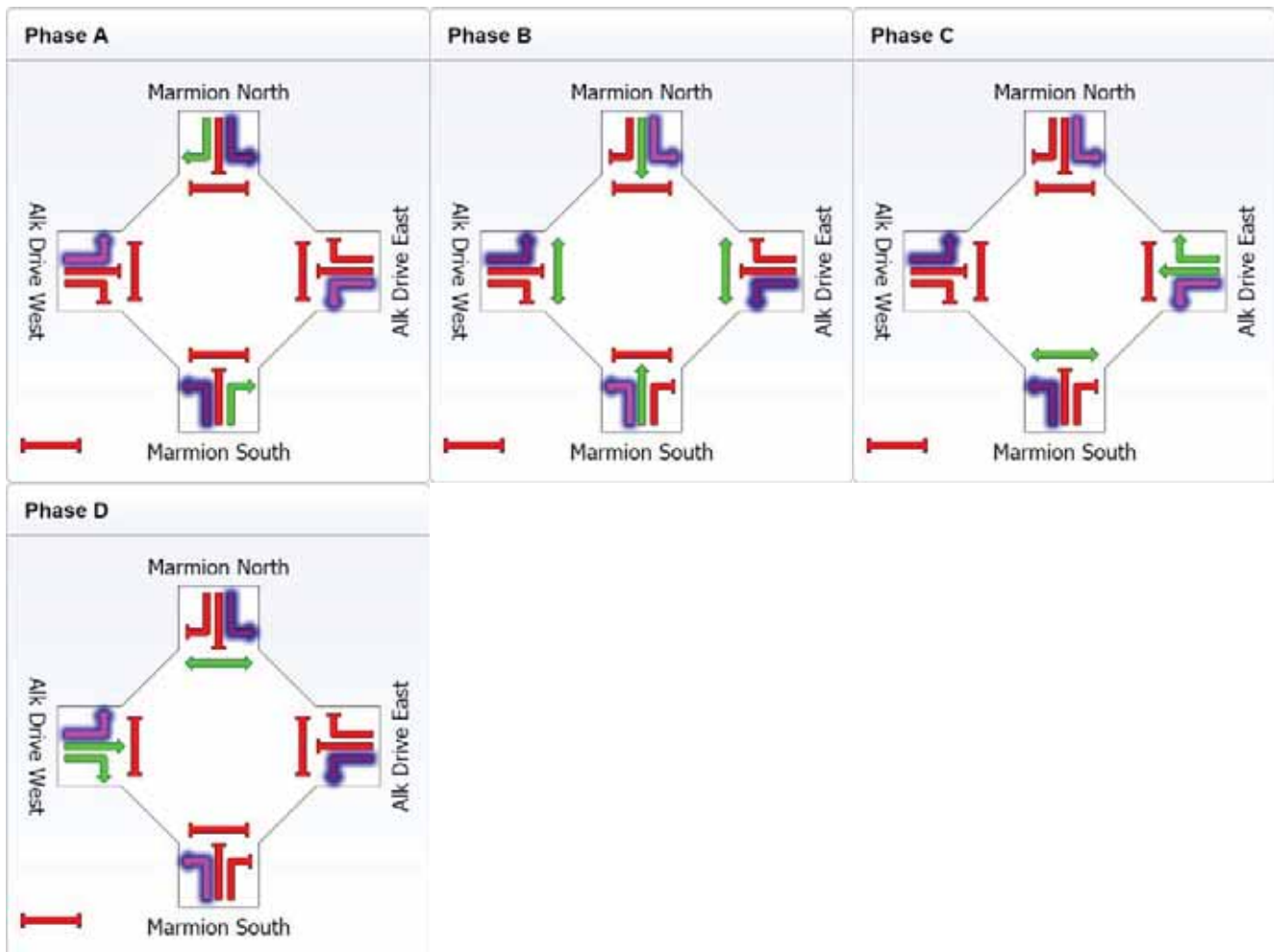
Central Alkimos LSP
Alkimos Drive & Marmion
Nov 2012

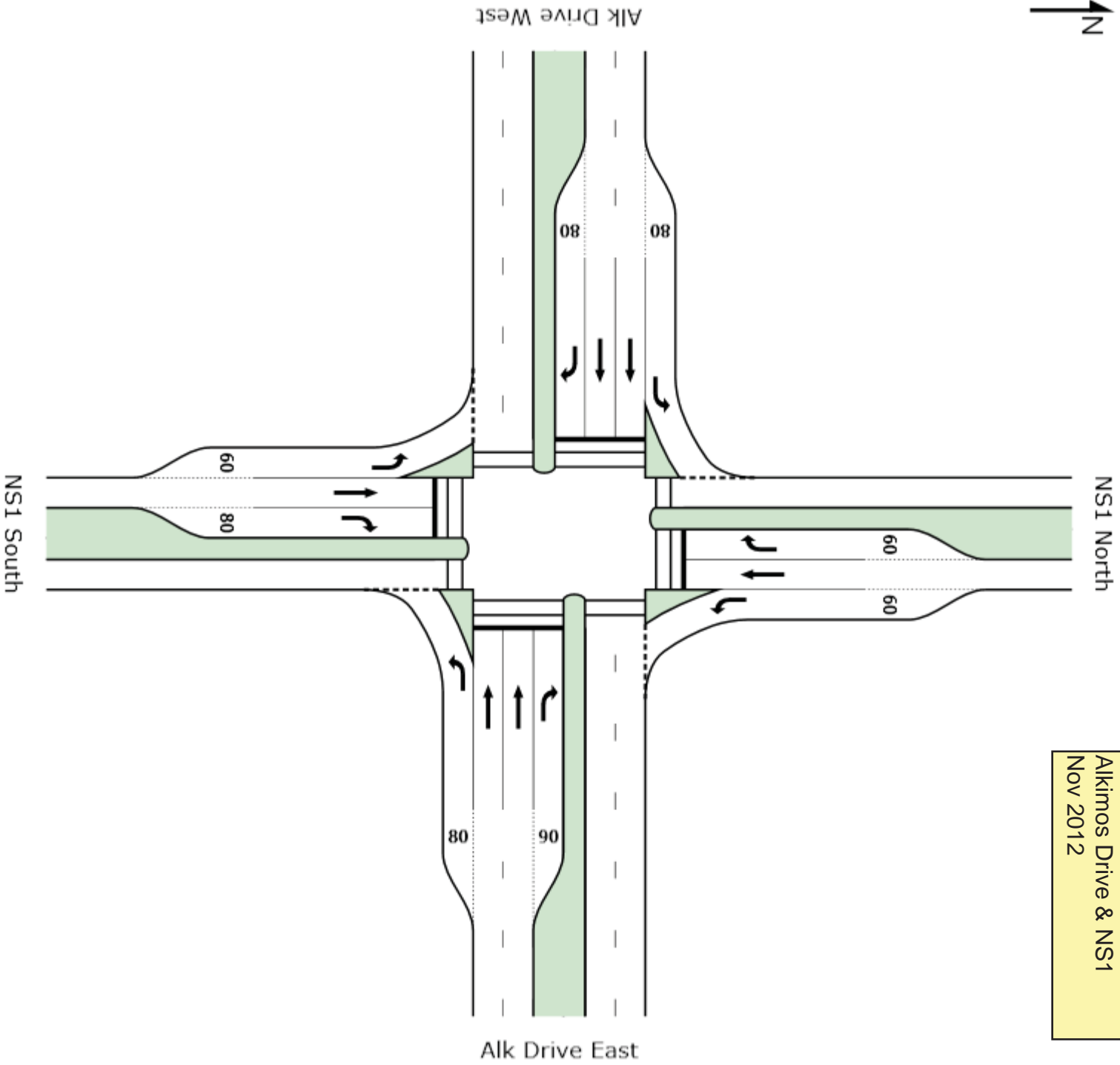
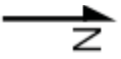
Standard Network with
LILO added at Trinity, LL & TBB Alkimos Pde changes in Central Alk
Alk Drive & Marmion Intersection
Nov 11 2012 using new NW Corridor traffic model.
HBW = 0.1, HBO = 0.2, HBS = 0.2, NHB = 0.2
RPS city centre employment info as of Nov 5 2012
Four-way intersection with slip lanes (Signals)
Scenario with Hschool Link added
4% heavies on arterial movements
3% heavies on local road movements
95% phf
Signals - Actuated Cycle Time = 140 seconds

Phase times determined by the program
Green Split Priority for Coordinated Movements applies
Sequence: Separate E & W phases
Input Sequence: A, B, C, D
Output Sequence: A, B, C, D

Phase Timing Results

Phase	A	B	C	D
Green Time (sec)	20	45	32	18
Yellow Time (sec)	4	4	4	4
All-Red Time (sec)	2	3	2	2
Phase Time (sec)	26	52	38	24
Phase Split	19 %	37 %	27 %	17 %





Central Alkimos LSP
Alkimos Drive & NS1
Nov 2012

MOVEMENT SUMMARY

Central Alkimos LSP
Alkimos Drive & NS1
Nov 2012

Alkimos Drive & NS1
Nov 11 2012 using new NW Corridor traffic model.
HBW = 0.1, HBO = 0.2, HBS = 0.2, NHB = 0.2
Lend Lease City centre employment at Nov 5 2012
Four-way intersection with slip lanes (Signals)
Scenario with Hschool Link added
4% heavies on arterial movements
3% heavies on local road movements
95% phf
Signals - Actuated Cycle Time = 120 seconds

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: NS1 South											
1	L	57	3.0	0.119	14.6	LOS B	1.1	8.2	0.39	0.66	39.6
2	T	78	3.0	0.264	51.9	LOS D	4.1	29.6	0.91	0.70	22.9
3	R	146	3.0	0.956	78.7	LOS E	9.7	69.8	1.00	0.93	18.9
Approach		281	3.0	0.956	58.3	LOS E	9.7	69.8	0.85	0.81	22.3
East: Alk Drive East											
4	L	164	3.0	0.126	8.5	LOS A	0.4	2.5	0.06	0.63	53.4
5	T	1054	4.0	0.803	38.2	LOS D	26.5	191.5	0.90	0.80	31.0
6	R	249	3.0	0.608	54.6	LOS D	12.4	89.1	0.87	0.82	24.5
Approach		1467	3.7	0.803	37.6	LOS D	26.5	191.5	0.80	0.78	31.0
North: NS1 North											
7	L	203	3.0	0.407	12.1	LOS B	3.6	25.6	0.36	0.68	41.4
8	T	58	3.0	0.196	51.2	LOS D	3.0	21.7	0.90	0.68	21.7
9	R	53	3.0	0.344	67.5	LOS E	3.0	21.8	0.96	0.75	20.8
Approach		314	3.0	0.407	28.6	LOS C	3.6	25.6	0.56	0.69	31.3
West: Alk Drive West											
10	L	53	3.0	0.049	8.8	LOS A	0.1	0.9	0.05	0.63	53.0
11	T	665	4.0	0.507	33.3	LOS C	13.7	99.4	0.74	0.63	33.4
12	R	53	3.0	0.123	48.8	LOS D	2.2	15.8	0.73	0.73	26.3
Approach		771	3.9	0.507	32.7	LOS C	13.7	99.4	0.69	0.64	33.6
All Vehicles		2833	3.6	0.956	37.3	LOS D	26.5	191.5	0.75	0.74	30.5

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	54.2	LOS E	0.2	0.2	0.95	0.95
P3	Across E approach	53	56.6	LOS E	0.2	0.2	0.95	0.95
P5	Across N approach	53	54.2	LOS E	0.2	0.2	0.95	0.95
P7	Across W approach	53	56.6	LOS E	0.2	0.2	0.95	0.95
All Pedestrians		212	55.4	LOS E			0.95	0.95

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

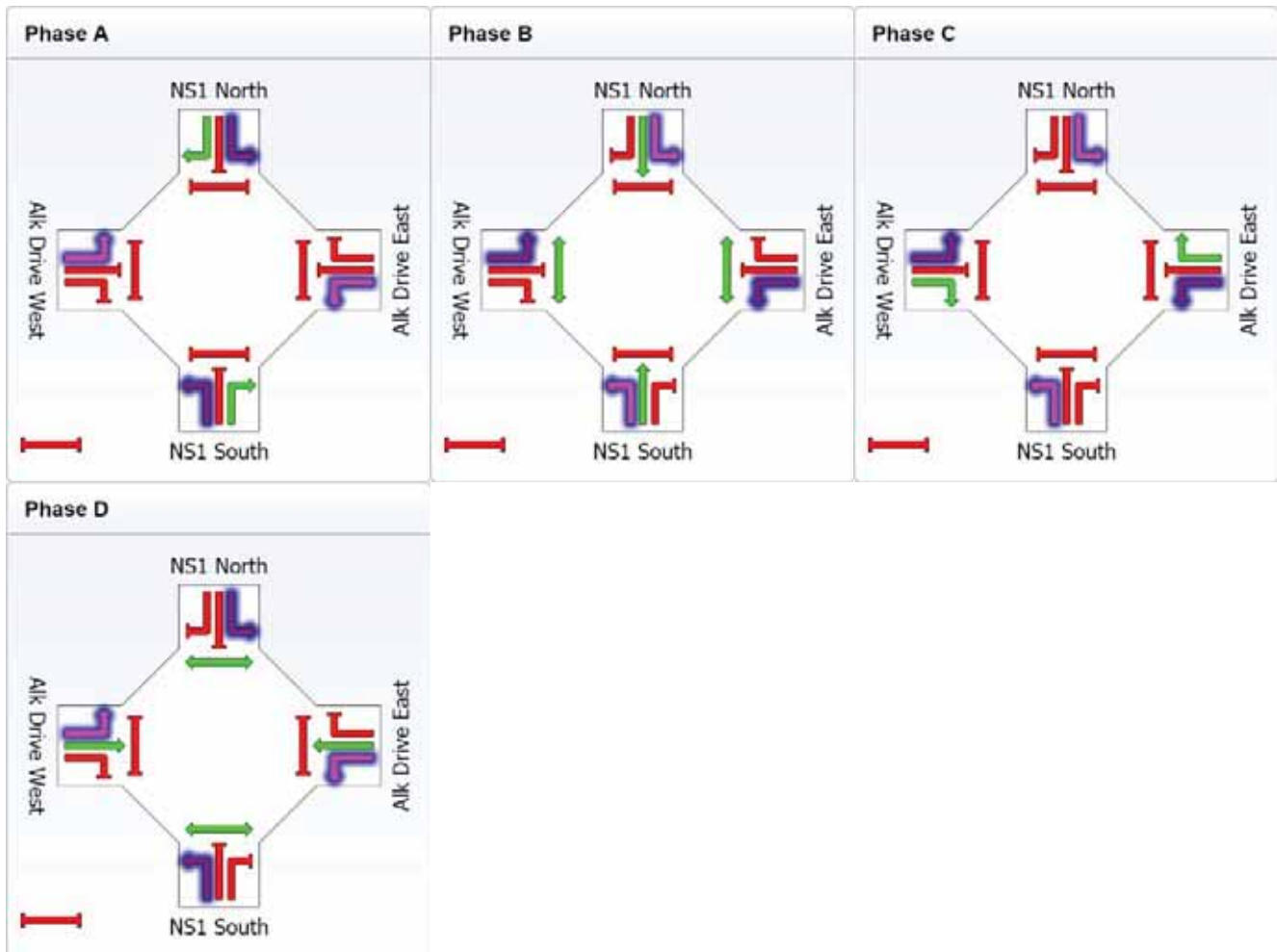
Central Alkimos LSP
Alkimos Drive & NS1
Nov 2012

Alkimos Drive & NS1
Nov 11 2012 using new NW Corridor traffic model.
HBW = 0.1, HBO = 0.2, HBS = 0.2, NHB = 0.2
Lend Lease City centre employment at Nov 5 2012
Four-way intersection with slip lanes (Signals)
Scenario with Hschool Link added
4% heavies on arterial movements
3% heavies on local road movements
95% phf
Signals - Actuated Cycle Time = 120 seconds

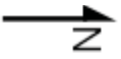
Phase times determined by the program
Green Split Priority for Coordinated Movements applies
Sequence: 4 phase
Input Sequence: A, B, C, D
Output Sequence: A, B, C, D

Phase Timing Results

Phase	A	B	C	D
Green Time (sec)	10	17	28	41
Yellow Time (sec)	4	4	4	4
All-Red Time (sec)	2	2	2	2
Phase Time (sec)	16	23	34	47
Phase Split	13 %	19 %	28 %	39 %

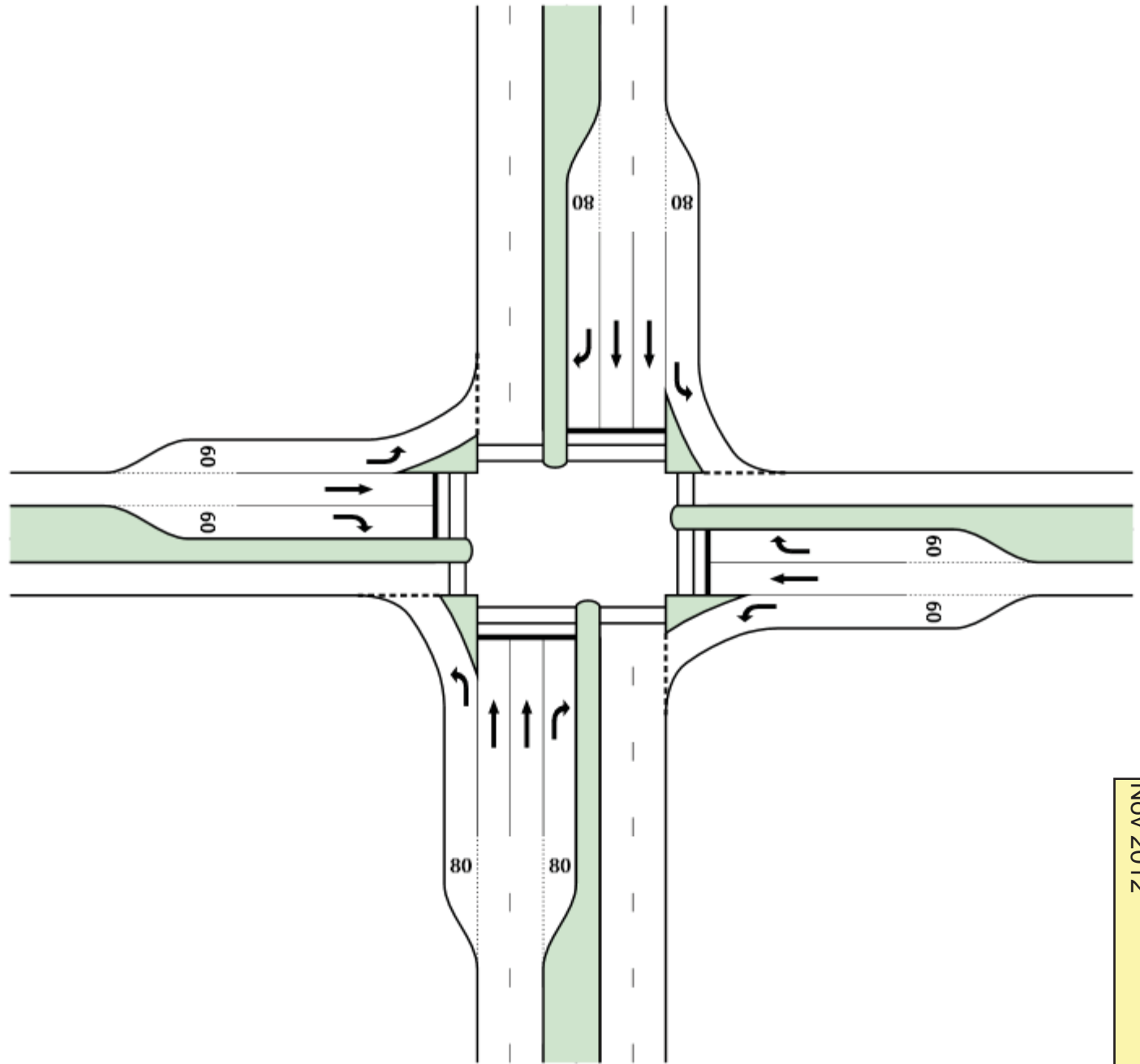


	Normal Movement		Permitted/Opposed
	Slip-Lane Movement		Opposed Slip-Lane



NS2 North Approach

Central Alkimos LSP
Alkimos Drive & NS2
Nov 2012



Alkimos Drive West

Alkimos Drive East

NS 2 South Approach

MOVEMENT SUMMARY

Central Alkimos LSP
Alkimos Drive & NS2
Nov 2012

Alk Drive & NS2 District Distributor B
Nov 11 2012 using new NW Corridor traffic model.
HBW = 0.1, HBO = 0.2, HBS = 0.2, NHB = 0.2
Lend Lease City centre employment at Nov 5 2012
Four-way intersection with slip lanes (Signals)
Scenario with Hschool Link added
4% heavies on arterial movements
3% heavies on local road movements
95% phf
Signals - Actuated Cycle Time = 120 seconds

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h	
South: NS 2 South Approach												
1	L	132	3.0	0.311	20.3	LOS C	3.6	25.8	0.52	0.71	38.7	
2	T	193	3.0	0.653	55.6	LOS E	10.9	78.3	0.97	0.79	22.9	
3	R	53	3.0	0.229	62.5	LOS E	2.8	20.4	0.91	0.75	23.2	
Approach		377	3.0	0.653	44.3	LOS D	10.9	78.3	0.80	0.76	26.7	
East: Alkimos Drive East												
4	L	432	3.0	0.370	9.4	LOS A	1.4	10.4	0.08	0.65	53.1	
5	T	1212	4.0	0.860	37.6	LOS D	31.2	226.0	0.93	0.84	30.6	
6	R	123	3.0	0.423	60.3	LOS E	6.4	45.8	0.89	0.78	23.0	
Approach		1766	3.7	0.860	32.3	LOS C	31.2	226.0	0.72	0.79	33.4	
North: NS2 North Approach												
7	L	117	3.0	0.234	12.9	LOS B	1.8	13.1	0.33	0.69	46.0	
8	T	118	3.0	0.400	53.2	LOS D	6.4	45.9	0.93	0.74	23.5	
9	R	123	3.0	0.536	64.5	LOS E	7.0	50.1	0.96	0.79	21.7	
Approach		358	3.0	0.536	43.9	LOS D	7.0	50.1	0.74	0.74	27.3	
West: Alkimos Drive West												
10	L	118	3.0	0.105	8.4	LOS A	0.3	2.2	0.06	0.61	49.0	
11	T	838	4.0	0.595	31.8	LOS C	17.6	127.4	0.75	0.66	31.6	
12	R	124	3.0	0.427	59.8	LOS E	6.4	46.2	0.89	0.78	22.8	
Approach		1080	3.8	0.595	32.5	LOS C	17.6	127.4	0.69	0.67	31.4	
All Vehicles		3581	3.6	0.860	34.8	LOS C	31.2	226.0	0.72	0.74	31.3	

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

Movement Performance - Pedestrians									
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Queue Distance m	Prop. Queued	Effective Stop Rate per ped	
P1	Across S approach	53	54.2	LOS E	0.2	0.2	0.95	0.95	
P3	Across E approach	53	56.6	LOS E	0.2	0.2	0.95	0.95	
P5	Across N approach	53	54.2	LOS E	0.2	0.2	0.95	0.95	
P7	Across W approach	53	56.6	LOS E	0.2	0.2	0.95	0.95	
All Pedestrians		212	55.4	LOS E			0.95	0.95	

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

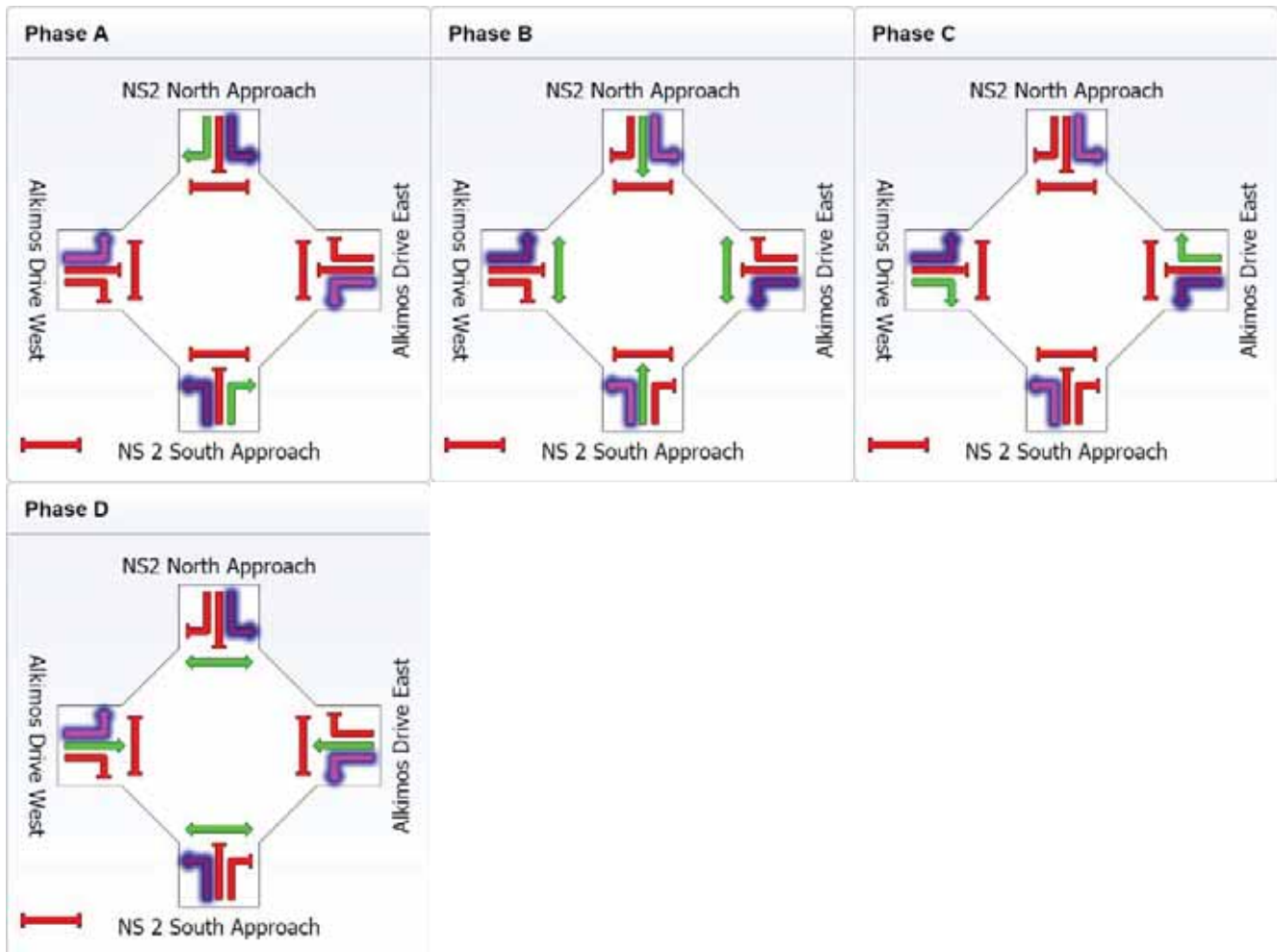
Central Alkimos LSP
Alkimos Drive & NS2
Nov 2012

Alk Drive & NS2 District Distributor B
Nov 11 2012 using new NW Corridor traffic model.
HBW = 0.1, HBO = 0.2, HBS = 0.2, NHB = 0.2
Lend Lease City centre employment at Nov 5 2012
Four-way intersection with slip lanes (Signals)
Scenario with Hschool Link added
4% heavies on arterial movements
3% heavies on local road movements
95% phf
Signals - Actuated Cycle Time = 120 seconds

Phase times determined by the program
Green Split Priority for Coordinated Movements applies
Sequence: 4 phase
Input Sequence: A, B, C, D
Output Sequence: A, B, C, D

Phase Timing Results

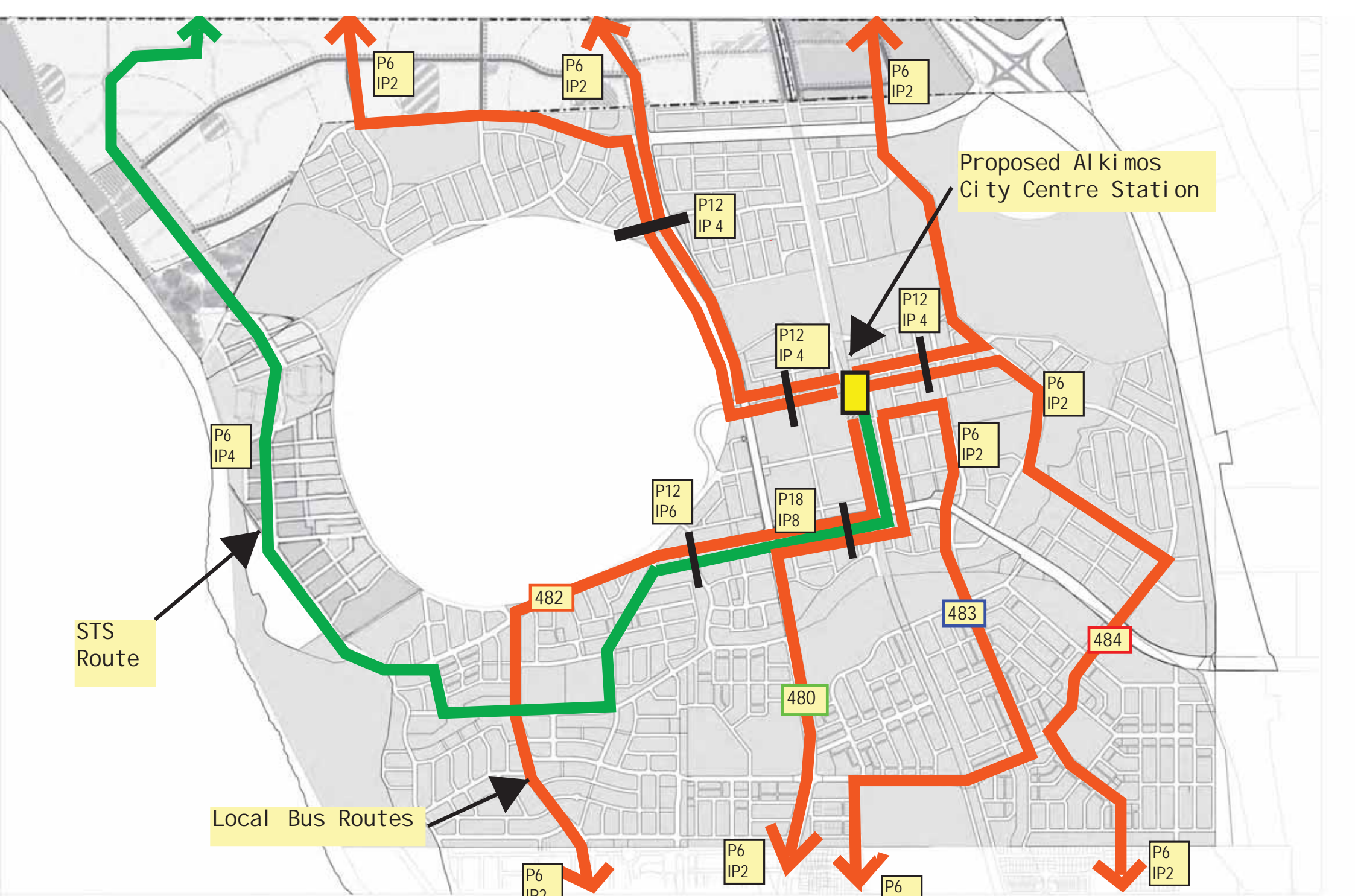
Phase	A	B	C	D
Green Time (sec)	15	17	19	44
Yellow Time (sec)	4	4	4	4
All-Red Time (sec)	2	3	2	2
Phase Time (sec)	21	24	25	50
Phase Split	18 %	20 %	21 %	42 %



Normal Movement	Permitted/Opposed
Slip-Lane Movement	Opposed Slip-Lane

APPENDIX G

DISTRICT BUS ROUTE PLAN AND BUS PRIORITY PLANS



Proposed Alimos
City Centre Station

STS
Route

Local Bus Routes

P6
IP2

P6
IP2

P6
IP2

P12
IP 4

P12
IP 4

P12
IP 4

P6
IP2

P6
IP4

P6
IP2

P12
IP6

P18
IP8

482

483

484

480

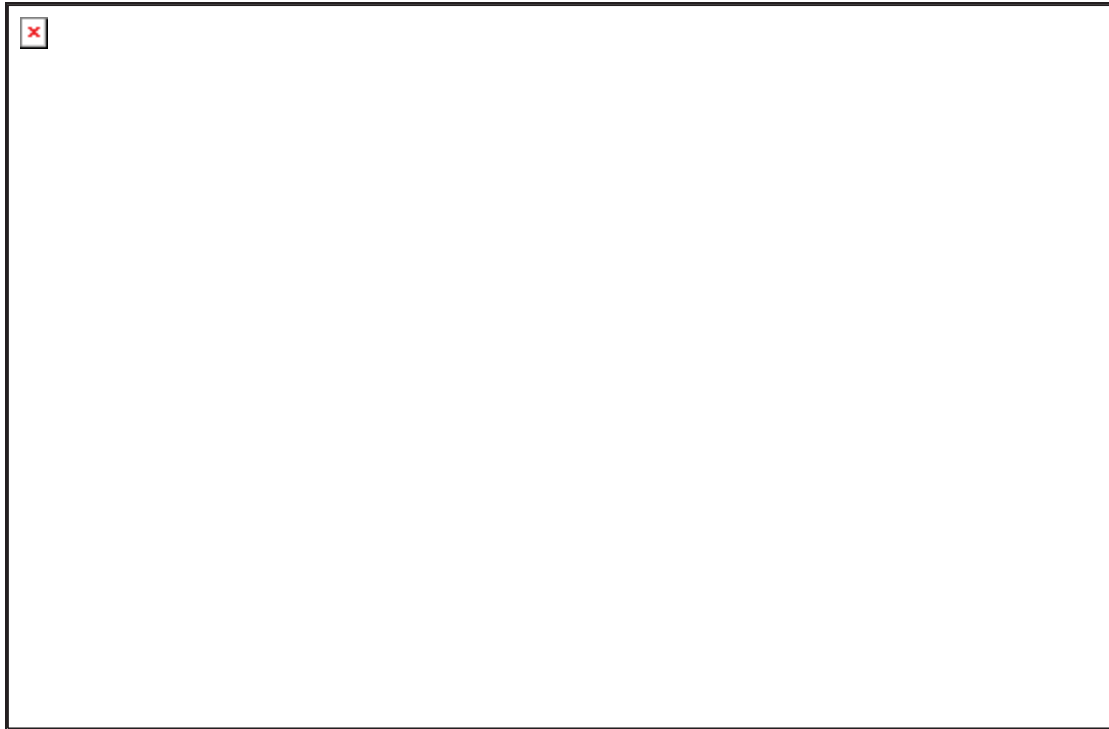
P6
IP2

P6
IP2

P6
IP2

P6
IP2

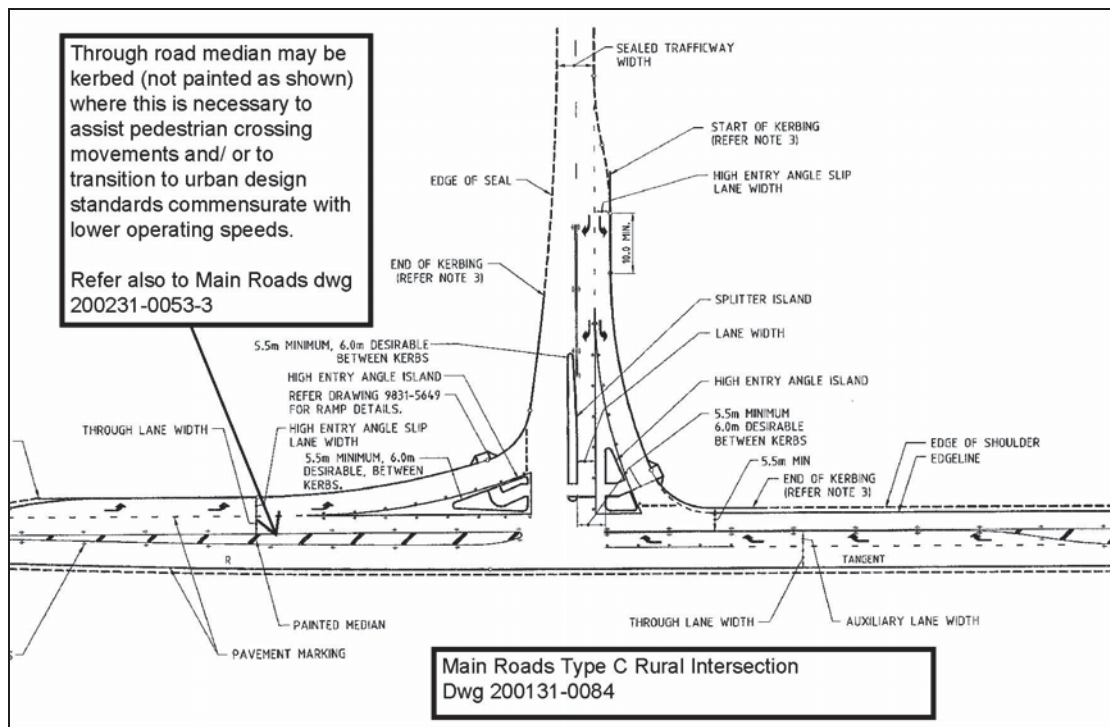
Appendix H: Main Roads T-junction Designs



Type B/ A intersection (right turn widening only): Source Main Roads



Type B/B Intersection (right and left turn widening). Source: Main Roads



Type C Intersection (right and left turn lanes with left turn islands: Main Roads

TECHNICAL NOTE

Traffic Engineering

Project Code: W122764 **Project Name:** Alkimos Vista - Further Work - Removal of the Bridge

Date: 11 May 2020 **Version No.** 5

Author: Gary Soo/Tanya Moran

SUBJECT: Alkimos Vista Local Structure Plan Amendment – Removal of the Bridge over the Railway Reserve

Page 1 of 21 plus two Attachments

Dear Laura

A Local Structure Plan (LSP) has been prepared for Alkimos Vista (formerly called Central Alkimos) located in the City of Wanneroo. As part of the initial works completed with the LSP preparation, a *“Traffic and Movement Network”* report was prepared by Bruce Aulabaugh Traffic Engineering and Transport Planning¹ in 2013 (referred herein as the Aulabaugh Report). Since the completion of the Aulabaugh Report, the future intersection arrangement on Marmion Avenue adjacent Alkimos Vista has been updated to better suit land use planning which was subsequently been approved by Main Roads WA and the City of Wanneroo in 2017. This Technical Note incorporates these adopted changes on Marmion Avenue adjacent Alkimos Vista.

The objective of this April 2020 Technical Note is to document the analysis findings of removing the secondary Bridge over the railway reserve within Alkimos Vista (located approximately 300m south of Alkimos Drive Bridge) (“The Amendment”). This Bridge previously connected road corridors NS 1 and NS 2 in the Aulabaugh Report. The Alkimos Drive Bridge further north will provide east-west connectivity and it is understood this will be constructed as part of the state METRONET project prior to the Yanchep Rail Line extension opening in 2022.

The Amendment also proposes a minor modification to realign the primary school site located within Alkimos Vista, just west of NS 1. The Amendment also proposes a modification to the LSP cell east of the railway, with a POS shifted further east. CAP Roads are also proposed for the viability of the mixed-use developments along Alkimos Drive (on both sides) and have been shown to fit well within the Alkimos Drive road reserve and within the ultimate dual carriageway cross-section between Marmion Avenue and the Mitchell Freeway. A plan showing the network changes is shown in Figure 1 on the next page.

In light of the above bridge removal proposal, GTA has been reengaged by Lendlease to prepare an Addendum Report to the Aulabaugh Report to address the Amendment, and in particular, define any impacts to the proposed local road hierarchy and movement network. This Technical Note provides supplementary information on the Amendment, within the context of the broader LSP and the Aulabaugh Report.

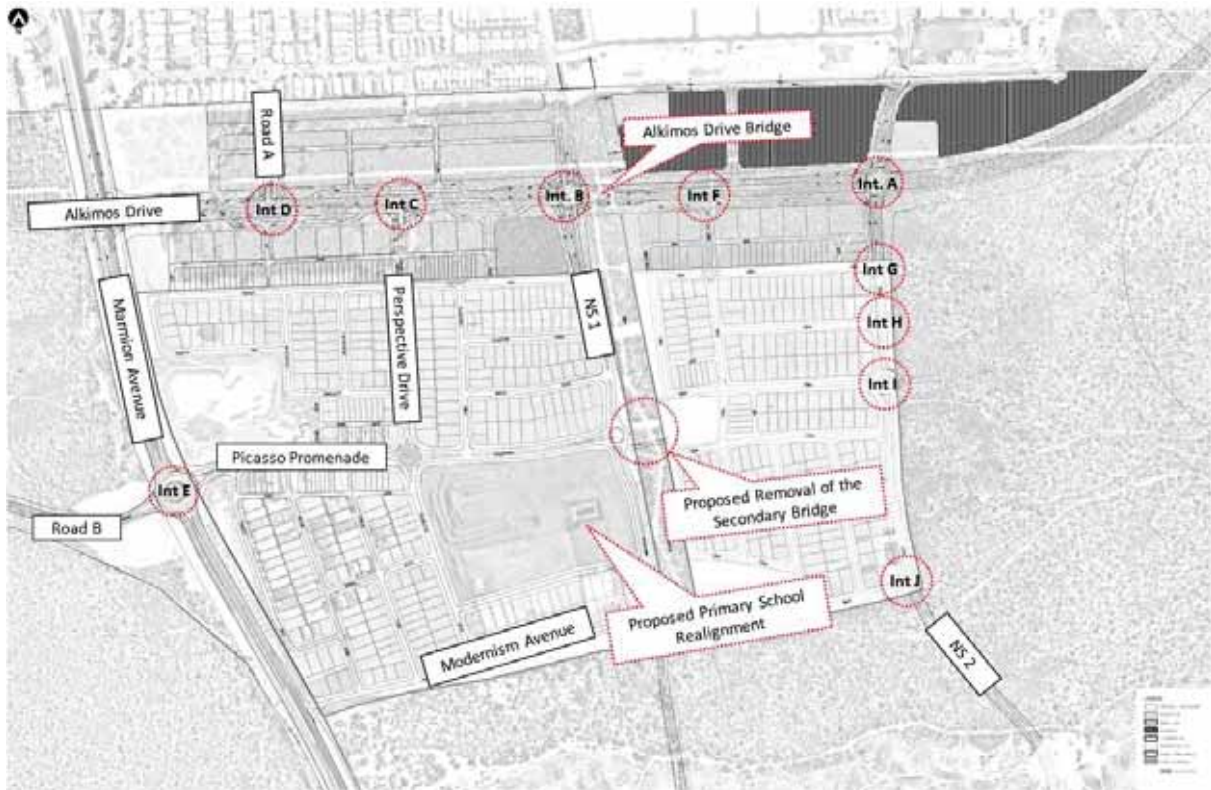
Cossill & Webley Engineers have prepared preliminary layouts of the intersections along Alkimos Drive to determine the land take requirements and to ensure compatibility with the METRONET bridge design on Alkimos Drive. These intersections are shown on Figure 1 as:

- Intersection A; Alkimos Drive / NS 2 intersection
- Intersection B; Alkimos Drive / NS 1 intersection

¹ Central Alkimos, Traffic and Movement Network, Final Report, Bruce Aulabaugh, Rev 1 – May 9, 2013

- Intersection C; full movement priority-controlled intersection at Alkimos Drive / Perspective Drive, west of NS 1.
- Intersection D; full movement priority-controlled intersection at Alkimos Drive / Road A (west of Intersection C).

Figure 1 "The Amendment" Plan for Alkimos Vista



The objectives of this April 2020 Technical Note are to determine:

1. Daily flows along the links within Alkimos Vista east of Marmion Avenue following the removal of the bridge;
2. Assessment of the impacts on the removal of the bridge on the surrounding road network;
3. SIDRA analysis of the four intersections on Alkimos Drive (A, B, C, and D) and four intersections on NS 2 (G, H, I, and J) to determine ultimate design requirements (post 2031 – assuming Alkimos Drive connects Marmion Avenue to the Freeway);
4. SIDRA analysis of the two intersections on Alkimos Drive (A and B) pre-2031 – assuming No Alkimos Drive and Freeway extensions north of Romeo Road;
5. Sensitivity SIDRA analysis of Intersection E to determine at which Year/Stage of Alkimos Vista the intersection will fail, assuming No Alkimos Drive and Freeway extensions;
6. Sensitivity SIDRA analysis of Intersection F as a full access T intersection to ensure it operates acceptably until such time that Alkimos Drive, NS 2 and Intersection A are constructed (and it reverts to a Left-in/Left-out);
7. Commentary on traffic speeds along NS 1 adjacent to the rail corridor and more importantly, the Primary School;
8. Commentary on suitability of CAP roads with the Alkimos Drive reserve; and
9. Commentary on traffic speeds and NS 2 adjacent to the District Open Space.

Previous Marmion Avenue Traffic Analysis

GTA has previously been involved in the transport planning for Alkimos Vista approved LSP area (ASP 95) having contributed to a 2017 Transport Assessment to support a Subdivision Application for Stage 1 of development. Further, GTA prepared a high level Traffic Assessment to support the provision of a revised access arrangement on Marmion Avenue to aid and facilitate the access to the first stages of development.

Prior to the planned Alkimos Drive and the Freeway extension being constructed (expected to be after 2031), Marmion Avenue will continue to act as the sole access for vehicles to travel to and through the northern corridor of Wanneroo, and as a result, all traffic associated with the Alkimos Vista will travel on Marmion Avenue. In this context, GTA developed vehicle demand scenarios and undertook intersection capacity tests to determine suitable access arrangements along Marmion Avenue.

It was determined that of the number of options tested, a left-in/left-out (LILO) intersection plus a Roundabout (with dual lane approaches on Marmion Avenue and single lane approaches on the LSP arms) would provide sufficient capacity to provide access for the LSP during the first stages of development. As such, GTA has considered the provision of these two access arrangements on Marmion Avenue as a permanent solution to provide access for the LSP.

The road network changes with the original 2013 Aulabaugh LSP movement network as base map layout are highlighted in Figure 2.

Figure 2 NW Corridor Traffic Model Network Extension (Bruce Aulabaugh, 2013)



The above Marmion Avenue intersection arrangements were accepted by Main Roads WA and the City of Wanneroo, subsequently constructed and so the traffic analysis for The Amendment is undertaken in line with the above accessibility arrangements.

Adopted Trip Rates

The Alkimos Vista will include a mix of residential and education land uses. The traffic generation and distribution estimates contained within the Aulabaugh Report were produced using the EMME modelling software package. Access to this model was not provided for the preparation of The Amendment, and as such GTA has estimated traffic generation impacts using conventional methods and standard trip generation rates.

The trip generation rates and arrival/departure proportions adopted for these land uses for the analysis are set out in Table 1 and have been extracted from *Western Australian Planning Commission Transport Impact Assessment Guidelines (2016)* (WAPC Guidelines).

Table 1 Adopted Trip Generation Rates for Alkimos Vista (Eastern Portion)

Land Use	Trip Rate (VPD)	Morning Peak		Evening Peak	
		IN	OUT	IN	OUT
Residential	8.0 per dwelling	25%	75%	67%	33%
School	1.0 per child	50%	50%	50%	50%

The assessed traffic generation for the eastern portion of Alkimos Vista is shown in Table 2.

Table 2 Assessed Daily Trip Generation for Alkimos Vista (Eastern Portion)

Proposed Land Use	Assumed Area/Number of Lots/Students	Daily Trip Generation Rate	Daily Trips (VPD)
Residential	Approx. 564 (lots)	8 trips per lot per day	4,512
School	650 (Students)	1.0 per child	650
			5,162 vpd Total

Vehicle Traffic Distribution and Assignment

A bespoke spreadsheet model was developed considering the eastern portion of Alkimos Vista where The Amendment occurs. Inputs to the model include the forecast background traffic on the adjacent network and the trip generation associated with the Alkimos Vista's full development.

The redistribution of traffic associated with the removal of the secondary Bridge over the railway is based upon the previous approved traffic modelling assumptions and results derived from the Aulabaugh Report Northwest Corridor Traffic Model for 2031 (NW Corridor Traffic Model). This traffic model covers an area from Hester Avenue (South) to Wilbinga Reserve in Two Rocks (North), and from the coast (West) to Old Yanchep Road located to the east of Wanneroo Road. Figure 3 shows the extent of the modelled road network in the NW Corridor Traffic Model.

The trips calculated in the trip generation exercise above were distributed onto the road network using the following method and assumptions:

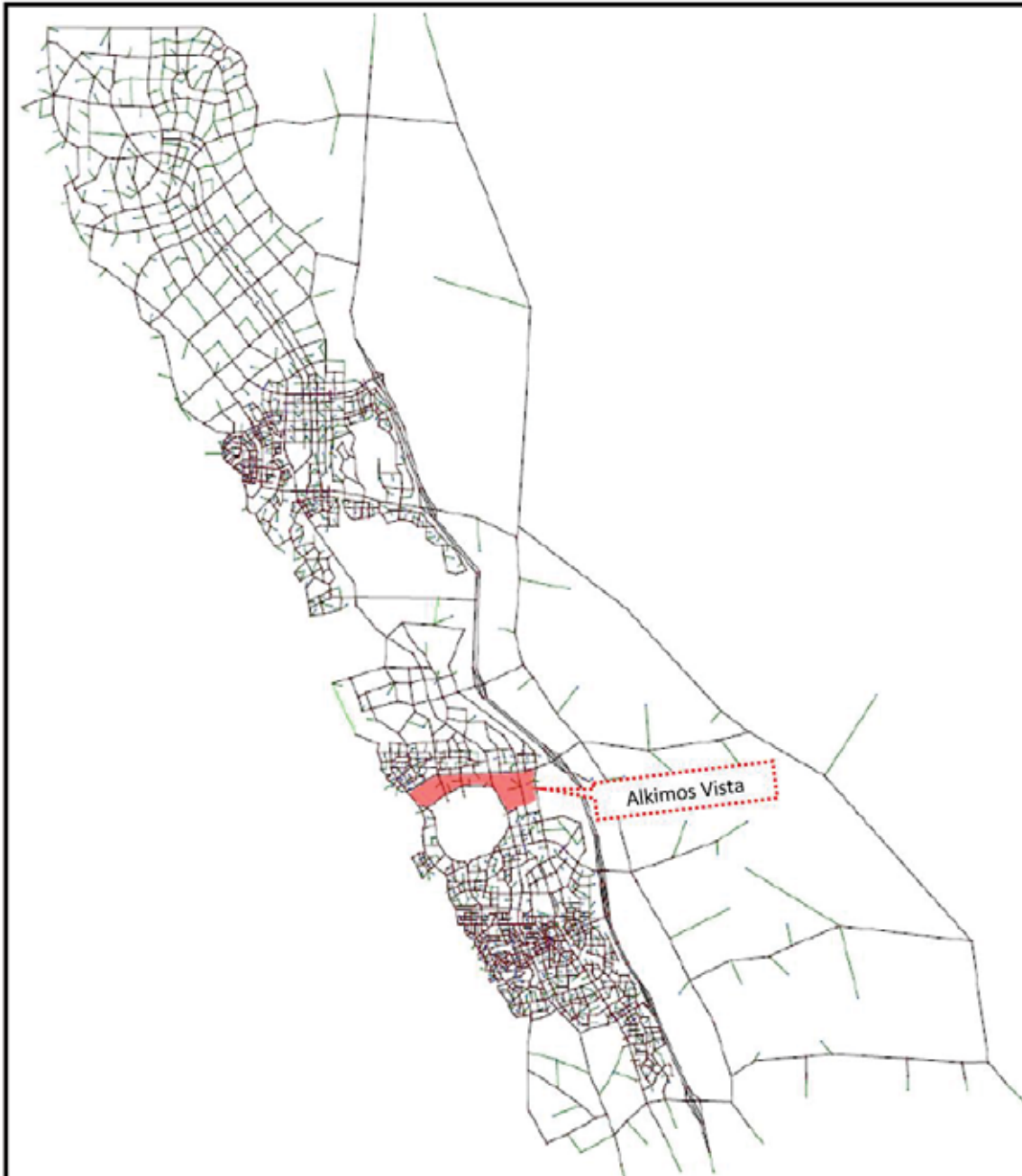
- Full development of the Alkimos Vista LSP (east of Marmion Avenue) is expected to be completed by 2027, based off recent market conditions and advice from Lendlease.
- GTA has modelled a post-2031 scenario where:
 - Alkimos Vista is fully developed
 - Alkimos Drive is connected to Marmion Avenue as a signalised intersection
 - Freeway extension occurs north of Romeo Road and connects to Alkimos Drive.
- GTA has modelled an interim pre-2031 scenario where:
 - Alkimos Drive has NOT been connected to Marmion Avenue. Only the Alkimos Drive Bridge exists.
 - Freeway / Alkimos Drive interchange does not exist
 - This scenario has been tested to determine at which development stage/lots the Picasso/Marmion Avenue will fail, prior to Alkimos Drive connecting Marmion Avenue to the Freeway.
- The traffic modelling divides the LSP into smaller internal sub-zones. This zone structure divided the project area into key traffic sub-areas within the development to provide and appropriate bespoke traffic model.

The external trip attraction patterns surrounding the site were analysed in accordance with ultimate demand forecasts sourced from the NW Corridor Traffic Model. These external distribution percentages are outlined in

- Table 3.

- Apart from primary school related trips, zero internal trips are assumed for the internal residential zones travelling within the LSP.
- For each internal zone within the LSP travelling to/from another zone, it was assumed that the vehicle making the trip would be following the shortest or the path of least resistance to get to their destination. An extract of the modelled network is shown in Figure 4.

Figure 3 NW Corridor Traffic Model Network Extension (Bruce Aulabaugh, 2013)

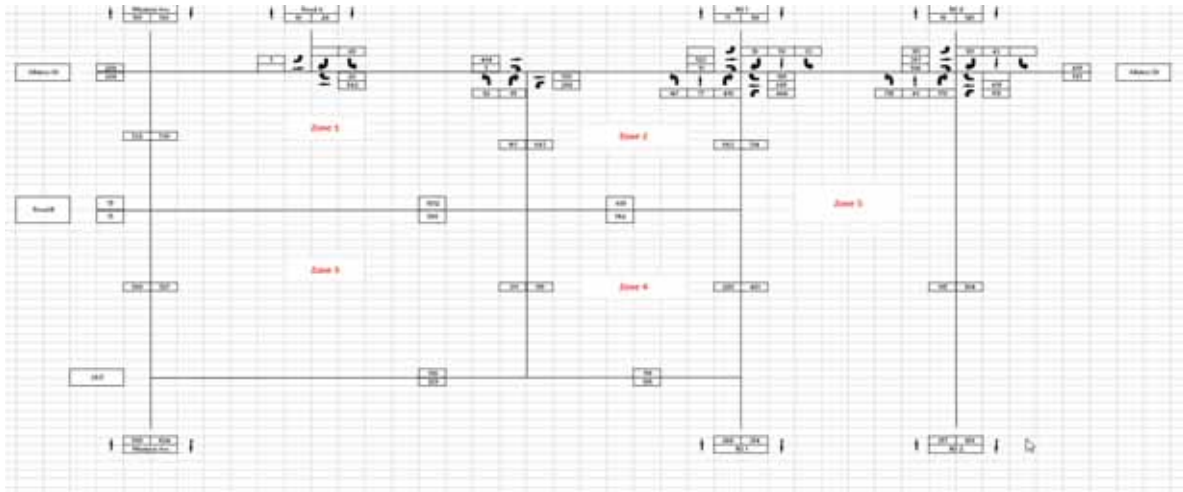


Source: Central Alkimos, Traffic and Movement Network, Final Report, Bruce Aulabaugh, Rev 1 – May 9, 2013

Table 3 Adopted External Traffic Distributions

To/From	Distribution Percentage (%)	
	Inbound/Outbound	
Marmion Avenue (North)	21.5%	
Marmion Avenue (South)	22.2%	
Alkimos Drive (West)	7.6%	
Road B south of Alkimos Drive (West)	2.8%	
Mitchel Freeway (East)	21.9%	
NS 1 (North)	4.0%	
NS 1 (South)	4.3%	
NS 2 (North)	5.3%	
NS 2 (South)	9.4%	
Road A west of NS 1 (North)	1.0%	
Total	100%	

Figure 4 Overview of the Alkimos Drive Traffic Demand Model Network



Traffic Flows and Road Hierarchy

The traffic generated within the eastern portion of Alkimos Vista was reassigned onto the adjacent road network taking into account the removal of the Bridge and using the methods and assumptions noted above. Future demands for each internal and external zone, in addition to background traffic from key strategic links and connections adjacent to the site, were then added together resulting in the daily demands set out in Figure 5.

Figure 5 Estimated Daily Vehicle Demands (post-2031)



Based on the information and analysis detailed above, the changes to the traffic generation characteristics of the eastern portion of the LSP have been evaluated and are shown in Figure 6.

Figure 6: Forecast Traffic Volumes Differences from the Original LSP (2013)*



*Flow difference information is not available along Perspective Drive and Picasso Promenade as these links were not reported in the original NW Corridor Model

As can be seen, following the removal of the secondary bridge over the railway line, there has been an increase in the two-way daily volumes estimated along **NS 1 approaching Alkimos Drive (6,200vpd)**; previously 5,000vpd in the Aulabaugh Report) as more trips are choosing this short section of route to access Alkimos Drive. It is also noted that flows along **NS 2 (12,600vpd)** have decreased as a result of the bridge removal (previously 15,000vpd in the Aulabaugh Report). The daily flows also decreased along Modernism Avenue as a result of the preference in routing through Picasso Promenade which provides a more direct link and roundabout controlled to the eastern portion of Alkimos Vista to/from Marmion Avenue.

The total future volumes overall and as shown in Figure 5 are still within what has been considered within the Aulabaugh Report. The proposed internal road hierarchy for the eastern portion of Alkimos Vista is shown in The cross-section for Alkimos Drive prepared by Cossill & Webley (dated December 2019) is included at Appendix B.

Figure 7. This road hierarchy has been verified using the guidelines and indicative daily traffic volume limits set out in *Liveable Neighbourhoods*, together with the overall design principles and aims for the LSP development.

The road reserve widths proposed for each class of road are in line with the *Liveable Neighbourhoods* guidance (indicative), as set out below:

- Integrator A = 50.6m – 52.6m, 2x8.2m including bike lane and 2x5.5 service roads with parking. The section of Alkimos Drive between Marmion Avenue and the freeway is recommended as an Integrator A.
- Integrator B = 27.0m, 2x7.5m including a bike lane and excluding on-street parking (5.5m verge width). NS 2 is recommended as an Integrator B (2-lanes).
- Neighbourhood Connector A = 22.5m - 24.4m (These are 'special' streets and their design needs to have regard to context, function and adjacent land uses). As indicated in the daily demands set out in Figure 5, NS 1 to the west of the railway corridor is expected to carry in the order of (7,950vpd to 5,075vpd) and accordingly is recommended to be constructed as a two-lane divided street to accommodate higher Neighbourhood Connector volumes. Road B is also expected to carry in the order of 5,000vpd and is also recommended to be constructed to this standard.

The remainder of the local road network is classified as Access Street B, C, and D with 16.5m – 14.2m road reserve width as follows:

- Access Street B = 16.5m – 18m. The access streets adjoining the primary school are recommended to be constructed to this standard in order to allow for on-street parking on both sides of the street.
- Access Street C = 15.4m – 16m.
- Access Street D = 14.2m (narrower access streets (5.5 to 6m pavement width) may be appropriate in locations further away from centres and activity where traffic flows are less than 1,000vpd and a low on-street parking demand exists).

Removing the secondary bridge will also remove the previously planned pedestrian/cycle connections over the railway corridor in Vista. To ensure adequate walk/cycle connections are present, Cossill & Webley's preliminary Alkimos Drive cross-section layout proposes a dual carriageway of 3.5m wide lanes and 2m wide on-road cycle lanes (both sides), a 6m median, shared path in one verge and a dual use path/footpath in the opposite verge. All Access Streets are also proposed to have a footpath on at least one side. The cross-section for Alkimos Drive prepared by Cossill & Webley (dated December 2019) is included at Appendix B.

Figure 7: Road Hierarchy for Alkimos Vista Eastern Portion



Local Traffic Management

Given the predominantly residential land use within Alkimos Vista, and their weighted one-directional peak hour flows within the internal road network, it is not expected any capacity issues will occur at junctions internal to the LSP and that uncontrolled priority and roundabout intersections will be sufficient to accommodate the expected demand.

The proposed road hierarchy detailed in The cross-section for Alkimos Drive prepared by Cossill & Webley (dated December 2019) is included at Appendix B.

Figure 7 assumes a Neighbourhood Connector A standard for Picasso Promenade along its full length. It is noted that the section of this road immediately to the west of NS 1 is estimated to carry some 3,450vpd which suggests that direct full movement access is still feasible for the lots fronting this section of road.

The default speed limit within built up areas is 50km/hr along Neighbourhood Connectors and Access Streets as per current *Liveable Neighbourhoods* guidance, however, a push to lower local road speeds to below the Killed or Serious Injured threshold speeds should be considered as per the Safe Systems Engineering designs adopted by State Government. It is recommended to have a School Speed Zone along the portion of NS 1 immediately to the east of the primary school as shown in Figure 8. Roundabouts are suggested along the northern corners of the primary school to maintain safe speeds and facilitate traffic turning movements with priority-controlled intersections recommended to be adequate at the other two corners of the school. Suggested speed limits within the portion of the LSP east of Marmion Avenue (in line with the *Liveable Neighbourhoods* guidance) are presented in Table 4.

Traffic management measures should be further confirmed at the time that the school is planned in detail to ensure appropriate treatments are provided at convenient locations for safe pedestrian, cyclists movement and school pick-up / set down.

Table 4 Suggested Speed Limits within Alkimos Vista Eastern Portion (Liveable Neighbourhoods Guidelines)

Road	Suggested Speed Limit (km/hr)
Perspective Drive	50/40km/hr
Picasso Promenade	50km/hr
Modernism Avenue	50/40km/hr
NS 1	Within school zone hours, 40km/hr immediately to the east of the primary school and 50km/hr along north of Road B Outside school zone hours, 50km/hr along its full length
NS 2	50/40km/hr
Alkimos Drive	60km/hr

CAP Roads along Alkimos Drive are proposed as an essential need for the viability of the mixed-use developments along Alkimos Drive (on both sides) and provides a suitable access solution to these land uses between Marmion Avenue and the Mitchell Freeway. The CAP roads have been shown to fit well within the Alkimos Drive road reserve and within the ultimate dual carriageway cross-section (refer Cossill & Webley plans at Appendix B). Passing traffic along this strategic east-west Alkimos Drive will have good exposure to the commercial land uses planned along Alkimos Drive and the CAP roads enable a direct access solution that also does not detrimentally impact the through flow. The CAP roads also remove undue pressure on just one all-movement intersection and the undesired re-routing of traffic to other supplementary local intersections. As an example, considering the section between the railway and Marmion Avenue, the provision of two left-only in slip lanes and 2 left-only out slip lanes distributes the traffic demands across 5 intersections in a non-imposing operational manner, as opposed to just one imposing all movement intersection. The same applies for the section between the railway corridor and NS 2.

The viability of the neighbourhood centre and mixed-use developments along Alkimos Drive fronting Alkimos Vista and abutting Shorehaven are greatly dependent on the CAP roads being in place. Without these, the amenity of the residential roads within Shorehaven and the Vista are expected to suffer and carry in excess of what they are intended to (above 3,000vpd).

Figure 8 Traffic Management for Alkimos Vista Eastern Portion



Assessment of Intersection Operations

The operation of the key intersections along Alkimos Drive for access to the eastern portion of Alkimos Vista has been assessed using SIDRA Intersection² (SIDRA) in 2031. SIDRA is a computer-based modelling package which calculates intersection performance. As detailed in the WAPC Guidelines, the critical measure of intersection performance is average delay per vehicle. Table 5 sets out the thresholds for intersection delays considered to provide an adequate Level of Service (LoS) within the WAPC Guidelines for priority-controlled intersections.

Table 5 WAPC Guideline Thresholds for Intersection Adequate Operations

Delay Component	Priority-Controlled Intersection Threshold	Signalised Intersection Threshold
Average delay for all vehicles passing through the intersection	<35 seconds	<55 seconds
Average delay for any individual vehicle, pedestrian or cyclist movement	<45 seconds	<65 seconds

SIDRA outputs are presented in the form of Degree of Saturation, Level of Service, Average Delay and 95% Queue. These characteristics are defined as follows:

- **Degree of Saturation (DoS)**; is the ratio of the arrival traffic flow to the capacity of the approach during the same period. The Degree of Saturation ranges from close to zero for varied traffic flow up to one for saturated flow or capacity.
- **Level of Service (LoS)**; is the qualitative measure describing operational conditions within a traffic stream and the perception by motorists and/or passengers. In general, there are 6 levels of service, designated from A to F, with Level of Service A representing the best operating condition (i.e. free flow) and Level of Service F the worst (i.e. forced or breakdown flow).
- **Average Delay**; is the average of all travel time delays for vehicles through the intersection.
- **95% Queue Length**; is the queue length below which 95% of all observed queue lengths fall.

The general layouts of intersections A and B along Alkimos Drive have been tested as signalised intersections in line with the recommendations presented in the Aulabaugh Report. Layouts are shown in Figure 9 and Figure 10, though this may also be in the form of roundabouts (subject to further analysis and stakeholder approval).

Figure 11 and Figure 12 demonstrate the **two-stage crossing** layouts suggested for **intersections C and D**. Outputs of the intersection performance assessment are summarised in Table 6 to Table 9 with full results presented at Appendix A.

² Program used under licence from Akcelik & Associates Pty Ltd

Figure 9 Alkimos Drive / NS 2 - Intersection A (Post 2031 Scenario)

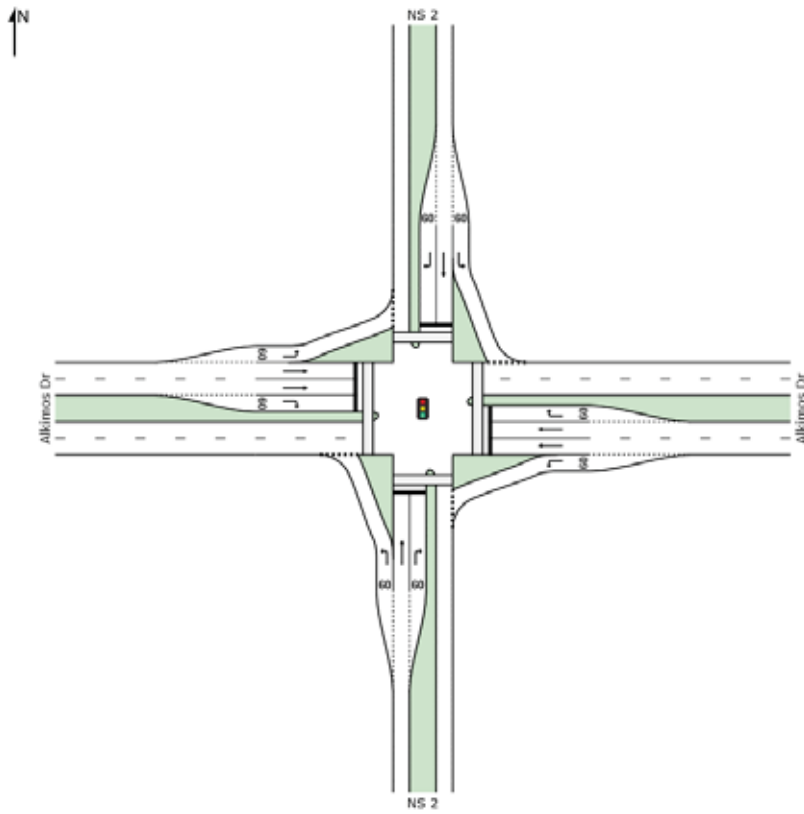


Figure 10: Alkimos Drive / NS 1 - Intersection B (Post 2031 Scenario)

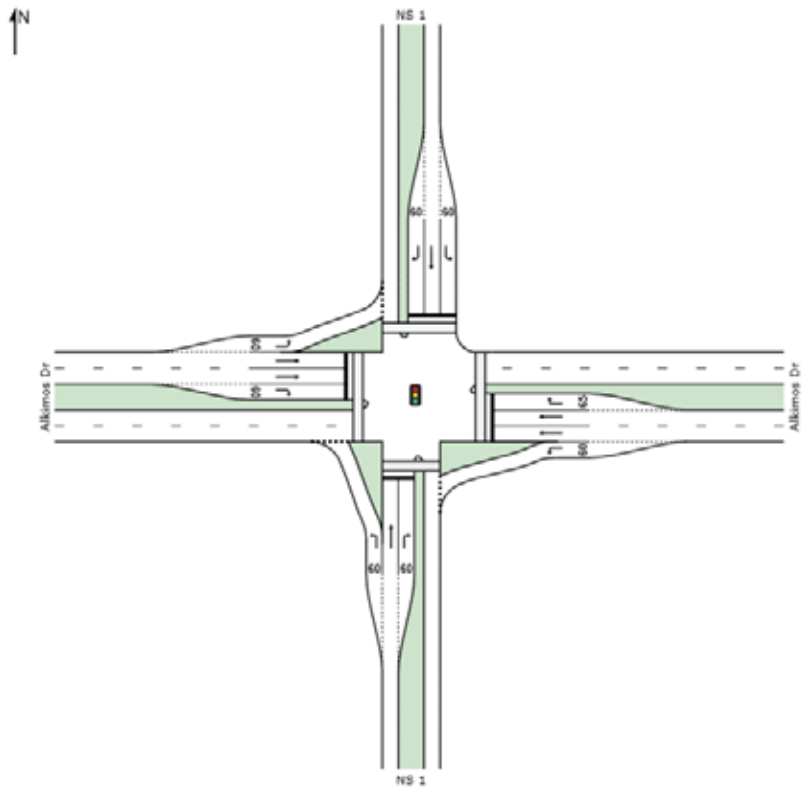


Figure 11: Alkimos Drive / Perspective Drive - Intersection C (Post 2031 Scenario)

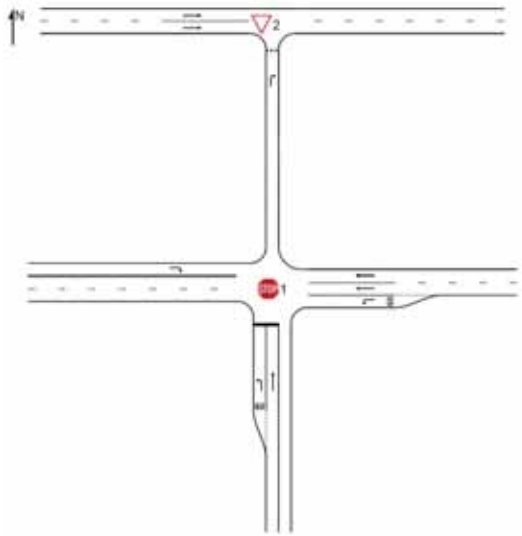


Figure 12: Alkimos Drive / Road A - Intersection D (Post 2031 Scenario)

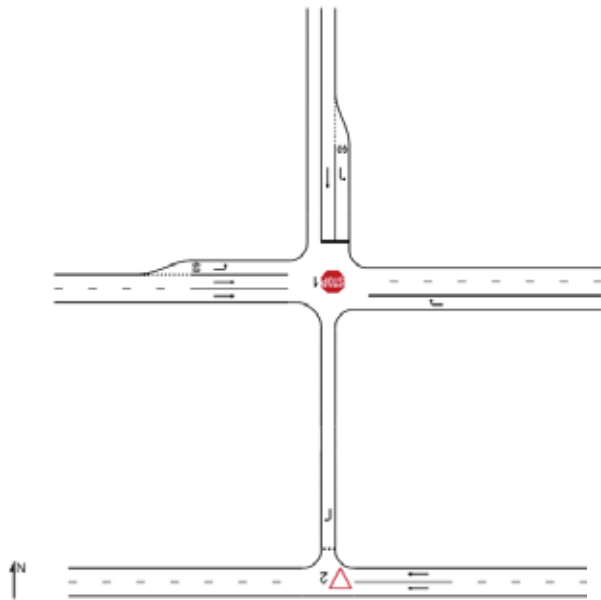


Table 6 Intersection A - Alkimos Drive/NS 2 Intersection Performance (Post 2031 Scenario)

Intersection	Arm	DOS	LOS	Avg Delay	95th %ile Q
Intersection A Alkimos Drive / NS 2 AM	NS2 (south)	0.650	C	26.0	99.0
	Alkimos Drive (east)	0.890	C	32.1	104.6
	NS2 (north)	0.870	D	40.8	93.6
	Alkimos Drive (west)	0.878	D	40.9	226.2
	Intersection		0.890	D	35.2
Intersection A Alkimos Drive / NS 2 PM	NS2 (south)	0.509	C	20.7	40.5
	Alkimos Drive (east)	0.875	C	26.5	121.5
	NS2 (north)	0.885	C	32.9	60.2
	Alkimos Drive (west)	0.854	D	36.4	115.8
	Intersection		0.885	C	29.4

Table 7 Intersection B - Alkimos Drive/NS 1 Intersection Performance (Post 2031 Scenario)

Intersection	Arm	DOS	LOS	Avrg Delay	95th %ile Q
Intersection B Alkimos Drive / NS 1 AM	NS1 (south)	0.810	D	35.4	51.9
	Alkimos Drive (east)	0.861	C	32.8	132.0
	NS1 (north)	0.738	C	29.8	46.0
	Alkimos Drive (west)	0.872	C	34.2	110.0
	Intersection	0.872	C	32.9	132.0
Intersection B Alkimos Drive / NS 1 PM	NS1 (south)	0.735	C	34.3	35.7
	Alkimos Drive (east)	0.789	C	25.4	105.6
	NS1 (north)	0.753	C	29.1	36.8
	Alkimos Drive (west)	0.755	C	27.1	82.7
	Intersection	0.789	C	27.1	105.6

Table 8 Intersection C - Alkimos Drive/Perspective Drive Intersection Performance (Post 2031 Scenario)

Intersection	Arm	DOS	LOS	Avrg Delay	95th %ile Q
Intersection C Alkimos Drive / Perspective Drive AM	Perspective Drive (south)	0.167	C	17.3	3.9
	Alkimos Drive (east)	0.258	N/A	0.8	0.0
	Alkimos Drive (west)	0.223	N/A	22.3	1.2
	Intersection	0.258	N/A	2.2	3.9
Intersection C Alkimos Drive / Perspective Drive PM	Perspective Drive (south)	0.109	C	15.1	2.6
	Alkimos Drive (east)	0.232	N/A	1.0	0.0
	Alkimos Drive (west)	0.207	N/A	19.4	1.0
	Intersection	0.232	N/A	2.0	2.6

Table 9 Intersection D - Alkimos Drive/Road A Intersection Performance (Post 2031 Scenario)

Intersection	Arm	DOS	LOS	Avrg Delay	95th %ile Q
Intersection D Alkimos Drive / Road A AM	Alkimos Drive (east)	0.264	N/A	14.4	2.5
	Road A (north)	0.051	B	11.6	1.3
	Alkimos Drive (west)	0.208	N/A	0.2	0.0
	Intersection	0.264	N/A	1.3	2.5
Intersection C Alkimos Drive / Road A PM	Alkimos Drive (east)	0.235	N/A	12.5	2.1
	Road A (north)	0.050	B	11.2	1.3
	Alkimos Drive (west)	0.180	N/A	0.3	0.0
	Intersection	0.235	N/A	1.5	2.1

Analysis results demonstrate that the three intersections are expected to operate acceptably upon full development of the site in 2031.

Further, the analysis results in Appendix A demonstrate that the four intersections (G, H, I and J along NS 2) are expected to operate acceptably upon full development of the site post 2031.

Interim Scenario Modelling (Pre 2031)

GTA has modelled an interim pre-2031 scenario where:

- Alkimos Drive has NOT been connected to Marmion Avenue. Only the Alkimos Drive Bridge exists.
- Freeway / Alkimos Drive interchange does not exist.

Figure 13 Alkimos Vista Road Network (Pre-2031 Interim Scenario)



The operation of the Marmion Avenue / Picasso Promenade intersection has been modelled to test the performance of the intersection without an Alkimos Drive and a Freeway extension at 2031. In this scenario, Marmion Avenue is carrying 25,000 vehicles per day in 2031, consistent with estimates undertaken for the Marmion Avenue Duplication Project by City of Wanneroo and Alkimos Central City Centre modelling by Development WA.

Figure 14 Marmion Avenue / Picasso Promenade Roundabout Intersection – Intersection E

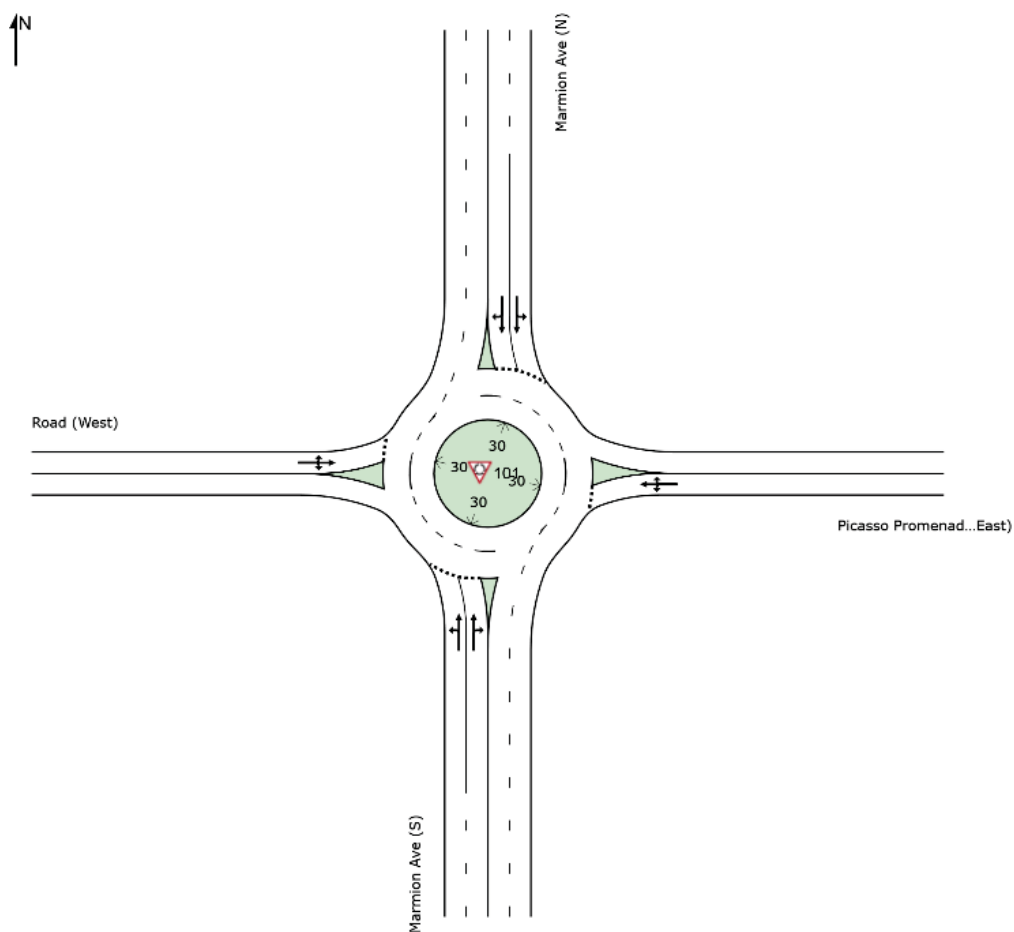


Table 10 Marmion Avenue / Picasso Promenade (Pre-2031 Interim Scenario)

Location	Arm	DOS	LOS	Avg Delay	95th %ile Q
Marmion Avenue / Picasso Promenade – Precinct West of Railway AM	Marmion Ave (S)	0.59	B	10s	42m
	Picasso Promenade (East)	0.90	C	24s	84m
	Marmion Ave (N)	0.50	A	7s	27m
	Road (West)	0.28	B	11s	11m
	Intersection	0.90	B	12s	84m
Marmion Avenue / Picasso Promenade – Stage 16 AM	Marmion Ave (S)	0.62	B	11s	47m
	Picasso Promenade (East)	0.99	D	43s	162m
	Marmion Ave (N)	0.50	A	7s	27m
	Road (West)	0.27	B	11s	10m
	Intersection	0.99	B	16s	162m
Marmion Avenue / Picasso Promenade – Full Development AM	Marmion Ave (S)	0.62	B	11s	47m
	Picasso Promenade (East)	1.02	E	58s	219m
	Marmion Ave (N)	0.50	A	7s	28m
	Road (West)	0.27	B	11s	10m
	Intersection	1.02	B	20s	219m

Location	Arm	DOS	LOS	Avg Delay	95th %ile Q
Marmion Avenue / Picasso Promenade - Precinct West of Railway PM	Marmion Ave (S)	0.54	A	9s	33m
	Picasso Promenade (East)	0.74	B	16s	45m
	Marmion Ave (N)	0.56	A	8s	33m
	Road (West)	0.24	A	10s	9m
	Intersection	0.74	A	10s	45m
Marmion Avenue / Picasso Promenade - Stage 16 PM	Marmion Ave (S)	0.56	A	9s	36m
	Picasso Promenade (East)	0.80	B	18s	53m
	Marmion Ave (N)	0.58	A	8s	36m
	Road (West)	0.25	B	10s	9m
	Intersection	0.80	B	10s	53m
Marmion Avenue / Picasso Promenade - Full Development PM	Marmion Ave (S)	0.60	B	10s	43m
	Picasso Promenade (East)	0.93	C	29s	97m
	Marmion Ave (N)	0.61	A	9s	42m
	Road (West)	0.28	B	10s	11m
	Intersection	0.93	B	13s	97m

Figure 15 NS 1 / Alkimos Drive T-Junction Intersection – Intersection B (Pre-2031 Interim Scenario)

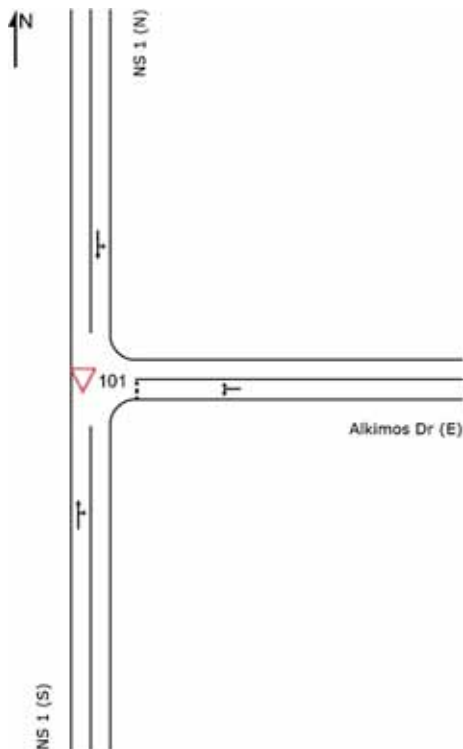


Table 11 NS 1 / Alkimos Drive Intersection (Pre-2031 Interim Scenario)

Location	Arm	DOS	LOS	Avg Delay	95th %ile Q
NS 1 / Alkimos Drive AM	NS 1 (S)	0.18	-	4s	7m
	Alkimos Dr (E)	0.39	A	7s	15m

Location	Arm	DOS	LOS	Avg Delay	95th %ile Q
	NS 1 (N)	0.11	-	2s	0m
	Intersection	0.39	-	5s	15m
NS 1 / Alkimos Drive PM	NS 1 (S)	0.22	-	5s	9m
	Alkimos Dr (E)	0.34	A	7s	11m
	NS 1 (N)	0.15	-	3s	0m
	Intersection	0.34	-	5s	11m

Figure 16 NS 2 / Alkimos Drive T-Junction Intersection – Intersection A (Pre-2031 Interim Scenario)

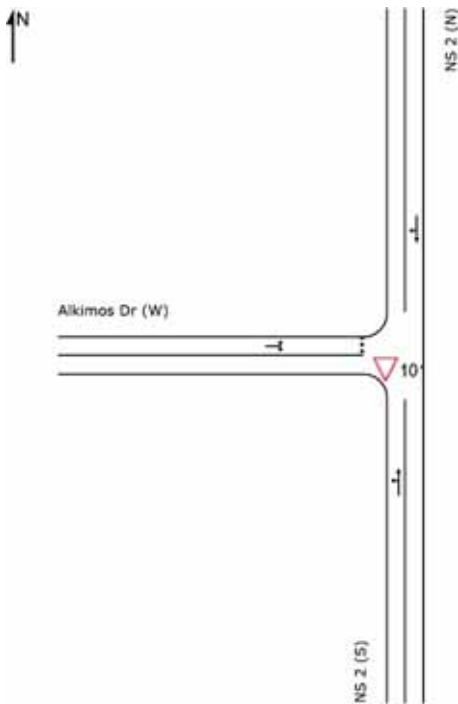


Table 12 NS 2 / Alkimos Drive Intersection Performance (Pre-2031 Interim Scenario)

Location	Arm	DOS	LOS	Avg Delay	95th %ile Q
NS 2 / Alkimos Drive AM	NS 2 (S)	0.16	-	5s	0m
	NS 2 (N)	0.14	-	6s	5m
	Alkimos Dr (W)	0.23	A	7s	7m
	Intersection	0.23	-	6s	7m
NS 2 / Alkimos Drive PM	NS 2 (S)	0.14	-	4s	0m
	NS 2 (N)	0.13	-	5s	5m
	Alkimos Dr (W)	0.34	A	7s	11m
	Intersection	0.34	-	6s	11m

Figure 17 Alkimos Drive / Alkimos Vista T-Junction – Intersection F (Pre-2031 Interim Scenario)

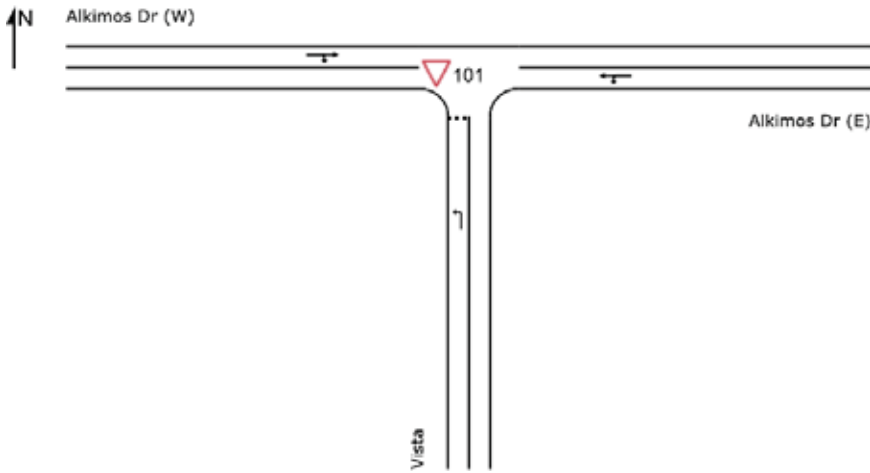


Table 13 Alkimos Drive / Alkimos Vista T-Junction (Pre-2031 Interim Scenario)

Location	Arm	DOS	LOS	Avg Delay	95th %ile Q
Alkimos Dr / Vista Access AM	Vista	0.04	A	7s	1m
	Alkimos Dr (E)	0.21	-	0s	0m
	Alkimos Dr (W)	0.15	-	1s	3m
	Intersection	0.21	-	1s	3m
Alkimos Dr / Vista Access PM	Vista	0.01	A	7s	0m
	Alkimos Dr (E)	0.19	-	0s	0m
	Alkimos Dr (W)	0.22	-	2s	6m
	Intersection	0.22	-	1s	6m

Based on the above, the following key development staging milestones arise:

All lots between Marmion Avenue and the Railway Corridor (Stages 1 - 11, 361 lots and school)

- Picasso Promenade / Marmion Avenue
 - AM Peak – 89.8%, LOS C
 - PM Peak – 74.2%, LOS B
- Acceptable operation in both peaks.**

91% of full development (Stages 1 – 16, 514 lots and school)

- Picasso Promenade / Marmion Avenue
 - AM Peak – 98.6%, LOS D
 - PM Peak – 79.5%, LOS B
- Acceptable Operation in both peaks** given LOS D (average delay <45s/veh) or better per WAPC Guidelines.

100% development of Alkimos Vista approximately 564 lots (anticipated 2027 Ultimate Development)

- Picasso Promenade / Marmion Avenue
- Acceptable Operation in both peaks in 2027 with DOS below 100%

- Just prior to 2031, Picasso Promenade reaches capacity at DOS of 101.8% / 93% with LOS E/C (AM/PM) but Marmion Avenue (both approaches) will be operating well with a DOS of 65% in both peaks.

The above highlights that with Alkimos Vista's Ultimately Developed in 2027, the Picasso Promenade / Marmion Avenue roundabout intersection will be operating acceptably. However, just prior to 2031, the Picasso Promenade approach to Marmion Avenue will begin to reach capacity and an Alkimos Drive signalised intersection at Marmion Avenue (or another access) is expected to be needed at 2031.

Summary and Conclusion

An LSP has been previously prepared for Alkimos Vista (formerly called Central Alkimos) located in the City of Wanneroo. As part of the initial works completed with the LSP preparation, a full "*Traffic and Movement Network*" report was prepared by Bruce Aulabaugh in 2013. A new Amendment ("The Amendment") is necessitated due to Lendlease's recent proposal to remove the secondary bridge located over the rail corridor which joined the North-South corridors NS 1 and NS 2 south of future Alkimos Drive. It is also proposed to realign the primary school site located west of NS 1 and shift the POS east of the railway corridor slightly further east as part of The Amendment. This does not result in any changes to the LSP yields or to the overall road network.

On this basis, GTA has been engaged by Lendlease to prepare an Addendum to the Aulabaugh Report to address the revised LSP and define any impacts to the proposed local road hierarchy and movement network. This Technical Note provides supplementary information on The Amendment, within the context of the broader context of the 2013 Aulabaugh Report.

Based on the findings presented within this addendum, the following conclusions are made:

- Following the removal of the secondary bridge, there has been an increase in the two-way daily volumes estimated along NS 1 northern portion approaching Alkimos Drive and a decrease in the daily flows along NS 2. The daily flows also decrease along Modernism Avenue as a result of the preference of Picasso Promenade which provides a more direct link and roundabout control to/from Marmion Avenue.
- Future traffic volumes on individual road links within the LSP are expected to be accommodated within the proposed road reserves and cross-sections.
- The proposed internal road network layout has been designed in accordance with *Liveable Neighbourhoods* design principles, and revised volumes are shown to still be within what was considered within the Aulabaugh Report.
- CAP Roads along Alkimos Drive fit well into the road reserve and the ultimate road cross section. They are proposed as an essential need for the viability of the mixed-use developments along Alkimos Drive (on both sides) and provides a suitable access solution to the land uses between Marmion Avenue and the Mitchell Freeway without detrimentally impacting the through flow.
- Without the CAP Roads, the amenity of the residential roads within Shorehaven and the Vista are expected to suffer and carry in excess of what they are intended to (above 3,000vpd).
- The default speed limit within built up areas is 50km/hr as per current Neighbourhood Connectors and Access Streets as per *Liveable Neighbourhoods* guidance.
- Internal traffic management treatments have been considered and are expected to be reviewed and agreed upon during the subdivision phase of development.
- Removing the secondary bridge also removes the pedestrian/cycle connectivity over the railway, this resulting in a higher emphasis for attractive pedestrian and cyclist facilities to be provided along the future Alkimos Drive.
- To ensure adequate walk/cycle connections are present, Cossill & Webley's preliminary Alkimos Drive layout proposes a dual carriageway 3.5m wide lanes and 2m wide on-road cycle lanes (both sides) with a 6m median. A shared path in one verge and a dual use path/footpath in the other verge are also proposed to cater for adequate walk/cycle infrastructure provisions for Alkimos Vista.

- Intersection capacity analysis at key intersections along Alkimos Drive demonstrate that these intersections are expected to operate acceptably upon full development of the site post 2031 when the Freeway and Alkimos Drive connections are in place.
- The Interim Scenario modelling highlights that with Alkimos Vista's ultimate development expected by 2027, the Picasso Promenade / Marmion Avenue roundabout intersection will be operating acceptably. However, just prior to 2031, the Picasso Promenade approach to Marmion Avenue will begin to reach capacity and an Alkimos Drive signalised intersection at Marmion Avenue (or another access) is expected to be needed at 2031.

Naturally, should you have any questions or require any further information, please do not hesitate to contact me or Gary Soo in our Perth office on (08) 6169 1000.

Yours sincerely

GTA CONSULTANTS



Tanya Moran

Director

encl. Attachment A; Detailed Outputs from the SIDRA Analysis

Attachment A - Detailed Outputs from the SIDRA Analysis

USER REPORT FOR SITE

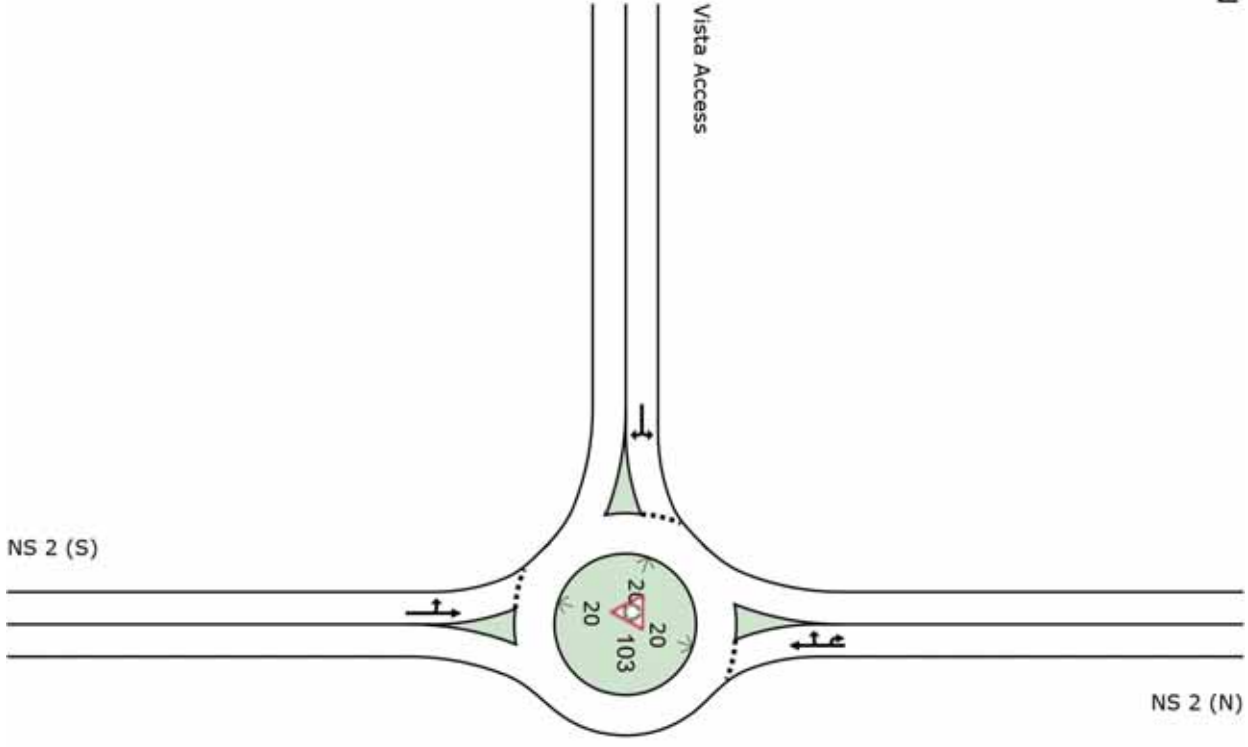
 Project: Alkimos Vista

Template: GTA Appendix Report
(Non Signalised)

 Site: 103 [NS 2/Vista Access (With Dev) - AM Peak - 2031]

Alkimos Vista
Site Category: (None)
Roundabout

Site Layout

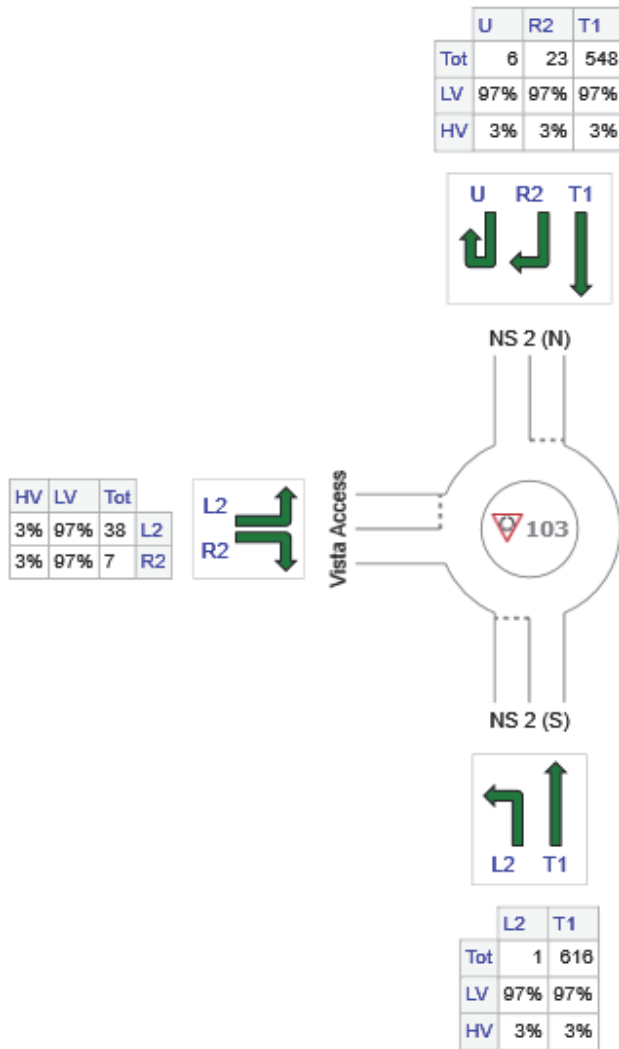


NS 2 (S)

NS 2 (N)

Input Volumes

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: NS 2 (S)	617	598	19
N: NS 2 (N)	577	560	17
W: Vista Access	45	44	1
Total	1239	1202	37

Lane Use and Performance													
	Demand Flows			Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue		Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
	Total veh/h	HV %	Cap. veh/h					Veh	Dist m				
South: NS 2 (S)													
Lane 1 ^d	649	3.0	1562	0.416	100	4.3	LOS A	2.9	22.2	Full	500	0.0	0.0
Approach	649	3.0		0.416		4.3	LOS A	2.9	22.2				
North: NS 2 (N)													
Lane 1 ^d	607	3.0	1675	0.363	100	4.4	LOS A	2.9	22.3	Full	500	0.0	0.0
Approach	607	3.0		0.363		4.4	LOS A	2.9	22.3				
West: Vista Access													
Lane 1 ^d	47	3.0	824	0.057	100	8.3	LOS A	0.3	2.4	Full	500	0.0	0.0
Approach	47	3.0		0.057		8.3	LOS A	0.3	2.4				
Intersection	1304	3.0		0.416		4.5	LOS A	2.9	22.3				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Roundabout LOS Method: SIDRA Roundabout LOS.

Lane LOS values are based on average delay per lane.

Intersection and Approach LOS values are based on average delay for all lanes.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

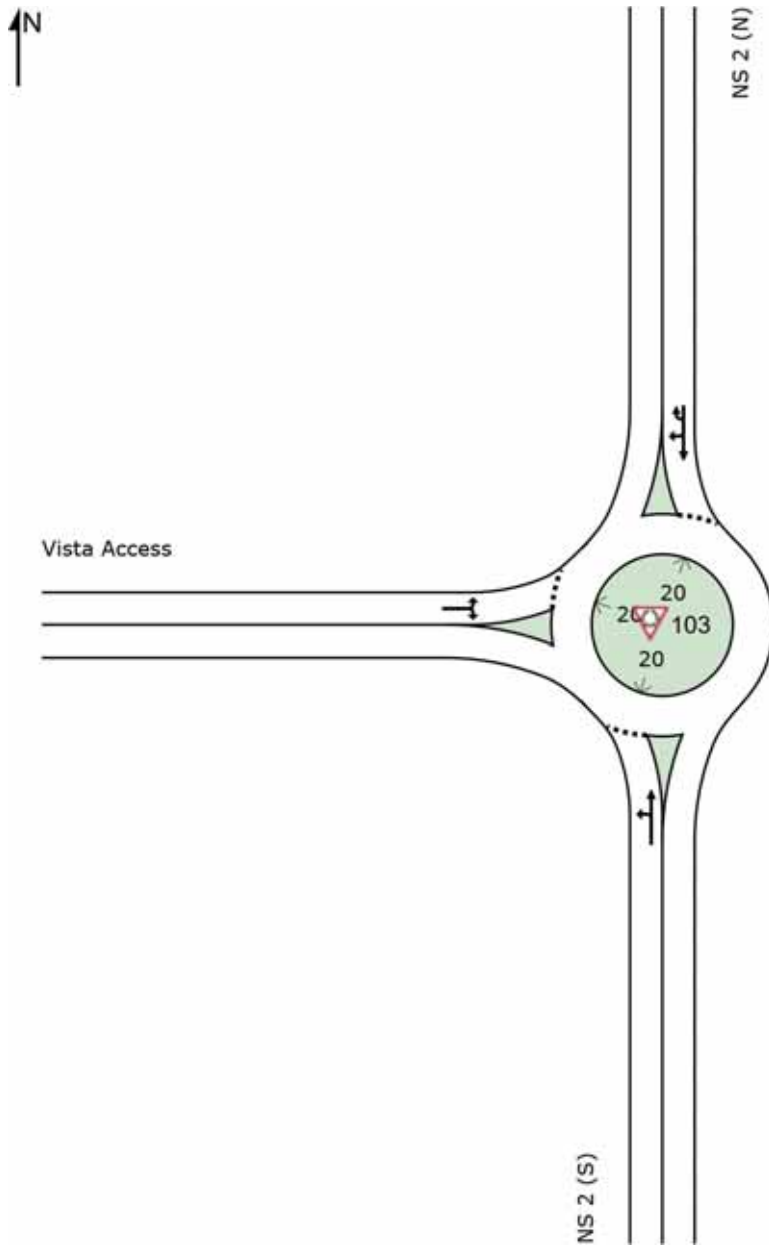
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

^d Dominant lane on roundabout approach

▼ Site: 103 [NS 2/Vista Access (With Dev) - PM Peak - 2031]

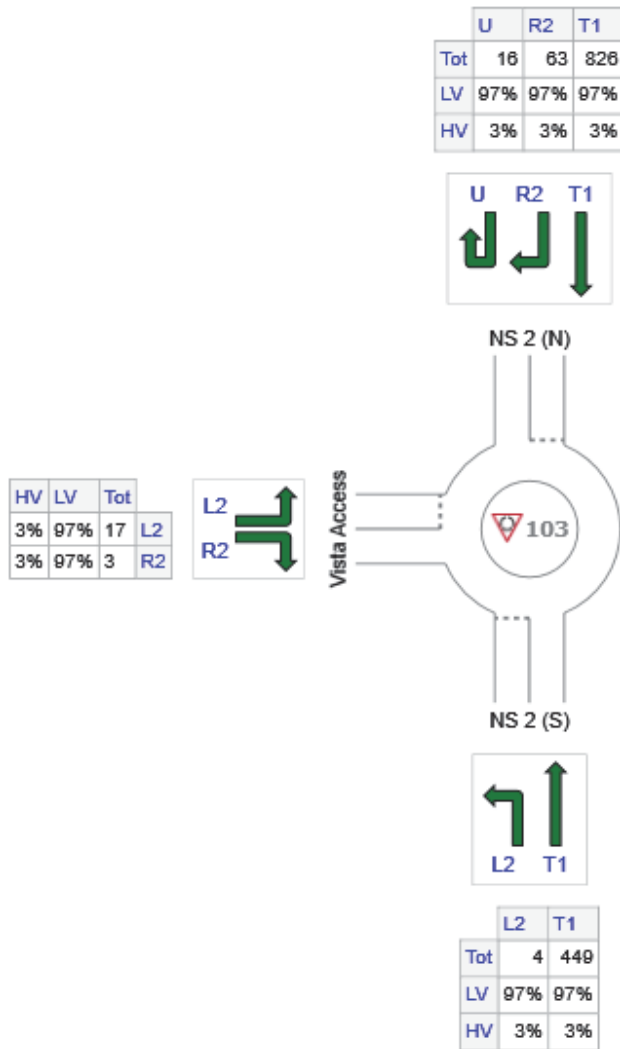
Alkimos Vista
Site Category: (None)
Roundabout

Site Layout



Input Volumes

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: NS 2 (S)	453	439	14
N: NS 2 (N)	905	878	27
W: Vista Access	20	19	1
Total	1378	1337	41

Lane Use and Performance													
	Demand Flows			Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue		Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
	Total veh/h	HV %	Cap. veh/h					Veh	Dist m				
South: NS 2 (S)													
Lane 1 ^d	477	3.0	1394	0.342	100	4.6	LOS A	2.1	16.3	Full	500	0.0	0.0
Approach	477	3.0		0.342		4.6	LOS A	2.1	16.3				
North: NS 2 (N)													
Lane 1 ^d	953	3.0	1714	0.556	100	4.6	LOS A	5.9	44.8	Full	500	0.0	0.0
Approach	953	3.0		0.556		4.6	LOS A	5.9	44.8				
West: Vista Access													
Lane 1 ^d	21	3.0	926	0.023	100	7.0	LOS A	0.1	0.9	Full	500	0.0	0.0
Approach	21	3.0		0.023		7.0	LOS A	0.1	0.9				
Intersection	1451	3.0		0.556		4.6	LOS A	5.9	44.8				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Roundabout LOS Method: SIDRA Roundabout LOS.

Lane LOS values are based on average delay per lane.

Intersection and Approach LOS values are based on average delay for all lanes.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

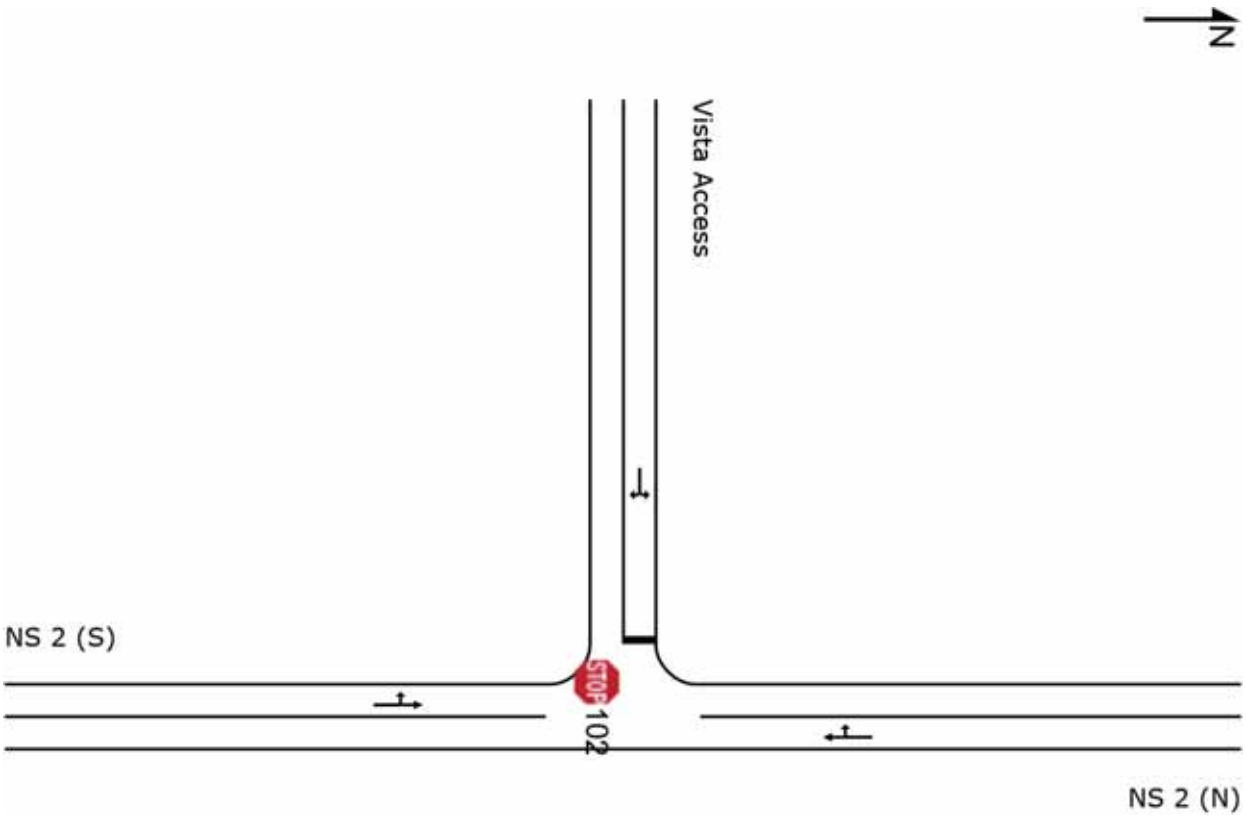
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

^d Dominant lane on roundabout approach

Site: 102 [NS 2/Vista South Access (With Dev) - AM Peak - 2031]

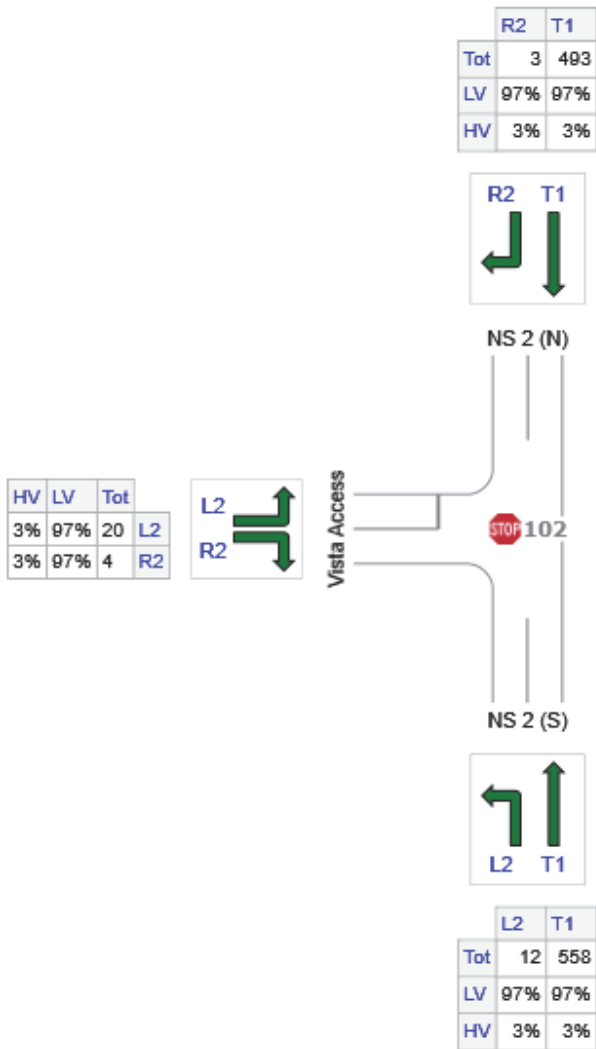
Alkimos Vista
Site Category: (None)
Stop (Two-Way)

Site Layout



Input Volumes

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: NS 2 (S)	570	553	17
N: NS 2 (N)	496	481	15
W: Vista Access	24	23	1
Total	1090	1057	33

Lane Use and Performance													
	Demand Flows			Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue		Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
	Total veh/h	HV %	Cap. veh/h					Veh	Dist m				
South: NS 2 (S)													
Lane 1	600	3.0	1891	0.317	100	0.2	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	600	3.0		0.317		0.2	NA	0.0	0.0				
North: NS 2 (N)													
Lane 1	522	3.0	1880	0.278	100	0.1	LOS A	0.1	0.4	Full	500	0.0	0.0
Approach	522	3.0		0.278		0.1	NA	0.1	0.4				
West: Vista Access													
Lane 1	25	3.0	546	0.046	100	12.9	LOS B	0.2	1.2	Full	500	0.0	0.0
Approach	25	3.0		0.046		12.9	LOS B	0.2	1.2				
Intersection	1147	3.0		0.317		0.4	NA	0.2	1.2				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

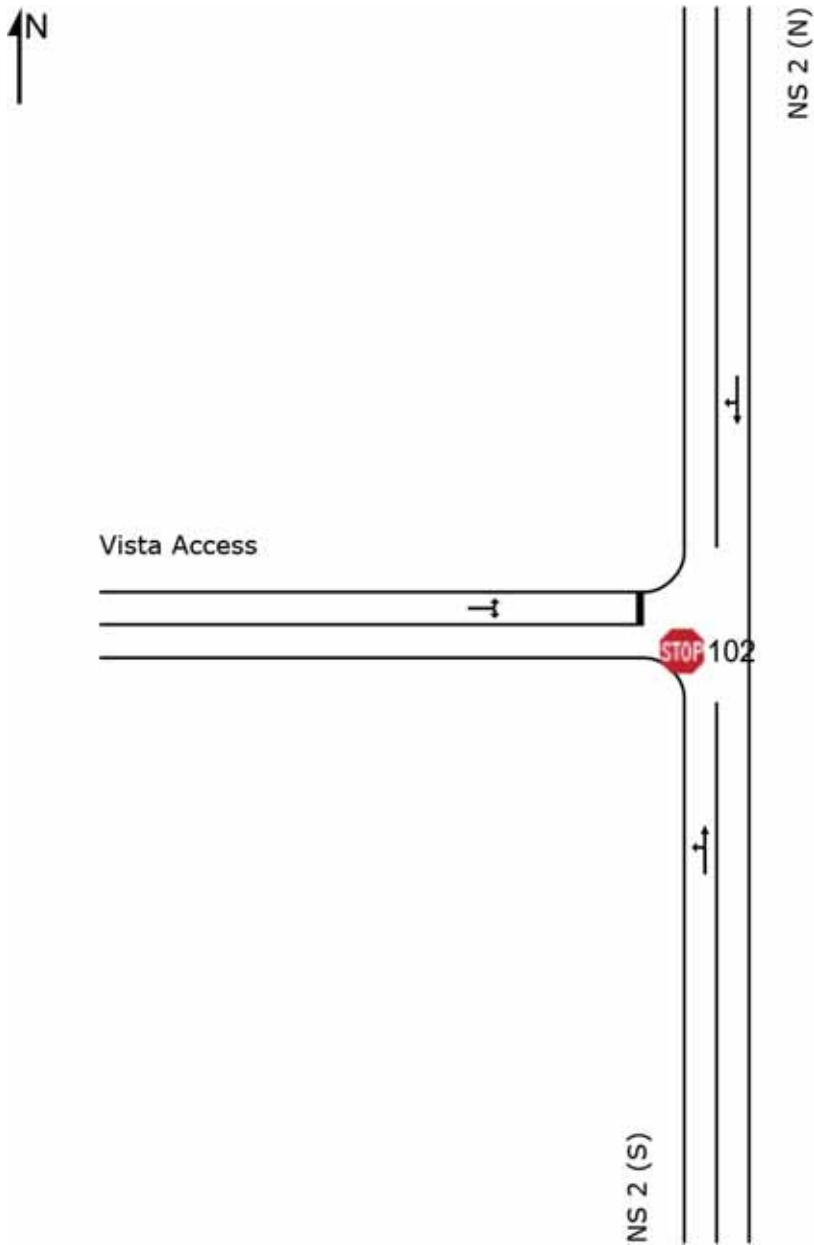
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

 Site: 102 [NS 2/Vista South Access (With Dev) - PM Peak - 2031]

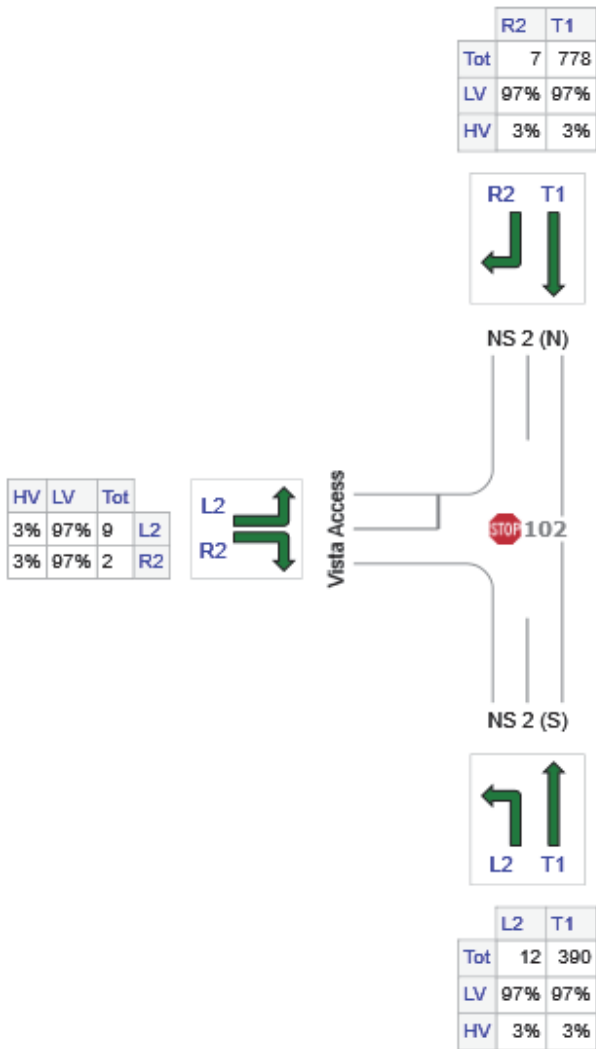
Alkimos Vista
Site Category: (None)
Stop (Two-Way)

Site Layout



Input Volumes

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: NS 2 (S)	402	390	12
N: NS 2 (N)	785	761	24
W: Vista Access	11	11	0
Total	1198	1162	36

Lane Use and Performance													
	Demand Flows			Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue		Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
	Total veh/h	HV %	Cap. veh/h					Veh	Dist m				
South: NS 2 (S)													
Lane 1	423	3.0	1890	0.224	100	0.2	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	423	3.0		0.224		0.2	NA	0.0	0.0				
North: NS 2 (N)													
Lane 1	826	3.0	1882	0.439	100	0.1	LOS A	0.1	1.1	Full	500	0.0	0.0
Approach	826	3.0		0.439		0.1	NA	0.1	1.1				
West: Vista Access													
Lane 1	12	3.0	528	0.022	100	12.8	LOS B	0.1	0.5	Full	500	0.0	0.0
Approach	12	3.0		0.022		12.8	LOS B	0.1	0.5				
Intersection	1261	3.0		0.439		0.3	NA	0.1	1.1				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

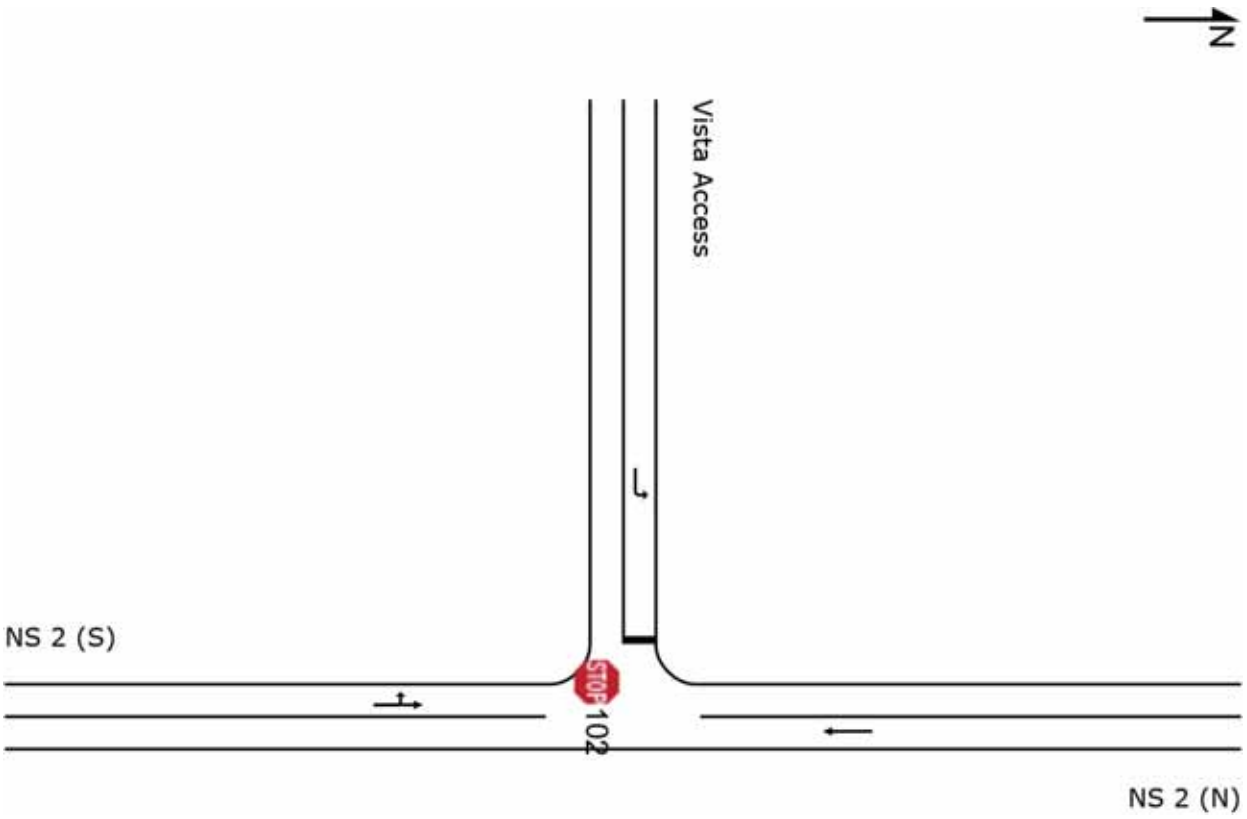
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Site: 102 [Int G @ NS 2 (With Dev) - AM Peak - 2031]

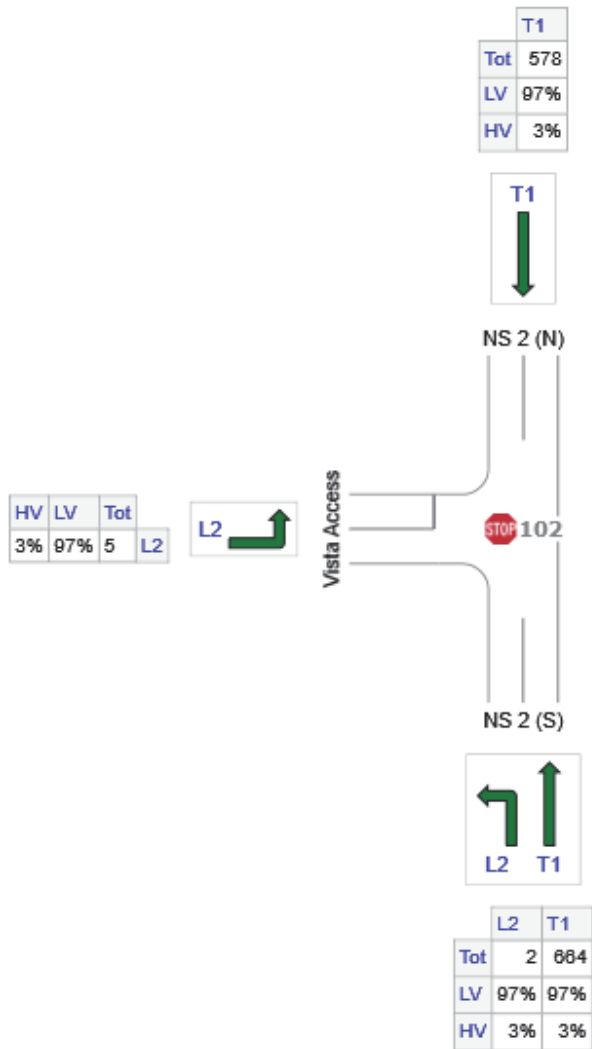
Alkimos Vista
Site Category: (None)
Stop (Two-Way)

Site Layout



Input Volumes

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: NS 2 (S)	666	646	20
N: NS 2 (N)	578	561	17
W: Vista Access	5	5	0
Total	1249	1212	37

Lane Use and Performance													
	Demand Flows			Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue		Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
	Total veh/h	HV %	Cap. veh/h					Veh	Dist m				
South: NS 2 (S)													
Lane 1	701	3.0	1893	0.370	100	0.1	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	701	3.0		0.370		0.1	NA	0.0	0.0				
North: NS 2 (N)													
Lane 1	608	3.0	1893	0.321	100	0.0	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	608	3.0		0.321		0.0	NA	0.0	0.0				
West: Vista Access													
Lane 1	5	3.0	577	0.009	100	12.7	LOS B	0.0	0.2	Full	500	0.0	0.0
Approach	5	3.0		0.009		12.7	LOS B	0.0	0.2				
Intersection	1315	3.0		0.370		0.1	NA	0.0	0.2				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

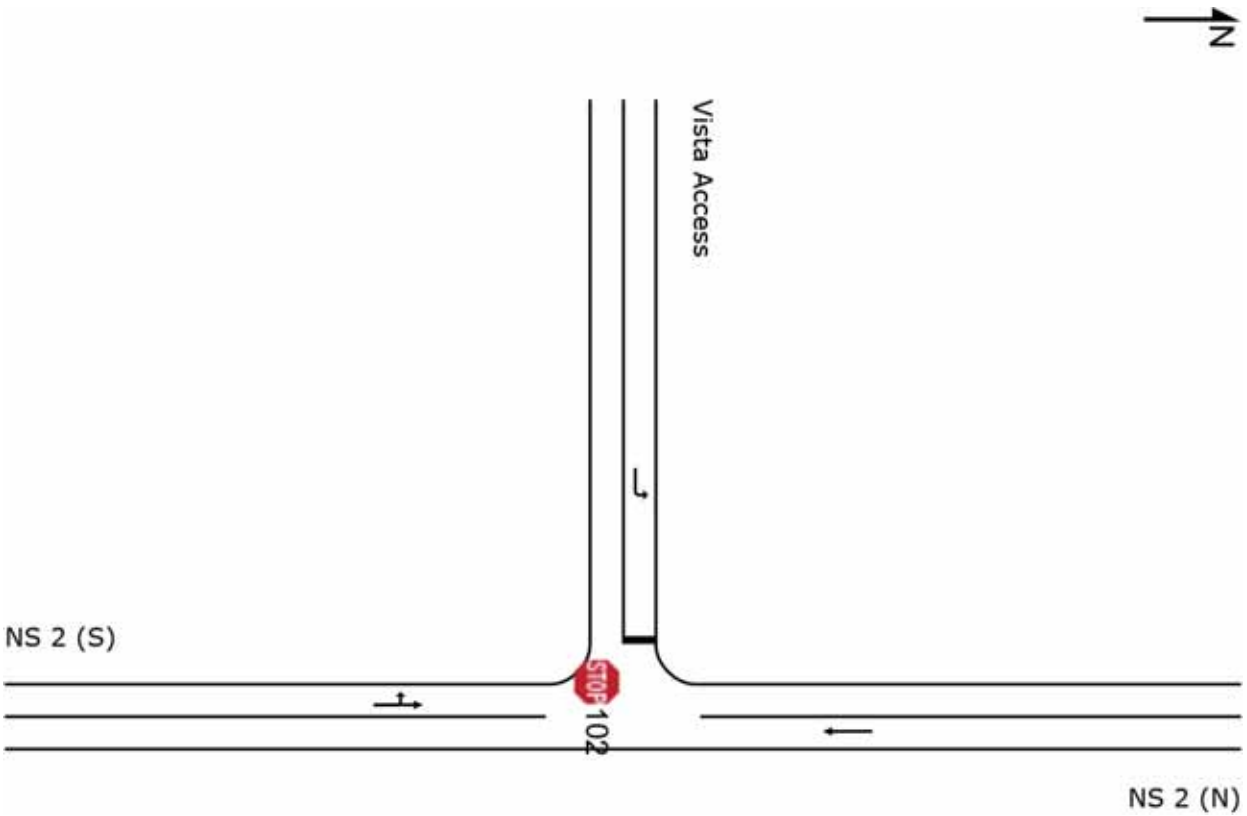
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Site: 102 [Int G @ NS 2 (With Dev) - PM Peak - 2031]

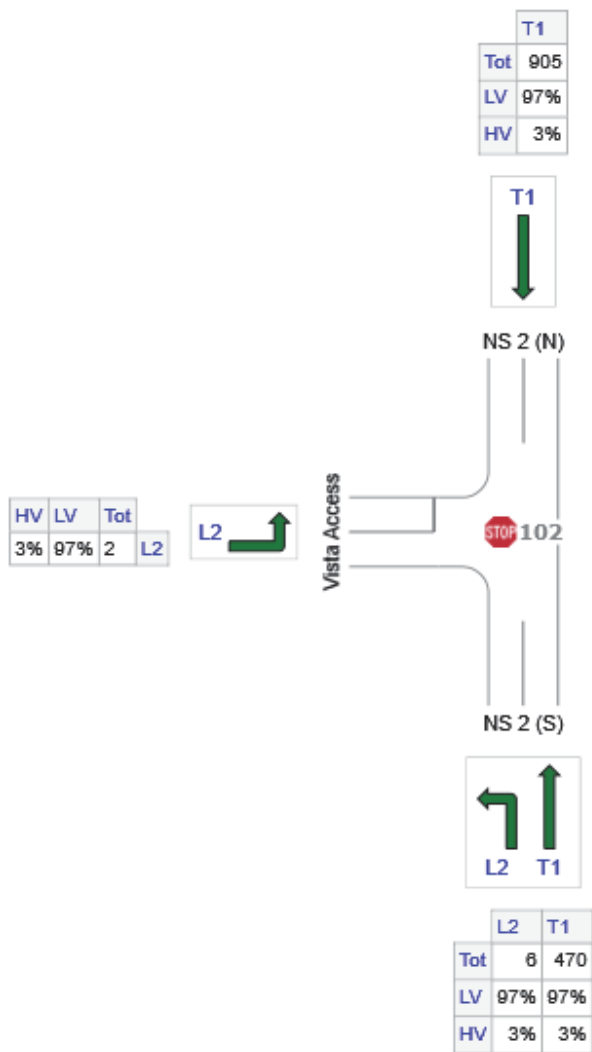
Alkimos Vista
Site Category: (None)
Stop (Two-Way)

Site Layout



Input Volumes

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: NS 2 (S)	476	462	14
N: NS 2 (N)	905	878	27
W: Vista Access	2	2	0
Total	1383	1342	41

Lane Use and Performance													
	Demand Flows			Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue		Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
	Total veh/h	HV %	Cap. veh/h					Veh	Dist m				
South: NS 2 (S)													
Lane 1	501	3.0	1892	0.265	100	0.1	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	501	3.0		0.265		0.1	NA	0.0	0.0				
North: NS 2 (N)													
Lane 1	953	3.0	1893	0.503	100	0.1	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	953	3.0		0.503		0.1	NA	0.0	0.0				
West: Vista Access													
Lane 1	2	3.0	801	0.003	100	10.6	LOS B	0.0	0.1	Full	500	0.0	0.0
Approach	2	3.0		0.003		10.6	LOS B	0.0	0.1				
Intersection	1456	3.0		0.503		0.1	NA	0.0	0.1				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

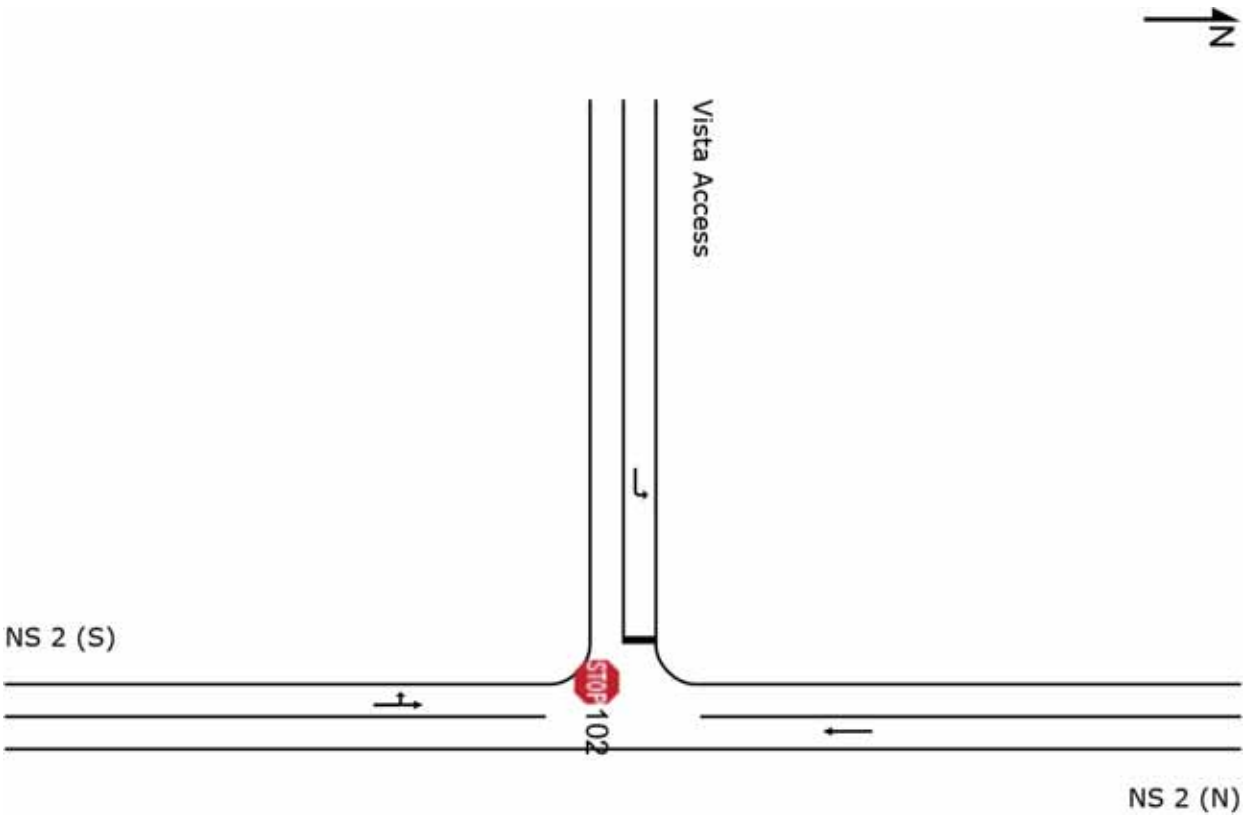
Site: 102 [Int H @ NS 2 (With Dev) - AM Peak - 2031]

Alkimos Vista

Site Category: (None)

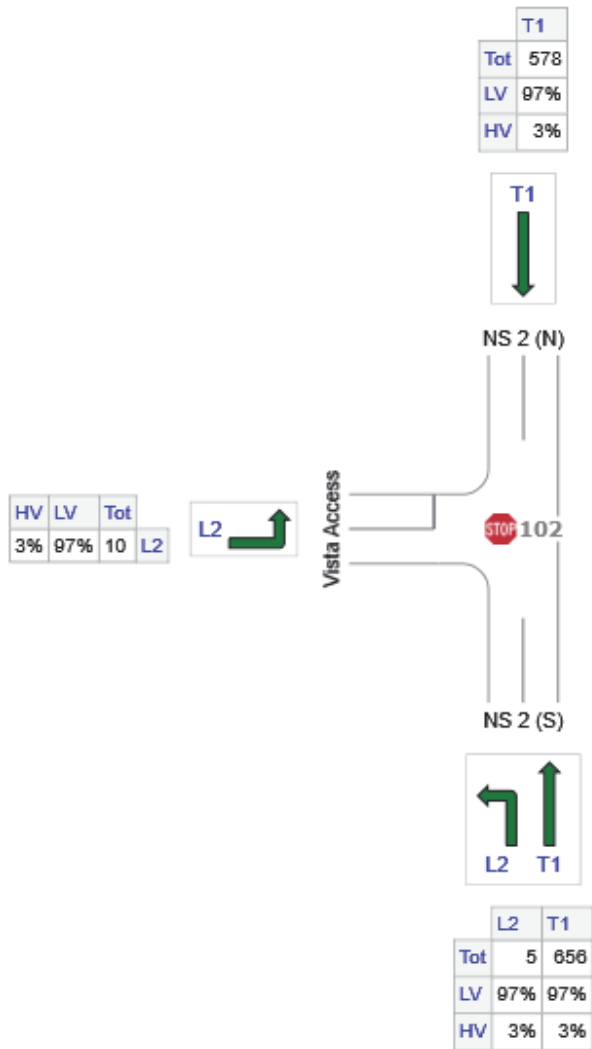
Stop (Two-Way)

Site Layout



Input Volumes

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: NS 2 (S)	661	641	20
N: NS 2 (N)	578	561	17
W: Vista Access	10	10	0
Total	1249	1212	37

Lane Use and Performance													
	Demand Flows			Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue		Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
	Total veh/h	HV %	Cap. veh/h					Veh	Dist m				
South: NS 2 (S)													
Lane 1	696	3.0	1892	0.368	100	0.1	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	696	3.0		0.368		0.1	NA	0.0	0.0				
North: NS 2 (N)													
Lane 1	608	3.0	1893	0.321	100	0.0	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	608	3.0		0.321		0.0	NA	0.0	0.0				
West: Vista Access													
Lane 1	11	3.0	585	0.018	100	12.6	LOS B	0.1	0.5	Full	500	0.0	0.0
Approach	11	3.0		0.018		12.6	LOS B	0.1	0.5				
Intersection	1315	3.0		0.368		0.2	NA	0.1	0.5				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

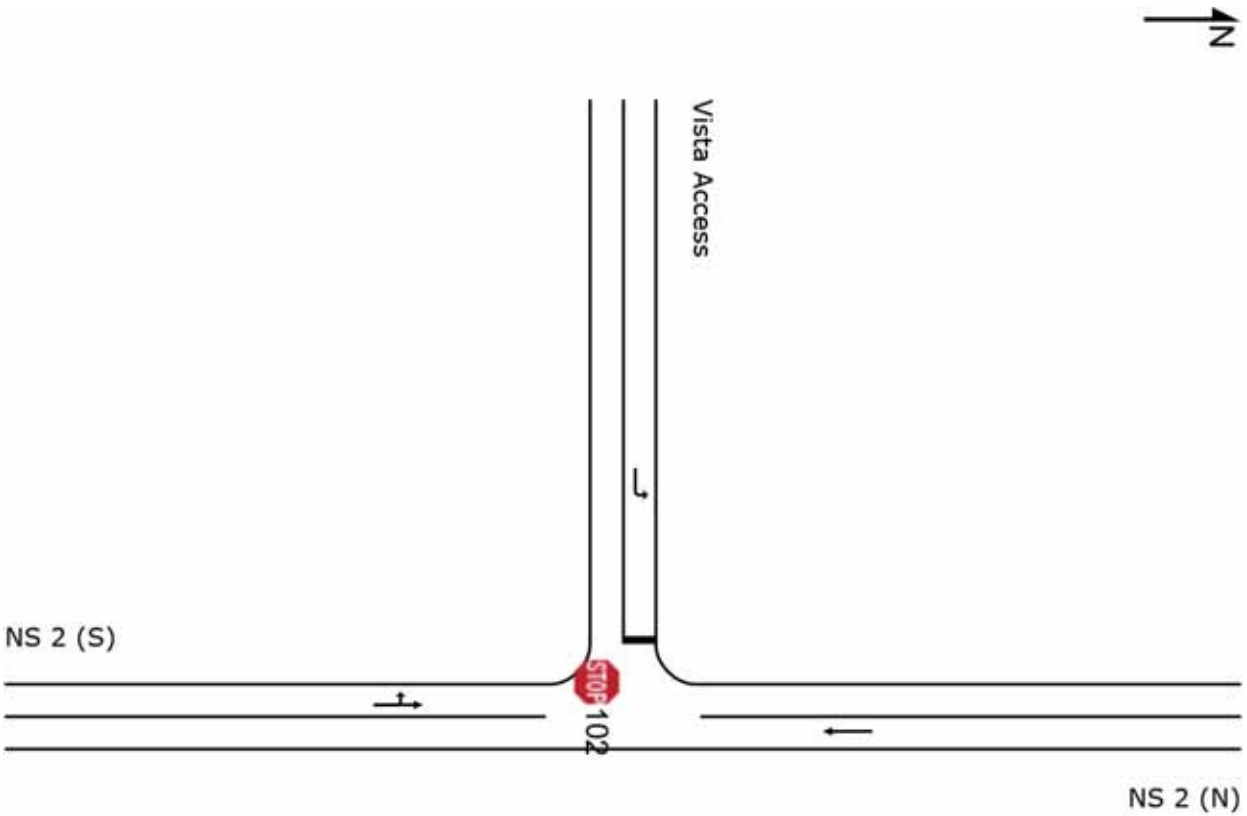
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Site: 102 [Int H @ NS 2 (With Dev) - PM Peak - 2031]

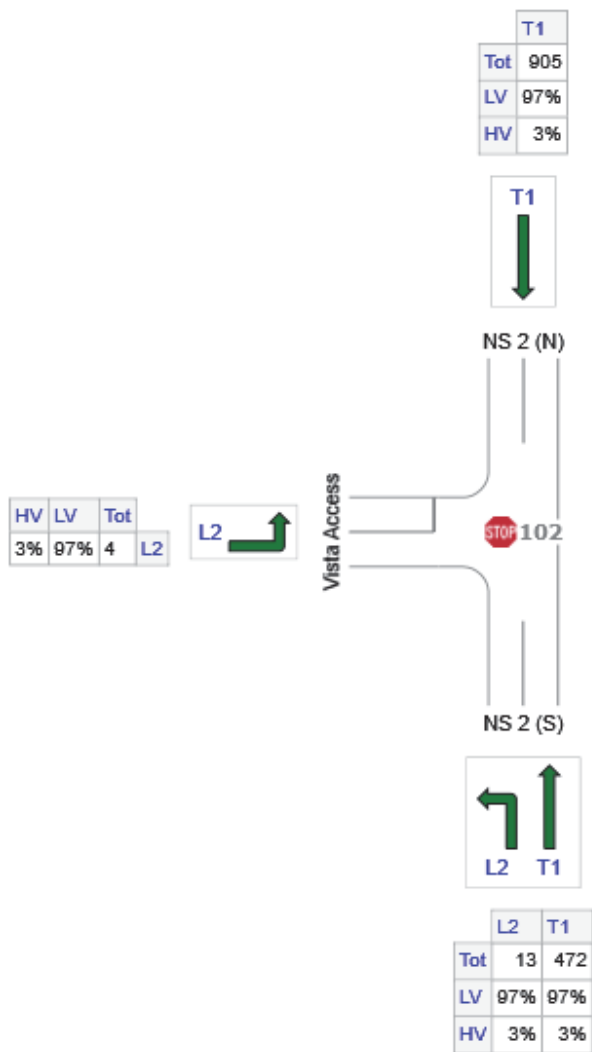
Alkimos Vista
Site Category: (None)
Stop (Two-Way)

Site Layout



Input Volumes

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: NS 2 (S)	485	470	15
N: NS 2 (N)	905	878	27
W: Vista Access	4	4	0
Total	1394	1352	42

Lane Use and Performance													
	Demand Flows			Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue		Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
	Total veh/h	HV %	Cap. veh/h					Veh	Dist m				
South: NS 2 (S)													
Lane 1	511	3.0	1891	0.270	100	0.2	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	511	3.0		0.270		0.2	NA	0.0	0.0				
North: NS 2 (N)													
Lane 1	953	3.0	1893	0.503	100	0.1	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	953	3.0		0.503		0.1	NA	0.0	0.0				
West: Vista Access													
Lane 1	4	3.0	798	0.005	100	10.7	LOS B	0.0	0.1	Full	500	0.0	0.0
Approach	4	3.0		0.005		10.7	LOS B	0.0	0.1				
Intersection	1467	3.0		0.503		0.1	NA	0.0	0.1				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

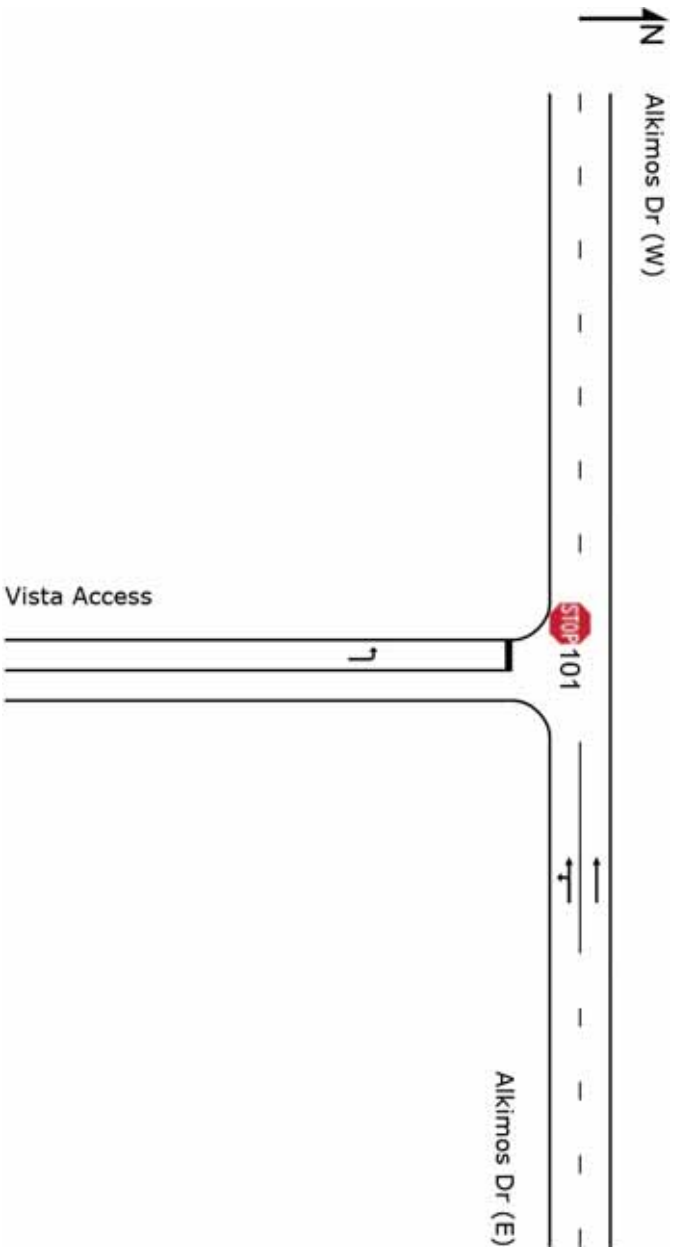
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Site: 101 [Alkimos Dr/LILO Access (With Dev) - AM Peak - 2031]

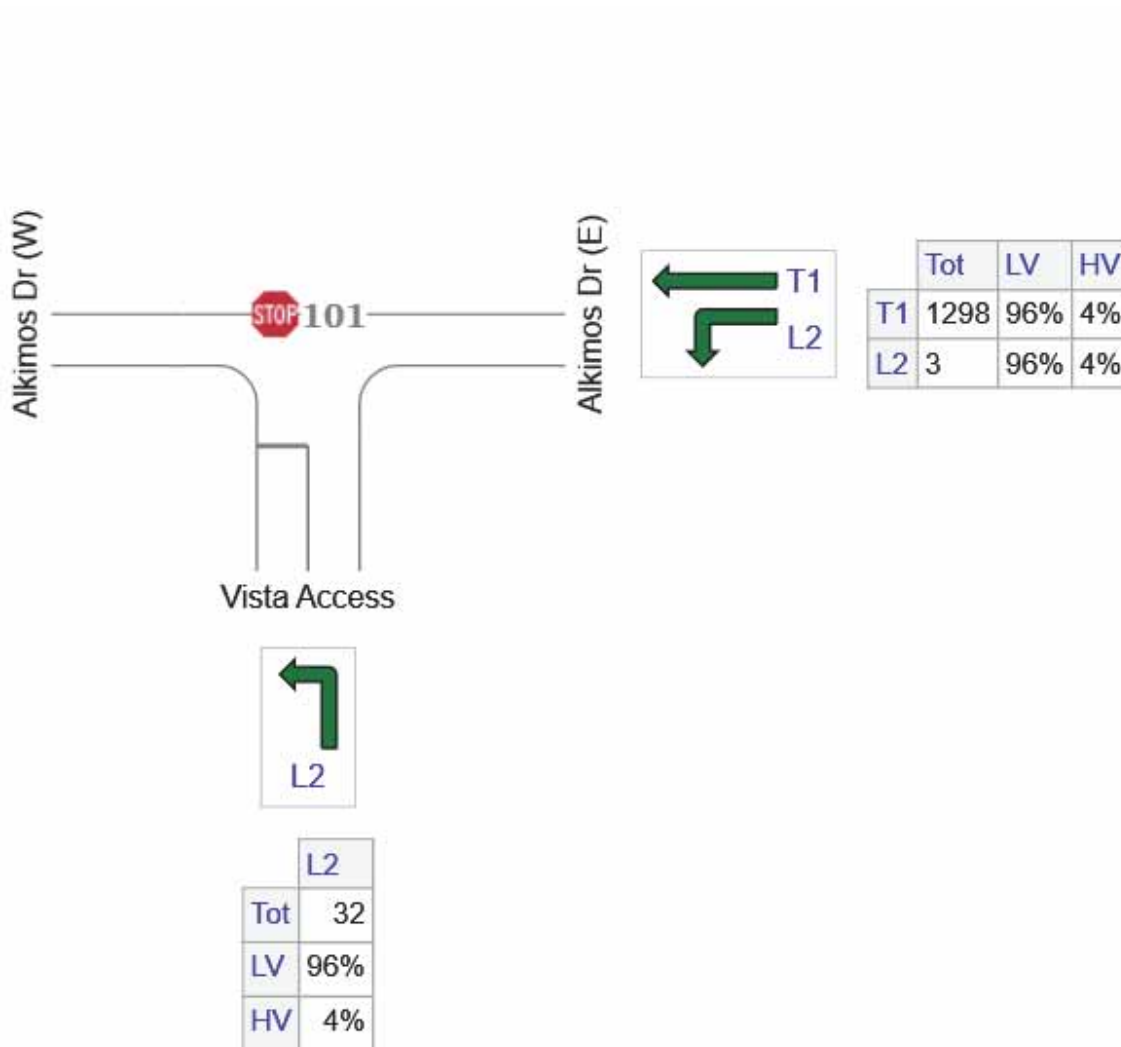
Alkimos Vista
Site Category: (None)
Stop (Two-Way)

Site Layout



Input Volumes

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Vista Access	32	31	1
E: Alkimos Dr (E)	1301	1249	52
Total	1333	1280	53

Lane Use and Performance													
	Demand Flows			Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue		Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
	Total veh/h	HV %	Cap. veh/h					Veh	Dist m				
South: Vista Access													
Lane 1	34	4.0	599	0.056	100	12.8	LOS B	0.2	1.5	Full	500	0.0	0.0
Approach	34	4.0		0.056		12.8	LOS B	0.2	1.5				
East: Alkimos Dr (E)													
Lane 1	685	4.0	1875	0.365	100	0.1	LOS A	0.0	0.0	Full	500	0.0	0.0
Lane 2	685	4.0	1875	0.365	100	0.0	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	1369	4.0		0.365		0.1	NA	0.0	0.0				
Intersection	1403	4.0		0.365		0.4	NA	0.2	1.5				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

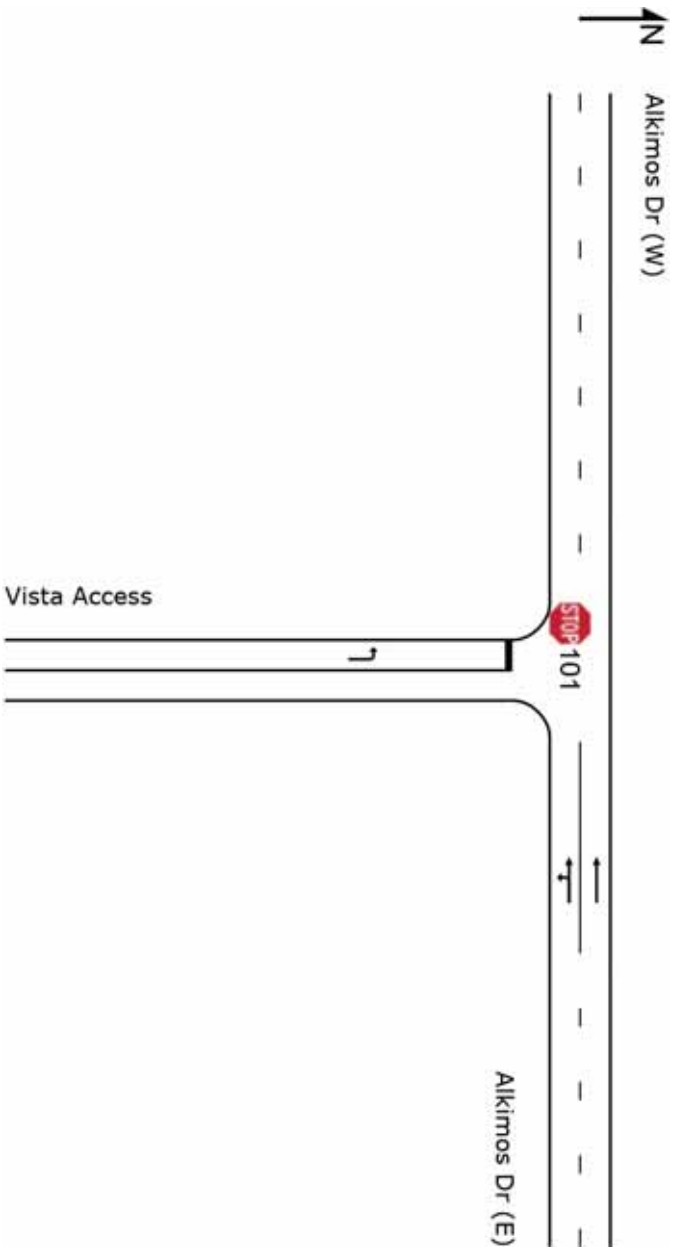
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Site: 101 [Alkimos Dr/LILO Access (With Dev) - PM Peak - 2031]

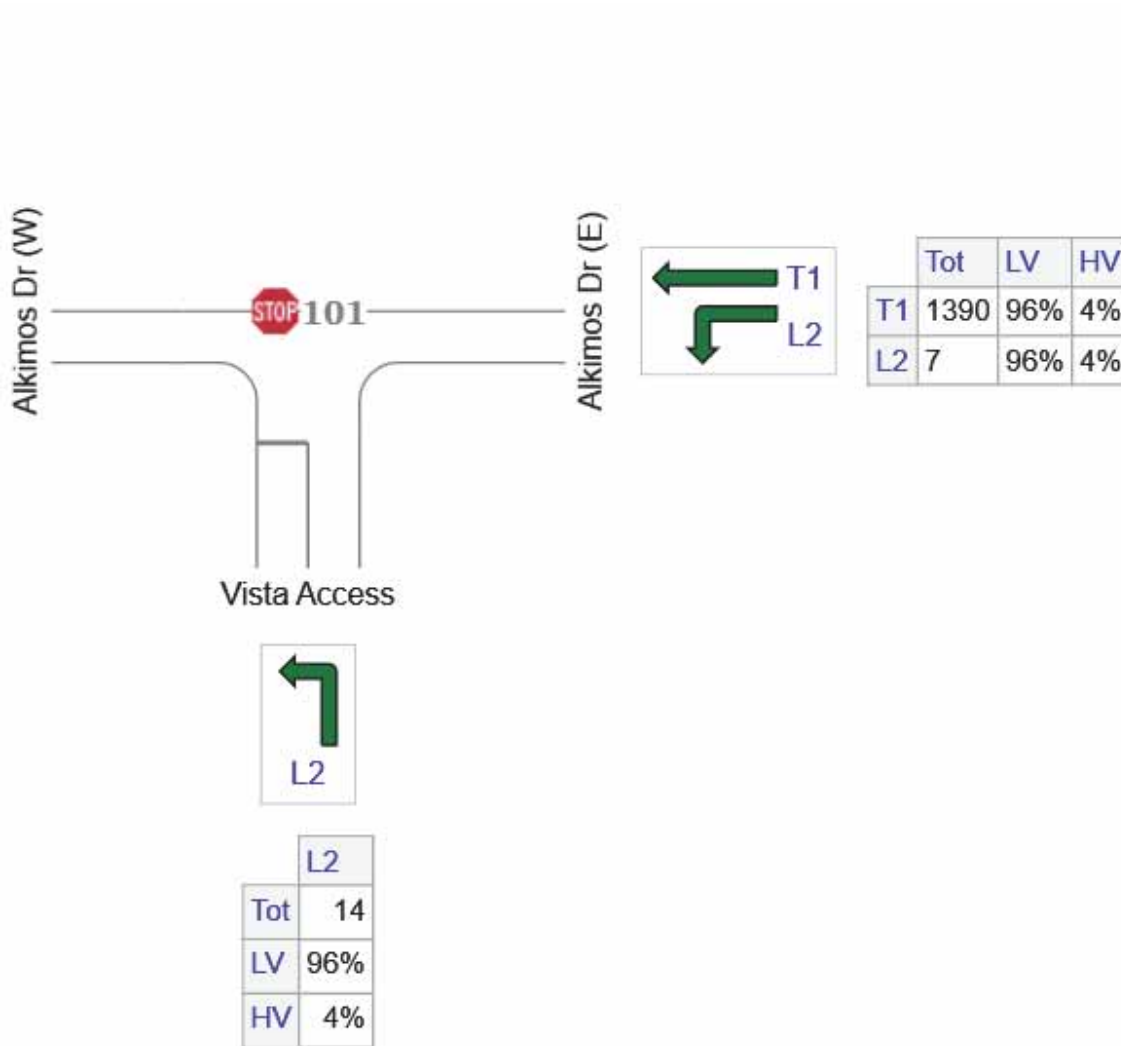
Alkimos Vista
Site Category: (None)
Stop (Two-Way)

Site Layout



Input Volumes

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Vista Access	14	13	1
E: Alkimos Dr (E)	1397	1341	56
Total	1411	1355	56

Lane Use and Performance													
	Demand Flows			Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue		Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
	Total veh/h	HV %	Cap. veh/h					Veh	Dist m				
South: Vista Access													
Lane 1	15	4.0	553	0.027	100	13.2	LOS B	0.1	0.7	Full	500	0.0	0.0
Approach	15	4.0		0.027		13.2	LOS B	0.1	0.7				
East: Alkimos Dr (E)													
Lane 1	735	4.0	1874	0.392	100	0.1	LOS A	0.0	0.0	Full	500	0.0	0.0
Lane 2	735	4.0	1875	0.392	100	0.1	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	1471	4.0		0.392		0.1	NA	0.0	0.0				
Intersection	1485	4.0		0.392		0.2	NA	0.1	0.7				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

USER REPORT FOR SITE

 Project: Alkimos Vista - Interim -Reduced

Template: GTA Appendix Report
(Non Signalised)

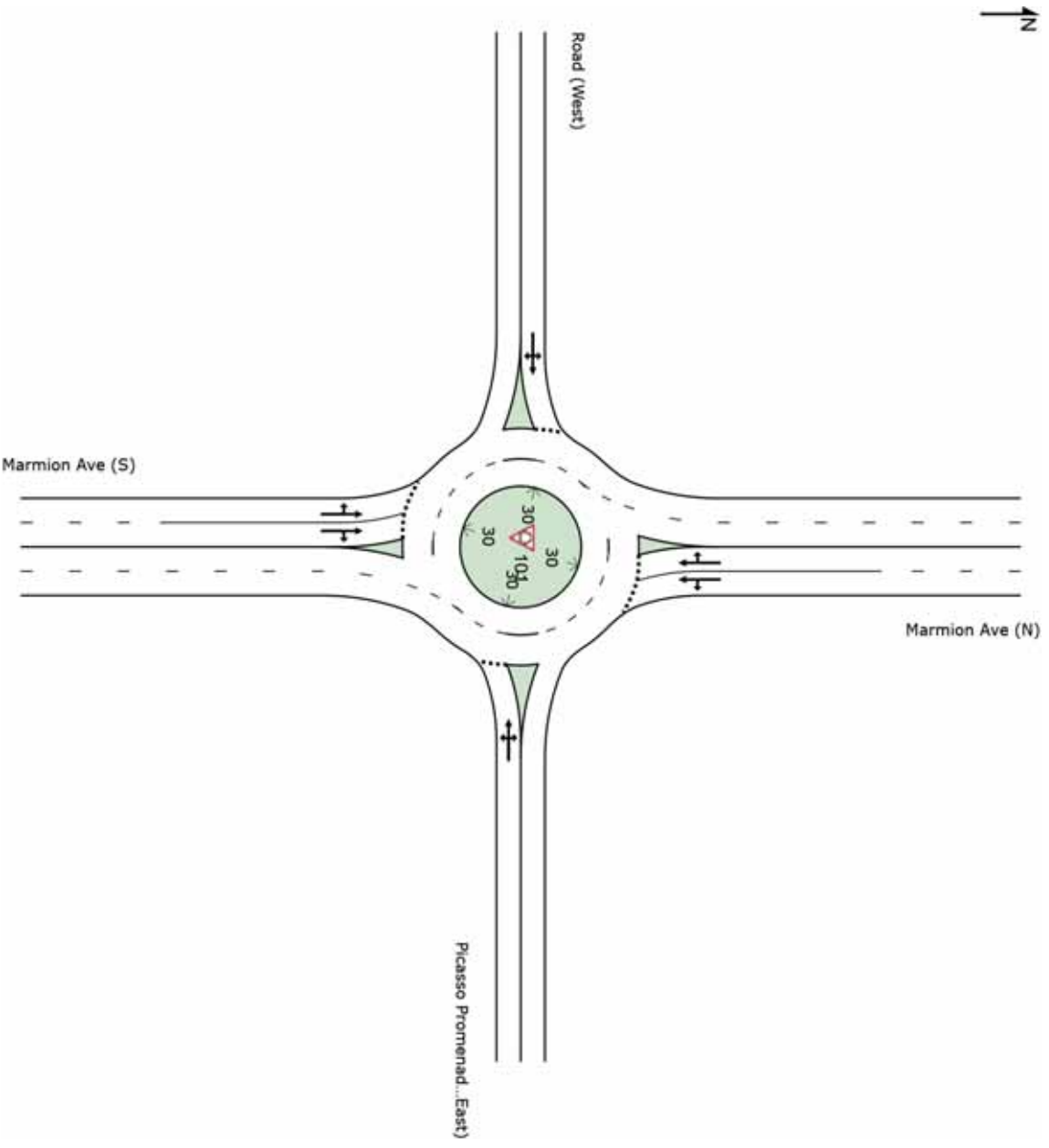
 Site: 101 [2031 AM - Marmion Avenue / Picasso Promenade - Full Development]

New Site

Site Category: (None)

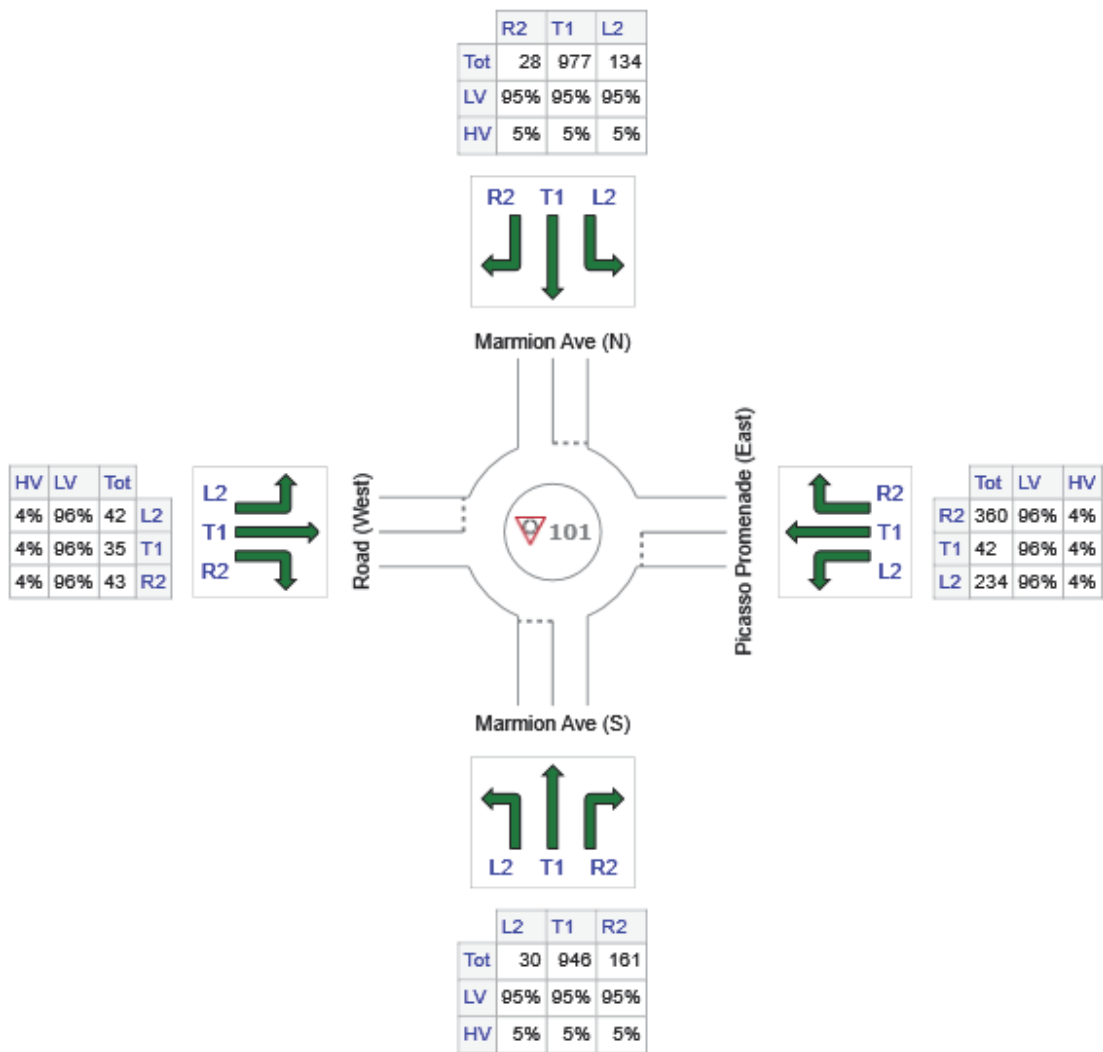
Roundabout

Site Layout:



Input Volumes

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Marmion Ave (S)	1137	1080	57
E: Picasso Promenade (East)	636	611	25
N: Marmion Ave (N)	1139	1082	57
W: Road (West)	120	115	5
Total	3032	2888	144

Lane Use and Performance													
	Demand Flows			Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue		Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
	Total veh/h	HV %	Cap. veh/h					Veh	Dist m				
South: Marmion Ave (S)													
Lane 1 ^d	638	5.0	1025	0.623	100	9.6	LOS A	6.1	47.2	Full	500	0.0	0.0
Lane 2	558	5.0	897	0.623	100	12.1	LOS B	5.9	45.4	Full	500	0.0	0.0
Approach	1197	5.0		0.623		10.8	LOS B	6.1	47.2				
East: Picasso Promenade (East)													
Lane 1 ^d	669	4.0	657	1.018	100	58.4	LOS E	28.6	219.3	Full	500	0.0	0.0
Approach	669	4.0		1.018		58.4	LOS E	28.6	219.3				
North: Marmion Ave (N)													
Lane 1 ^d	634	5.0	1268	0.500	100	7.2	LOS A	3.6	27.6	Full	500	0.0	0.0
Lane 2	565	5.0	1129	0.500	100	7.8	LOS A	3.5	26.8	Full	500	0.0	0.0
Approach	1199	5.0		0.500		7.5	LOS A	3.6	27.6				
West: Road (West)													
Lane 1 ^d	126	4.0	468	0.270	100	11.2	LOS B	1.4	10.3	Full	500	0.0	0.0
Approach	126	4.0		0.270		11.2	LOS B	1.4	10.3				
Intersection	3192	4.8		1.018		19.6	LOS B	28.6	219.3				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Roundabout LOS Method: SIDRA Roundabout LOS.

Lane LOS values are based on average delay per lane.

Intersection and Approach LOS values are based on average delay for all lanes.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

^d Dominant lane on roundabout approach

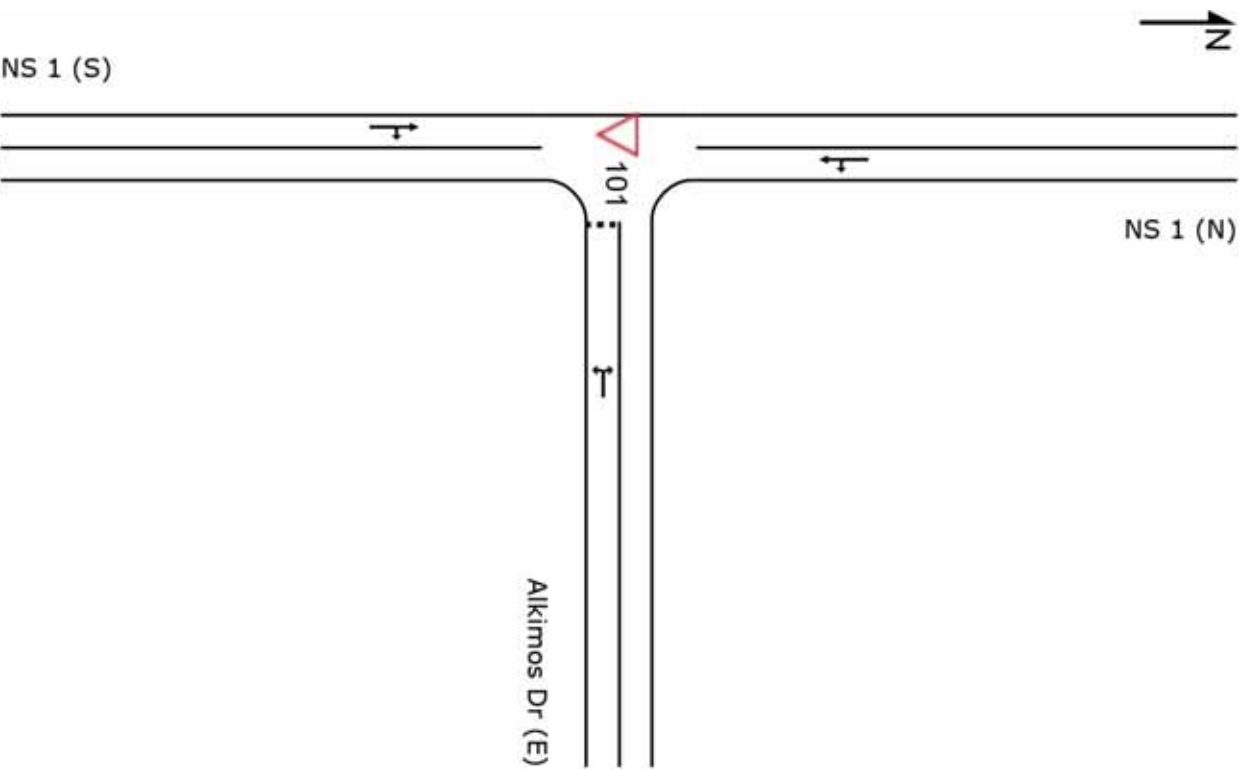
▼ Site: 101 [2031 AM - NS 1 / Alkimos Drive]

New Site

Site Category: (None)

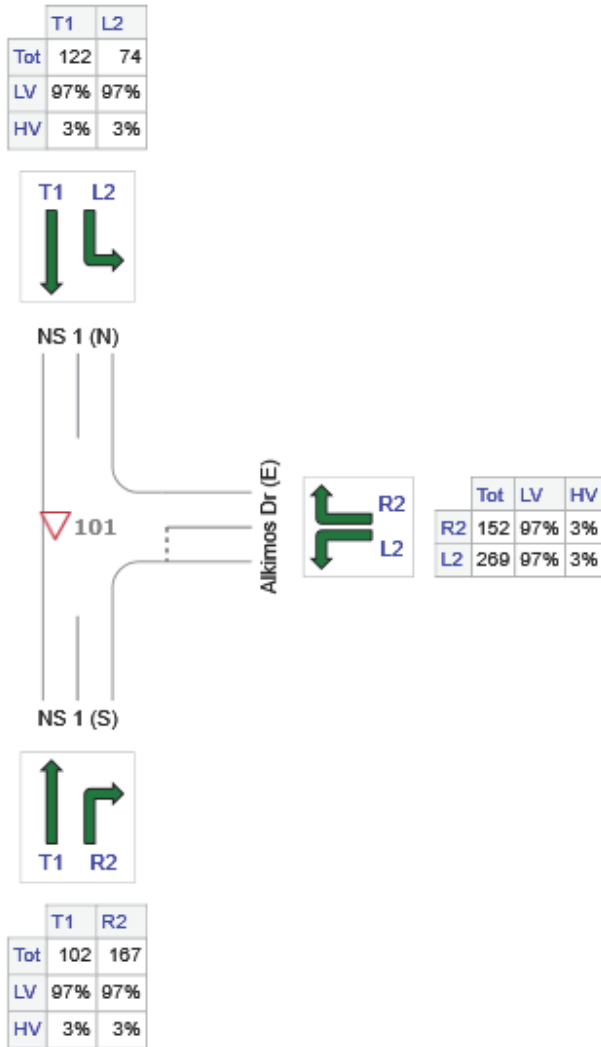
Giveaway / Yield (Two-Way)

Site Layout



Input Volumes

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: NS 1 (S)	269	261	8
E: Alkimos Dr (E)	421	408	13
N: NS 1 (N)	196	190	6
Total	886	859	27

Lane Use and Performance													
	Demand Flows		Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue		Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
	Total veh/h	HV %						Veh	Dist m				
South: NS 1 (S)													
Lane 1	283	3.0	1585	0.179	100	4.2	LOS A	0.9	6.9	Full	500	0.0	0.0
Approach	283	3.0		0.179		4.2	NA	0.9	6.9				
East: Alkimos Dr (E)													
Lane 1	443	3.0	1134	0.391	100	7.1	LOS A	2.0	15.1	Full	500	0.0	0.0
Approach	443	3.0		0.391		7.1	LOS A	2.0	15.1				
North: NS 1 (N)													
Lane 1	206	3.0	1857	0.111	100	2.1	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	206	3.0		0.111		2.1	NA	0.0	0.0				
Intersection	933	3.0		0.391		5.1	NA	2.0	15.1				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

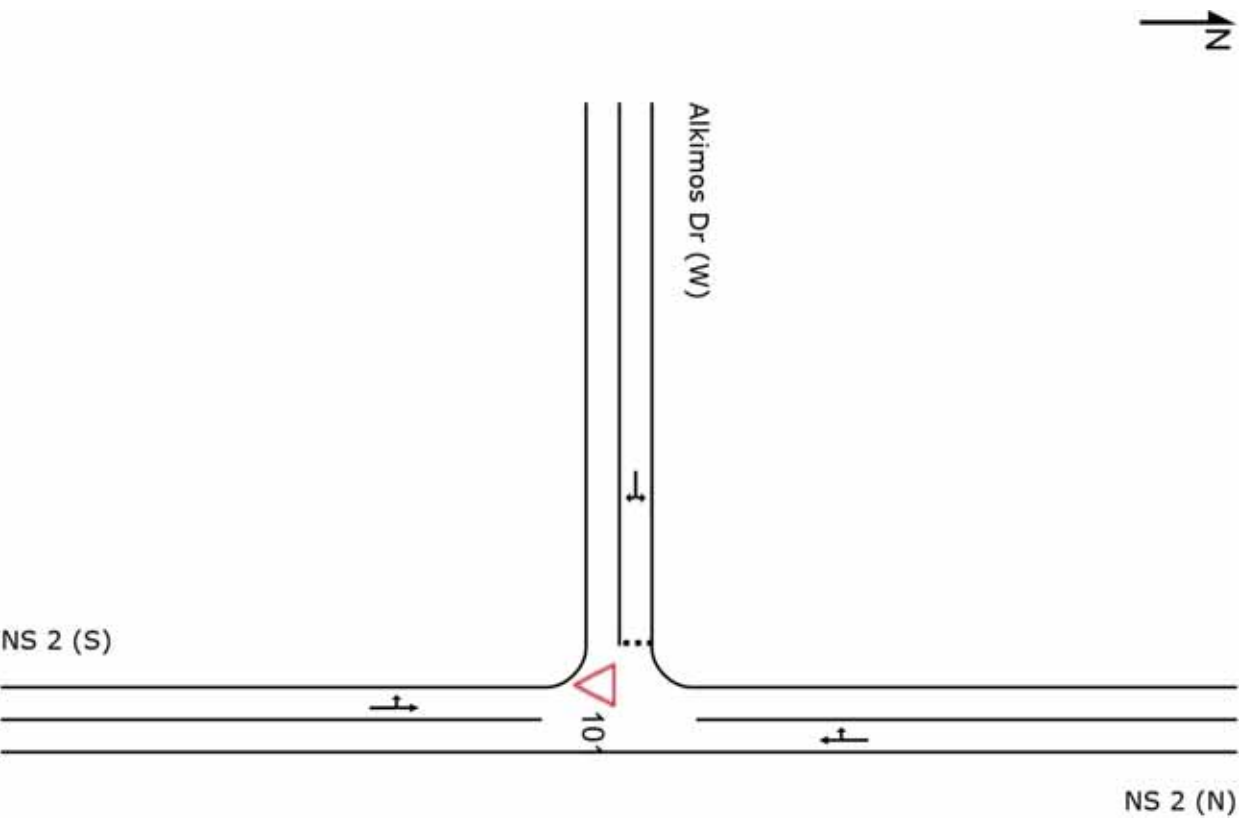
▽ Site: 101 [2031 AM - NS 2 / Alkimos Drive]

New Site

Site Category: (None)

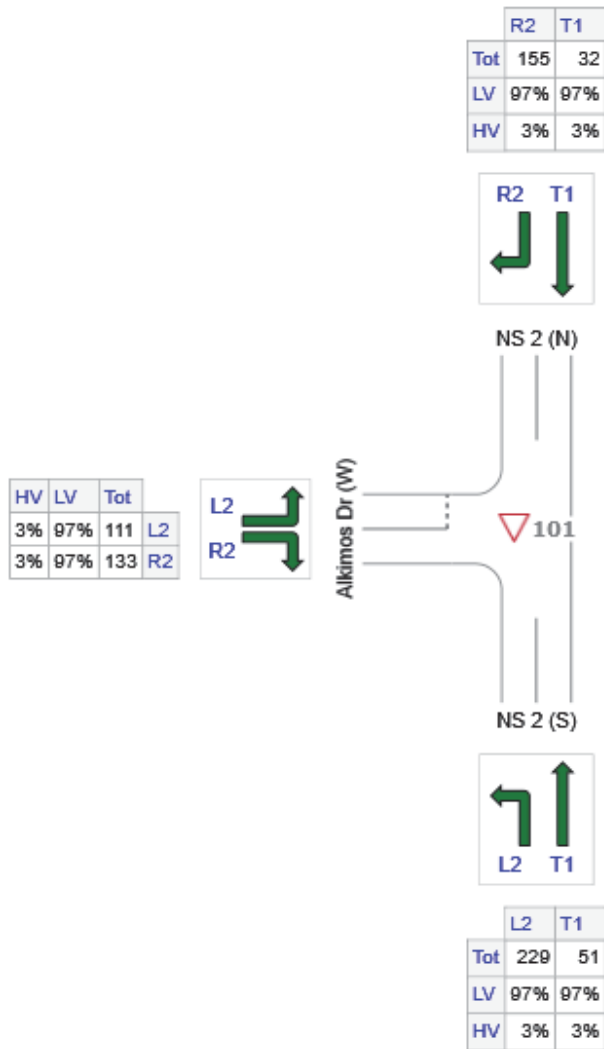
Giveaway / Yield (Two-Way)

Site Layout



Input Volumes

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: NS 2 (S)	280	272	8
N: NS 2 (N)	187	181	6
W: Alkimos Dr (W)	244	237	7
Total	711	690	21

Lane Use and Performance													
	Demand Flows			Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue		Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
	Total veh/h	HV %	Cap. veh/h					Veh	Dist m				
South: NS 2 (S)													
Lane 1	295	3.0	1816	0.162	100	4.6	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	295	3.0		0.162		4.6	NA	0.0	0.0				
North: NS 2 (N)													
Lane 1	197	3.0	1398	0.141	100	5.7	LOS A	0.7	5.2	Full	500	0.0	0.0
Approach	197	3.0		0.141		5.7	NA	0.7	5.2				
West: Alkimos Dr (W)													
Lane 1	257	3.0	1109	0.232	100	6.6	LOS A	0.9	7.1	Full	500	0.0	0.0
Approach	257	3.0		0.232		6.6	LOS A	0.9	7.1				
Intersection	748	3.0		0.232		5.6	NA	0.9	7.1				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

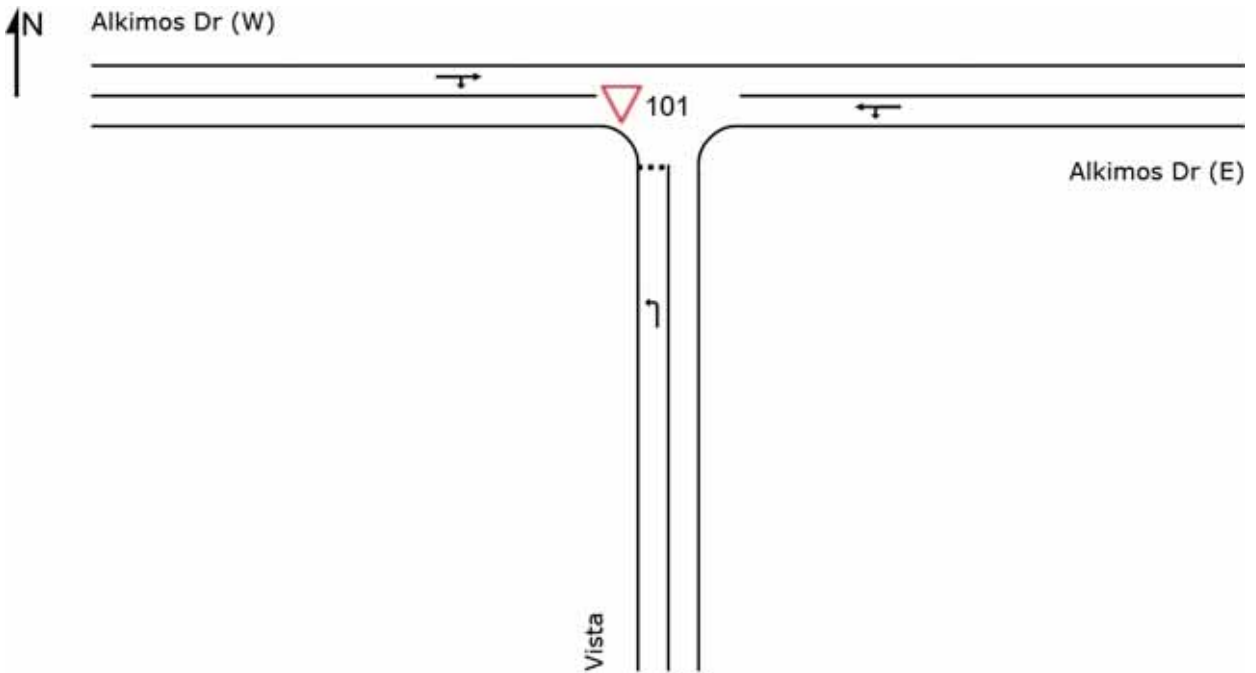
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

▽ Site: 101 [2031 AM - Alkimos Dr / Vista Access]

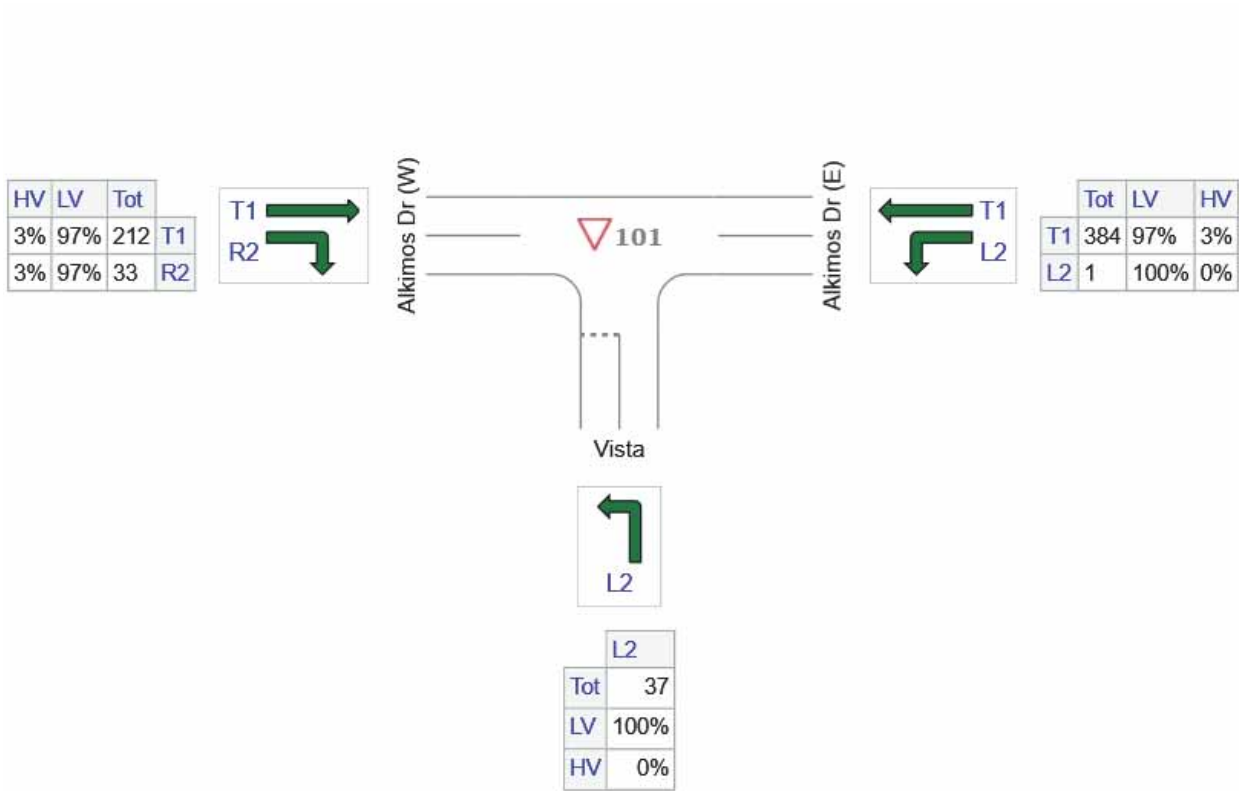
New Site
Site Category: (None)
Giveaway / Yield (Two-Way)

Site Layout



Input Volumes

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Vista	37	37	0
E: Alkimos Dr (E)	385	373	12
W: Alkimos Dr (W)	245	238	7
Total	667	648	19

Lane Use and Performance													
	Demand Flows			Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue		Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
	Total veh/h	HV %	Cap. veh/h					Veh	Dist m				
South: Vista													
Lane 1	39	0.0	1108	0.035	100	7.0	LOS A	0.1	1.0	Full	500	0.0	0.0
Approach	39	0.0		0.035		7.0	LOS A	0.1	1.0				
East: Alkimos Dr (E)													
Lane 1	405	3.0	1893	0.214	100	0.0	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	405	3.0		0.214		0.0	NA	0.0	0.0				
West: Alkimos Dr (W)													
Lane 1	258	3.0	1740	0.148	100	1.3	LOS A	0.3	2.5	Full	500	0.0	0.0
Approach	258	3.0		0.148		1.3	NA	0.3	2.5				
Intersection	702	2.8		0.214		0.9	NA	0.3	2.5				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

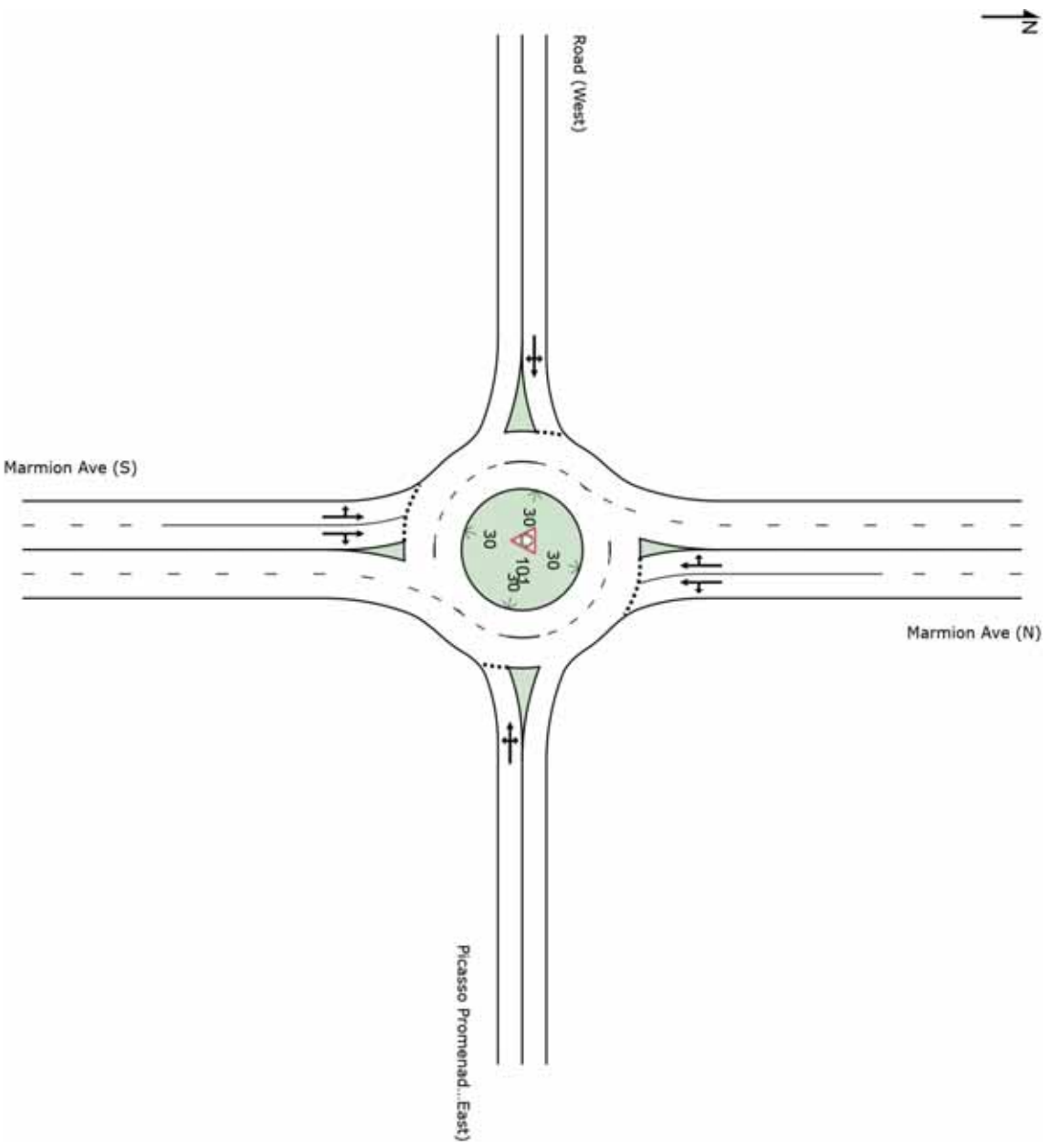
Site: 101 [2031 PM - Marmion Avenue / Picasso Promenade - Full Development]

New Site

Site Category: (None)

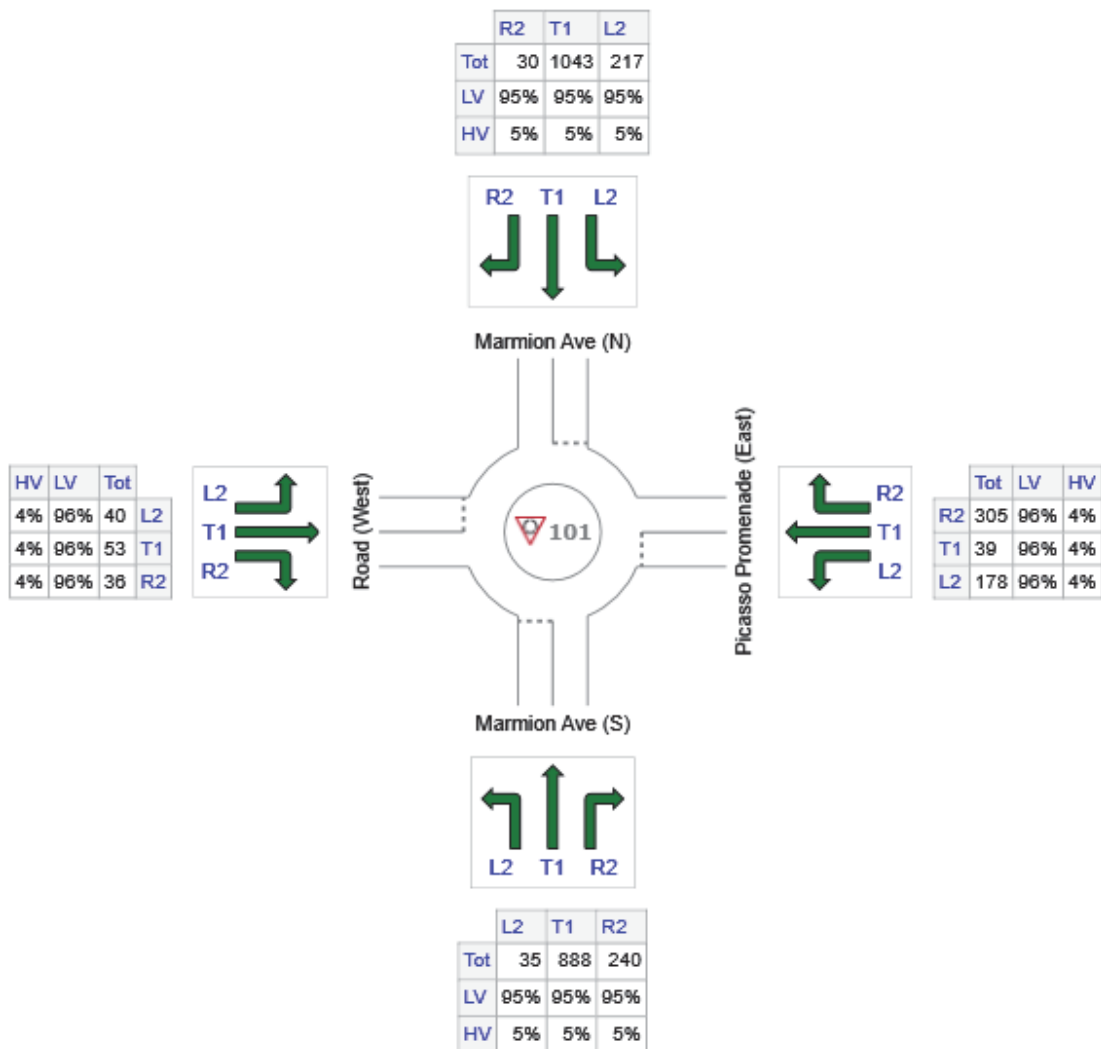
Roundabout

Site Layout



Input Volumes

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Marmion Ave (S)	1163	1105	58
E: Picasso Promenade (East)	522	501	21
N: Marmion Ave (N)	1290	1226	65
W: Road (West)	129	124	5
Total	3104	2955	149

Lane Use and Performance													
	Demand Flows			Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue		Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
	Total veh/h	HV %	Cap. veh/h					Veh	Dist m				
South: Marmion Ave (S)													
Lane 1 ^d	651	5.0	1087	0.599	100	8.8	LOS A	5.5	42.7	Full	500	0.0	0.0
Lane 2	573	5.0	956	0.599	100	12.0	LOS B	5.4	41.5	Full	500	0.0	0.0
Approach	1224	5.0		0.599		10.3	LOS B	5.5	42.7				
East: Picasso Promenade (East)													
Lane 1 ^d	549	4.0	593	0.927	100	29.4	LOS C	12.6	96.6	Full	500	0.0	0.0
Approach	549	4.0		0.927		29.4	LOS C	12.6	96.6				
North: Marmion Ave (N)													
Lane 1 ^d	722	5.0	1177	0.613	100	8.4	LOS A	5.4	41.8	Full	500	0.0	0.0
Lane 2	636	5.0	1037	0.613	100	9.4	LOS A	5.3	41.3	Full	500	0.0	0.0
Approach	1358	5.0		0.613		8.9	LOS A	5.4	41.8				
West: Road (West)													
Lane 1 ^d	136	4.0	489	0.277	100	10.5	LOS B	1.4	10.5	Full	500	0.0	0.0
Approach	136	4.0		0.277		10.5	LOS B	1.4	10.5				
Intersection	3267	4.8		0.927		13.0	LOS B	12.6	96.6				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Roundabout LOS Method: SIDRA Roundabout LOS.

Lane LOS values are based on average delay per lane.

Intersection and Approach LOS values are based on average delay for all lanes.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

^d Dominant lane on roundabout approach

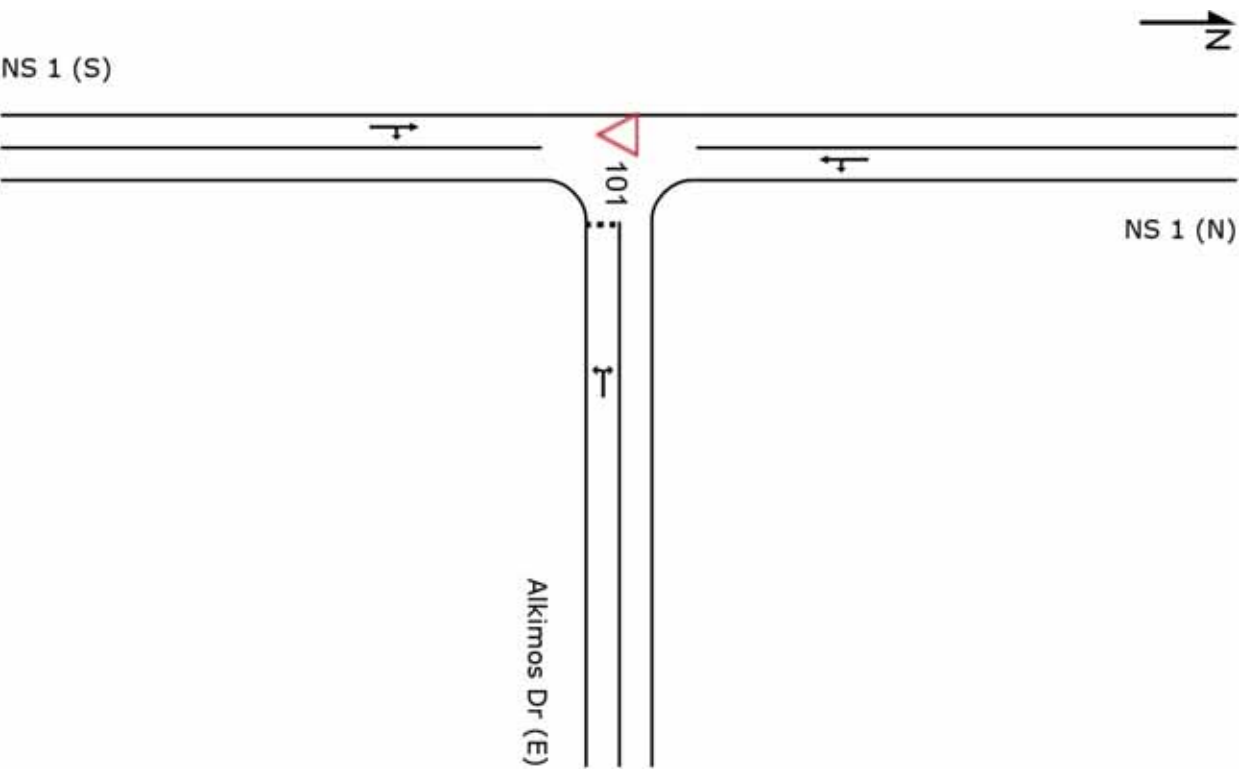
▼ Site: 101 [2031 PM - NS 1 / Alkimos Drive]

New Site

Site Category: (None)

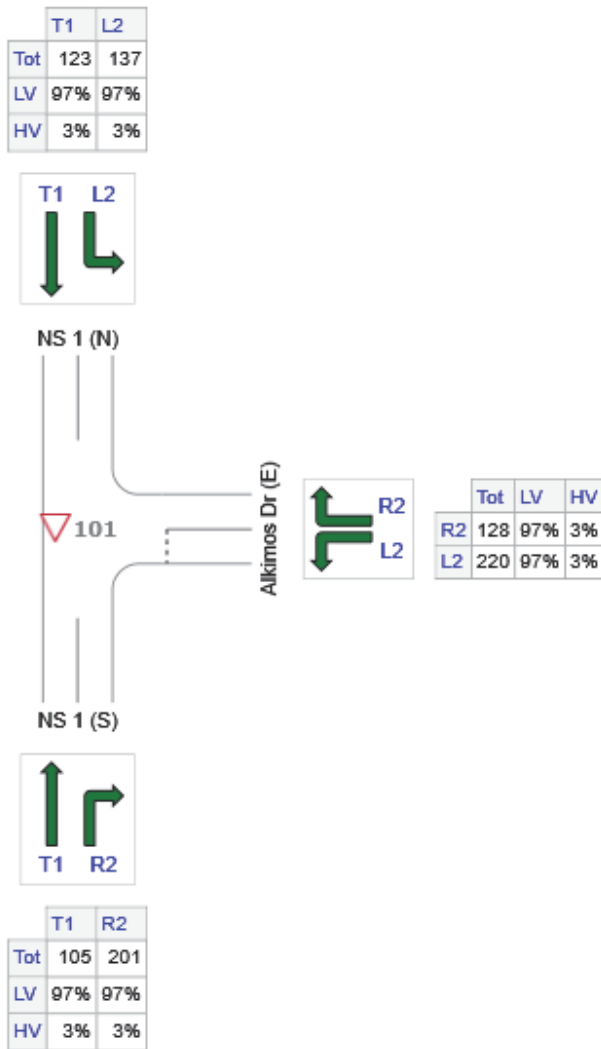
Giveaway / Yield (Two-Way)

Site Layout



Input Volumes

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: NS 1 (S)	306	297	9
E: Alkimos Dr (E)	348	338	10
N: NS 1 (N)	260	252	8
Total	914	887	27

Lane Use and Performance													
	Demand Flows			Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue		Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
	Total veh/h	HV %	Cap. veh/h					Veh	Dist m				
South: NS 1 (S)													
Lane 1	322	3.0	1496	0.215	100	4.7	LOS A	1.1	8.7	Full	500	0.0	0.0
Approach	322	3.0		0.215		4.7	NA	1.1	8.7				
East: Alkimos Dr (E)													
Lane 1	366	3.0	1082	0.338	100	7.1	LOS A	1.5	11.4	Full	500	0.0	0.0
Approach	366	3.0		0.338		7.1	LOS A	1.5	11.4				
North: NS 1 (N)													
Lane 1	274	3.0	1842	0.149	100	3.0	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	274	3.0		0.149		3.0	NA	0.0	0.0				
Intersection	962	3.0		0.338		5.1	NA	1.5	11.4				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

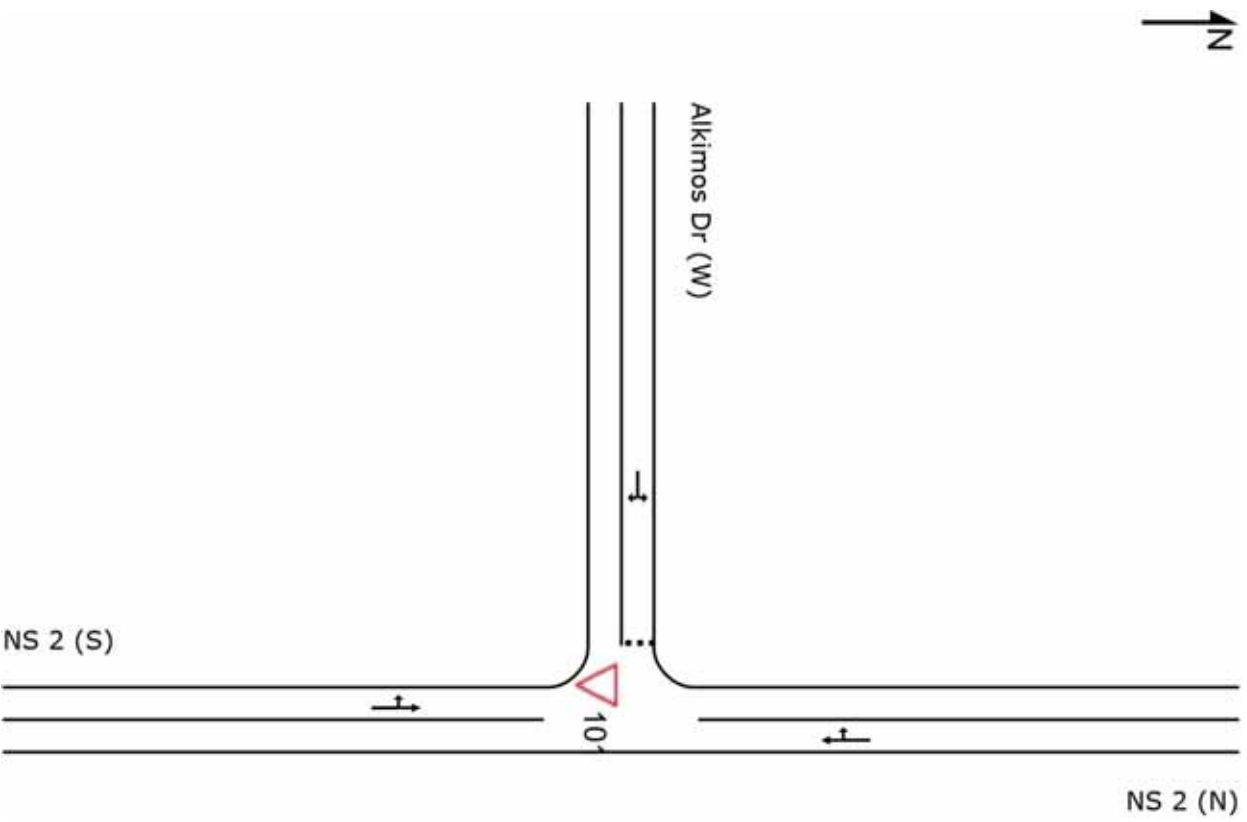
▽ Site: 101 [2031 PM - NS 2 / Alkimos Drive]

New Site

Site Category: (None)

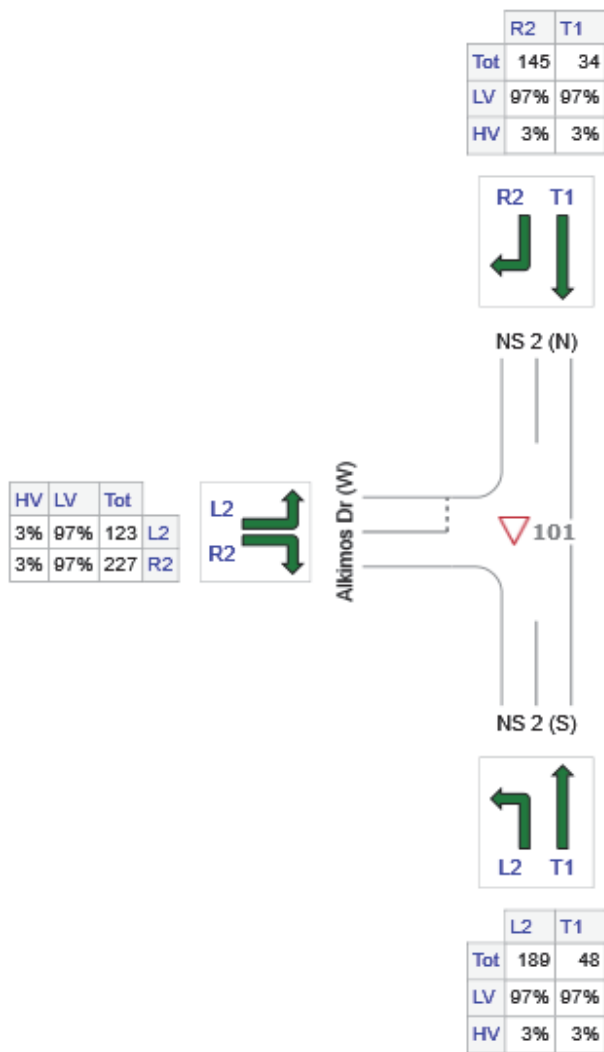
Giveaway / Yield (Two-Way)

Site Layout



Input Volumes

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: NS 2 (S)	237	230	7
N: NS 2 (N)	179	174	5
W: Alkimos Dr (W)	350	340	11
Total	766	743	23

Lane Use and Performance													
	Demand Flows			Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue		Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
	Total veh/h	HV %	Cap. veh/h					Veh	Dist m				
South: NS 2 (S)													
Lane 1	249	3.0	1817	0.137	100	4.5	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	249	3.0		0.137		4.5	NA	0.0	0.0				
North: NS 2 (N)													
Lane 1	188	3.0	1464	0.129	100	5.4	LOS A	0.6	4.8	Full	500	0.0	0.0
Approach	188	3.0		0.129		5.4	NA	0.6	4.8				
West: Alkimos Dr (W)													
Lane 1	368	3.0	1080	0.341	100	6.8	LOS A	1.5	11.3	Full	500	0.0	0.0
Approach	368	3.0		0.341		6.8	LOS A	1.5	11.3				
Intersection	806	3.0		0.341		5.8	NA	1.5	11.3				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

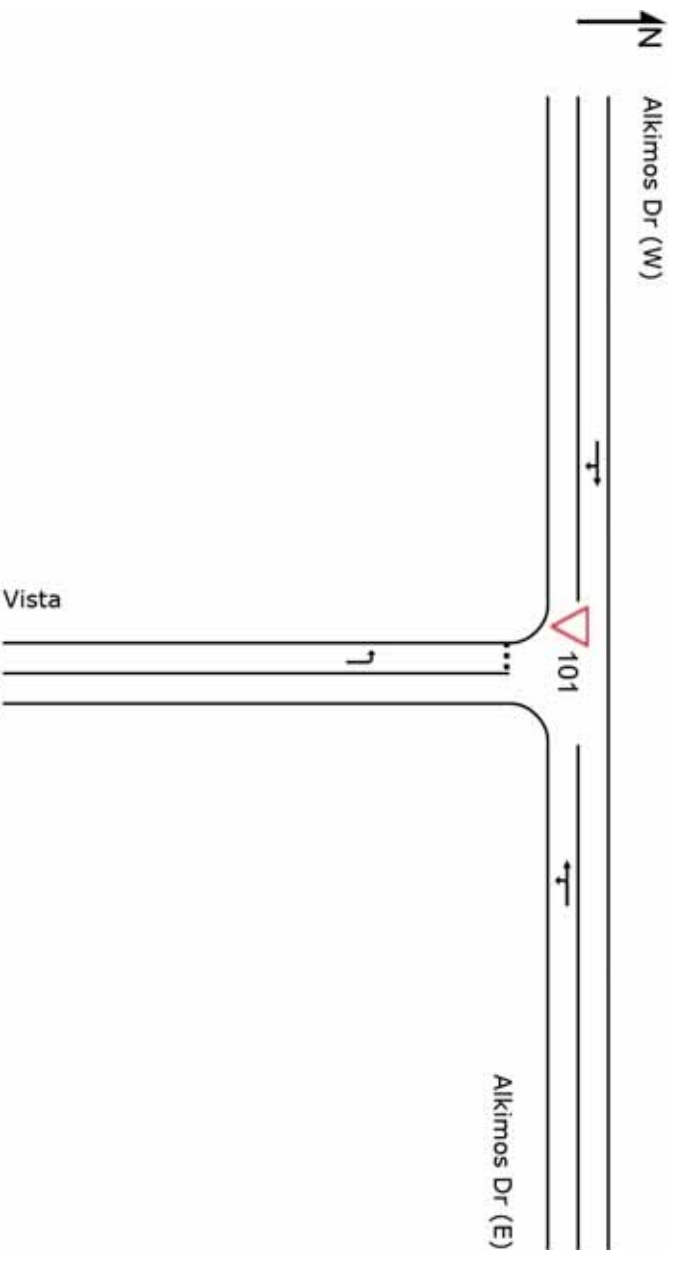
▽ Site: 101 [2031 PM - Alkimos Dr / Vista Access]

New Site

Site Category: (None)

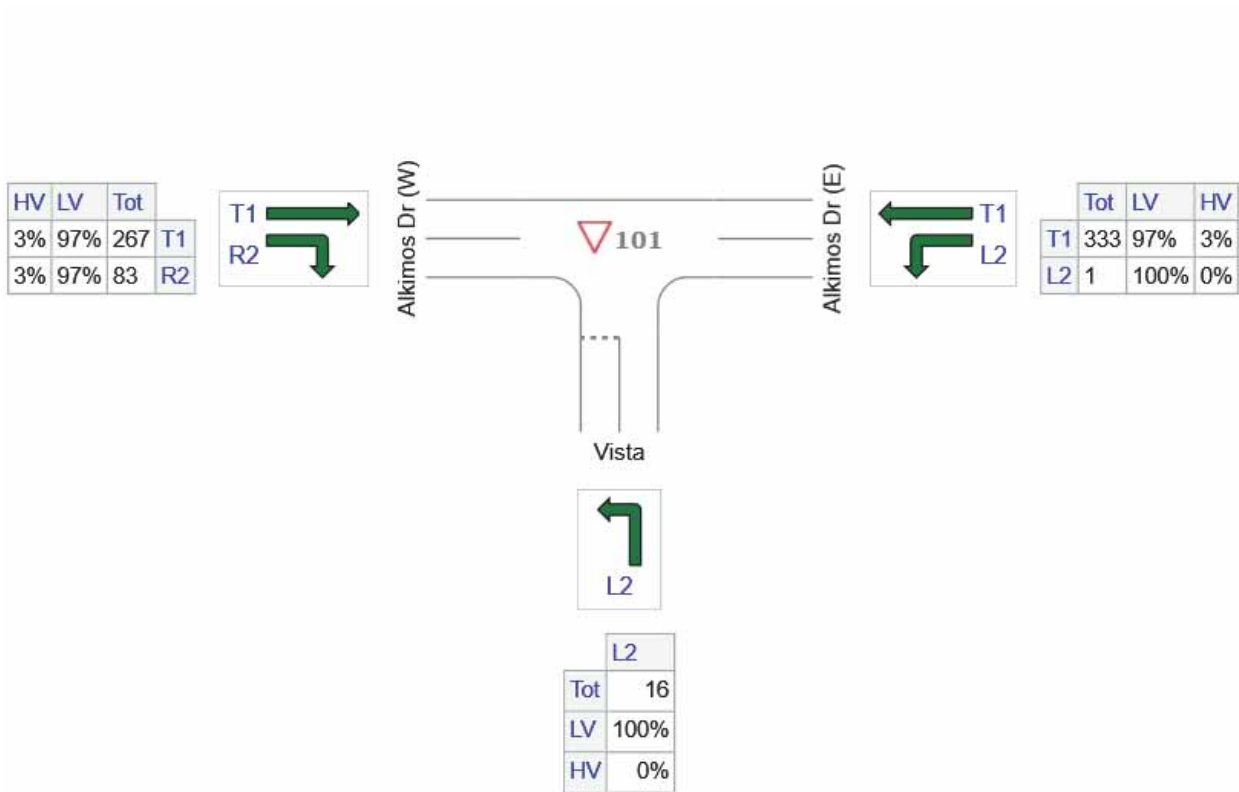
Giveaway / Yield (Two-Way)

Site Layout



Input Volumes

Volume Display Method: Total and %



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Vista	16	16	0
E: Alkimos Dr (E)	334	324	10
W: Alkimos Dr (W)	350	340	11
Total	700	680	20

Lane Use and Performance													
	Demand Flows			Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue		Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
	Total veh/h	HV %	Cap. veh/h					Veh	Dist m				
South: Vista													
Lane 1	17	0.0	1176	0.014	100	6.7	LOS A	0.1	0.4	Full	500	0.0	0.0
Approach	17	0.0		0.014		6.7	LOS A	0.1	0.4				
East: Alkimos Dr (E)													
Lane 1	352	3.0	1893	0.186	100	0.0	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	352	3.0		0.186		0.0	NA	0.0	0.0				
West: Alkimos Dr (W)													
Lane 1	368	3.0	1675	0.220	100	2.2	LOS A	0.8	5.9	Full	500	0.0	0.0
Approach	368	3.0		0.220		2.2	NA	0.8	5.9				
Intersection	737	2.9		0.220		1.2	NA	0.8	5.9				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Lane LOS values are based on average delay per lane.

Minor Road Approach LOS values are based on average delay for all lanes.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Attachment B – Alkimos Drive Cross-section (by Cossill & Webley, dated December 2019)



REFER DRAWING 9270-P2-SK02 FOR CONTINUATION

P:\9270 Alkimos Vista\9270\9270_P2_SK01_SK02.dwg, 12/11/19 9:27:06 AM, dwg, Digital Signing, PDF, 11 - Civil Reference

REV	DATE	DRN	CHK	APP	AMENDMENT
A	12/11/19	DP			ISSUED FOR INFORMATION

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PROJECT
 ALKIMOS VISTA - PRECINT 2
 TITLE
 ULTIMATE ROAD LAYOUT CONCEPT
 SHEET 1 OF 2
 WAPC No.
 DRAWING No.
 6270-P2-SK01

REVISION
 A
 ORIGINAL SIZE
 A1





APPENDIX F
LOCAL WATER
MANAGEMENT STRATEGY

(EMERGE, NOVEMBER 2012)



LOCAL WATER MANAGEMENT STRATEGY

CENTRAL ALKIMOS LSP
Project Number EP11-065

**Prepared for Lend Lease
November 2012**

Document Control

DOC NAME	CENTRAL ALKIMOS LSP LWMS				
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Executive Summary

The Central Alkimos Local Structure Plan (LSP) area, referred to herein as the 'site', is located approximately 40 km north of Perth Central Business District, within the City of Wanneroo (CoW). Lend Lease (the 'proponent') proposes to develop the site for a mixture of residential housing and commercial uses. The site is a part of Lot 9002 and 9003, Lot 9011 and Lot 9013 and currently consists of remnant vegetation of varying condition across the sand dunal system.

The site is currently zoned as 'Urban' and 'Parks and Recreation' under the Metropolitan Region Scheme (MRS) (WAPC 2010) and 'Residential' and 'Parks and Recreation' under CoW District Planning Scheme No. 2 (DPS 2) (CoW 2011).

The Local Water Management Strategy (LWMS) for Central Alkimos has been developed in accordance with *Better Urban Water Management* (WAPC 2008a), *State Planning Policy 2.9 Water Resources* (WAPC 2006) and *Planning Bulletin 92 Urban Water Management* (WAPC 2008b). Water will be managed using an integrated water cycle management approach, which has been developed using the philosophies and design approaches described in the *Stormwater Management Manual for Western Australia* (DoW 2007).

The first step in applying integrated water cycle management in urban catchments is to establish agreed environmental values for receiving waters and their ecosystems. Characteristics of both the existing and past environment within the site have been investigated. In summary, the environmental investigations conducted to date indicate that:

- The site receives 645 mm of average annual rainfall with the majority of rainfall received in June and July.
- The site is highly undulating and ranges from 15 m Australian Height Datum (AHD) to 54 m AHD in elevation. A dunal ridge runs along the southern boundary of the site at a height of 30-55 m AHD.
- The soil types encountered during investigations were consistent with the Quindalup and Spearwood dunal systems comprising of sand and limestone.
- Acid Sulfate Soils (ASS) risk maps classify the entire site as having no known risk of encountering ASS within 3 m of the surface.
- Vegetation across the Central Alkimos LSP is largely low open *Banksia* woodland in 'excellent' to 'good' condition with low *Melaleuca* open heath in 'very good' condition along the dunal ridge.
- The *Geomorphic Wetlands of the Swan Coastal Plain* dataset indicates that there are no wetlands within the site.
- Surface water is largely retained within the site due to the high permeability of the underlying sands.
- Surface water quality monitoring has not been possible due to there being no defined surface water bodies within the site.
- The site is located within a Public Drinking Water Source Area (PDWSA) and Well Head Protection Zone (WHPZ).
- Groundwater underlying the site flows towards the Indian Ocean to the west.
- Groundwater levels underlying the site range between 42.5 and 14.3 m Below Top Of Casing (BTOC). Groundwater elevation varies between approximately 1.0 and 1.5 m AHD
- Groundwater quality underlying the site has some variability in nutrient concentrations, however these are generally low.

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- Parts of the site have historically been used for grazing. The site is currently being used by recreational vehicles.

Central Alkimos is proposed to be developed as a suburban residential area including multiple housing types and a school. The LSP also incorporates areas of Public and Regional Open Space (POS/ROS) to retain surface runoff, vegetation retention and easements for infrastructure.

The overall objective for integrated water cycle management for residential developments is to minimise pollution and maintain an appropriate water balance. The Central Alkimos LWMS design objectives seek to deliver best practice outcomes using a Water Sensitive Urban Design (WSUD) approach, including detailed management approaches for:

- Potable water consumption
- Flood mitigation
- Stormwater quality management
- Groundwater management.

The criteria proposed within this LWMS are based on the characteristics of the existing environment and a contemporary best-practice approach to integrated water cycle management.

The overall approach to water conservation is to reduce the amount of scheme water required within the development at both a lot and an estate scale. Water conservation measures proposed include fit-for-purpose water sources including groundwater for POS and road verge irrigation, scheme water for potable uses within lots and harvested rainwater for irrigation of private lot gardens and to supplement potable water use within dwellings of suitable built form. Within residential areas scheme water will also be reduced by provision of smaller lot sizes (with less garden), water efficient fittings and appliances, and waterwise gardens/landscaping. On an estate scale water will be reduced by use of waterwise landscaping practices including retention and use of native vegetation.

Stormwater management focuses on stormwater runoff quantity and quality. The principle behind the stormwater management strategy for Central Alkimos is to maintain the existing hydrology by retaining surface flows and to infiltrate stormwater runoff as close to source as possible. The Central Alkimos LSP area will retain all runoff up to the 100 year ARI event within the site. The 1 year 1 hour ARI event will be retained as close to source as possible using a combination of soakwells in lots and bio-retention areas within POS. Runoff from events greater than the 1 year 1 hour ARI event will be conveyed downstream via surface flow and the road network to flood storage areas within POS where it will infiltrate to groundwater. Stormwater quality will be addressed using a treatment train approach, utilising the storage provisions discussed above.

Depth to groundwater across the site is significant and groundwater level management measures are therefore somewhat passive and the focus of groundwater management is on water quality. Groundwater quality will be managed by controlling nutrient inputs within surface runoff, and will aim to ensure that groundwater leaving the site is ideally better than existing conditions. Measures to address groundwater quality are consistent with those proposed for stormwater quality.

The proposed criteria and the manner in which they are proposed to be achieved are presented in **Table E 1**. This table provides a readily auditable summary of the required outcomes which can be used in the future detailed design stage to demonstrate that the agreed objectives for water management across the site have actually been achieved.

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Table E 1 Water management criteria and compliance summary

Management Aspect	Criteria Number	Criteria Description	Manner in which compliance will be achieved	Responsibility for implementation	Timing of implementation
Water Conservation	WC1	Use fit for purpose water source	Groundwater to be used for irrigation of POS and road verges	Proponent	Landscape implementation
			Harvested rainwater used in lots of suitable built form for irrigation of lot gardens and in lot use of	Lot owner	Post-house construction
	WC2	Consumption target for water of 100 kL/person/year, including not more than 40-60 kL/person/year scheme water	Provide contemporary lot sizes with less room for garden	Proponent	Subdivision design
			Provide advice for residents on water conservation measures	Proponent	Point of sale
			Use of rainwater tanks within applicable lots	Lot owner	Post-house construction
			Promotion of waterwise gardening principles in lots	Proponent	Point of sale
			Use of waterwise gardening principles in lots	Lot owner	Post-house construction
			Use of waterwise gardening principles in POS	Proponent	Landscape design
				Landscape contractor	Landscape implementation
			Promotion of water efficient appliances	Proponent	Point of Sale
			Use of water efficient appliances	Lot owner	Post-house construction
			Mandate water efficient fittings	Proponent/City of Waneroo	Building approval
	WC3	Minimise use of water at an estate scale	Use of waterwise gardening principles in POS	Proponent	Landscape design
			Landscape contractor	Landscape implementation	

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Management Aspect	Criteria Number	Criteria Description	Manner in which compliance will be achieved	Responsibility for implementation	Timing of implementation
Groundwater	GW1	Maintain or improve groundwater quality onsite	Bio-retention areas to treat surface water runoff prior to infiltration to groundwater	Proponent	During detailed drainage design
			Bio-retention areas to be underlain by soils with PRI>10	Proponent	During detailed drainage design
				Landscape contractor	Landscape implementation
	GW2	Treat stormwater runoff before infiltrating to groundwater	Bio-retention areas to treat surface water runoff prior to infiltration to groundwater	Proponent	During detailed drainage design
			Bio-retention areas to be underlain by soils with PRI>10	Proponent	During detailed drainage design
				Landscape contractor	Landscape implementation
	GW3	Use water sensitive design approaches to recharge the superficial aquifer	Flood storage areas sized to retain and infiltrate flows up to the 100 year ARI event	Proponent	During detailed drainage design
			Bio-retention areas sized to retain and infiltrate the 1 year 1 hour ARI event from road reserves and excess runoff from high density residential lots	Proponent	During detailed drainage design
			Soakwells within lots sized to infiltrate up to the 1 year 1 hour ARI event	Lot owner	Construction
			Soakwells within high density lots sized to infiltrate up to 50% of the 1 year 1 hour ARI event	Lot owner/developer	Construction
Stormwater	SW1	Accommodate all runoff from all events up to the 100 year ARI event onsite	Residential lots to retain 1 year 1 hour ARI event in soakwells and garden areas	Lot owner	Construction
			High density lots to retain 50% of 1 year 1 hour ARI event in soakwells and garden areas	Lot owner/developer	Construction
			Commercial and school lots to retain 100 year ARI events onsite	Lot owner/developer/DET	Construction

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Management Aspect	Criteria Number	Criteria Description	Manner in which compliance will be achieved	Responsibility for implementation	Timing of implementation
			Road runoff and excess runoff from lots will be retained within bio-retention areas and flood storage areas within POS	Proponent	During detailed drainage design
	SW2	Finished floor levels of lots shall have a minimum 500 mm clearance to the 100 year ARI top water level	Preliminary earthworks strategy presented in Appendix E confirms that lots adjacent to flood storage areas will be at least 500 mm above the top water level of the 100 year ARI event.	Proponent	During detailed drainage design
	SW3	Provide stormwater flow pathways for runoff from the 100 year ARI event	Preliminary earthworks strategy presented in Appendix E confirms that the road network will be graded towards POS areas, providing a flow path for 100 year ARI event runoff to reach flood storage areas	Proponent	During detailed drainage design
	SW4	Provide minimum 300 mm clearance from dynamic 100 year ARI event flood levels within road reserves	This will be demonstrated within the earthworks strategy at detailed design stage	Proponent	During detailed drainage design
	SW5	Minor roads are to be designed to remain passable in the 5 year ARI storm event	The pipe network will be designed to convey the 5 year ARI event which will ensure roads remain passable	Proponent	During detailed drainage design
	SW6	Design infiltration areas to avoid creating mosquito habitat	The high infiltration rates of the underlying sands ensure that the maximum inundation time within the flood storage areas will be no more than 21.5 hours	N/A	N/A
	SWQ1	Retain the 1 year 1 hour ARI rainfall event onsite as close to source as practicably possible	Residential lots to retain 1 year 1 hour ARI event within soakwells and garden areas	Lot owner	Construction
High density lots to retain 50% of 1 year 1 hour ARI event within soakwells and garden areas			Lot owner/developer	Construction	
Commercial and school lots to retain 100 year ARI events onsite			Lot owner/developer/DET	Construction	
Bio-retention areas sized to retain 1 year 1 hour ARI event from roads and overflow from high density lots			Proponent	During detailed drainage design	
	SWQ2	Size bio-retention areas to (at least) 2% of the connected impervious area	Bio-retention areas are sized to 2.4% of the connected impervious area	Proponent	During detailed drainage design
	SWQ3	Apply appropriate structural and non-structural measures to reduce nutrient loads	Use of soakwells within residential lots	Lot owner/developer	Construction

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Management Aspect	Criteria Number	Criteria Description	Manner in which compliance will be achieved	Responsibility for implementation	Timing of implementation
			Use of soakwells within school lots	Lot developer/DET	Construction
			Use of bio-retention areas	Proponent	During detailed drainage design
			Minimise use of fertilisers within POS and road verges	Proponent	Landscape implementation
			Maintenance of POS and drainage areas	Landscape contractor	Landscape implementation
			Education of residents regarding responsible nutrient application	Proponent	Point of sale

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Appendix A

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Appendix B

Landscape Designs

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Appendix D

Hydrological Modelling Summary

1.1 Background

The Central Alkimos Local Structure Plan (LSP) area, referred to herein as the 'site', is located approximately 40 km north of Perth Central Business District, within the City of Wanneroo (CoW). The site is located on both east and west sides of Marmion Avenue. The site is bounded by the Indian Ocean to the west and the future Mitchell Freeway to the east. Lend Lease (the 'proponent') proposes to develop the site for a mixture of residential housing and commercial uses.

The site is a part of Lots 9002 and 9003, Lot 9011 and Lot 9013 and currently consists of remnant vegetation of varying condition across the sand dunal system. The location of the site is shown in **Figure 1**. An aerial photograph illustrating the current condition and cadastral boundaries of the site is provided in **Figure 2**.

It is important that the manner in which stormwater runoff from urban zoned areas is to be managed to avoid flooding and protect the environment are clearly documented early in the planning process. This approach provides the framework for actions and measures to achieve the desired outcomes at subdivision and development stages. This Local Water Management Strategy (LWMS) details the water management approach to support the Central Alkimos LSP.

1.2 Town planning context

The site is currently zoned as 'Urban' and 'Parks and Recreation' under the Metropolitan Region Scheme (MRS) (WAPC 2010) and 'Residential' and 'Parks and Recreation' under CoW District Planning Scheme No. 2 (DPS 2) (CoW 2011).

1.3 Policy framework

There are a number of State Government policies of relevance to the site. These policies include:

- *State Water Strategy* (Government of WA 2003)
- *State Water Plan* (Government of WA 2007)
- *State Planning Policy 2.9 Water Resources* (WAPC 2006)
- *Guidance Statement No. 33: Environmental Guidance for Planning and Development* (EPA 2008)
- *Liveable Neighbourhoods Edition 4* (WAPC 2007)
- *Planning Bulletin No. 64: Acid Sulfate Soils* (WAPC 2009)
- *Bush Forever* (Government of WA 2000)
- *Gnangara Sustainability Strategy* (Government of WA 2009).

In addition to the above policies, there are a number of published guidelines and standards available that provide direction regarding the water discharge characteristics that urban developments should aim to achieve. These are key inputs that relate either directly or indirectly to the site and include:

- *Better Urban Water Management* (WAPC 2008a)
- *Australian Runoff Quality* (Engineers Australia 2006)
- *Australian Rainfall and Runoff* (Engineers Australia 1987)
- *Decision Process for Stormwater Management in Western Australia* (DoW 2009a)
- *Stormwater Management Manual for Western Australia* (DoW 2007)
- *National Water Quality Management Strategy* (ANZECC 2000).

The guidance documents listed indicate a need for accurate water quality baseline data prior to urban development. This will ensure that any future development is able to fulfil the stormwater management requirements of DoW and engineering standards specified by the CoW, but will also ensure that realistic water quality criteria that are practically achievable are adopted.

1.4 Previous studies

1.4.1 Alkimos Eglinton District Structure Plan

The Alkimos-Eglinton District Structure Plan (DSP) was prepared by the CoW in 2007 (CoW 2007). A District Water Management Strategy (DWMS) was not prepared as part of the DSP, however a Sustainability Strategy including an Integrated Water Cycle Management Strategy (IWCMS) was produced by GHD and appended to the DSP (GHD Australia 2006).

1.4.2 Alkimos Eglinton District Water Management Strategy

A Draft DWMS has been prepared for Alkimos-Eglinton (GHD Australia 2011b), which is yet to be approved by the CoW and the DoW. Objectives for the District (outlined in the *State Water Plan* (Government of WA 2007) that were intended to be addressed in the DWMS include:

1.4.2.1 Water conservation

The proposed objectives for water conservation included:

- Efficient use of water inside buildings and for irrigation.
- Restricted supply of potable (scheme) water for drinking and associated uses only.
- Supply of a separate fit-for-purpose water service for non-drinking water uses.

To achieve these targets, alternative approaches including water harvesting and storage, use of treated waste water and/or recharge of groundwater have been proposed. The ultimate recommendation of the DWMS was that a groundwater based non-potable scheme be investigated, in tandem with the use of rainwater tanks. The feasibility of this system is only likely to eventuate with the support of the Water Corporation, DoW, Department of Health, CoW and a service provider, and as of this date the proposal is yet to be finalised.

1.4.2.2 Groundwater management

The objectives proposed for groundwater management included:

- Groundwater quality is to be maintained, or improved post-development.
- Groundwater quality will be maximised through the use of the stormwater management measures described below.

1.4.2.3 Stormwater quantity

The objectives proposed for stormwater quantity management included:

- All lots will be required to retain stormwater on-site and infiltrate through the use of soakwells. Rainwater tanks (where used) will also be effective to attenuate runoff generated from roofs.
- All stormwater runoff will be retained for infiltration within the district structure plan area with a specific focus on infiltrating runoff from 1 year ARI events as close to source as possible.

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- Stormwater runoff that is unable to be infiltrated at source will be conveyed via various methods (such as surface flow or a more traditional piped network) to landscaped infiltration areas located in parks.
- Major storm events (i.e. larger than the 5 year ARI event, up to the 100 year ARI event) will be managed via overland flow within the designated road reserves discharging to the dedicated infiltration areas.
- The landscaped infiltration areas will be designed to accommodate the estimated flows from the 100 year ARI event. Design will ensure that standing water will not persist in the basins for longer than 96 hours to reduce the risk of mosquito breeding.
- A minimum freeboard of 0.3 m is to be provided between the 100 year ARI water level and building floor levels

1.4.2.4 Stormwater quality

The objectives proposed for stormwater quality included:

- Adopt a treatment train approach to runoff through the use of water sensitive urban design best management practices such as permeable pavements, buffer strips, bio-retention swales, rain gardens, bio-filtration pockets, median swales, gross pollutant traps and infiltration basins.
- A maintenance plan for the upkeep of the treatment train.
- A monitoring program implemented during construction and post-development to ensure that the management measures for stormwater quality are meeting the design objectives.

1.5 LWMS objectives

This LWMS has been developed in consideration of the objectives and principles detailed in the *Draft Alkimos-Eglinton DWMS* (GHD Australia 2011b) and *Better Urban Water Management* (WAPC 2008a). It is intended to support the Central Alkimos LSP and is further based on the following major objectives:

- Provide a broad level stormwater management framework to support future urban development.
- Incorporate appropriate best management practices (BMPs) into the drainage systems that address the environmental and stormwater management issues identified.
- Minimise development construction costs, which will result in reduced land costs for future home owners.
- Minimise ongoing operation and maintenance costs for the land owners and CoW.
- Develop a water conservation strategy for the site that will accommodate existing groundwater allocation constraints for the area.
- Gain support from the DoW and CoW for the proposed method to manage stormwater within the site and potential impacts on downstream areas.

Detailed objectives for water management within the site are further discussed in **Section 4**.

2 Proposed development

Central Alkimos is a coastal community incorporating suburban residential housing, schools and commercial uses. The LSP area includes a total land area of 266 hectares and proposed land uses include:

- 69 ha of residential housing
- 1.6 ha of business enterprise and commercial uses
- 16 ha of Public Open Space (POS)
- 104 ha of Regional Open Space (ROS)
- Private School and sports field
- High School
- Road network.

The Central Alkimos LSP is included in **Appendix A**.

3 Pre-development environment

3.1 Sources of information

The following sources of information were used to provide a broad regional environmental context for the site:

- National Water Quality Management Strategy (ANZECC 2000)
- Regional 1:50 000 Geology Map Sheet (Gozzard 1982)
- WA Atlas (Landgate 2012)
- Water Register (DoW 2012b)
- Perth Groundwater Atlas (DoW 2012a)
- Weather and Climate Statistics Data (Bureau of Meteorology 2012).

In addition to the above information, site-specific investigations have been conducted. These have aimed at providing more detail to the existing regional information. These site-specific investigations include:

- Geotechnical Desktop Study: Karst formations (Douglas Partners 2012a)
- Alkimos Eglinton Groundwater Monitoring Report (GHD Australia 2011a)
- Environmental Assessment and Justification Report (Emerge Associates 2012)
- Alkimos Eglinton Flora, Vegetation and Fauna baseline information (ATA Environmental 2005).

The above studies have been reviewed to determine infiltration potential within the site and existing groundwater levels. This is important, as both can have implications for the stormwater management measures and the extent of earthworks that may be required to facilitate subdivision.

3.2 Climate

The site experiences a dry Mediterranean climate of hot dry summers and cool wet winters. Long term climatic averages indicate that the site is located in an area of moderate rainfall, receiving 645 mm on average annually (Bureau of Meteorology 2012) with the majority of rainfall received in June and July. The region experiences rainfall for 82 days annually (on average).

3.3 Geotechnical conditions

3.3.1 Topography

The site has highly undulating topography due to the parabolic dunal system on which it lies. The site ranges in height from 54 m Australian Height Datum (AHD) in the east to 15 m AHD in the centre, rising again to 40 m AHD in the west. A dunal ridge runs along the south-eastern boundary of the site at a height of between 36 and 54 m AHD and has steep side slopes. The Alkimos Central LSP proposes to incorporate the existing topography into the development by retaining a significant portion of the dunal ridge.

Topographic contours across the site are shown in **Figure 3**.

3.3.2 Soils and geology

The site is situated within the coastal belt of the Swan Coastal Plain, within the Quindalup Dune geomorphological unit. The Quindalup system comprises of a complex pattern of dunes with gentle to moderate relief, resulting in an undulating landscape with calcareous sands overlying limestone. Sand depths range across the site in line with the topography (Landgate 2012).

The site is within the geological units described below, with geological mapping shown in **Figure 4**.

- S3 – Safety Bay Sand (Quindalup Sand) – white, fine to medium grained, sub rounded quartz and shell debris, of eolian nature.
- S7 – Sand derived from Tamala Limestone – pale and olive yellow, medium to coarse grained, sun angular quartz with a trace of feldspar, moderately sorted, of residual origin.
- LS1 – Tamala Limestone – light yellowish brown, fine to coarse grained, sub angular to well rounded, quartz, trace of feldspar, shell debris, variably lithofied, surface kankar, of eolian origin.
- LS4 - Safety Bay sand (Quindalup Limestone) – pale yellowish brown, weakly cemented, friable, medium grained, sub rounded, quartz and shell debris, of eolian origin (Davidson 1995).

A geotechnical desktop study was carried out for the site (Douglas Partners 2012a) which identified the risk of karst formations being located within the site. The ground conditions underlying the development site contain a geological unit which has 'common solution cavities and fissures' but is not known to have large karst features such as caves. The risk of large karst structures forming within the site and impacting on the proposed development is considered very low (Douglas Partners 2012a).

The soil types on the site are highly permeable with the sands being the dominant influence at the surface. Preliminary site investigations carried out within the adjacent Alkimos South LSP, an area which has a soil profile consistent with the site, included infiltration testing (Douglas Partners 2012b). Eight in-field infiltration tests were carried out using the falling head method with infiltration rates estimated using Hvorslev's method. Permeability rates of between 1.9 and 7.8 x 10⁻⁴ m/s were measured, resulting in a calculated average infiltration rate of 25 m/day (Douglas Partners 2012b). An infiltration rate of 2 m/day has been assumed within the hydraulic modelling (discussed in **Section 7.4**).

3.3.3 Acid Sulfate Soils

There is no known risk of Acid Sulfate Soils (ASS) occurring within three metres of the natural surface (DEC 2012).

3.4 Flora

A flora, vegetation and fauna survey of the site was undertaken by ATA Environmental which mapped the types and current condition of vegetation identified onsite (ATA Environmental 2005). A site visit by Emerge in 2011, and more recently in October 2012 confirmed and updated the spatial extent of these vegetation associations.

The site currently contains large areas of low open *banksia* woodland and heath with areas of emergent *eucalyptus* and some high shrubland. The majority of the vegetation within the LSP area is in 'excellent' to 'very good' condition. There is however a section of 'degraded' to 'completely degraded' *banksia* woodland towards the centre of the site, adjacent to Marmion Avenue and along the southern site boundary. Vegetation on the dunal ridge consists of *Melaleuca*, low open heath which is in 'degraded' to 'completely degraded' condition (ATA Environmental 2005).

Vegetation condition mapping is shown in **Figure 5**, updated from mapping carried out by ATA Environmental (ATA Environmental 2005).

3.5 Wetlands

A review of the *Geomorphic Wetlands on the Swan Coastal Plain dataset* (DEC 1992) indicates that there are no geomorphic wetlands on site.

3.6 Surface water

3.6.1 Surface water quantity

The hydrological characteristics of the site are dominated by the high infiltration capacity of the soils onsite. This leads to little to no surface runoff except during extreme events. When combined with the steep slopes onsite and the localised low points, the result is that there will be no runoff leaving the site. The pre-development catchments are shown in **Figure 6**.

The existing drainage network is minimal and informal, being the runoff from the existing pavement of Marmion Avenue. In the pre-development environment runoff from Marmion Avenue sheets into the low points of the road reserve and potentially within adjacent low-lying areas of the site during an extreme event. This would be a very infrequent occurrence.

3.6.2 Modelling approach

The stormwater management strategy aims to maintain the existing runoff regime of the site. In this instance, the site is effectively self-contained and modelling of pre-development runoff will not provide significant guidance to the spatial requirements for the post-development environment. There are some minor catchments that could potentially discharge from the site, however all runoff from these areas will be retained onsite. The spatial requirements for stormwater detention are discussed in **Section 7**.

3.6.3 Surface water quality

There is no information regarding surface water quality available within the site due to surface water runoff only occurring during extreme events, and on this basis water quality analysis has not been carried out.

3.7 Groundwater

3.7.1 Public Drinking Water Source Areas

A large proportion of the site is located within a Priority 3 Public Drinking Water Source Area (PDWSA) and contains Well Head Protection Zones (WHPZ) (DoW 2009b), as shown in **Figure 7**, and as such is subject to restricted land uses (WC 2007; DoW 2010).

Priority 3 classification areas are defined to '*manage the risk of pollution*' to the water source from catchment activities. Protection of P3 areas is achieved through guided or regulated environmental risk management for land use activities. Land uses considered to have significant pollution potential are opposed or constrained (DoE 2004).

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WHPZ are used to protect underground sources of drinking water, are circular with a radius of 300 m in P3 areas and are subject to special protection measures (DoE 2004).

All of the land uses proposed under the Central Alkimos LSP are classified as 'Acceptable' within these areas (DoE 2004).

3.7.2 Groundwater levels

Information on groundwater from the DoWs 'Online Water Register' indicates that groundwater beneath the site is a multi-layered system comprised of the following:

- Perth – Superficial Swan unconfined aquifer
- Perth – Leederville confined aquifer
- Perth – Yarragadee confined aquifer.

Groundwater data from the *Perth Groundwater Atlas* (DoW 2012a) show that groundwater levels across the district range from between 5 m AHD in the east to <1 m AHD in the west before leading down to sea level at the coast.

Groundwater monitoring has been carried out across the Alkimos-Eglinton DSP area (which incorporates the site) with six rounds of monitoring between July 2010 and November 2011 including groundwater levels, in situ field chemistry measurements and laboratory analysis for nutrient, metal and salt contents.

Within the groundwater monitoring report (GHD Australia 2011a) the site is referred to as *Area 4 – Alkimos Central*. Four working monitoring bores are located within, or adjacent to, this area (including one existing observation bore owned by DoW) that provide representative groundwater conditions for the site.

Average groundwater levels within the bores across the site range between 38.9 m Below Top of Casing (BTOC) in the east to 14.3 m BTOC directly adjacent to Marmion Avenue, which relates to groundwater elevations of 1.27 and 1.01 m AHD respectively. Depth to groundwater is largely representative of the topography, with groundwater elevation reducing with proximity to the coast. Groundwater elevation across the site varies between approximately 1.0 and 1.5 m AHD (GHD Australia 2011a).

Maximum measured groundwater levels and sampling locations are shown in **Figure 8**.

3.7.3 Groundwater quality

Water quality monitoring carried out across the site included sampling of physio-chemical parameters in situ and laboratory analysis of nutrients, metals and salt concentrations.

The measured groundwater quality across the site is summarised in **Table 1** and details the parameters significant to, and managed within, this LWMS (i.e. physio-chemical parameters and nutrient concentrations). DoW bore WIN5746 is not included as water quality data was not available.

Table 1 Central Alkimos groundwater quality

Bore ID	pH	EC (mS/cm)	TDS (mg/L)	TN (mg/L)	TP (mg/L)	NO ₃ (mg/L)
ALCEN2	7.01 (0.41)	467.50 (71.82)	290.67 (34.95)	1.09 (1.48)	0.10 (0.06)	3.34 (5.14)

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Bore ID	pH	EC (mS/cm)	TDS (mg/L)	TN (mg/L)	TP (mg/L)	NO ₃ (mg/L)
ALCEN3	7.74 (0.35)	626.67 (221.43)	377.33 (132.67)	0.82 (1.33)	0.08 (0.03)	2.73 (0.29)
ALCEN4	7.25 (0.19)	756.67 (28.87)	450 (17.32)	3.68 (0.34)	0.02 (0.01)	15.50 (1.00)
WIN5744	6.91 (0.02)	1750.00 (70.71)	998.00 (2.83)	0.44 (0.07)	0.01 (0.00)	0.89 (0.16)

Values given are average and (standard deviation)

The full dataset (GHD Australia 2011a) shows that since July 2010 concentrations of nutrients remained relatively stable across the site except for a decrease in Total Nitrogen (TN) and Nitrate (NO₃) and increase in Total Phosphorous (TP) within ALCEN2 over the monitoring period. Nitrogen concentrations also dropped within ALCEN3 between July and November 2011.

3.8 Current and historical land uses

Parts of the site have previously been used for grazing and it is currently being used by recreational vehicles.

3.9 Summary of existing environment

In summary, the environmental investigations conducted to date indicate that:

- The site receives 645 mm of average annual rainfall with the majority of rainfall received in June and July.
- The site is highly undulating and ranges from 15 m AHD to 54 m AHD in elevation. A dunal ridge runs along the south-eastern boundary of the site at a height of 36-54 m AHD.
- The soil types encountered during investigations were consistent with the Quindalup and Spearwood dunal systems comprising of sand and limestone.
- ASS risk maps classify the entire site as having no known risk of encountering ASS within 3 m of the surface.
- Vegetation across the Central Alkimos LSP is largely low open *Banksia* woodland in 'excellent' to 'good condition' with low *Melaleuca* open heath in 'very good' condition along the dunal ridge.
- The *Geomorphic Wetlands of the Swan Coastal Plain* dataset indicates that there are no wetlands within the site.
- Surface water is largely retained within the site due to the high permeability of the underlying sands.
- Surface water quality monitoring has not been possible due to there being no defined surface water bodies within the site.
- The site is located within a PDWSA and WHPZ.
- Groundwater underlying the site flows towards the Indian Ocean to the west.
- Groundwater levels within the bores across the site range between 38.9 and 14.3 m BTOC, relating to 1.01 and 1.27 m AHD respectively. Groundwater elevation across the site varies between approximately 1.0 and 1.5 m AHD
- Groundwater quality underlying the site has some variability in nutrient concentrations, however these are generally low.

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- Parts of the site have previously been used for grazing and it is currently being used by recreational vehicles.

4 Design criteria and objectives

This section outlines the objectives and design criteria that this LWMS and future UWMPs must achieve. The water management strategy covers stormwater management, groundwater management and water consumption.

4.1 Total water cycle management

The *State Water Strategy* (Government of WA 2003) and *Better Urban Water Management* (WAPC 2008a) endorses the promotion of integrated water cycle management and application of WSUD principles to provide improvements in the management of stormwater, and to increase the efficient use of other existing water supplies.

The key principles of integrated water cycle management include:

- Considering all water sources, including wastewater, stormwater and groundwater
- Integrating water and land use planning
- Allocating and using water sustainably and equitably
- Integrating water use with natural water processes
- Adopting a whole of catchment integration of natural resource use and management.

Integrated water cycle management addresses not only physical and environmental aspects of water resource use and planning, but also integrates other social and economic concerns. Stormwater management design objectives should therefore seek to deliver better outcomes in terms of:

- Potable water consumption
- Flood mitigation
- Stormwater quality management
- Groundwater management.

The first step in applying integrated water cycle management in urban catchments is to establish agreed environmental values for receiving environments. The existing environmental context of the site has been discussed in **Section 3** of this document. Guidance regarding environmental values and criteria is provided by a number of National and State policies and guidelines and site specific studies undertaken in and around the site. These were detailed in **Sections 1.3** and **3.1**.

The overall objective for preparing integrated water cycle management plans for proposed residential developments is to minimise pollution and maintain an appropriate water balance. This objective is central to the water management approach for the Central Alkimos LSP.

4.2 Water conservation

Water conservation design criteria have been determined in line with the guidelines presented in *Better Urban Water Management* (WAPC 2008a). This LWMS proposes the following water conservation criteria:

Criteria WC 1 Use fit for purpose water sources throughout the development.

Criteria WC 2 Minimise use of water at an estate scale.

Criteria WC3 Consumption target for water of 100 kL/person/year, including not more than 40-60 kL/person/year scheme water.

The manner in which these objectives will be achieved is further detailed in **Section 4**.

4.3 Groundwater management

The principle behind the groundwater management strategy is to maintain the existing groundwater hydrology. This LWMS proposes the following groundwater management criteria:

Criteria GW1 Maintain or improve groundwater quality onsite.

Criteria GW2 Treat stormwater runoff before infiltration to groundwater.

Criteria GW3 Use water sensitive design approaches to recharge the superficial aquifer.

The manner in which these objectives will be achieved is further detailed in **Section 5**.

4.4 Stormwater management

The principle behind stormwater management at the site is to mimic the pre-development hydrological conditions, as described in **Section 3.6**. This principle and the guidance documents discussed in **Section 1.3** have guided the stormwater management criteria.

4.4.1 Stormwater quantity

This LWMS proposes the following stormwater quantity design criteria:

Criteria SW1 Accommodate runoff from all events up to the 100 year ARI event onsite.

Criteria SW2 Finished floor levels of lots shall have a minimum 500 mm clearance to the 100 year ARI top water level in Flood Storage Areas (FSA).

Criteria SW3 Provide stormwater flow pathways for runoff from the 100 year ARI event.

Criteria SW4 Finished floor levels of lots shall have a minimum 300 mm clearance from dynamic 100 year ARI event flood levels within road reserves.

Criteria SW5 Minor roads are to be designed to remain passable in the 5 year ARI storm event.

Criteria SW6 Design infiltration areas to avoid creating mosquito habitat.

The manner in which these objectives will be achieved is further detailed in **Section 7**.

4.4.2 Stormwater quality

This LWMS proposes the following stormwater quality design criteria:

Criteria SWQ1 Retain the 1 year 1 hour ARI rainfall event onsite as close to source as practicable.

Criteria SWQ2 Size bio-retention areas to (at least) 2% of the connected impervious area.

Criteria SWQ3 Apply appropriate structural and non-structural measures to reduce nutrient loads.

The manner in which these objectives will be achieved is further detailed in **Section 7**.

5 Water source allocation, infrastructure, fit-for-purpose and water use

5.1 Fit-for-purpose water use

Conservation of water through fit-for-purpose use and best management practices is encouraged so that scheme water is not wasted. Fit-for-purpose describes the use of water that is of a quality suitable for the required use of the water. Fit-for-purpose principles have been utilised in the water conservation strategy for the Central Alkimos LSP and will achieve **Criteria WC1**.

5.1.1 Scheme water

The site is proposed to be connected to the Water Corporations Integrated Water Supply Scheme (IWSS).

5.1.2 Groundwater

The DoW 'Online Water Register' indicates that the site is located in the Perth groundwater area, within the Eglinton sub-area (DoW 2012b).

Groundwater can be used for irrigation of POS areas and some road verges instead of utilising scheme water. The water register indicates that there is potentially additional allocation available within the Perth-Superficial aquifer.

Within the Central Alkimos LSP there are 16 ha of POS, 104 ha of ROS and approximately 2.63 ha of road verge. The ROS largely consists of retained natural vegetation that will not require irrigation, however small areas along the edge of these areas may require some minor revegetation works.

An application for a total allocation of 318.9 ML (including an allowance for dust suppression during construction phase) has been submitted to the DoW and is awaiting assessment.

Groundwater use for POS irrigation is further discussed in **Section 5.4**.

5.1.3 Waste water reuse

Within the Alkimos Eglinton DWMS (GHD Australia 2011b) provision of a non-drinking water (NDW) supply through a dual reticulation (third pipe) network was proposed. The NDW supply was proposed for irrigation uses in the initial stages of development (up to 2015) with the intention of expanding its use to non-potable in-house water uses in the future.

Alternative water sources to supply the NDW network included groundwater, stormwater harvesting and treated wastewater from the adjacent Alkimos WWTP. The network requires the agreement and input of a number of stakeholders across the Alkimos-Eglinton DSP area, including the local government and identification of a long term service provider.

As at November 2012, a recycled effluent scheme capable of supplying a third pipe system to dwellings and commercial premises had not been agreed. The installation of a third pipe network is considered an opportunity for Alkimos Central. In accordance with the Environmental Sustainability Strategy (Lend Lease 2012) ongoing assessment of opportunities for a third pipe system will continue to be undertaken.

5.2 Water conservation measures

The development will utilise groundwater for POS irrigation, active POS irrigation management, contemporary lot sizes (CLS) (which provide less room for gardens), Rainwater Tanks (RWT), WaterWise Garden (WWG) principles for lot scale gardens and within estate landscaping and Water Efficient Fixtures and Appliances (WEFA) to ensure that the development minimises the use of water. These measures are further discussed in the following Sections.

5.2.1 Contemporary lot sizes

Central Alkimos incorporates a range of lot sizes across the LSP area, with single dwelling lots between 175 m² to 360 m². High density multiple dwelling lots (apartments) are also included with an equivalent average land area of 100 m² per unit. These contemporary lot sizes (CLS) reflect a trend towards smaller residential lots in new urban areas. Smaller lot sizes result in more compact garden areas than traditional residential lots, and therefore external house water requirements are reduced.

5.2.2 Rainwater tanks

Harvest of runoff from roof surfaces can be undertaken, with this water stored within rainwater tanks (RWT) for later use. This water is of high quality however and can be used to substitute non-potable water requirements. In Perth, 90% of the rainfall occurs in the seven month period from April to October. The remainder of the year has little rainfall but collection is still possible. Therefore stored rainwater may be used for irrigation requirements however this will need to be supplemented with scheme water towards the end of the summer period. During the higher rainfall months, the majority of the stored rainwater can be used to supplement internal building non-potable uses.

The use of rainwater tanks as described in the following sections will not be mandated within the LSP area. An uptake rate for RWT of 15% has been assumed within the lot scale water balance (discussed in **Section 5.3**) to account for potential implementation of RWT by lot owners post-construction.

The above measure will assist in achieving **Criteria WC2** and **WC3**.

5.2.3 Water efficient fixtures and appliances

Significant reduction in in-house water uses can be achieved with the use of WEFA. **Table 2** provides an example of the water uses of typical appliances versus water efficient appliances. These water use rates have been used in the water balance analysis.

Table 2 Water efficient fixtures and appliances

Appliance	Water Use	
	Standard Device	Water Saving Device
Toilet	12 Litres/Flush	4 Litres/Flush
Washing Machine	130 Litres/Wash	40 Litres/Wash
Dishwashers	50 Litres/Wash	25 Litres/Wash
Shower Head	15-25 Litres/Minute	6-7 Litres/Minute
Taps	15-18 Litres/Minute	5-6 Litres/Minute

(Melbourne Water 2003; Australian Government 2009)

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The Central Alkimos LSP water conservation strategy proposes that all residential dwellings and commercial buildings use water efficient fixtures and that all residential dwellings use water efficient appliances. Water efficient fittings will be mandated through the building design guidelines, while uptake of water efficient appliances can be encouraged by State and local government rebates, as well as education from the proponent at point of sale.

The above measures will assist in achieving **Criteria WC2** and **WC3**.

5.2.4 Water Wise Gardens

The Water Corporation (WC 2003) has found that for a traditional household, 56% of the water consumed by the lot is used on the gardens. Therefore, employing WWG measures can significantly reduce the total water usage of the lot. The following water efficiency measures will be used on lot gardens:

- Improve soil with conditioner certified to Australian Standard AS4454 to a minimum depth of 150mm where turf is to be planted and a minimum depth of 300 mm for garden beds (for entry statement only).
- Design and install the irrigation system according to best water efficient practices and to consider
 - Control systems that are able to irrigate different zones with different irrigation rates.
 - Emitters that disperse coarse droplets or be subterranean.
 - Utilise subsoil irrigation where appropriate.
- Minimise the amount of turfed areas.
- Select turf species of a genotype endorsed by the UWA Turf Industries Research Steering Committee (e.g. Couch grass – *Cynodon dactylon*).
- Mulch garden beds to 75 mm with a product certified to Australian Standard AS4454.
- Increase community awareness of water conservation by promoting waterwise practices, fixtures and fittings at the point of sale.

Water conservation can also be reduced on a development scale within POS areas. As well as using the lot scale garden measures on POS gardens, the following additions measures will be utilised:

- Retain remnant native trees within POS areas where possible. This will provide shade, reduce water requirements during POS establishment and will assist in providing buffers for waterways.
- Garden beds within POS areas will utilise 'waterwise' plants, which are (where possible) locally native species or plants from regions with similar climates. These plants require less water input than exotic species.
- Minimise water requirements for POS maintenance. This will be achieved by implementing an appropriate management and maintenance program for POS areas – to be further detailed at the UWMP stage.

WWG principles will be carried out within all POS areas and road reserves, and will be promoted to purchasers on sale of lots.

The above measures will assist in achieving **Criteria WC2** and **WC3**.

5.3 Lot water balance

A water balance analysis has been undertaken to demonstrate the effectiveness of the water conservation strategy proposed for lot-scale measures. Two scenarios are compared to demonstrate both the expected and the potential scheme water requirements for the proposed development.

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Assumed up-take rates have been derived from data supplied by the Australian Bureau of Statistics (ABS 2004; ABS 2010a; ABS 2010b) and development specific criteria. Note that the water balance does not include assessment of estate scale irrigation of POS; this is detailed in **Section 5.4**.

This water balance compares:

- Scenario 1 – Central Alkimos Water Conservation Strategy (WCS) - CLS, 15% RWT, WEFA (100% fittings, 35% appliances), 50% WWG
- Scenario 2 – Central Alkimos WCS - CLS, RWT, WEFA, WWG (full implementation).

The water balance analysis has been based on the rates and calculation methodology presented in the WC Spreadsheet AltWaterSupply_Water_Use_Model.xls. This spreadsheet has been adapted to model the effects of using the water conservation measures proposed. A number of key assumptions were made to carry out the lot scale water balance including:

- Lot sizes and densities across the Central Alkimos LSP area have been based on the LSP plans prepared by Lend Lease.
- Average residency of 2.9 people per single lot dwelling and 1.8 people per unit in group housing. These values have been calculated from data provided by ABS for new housing developments in Perth (ABS 2009).
- The private school lots have assumed a total of 600 students per school with 15% irrigated area.
- The high school lots have assumed a total of 1000 students with 15% irrigated area (the oval has been included within the POS irrigation calculations included in the estate scale water balance, detailed in **Section 5.4**).
- Commercial/business lots have assumed a consumption rate of between 0.8 and 1.08 kL/m²/year.

The lot scale water consumption for the two water conservation scenarios is presented in **Table 3**.

Table 3 lot water consumption

	Scenario 1 WCS – 100% CLS, 15% RWT, WEFA (100%,35%), 50% WWG	Scenario 2 100% WCS
Scheme water required in residential lots (ML/year)	280.3	150.3
Scheme Water Required per Capita in residential lots (kL/year/person)	39.0	20.9
Total Scheme Water Required (ML/year)	319.2	189.2

The results of the water balance indicate that on average in the development, a dwelling not using any water conservation strategies will not achieve the 100 kL/year/person water consumption target.

If households in Central Alkimos adopt CLS, RWT, WWG and WEFA at typical uptake rates (groundwater is used for irrigation of POS and therefore does not reduce the lot scale water consumption), then households within the Central Alkimos LSP area will use on average 39.0 kL/person/year.

This achieves the state water consumption target of no more than 100 kL/year/person, the *Better Urban Water Management* (WAPC 2008a) aspirational goal of 40-60 kL/year/person and satisfies **Criteria WC2 and WC3**.

5.4 Estate scale water use

The water use at an estate scale is determined by the amount of POS provided that requires irrigation, the amount of road verge that will require irrigation and the rates at which these are irrigated. Not all of the POS areas will be irrigated at the same rates as some areas consist of native vegetation (new and retained), while others will utilise turf to provide active recreation areas.

The Central Alkimos irrigation requirements have been summarised in **Table 4**. Preliminary landscape designs are included within **Appendix D**.

Table 4 Central Alkimos irrigation water use

	Irrigated Area (ha)	Irrigation rate (ML/ha/year)	Water required (ML/yr)
POS – Local	1.84	7.5	13.8
POS – Neighbourhood	3.51	7.5	26.3
POS – District	9.63	7.5	72.2
POS – Entry	0.23	7.5	1.7
Streetscapes	8.69	5.5	47.8
<i>Total</i>	23.9		161.8

Following establishment both garden bed planting and turf will require less water to be maintained. The irrigation rates will be reduced to 75% after the first year for two years and further reduced to 60% of the initial rate from the third year onwards (except within streetscapes). This reduces the ongoing irrigation requirement to 115.5 ML. The staged nature of the development leads to a peak in irrigation requirement of 135.3 ML. A detailed, staged irrigation schedule is provided in **Appendix D**.

The irrigation water requirements discussed in **Table 4** are proposed to be supplied by groundwater.

As discussed in **Section 5.1.2**, an application for a total allocation of 318.9 ML has been submitted to the DoW and is awaiting assessment.

The above measures will assist in meeting **Criteria WC2**.

5.5 Wastewater management

The site will be connected to the Water Corporations Yanchep main sewer to the north.

5.6 Water conservation criteria compliance summary

A summary of the proposed water conservation design criteria and how these are addressed within the Central Alkimos LSP is provided in **Table 5**.

Table 5 Water conservation compliance summary

Criteria number	Criteria description	Manner in which compliance will be achieved
WC1	Use fit for purpose water source	Groundwater to be used for irrigation of POS and road verges

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Criteria number	Criteria description	Manner in which compliance will be achieved
		Rainwater harvesting promoted within lots for irrigation of private gardens
		Scheme water for use in lots
WC2	Consumption target for water of 100 kL/person/year, including not more than 40-60 kL/person/year scheme water	Contemporary lot sizes with less room for garden
		Provision of advice to residents regarding water conservation measures
		Use of rainwater tanks within lots of suitable built form
		Promotion/use of waterwise gardening principles
		Promotion/use of water efficient appliances
		Mandated use of water efficient fittings
WC3	Minimise use of water at an estate scale	Use of waterwise gardening principles within POS areas

6 Groundwater management strategy

The development drainage system has been designed to achieve the objectives and criteria stated in **Section 4.3**.

6.1 Groundwater level management

As discussed in **Section 3.7**, depth to groundwater varies between 52 and 14 m below natural surface. Groundwater level management measures are therefore not required, and none are proposed in the Central Alkimos LSP area.

6.2 Groundwater quality management

The main objective for the management of the groundwater quality is to maintain or improve the existing groundwater quality. This can be achieved by treating surface runoff prior to infiltration via application of appropriate WSUD measures, thereby reducing the total nutrient load into the groundwater that originates from the development.

The reduction of nutrient load to the groundwater will be achieved in the development by:

- Directing stormwater to vegetated (with native wetland species) bio-retention areas (detailed further in **Section 7.3**).
- Bio-retention areas will be underlain by a 150 mm band of material with a minimum Phosphorous Retention Index (PRI) of 10. It is acceptable for this to be achieved with a thicker layer of lower PRI soil.
- Fertiliser use to establish and maintain vegetation within POS areas and road verges will be minimised.
- Drought tolerant turf species that require minimal water and nutrients will be used.
- Roll-on turf will be used within the POS areas and road verges, to prevent the high nutrient input requirement during establishment of the turf.
- Garden beds should not be immediately adjacent to the FSAs or bio-retention areas to reduce nutrient transportation into these infiltration areas.

The above measures will improve the quality of the water prior to it infiltrating into the underlying groundwater, and will assist in achieving **Criteria GW1, GW2 and GW3**.

6.3 Groundwater criteria compliance summary

A summary of the proposed groundwater quantity design criteria and how these are addressed within the Central Alkimos LSP area is provided in **Table 6**.

Table 6 Groundwater criteria compliance summary

Criteria number	Criteria description	Manner in which compliance will be achieved
GW1	Maintain or improve groundwater quality onsite	Bio-retention areas to treat surface water runoff prior to infiltration to groundwater
		Bio-retention areas to be underlain by soils with PRI>10

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Criteria number	Criteria description	Manner in which compliance will be achieved
GW2	Treat stormwater runoff before infiltrating to groundwater	Bio-retention areas to treat surface water runoff prior to infiltration to groundwater
		Bio-retention areas to be underlain by soils with PRI>10
GW3	Use water sensitive design approaches to recharge the superficial aquifer	Soakwells within lots sized to infiltrate up to the 1 year ARI event
		Soakwells within high density lots sized to infiltrate up to 50% of the 1 year 1 hour ARI event
		FSAs sized to retain and infiltrate flows up to the 100 year ARI event
		Bio-retention areas sized to retain and infiltrate the 1 year 1 hour ARI event from road reserves and excess runoff from high density residential lots

7 Stormwater management strategy

The principle behind the stormwater management strategy for the Central Alkimos LSP area is to maintain the existing hydrology by retaining surface flows and to infiltrate the stormwater runoff as close to source as possible. The development drainage system has been designed to achieve the objectives and criteria stated in **Section 4.4**.

7.1 Residential lot drainage system

Rainfall on the front and backyards of lots (garden areas) will either infiltrate directly at-source or, in large rainfall events (i.e. approximately a 5 year ARI event), a portion of the runoff may discharge to the road network. The runoff from roof areas will be directed to soakwells which will infiltrate into the sandy soil and ultimately the groundwater.

Soakwells for lots will be sized to retain all flows from the 1 year 1 hour ARI event. The exception to this are the high-density lots (those with a total lot area of less than 220 m²) as these lots are generally too small to allow the required storage of the entire 1 year 1 hour ARI event. High density lots will therefore be required to have soakwells with capacity for 50% of the 1 year 1 hour ARI event. The remainder will be catered for within the downstream bio-retention areas.

The implementation of soakwells will assist in achieving **Criteria SW1** and **SWQ1**.

7.2 Non-residential lot drainage system

7.2.1 Commercial/business lots

Commercial/business lots will be required to retain all runoff from all events up to the 100 year ARI event within lot. This can be achieved within soakwells, subsurface storage or alternative storage methods.

7.2.2 School lots

All school lots will be required to retain all runoff from all events up to the 100 year ARI event within lot. This can be achieved within soakwells, subsurface storage or alternative storage methods.

The above measures will assist in achieving **Criteria SW1** and **SWQ1**.

7.2.3 Rail reserve and Marmion Avenue

All rail reserve areas are assumed to fully retain runoff from the 100 year ARI event within the reserve.

Marmion Avenue runs through the centre of the site, but is not contained within it. Runoff from Marmion Avenue will be retained within infiltration areas located within a combination of road reserve for the 1 year 1 hour ARI event runoff within bio-retention areas, and the adjacent POS for major event flooding, as shown in **Figure 9**.

7.3 Development drainage system

The storm water runoff from the 1 year 1 hour ARI rainfall event will be retained as close to source as practicably possible. There will be no runoff from the development during a 1 year 1 hour ARI rainfall

event. This is consistent with the pre-development environment and the design criteria (see **Section 4.4**).

The retention storage will be provided via vegetated bio-retention areas in POS. The vegetation and the infiltration process within the soil column will remove a large portion of the contaminants (nutrients, gross pollutants, suspended sediments, etc.) within the stormwater runoff.

Rainfall events greater than the 1 year 1 hour ARI event will be conveyed by overland flow or a pipe network to flood storage areas. The size of the flood storage areas will be minimised due to the retention storage provided higher up in the catchment and within lots. The stormwater drainage system for the Central Alkimos LSP area (including nominal locations for bio-retention areas and flood storage areas) is provided within **Figure 9**.

7.3.1 Bio-retention areas

Runoff from the 1 year 1 hour ARI event that is not captured on lot will be captured and retained within vegetated bio-retention areas located in POS. The bio-retention areas have been assumed to have a depth of 0.5 m, 1:3 side slopes and contain amended soil with a high PRI. The use of bio-retention areas will assist in achieving **Criteria SW1, SWQ1 and SWQ2**.

7.3.2 Flood storage areas

FSAs will be utilised to infiltrate major event flows in order to maintain the pre-development hydrological regime. The flood storage areas are not designed to be permanently wet. To achieve this, the inverts of the basins will have a significant clearance above groundwater (>10m). There will be no offsite discharge from the flood storage areas. The sizes and spatial requirements for flood storage areas are further discussed in **Section 7.4**.

The design of flood storage areas will be such that maximum top water levels within basins will remain at least 500 mm below finished floor levels of adjacent lots to ensure protection from flooding during extreme rainfall events (the preliminary earthworks strategy is provided in **Appendix E**).

The use of flood storage areas will achieve **Criteria SW1**, while the design of the basins will ensure that **Criteria SW2** are achieved.

7.4 Drainage design assessment

As described in **Section 7.3**, this LWMS proposes to utilise soakwells, bio-retention areas and FSAs to retain runoff from all events up to the 100 year ARI event onsite. The sizing of these retention areas is best achieved via a computational model. The post-development modelling methodology and parameters are detailed in the hydrological and hydraulic modelling report provided in **Appendix F**. Post development catchments for the Central Alkimos LSP area are shown in **Figure 9**.

7.4.1 Minor rainfall event modelling results

The 1 year 1 hour rainfall event will be retained onsite to satisfy **Criteria SWQ1**. The location and size of the proposed retention storage required to achieve the design criteria is presented in **Figure 9** and the design depth, volume and inundated areas of the bio-retention areas are shown in **Table 7**.

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Table 7 1 year 1 hour bio-retention storage

Bio-retention area	Top Water Level surface area (m ²)	Volume (m ³)
FSA1	2154	1009
Marmion Ave	1300	600
FSA2.1	378	161
FSA2.2	620	274
FSA3	677	301
FSA4.1	945	428
BRA4.3	255	105
FSA5	677	301
FSA 6	1056	481
<i>Total east of Marmion Ave</i>	8062	3660
FSA10	207	84
FSA11	728	325
FSA12	156	61
FSA13.1	862	388
FSA13.2	694	309
FSA14	306	128
FSA15	413	178
FSA8	620	274
BRA8.2	767	343
FSA9	0	0
<i>Total west of Marmion Ave</i>	4753	2090
<i>Total</i>	12815	5750

The total size of the bio-retention system, achieved through at-source retention storage provided by bio-retention areas, is equal to 2.4% of the connected impervious area, which achieves **Criteria SWQ2**. Native vegetation known for nutrient uptake potential will be used for areas equal to at least 2% connected impervious area to ensure nutrient uptake is undertaken. The remainder of the bio-retention area will be utilised for the retention of the 1 year 1 hour ARI event, however will only require turf to ensure infiltration of the stormwater runoff occurs. This provides some flexibility at detailed design stage to accommodate other considerations (e.g. landscaping, parking and services).

The inundated area within the Central Alkimos development for the 1 year 1 hour ARI event is shown in **Figure 10**. Note that the number of bio-retention areas can be modified at detailed design stage provided the assumed storages detailed in **Table 7** are maintained. The Central Alkimos LSP Landscape Masterplan, provided in **Appendix D**, shows how the development and stormwater management components within the development are intended to be landscaped.

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7.4.2 Major rainfall event modelling results

The Central Alkimos LSP area aims to retain runoff from events up to the 100 year ARI event, as required under **Criteria SW1**. This is achieved by the use of at-source retention and infiltration storage within bio-retention areas and FSAs. The proposed locations of the FSAs are shown in **Figure 9**. The design depth, volume and inundated areas in the 5 year and 100 year ARI events of the FSAs are provided within **Table 8**.

Table 8 Infiltration basin volumes and depths in 5 year and 100 year ARI event

Infiltration area	5 year ARI event			100 year ARI event		
	Depth (m)	Top Water Level surface area (m ²)	Volume (m ³)	Depth (m)	Top Water Level surface area (m ²)	Volume (m ³)
FSA1 (incl. Marmion Avenue)	0.497	11094	5085	1.2	13492	13661
FSA2.1	0.636	1150	1150	1.2	1727	1262
FSA2.2	0.587	1674	751	1.2	2458	1955
FSA3	0.56	2556	1176	1.2	3578	3063
FSA4	0.5	4884	2154	1.2	6470	6058
FSA5	0.58	1826	819	1.2	2662	2154
FSA6	0.56	2511	1145	1.19	3534	3018
<i>Total east of Marmion Ave</i>		<i>25695</i>	<i>12280</i>		<i>33921</i>	<i>31171</i>
FSA10	0.63	967	411	1.19	1488	1039
FSA11	0.55	2902	1320	1.2	4028	3516
FSA12	0.65	624	239	1.2	1013	629
FSA13.1	0.54	3336	1523	1.2	4552	4047
FSA13.2	0.55	3126	1429	1.19	4282	3757
FSA14	0.58	2268	1048	1.2	3203	2685
FSA15	0.6	1410	628	1.2	2100	1610
FSA8	0.51	4512	2026	1.2	5999	5559
FSA9	0.65	733	294	1.2	1166	758
<i>Total west of Marmion Ave</i>		<i>19878</i>	<i>8918</i>		<i>27831</i>	<i>23600</i>
<i>Total</i>		<i>45573</i>	<i>21198</i>		<i>61752</i>	<i>54771</i>

The 5 year ARI event stormwater inundation areas for Central Alkimos are shown in **Figure 11**. The 100 year ARI event stormwater inundation areas and flow paths are shown in **Figure 12**.

The maximum inundation time within the FSAs following a 100 year ARI event has been calculated using Darcy's law to be 21.5 hours.

The above measures will help to achieve **Criteria SW1, SW6 and SWQ1**.

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7.5 Non-structural water quality measures

The structural measures proposed within the Central Alkimos LSP area provide both a storage and treatment function to stormwater runoff, as detailed in **Sections 7.3** and **7.4**. A number of non-structural measures will also be implemented across the site to help reduce nutrient loads within stormwater runoff. These measures include:

- Minimising fertiliser use to establish and maintain vegetation within POS areas and road verges.
- Drought tolerant turf species that require minimal water and nutrients will be used.
- Maintenance of bio-retention areas to remove accumulated sediments and gross pollutants.
- Garden beds will not be located immediately adjacent to the flood storage areas or bio-retention areas (including verge swales) to reduce nutrient transportation into these areas.
- Education of residents regarding fertiliser use and low nutrient requirement vegetation species within lots.

The above measures will assist in achieving **Criteria SWQ3**.

7.6 Stormwater criteria compliance summary

A summary of the proposed stormwater design criteria and how these are addressed is given within **Table 9**.

Table 9 Stormwater management criteria compliance

Criteria number	Criteria description	Manner in which compliance will be achieved
SW1	Accommodate all runoff from all events up to the 100 year ARI event onsite	Residential lots to retain 1 year 1 hour ARI event in soakwells and garden areas
		High density lots to retain 50% of 1 year 1 hour ARI event within soakwells and garden areas
		Commercial and school lots to retain 100 year ARI events onsite
		Road runoff and excess runoff from lots will be retained within bio-retention areas and infiltration basins within POS
SW2	Finished floor levels of lots shall have a minimum 500 mm clearance to the 100 year ARI top water level	Preliminary earthworks strategy presented in Appendix E confirms that lots adjacent to infiltration basins will be at least 500 mm above the top water level of the 100 year ARI event.
SW3	Provide stormwater flow pathways for runoff from the 100 year ARI event	Preliminary earthworks strategy presented in Appendix E confirms that the road network will be graded towards POS areas, providing a flow path for 100 year ARI event runoff to reach infiltration basins
SW4	Provide minimum 300 mm clearance from dynamic 100 year ARI event flood levels within road reserves	This will be demonstrated within the earthworks strategy at detailed design stage
SW5	Minor roads are to be designed to remain passable in the 5 year ARI storm event	The pipe network will be designed to convey the 5 year ARI event which will ensure roads remain passable

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Criteria number	Criteria description	Manner in which compliance will be achieved
SW6	Design infiltration areas to avoid creating mosquito habitat	The high infiltration rates of the underlying sands ensure that the maximum inundation time within the flood storage areas will be no more than 21.5 hours
SWQ1	Retain the 1 year 1 hour ARI rainfall event onsite as close to source as practicably possible	<p>Residential lots to retain 1 year 1 hour ARI event in soakwells and garden areas</p> <p>High density lots to retain 50% of 1 year 1 hour ARI event in soakwells and garden areas</p> <p>Commercial and school lots to retain 100 year ARI events onsite</p> <p>Bio-retention areas sized to retain 1 year 1 hour ARI event from roads and overflow from high density lots</p>
SWQ2	Size bio-retention areas to (at least) 2% of the connected impervious area	Bio-retention areas are sized to 2.4% of the connected impervious area
SWQ3	Apply appropriate structural and non-structural measures to reduce nutrient loads	<p>Soakwells within lots and bio-retention areas in POS</p> <p>Minimise use of fertilisers within POS and road verges</p> <p>Maintenance of POS and drainage areas</p> <p>Education of residents regarding responsible nutrient application</p>

8 Subdivision and urban water management plans

The requirement to undertake preparation of more detailed water management plans to support subdivision is generally imposed as a condition of subdivision. The development of any future UWMP should follow the guidance provided in *Urban Water Management Plans: Guidelines for Preparing Plans and for Complying with Subdivision Conditions* (DoW 2008).

While strategies have been provided within this LWMS that address planning for water management within the site, it is a logical progression that future subdivision designs and the supportive UWMP will clarify details not provided within the LWMS. The main areas that will require further clarification within future UWMPs include:

- Modelling of local road drainage network
- Stormwater storage within non-residential lots
- Flood storage area configurations
- Imported fill specifications and requirements
- Implementation of water conservation strategies
- Non-structural water quality improvement measures
- Management and maintenance requirements
- Construction period management strategy
- Monitoring and evaluation program
- Status of groundwater abstraction license
- Infiltration assumptions.

These are further detailed in the following sections. As stated above, ongoing monitoring of groundwater will be detailed in the UWMP, however in this LWMS is outlined broadly in **Section 9**.

8.1 Modelling of local road drainage network

It is acknowledged that the drainage strategies documented in this LWMS, are based upon broad-scale assumptions and regional data. These assumptions are considered adequate for development of the proposed infiltration basin sizes and are of an appropriate level of detail; however verification of proposed subdivision drainage designs within the LSP area will be undertaken by modelling the catchments serviced by the piped drainage network. Such modelling will allow verification that the development undertaken within the LSP area is consistent with this LWMS. The design of the drainage system to date has been undertaken at an appropriate level for local structure planning and runoff-routing computer modelling of the stormwater drainage system will be reviewed once detailed drainage design has commenced for the area. It is anticipated that this will occur during the subdivision design process and detailed within the future UWMPs.

The exception to the requirement to revise the surface runoff modelling is if the catchment details and basin designs are consistent with the assumptions made in this LWMS. If this were the case it would be acceptable to provide design calculations for the concrete pipe and retention areas to demonstrate compliance with the LWMS.

8.2 Stormwater storage within non-residential lots

The Central Alkimos LSP stormwater management strategy assumes that all commercial/business and school lots will retain all runoff from the 100 year ARI event (as discussed in **Section 7.2**). Future UWMPs will be required to confirm the manner in which this will be achieved.

8.3 Flood storage area configurations

While the Central Alkimos LSP area drainage catchments have been defined based on the earthworks model presented in **Appendix E**, it is possible that these could undergo some change to accommodate stakeholder feedback prior to final subdivision design. The exact location and shape of the flood storage areas will still need to be specified and presented within the future UWMPs.

In order to review the final flood storage area configurations, the hydrological model that has been developed to support this LWMS may need to be refined in light of stakeholder feedback. It is expected that the civil drainage designs will be progressed to a level that provides detailed cross-sections, sizes of storage areas, pipe sizes, inverts, etc. The ultimate aim of revising the hydrological model will be to confirm that the post-development runoff volumes are able to meet the performance criteria proposed in **Section 4** of this LWMS.

8.4 Imported fill specifications

As discussed previously the use of clean fill will be required to ensure the flood storage areas remain as dry basins and sufficient clearance of 100 year ARI flood levels is maintained. Soils beneath bio-retention areas will require a high PRI to ensure at-source nutrient retention leading to the protection of downstream water bodies. The specification for this would typically be that a 150 mm band of soil with a PRI >10 will be imported beneath any bio-retention or treatment areas.

8.5 Implementation of water conservation strategies

A number of potential measures to conserve water have been presented within this LWMS. These water conservation strategies will be incorporated into the design and the ongoing maintenance of all POS areas. Landscape design measures that will be incorporated into the water conservation strategy will be further detailed within the future UWMPs produced for the development. The manner in which the developer intends to promote water conservation measures discussed in this LWMS to future lot owners will also be discussed within the future UWMPs.

8.6 Non-structural water quality improvement measures

Guidance for the development and implementation of non-structural water quality improvement measures is provided within the *Stormwater Management Manual for Western Australia* (DoW 2007). Some measures will be more appropriately implemented at a local government level, such as street sweeping, however many can be implemented relatively easily within the design and maintenance of the subdivision and the POS areas. It is expected that the future UWMP will provide reference to measures such as public education (through measures such as signage that may be implemented to raise awareness).

8.7 Management and maintenance requirements

The management measures to be implemented to address surface water quality, such as the use of vegetation within bio-retention areas and infiltration basins will require ongoing maintenance. It is therefore expected that the future UWMP will detail management and maintenance procedures that will set out required maintenance actions (e.g. gross pollutant removal), timing (e.g. how often it will occur), locations (e.g. exactly where it will occur) and responsibilities (e.g. who will be responsible for carrying out the actions). Given that approval from the CoW and DoW will be sought for the proposed measures, it is anticipated that consultation with these agencies will be undertaken and referral to guiding policies and documents will be made.

8.8 Construction period management strategy

It is anticipated that the construction stage will require some management of various aspects (e.g. dust, surface runoff, noise, traffic etc.). The management measures undertaken for construction management will be addressed either in the future UWMP or a separate Construction Management Plan (CMP).

8.9 Monitoring and evaluation program

It will be necessary to confirm that the management measures that are implemented are able to fulfil their intended management purpose, and are in a satisfactory condition at a point of management hand-over to the CoW. A post-development monitoring program will be developed to provide this confirmation, and it will include details of objectives of monitoring, relevant issues and information, proposed methodology, monitoring frequency and reporting obligations. These monitoring programs are discussed in **Section 9** of this LWMS and will be further detailed at the UWMP stage.

8.10 Groundwater license status

An application for groundwater allocation from the superficial aquifer has been submitted to the DoW for the Central Alkimos LSP area (as discussed in **Section 5.4**). This applications is pending and it is expected that future UWMPs will demonstrate that adequate allocation of water has been obtained to irrigate POS and road verges within both LSP areas, or that an appropriate contingency plan has been established in the event that a reduced water allocation is obtained.

8.11 Infiltration assumptions

The infiltration rates used within the hydrological modelling have been based on measurements recorded within the adjacent Alkimos South development site. A detailed geotechnical study, including measurement of site specific infiltration rates, is required to inform further modelling for future UWMPs. Assumed infiltration rates to be used for detailed design of all infiltration basins (bio-retention areas and FSAs) should be based on site specific measurements plus an allowance for clogging, to be agreed with the CoW.

9 Monitoring

It is proposed that the overall condition of the development will be monitored on a bi-annual basis. This monitoring will be implemented after the completion of the civil and landscaping works and will continue for a period of two years.

A visual assessment will be undertaken to monitor the overall condition of the development, with the aim to ascertain that the maintenance activities are achieving the overall management objectives for the development. The parameters that will be monitored include:

- Gross Pollutants
- Terrestrial Weeds
- Irrigation
- Vegetation density
- Paths, benches, walkways and other infrastructure.

The management and maintenance objectives will be detailed within future UWMPs along with details of the corresponding monitoring program.

9.1 Groundwater monitoring

Given that there will be no surface water discharge from the site during a 1 year 1 hour ARI event it will be very difficult to collect a water quality sample for treated surface runoff. Rather, post-development monitoring will instead focus on groundwater quality.

Due to the significant depth to groundwater across the site, groundwater quality is not representative of the management practices of the site above. Groundwater monitoring is therefore proposed as an indication of quality and management of the wider area and not the LSP areas specifically. As such, a single monitoring bore within a representative POS is proposed. The proposed location for the groundwater monitoring bore is indicated on **Figure 9**.

Groundwater quality monitoring will be conducted on a quarterly basis. A summary of the post-development monitoring program is shown in **Table 10**. The post-development monitoring should be conducted for two years post construction.

Table 10 Groundwater monitoring program

Monitoring Type	Locations	Frequency	Parameters
Groundwater	Single bore within a representative POS	Quarterly (typically Jan, April, July, Oct).	<i>In situ</i> pH, EC, temperature. Sample TSS, TN, TKN, NH ₄ , NO _x , TP, FRP.

9.2 Reporting

A post-development monitoring report will be prepared on conclusion of the two year monitoring period, and will be provided to the CoW and the DoW. Interim results (spreadsheet) can be provided to either CoW or DoW on request during the monitoring program.

10 Implementation

The LWMS is a key supportive document for the LSP. The development of the LWMS has been undertaken with the intention of providing a structure within which subsequent development can occur consistent with a total water cycle management approach. It is also intended to provide overall guidance to the general stormwater management principles for the area and to guide the development of the future UWMPs.

10.1 Roles and responsibility

The LWMS provides a framework that the proponent can utilise to assist in establishing stormwater management methods that have been based upon site-specific investigations, are consistent with relevant State and Local Government policies and have been endorsed by the CoW. The responsibility for working within the framework established within the LWMS rests with the subdivider, although it is anticipated that the future UWMP will be developed in consultation with the CoW and DoW and in consideration of other relevant policies and documents.

10.2 Funding

The site includes multiple landholdings held by LandCorp. While there is no regional drainage system for the development to connect to, the proponent will need to work with the CoW to ensure provision of services is staged appropriately throughout the construction process.

10.3 Review

It is not anticipated that this LWMS will be reviewed, unless additional land parcels/lots are added to the LSP areas prior to subdivision, or the LSPs undergo significant change post-lodgement of the LWMS. If additional areas are required to be covered by the LWMS it is most likely that an addendum to cover these areas could be prepared. If the LSP is substantially modified surface runoff modelling undertaken for this LWMS will need to be reviewed and the criteria proposed revised to ensure that all are still appropriate.

The next stages of water management are anticipated to be lot planning through subdivision. Subdivision approvals will be supported by a UWMP. The UWMP is largely an extension of the LWMS, as it should provide detail to the designs proposed within this LWMS, and will demonstrate compliance with the Criteria proposed in **Section 4**.

In addition to the issues detailed in **Section 6**, the UWMP will address:

- Compliance with design objectives within the LWMS
- Detailed stormwater management design
- Specific structural and non-structural methods to be implemented and their manner of implementation
- Details of proposed roles and responsibilities for the above measures.

The next stage of development following the UWMP is single lot or multiple dwelling developments. It is recognised that certain elements of the LWMS and the UWMP will not be implemented until this late stage, and that there is little or no statutory control that can be applied to ensure the implementation of

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any remaining measures. While the remaining measures are unlikely to be enforced at this stage, their implementation could be encouraged by the CoW through policy (or modification of these where necessary), building licence or awareness programs (such as the Water Corporation's Waterwise program).

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FIGURES



Figure 1: Locality diagram

Figure 2: Site boundary

Figure 3: Topographical contours

Figure 4: Geological units

Figure 5: Vegetation condition mapping

Figure 6: Pre-development catchments

Figure 7: Hydrological Features

Figure 8: Groundwater Levels

Figure 9: Stormwater management features

Figure 10: 1 year 1 hour inundation areas

Figure 11: 5 year ARI inundation areas

Figure 12: 100 year ARI inundation areas

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Figure 1: Location Plan

Project: Central Alkimos LWMS

Client: Lendlease Communities (Alkimos) Pty Ltd



Legend

 Site boundary

Plan Number: EP11-065(12)--F14

Drawn: GRO Date: 27/03/12

Approved: DPC Date: 20/11/12

Checked: RLE Scale: 1:30,000@A4

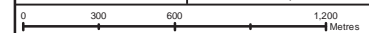




Figure 2: Site Boundary

Project: Central Alkimos LWMS

Client: Lendlease Communities (Alkimos) Pty Ltd



Legend

Site boundary

Cadastral boundaries

Plan Number: EP11-065(12)-F15

Drawn: GRO	Date: 27/03/12
Approved: DPC	Date: 20/11/12
Checked: RLE	Scale: 1:17,000@A4

0 165 330 660 Metres






Figure 3: Topography

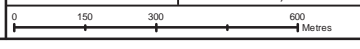
Project: Central Alkimos LWMS

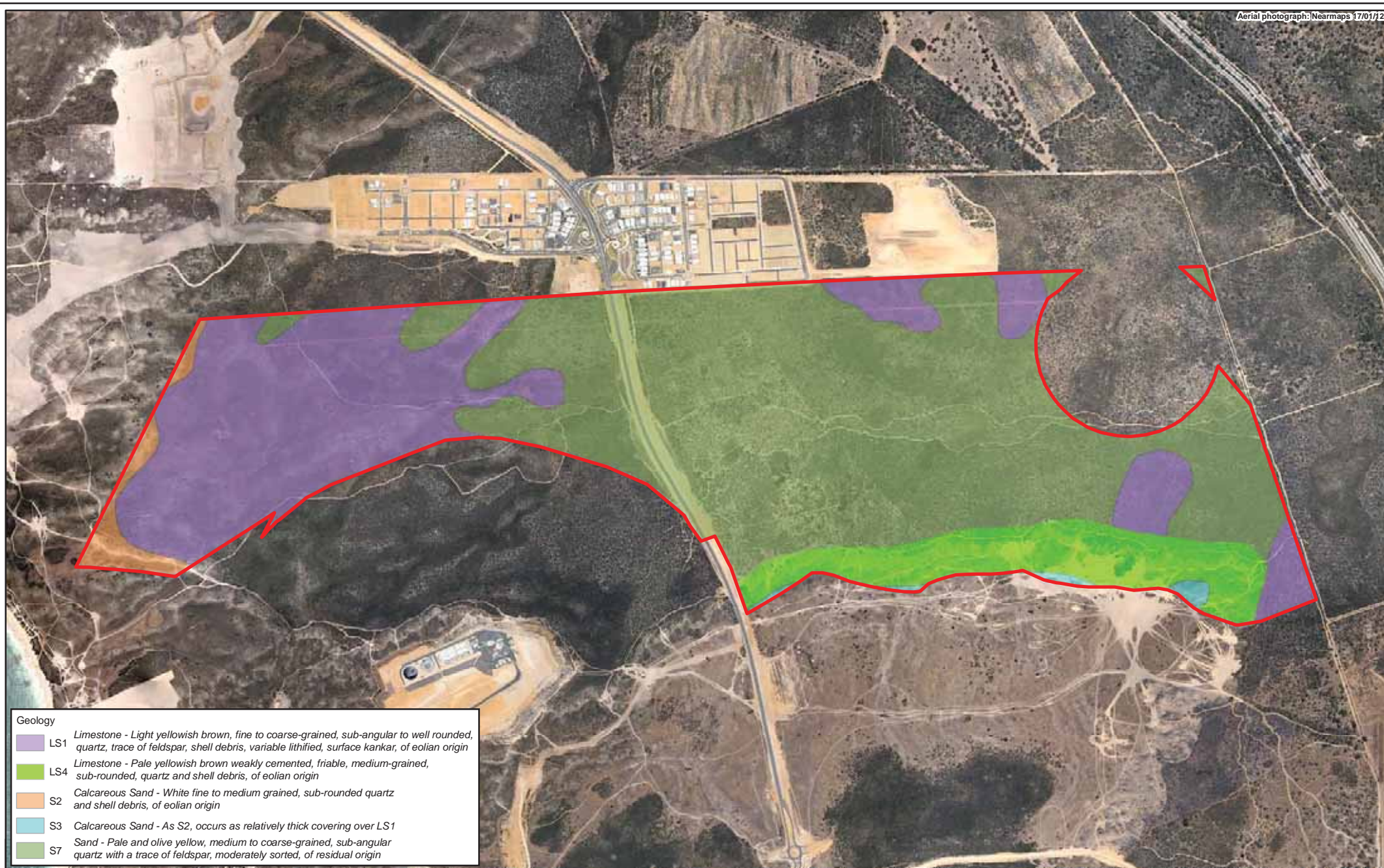
Client: Lendlease Communities (Alkimos) Pty Ltd



Legend	
	Site boundary
	Contours (mAHD)

Plan Number: EP11-065(12)-F16	
Drawn: GRO	Date: 27/03/12
Approved: DPC	Date: 20/11/12
Checked: RLE	Scale: 1:16,000@A4








Geology	
	LS1 Limestone - Light yellowish brown, fine to coarse-grained, sub-angular to well rounded, quartz, trace of feldspar, shell debris, variable lithified, surface kankar, of eolian origin
	LS4 Limestone - Pale yellowish brown weakly cemented, friable, medium-grained, sub-rounded, quartz and shell debris, of eolian origin
	S2 Calcareous Sand - White fine to medium grained, sub-rounded quartz and shell debris, of eolian origin
	S3 Calcareous Sand - As S2, occurs as relatively thick covering over LS1
	S7 Sand - Pale and olive yellow, medium to coarse-grained, sub-angular quartz with a trace of feldspar, moderately sorted, of residual origin

Figure 4: Geological Mapping

Project: Central Alkimos LWMS

Client: Lendlease Communities (Alkimos) Pty Ltd



Legend

 Site boundary

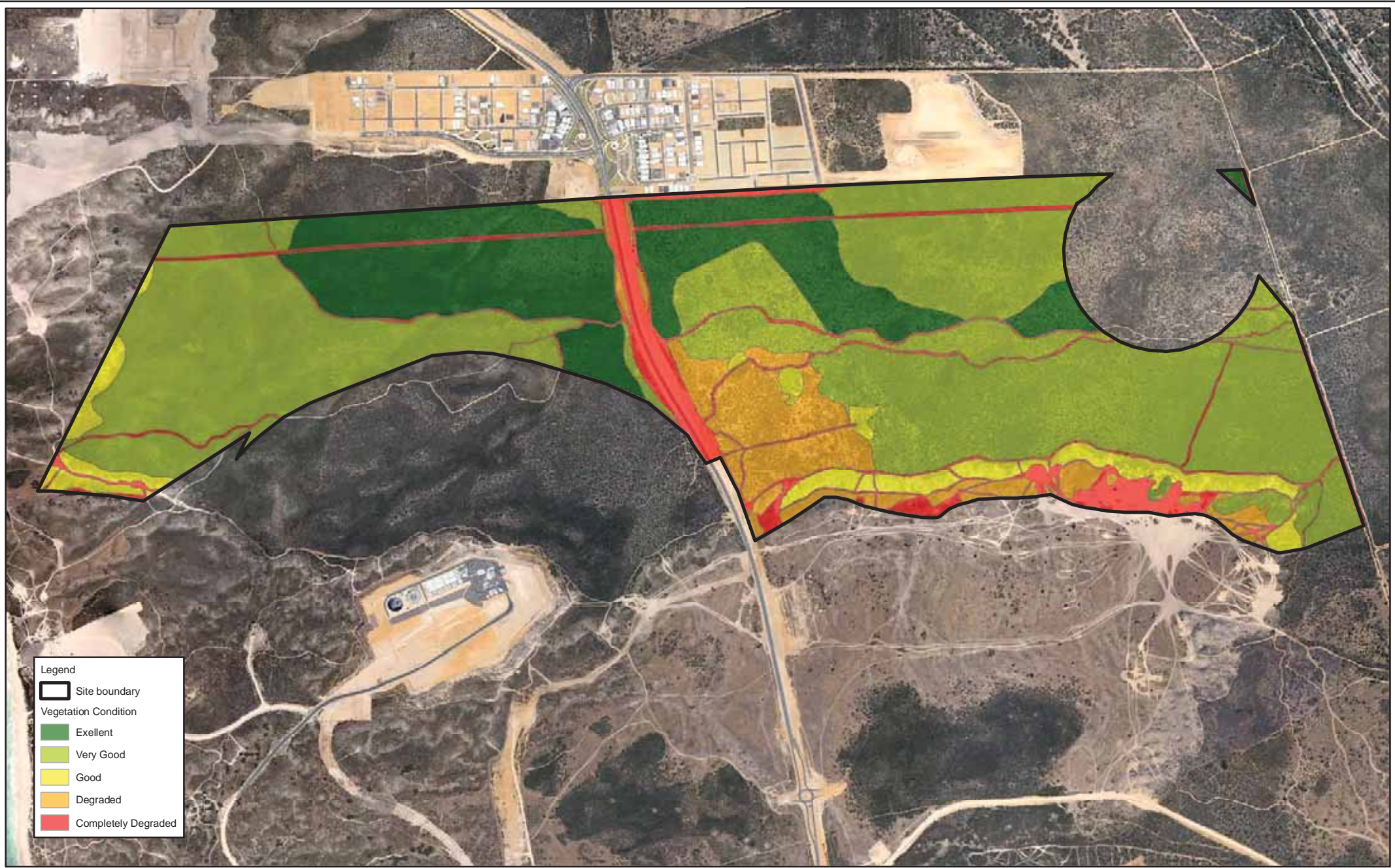
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Drawn: GRO Date: 27/03/12

Approved: DPC Date: 20/11/12

Checked: RLE Scale: 1:16,000@A4



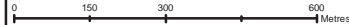


Legend

-  Site boundary
- Vegetation Condition**
-  Exellent
-  Very Good
-  Good
-  Degraded
-  Completely Degraded

Figure 5: Vegetation Condition	
Project:	Central Alkimos LWMS
Client:	Lend Lease Communities (Alkimos) Pty Ltd



Plan Number: EP11-065(12)-F81	
Drawn: GRO	Date: 18/10/12
Approved: DPC	Date: 20/11/12
Checked: RLE	Scale: 1:15,000@A4
	



Sources: The following datasets were used in the production of this map: Vegetation Condition - Emerge Associates (2005)

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used

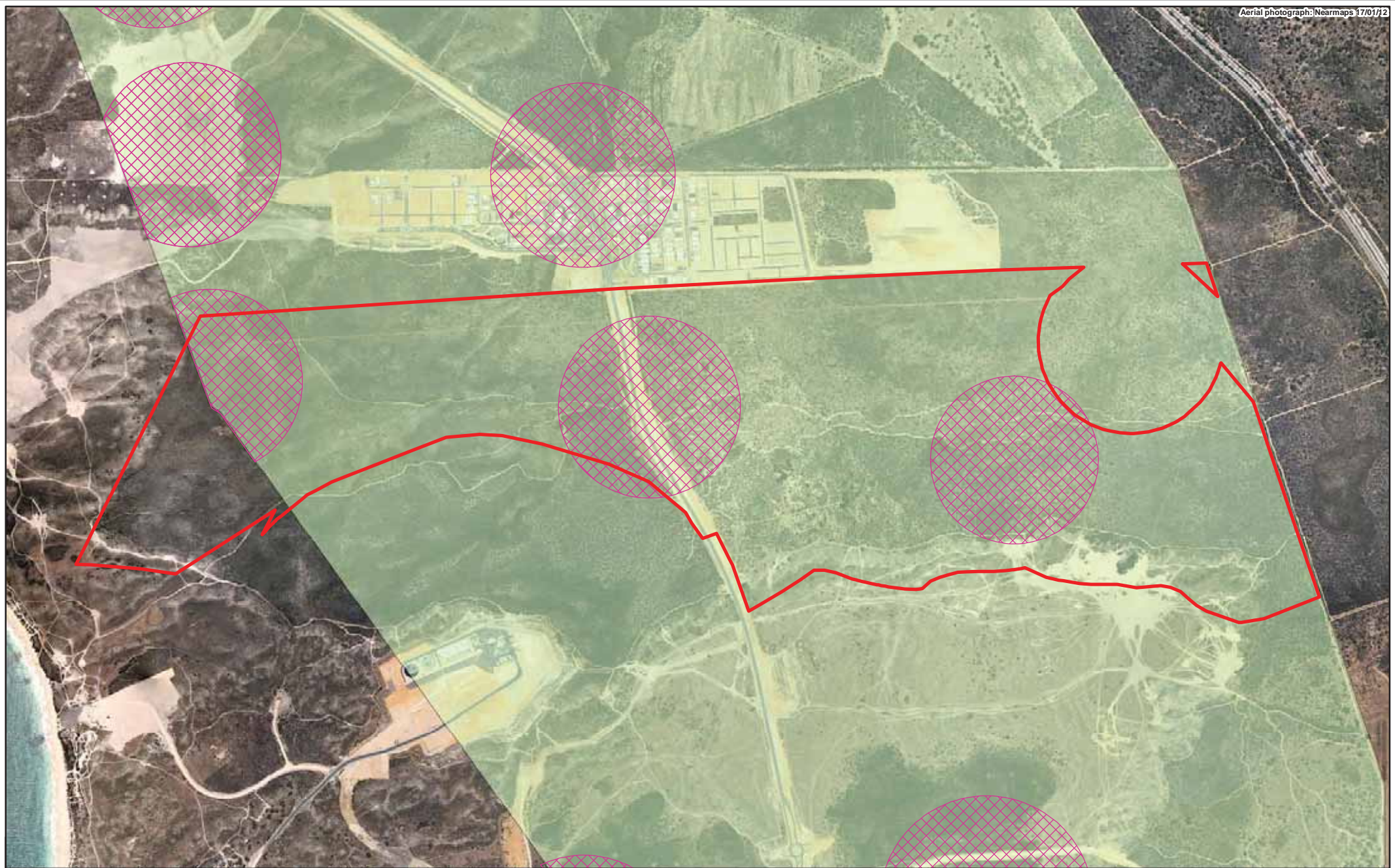






Figure 6: Hydrological Features

Project: Central Alkimos LWMS

Client: Lendlease Communities (Alkimos) Pty Ltd



Legend	
	Site boundary
	Public Drinking Water Source Area - Priority 3
	Well Head Protection Zone

Plan Number: EP11-065(12)-F19	
Drawn: GRO	Date: 27/03/12
Approved: DPC	Date: 20/11/12
Checked: RLE	Scale: 1:16,000@A4
	



Sources: The following datasets were used in the production of this map: Public Drinking Water Source Areas - DoW (2011)



Figure 7: Pre-development Catchments

Project: Central Alkimos LWMS

Client: Lendlease Communities (Alkimos) Pty Ltd



Legend

- Site boundary
- Catchment

Plan Number: EP11-065(12)-F20

Drawn: GRO	Date: 27/03/12
Approved: DPC	Date: 20/11/12
Checked: RLE	Scale: 1:17,000@A4

0 175 350 700 Metres





Figure 8: Groundwater Levels

Project: Central Alkimos LWMS

Client: Lendlease Communities (Alkimos) Pty Ltd



Legend

- Site boundary
- + Monitoring locations
- (1.01) Maximum measured groundwater Levels (mAHD)

Plan Number: EP11-065(12)-F38

Drawn: GRO	Date: 09/07/12
Approved: DPC	Date: 20/11/12
Checked: RLE	Scale: 1:17,500@A4

0 175 350 700 Metres





Figure 9: Central Alkimos Stormwater Management Features

Project: Central Alkimos LWMS

Client: Lendlease Communities (Alkimos) Pty Ltd



Legend

- Site boundary
- Bio retention area
- 100 year basin
- POS/ROS
- Catchment boundary
- GW monitoring bore

Plan Number: EP11-065(12)-F43

Drawn: GRO Date: 05/11/12

Approved: DPC Date: 20/11/12

Checked: RLE Scale: 1:14,500@A4

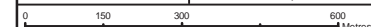




Figure 10: Central Alkimos 1 Year ARI Inundation Areas

Project: Central Alkimos LWMS

Client: Lendlease Communities (Alkimos) Pty Ltd

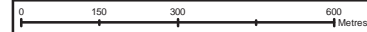


Legend

- Site boundary
- Catchment boundary
- 1 year inundation area
- POS/ROS
- 100 year basin
- LSP

Plan Number: EP11-065(12)-F41

Drawn: GRO	Date: 05/11/12
Approved: DPC	Date: 20/11/12
Checked: RLE	Scale: 1:14,500@A4



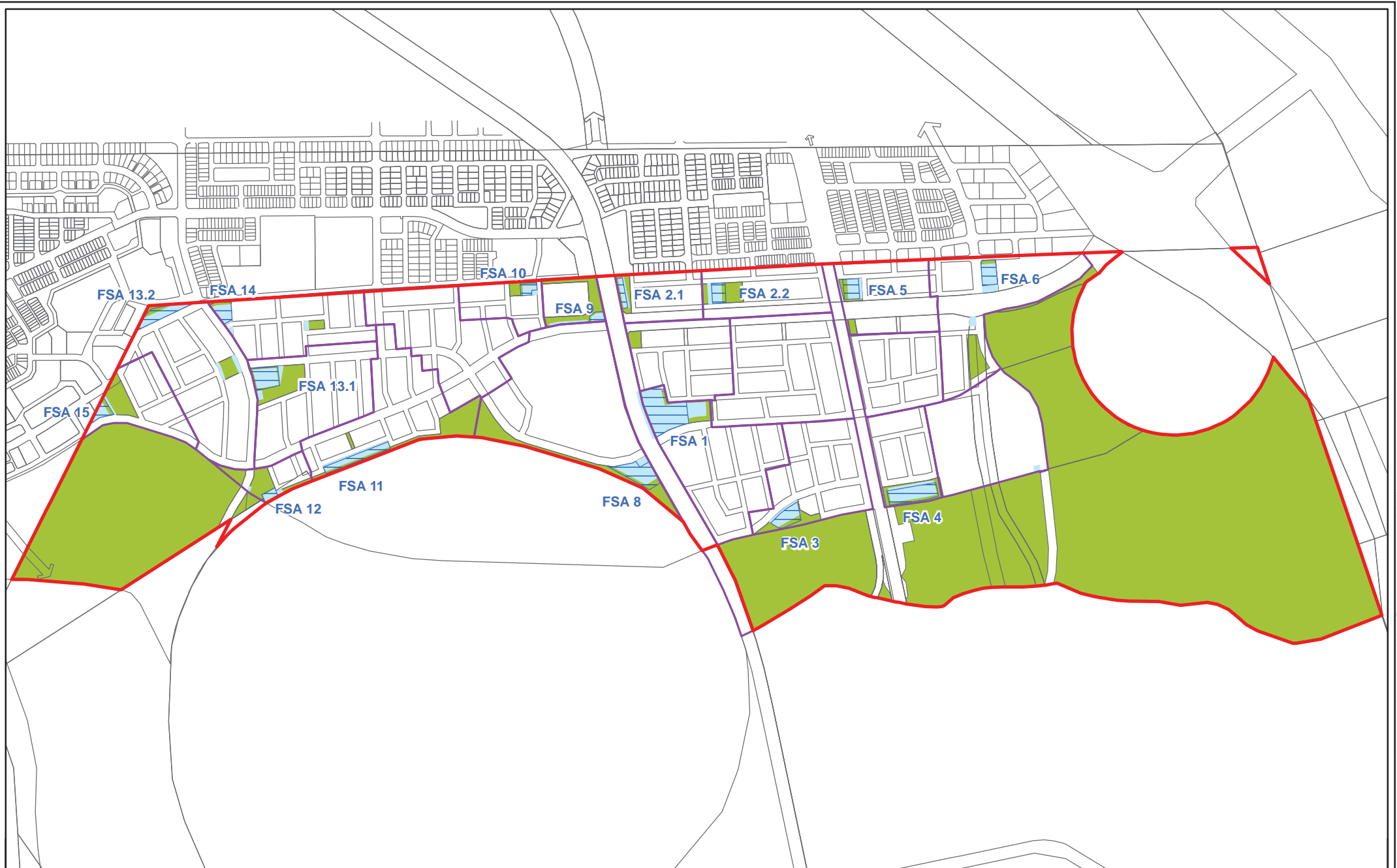


Figure 11: Central Alkimos 5 Year ARI Inundation Areas

Project: Central Alkimos LWMS

Client: Lendlease Communities (Alkimos) Pty Ltd

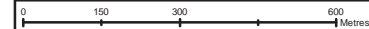


Legend

- Site boundary
- Catchment boundary
- 5 year inundation areas
- POS/ROS
- 100 year basin
- LSP

Plan Number: EP11-065(12)-F42

Drawn: GRO	Date: 09/07/12
Approved: DPC	Date: 20/11/12
Checked: RLE	Scale: 1:14,500@A4



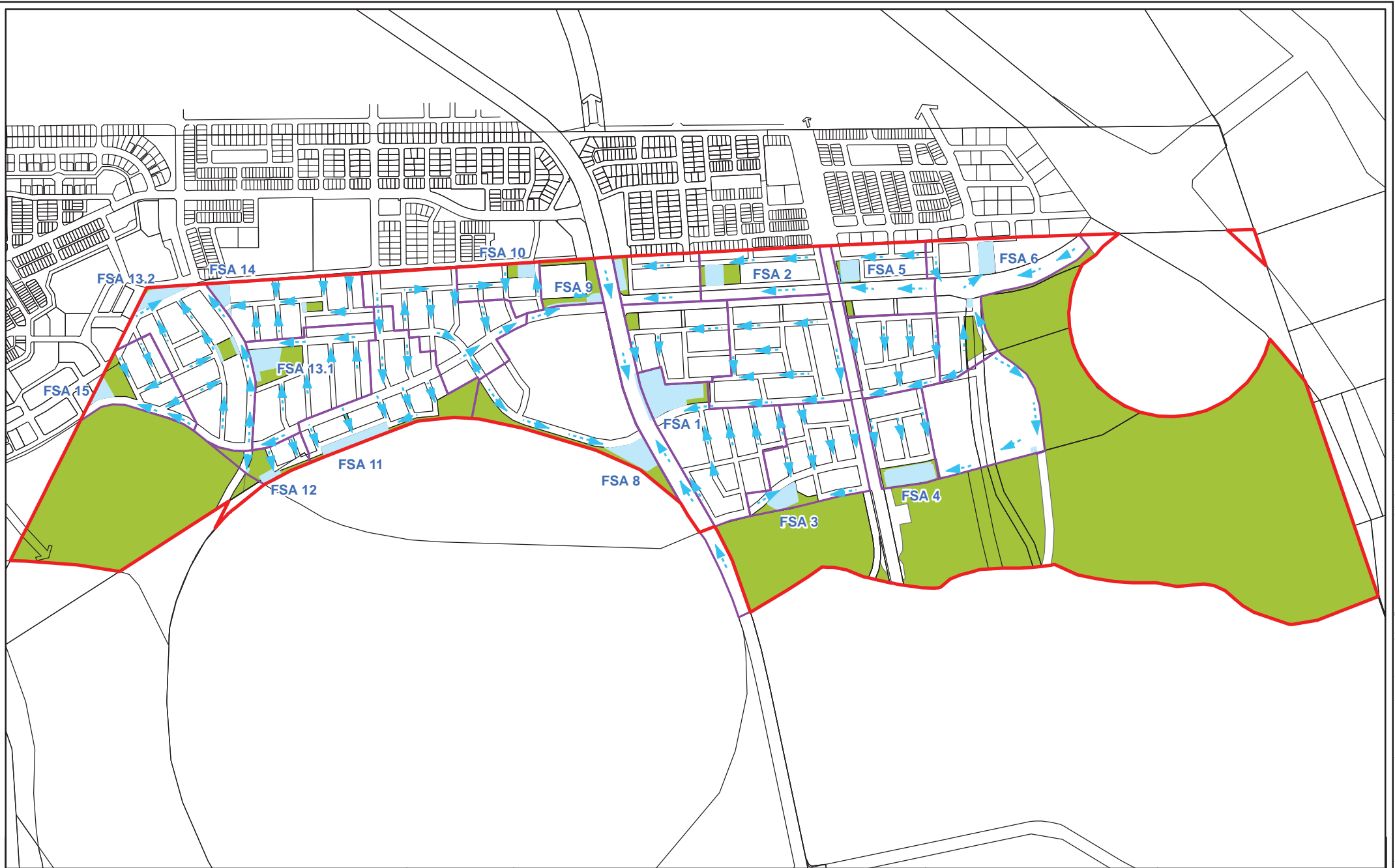


Figure 12: Central Alkimos 100 Year ARI Inundation Areas

Project: Central Alkimos LWMS

Client: Lendlease Communities (Alkimos) Pty Ltd



Legend

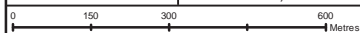
- Site boundary
- Catchment boundary
- 100 year ARI inundation area
- POS/ROS
- Flow paths
- LSP

Plan Number: EP11-065(12)-F39

Drawn: GRO Date: 09/07/12

Approved: DPC Date: 20/11/12

Checked: RLE Scale: 1:14,500@A4



APPENDIX A



CENTRAL ALKIMOS LSP

LOCAL WATER MANAGEMENT STRATEGY
CENTRAL ALKIMOS LSP

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- LEGEND: ALKIMOS CENTRAL
- Alkimos Central
 - Mixed Use
 - Neighbourhood Residential
 - Business Enterprise
 - Education / POS
 - POS - Public Open Space
 - ROS - Regional Open Space
 - PAV/ Street Share
 - Rail Route Planning Area
 - Rail Route Planning Area (reduced)

POS 2100m²
RESIDENTIAL 100m²
ROAD RESERVE 1292m²

LOCAL WATER MANAGEMENT STRATEGY
ALKIMOS CITY CENTRE LSP

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APPENDIX B



LANDSCAPE DESIGNS

LOCAL WATER MANAGEMENT STRATEGY
CENTRAL ALKIMOS LSP

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STAGED WATER REQUIREMENTS FOR ALKIMOS BALANCE LAND (Central)

Nov-12

PUBLIC OPEN SPACE

Stage	Area (m2)	Area (Ha)	% of area to be irrigated	Irrigated Area (Ha)	POS Type	Irrigation Rate / Year ML/Ha/Yr	POS Irrigation Demand (ML per annum)	TOTAL DEMAND (ML over 16years)	Year 2014	Year 2015	Year 2016	Year 2017	Year 2018	Year 2019	Year 2020	Year 2021	Year 2022	Year 2023	Year 2024	Year 2025	Year 2026	Year 2027	Year 2028	Year 2029
									0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Central Alkimos Park Letter																								
N1	A	8,883	0.8883	40	0.35532	Neighbourhood	7.5	2.6649	13.06									2.66	2.00	2.00	1.60	1.60	1.60	1.60
N1	B	4,806	0.4806	40	0.19224	Local	7.5	1.4418	7.06									1.44	1.08	1.08	0.87	0.87	0.87	0.87
N1	E	3,194	0.3194	40	0.12776	Local	7.5	0.9582	4.70									0.96	0.72	0.72	0.57	0.57	0.57	0.57
N1	G	2,421	0.2421	40	0.09684	Local	7.5	0.7263	3.56									0.73	0.54	0.54	0.44	0.44	0.44	0.44
N2	F	13,611	1.3611	40	0.54444	Neighbourhood	7.5	4.0833	20.01									4.08	3.06	3.06	2.45	2.45	2.45	2.45
N2	H	5,040	0.504	40	0.2016	Local	7.5	1.512	7.41									1.51	1.13	1.13	0.91	0.91	0.91	0.91
N3	C	3,005	0.3005	40	0.1202	Local	7.5	0.9015	5.50									0.90	0.68	0.68	0.54	0.54	0.54	0.54
N3	D	1,410	0.141	40	0.0564	Local	7.5	0.423	2.58									0.42	0.32	0.32	0.25	0.25	0.25	0.25
N4	J	3,200	0.32	40	0.128	Local	7.5	0.96	6.43									0.96	0.72	0.72	0.58	0.58	0.58	0.58
N4	K	9,925	0.9925	40	0.397	Entry/Neighbourhood	7.5	2.9775	19.95									2.98	2.23	2.23	1.79	1.79	1.79	1.79
N5	I	38,887	3.8887	30	1.16661	Neighbourhood/Conservation	7.5	8.749575	74.37			8.75	6.56	6.56	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25
N6 North	N	1,869	0.1869	40	0.07476	Local/Entry	7.5	0.5607	4.77									0.56	0.42	0.42	0.34	0.34	0.34	0.34
N6 North	O	16,117	1.6117	40	0.64468	Neighbourhood	7.5	4.8351	41.10			4.84	3.63	3.63	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90	2.90
N6 South	P	7,516	0.7516	40	0.30064	Local	7.5	2.2548	23.22	2.25	1.69	1.69	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35
N7	L	3,920	0.392	40	0.1568	Entry/Local	7.5	1.176	8.58									1.18	0.88	0.88	0.71	0.71	0.71	0.71
N7	M	7,098	0.7098	40	0.28392	Local	7.5	2.1294	15.54									2.13	1.60	1.60	1.28	1.28	1.28	1.28
N8	S	10,080	1.008	40	0.4032	Neighbourhood	7.5	3.024	11.19									3.02	2.27	2.27	1.81	1.81	1.81	1.81
N8	T	6,312	0.6312	85	0.53652	District	7.5	4.0239	14.89									4.02	3.02	3.02	2.41	2.41	2.41	2.41
N8*	U	106,342	10.6342	85	9.09007	District	7.5	68.175525	252.25									68.18	51.13	51.13	40.91	40.91	40.91	40.91
N9	Q	4,019	0.4019	40	0.16076	Local	7.5	1.2057	10.97			1.21	0.90	0.90	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72
N10	R	4,217	0.4217	40	0.16868	Local	7.5	1.2651	11.51			1.27	0.95	0.95	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
TOTALS (Cumulative)								112.78	547.14	2.25	1.69	1.69	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35	1.35

Central Alkimos Based on Roberts Day DLL CIT Drawing No. RDT 001 Issue B - ROS Not Included According to allocated Park Typologies 100% of rate applicable for first year only Reduction in rate following first year of establishment based on 75% for following 2 years, followed by 60% for 3rd and all consecutive years Following hand over (approx 3-4 years after construction) it is anticipated all native planter beds will cease being irrigated - only turf areas will be irrigated in perpetuity

STREETSCAPES

Length of ALL Streets/ Roads (Lm)	% Expected to be irrigated	Length of irrigated Streets/Roads (m)	Width (m) to be irrigated (averaged)	Area (m2)	Area (Ha)	Irrigation Rate / Year ML/Ha/Yr	POS Irrigation Demand (ML per annum)	TOTAL DEMAND (ML over 16years)	Year 2014	Year 2015	Year 2016	Year 2017	Year 2018	Year 2019	Year 2020	Year 2021	Year 2022	Year 2023	Year 2024	Year 2025	Year 2026	Year 2027	Year 2028	Year 2029
									2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99
Central Alkimos																								
26,346	30%	7,904	11	86,942	8.6948	5.5	47.82	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	
TOTALS (Cumulative)								2.99	5.98	8.97	11.95	14.94	17.93	20.92	23.91	26.90	29.89	32.87	35.86	38.85	41.84	44.83	47.82	

Streetscape Assumptions: Based on current allocations in South Alkimos (General Scheme roads only to be irrigated) Based on average Alkimos Design Code street cross sections for General Scheme Roads DoW recommended rate = 7.5ML/Ha/Yr 5.5 ML/Ha/Yr accommodates for trail off (reduction of rate following first year of establishment) Assumed average roll out over 16 year construction program

GRAND TOTALS

CENTRAL - IRRIGATION DEMAND (POS and Streetscapes) - Cumulative								160.60	5.24	7.67	11.86	28.36	27.81	33.92	37.90	41.23	43.39	57.18	57.12	135.33	117.81	120.79	112.50	115.49
--	--	--	--	--	--	--	--	---------------	-------------	-------------	--------------	--------------	--------------	--------------	--------------	--------------	--------------	--------------	--------------	---------------	---------------	---------------	---------------	---------------

Note: Water usage for dust suppression not included



ALKIMOS CITY AND CENTRAL

PROPOSED STAGING PRECINCTS & YIELDS

SCALE SHEET - 03 September 2012

1000m
DRAFT

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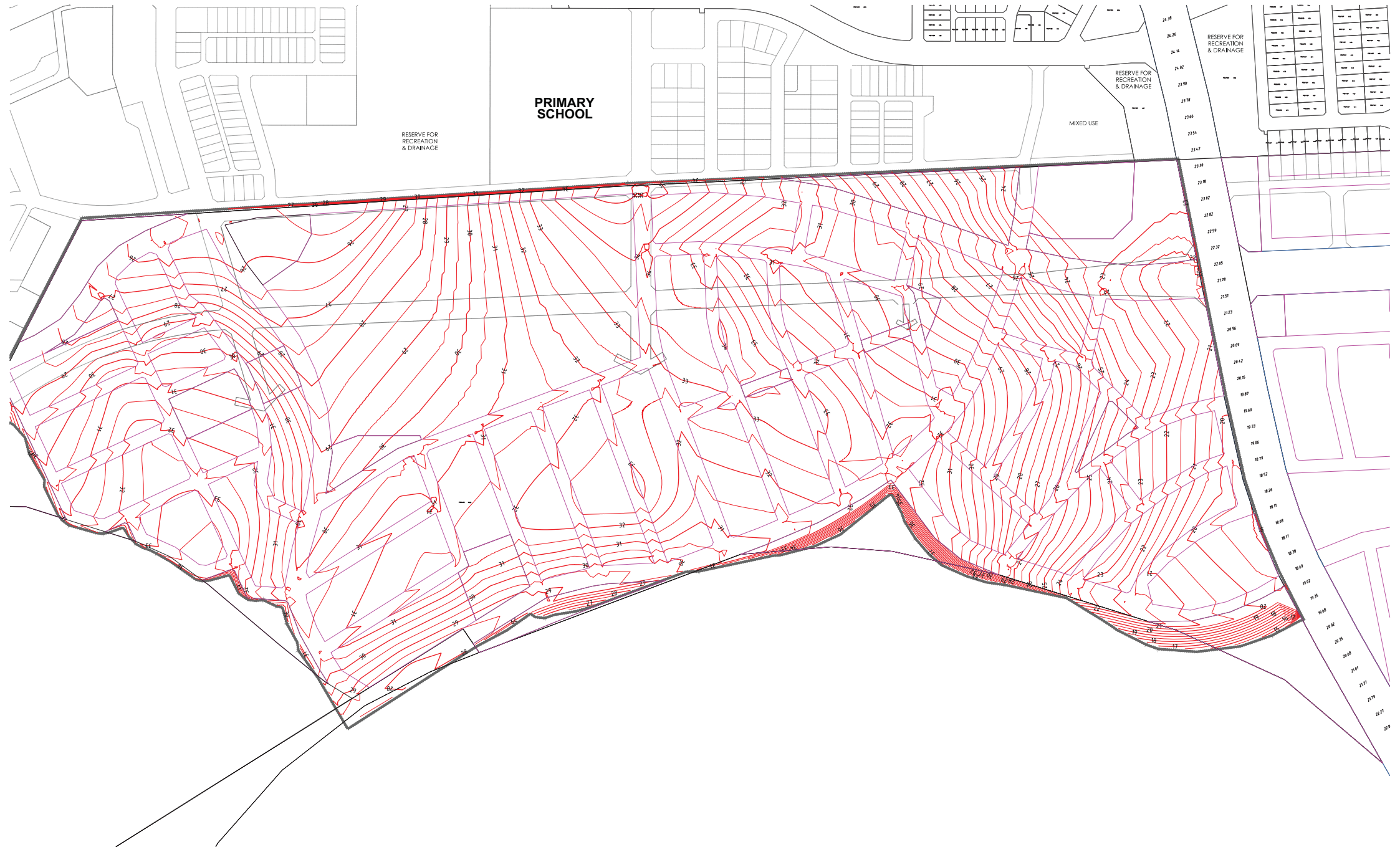
APPENDIX C



EARTHWORKS PLANS

LOCAL WATER MANAGEMENT STRATEGY
CENTRAL ALKIMOS LSP

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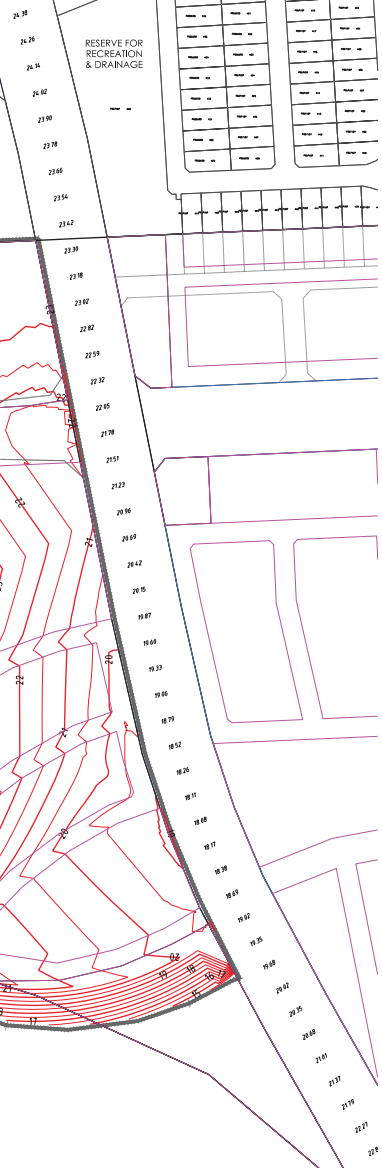
**PRIMARY
SCHOOL**

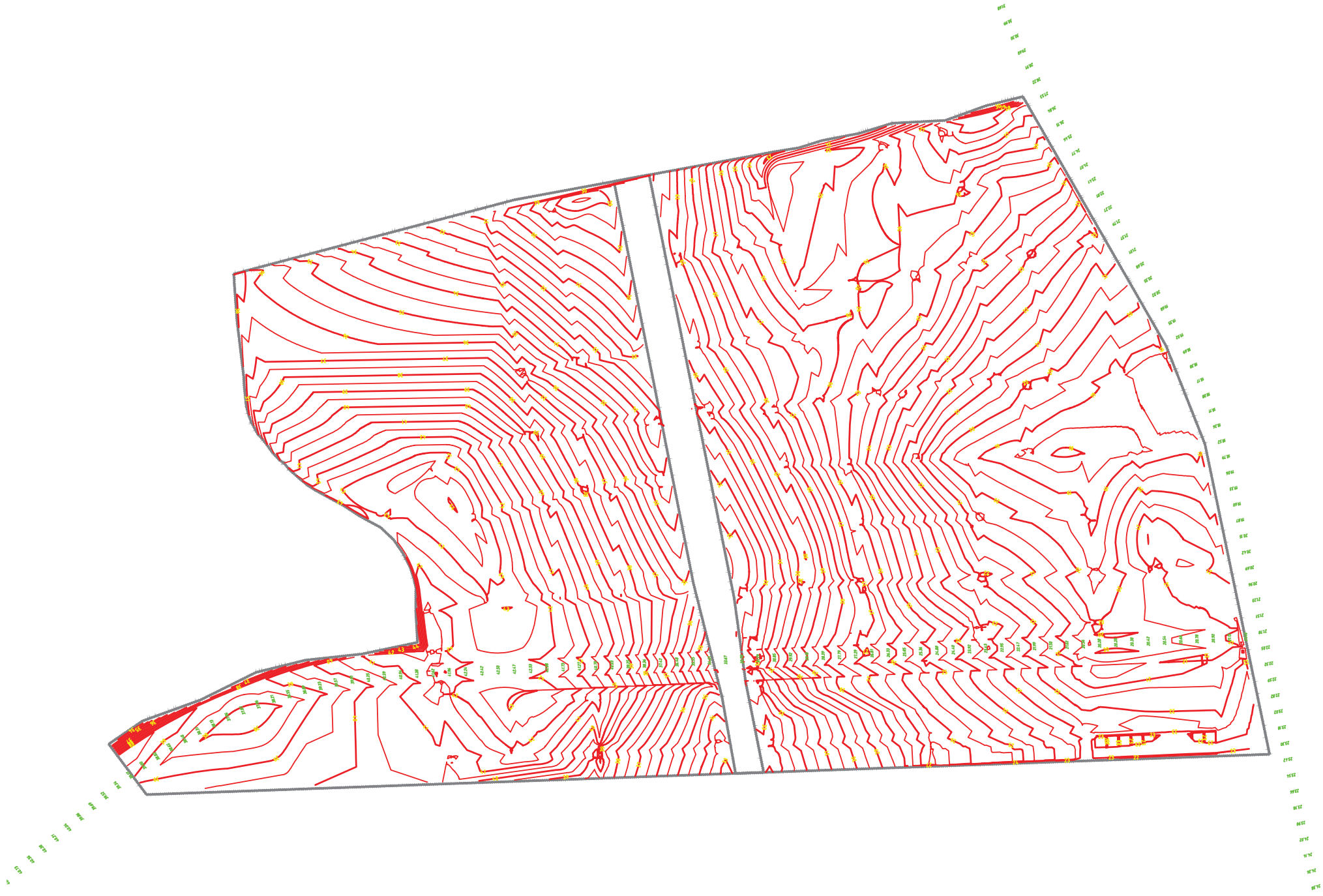
RESERVE FOR
RECREATION
& DRAINAGE

RESERVE FOR
RECREATION
& DRAINAGE

MIXED USE

RESERVE FOR
RECREATION
& DRAINAGE





APPENDIX D



HYDROLOGICAL MODELLING SUMMARY

LOCAL WATER MANAGEMENT STRATEGY
CENTRAL ALKIMOS LSP

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CENTRAL ALKIMOS

MODELLING ASSUMPTIONS

Project Number EP11-065

**Prepared for Lend Lease
November 2012**

**CENTRAL ALKIMOS
MODELLING ASSUMPTIONS**

Document Control

DOC NAME	ALKIMOS CENTRAL LWMS MODELLING SUMMARY				
DOC NO.	EP11-065(12)--039 AP				
REVISION	DATE	AUTHOR		REVIEWER	
1	November 2012	Amila Prasad	AP	Dave Coremans	DPC
	Appendix to LWMS				
A					

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1 Modelling Assumptions

For the calculation of the surface water runoff within the Central Alkimos LSP area, XPSstorm hydrologic and hydraulic modelling software was used.

The hydrologic component of the software uses the Laurenson non-linear runoff-routing method to simulate runoff from design storm events. Key assumptions regarding the hydrologic model include:

- Runoff is proportional to slope, area, infiltration and percentage of imperviousness of a catchment.
- Sub-catchment areas and slopes are determined from surveyed topographical data and earthworks plans.
- Infiltration rates and percentage imperviousness is based on experience with model preparation for similar soil conditions.

Runoff from each sub-catchment is routed through the catchment using the hydraulic component of XPSstorm. Assumptions associated with the hydraulic component of the model include:

- Virtual links (i.e. purely for model construction, not equivalent to flow path onsite) between nodes within a sub-catchment are given the length of 10m and slope of 0.05 to minimise the lag time of conveying the water from a sub-catchment node to a 'storage' node, a 'dummy intermediate' node or a conduit/link.
- Links between sub-catchment storages act as conveyance channels (e.g. sheet flow within roads in 100 year ARI event). These links are given lengths and slopes that are representative of the site conditions and actual pathway lengths between catchments.
- All channels are designed with width of 4 m, roughness of 0.014 (Manning's N) and are trapezoidal in shape. This allows for easy conveyance and/or represents concrete pipes/ road surfaces.
- No ponding conditions have been allowed within 1 year 1 hour ARI storage nodes for events greater than the 1 year 1 hour ARI event.

CENTRAL ALKIMOS
MODELLING ASSUMPTIONS

2 Pre-development Model

An “initial loss - continual loss” infiltration model was adopted to represent the pre-development environment, with loss values chosen based on project team experience with similar vegetation and soil types to those found within the site. **Table 1** gives the parameters used within the pre-development model.

Table 1 Pre-development parameters

Land Type	Initial Loss (mm)	Continual Loss (mm)	Manning's N
Sand-Sparse	25	3.5	0.100

Pre-development catchment areas were identified using publicly available contours for the upstream catchments (obtained from Landgate). The pre-development catchments are shown in **Figure 1** and areas and detailed assumptions are shown in **Table 2**.

Table 2 Pre-development catchment areas

Catchment	Slope	Area (ha)
CtCA1	0.042	10.253
CtCA10	0.008	5.691
CtCA2	0.054	16.414
CtCA3	0.036	14.567
CtCA4	0.019	17.779
CtCA5	0.020	7.759
CtCA6	0.038	19.311
CtCA7	0.042	39.05
CtCA8	0.029	3.279
CtCA9	0.043	6.215
CtCA11	0.009	3.899
CtCA12	0.078	1.619
CtCA13	0.019	22.459
CtCA14	0.056	4.373
CtCA15	0.120	1.638
CtCA16	0.080	0.304
CtCA17	0.100	0.445
CtCA18	0.056	0.126
Total		175.181

The pre-development model was used to find the critical duration Annual Recurrence Interval (ARI) for major rainfall events (100 year ARI event). The critical duration event considering maximum peak flows was found to be 360 minutes in duration. Graphical results of the critical duration analysis within a number of sub-catchments are shown in **Figure 2**.

CENTRAL ALKIMOS
MODELLING ASSUMPTIONS

3 Post-development Model

The post-development model used an "initial loss - continual loss" infiltration model with parameters that were influenced by the existing loss rates used in the pre-development model. **Table 3** gives the parameters used within the post-development model.

Table 3 Post-development parameters

Land Type	Initial Loss (mm)	Continual Loss (mm)	Roughness
Road Surface	1	0.1	0.014
Road Verge	2	0.1	0.040
Roof	1	0.1	0.014
Lot IMP	1	0.1	0.020
Gardens	20	2.5	0.050
POS	17.5	2.5	0.040

The post-development catchment areas were taken from the earthworks strategy provided by the project team. Land types within the catchments were guided by the Central Alkimos LSP. A summary of post-development catchment information is shown in **Table 4** and the catchment layout is shown in **Figure 3**.

The infiltration rates used were predominantly based upon the following assumptions:

- Lot types have been divided into two distinct types; Low Density Residential lots and Commercial/ Business lots.
- Commercial Mixed-Use areas contain 33% low density residential lots and 67% commercial/business lots.
- Low Density Residential lots are assumed to have 50% roof area from the total lot area, with the remainder of the lot paved (25%) and pervious garden (25%).
- Commercial/Business lots contain 60% roof areas from the total lot area, with the remainder of the lot paved (35%) and pervious garden (5%).
- Road reserves within the LSP area contain 42% pervious verge and 58% impervious bitumen.
- Marmion Avenue road reserve contains 20% pervious verge and 80% impervious bitumen.
- There will be no infiltration on roads, pavements and driveways. There will however be some minor absorption storage loss – this is accounted for in the initial and continuing loss values.
- Low density residential lots will provide onsite storage within soakwells sized to cater for the 1 year 1 hour ARI event from lot roof and paved areas.
- Commercial/Business lots will provide onsite storage sized to cater for the 100 year critical duration ARI event from lot roof and paved areas.
- School sites will provide onsite storage sized to cater for the 100 year critical duration ARI event from lot roof and paved areas.
- Garden areas in all lots will have high infiltration rates as it is likely that sand-based landscape mix or mulch will be used, and will infiltrate 1 year 1 hour ARI event within them.
- Residential lots will be relatively flat and pockets of storage are likely, particularly in back yards. This will effectively increase the initial loss (storage) and overall infiltration rate (continual loss).

CENTRAL ALKIMOS
MODELLING ASSUMPTIONS

- POS areas will likely contain dense vegetation or turf over a sand-based landscape mix. This turfed area will become compacted over time and reduce initial infiltration rates. It is anticipated that the effect of initial loss and continual loss will be higher than the rate of runoff accumulation from the 1 year 1 hour ARI event.
- The road verge area will have some vegetation and green cover with an impervious fraction for vehicle crossings and footpaths. It is anticipated that the averaged initial loss and continual loss will be quite lower than the POS rates.
- An infiltration rate of 2 m/day (hydraulic conductivity of 2.31×10^{-5} m/s) was assumed for the infiltration of soakwells, bio-retention areas and infiltration basins.
- The vertical infiltration through the bottom and sides (sloped) of bio-retention areas and flood storage areas was considered.
- Lateral infiltration from soakwells, bio-retention and flood storage areas was neglected.
- Volumes leaving the system through evapotranspiration were assumed to be negligible when compared to the total runoff volume and in the timeframe of a storm event since the duration of the model run was short, and there would be little/no transpiration when air moisture levels are close to saturation. XPS storm default evapotranspiration assumptions are therefore used.

CENTRAL ALKIMOS
MODELLING ASSUMPTIONS

Table 4 Alkimos Central Post-development catchment areas

Sub-catchment	Slope	Area (ha)												
		Total Area (sub-catchment)	Total Road	Total Road Pavement	Total Road Verge	Total Residential Lot	Lot Roof	Lot Paved	Garden	School and Business Lots	Roof	Paved	Garden	POS
ACMARS	.005-.017	5.608	5.608	4.486	1.122	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CtAC1.1.S	0.017	10.103	2.750	1.595	1.155	5.952	2.976	1.488	1.488	0.000	0.000	0.000	0.000	1.402
CtAC1.2.S	0.006	6.849	2.304	1.336	0.968	4.308	2.154	1.077	1.077	0.000	0.000	0.000	0.000	0.237
CtAC1.3.S	0.030	10.953	4.109	2.383	1.726	6.744	3.372	1.686	1.686	0.000	0.000	0.000	0.000	0.100
CtAC2.1.S	0.012	3.489	1.470	0.853	0.617	1.627	0.813	0.407	0.407	0.000	0.000	0.000	0.000	0.392
CtAC2.2.S	0.034	5.256	2.397	1.390	1.007	2.149	1.075	0.537	0.537	0.000	0.000	0.000	0.000	0.710
CtAC3.1.S	0.018	7.874	2.702	1.567	1.135	4.420	2.210	1.105	1.105	0.000	0.000	0.000	0.000	0.752
CtAC4.1.S	0.013	4.732	1.349	0.782	0.567	2.368	1.184	0.592	0.592	0.000	0.000	0.000	0.000	1.015
CtAC4.2.S	0.031	5.646	2.458	1.426	1.032	3.189	1.594	0.797	0.797	0.000	0.000	0.000	0.000	0.000
CtAC4.3.S	0.033	9.203	0.900	0.522	0.378	0.000	0.000	0.000	0.000	3.528	2.117	1.058	0.353	4.775
CtAC5.1.S	0.027	5.779	2.650	1.537	1.113	2.579	1.290	0.645	0.645	0.000	0.000	0.000	0.000	0.550
CtAC6.1.S	0.013	6.248	3.393	1.968	1.425	0.891	0.446	0.223	0.223	1.564	0.938	0.469	0.156	0.400
CtAC6.2.S	0.009	3.193	1.144	0.664	0.480	1.495	0.748	0.374	0.374	0.000	0.000	0.000	0.000	0.554
Total Alkimos Central East		84.933	33.234	20.509	12.725	35.721	17.860	8.930	8.930	5.092	3.055	1.528	0.509	10.885
CtAC10.1	0.044	2.928	0.710	0.412	0.298	1.898	0.949	0.475	0.475	0.000	0.000	0.000	0.000	0.320
CtAC11.1	0.008	9.217	3.190	1.850	1.340	4.237	2.119	1.059	1.059	0.000	0.000	0.000	0.000	1.790
CtAC12.1	0.024	2.006	0.509	0.295	0.214	0.548	0.274	0.137	0.137	0.000	0.000	0.000	0.000	0.949
CtAC13.1	0.006	10.809	3.986	2.312	1.674	5.462	2.731	1.366	1.366	0.000	0.000	0.000	0.000	1.361
CtAC13.2	0.009	9.588	2.981	1.729	1.252	5.827	2.914	1.457	1.457	0.000	0.000	0.000	0.000	0.780
CtAC14.1	0.014	6.874	1.125	0.653	0.473	5.268	2.634	1.317	1.317	0.000	0.000	0.000	0.000	0.481

CENTRAL ALKIMOS
MODELLING ASSUMPTIONS

CtAC15.1	0.016	4.420	1.566	0.908	0.658	1.975	0.988	0.494	0.494	0.000	0.000	0.000	0.000	0.879
CtAC8.1	0.018	15.437	2.482	1.440	1.042	0.946	0.473	0.237	0.237	9.791	5.875	2.937	0.979	2.218
CtAC8.2	0.025	9.075	3.066	1.778	1.288	6.009	3.005	1.502	1.502	0.000	0.000	0.000	0.000	0.000
CtAC9.1	0.005	2.312	0.000	0.000	0.000	1.319	0.660	0.330	0.330	0.000	0.000	0.000	0.000	0.992
Total Alkimos Central West		72.666	19.615	11.377	8.238	33.489	16.745	8.372	8.372	9.791	5.875	2.937	0.979	9.770
Total Alkimos Central		157.599	52.849	31.886	20.963	69.210	34.605	17.303	17.303	14.883	8.930	4.465	1.488	20.655

CENTRAL ALKIMOS
MODELLING ASSUMPTIONS



Figure 1: Pre-development catchments.

**CENTRAL ALKIMOS
MODELLING ASSUMPTIONS**

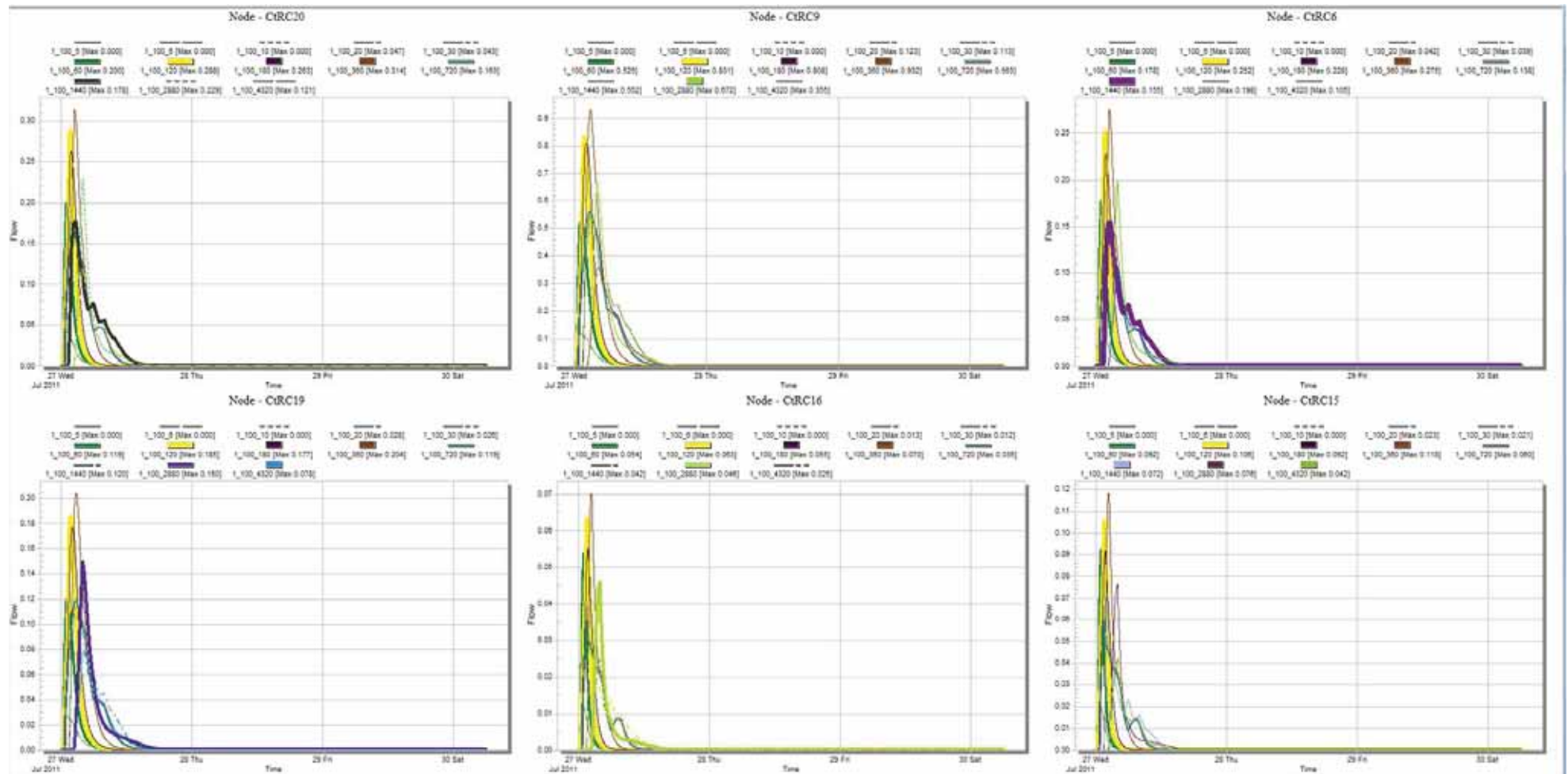
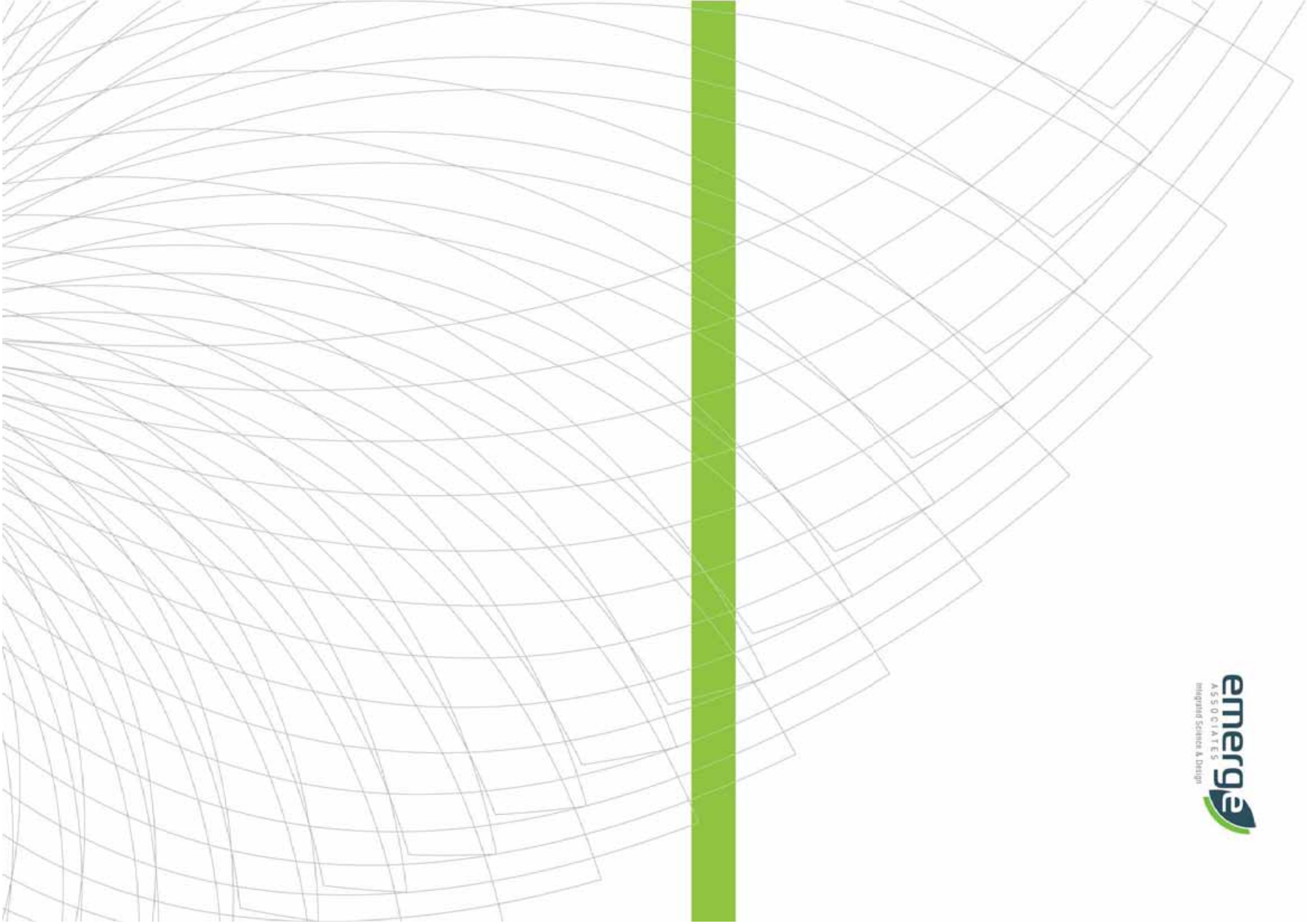


Figure 2: Critical duration event analysis.

CENTRAL ALKIMOS
MODELLING ASSUMPTIONS



Figure 3: Post-development catchments.





APPENDIX G
LOCAL ECONOMIC STRATEGY

(RPS, AUGUST 2013)





CENTRAL ALKIMOS

UPDATED Local Economic Strategy

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Summary

Introduction

Central Alkimos is located north of the Waste Water Treatment Plant and Central Alkimos and south of the Shorehaven development. It extends from the future Mitchell Freeway extension in the east, across the proposed rail line and Marmion Avenue towards, but not entirely to the coast. It is a predominantly residential area within the Alkimos-Eglinton District, located adjacent to Central Alkimos and associated employment, retail, public transport and amenity. It is located in the Alkimos-Eglinton District.

The Central Alkimos area, along with South Alkimos, will play an essential role in providing a critical mass of residential population and labour force collocated with Central Alkimos. It will also provide economic, investment and employment opportunities in mixed use land along Marmion Avenue, in the southern entrance to the north-south service commercial strip and through accommodation of home-based businesses. The economic contribution of the area will be dependent on strong linkages to Central Alkimos and the timing of investments in road and rail transport infrastructure by State Government.

The purpose of this Local Economic Strategy is to define the likely future size, composition and character of economic activity in Central Alkimos and provide a framework and action plan for stakeholders to facilitate this growth and evolution over time.

Economic and Employment Activity

Vision for Central Alkimos Economic Health:

The Central Alkimos area will be a dynamic, sustainable residential community with strong linkages to employment, infrastructure and amenities of Alkimos City Centre. It will leverage the presence of major road and rail infrastructure to capture and facilitate mixed use business investment targeting passing trade. Strong technology-based connectivity, coupled with the promotion of entrepreneurship, will underpin home-based business and employment activity, reinforcing local employment self-sufficiency.

Central Alkimos has the following key economic drivers:

- Colocation with Alkimos City Centre;
- Centrality in a high growth district;
- Frontage to Marmion Avenue;
- Freeway Entrance/Exit;
- Southern Entrance to Service Commercial Land; and
- High School.

These economic drivers, if successfully captured and delivered, will underpin the economic health of the Central Alkimos area and support the creation of a dynamic local economy.

Based on a review of previous economic modelling undertaken for the District and updated “bottom-up” analysis by RPS Economics in support of this Strategy, it is estimated that by residential build out, the Central Alkimos region will accommodate 807 EFT jobs. This employment will be distributed across service commercial (268 jobs), home-based business (267 jobs) and community uses (134 jobs).

These floorspace and employment activity estimates assume that the potential Alkimos North train station is not delivered, in line with advice from the relevant State Government agencies. Such non-delivery has a significant implication for the employment generating capacity and self-sufficiency of the LSP area, reducing both the amount and intensity of employment land.

The Alkimos Eglinton District Structure Plan established a minimum employment self-sufficiency target of 60%¹. This means that there is to be minimum six jobs for every ten workers living in the Alkimos-Eglinton District.

Over the course of its development, the Central Alkimos area is expected to experience a growth in its local employment self-sufficiency rate. From a low of 17% in Stage 2, ESS is projected to increase to 32% when the district is at capacity. Such employment self-sufficiency rates are expected for a predominantly residential area. The exposure to service commercial land and mixed use development opportunities along Marmion Avenue do provide a boost to local employment.

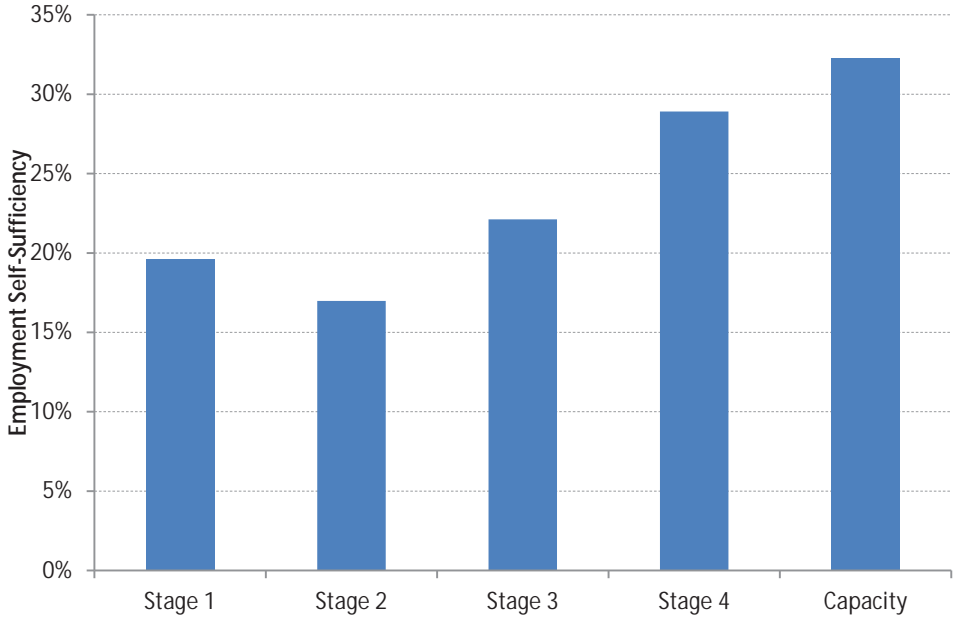


Figure ES1: Employment Self-Sufficiency Rate, Central Alkimos

The employment generated and accommodated in Central Alkimos is expected to be primarily population-serving in nature. This reflects the community and convenience nature of employment generators such as the proposed high school and local retail floorspace. There is some potential for the service commercial land and the mixed use area along Marmion Avenue to accommodate strategic industry employment, particularly later in the economic evolution of the area. However, the proximity of the area to Central Alkimos means that Central Alkimos generally lacks sufficient competitive advantage to attract higher value adding industries.

A summary of key employment indicators for the Central Alkimos are outlined below.

¹ Alkimos Eglinton District Structure Plan (August 2008); page 10

Table ES2: Key Employment Indicators, Central Alkimos

Indicators	At Completion
Dwellings	2,000
Estimated Population	5,000
Estimated Workers	2,500
Estimated Employment	887
Employment Self-Sufficiency	35.5%
Strategic Industry Share of Employment	<10%
Employment Density ²	3.3 jobs/ha

Approach to Economic Development

The realisation of Central Alkimos’ potential, aspirations and objectives will rely on a long term cooperative partnership between LandCorp, private developers and the City of Wanneroo.

A proactive approach to economic development is required that includes early investment in:

- Human resources dedicated to achieving the objectives (e.g. Business and Economic Development Manager)
- Economic enabling infrastructure (such as a quality fibre optic network)
- Services and initiatives that support innovation & entrepreneurship, sustainability, growing local business, health, recreation & wellness (indicative action plan).

Strategic Themes

The economic development of Central Alkimos will be guided by a range of strategic themes. These themes provide an organising framework for economic development actions proposed for the Area in section 5.0 of this Strategy and include:

- Growing Local Business;
- Business Connectedness;
- Retail and Amenity;
- Economic Flexibility;
- Enabling Infrastructure; and
- Governance and Resourcing.

² Including Regional Open Space. 5.6 EFT jobs per hectare when Regional Open Space is removed.

Economic Development Action Plan

The Action Plan outlined in section 5.0 of the Local Economic Strategy outline a range of potential initiatives and outlines relevant objectives, deliverables and stakeholder responsibilities. Examples of initiatives identified include:

- Business Networking Program;
- Local Business Association Integration Plan;
- Local Convenience Retail Offering;
- High Quality Urban Landscaping;
- Flexible Land Use Framework;
- Delivery of Mitchell Freeway;
- Fibre to the Premise (FTTP) Deployment;
- Central Alkimos Employment Modelling; and
- Business and Economic Development Manager.

Conclusions

Central Alkimos will primarily fulfil the role and function of a dormitory residential area supporting major economic and employment nodes

Essential will be appropriate early support and facilitation of the local economy. This will entail strong commitment from all levels of Government to the provision of enabling infrastructure (such as road and rail transport infrastructure) and proactive growth strategies and initiatives by project proponents. Failure to do so will undermine the capacity of stakeholders to facilitate the realisation of the Area's economic potential and render the achievement of the 60% employment self-sufficiency target impossible.

1.0 Introduction

1.1 Central Alkimos Project Overview

Central Alkimos is located north of the Alkimos Waste Water Treatment Plan and the Alkimos City Centre and south of the Shorehaven development. It extends from the future Mitchell Freeway extension in the east, across the proposed rail line and Marmion Avenue towards, but not entirely to the coast. It is a predominantly residential area within the Alkimos-Eglinton District, located adjacent to the Alkimos City Centre and associated employment, retail, public transport and amenity. It is located in the Alkimos-Eglinton District.

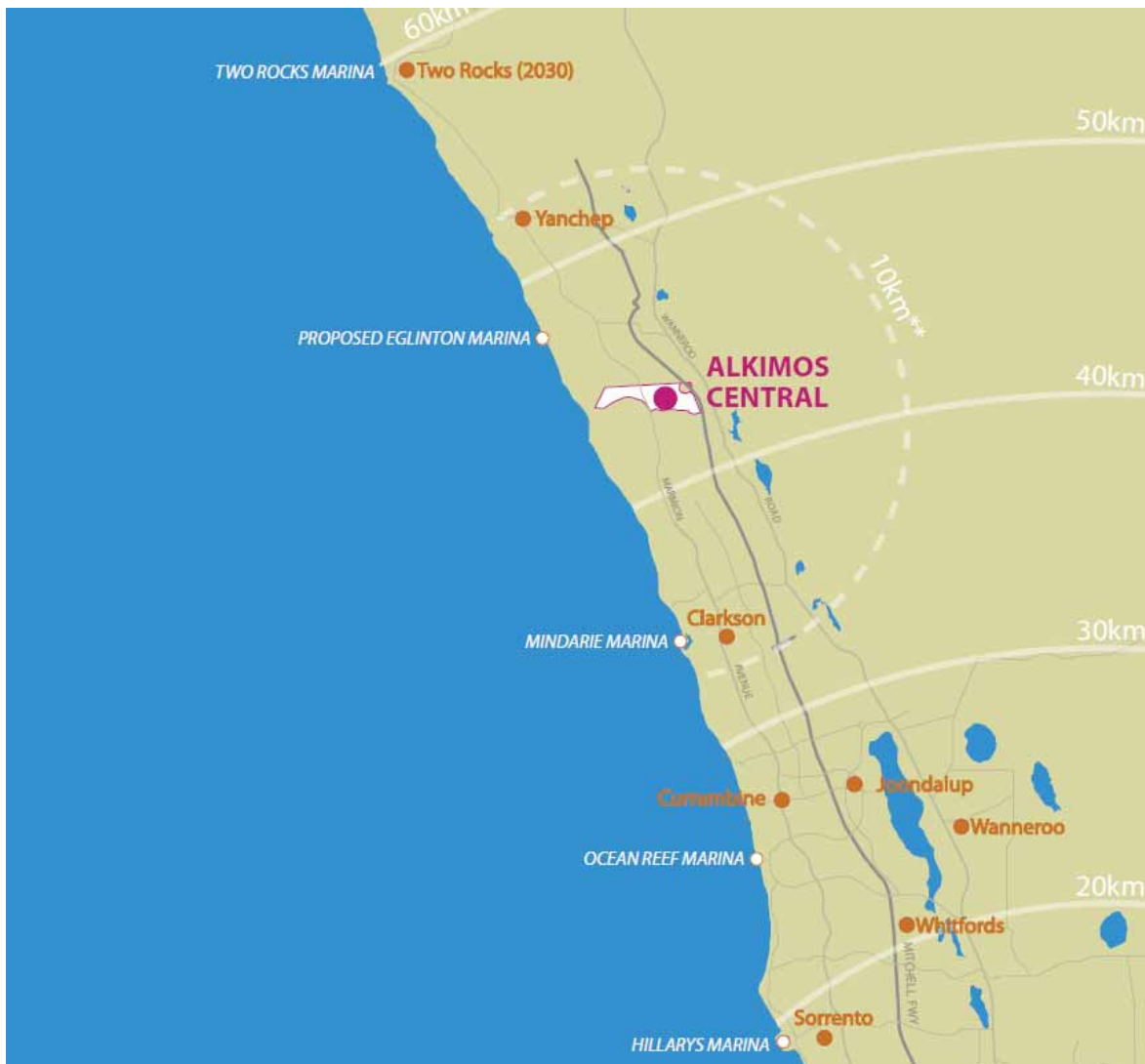


Figure 1 Central Alkimos, North West Corridor of Metropolitan Perth

The Central Alkimos area, along with South Alkimos, will play an essential role in providing a critical mass of residential population and labour force collocated with the Alkimos City Centre. It will also provide economic, investment and employment opportunities in mixed use land along Marmion Avenue, in the southern entrance to the north-south service commercial strip and through accommodation of home-based businesses. The economic contribution of the area will be dependent on strong linkages to the

Alkimos City Centre and the timing of investments in road and rail transport infrastructure by State Government.

1.2 What is Economic Development?

Economic development is any effort or undertaking which aids in the growth of the economy. Measures of success are many and varied, which reflects the broad interpretation of 'economic development' activities. These efforts are particularly important for Greenfield locations which lack an existing local economy and therefore require additional investment, facilitation and support from both private and public sectors.

Primary indicators for LandCorp and the development proponent include:

- Employment yield - both onsite and offsite (Full Time Equivalents or FTEs)
- Short-term and construction employment (FTEs)
- Business expenditure during construction and operational phase
- Local household wealth and expenditure
- Level of business attraction (number of businesses, level of investment)
- Employment self-sufficiency (Percentage)

Typically, strategies for regional economic development aim to:

- increase the flow of money into the region
- improving the efficiency of existing businesses
- improve the recirculation of finance and resources within the region

If achieved, these aims should result in the growth in value of the regional economy. This is more or less the basis for a region 'moving forward' and meeting the kinds of community aspirations (e.g. housing choice, lifestyle, employment, education, health, security) so often referred to as 'must haves' in modern day Australia.

Economic Development is particularly important – and difficult – in Greenfield locations. The lack of an established residential population, enabling infrastructure and business and investment profile all limit the capacity for local nodes of economic activity to establish and grow, without significant support and facilitation by Government.

A collaborative approach to economic development, building upon Government's traditional role in facilitating local economies through partnership with private sector organisations, is critical to achieving the goals and objectives established for the North West Corridor generally, and Central Alkimos specifically.

1.3 Post GFC Environment

In recent years, Western Australia's (WA's) economic prosperity has been well documented and widely reported. Economic growth rates have exceeded national averages and the influx and increase in population levels has mirrored this success.

Post the Global Financial Crisis (GFC) uncertainty remains in markets across the globe. Compared to other nations, Australia still retains some sense of economic stability with an acknowledgement of our heavy reliance of the resources sector.

Despite these events, WA has to date performed well when compared to other state economies. As of Jun 2013, WA's unemployment rate was 4.6%, above the 2012 lows of 3.8% due to the peaking of mining investment but well below the national rate of 5.7%. This is being driven by a combination of still historically high mining investment, recovering housing activity and strong population growth. The interesting dynamic for WA in both the pre and post GFC environment is that proactive economic interventions are still required in order to create local employment, prosperity, diversity and self-reliance. This is true for good economic times or bad.

Why is this so? Quite simply the attractiveness of Perth and its surrounds as an economic and lifestyle destination will ensure that migration to the city and state continues for some time yet. The City of Wanneroo is currently one of the fastest growing locations in the country and has been identified as a growth hot spot for decades to come. A diversified economic base and localised economic initiatives are required to ensure meaningful jobs for today as well as new (yet to be created) jobs for the future.

Without the right economic development strategies in place, Alkimos, Perth and Western Australia cannot continue to grow and support the lifestyle we find so attractive.

1.4 Strategy Purpose

The purpose of this Local Economic Strategy is to define the likely future size, composition and character of economic activity in Central Alkimos and provide a framework and indicative action plan for stakeholders to facilitate this growth and evolution over time.

The strategy is comprised of the following key sections:

- Economic and Employment Activity – including identification of the key drivers of and challenges to the economic health of Central Alkimos and estimates of projected employment, floorspace and self-sufficiency over the next 20 years.
- Approach to Economic Development – outlining the approach to be adopted by project stakeholders to facilitate the
- development of Central Alkimos economy.
- Strategic Themes – identification and definition of the strategic themes which will characterise the development of Central Alkimos economy.
- Economic Development Action Plan – including potential actions and deliverables to facilitate the development of the local economy by stakeholders.
- Conclusion – summarising the key findings of the Strategy.

2.0 Economic & Employment Activity

2.1 Vision for Central Alkimos Economic Health

The Central Alkimos area will be a dynamic, sustainable residential community with strong linkages to employment, infrastructure and amenities of Alkimos City Centre. It will leverage the presence of major road and rail infrastructure to capture and facilitate mixed use business investment targeting passing trade. Strong technology-based connectivity, coupled with the promotion of entrepreneurship, will underpin home-based business and employment activity, reinforcing local employment self-sufficiency.

2.2 Key Drivers of Economic Health

The following list outlines the key drivers of the economic health of Central Alkimos:

- Colocation with Alkimos City Centre – the position of Central Alkimos to the Alkimos City Centre will provide local residents with strong access to the highest concentrations employment, retail and economic activity between Joondalup and Yanchep;
- Centrality in a high growth district – the central location of the Central Alkimos area in the Alkimos-Eglinton District will provide local businesses with access to a strong labour force and consumer catchment;
- Frontage to Marmion Avenue – Central Alkimos is split north-south by Marmion Avenue, providing the area with the opportunity to capture expenditure from passing traffic and local businesses with a high exposure business location;
- Freeway Exit – the Central Alkimos Area includes one of the three proposed exits to Alkimos-Eglinton District off the Mitchell Freeway. This will enhance accessibility of workers and freight transport to the area, including entrance into the District's primary service commercial land;
- Southern Entrance to Service Commercial Land – the southern entrance to the District's primary service commercial land is located within the Central Alkimos area. This gateway location will provide a high profile business investment location, with higher density employment contributing to local, district and regional employment self-sufficiency.
- High School – the inclusion of a high school in the Central Alkimos area will generate employment in the education sector. The proximity of the school to the Alkimos City Centre and proposed tertiary education facilities provides opportunities for secondary/tertiary education and school/business collaborations.
- Home-based business – the critical mass of residential homes and proximity to the Alkimos City Centre will promote and encourage the establishment of home-based businesses in the area.

These economic drivers, if successfully captured and delivered, will underpin the economic health of Central Alkimos and support the creation of a dynamic local business, investment and employment environment.

Note the employment generation and accommodation capacity of Central Alkimos will be significantly impacted by whether the potential Alkimos North rail station is delivered. At this stage, advice from the relevant State authorities is that the rail station **not** be incorporated in the Local Economic Strategy.

2.3 Proposed Locations of Economic Activity

Central Alkimos will be comprised of a number of distinct economic nodes include:

- High School – generating education-based employment
- Mixed Use Land Adjacent to Marmion Avenue – with passing traffic and high visibility providing economic and employment opportunities within a mixed use environment.
- Southern Entrance to Service Commercial Precinct – which will be the primary entry point for freight, business and worker traffic into the broader north-south service commercial strip.

2.4 Employment Generation

RPS has estimated projected local employment using a “bottom up” approach. This approach seeks to identify land uses and floorspaces commonly associated with local areas, taking into consideration the economic drivers and advantages of the local area. This floorspace is then converted to employment by applying national standard workspace ratios to estimate the number of Full-Time Equivalent jobs that the Centre will accommodate.

Based on a review of previous economic modelling undertaken for the District and updated “bottom-up” analysis by RPS Economics in support of this Strategy, it is estimated that by residential building out of the District (2031), the Central Alkimos region will accommodate 807 EFT jobs. This employment will be distributed across service commercial (268 jobs), home-based business (267 jobs) and community uses (134 jobs). This is outlined in Appendix 3.

These floorspace and employment activity estimates assume that the potential Alkimos North train station is not delivered, in line with advice from the relevant State Government agencies. Such non-delivery has a significant implication for the employment generating capacity and self-sufficiency of the LSP area, reducing both the amount and intensity of employment land.

2.5 Employment Self-Sufficiency

Employment and economic activity is more spatially concentrated than residential development. As such, the employment self-sufficiency rates of individual Local Structure Plan areas are irrelevant unless viewed within the context of the broader district or corridor. It is acknowledge therefore that the Central Alkimos area, with its predominantly residential nature, will play a supporting role in the provision of employment opportunities in the corridor.

The Alkimos Eglinton District Structure Plan established a minimum employment self-sufficiency target of 60%³. This means that there is to be minimum six jobs for every ten workers living in the Alkimos-Eglinton District. Self-sufficiency means that these jobs are not necessarily filled by local workers (that is employment self-containment), though it is expected that the provision of a diversified range of high order local employment will be a major driver in residential settlement and therefore enhance the levels of economic-based travel containment over time.

³ Alkimos Eglinton District Structure Plan (August 2008); page 10

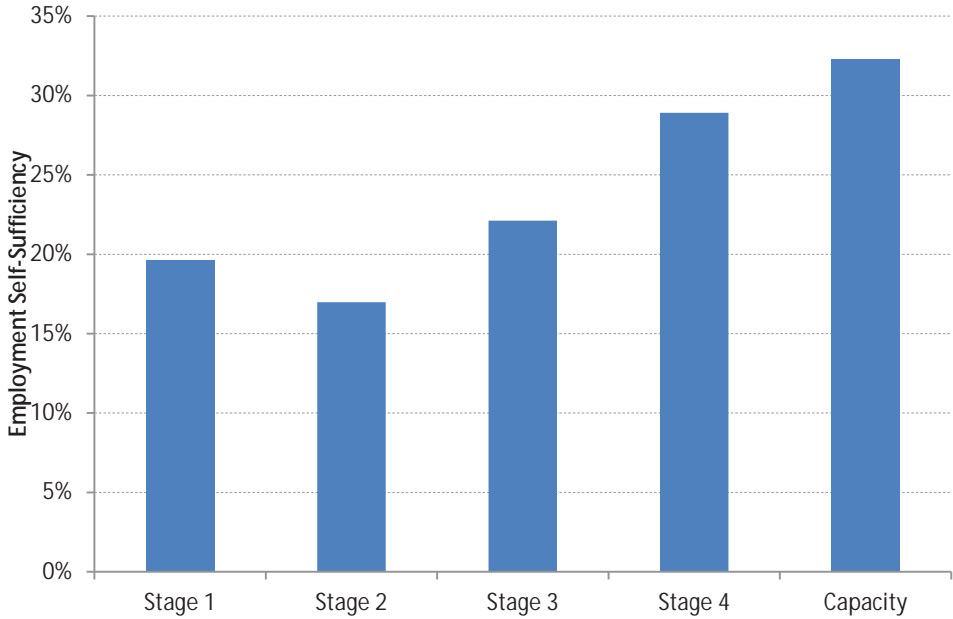


Figure 2 Central Alkimos Employment Self-Sufficiency, by Stage

Over the course of its development, the Central Alkimos area is expected to experience a growth in its local employment self-sufficiency rate. From a low of 19.2% in Stage 2, ESS is projected to increase to 35.5% when the district is at capacity. In light of the predominantly residential nature of the area, such an employment self-sufficiency rate represents a strong performance. The exposure to service commercial land and mixed use development opportunities along Marmion Avenue do provide a boost to local employment.

2.6 Employment Diversity

The employment generated and accommodated in Central Alkimos is expected to be primarily population-serving in nature. This reflects the community and convenience nature of employment generators such as the proposed high school and local retail floorspace. There is some potential for the service commercial land and the mixed use area along Marmion Avenue to accommodate strategic industry employment, particularly later in the economic evolution of the area. However, the proximity of the area to the Alkimos City Centre means that Central Alkimos generally lacks sufficient competitive advantage to attract higher value adding industries.

2.7 Employment Density

The Central Alkimos area covers a gross land area of 266 ha. At build-out, it is estimated that Central Alkimos will have an employment density of 3.3 EFT jobs per hectare. However, a large proportion of the LSP area is Regional Open Space. When this area is removed from the calculations, employment density in Central Alkimos increases to 5.6 EFT jobs per hectare. This is a true representation of the level of employment concentration in the LSP area and reflects the predominantly residential nature of the area.

3.0 Approach to Economic Development

3.1 Approach

The realisation of Central Alkimos's potential, aspirations and objectives will rely on a long term cooperative partnership between LandCorp, private developers and the City of Wanneroo.

LandCorp and the project developer will need to play a leading role through its commitment to and delivery of key components within its sphere of influence. It is understood that for Alkimos City Centre to become a recognised success, the region will also need to be successful. To this end, the intent should be to ensure that our key deliverables compliment and benefit the surrounding region. This cooperative approach is highlighted by the need for the Alkimos Eglinton District Structure Plan (DSP) area to "aim for a minimum 60% employment self-sufficiency"⁴.

3.2 Philosophy

Our economic vision is to establish an integrated, dynamic and sustainable, residential community to facilitate and support the growth of the Alkimos City Centre.

The role of the Coastal Alkimos area in supporting and facilitating economic activity in the City Centre (through provision of local residential population and labour force) will require an integrated approach to economic development. The role of Central Alkimos in the district and regional economy must be examined and implemented within the context of other local, district and regional centres and nodes in the area.

3.3 Government Support & Investment

Government support and investment is critical to the economic potential of Central Alkimos being realised and District and Catchment level employment self-sufficiency targets being achieved. The public sector plays an important role in Western Australia's economic growth and prosperity by:

- Providing a regulatory framework conducive to private sector investment (regulator);
- Procuring goods and services from the private sector (customer);
- Delivering a range of community services (service provider); and
- Investing in enabling infrastructure that supports economic and business growth and employment generation (investor).

This role is illustrated in the figure below.

⁴ Alkimos Eglinton District Structure Plan (August 2008); page 10

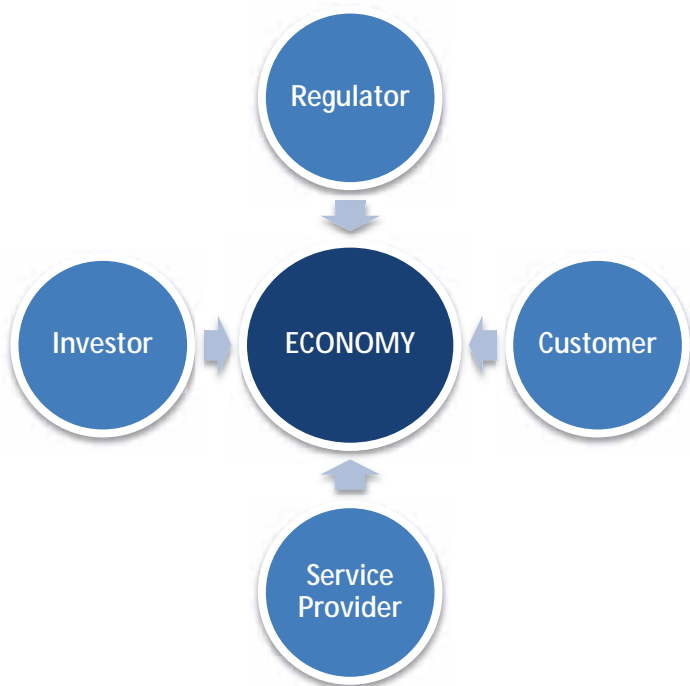


Figure 3 Role of Government in the Economy

In the case of the Central Alkimos, major potential contributions of State and Local Governments to the development of the local economy include timely investment in major transport infrastructure (such as passenger rail and Mitchell Freeway extension) to maximise the accessibility of local workers to employment opportunities in the Corridor and increase the prosperity and quality of life of residents and households..

The absence of effective Government investment and facilitate will significantly constrain the economic potential of the City Centre, reduce its employment generation capacity and hamper the achievement of employments self-sufficiency targets into the District and broader Catchment.

3.4 Ongoing Monitoring

To ensure employment is continually monitored and measured, project stakeholder s will actively contribute to formal modelling of local employment creation.

In response to the need for a robust and credible methodology for estimating and forecasting employment figures within a defined local area, private sector developers in partnership with economic consultants, to develop customised and peer-reviewed tools for tracking and monitoring employment generation within local areas.

Reporting should be undertaken every two years during the development phase of the project after which time it will covert to 5 yearly in line with Australian Bureau of Statistics Census periods.

It is proposed that this information be made available to the Alkimos Economic Development Committee⁵ and other key government stakeholders in order to evaluate past performance and help set the best strategies and targets for future development activities.

3.5 Relationship with Community Development

The Local Economic Strategy has a strong interrelationship with community development. This interrelationship is based on a number of factors including:

- The role of economic development in generating employment, wealth and prosperity for the local community;
- The role of businesses as both part of the broader community and as a community in their own right;
- The opportunity to leverage investments in community facilities and services to generate genuine local economic opportunities;
- The influences of demographic and socio-economic characteristics of the local residential population (i.e. population ageing or income levels) on local industry growth, development and investment (e.g. in health, education and retail)

The existence of these factors illustrates the fact that economic and community development are not mutually exclusive. Instead, the interrelationship that exists presents considerable opportunities for project stakeholders to facilitate the growth of a prosperous, dynamic and sustainable local community.

⁵ The proposed Alkimos Economic Development Committee will be a reference group comprising representatives of core project proponents to engage with stakeholders and provide support and guidance to the Business and Economic Development Manager. This is outlined in the indicative Economic Development Action Plan in Section 5.0.

It is proposed that this information be made available to the Alkimos Economic Development Committee⁵ and other key government stakeholders in order to evaluate past performance and help set the best strategies and targets for future development activities.

3.5 Relationship with Community Development

The Local Economic Strategy has a strong interrelationship with community development. This interrelationship is based on a number of factors including:

- The role of economic development in generating employment, wealth and prosperity for the local community;
- The role of businesses as both part of the broader community and as a community in their own right;
- The opportunity to leverage investments in community facilities and services to generate genuine local economic opportunities;
- The influences of demographic and socio-economic characteristics of the local residential population (i.e. population ageing or income levels) on local industry growth, development and investment (e.g. in health, education and retail)

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⁵ The proposed Alkimos Economic Development Committee will be a reference group comprising representatives of core project proponents to engage with stakeholders and provide support and guidance to the Business and Economic Development Manager. This is outlined in the indicative Economic Development Action Plan in Section 5.0.

4.0 Strategic Themes

The economic development of Central Alkimos will be guided by a range of strategic themes. These themes provide an organising framework for economic development actions proposed for the Area in section 5.0 of this Strategy.

These strategic themes are outlined in the table below.

Table 1: Strategic Themes

Strategic Theme	Description
Growing Local Business	The sustainability of economic activity and growth requires medium and long-term growth of local businesses. Central Alkimos can play an important role in incubating and fostering small businesses, to enable their transition into medium and large employers and relocation to the City Centre.
Business Connectedness	The strength and resilience of the local economy will be contingent on the degree of connectedness among the local business community. This is a natural extension of the “Growing Local Business” theme. Promotion of connections between businesses through regular programs and events and guiding the establishment of a local business association are fundamental to reinforcing the beneficial interrelationships that exist between local businesses in successful and vibrant economic centres.
Retail and Amenity	Population serving employment represents those jobs that service the immediate needs of the local community. “Retail” falls into this category and is one of the foundation employment categories required to attract a critical mass of residential population in an area. Additionally, the establishment of a high quality urban environment, through effective landscaping, streetscaping and public space provision, can provide a significant incentive for early redevelopment and evolution of commercial centres through the emergence of higher and better uses.
Economic Flexibility	The Post GFC environment (summarised in Error! Reference source not found.) has emphasised the volatile and unpredictable nature of the future. As such, static and inflexible planning frameworks and design guidelines have the potential to not only endanger the sustainability of local economic activity, but also constrain the ability of the private sector to capture and leverage new and emerging business opportunities. Flexibility in both planning and design, to enhance the longevity of the land use and built form environment is therefore needed.
Enabling Infrastructure	Local economies can only develop, grow and prosper when core enabling infrastructure is provided. This includes basic services (e.g. water, waste water, electricity), transport infrastructure and communication technologies. These enabling infrastructures not only provide business and industry with the capacity to function but also play important macro-economic and behavioural roles. Such investments can de-risk locations for private sector investment, by enhancing the locations profile as an economic centre. Early delivery of public transport, for example, can have a critical role in the travel behaviours of both residents and workers in a community, underpinning a more sustainable and competitive economic environment.
Governance and Resourcing	Managing, resourcing and monitoring the evolution of local

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Governance and Resourcing	Managing, resourcing and monitoring the evolution of local

Strategic Theme	Description
	economies are essential. The volatility of the economic environment in the Post GFC environment, not only necessitates “Economic Flexibility” but sufficient monitoring to know when such flexibility needs to be utilised.

These strategic themes form the foundation of the indicative Economic Development Action Plan.

5.0 Economic development action plan

The following Economic Development Action Plan outlines potential initiatives, objectives and deliverables of the responsible stakeholders to facilitate the development of Central Alkimos economy.

Table 2: Economic Development Action Plan

Strategic Theme	Initiative	Objective	Deliverable	Lead	Key Partners	Prerequisite Deliverable
Growing Local Business	Refer to Business Connectedness					
Business Connectedness	Business-Education Connection Program	Establishment of a dedicated program of events connecting local businesses and secondary and tertiary education and training providers/institutions. Maximises utilisation of education facilities and practical relevance of education/training courses. Potential industry placement/research and development spin-offs	Ongoing program	City of Wanneroo, Private Developer	Business associations	Business and Economic Development Manager
	Business Networking Program	Series of regular events and seminars to promote awareness, interaction and cohesion amongst the local business community.	Program of ongoing events	City of Wanneroo, Private Developer		Business and Economic Development Manager
	Local Business Association Integration Plan	Development of a plan to facilitate establishment or integration of flexible and inclusive local business association through engagement with existing business associations and the City of Wanneroo.	Documented report	City of Wanneroo, Private Developer		Business and Economic Development Manager
Retail and Amenity	Local Convenience Retail Offering	High level analysis of the mix of uses for the local convenience retail centre in Central Alkimos, with a focus on boutique, quality offering.	Documented Strategy	Private Developer, LandCorp	City of Wanneroo	Business and Economic Development Manager
	High Quality Urban Landscaping	Establishment of high amenity urban environment, including in service commercial land, to promote early redevelopment and evolution of major employment areas.	Deployed infrastructure	Private Developer, LandCorp	City of Wanneroo	
Economic Flexibility	Temporary Commercial Land Uses	Allow for temporary commercial land uses in short-term to generate economic activity from land to be occupied when at capacity.	Documented structure plan	Private Developer, LandCorp, City	WAPC	Structure Plan

Strategic Theme	Initiative	Objective	Deliverable	Lead	Key Partners	Prerequisite Deliverable
				of Wanneroo		
	Ground Floor Activation and Pedestrian Permeability	Promote ground floor activation of mixed use buildings and facilities to encourage dynamism in the local urban environment.	Documented structure plan	LandCorp, City of Wanneroo, Private Developer	WAPC	Structure Plan
	Flexible Land Use Framework	Incorporation for flexible land use frameworks as part of Structure Plan to maximise ability of local economy and business community to evolve over time without planning constraints.	Documented structure plan	LandCorp, City of Wanneroo, Private Developer		Structure Plan
Flexible Building Design Guidelines	Promotion of flexible and convertible building design to future proof major development and allow for transition between commercial and residential uses.	Documents Design Guidelines	LandCorp, City of Wanneroo, Private Developer	Structure Plan		
Enabling Infrastructure	Delivery of Mitchell Freeway	Timely delivery of the Mitchell Freeway in the medium term to enhance accessibility of workers, business and visitors to and from the area and support take-up of service commercial land.	Deployed infrastructure	Department of Main Roads	LandCorp, City of Wanneroo, Private Developer	
	Alkimos Information & Communication Technology (ICT) Masterplan	To masterplan the efficient deployment of community wide technology infrastructure. Capacity for master plan to also cover South Alkimos and City Centre precincts.	Documented masterplan	Private Developer, LandCorp		
	Fibre to the Premise (FTTP) Deployment	To deploy FTTP infrastructure across the Coastal Alkimos area in accordance with the ICT masterplan.	Deployed infrastructure	Private Developer, LandCorp	LandCorp, City of Wanneroo	Structure Plan
Governance and Resourcing	Alkimos Economic Development Committee	Committee to facilitate active engagement and participation of key regional stakeholders in Coastal Alkimos' economic development.	Appointed committee	Private Developer, City of Wanneroo	LandCorp, City of Wanneroo	ICT Master Plan
	Central Alkimos Employment Modelling	Annual modelling of employment generation in Alkimos City Centre during project delivery to track local economic performance against targets.	Documented report	Private Developer, City of Wanneroo	LandCorp	Business and Economic Development Manager
	Business and Economic Development Manager	Dedicated resource to drive and coordinate economic development and business and investment attraction to Coastal Alkimos area.	Appointed Resource	Private Developer, LandCorp	City of Wanneroo	Alkimos Economic Development Committee

Strategic Theme	Initiative	Objective	Deliverable	Lead	Key Partners	Prerequisite Deliverable
						Alkimos Economic Development Committee

Considerable synergies exist across South Alkimos, Central Alkimos and Alkimos City Centre in the delivery of potential economic development initiatives and actions. In many cases, the same initiative can be applied to all three regions, to eliminate duplication of effort. This approach also recognises the strong interrelationship and unique roles and functions each LSP area have in the broader regional Alkimos-Eglinton economy, necessitating effective coordination.

6.0 Summary & Conclusion

Central Alkimos has a critical role to play in supporting the establishment and development of the primary economic and commercial node in the Alkimos-Eglinton District – the City Centre. The residential population of Central Alkimos will provide businesses and employers in the City Centre with an important early local retail expenditure pool and labour force. Considering the role that retail and population serving industries play in the establishment of new economic nodes, this local population critical mass will assist in the growth and evolution of the City Centre as one of the major economic centres in the North West Corridor of Perth.

Despite its primary role being a supporting residential area for the City Centre, Central Alkimos will also accommodate employment in its own right. Community and population serving industries like education, care and convenience retail will generate employment opportunities in response to the growing local population. In contrast, employment in service commercial land and mixed use opportunities along Marmion Avenue will provide opportunities for businesses to trade into the broader catchment, either through the capture of passing traffic or through strong connectivity to the proposed Mitchell Freeway extension. In addition, more than 25% of local employment will be in the form of home-based businesses, reflecting the residential character of the area.

A summary of key employment indicators for the Central Alkimos are outlined below.

Table 3: Key Economic Indicators, Central Alkimos

Indicators	At Completion
Dwellings	2,000
Estimated Population	5,000
Estimated Workers	2,500
Estimated Employment	887
Employment Self-Sufficiency	35.5%
Strategic Industry Share of Employment	<10%
Employment Density ⁶	3.3 jobs/ha

The absence of a rail station in Central Alkimos will have a significant impact on the local economic potential of the area, foregoing both the quantum and intensity of employment that could be achieved. This Strategy has assumed that the rail station will not be delivered, in line with advice from the relevant State Government agencies, though allowance for the station to be delivered in the future has been made in the Structure Plan itself.

Overall, Central Alkimos's primary role in the Alkimos-Eglinton District is residential. However, its position and location means it will play an important role in providing a local population, retail expenditure pool and labour force for businesses and employers in the City Centre, helping to reinforce the sustainability of the major economic node of the District.

⁶ Including Regional Open Space. 5.6 EFT jobs per hectare when Regional Open Space is removed.

Appendix 1 – Related Strategies

A scan of government and key stakeholder departments identified a number of important documents that will influence economic development initiatives and outcomes in the region and in Central Alkimos.

The following provides a summary list of primary and related documents with respect to economic development within Central Alkimos. Also included under the primary documents are the key themes which must be acknowledged when planning and implementing economic development initiatives at Alkimos:

City of Wanneroo Strategic Plan 2006 – 2021 (Revised 2010)

Economic Pillar – A prosperous region achieved through economic growth and employment:

- create strategic shifts in job markets to meet future needs and demands
- support business and initiatives
- provision of timely and coordinated regional infrastructure
- increase the capacity of education and training support to industry

City of Wanneroo Economic Development Strategy (2004 – 2007)

Key action items:

- Internal monitoring & support: the economic development portfolio
- Innovation and entrepreneurship
- broadband
- commercial/industrial
- rural economy
- home-based-business
- tourism development

City of Wanneroo Draft Tourism Strategy and Supporting Actions (2011 – 2017)

Six key strategies have been identified and proposed:

- Maximise tourism opportunities by ensuring that tourism receives adequate planning consideration
- Develop a coordinated and supportive approach to holding events in the City of Wanneroo
- Review internal processes to ensure that they support tourism outcomes
- Support an integrated approach to tourism signage across the City
- Maximise visitation through effective promotional activities
- Facilitate tourism opportunities and encourage stakeholder participation

Alkimos Eglinton Economic and Employment Strategy March 2007 (Syme Marmion & Co)

Alkimos Eglinton economic programs:

- Waste Water Treatment Plant buffer zone
- Broadband

- Business outreach service
- Business Activity Centre
- Small business incubator
- Home Based Business support
- Early retail provision
- Contribution towards the Wanneroo Business Association
- Ancillary contribution to smaller projects
- External opportunities (St Andrews, Neerabup Industrial Area)

State Planning Policy 4.2 - Activity Centres for Perth and Peel (2010)

This Policy aims to provide a more flexible regulatory approach to enable appropriate commercial, residential, mixed business and retail redevelopment opportunities in activity centres, with a much reduced emphasis on retail floor space guidelines.

A portion of the South Alkimos site, known as the Gateway Village, is identified as a 'Secondary Centre' in accordance with the Activity Centres Hierarchy. The Gateway Village will be included in the Activity Centre Structure Plan which is to be prepared over the land to the east of the site, known as the Alkimos Regional Centre, in accordance with the Policy.

In accordance with the Policy an Activity Centre Structure Plan is not required for the Central or Beach Villages.

City of Wanneroo Local Planning Policy 4.2: Structure Planning

This Policy requires the preparation of a Local Economic Strategy. The Strategy is to include the following elements:

- Demographic, planning, economic, infrastructure and land use context;
- Floorspace modelling addressing shop retail, industrial and public purpose floorspace, including health, education and leisure, as defined by the Western Australian Planning Land Use Categories; and
- Economic strategies detailing floorspace distribution, land uses, infrastructure, employment density, employment self-sufficiency targets and employment staging.

This document is considered to meet the required elements as detailed in the Policy.

- City of Wanneroo Employment Policy (December 2003)
- City of Wanneroo Smart Growth Strategy 2005
- Alkimos - Eglinton District Structure Plan June 2007 (Revised August 2008)
- Alkimos Eglinton District Structure Plan. Appendix 6. Retail Assessment. October 2006 (Ibecon)
- Directions 2031 and Beyond (August 2010)

Appendix 2 – Wanneroo Economic Profile

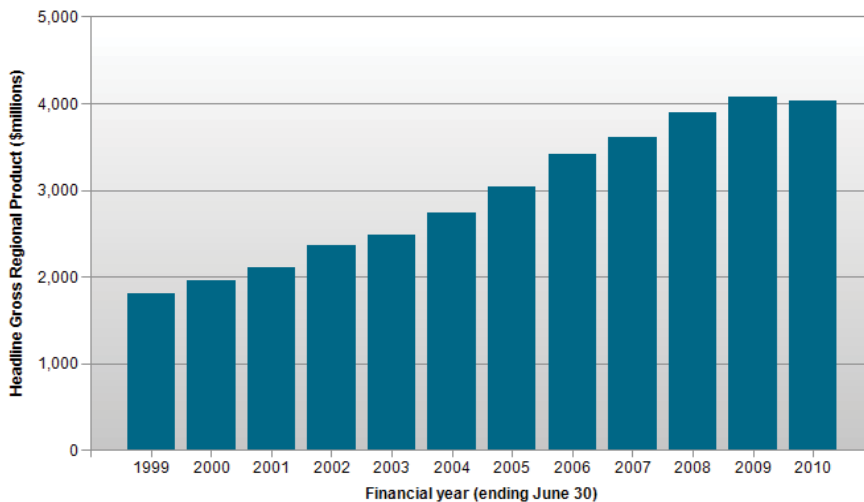
The following information (section 1.2) was sourced from the City of Wanneroo website (economy.id and ABS data). It is considered current at the time of writing this document.⁷

Economic Highlights



Figure 4 City of Wanneroo Economic Highlights

Gross Regional Product

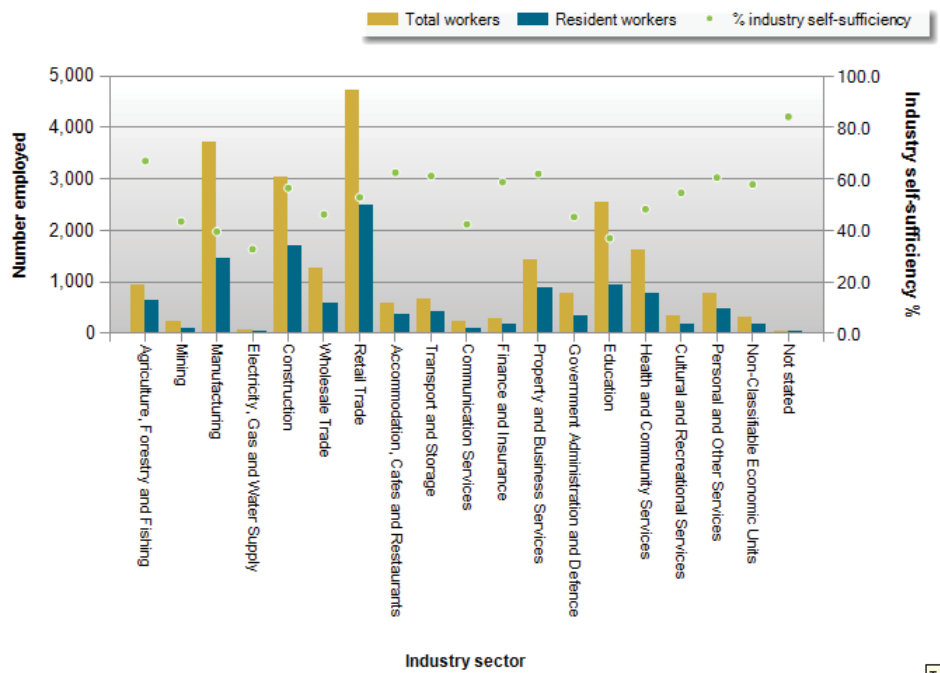


Source: National Institute of Economic and Industry Research (NIEIR) ©2011 Please note that NIEIR modelled estimates are subject to change and review for the most recent two financial years.
Modelled data - All \$ values are represented in constant 2007-08 year dollars

⁷ <http://economy.id.com.au> and <http://www.wanneroo.wa.gov.au/Business/Statistics>

Figure 5 City of Wanneroo Gross Regional Product, 1999 to 2010

Industry Self Sufficiency



Source: Australian Bureau of Statistics, Census of Population and Housing 2001 and 2006.

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Figure 1: City of Wanneroo Industry Self-Sufficiency, 2001 and 2006

Employment by Industry Sector

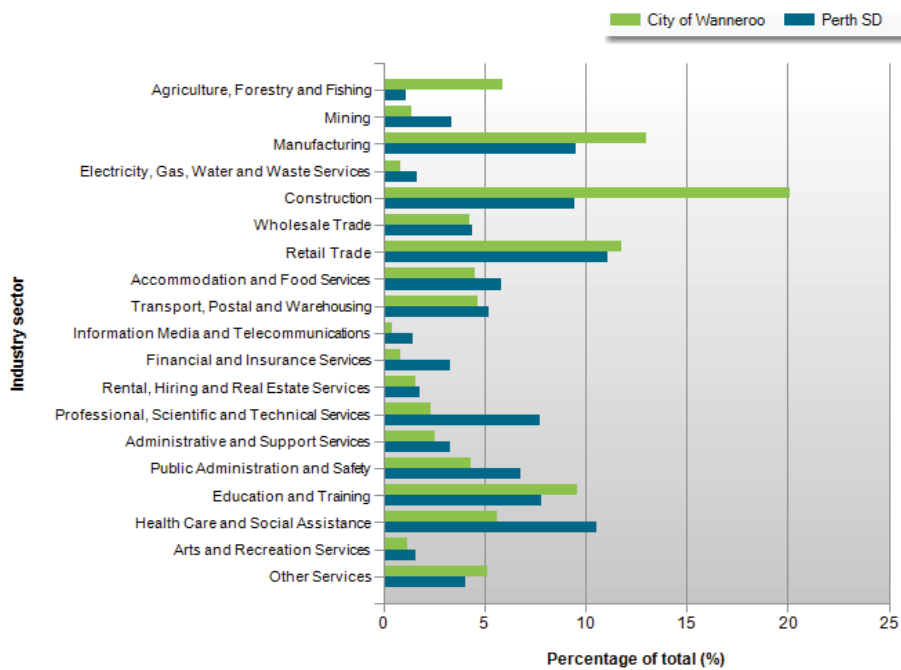


Figure 6 City of Wanneroo Employment by Industry Sector

Changes in Employment by Industry Sector

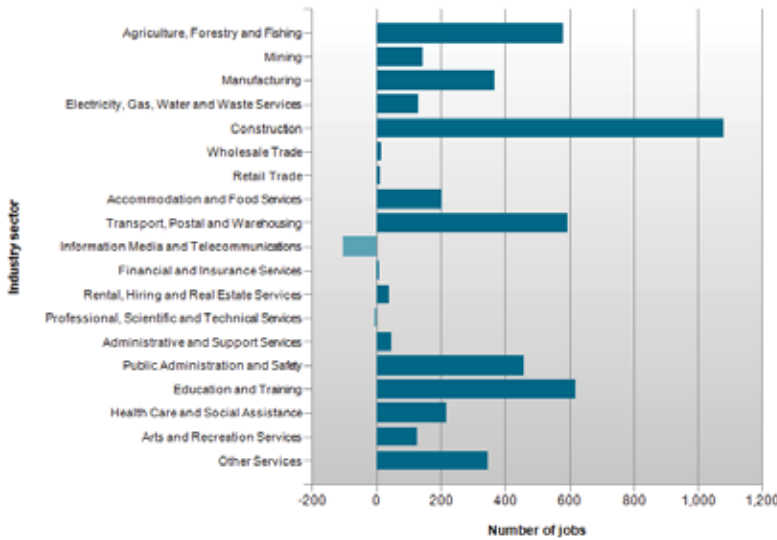


Figure 7 City of Wanneroo Changes in Employment by Industry Sector

Local Employment Self-Sufficiency Ratio

The employment self-sufficiency ratio within the City of Wanneroo (2006) is 46.0%, as calculated in the table below:

Table 4: City of Wanneroo Employment Self Sufficiency Comparison⁸

	City of Wanneroo (2001)	City of Wanneroo (2006)	City of Joondalup (2001)	City of Joondalup (2006)	Perth NW Corridor (2001)	Perth NW Corridor (2006)	Perth Metro (2006)
Resident Workers	33,908	51,114	75,295	81,381	109,203	132,495	704,115
Total Jobs	17,191	23,511	28,611	32,787	45,802	56,298	621,689
Employment Self Sufficiency	50.7%	46.0%	38.0%	40.3%	41.9%	42.5%	88.3%

“The above illustrates that the City of Wanneroo area has jobs available equivalent to 46.0% of the resident workforce but this ratio has declined from 50.7% since 2001, indicating that jobs growth has not kept pace with population growth. In comparison, the City of Joondalup experienced an increase in employment self-sufficiency between 2001 and 2006. Overall, the Perth metropolitan northwest corridor (Joondalup and Wanneroo combined) experienced a slight increase in employment self-sufficiency during the period.

If the projected population at 2021 for the City of Wanneroo as forecast by ID Consulting is realised and the labour force participation rate by age remains constant, the number of employed persons living in the City will be approximately 107,000 in 2021. This means that the City will need an additional 25,500 jobs to be

⁸ ABS Census Basic Community Profile and Worker Population Profile 2001 and 2006 as referenced in City of Wanneroo Briefing Note Executive Management Team (EMT) 30 June 2010

located in the City within the 15-year period from 2006 to 2021 to maintain the current self-sufficiency rate of 46.0%.

In order to increase the local self-sufficiency or to maintain the current 46.0% ratio, a coordinated strategy is essential. Neglecting the regional employment self-sufficiency will have serious economic, social and environmental consequences including higher local unemployment, lower median household income, road congestion, pollution, higher transport costs, reduced family/quality time and dormitory suburbs".⁹

⁹ City of Wanneroo Briefing Note Executive Management Team (EMT) 30 June 2010

Appendix 3 – Employment & Floorspace Estimates

Table 5: Floorspace and Employment, Central Alkimos, Scenario 1 - Base Case

Central Alkimos	PLUC	Stage 1		Stage 2		Stage 3		Stage 4		Capacity	
Catchment Population	Category	250-750		2,000-3,000		3,500-4,500		4,000-5000		4,500-5,500	
Employment (Scale and Jobs)		Scale	Jobs	Scale	Jobs	Scale	Jobs	Scale	Jobs	Scale	Jobs
Retail (Local Centre) Uses (Sqm)											
1 x Supermarket (Convenience)	SHP	0		0		600		800		800	
Retail/Dining	SHP					200		400		400	
Sub Total		0	0	0	0	800	32	1,200	48	1,200	48
Community and Commercial											
High School (sqm land)	HEL	0	0	35,000	42	70,000	84	100,000	120	100,000	120
Child Care (sqm land)	HEL	0		2,500	14	2,500	14	2,500	14	2,500	14
Sub Total			0		56		98		134		134
Other - Population Driven											
Mixed Use (9ha sqm land)	OFF	0.7	7	1.7	17	3.4	34	5.0	50	9.0	90
Service Commercial (6.7ha sqm land)	SER	0.7	27	1.7	67	3.4	134	5.0	201	6.7	268
Home Based Business (dwellings)	OFF	250	33	750	100	1,500	200	2,000	267	2,600	347
Sub Total			67		184		368		518		705
Employment (Estimate)			67		240		498		700		887



APPENDIX H
ENGINEERING
AND SERVICING REPORT

(COSSILL AND WEBLEY, AUGUST 2013)



**ALKIMOS CENTRAL
LOCAL STRUCTURE PLAN
ENGINEERING SERVICING REPORT**

**AUGUST 2013
(Revision B – 26/08/13)**



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- Local Structure Plan, Central Alkimos, RDG Draw RD1 001 Rev H

- Figure 1 - Alkimos Central Proposed Sewer Strategy
- Figure 2 - Alkimos Central Water Supply Scheme Concept
- Figure 3 - Alkimos Central Proposed Electrical Power Network

- Dwg 1 - 6016-00-SK05 Alkimos Proposed Water Corporation Ground Water Production Bores
- Dwg 2 - 6016-AC-200-A Alkimos Central Proposed Sewer Strategy

1. EXECUTIVE SUMMARY

This report has been prepared by Cossill & Webley Pty Ltd (CW) for the Alkimos Central Local Structure Plan. It summarises the results of a review of the civil engineering issues which have influenced the form of the structure plan and which are related to the future servicing of the developed land within the structure plan area.

This engineering servicing report provides details for each major infrastructure type and a servicing strategy for implementation required for the development of the Alkimos Central area. The level of detail is consistent with the requirements of a local structure plan and acknowledges further more detailed work will be required at the time of land subdivision.

The engineering review has covered siteworks, roads, stormwater drainage and utility services.

The investigation has found the land is capable of development in accordance with the proposed local structure plan with logical progressive extension of infrastructure and base capacity.

The ground conditions and past uses (Unexploded Ordnance UXO) will not limit the proposed urban development.

The existing road access, via the Marmion Avenue will provide initial road access and can be progressively upgraded to accommodate a traffic signalled controlled 4-way at Alkimos Drive in the ultimate configuration. The proposed extension of the Perth northern suburbs railway has been accommodated and the future development levels of adjoining land coordinated with the Perth Transport Authority's railway design concept. Grade separated road crossing have been proposed and provision made in the proposed site grading.

Waste water service can be provided through the extension of gravity mains (Yanchep Main Sewer) from the existing Alkimos Waste Water Treatment Plant. A portion of the Alkimos Central catchment cannot be connected through gravity sewers to the Yanchep Main Sewer, these areas will be managed through the construction of a permanent waste water pump station in accordance with the Water Corporation's waste water scheme. Cossill and Webley has prepared a strategy which meets the conveyance requirements of the Water Corporation and the vertical separation required by the PTA at the sewer crossing of the railway, although we are awaiting comment on this proposal from the Water Corporation.

Initial water supply can be provided from the existing pipe infrastructure in Marmion Avenue, with the balance of the proposed development serviced through progressive staged expansion of the trunk water main network. The Water Corporation has plans to develop a local network of groundwater supply bores and a local groundwater treatment plant to supply treated water to the Carabooda reservoir and distribution network.

Initial electrical supply can be provided from the existing high voltage HV underground infrastructure in Marmion Avenue, with the balance of the proposed development serviced through progressive staged expansion of the trunk electrical network. It is likely within approximately ten years (subject to individual dwelling loads and rate of development) the capacity of the Romeo Road (Yanchep) Zoned Substation will be exceeded and a new substation will be required to be constructed in Eglinton as planned through the Alkimos Eglinton District Structure Plan. A 132kV overhead line will be required to be installed on the western boundary of the Mitchell Freeway to provide supply to the new Eglinton Zoned Substation.

Telecommunications and gas are available from existing services in Marmion Avenue; they have capacity for the Alkimos Central development.

The investigations and preparation of the report are largely based on preliminary advice from the various service authorities. The information is current as of December 2012 and is subject to change as development proceeds in the Perth north-west corridor resulting in the extension of service infrastructure and the creation of new capacity.

2. INTRODUCTION

This report has been prepared by Cossill & Webley Pty Ltd for the Alkimos Central Local Structure Plan (Alkimos Central LSP). It summarises the results of a review of the engineering infrastructure coordination, servicing and staging in relation to the structure plan area.

The Alkimos Central LSP is being prepared by Lend Lease and Roberts Day Group, on behalf of LandCorp who own the land.

Regional Context

The LSP site is located within the north-west sub-region of the Perth metropolitan area. The site is adjacent to the proposed Alkimos Secondary Centre and is located approximately 17 kilometres north of the Joondalup Strategic Metropolitan Centre and approximately 8 kilometres south of the Yanchep Strategic Metropolitan Centre.

District Context

The LSP site is located within the central portion of the Alkimos-Eglinton District. The Alkimos-Eglinton District Structure Plan (DSP) has been prepared to guide development of this 2626 hectare District which is proposed to create over 23,000 dwellings and house a population of approximately 57,000 residents. The DSP has been approved by the City of Wanneroo and endorsed by the WAPC.

Local Context

The land to the north is being developed for urban purposes, the land to the east is vacant but is reserved for a Water Corporation groundwater treatment plant and Mitchell Freeway extension, the land to south of the western side of Marmion Avenue is the Water Corporation waste water treatment plant and associated buffer, the land the eastern side of Marion Avenue is currently vacant but is the site of the Alkimos Secondary Centre. The foreshore reserve and Indian Ocean is located to the west of the site.

Area and Land Use

The site has a total land area of 266 hectares. The site is currently vacant and is unimproved.

Legal description and ownership

The LSP area comprises portion of Lots 9002 and 9003 Marmion Avenue.
The legal description of the subject land is provided in Table 1.

TABLE 1 – LOT DETAILS

Lot Number	Certificate of Title	Owner
9002	Volume 2771 Folio 786	Western Australian Land Authority
9003	Volume 2771 Folio 789	Western Australian Land Authority

This engineering review has covered siteworks, roads, stormwater drainage and utility services.

The engineering review has been carried out to ensure the Central LSP responds as necessary to the engineering constraints and is capable of being serviced with common infrastructure. The level of detail provided is consistent with a local structure planning context and is not intended to provide all of the detail required at final land subdivision stage.

3. SITEWORKS

3.01 Topography

The existing topography within the Alkimos Central LSP is typical of the Perth north west corridor coastal area in general it comprises an undulating sand dune landform with younger dunes close to the coast and older more stable dunes further inland. The area contains a number of prominent east-west ridges, with elevations up to RL 57 metres AHD and lows in the area of approximately RL 29m.

The southern boundary of the Central LSP area borders the northern arm of a large parabolic sand dune located across the broader Alkimos land holding. This distinctive landform has had a major influence on the layout and form of the District Structure Plan land uses. As a result of its relative dominance in the local land form and reflecting the conservation value of the dune, this arm on the southern boundary, forms the boundary between the northern limits of the City Centre Activity area and this Central residential area.

3.02 Ground Conditions

The state geological map series indicates the parabolic dune consists of underlying weakly cemented limestone with sand overlying limestone at varying depth in the remainder of the land holding. Coffey Geotechnics has carried out a number of geotechnical site investigations within the broader Alkimos area over the past five years. Based on the results of these investigations and the experience gained from recent engineering works in this area, the ground conditions within the Alkimos Central LSP area are expected to be as follows:

The Alkimos Central LSP is within an area of coastal Quindalup sand dunes extending inland from the coastline. They are geologically younger than the Tamala Limestone which occurs at depth, and as outcrop, further inland. The dunes are comprised of fine to medium grained, light brown to white, calcareous sand. The natural density of the sand is predominantly medium dense to dense, however loose surface sand can occur on the lee (eastern) sides of dunes. The sand is comparatively high permeability (typically 2m/d to 20m/d), high void ratio, no shrinkage and low bearing capacity.

Areas of rock outcrop occur and are comprised of well cemented cap rock zones formed by the dissolution and reprecipitation of calcium carbonate within the weathering profile to form calcrete deposits, the well cemented high strength calcrete layers are relatively less developed within the Quindalup Dunes and generally less than 0.5m thick.

Surface rock is anticipated to occur predominately as cemented limestone cap rock outcrops along ridge lines within the Quindalup Dunes. Below the cap rock layers the limestone is generally of lower strength. Within the Quindalup Dunes, limestone is generally weakly cemented to form a low strength rock.

Excavation conditions within the areas of rock are highly variable and are largely affected by the thickness of cap rock development. Within the Quindalup Dunes where cap rock development is thin (<0.5m) it is generally easily ripped with a large dozer (~D10) and the underlying, weakly cemented material can often be excavated with a large excavator (~40t).

In very general terms excavation conditions are potentially more difficult with increasing age of the formation as the cap rock layers have had a greater length of time to develop. As a generalisation the potential for encountering difficult excavation conditions increases with further distance from the coast and with increasing depth of excavation due to the potential for encountering older cap rock formations.

3.03 Karstic Formations

Karstic ground formations are known to occur in the limestone rock along a band running north-south along the eastern side of Wanneroo Road, well clear of the Alkimos Central LSP area.

The Alkimos Water Alliance has excavated an area, south of the Alkimos Central LSP area, for the Alkimos Wastewater Treatment Plan. The excavation extends down to levels of 3 metres AHD, in some areas, in limestone rock, there has been no evidence of karstic ground conditions. Similarly, we are unaware of any karstic evidence experienced in excavation at Peet's Shorehaven (to the north) to date or in the past works of Brighton, Trinity and Jindalee to the south of this LSP area.

Based on this evidence it is considered very unlikely that the Alkimos Central LSP area contains karstic ground formations.

Notwithstanding this, provision will be made in the construction specifications for earthworks at the time of subdivision of the land for progressive inspections of the works by qualified geotechnical engineers to confirm, or otherwise, the above and confirm the adequacy of the land for further development.

3.04 General Siteworks

Siteworks for urban development typically comprises the identification of areas of vegetation for conservation, protecting these areas (during and after construction) and in areas for commercial and residential development clearing of the existing vegetation to receive the built form and, where necessary, the earthworking of the existing ground to accommodate the required form of development.

In Perth it is often the case that the extent of siteworks is dictated by the density and nature of development and by the finished ground shape required for building houses, commercial buildings etc. Increased densities and decreasing lot sizes has led to a current trend for the development areas to be fully earthworked to create level lots which are terraced between retaining walls.

This approach has provided a number of positive outcomes in the past including:-

- Reduction in the total house building cost
- Rationalisation of retaining wall layouts and designs consistent with Local Authority specifications
- Enables lots to be terraced up natural slopes to maintain elevation and views while providing certainty between boundaries.

This approach assumes the home builder or commercial builder is unable to manage the levels changes between allotments across each site within or around the building itself. LandCorp is currently trialling leaving the building sites graded at Alkimos Beach west of Marmion Avenue with their joint venture partner Lend Lease, if this method is successful it may be transferred to the Alkimos Central, meaning the sites will be left graded without retaining walls.

3.05 Siteworks Controls

There are a number of factors which need to be considered in reviewing the finished levels of the development of the Alkimos Central LSP. These are summarised as follows:

- The parabolic dune which is located to the south of the site the LSP area will need to be accommodated in the earthworks design concept if significant dune retention at the boundary is to be achieved.
- Finished development levels within the Central and the grade of linking roads will need to match the finished development levels within the adjoining land to the north, the Shorehaven Development by Peet. A close liaison will need to be maintained therefore, with the developers of the land and their consultants to ensure that this is the case and to ensure that the Central levels are not compromised by unreasonable proposals from the adjacent landholdings.

Contact has been made with the engineering consultants for Shorehaven, the preliminary design details have been exchanged and a continued liaison will be maintained with them as a part of the detailed engineering design of the road and development levels along the common boundary of the Alkimos Central LSP area.

- The western boundary is fixed by the extension of the Foreshore reserve across to link to the Conservation area protecting the dune and surrounding the Waste Water Treatment Plant, existing first stage of Marmion Avenue sets a constraint central to the LSP.
- The far eastern limit of the Alkimos Central LSP adjoins the reserve for the future extension of the Mitchell Freeway and the proposed Alkimos Ground Water Treatment Plant site and associated regional open space. Development levels in this location will need to be prepared accommodating the constraints of the Main Roads WA Freeway batter limits and Alkimos Drive freeway approach levels.
- The Perth northern suburbs railway reserve (Butler to Yanchep extension) is aligned north south through the Alkimos Central and presents a significant constraint for the development at Alkimos.
- Siteworks within the Alkimos area may be subject to further investigation surveys for Unexploded Ordnance (UXO), in accordance with FESA requirements. However FESA advice suggests that sufficient surveys have now been completed for Alkimos, without any high explosive finds which would require further searching.

3.06 Proposed Siteworks

The Alkimos Central LSP has been designed in accordance with the following objectives:

- To maximise the preservation of the significant topographic features in specific conservation public open space areas, namely the parabolic dune forming the southern limits of the Central area.
- To allow for roads and development sites to be graded to follow the existing topography where possible and to best reflect the coastal landscape.
- Provision in the design of the Alkimos Central and Perth Northern Railway extension has been made to ensure sufficient track to structure clearance is possible at proposed road crossings.

The approach adopted to achieve the above objectives is outlined as follows:

3.6.1 Significant Landscape Features

In the case of significant landscape features the Alkimos Central LSP includes the retention of high dune ridge within regional open space areas to the south.

Road levels adjacent to these areas will be designed, therefore, to minimise the extension of earthworks batters, into the ridges, to maintain their natural form.

3.6.2 Roads and Development Sites

The preparation of the Alkimos Central LSP has involved a review of a number of options for the grading of roads and development sites. This has comprised a number of iterations of the review of development levels, between Cossill & Webley, the Town Planning and Landscape consultants, aimed at identifying a plan which best balances the grading objectives with the other objectives for economics, engineering design, development land uses, traffic planning etc.

The Alkimos Central LSP promotes the adoption of lower road design and operating speeds, in accordance with Liveable Neighbourhoods objectives, through the road layout and the urban design of streetscapes. The engineering design standards which suit these lower speeds provide greater flexibility, therefore, to follow the existing topography through the adoption of steeper grades, shorter sight distances, etc.

The approach to the grading of residential development sites for the Alkimos Central LSP is as follows:

- For gently sloping sites it is proposed that where possible minimal siteworks be carried out as a part of subdivision and that the existing grades within the allotments be dealt with as a part of building works. This should not require complex or special building forms.
- Medium and steeply sloping sites would be earthworked as a part of subdivision but only to the extent where resultant grades allow building works as above for gentle sloping sites. This may involve the construction of some retaining walls as a part of the subdivision siteworks.

In areas where medium and higher density development is proposed the subdivision siteworks would be minimal. Existing slopes and topography would be dealt with as a part of building design and construction. This would be the same as larger commercial and retail sites which would be left graded between adjoining development roads.

Similarly in some special design areas the existing steeper topography may be left for single residential houses where special building forms, like split levels, framed construction, undercroft garages, etc. could be employed to suit the existing grades.

In practice the final choice of subdivision siteworks and building typologies will be dependent on a range of factors including, affordability, product mix, economics, etc.

It is considered, however, that the Alkimos Central LSP, as proposed will provide flexibility for the consideration of the range of options, in ongoing development, to maintain the landowner's objectives for the project.

3.6.3 Roads and Railway Crossing Levels

The preparation of the Alkimos Central LSP and the establishment of the separate Metropolitan Region Scheme Amendment 1192/57 for the Railway reserve and Romeo Road has involved extensive liaison between the Public Transport Authority, their consultants and the Alkimos development team. As a minimum outcome the design concepts for both the railway and land development will be coordinated to ensure sufficient vertical separation at proposed road crossings will be possible without significant modification of the road grading on approach to the railway reserve (to avoid unsightly local build-up of roads with corresponding loss of urban amenity and available developable land).

4. STORMWATER DRAINAGE

4.01 Integrated Urban Water Management

The Alkimos Central LSP Local Water Management Strategy (LWMS) has been prepared by Emerge Consultants. This provides a basis for ongoing development to ensure that appropriate allowances are made for total water management including the minimisation of scheme water use, the maximisation of recharge of stormwater runoff etc.

Stormwater drainage management is a major component of an overall LWMS for which the achievement of the principals of the plan may be facilitated through the application of Water Sensitive Urban Design (WSUD) techniques. Objectives of WSUD include:-

- Detention of stormwater rather than rapid conveyance;
- Use of stormwater to conserve potable water;
- Use of vegetation for filtering purposes; and
- Water efficient landscaping.

For the Alkimos Central LSP and broader Alkimos area, the main WSUD practices which should be incorporated into the ongoing implementation of the Alkimos Central LSP proposals are as follows:-

Stormwater Management

The maximisation of stormwater recharge of the shallow aquifer is through the adoption of 'Best Management Practices', which promote the dispersion and infiltration of runoff. These include the use of porous paving for roads and car parks, the diversion of runoff into road medians and road-side swales, drainage soakwells to infiltrate runoff from building roofs and private open space areas and the disposal of road runoff into infiltration basins within POS areas.

Water Quality Management

The maximisation of the quality of recharge water through the adoption of "Best Management Practices", which promote the disposal of runoff via water pollution control facilities (including vegetated swales and basins, detention storage and gross pollutant traps) and the implementation of non-structural source controls (including urban design, street sweeping, community education, low fertiliser landscaping regimes, etc.).

4.02 Stormwater Collection and Management

The Alkimos land is generally free draining with no low-lying areas with high groundwater levels or defined watercourses. The existing limestone and sandy ground is permeable and the depth from the ground surface to groundwater is significant.

Overall, therefore, the land is highly suited to the implementation of the WSUD management practices outlined above.

In all areas of development low residential densities, it is expected that runoff within developed sites will be contained within the lots. Stormwater disposal will be via soakwells or other infiltration facilities which form a part of the building and private open space development. In areas of high urban density allowance has been made in the stormwater model to manage a proportion of the runoff in the council controlled street drainage network.

Drainage from public roads and lanes can be managed in a number of ways depending on the nature of the adjacent land uses, the extent of traffic and pedestrians and the objectives for drainage management.

For the development of the Alkimos Central LSP it is proposed to adopt the WSUD approach recommended by the Department of Water where this approach provides an improved environmental outcome. DOW's target of infiltrating storms up to 1 in 1 year ARI at source (dispersed throughout the drainage catchments) may be difficult to economically achieve throughout the catchment where there are highly urbanised City Centre roads as a consequence runoff will likely be conveyed to the local low points where stormwater runoff infiltration areas will be co-located with areas of public open space. Stormwater runoff will soak efficiently into the ground and return a significant proportion of the runoff to the unconfined aquifer.

Infiltration could also be via swales within or adjacent to road reserves, via gully pits with permeable bases, slotted drainage pipes, porous road pavements, under road storages etc. subject to the City of Wanneroo approval and consideration of whole of life costs including the ongoing maintenance.

Runoff from storms up to 1 in 5 years ARI would be conveyed in an underground pipe system to low point infiltration basins consistent with the requirements of the City of Wanneroo.

Roads and POS would be designed to cater for the surface overflow for more severe storms with building pads constructed at least 300 millimetres above the 1 in 100 year ARI flood or storage level at any location.

The dispersion of stormwater disposal will maximise the area of recharge down through the soil profile to the shallow aquifer, thereby, maximising the potential for nutrient stripping and water quality improvements.

The WSUD approach has yet to be fully adopted by the City of Wanneroo and, therefore discussions will need to be held with Council in this regard.

The LWMS prepared by Emerge details the stormwater drainage plan for the Alkimos Central LSP. The plan shows the approximate location of stormwater disposal sites based on a preliminary assessment of finished development levels. As indicated in Section 3 the preliminary assessment has been based on road alignments and grades reflecting the existing topography as far as practical. This approach results in a number of natural 'low points' throughout the development area which will need to be designed, with drainage infiltration sites and flood storage areas to accommodate runoff for up to 100 year ARI storm events.

The LWMS also includes tabulated data for areas required at each low point infiltration swale to cater for the 1 in 1 year, 1 in 5 year and 1 in 100 year ARI storms.

5. ROADWORKS

5.01 Traffic and Transportation

An assessment of the traffic planning aspect of the Alkimos Central LSP proposals has been carried out by Bruce Aulabaugh, Traffic Engineering and Transport Planning Consultant (BA).

The results of this investigation include a recommended hierarchy for the roads within the Alkimos Central LSP and the future subdivision development together with recommendations for public transport services, pedestrian and cyclist facilities.

In all cases the engineering review has taken account of the above recommendations.

5.02 Regional Roads

Marmion Avenue is complete to a first stage rural standard arterial road between Butler and Yanchep and the land the subject of this Alkimos Central LSP is a party to the agreement through LandCorp with Capricorn Village Joint Venture for repayment of the proportional share of the stage 1 road construction on agreed terms. The construction of the stage 1 road extension was completed in November 2008.

Main Road WA has no programme for the extension of the Mitchell Freeway beyond Burns Beach Road. It is likely without Government intervention this state infrastructure will not be extended to the Alkimos Central area and the Alkimos Drive interchange for at least fifteen years.

On this basis, Marmion Avenue will be required to provide a regional road access function for the development of the Alkimos Central LSP land until the freeway is further extended in the longer term and access to the freeway via Alkimos Drive will become the second region linkage. Marmion Avenue therefore in the interim provides the only direct primary distributor function in the absence of the freeway.

The design of the district distributor roads will be based on an ultimate operating speed of 60-70 kph, with the lower speeds applying through the more active urban areas and activity centres. These operating speeds are also consistent with the intended function of the roads to integrate more with the surrounding land uses as well as cater for district traffic movements.

State Planning Policy 5.4 Noise Considerations will need to be reviewed for these roads as they meet the definition provided in the policy requiring noise design consideration in some cases for both their road classification and where their ultimate traffic volume exceeds 20,000 vehicles per day. The requirements for noise management will be incorporated in more detailed local planning work at subdivision stage.

5.03 Development Roads

The Alkimos Central LSP comprises a network of development roads including district distributor roads, neighbourhood connector roads and local access roads and laneways.

The Alkimos Central LSP includes an urban design hierarchy for the development roads, which is an expansion of the traffic hierarchy, to better reflect the intended functions of the roads and their corresponding streetscape characters. Typical road cross-sections are documented in the traffic report.

In all cases the road cross-sections will be designed to cater for utility services, street trees, parking embayments, etc. as required.

The engineering design of roads will be carried out to comply with the Department of Planning Liveable Neighbourhoods recommendations for design speeds, sight distances, etc. and with the requirements of the City of Wanneroo and Main Roads WA where applicable.

In particular, it is proposed that the development roads be designed to suit lower vehicle operating speeds to ensure safer operation and to provide more flexibility to better follow the existing topography with road alignments and grades. The lower speeds on local roads will also support initiatives to adopt smaller street truncations and associated intersection curve radii.

The Alkimos Central LSP includes some short sections of development roads located adjacent to the boundary of the dunes and Regional Open Space network. The existing topography along these sections is such that to achieve appropriate road alignment it may be necessary to extend the road earthworks batters into parts of the reserve. The extent of this would be minimised as an objective of the road design and would be detailed through relevant environmental approval processes.

6. WASTEWATER

6.01 Wastewater Collection and Treatment

The Water Corporation of WA's (WCWA) has commissioned the first stage of the Alkimos Wastewater Treatment Plant WWTP and the associated Quinns Main Collector Sewer for collection of flows from the south. To the north, there is a planned 1350mm diameter gravity main to collect flow from as far north as Yanchep and deliver it by gravity to the WWTP.

The WCWA's strategy for the Alkimos Central area is to collect waste water from the individual allotments and convey the flow via local waste water gravity sewers (where possible) to the trunk gravity sewer main known as the Yanchep Main Sewer which traverses north through the land west of Marmion Avenue following the natural low points in the topography. Isolated catchments which cannot be served via a gravity sewer have been identified to be served by permanent waste water pump stations, pumping the flow back to the gravity mains.

The Alkimos WWTP has been funded by Water Corporation although prefunding by developers may be required for other headwork items, such as permanent waste water pumping stations and other trunk gravity branch sewers. The waste water strategy for Alkimos Central includes one permanent waste water pump station near the eastern verge of Marmion Avenue, to be located adjacent to public open space, refer to the schematic Figure 1 drawing 6016-AC-Fig1.

6.02 Initial Wastewater System

The staging of the initial waste water scheme for the Alkimos Central will depend on how the Central area will be staged and this will largely be driven by market and commercial land sales. There is limited opportunity to grade relatively small areas into the existing system installed for Shorehaven. The majority of the Central LSP area will require the construction of the permanent sewer pump station referred to as Alkimos Pump Station M on the Water Corporation scheme planning.

The western most land within the Alkimos Central LSP gravitates towards the Yanchep Main Sewer. Given the Water Corporation may defer the construction of this major infrastructure for some time an interim sewer pump station may be required to form a temporary link to the Alkimos WWTP. If allowance is made for sufficient pipe sizes in Shorehaven much of the western area could be graded north through Shorehaven to the interim pump station being constructed by Peet.

6.03 Ultimate Wastewater System

The ultimate WCWA scheme proposed for Alkimos Central includes the extension of the 1350mm diameter gravity trunk sewer, the Yanchep Main Sewer.

The alignment of the 1350mm Yanchep Main Sewer is not finalised although the Water Corporation scheme plan indicates its approximate alignment following the low points in the local valley between dunal ridges. Cossill and Webley has prepared a detailed sewer strategy taking account of the existing WCWA sewer scheme, the proposed finished development levels, conceptual development layouts and constraints such as the future Perth Northern Suburbs railway extension, refer drawings 6016-AC-200-A for a more detailed view of the sewer strategy than the schematic Figure 1. This sewer strategy concept is currently being reviewed and considered by WCWA.

The permanent waste water pump station represents significant capital expenditure for the Water Corporation and should be placed on their capital works program five years prior to development proceeding and requiring the infrastructure.

6.04 Alternative Wastewater Treatment and Reuse

The WCWA is reviewing alternative options for the potential reuse of treated waste water effluent at the Alkimos Waste Water Treatment Plant. At present we understand the WCWA's preference is to pursue the indirect reuse of treated effluent. One method being considered is the recharge of ground water aquifers by treated effluent injection as is being trialled from the Beenypup Waste Water Treatment Plant.

We understand that there is limited support for direct reuse of treated waste water effluent and consequently a non-drinking water system is unlikely to be promoted for Alkimos Central.

7. WATER SUPPLY

7.01 Water Resources

The Alkimos Central area is located within the Water Corporation's future Eglinton ground water source area for potable water supply. Provision has been made for some time for the development of this ground water resource.

Water supply to the Alkimos Central LSP area will ultimately be via a series of groundwater bores, located throughout the Alkimos– Eglinton area, linked by collector water main's to a central treatment plant and reservoir. Areas of urban development will be serviced by a network of distribution water mains, from the reservoir, connected to reticulation systems within those areas.

Alkimos Central is near the boundary of the existing Neerabup treatment and reservoir scheme and the Carabooda reservoir service areas and at ultimate development may receive water from either source at different times in the demand cycle although most water more likely will ultimately be from Carabooda reservoir.

The Water Corporation developed a new reservoir at a site located in Carabooda, east of Wanneroo Road during 2011/12. A second ground water treatment plant (Eglinton Ground Water Treatment Plant) is proposed to be developed adjacent to the Regional Open Space in Alkimos east of the Alkimos Central area near the corner of the interchange between the Mitchell Freeway and Alkimos Drive, this site was identified through the Alkimos Eglinton District Structure Planning process. The site has been created and transferred to the Water Corporation for water supply, public purposes.

The first stage of the Carabooda reservoir has recently been completed by the Water Corporation. Initially the reservoir will be supplied by an existing 1200mm diameter trunk water main from the Neerabup scheme which distributes water from the Neerabup groundwater treatment plant and reservoir. The water main will in the interim function as both an inlet and outlet water main, receiving water from Neerabup in off peak times through the distribution mains in Butler and supplying water from the Carabooda reservoir back to the Butler / Alkimos areas, Alkimos Central will receive some of its water from this system when it is integrated in the overall water supply scheme.

The Carabooda reservoir will continue to receive water from the Neerabup scheme until the Eglinton GWTP is operational, current expectations are this will be required in late 2017, although the actual date will be dependent on the rate of development in the Perth north west corridor and the public drinking water demand in the broader Perth metropolitan area.

Preliminary Water Corporation planning for the Eglinton GWTP and abstraction bores indicates groundwater bore sites in the vicinity of Alkimos Central LSP area will be required in accordance with the drawing 6016-00-SK05. The sites will be approximately 25 x 25 metres in size where only one superficial bore is proposed. If the Water Corporation chose to co-locate a deeper Leederville aquifer bore with a superficial bore the site area will be approximately 25 x 65 metres, in the case of EG40/ EG15 (south of Alkimos Central) a site area of 50 x 25m has been agreed based on the surrounding land use and the available access. Detailed negotiations are progressing with the Water Corporation for the provision of these sites at the time of subdivision or prior to ensure they can be developed and tested by the WCWA to meet their water resource development program. The Water Corporation has indicated acceptance of the site locations as detailed on this drawing.

The bore sites have a well head protection of 300 metres restricting land uses as per the P3 ground water protection zones; generally this limits land uses such as petrol stations. There may also be a noise buffer requirement of approximately 35 metres limiting land uses or requiring some form of noise mitigation, to be confirmed following detailed design.

Water from the ground water bores in Alkimos Eglinton is to be collected via collector mains and conveyed to the Eglinton ground water treatment plant GWTP before being distributed to the end users via the Carabooda reservoir. The WCWA's currently proposed collector main network is shown on drawing 6016-00-SK05. These mains require their own alignment and are independent of the water distribution network.

7.02 Initial Water Supply Network

Supply to Alkimos Central will initially be via the 800mm diameter trunk water main in Marmion Avenue being installed by the Water Corporation to Shorehaven during 2013.

7.03 Ultimate Water Supply Network

The Water Corporation has a long term distribution network plan that includes a 900mm diameter water main required in Romeo Road (Alkimos City Centre), linking the 1200mm diameter main in east Romeo Road and the Carabooda reservoir with the other trunk distribution mains south into Butler, in Marmion Avenue and along the north south alignment between Marmion Avenue and the Mitchell Freeway (the old Connolly Drive alignment).

The WCWA is currently reviewing the latest date the trunk water main linking Marmion Ave and Carabooda reservoir along Romeo Road (from its present limit at the Freeway Reserve) is required. The timing for this main had previously been estimated to coincide with approximately 8,000 to 10,000 allotment creations in the Alkimos Eglinton area, a time when the security of supply and capacity of the single Marmion Avenue trunk main would require augmentation, this may still be some five years from this date based on development to date and the current planned rate of development. However, the timing may now be sooner than previously thought depending on the outcome of the Eglinton North (Satterley/LandCorp JV) development, which would bring forward the timing requirement for the Romeo Road main in order to satisfy head loss and pressure requirements at the far northern extremity of the Carabooda Reservoir supply area where the LandCorp Eglinton land holding is located.

The balance of the trunk water main network as shown on Figure 2 will be progressively expanded by the WCWA directly or through Developer Constructed Works with negotiated pre-funding arrangements. The WCWA is currently planning to fund capital works associated with the orderly development of urban areas identified on the WCWA's five year program without prefunding by the developers. Importantly, developers must inform the WCWA of their intentions early to ensure the required works are budgeted in the five year program.

8. ELECTRICAL POWER SUPPLY

8.01 Existing Electrical Power Network

Alkimos Central has an existing 22kV high voltage underground cable in Marmion Avenue (eastern verge) for its full frontage. The cable was installed by Western Power to reinforce the electrical power supply into Yanchep in 2009/10. This same feed has been used to supply the initial developments at Shorehaven and Eglinton (Amberton); it will also be used for the initial supply for the Alkimos Central LSP area.

There is a second independent 22kV high voltage feed in Marmion Avenue (western verge) installed as a dedicated supply for the Alkimos WWTP.

The 22kV HV cable in Marmion Avenue follows an alignment from Marmion Avenue to Romeo Road east via a temporary alignment in the WCWA's access track. The cable receives its feed from the "Yanchep Zone Substation" on Romeo Road near the intersection of Wanneroo Road.

The Yanchep Zone Substation is a three transformer outdoor 132/22 kV zone substation. There are currently six 22 kV feeders out of this site. These feeders supply residential developments to the north along the coast and semi-rural loads north and to the east of the substation. The capacity expansion of the Romeo Road site is limited as the site already contains three 132/22 kV transformers. Western Power, Transmission Section is currently looking into the matter. We understand the substation is expected to be able to supply some 9,500 allotments in the Alkimos Eglinton area.

It is expected that the new Eglinton zone substation proposed in the Alkimos District Structure Plan south of Eglinton Drive and between the Railway reserve and the Mitchell Freeway reserve will need to be established within the next 10 years say by 2021 to accommodate the growth of existing loads in the region.

8.02 Initial Electrical Power Supply

We expect the local network will be incrementally extended from the 22kV HV feed in Marmion Avenue into the Alkimos Central LSP area.

A series of HV feeds, switch stations and transformers will be required throughout the Alkimos Central to meet individual site requirements, large high density residential, commercial and public purposes sites (such as high school sites) usually require a direct HV feed and have a sole use transformer to meet their power requirements. At subdivision it is likely these sites will be provided with access to a HV feed only and will install a transformer at building stage after the power demand is better understood through building design.

8.03 Ultimate Electrical Power Network Requirements

As the available capacity in the 22kV high voltage feeders in Marmion Avenue are exceeded additional feeds from the Romeo Road (Yanchep) Zone Substation will be required. It is anticipated over time the developments of LandCorp's Alkimos City Centre will provide new feeds which will link directly back to the Romeo Road substation. Preliminary advice from Western Power and independent electrical consultants suggest up to six 22kV feeds may be required ultimately in the Romeo Road reserve at its eastern limit near the Freeway.

Each 22kV feed has capacity for approximately 8 MVA (depending on distance and other factors), with individual allotments using approximately 4.7kVA each this indicates a likely capacity per feed of 1,700 residential allotments. However, Western Power is finding recent trends in housing types (smaller individual buildings with less load per household) and uptake of solar panels is reducing the average power demand per dwelling by as much as 50% in some areas. Hence, as the power demand per dwelling is better understood for the Alkimos Eglinton area, Western Power may find the number of dwellings it can supply per feed and from the Romeo Road (Yanchep) substation in total may increase substantially.

Depending on the actual power demands per dwelling experienced in Alkimos - Eglinton and the rate of development, Western Power expects the new Eglinton zone substation (proposed by the Alkimos District Structure Plan to be south of Eglinton Drive and between the Railway reserve and the Mitchell Freeway reserve) to be required in approximately ten years say 2021. The new substation will require the installation of a 132kV overhead power line extension adjacent to the Mitchell Freeway (west side), in a separate road reserve or easement in Western Power's favour.

The 132kV overhead line is expected to be a dual circuit line and Western Power will need to progress the design prior to finalising the easement dimensions and details of how the 132kV will cross the Freeway reserve. This further detail is expected to be progressed as subdivision of the land occurs near the proposed corridor or when the Eglinton Zone Substation design development proceeds.

The funding of individual HV feeds (for broader network capacity), the upgrade to the Romeo Road (Yanchep) Zone Substation and provision of the Eglinton Zone Substation will potentially be subject to system reinforcement investigations where a business case is put to the Economic Regulatory Authority to consider the funding.

We understand if the Perth Transport Authority requires a new electrical injection point for the Perth Northern Suburbs Railway extension Butler to Yanchep then this would likely occur near the future Eglinton Zone Substation, north of this Alkimos Central LSP area, utilising the direct feeds available from this site.

We understand the Alkimos Ground Water Treatment Plant site will most likely seek to establish a sole use dedicated high voltage supply, this has been assumed to be a 22kV cable provided from the Yanchep Sub Station at Romeo Road via Wanneroo Road, across the Freeway reserve and directly into the GWTP site. The Water Corporation will undertake detailed design investigations to prove up their ultimate power supply design.

A schematic representation of the proposed major HV electrical network is provided on Figure 3 drawing 6016-AC-Fig 3.

9. TELECOMMUNICATIONS

9.01 Telecommunications

Telstra has an existing exchange building adjacent to Marmion Avenue approximately four kilometres south of the Alkimos Central. Telstra has been providing fibre to the home services for Butler (Brighton) and other developments in the Alkimos Eglinton area. It is likely this same infrastructure will be used as part of the Federal Government's National Broadband Network (NBN) as this system is rolled out. It is not clear yet whether the NBN will develop a second exchange / headend in the Alkimos Central or surrounding suburbs, this will depend on the demand and final design of the system.

Telstra is currently the provider for the Shorehaven development north of the Alkimos Central. Amberton in the Eglinton area north of Shorehaven has signed a service agreement with the NBN for provision of telecommunications.

9.02 Broadband Communications

The Federal Government has a stated objective to roll out fibre to the home for all residences within metropolitan areas. There is still much uncertainty how these services will be delivered in new residential estates. However, it is expected the scheme will be similar to Telstra's current fibre to the home option available to developers by commercial agreement or will be part of the government funded network expansion.

As a result of the Australian Government's decision to roll out a National Broadband Network (NBN) the ownership issues of delivering the wholesale fibre to the home system have been transferred to the Government with a number of retail service providers likely to offer services over the network. There are other private telecommunication providers which can also offer similar services.

Developers of new residential estates then have the option to pay NBN or an alternative service provider for provision of a high speed broadband network. In either case the developer will install pit and pipe infrastructure that can accommodate a future high speed broadband network.

9.02.01 Design Specification

Broadband is a term used to refer to 'always on' high speed Internet. In the past, broadband services and technologies were defined in terms of a capability to transfer information at higher rates than traditional dial-up services. Today broadband is more commonly associated with the speeds equal to or greater than those provided by Asymmetric Digital Subscriber Line (ADSL), that is, a minimum download speed of 265 kbps and minimum upload speed of 64 kbps. The current strategy for the NBN is targeting 100 megabits per second (Mbps) technology to be delivered in new estates with fibre to the home networks. The detailed design of the network will be to meet the specifications of the NBN.

9.02.02 Delivery

There have been some delays with the delivery of the NBN making predictions as to the date when services in new and existing suburbs will be available. It is expected the NBN make good it's back log and begin to match the development timetable of developers with the delivery of the system generally to coincide with early home occupation in new developments.

It is possible the NBN Co will contract wholesale companies like Vision Stream and Opticomm to provide the delivery of the wholesale network. The delivery therefore of the NBN will not appear significantly different to the previous optional 'Telstra Velocity' delivery method.

9.02.03 Selection of Service Providers

The National Broadband Network (NBN) is to be designed, built and operated by NBN Co. We understand NBN Co will also contract wholesale only companies as operators of the NBN, to be infrastructure providers only, there will be no vertical integration and no retail service providers (RSP) will have interests in the wholesale NBN.

The NBN will be Australia's first national wholesale-only open access, high speed broadband platform. Operators of the NBN must have a minimum number of RSPs on the network for customer choice.

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The NBN will be Australia's first national wholesale-only open access, high speed broadband platform. Operators of the NBN must have a minimum number of RSPs on the network for customer choice.

Retailers will be able to access the NBN in order to provide services and content to the general public and business.

This system of multiple retail service providers operating over one wholesale network should lead to greater choice for actual service delivery even if the line haul costs are common.

At Alkimos Central there is no need to isolate particular service providers at this stage until the development is ready to negotiate other incentives they may wish to include at the time of land sales. Based on the competitiveness of the telecommunications market, with more open access to the network the delivery of retail services should not be a problem and should result in more choice for the end users.

9.02.04 Capacity to Receive Broadband Network in the Urban Design

The current design practice for road reserves, pavement and verge provisions will make adequate allowance for services including broadband in accordance with the agreed Utilities Service Providers handbook. There will be some local land requirements for equipment sites, similar to current provisions which will be accommodated at detailed subdivision stage.

At Alkimos Central, provision will be made for all allotments, to receive pit and pipes which will allow the future installation of a broadband network.

The broadband network will have potential to carry services such as:

- Internet
- Free to air television services both analogue and digital (without the need for an antenna)
- Pay television (no dish required)
- Telecommunications Services (multiple fixed line services)

10. GAS

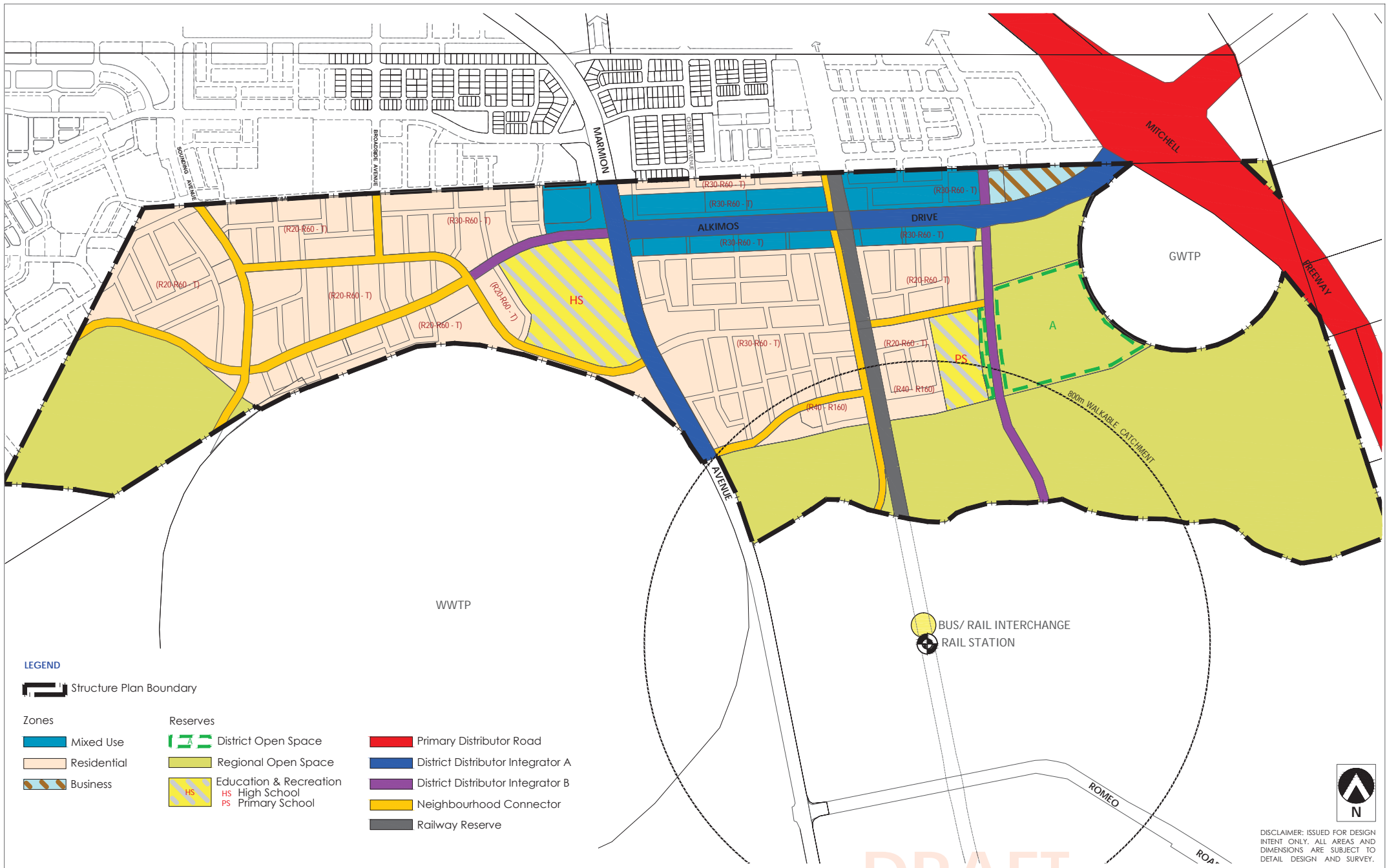
The existing high pressure gas network has been extended from Butler to Yanchep by the gas supply operator, Atco. The same gas network extension has provided branch service connection to the Shorehaven development and Amberton (Eglinton) development north of the Alkimos Central. Atco the gas service provider has indicated the high pressure main installed in Marmion Avenue will have capacity for development in the Butler, Jindalee, Alkimos and Eglinton.

In general terms it is expected the gas reticulation network will be progressively extended from Marmion Avenue through the Alkimos Central and linked north and south into the adjoining developments as they proceed. There are not expected to be any gas supply capacity issues.

11. INFRASTRUCTURE COORDINATION SERVICING AND STAGING

The table below summaries the major infrastructure items proposed to service the Alkimos Central LSP area and have been notionally assigned to short, medium and long term. However, marketing and other factors may change the desired order of development and infrastructure needs.

NOTIONAL INFRASTRUCTURE STAGING REQUIREMENTS AS ALKIMOS CENTRAL DEVELOPS			
Infrastructure	Short Term Years 0 to 5	Medium Term Years 5 to 10	Long Term Years 10+
Road and Transport	Utilise existing Marmion Avenue construct first access at Alkimos Drive, possibly through an interim roundabout	Upgrade Marmion Avenue and Alkimos Drive intersection to traffic signal controlled 4-way	Provide Freeway extension to Alkimos Drive
	Potentially develop other road linkages north and south to adjoining developments	Progressively develop network of integrator roads and local roads as development proceeds, including further major intersections on Romeo Road	Provide Freeway interchange at Alkimos Drive Provide Freeway extension north of Alkimos Drive to Yanchep
Waste Water	Utilise existing sewers in Shorehaven where possible for initial service.		Construct Yanchep Main Sewer and grade out any interim pump stations
	Install Alkimos sewage pump station 'M'		
Water Supply	Utilise existing 375mm diameter temporary supply in Water Corp access track.	Progressively develop internal network of trunk mains and larger reticulation mains.	Further develop the trunk main network and fully integrate the Carabooda reservoir and northern limit of Neerabup Reservoir
	Utilise extension proposed in 2012/13 of 800mm diam trunk main in Marmion Ave.	Install 900mm diameter main in Romeo Road as number of dwellings in Alkimos Eglinton approach 8,000 to 10,000 or to assist LandCorp's north Eglinton development.	
		Develop the Eglinton Groundwater Scheme to locally supply Carabooda reservoir	
Electrical Power Supply	Utilise existing 22kV feed in Marmion Avenue.	Extend additional 22kV feeds in Romeo Road, relocate temporary feeds from Water Corp access track to Romeo Road.	Further develop the network of 22kV feeds from Romeo Road (Yanchep) Zone Substation
		Upgrade Romeo Road (Yanchep) Zone Substation	Extend 132kV overhead on western boundary of Mitchell Freeway reserve to supply new zone substation at Eglinton. Build Eglinton Zoned Sub Station.



DESIGN LEADER - LEND LEASE

robertsday
COMPILED BY - ROBERTS DAY

AERIAL PHOTOGRAPHY
SOURCE: NA
YYMMDD: NA

CADASTRAL INFORMATION
SOURCE: LANDGATE
YYMMDD: 101101
DWG REF: 0845cod
PROJECTION: PCG94

DRAFT

LOCAL STRUCTURE PLAN
Central Alkimos
City of Wanneroo

SIZE A3
1:10000



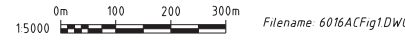
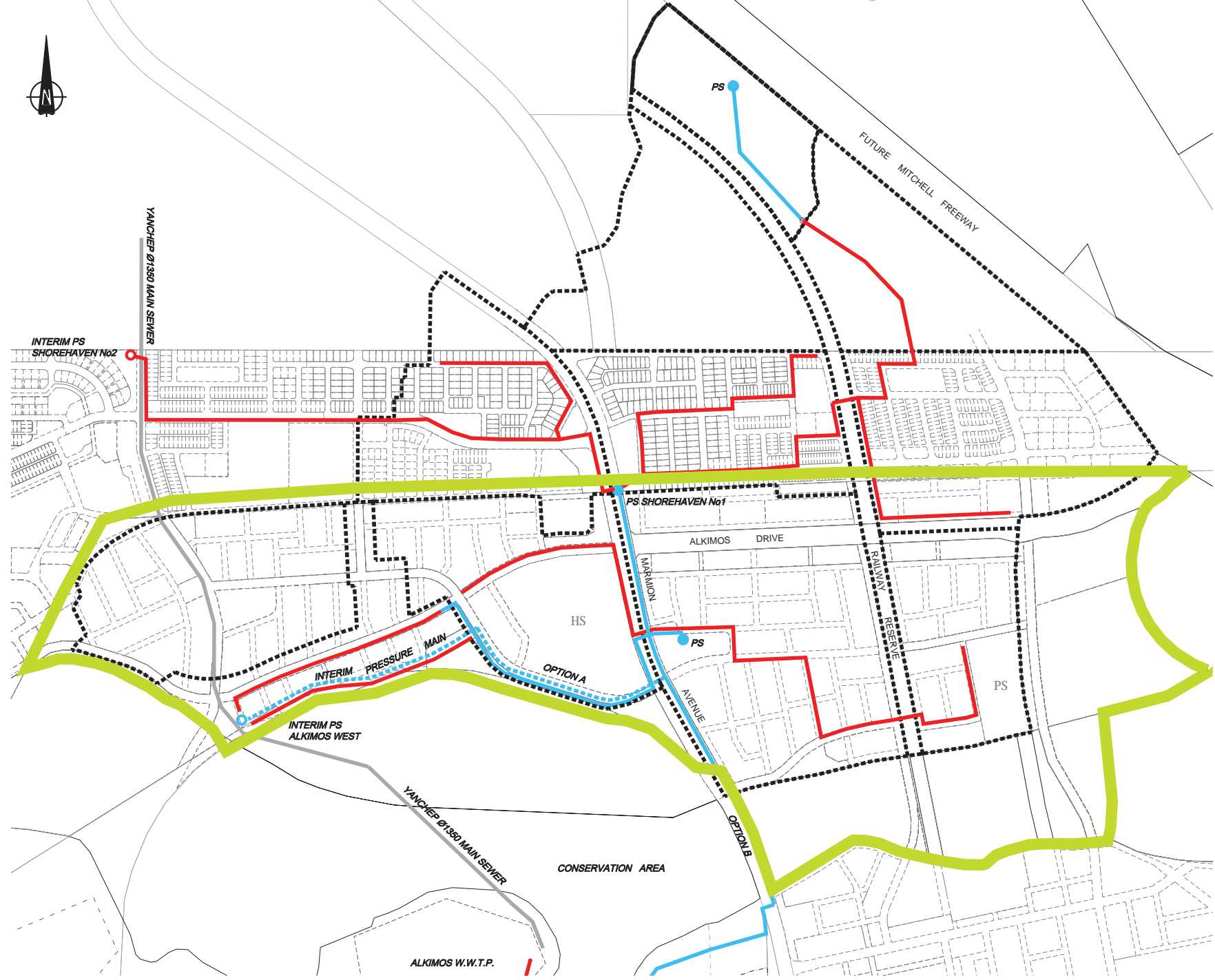
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REV. H

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- LEGEND**
- LOCAL STRUCTURE PLAN BOUNDARY
 - SEWER CATCHMENT BOUNDARY
 - PROPOSED GRAVITY SEWER MAIN
 - PROPOSED PRESSURE MAIN
 - PS PUMP STATION SITE



No.	DATE	DRAWN	CHECKED	AMENDMENT	No.	DATE	DRAWN	CHECKED	AMENDMENT
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A	26.11.12	JV	CH	ISSUED FOR APPROVAL					

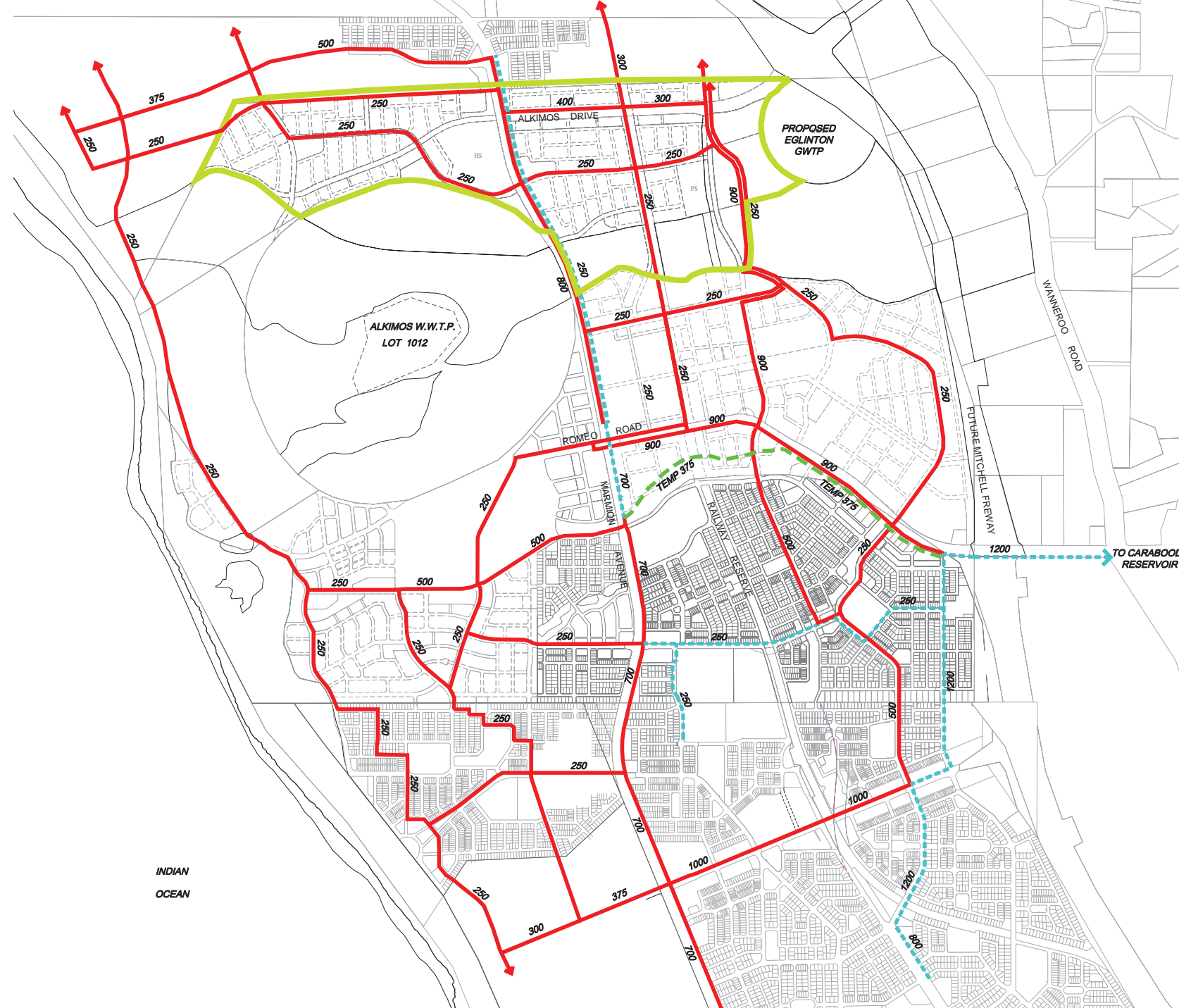
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Subiaco WA 6108

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E admin@cosweb.com.au

PROJECT ALKIMOS BEACH	TITLE PROPOSED SEWER STRATEGY	FIGURE 1
SCALE 15000	DRAWING NUMBER 6016-AC-Fig1	ISSUE B



LEGEND

- LOCAL STRUCTURE PLAN BOUNDARY
- PROPOSED WATER MAIN
- - - - TEMPORARY WATER MAIN
- - - - EXISTING WATER MAIN



Filename: 6016ACFig2.DWG
WAPC No. 145429

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CHECKED CH

APPROVED
CRAIG HANSEN 12.12.12

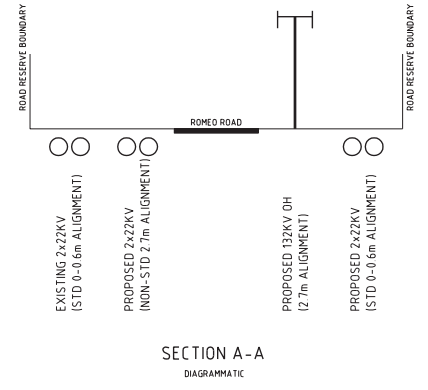
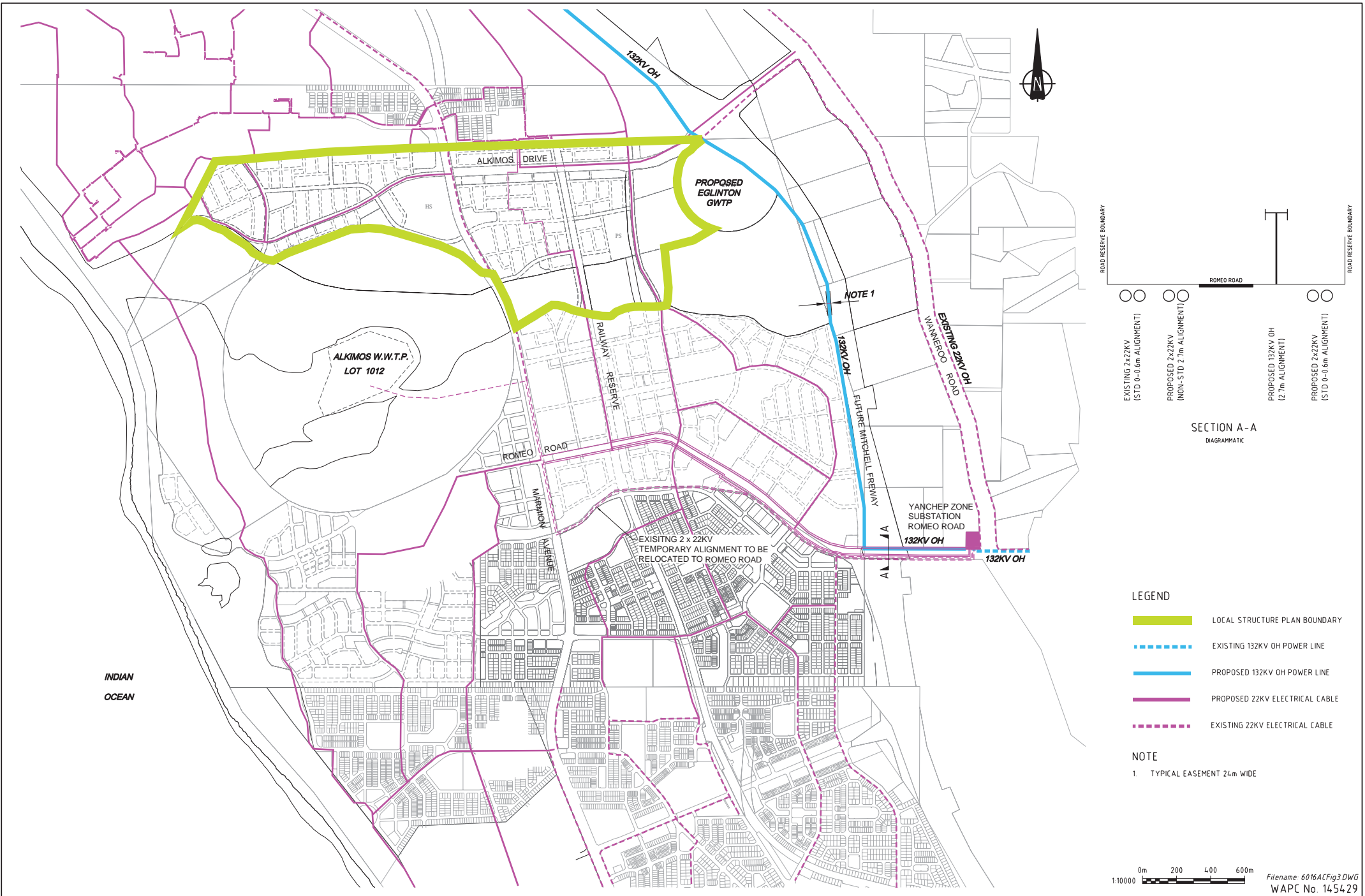
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PROJECT ALKIMOS BEACH
TITLE WATER SUPPLY SCHEME CONCEPT **FIGURE 2**

SCALE 1:10000
DRAWING NUMBER 6016-AC-Fig2
ISSUE B

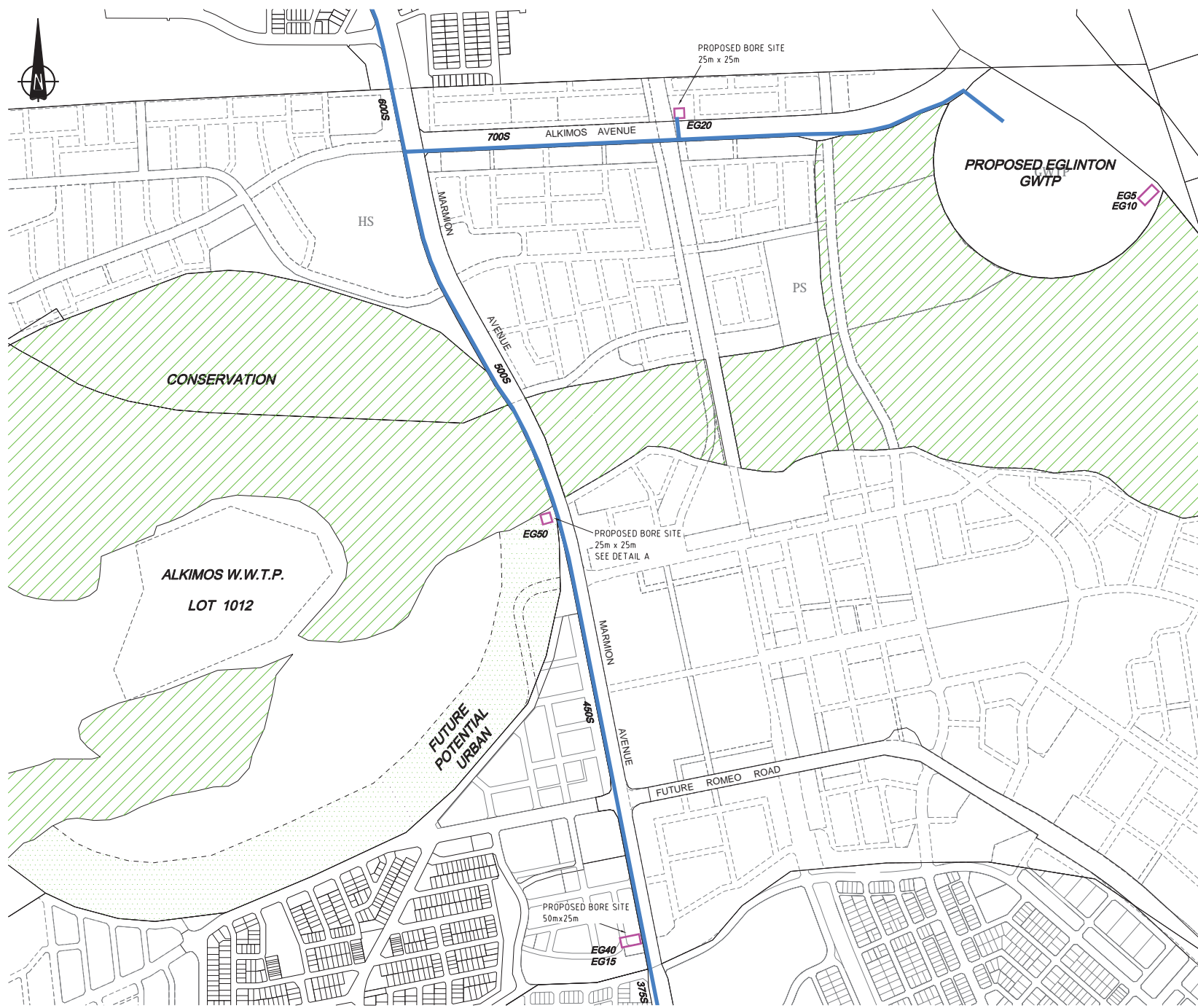


- LEGEND**
- LOCAL STRUCTURE PLAN BOUNDARY
 - EXISTING 132KV OH POWER LINE
 - PROPOSED 132KV OH POWER LINE
 - PROPOSED 22KV ELECTRICAL CABLE
 - EXISTING 22KV ELECTRICAL CABLE

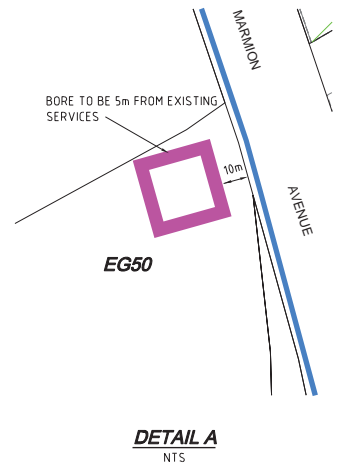
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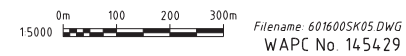


- LEGEND:**
- PROPOSED BORE LOCATIONS
 - EG20** WATER CORPORATION BORE NUMBER
 - CONSERVATION
 - FUTURE POTENTIAL URBAN
 - BORE COLLECTOR MAIN



NOTE:

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B	26/11/12	JV	CH	BORE COLLECTOR MAIN ADDED					
A	17/09/12	EL	CH	ISSUED FOR APPROVAL					

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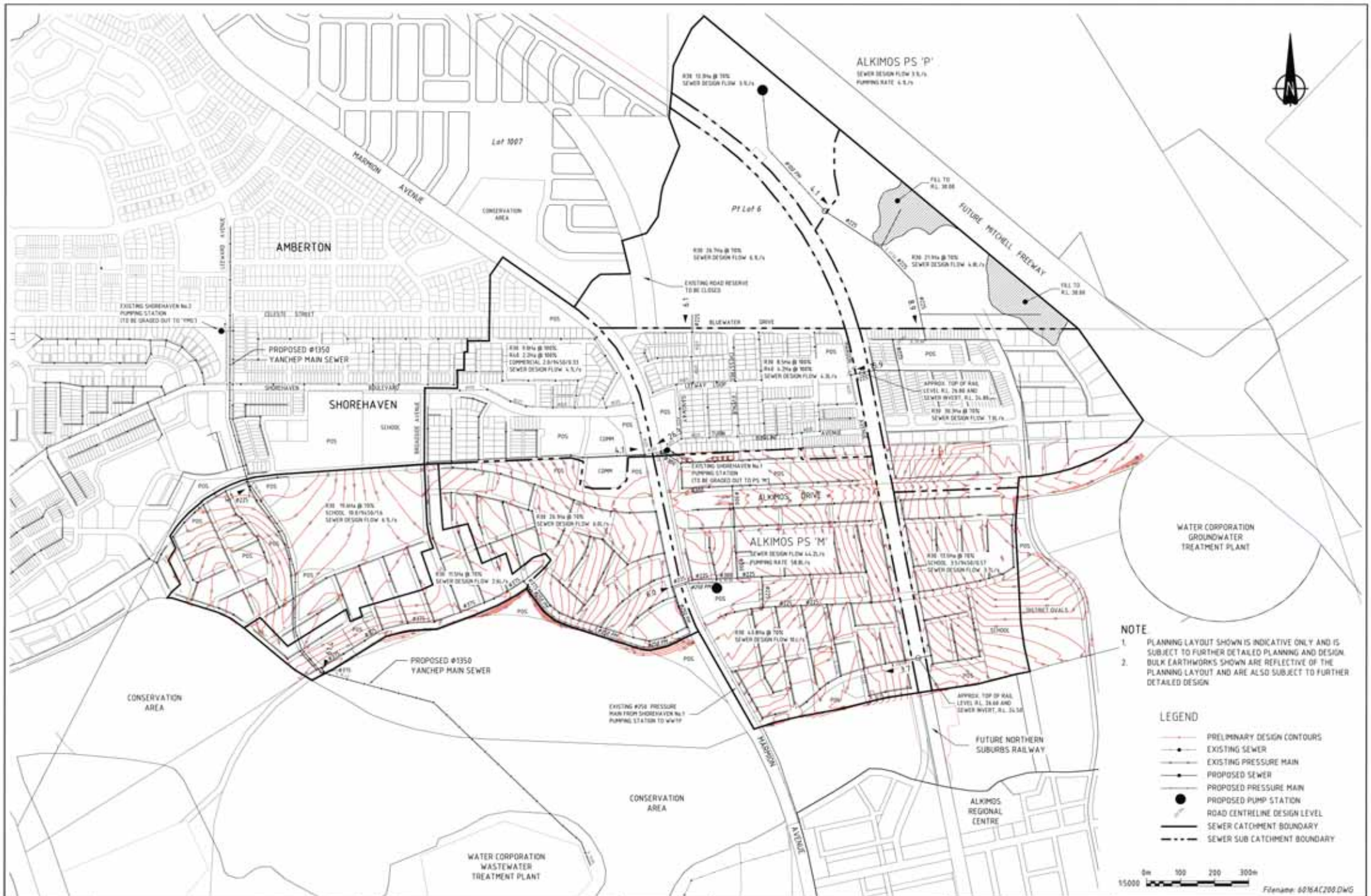
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APPROVED		CRAIG HANSEN 10.12.12	

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PROJECT	ALKIMOS BEACH		
TITLE	PROPOSED WATER CORPORATION GROUND WATER PRODUCTION BORES		
SCALE	DRAWING NUMBER	ISSUE	
15000	6016-00-SK05	C	



- NOTE**
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- LEGEND**
- PRELIMINARY DESIGN CONTOURS
 - EXISTING SEWER
 - EXISTING PRESSURE MAIN
 - PROPOSED SEWER
 - PROPOSED PRESSURE MAIN
 - PROPOSED PUMP STATION
 - ROAD CENTRELINE DESIGN LEVEL
 - SEWER CATCHMENT BOUNDARY
 - SEWER SUB CATCHMENT BOUNDARY

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15000
Filename: 6076AC200.DWG

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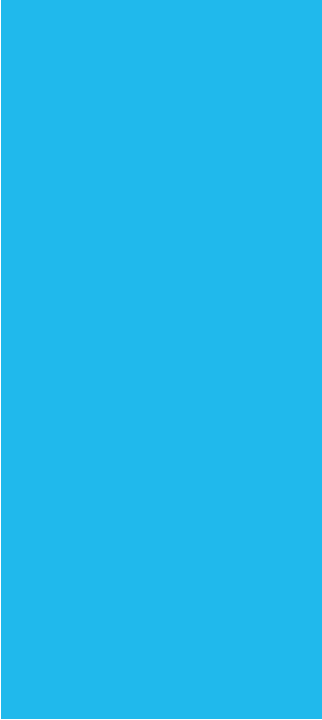
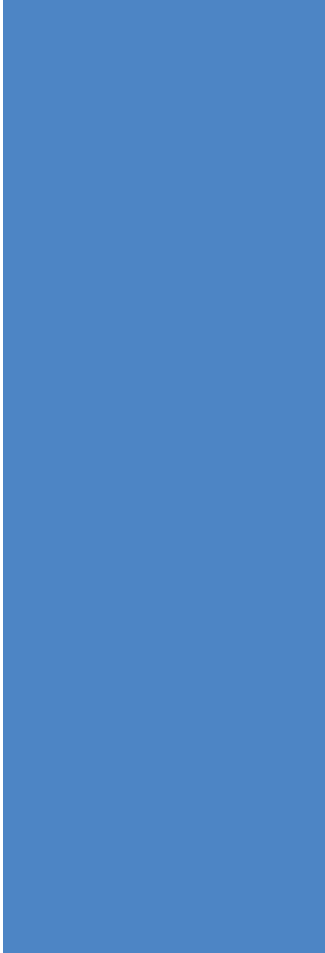
APPENDIX I
ENVIRONMENTAL
SUSTAINABILITY STRATEGY

(LEND LEASE, MAY 2012)



Central Alkimos

Environmental Sustainability Strategy
May 2012



Central Alkimos Environmental Sustainability Strategy

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Glossary

BDG: Building Design Guidelines

FIN: Feed in tariff

IWCMS: Integrated Water Cycle Management System

Lpppd: Litres per person per day

Mfg: Manufacturing

1. Introduction

1.1 Environmental leadership at Central Alkimos

Alkimos is one of the largest and most significant urban developments in Perth's north-west corridor taking in the South Alkimos, Central Alkimos and Alkimos City Centre local structure plans. The aspiration for the greater development is to demonstrate national and international leadership in sustainability – in particular environmental sustainability. A stated vision for Alkimos is '...to create a master-planned coastal community of global significance that is moving towards carbon-neutral living'.

Following on from the benchmark being set at South Alkimos, Central Alkimos will continue to deliver best practice outcomes in environmental sustainability for major greenfield development. The Environmental Sustainability Strategy for South Alkimos (known as the Environmental Leadership Strategy) established a continual improvement process across the major categories of natural environment, energy, water, waste and materials, transport and overall carbon management – Central Alkimos will benefit from the improved processes identified as part of this process to ensure that the final plan is both practical and of a very high standard. The Central Alkimos proposed Local Structure Plan is set out in Figure 1 below.

1.2 Core objectives

The core objectives that have set the direction for the Environmental Sustainability Strategy at Central Alkimos, consistent with those embodied in the South Alkimos strategy and KPIs agreed between Landcorp and Lend Lease (as partner developer), are :

1. Maintain the high value of natural environment in perpetuity.
2. Reduce energy consumption and source more renewable energy through targets and initiatives based on energy efficiency, energy demand management and alternative energy strategies.
3. Reduce drinking water scheme demand through water efficiency, water demand management and alternative water supply strategies.
4. Recycle high proportions of waste from subdivision and built form construction and community operation.
5. Identify and facilitate use of low impact, non virgin and low embodied energy materials in construction.
6. Create a substantial mode shift from car use to walking, bike riding and public transport for short local trips and longer distance trips for work and education.
7. Deliver a carbon management strategy that drastically cuts the ongoing carbon footprint of the community compared to the typical Perth outer urban average.

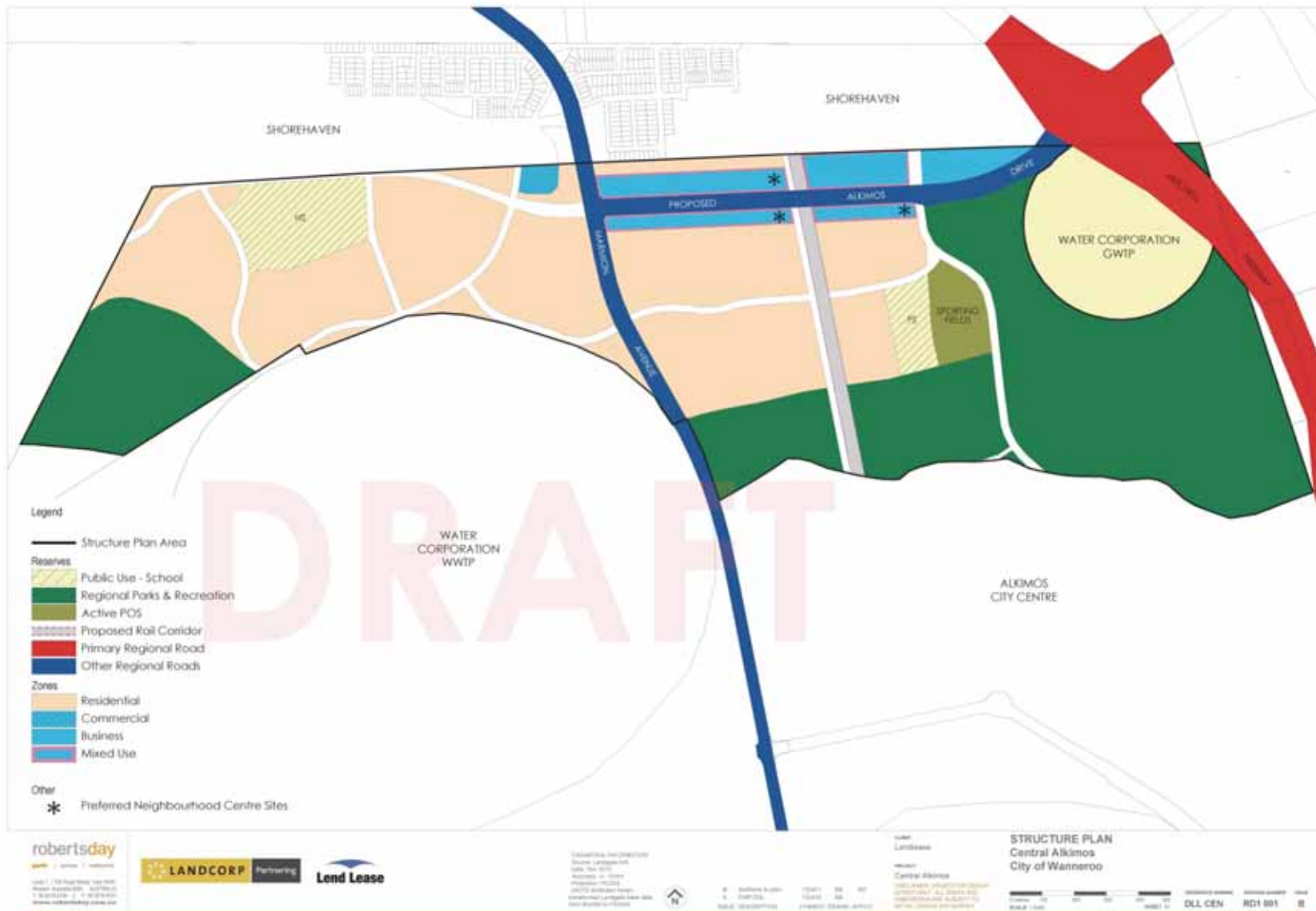


Figure 1 Central Alkimos Structure Plan

1.3 Background and purpose of this report

This report has considered a number of excellent inputs to the wider development of an environmental leadership strategy for Alkimos. These inputs include:

- GHD sustainability strategy reports prepared for the Alkimos Local Structure Plan, various 2007-2009
- Kinesis CCAP report prepared for stage one of South Alkimos, 2011
- Lend Lease Alkimos Sustainability Strategy and Initiatives Review, 2011
- South Alkimos Environmental Leadership Strategy – strategic initiative and actions combined report, 2012

The purpose of this report is to set out the strategic approach, proposed objectives and targets and key strategic initiatives to be delivered at Central Alkimos.

The initiatives from this report will form the basis of final action planning and ongoing governance as the Central Alkimos project progresses from Local Structure Plan approval into delivery.

1.4 Structure of this report

The basic structure of the report breaks Environmental Leadership into the key areas of:

- Natural environment
- Energy
- Water
- Transport
- Waste and materials
- Carbon management

Wider project management and governance issues are then summarised. Under each area the strategic approach, guiding objectives and targets are set out together with the series of proposed strategic initiatives and proposed actions to be considered and finalised for each initiative ready for delivery.

1.5 Links to Alkimos City Centre Strategy and South Alkimos Environmental Leadership Strategy

The South Alkimos Environmental Leadership Strategy and Alkimos City Centre Environmental Sustainability Strategy directly inform the Central Alkimos Environmental Sustainability Strategy. The majority of the initiatives in the Central Alkimos strategy have been drawn from the South Alkimos Environmental Leadership Strategy as they are both focused predominantly on residential development. Central Alkimos however will have the benefit of implementing the successful pilot projects from South Alkimos as part of a continual improvement process for the entire Alkimos group of projects.

2 Natural environment

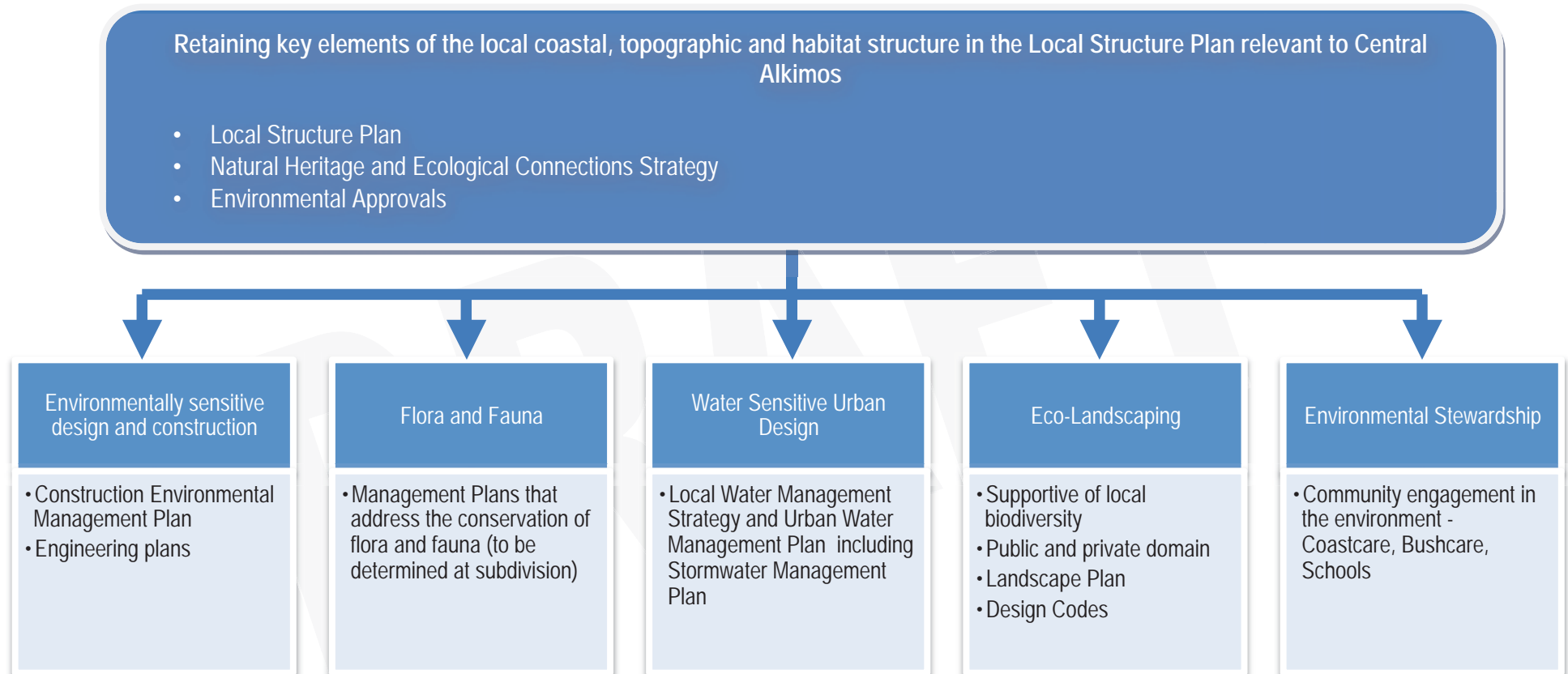


Figure 2: Building blocks of an integrated natural environment strategy at Central Alkimos

2.1 An integrated natural environment strategy

The values of the natural environment have underpinned the design and delivery of the masterplanned community at Alkimos. The protection and enhancement of the natural environment at Alkimos presents both challenges and opportunities in each stage of the development. Each of these stages requires specific initiatives that respond to the local natural environmental needs. The primary aspects of the natural environment which need to be considered and integrated at a strategic level include:

- Retaining the key elements of local coastal, topographic and habitat in the design;
- Executing environmentally sensitive construction and road design;
- Preserving the inherent flora and fauna values;
- Preserve and enhance the surface water and ground water systems existing in the natural environment
- Maximising the use of endemic species in landscaping;
- Ensuring that what we leave behind survives; and
- Promoting environmental stewardship.

By implementing strategic initiatives in the design, delivery and operation of the development, there is the opportunity to limit any negative environmental impacts and ensure that the desired high value natural environment outcome is maintained in perpetuity by the local community when established.

These initiatives also tie in with the South Alkimos Natural Heritage and Ecological Connections Strategy (NHEC Strategy). The principles of the NHEC Strategy will be applied to Central Alkimos.

2.2 Objectives

Based on the recommendations from relevant environmental assessment reports completed for the site and additional advice from landscaping and environment industry leaders, as well as recommendations from other Lend Lease master planned communities, the following objectives have been identified for preserving and enhancing the natural environment:

- Local Structure Plan design incorporates high value natural habitat and land form outcomes that will be enduring in the face of later urban development – including the significant foreshore areas.
- Specific management plans and initiatives are put in place to protect local and regional populations of Carnaby's Cockatoo and the Graceful Sun Moth – endangered fauna species as well preserve and enhance the natural ecosystems within conservation reserves.
- A specific WSUD plan will be put in place to manage the quality and quantity impacts of urban development on natural surface water and groundwater systems with post development impacts assessed against pre development impacts
- Civil and built form works will be carried out under a strict environmental management plan regime that protects and maintains the values of the local Alkimos environment.
- Encouraging community resident participation / ownership through community groups such as Coastcare and Bushcare community groups or local environmental education campaign for residents and schools. Through community participation, 'environmental stewardship' will become a strong part of the culture in the local community.

2.3 Strategic initiatives

This section details the strategic initiatives formulated to address the key natural environment needs and opportunities of Central Alkimos. These initiatives build on the initiatives prepared as part of the South Alkimos Environmental Leadership Strategy.

2.3.1 Natural Environment

A comprehensive site analysis was undertaken as part of the structure planning process including investigations into landform and topography, soils, significant flora and fauna and heritage values. These documents including the primary document, the Environmental Assessment and Justification report (Emerge 2012) prepared for Alkimos City Centre and Alkimos Central, identified the key environmental characteristics of the site to be retained and preserved within the design of the development.

2.3.2 Environmental sensitive design and construction

In line with Lend Lease's Global Minimum Requirements (GMR's)¹ and E-smart management process, a Construction Environmental Management Plan (CEMP) has been prepared to manage the potentially negative environmental impacts during construction. Specifically this sets the environmental procedures for construction and informs each party of their responsibility under the plan. The CEMP will also be bound within the civil contracts to ensure that the requirements are enacted.

The CEMP details the procedures required to prepare the site prior to construction including demarcating clearing boundaries in accordance with environmental approvals and information (and inductions) for contractors relating to their responsibilities under the plan. During civil construction the following environmental risks will be managed safely and appropriately to ensure there is little to no damage of the natural environment:

- Dieback management;
- Safe fauna operations and fauna incident reporting;
- Clearing boundaries and clearing incident reporting;
- Environmental noise, light and air pollution management associated with water quality and fauna);
- Management of spills or potential contaminants;
- Appropriate waste management (linked to the Construction Waste Management Plan)
- Erosion and sediment control;
- Appropriate fire management (linked to the Bushfire Management Plan); and
- Minimising disruption to landform and natural drainage.

Additional requirements of the CEMP will include monitoring and reporting on the progress of the construction/clearing in relation to the areas identified as sensitive. This monitoring and reporting process will support any future EPBC Act annual reporting requirements or audits.

2.3.3 Preserving the flora and fauna values

The ongoing environmental management of significant vegetation and key fauna habitat is important for preserving the flora and fauna values of the site. Management Plans will be prepared in line with LSP approval and subdivision approval which will address the restoration and rehabilitation of conservation areas, provision of public access and ongoing protection and awareness of endangered species including the Carnaby's Black Cockatoo and Graceful Sun Moth. The rehabilitation and revegetation work undertaken as part of the relevant management plans will be coordinated with the community participation programs established in line with the Environmental Stewardship initiatives. The development has also incorporated design measures during the delivery and operation to allow for safe fauna movement.

¹ Lend Lease Asset Physical GMR 9

2.3.4 Water Sensitive Urban Design

Water Sensitive Urban Design (WSUD) principles will be employed and will be reflected in the stormwater management infrastructure design criteria. The WSUD outcome will be designed to meet post development outcomes on water quality and quantity compared to the pre development situation. This strategy will also seek to innovate as possible to direct surface water run off to street tree root zones as a way to support the sustainability of larger canopy street trees.

2.3.5 Eco-Landscaping

There is an opportunity to enhance the natural environment through using endemic species in the landscaping, reducing the use of pesticides, herbicides and fertilisers and encouraging landowners to include eco-landscaping in their gardens. The Landscape Plan for Central Alkimos will support and enhance the natural environment and has employed a number of initiatives to maximise this opportunity. These initiatives include:

- Native and low water demand species selection and targets. The native species list includes seed propagated from local provenance and informs the native planting schedule provided to residents.
- An irrigation strategy negating the need for potable water and clarifying the preferred water efficient irrigation scheme and alternative water supply.
- Measures to minimise the use of pesticides, herbicides and chemical fertilisers during revegetation and landscaping.
- Landscape guidelines and codes will be included in all major site tenders for super lots or major building projects.
- Residents will also be provided with a Welcome Kit which includes native seedlings and front garden concept plans amongst other sustainability information.

2.3.6 Environmental Stewardship

Community involvement in the natural environment is paramount to the ongoing conservation of the natural environment at Alkimos. Lend Lease aims to encourage community participation in these groups, which will help establish a sense of ownership of the bushland within the community. There is an opportunity to coincide the funding of community groups with the handover of revegetation sites to the City of Wanneroo.

It is anticipated that these programs will be run through the local schools and community to educate residents on the environmental impacts on soil, water, air, noise and light pollution. Programs may include initiatives such as a walking school bus to encourage the use of alternative transport or starting up a community garden. These programs will run in partnership with the Community Plan and will be enacted by the Community Development Officer. Programs within schools will require the support from the Department of Education and the school's principal.

Table 1: Strategic Initiatives for retaining key elements of the local coastal, topographic and habitat structure in the Local Structure Plan

INITIATIVE	DESCRIPTION	POTENTIAL ACTIONS TO BE CONSIDERED	DATE OF COMPLETION
EL1. Site responsive design	Undertake a comprehensive site analysis to identify the key environmental characteristics of the site that will be preserved	<ul style="list-style-type: none"> Undertake required environmental assessment prior to the design of the development Complete necessary environmental approvals associated with the key environmental characteristics 	Completed as part of the Local Structure Planning and environmental approvals
EL2. Conservation through design	Incorporate significant vegetation and key fauna habitat into design of Alkimos Central.	<ul style="list-style-type: none"> Design and restore suitable vegetation communities and key fauna habitat to provide ecological linkages across Alkimos Identify suitable offsets in line with federal approval Retention of a greater diversity of natural landform within the design of development. 	Local Structure Plan
EL3. Environmentally sensitive construction	Undertake appropriate measures during construction to minimise any negative impact on the natural environment	<ul style="list-style-type: none"> Management of vegetation communities and fauna habitat during civil construction Management of air, noise and light pollution during civil construction Management of soil and water erosion during civil construction through an appropriate management plan Management of civil construction phase to minimise disruption to landform and natural drainage 	Construction Environmental Management Plan
EL4. Road Design Codes	Minimise environmental impacts within the road design	<ul style="list-style-type: none"> Reduce light and noise pollution in road design Manage soil and water systems in road designs including use of bioretention basins or swales 	Engineering Plans
EL5. Ongoing environmental management	Conduct ongoing environmental management	<ul style="list-style-type: none"> Prepare Management Plans for conservation areas within development for ongoing protection and rehabilitation of disturbed areas Promote resident participation in community groups Prepare and implement a Bushfire Management Plan 	Completion of Management Plans
EL6. Safe fauna movement	Implement design measures to allow for safe fauna movement	<ul style="list-style-type: none"> Ensure that ecological corridors include fauna crossings, bridges or tunnels at road crossing Restrict the use of fencing that may restrict safe fauna movement in conservation areas Adopt traffic management strategies to help protect fauna Implement design features that allows for safe fauna habitation Reduce heat island effect in conservation areas 	Design Codes

INITIATIVE	DESCRIPTION	POTENTIAL ACTIONS TO BE CONSIDERED	DATE OF COMPLETION
EL7. Finalise and implement WSUD plan	Determine quantity management and treatment processes required in the stormwater system to preserve the existing surface water and groundwater environmental characteristics	<ul style="list-style-type: none"> Identify appropriate post development stormwater flows and quality characteristics at key receiving environment discharge points – consider environmental approval outcomes required Include quantity and quality criteria in stormwater design requirements Use recognised stormwater quality model (eg. MUSIC) to support design performance against quality criteria 	LWMS and UWMP
EL8. Use of endemic species in landscaping	Use, where possible, endemic species in landscaping to ensure the ecological environment is supported, enhanced and thrives	<ul style="list-style-type: none"> Include local provenance seed propagation in landscaping Endemic species in public realm Prepare a native plant schedule for residents Provide Resident Welcome Kits including native seedlings and front garden concept plans Prevent the planting of invasive plant species Minimise the use of pesticides, herbicides and chemical fertilizers Employ Water Sensitive Urban Design Principles 	Landscape Plan
EL9. Micro Climate	Retention of the site's microclimates through natural landform and landscaping	<ul style="list-style-type: none"> Identify opportunities to maintain the site's microclimate through landscaping in the public and private realm 	Landscape Plan
EL10. Environmental stewardship	Establish environmental stewardship within the community	<ul style="list-style-type: none"> Encourage community participation in Coastcare and Bushcare groups for the conservation areas Conduct education programs with local community and schools on the environmental impacts on soil, water, air, noise and light pollution (ie. Minimize the use of pesticides, herbicides or chemical fertilizers). 	Community development program - ongoing

3 Energy

3.1 An integrated energy cycle management strategy

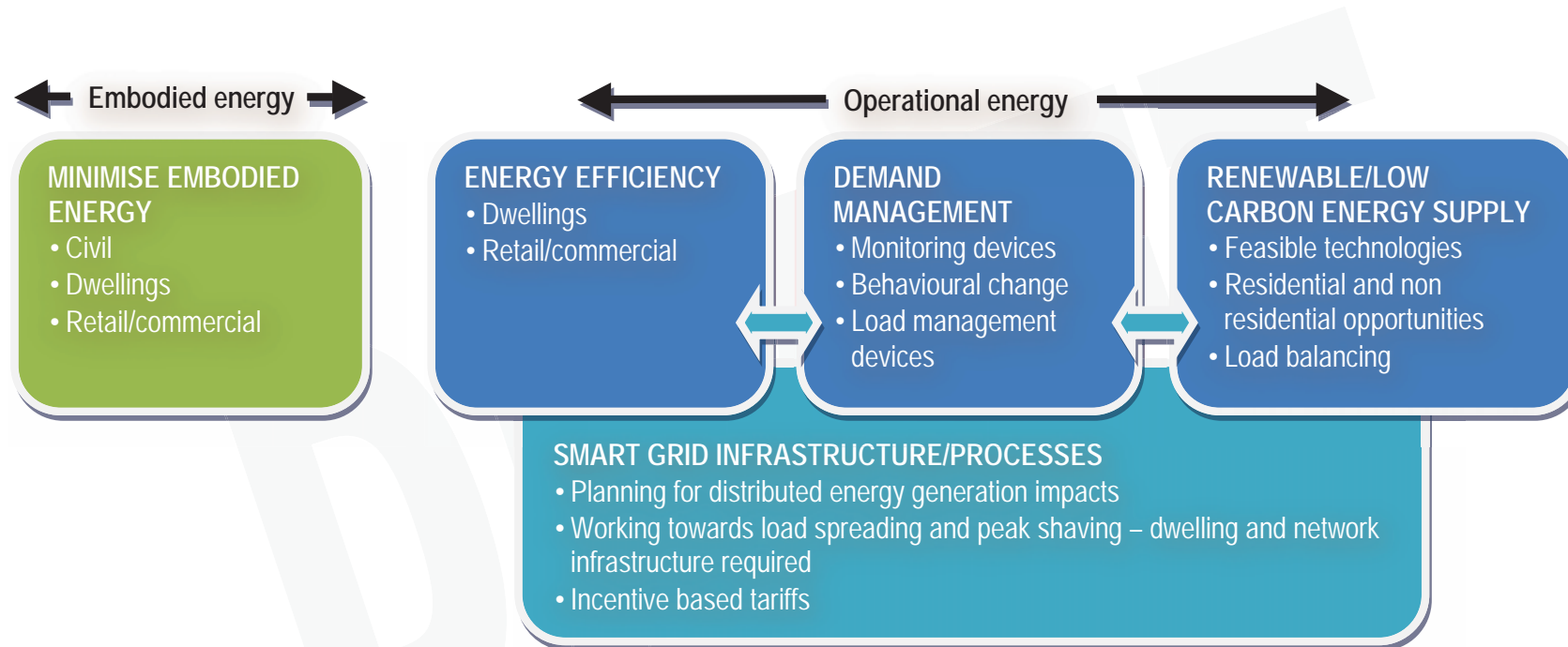


Figure 3: Building blocks for energy management at Central Alkimos

To achieve the most sustainable energy outcome possible, and to ensure that the development is set up to move towards carbon neutrality, multiple energy management factors need to be considered and planned for at Central Alkimos (as previously planned for at South Alkimos). The interdependence of these factors, particularly in relation to improving operational energy outcomes, needs to be considered to deliver the most practical and cost efficient outcomes. The different factors that need to be considered and integrated at a strategic level include:

- Embodied energy and operational energy requirements of dwellings and subdivision works
- Different constraints and opportunities at a residential and non residential level
- Opportunities and requirements in each of energy efficiency, demand management and renewable energy and low carbon energy supply
- The required new approaches for local electrical network design and in home electrical circuitry, metering and energy monitoring to ensure that new technologies and approaches are enabled by underlying system capabilities

Figure 3 demonstrates the different components underlying the integrated energy cycle management strategy proposed for Central Alkimos. Strategic initiatives identified under each of these key areas will be required for the residential and retail/commercial/community developments due to the different development programs and opportunities for each.

3.2 Objectives

A top down review of previous studies on Alkimos by GHD and Kinesis, a review of other masterplanned community projects in other states, and a bottom up review of practical initiatives at Central Alkimos has helped identify an initial set of objectives to guide the development. The objectives/targets in each key area proposed are:

- Embodied energy for civil infrastructure >20% carbon reduction on average Perth works and embodied energy for built form >30% on average Perth construction.
- Residential operational consumption – 50-70% carbon reduction on Perth average from energy efficiency, demand management and energy supply initiatives.
- Commercial/retail/community operational consumption – 50-70% carbon reduction on Perth average from energy efficiency, demand management and energy supply initiatives.
- Extend pilot for key smart grid infrastructure (based on the successful implementation of pilot at South Alkimos) inclusions at the dwelling and local network level to promote improved energy demand management and ability to manage various distributed energy generation systems.
- Extend pilot for the highest potential dwelling based low carbon/renewable energy technologies on the cusp of commercialization (continuing approach at South Alkimos).

3.3 Embodied energy initiatives

3.3.1 Civil and Landscape works

Table 2: Strategic Initiatives for Civil and Landscape Works

INITIATIVE	DESCRIPTION	POTENTIAL ACTIONS TO BE CONSIDERED	DATE OF COMPLETION
EL11: Cement replacement in concrete	Target cement replacement concrete mixes capable of meeting technical performance requirement	<ul style="list-style-type: none"> ▪ 30%- 50% cement replacement standard for footpaths, bike paths and kerbs <ul style="list-style-type: none"> – Confirm available suppliers and negligible price difference – Use data from South Alkimos pilots to support technical performance – Include on eco materials list 	First stage civil and landscape works
EL12: Warm mix asphalt	Replace all hot mix applications with warm mix	<ul style="list-style-type: none"> ▪ Confirm available suppliers and negligible price difference <ul style="list-style-type: none"> – Include on eco materials list 	First stage civil works

INITIATIVE	DESCRIPTION	POTENTIAL ACTIONS TO BE CONSIDERED	DATE OF COMPLETION
EL13: High recycled steel content in mesh and reinforcement	Use steel products with confirmed high recycled content and low carbon footprint	<ul style="list-style-type: none"> ▪ >80% recycled steel content, and efficient mfg process, for steel reinforcement product <ul style="list-style-type: none"> – Confirm available suppliers and negligible price difference – Include on eco materials list 	First stage civil works

3.3.2 Dwelling construction

Table 3: Strategic Initiatives for Dwelling Construction

INITIATIVE	DESCRIPTION	POTENTIAL ACTIONS TO BE CONSIDERED	DATE OF COMPLETION
EL11: Cement replacement in concrete	Target cement replacement concrete mixes capable of meeting technical performance requirements for slab construction	<ul style="list-style-type: none"> ▪ 30%-50% cement replacement for residential slabs and driveways <ul style="list-style-type: none"> – Confirm available suppliers and negligible price difference – Include on eco materials list 	First stage
EL14: High recycled steel content in mesh and reinforcement	Use steel products with confirmed high recycled content and low carbon footprint	<ul style="list-style-type: none"> ▪ >80% recycled steel content standard for steel reinforcement product <ul style="list-style-type: none"> – Confirm available suppliers and negligible price difference – Include on eco materials list 	First stage
EL15: Low energy bricks and blocks	Target brick manufacturers that use efficient kilns and have lower material content bricks and blocks	<ul style="list-style-type: none"> ▪ Identify low embodied energy bricks available in northern Perth <ul style="list-style-type: none"> – Confirm available suppliers and price difference – Include on eco materials list 	First stage
EL16: Light weight materials	Facilitate low embodied energy wall and roofing systems for homes (Based on the successful implementation of pilot at South Alkimos)	<ul style="list-style-type: none"> ▪ Identify 1-3 light weight material systems aimed at wall and roof solutions for dwellings proven at South Alkimos <ul style="list-style-type: none"> – Confirm available suppliers and negligible price difference – Include on eco materials list 	First stage

3.4 Operational energy demand and supply

3.4.1 Residential community and public domain – operational stage

Table 4: Strategic Initiatives for residential and public domain – operational stage

INITIATIVE	DESCRIPTION	POTENTIAL ACTIONS TO BE CONSIDERED	DATE OF COMPLETION
EL17: Energy efficient home design, fixtures and appliances	Develop combination of mandatory and/or recommended home inclusions in BDG/covenants aimed to promote up to 60-70% energy savings on Perth average (including demand management and renewable energy)	<ul style="list-style-type: none"> ▪ Solar orientation >80% efficiency across lots ▪ LED light specification for downlight systems – 5-6 watt globes ▪ Alkimos ‘Smart Home’ product development and display village development to include examples of efficient lighting systems, thermal comfort ratings, PV arrays, gas boosted solar hot water, in home energy displays, efficient appliance packages 	<p>Subdivision plan</p> <p>First stage</p>
EL18: Energy efficient streetlights	Ensure that energy efficient globes are specified and that solar power to public domain lights are used as possible	<ul style="list-style-type: none"> ▪ Specify latest versions of LED globes in consultation with Western Power and City of Wanneroo ▪ Specify self sufficient solar powered public domain lighting for parks ▪ Extension of South Alkimos pilot for movement based sensors for public domain and potentially street application (if successful) 	First stage
EL19: Energy Demand management	Consumer behavioural change program supported by measurement tools and cost saving focus	<ul style="list-style-type: none"> ▪ Continue energy demand management strategy from South Alkimos <ul style="list-style-type: none"> – Tailored Alkimos energy smart living strategy – user friendly, individual and community focus, simple messages, cost of living focus – In home energy display to all homes (ideally in partnership with WP) – Smart circuits specified for all homes to allow easier implementation of home area networks and consumption monitoring, off peak tariffs – Home user guide designed in simple language for ‘lay person’ and tailored for each home from thermal comfort software 	First stage
EL20: Low carbon and renewable energy supply	<p>Incorporate financially feasible renewable energy sources at the dwelling level</p> <p>Extension of South Alkimos pilot for highest potential dwelling based renewable energy technologies</p>	<ul style="list-style-type: none"> ▪ Include instant gas boosted solar hot water requirement ▪ Include PV array to > 80% of dwellings sized for maximum non grid export efficiency due to FIT wind back ▪ Extend pilot for larger (3kW) PV array system in conjunction with highest potential battery/storage solution currently in commercialization phase <ul style="list-style-type: none"> – Nominate low carbon and/or renewable energy technologies for trial at Central Alkimos 	First Stage

3.4.2 Commercial, retail and community buildings – operational stage

Table 5: Strategic Initiatives for commercial, retail and community buildings – operational stage

INITIATIVE	DESCRIPTION	POTENTIAL ACTIONS TO BE CONSIDERED	DATE OF COMPLETION
EL21: Energy efficient commercial building design, fixtures and appliances	Incorporate latest technologies for retail and commercial building operation to reduce energy consumption	<ul style="list-style-type: none"> ▪ Determine a Greenstar rating target minimum for large retail centres and commercial buildings (>5000 sqm NLA) ▪ Develop design guidelines for all retail and commercial buildings: <ul style="list-style-type: none"> – To consider design for natural light benefit, efficient lighting systems, latest generation of energy efficient mechanical plant, latest generation of variable volume air handling plant 	Commercial Building Design Guidelines
EL22: Demand management in commercial and retail	Allow for individualized and automated demand management devices across commercial and retail premises	<ul style="list-style-type: none"> ▪ Develop an energy demand management plan for the mixed use corridor (proposed Alkimos Drive) <ul style="list-style-type: none"> – Potential for green lease schemes in larger projects – Potential for self regulated air conditioning to each tenancy – Sensor based controls for lighting, A/C, mechanical movement infrastructure, car park fans wherever possible 	Commercial Building Design Guidelines
EL23: Low carbon and renewable energy supply	Deliver large proportion of renewable or low carbon energy to the mixed use precinct (proposed Alkimos Drive)	<ul style="list-style-type: none"> ▪ Assess the most technically and financially viable supply solutions for renewable and low carbon energy – extend earlier solar energy models developed for South Alkimos and Alkimos City Centre 	Aligned with electrical services design for commercial buildings

3.5 Smart grid development and peak load shaving initiatives with Western Power

Table 6: Strategic Initiatives for smart grid development and peak load shaving initiatives with Western Power

INITIATIVE	DESCRIPTION	POTENTIAL ACTIONS TO BE CONSIDERED	DATE OF COMPLETION
EL24: Peak load reduction residential and commercial users	Target a reduction in residential and commercial peak load (in conjunction with total average daily load) to minimize electrical infrastructure cost	<ul style="list-style-type: none"> ▪ Dependent on success of earlier South Alkimos pilots extend smart appliance and smart wiring incentives and education 	First stage

INITIATIVE	DESCRIPTION	POTENTIAL ACTIONS TO BE CONSIDERED	DATE OF COMPLETION
<p>EL25: Accommodation of distributed renewable energy in the local grid</p>	<p>Design the local Alkimos grid to cope with renewable energy generation – ie: voltage increases and decreases and harmonics</p>	<ul style="list-style-type: none"> Dependent on success of earlier South Alkimos pilots extend network design suitable for distributed energy generation in residential and commercial precincts 	<p>First stage</p>
<p>EL26: Promote matching of residential energy balance with non residential energy balance at Alkimos</p>	<p>Accommodate PV production from residential areas in electrical supply solution for non-residential areas</p>	<ul style="list-style-type: none"> Dependent on success of earlier South Alkimos pilots extend local grid capability to export from residential PV generation to commercial demand via local grid 	<p>First stage</p>

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4 Water

4.1 An integrated water cycle management strategy

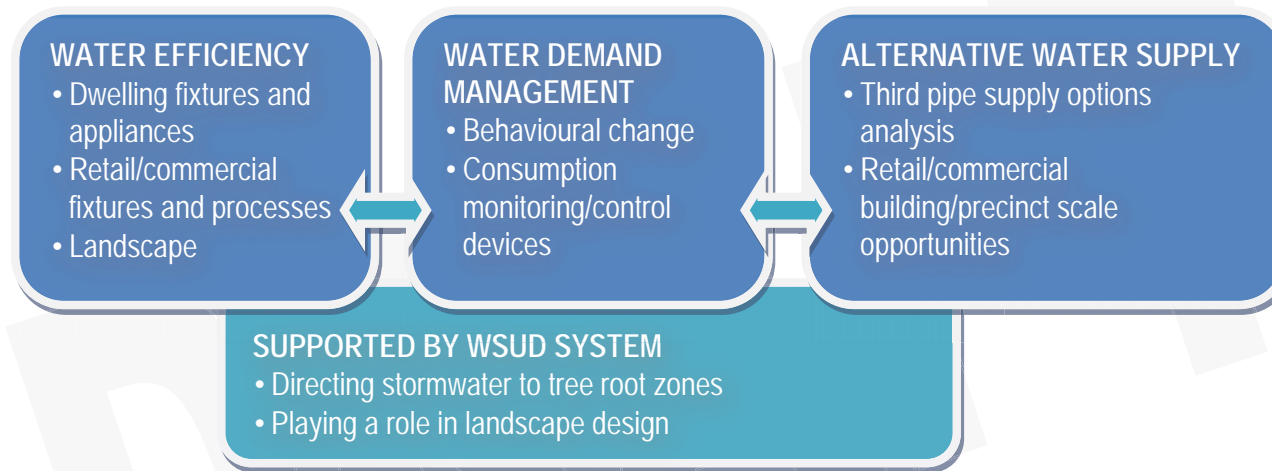


Figure 4: Building blocks for water management at Central Alkimos

To achieve the most sustainable water outcome possible multiple water management factors need to be considered and planned for at Central Alkimos. The best outcome for water management occurs when all interdependent factors are considered in an integrated manner – an ‘Integrated Water Cycle Management System’ that considers potable water, stormwater and wastewater systems. The different water cycle factors that need to be considered include:

- Different constraints and opportunities at a residential versus retail/commercial facility level
- Opportunities and requirements in the areas of water efficiency, water demand management and differing alternative water supplies
- The opportunities available in WSUD to support irrigation needs and potential stormwater harvesting needs at Alkimos

Figure 4 demonstrates the building blocks underlying the integrated water cycle management strategy for Central Alkimos. Agreeing the long term supply of one or more alternative water sources (to the drinking water scheme) is clearly necessary to close the loop and achieve integration. For this reason assessment of alternative water opportunities closer to the delivery of Central Alkimos will be required. It should be noted that as at May 2012 a recycled effluent scheme capable of supplying a third pipe system to dwellings and commercial premises had not been agreed.

4.2 Objectives

A top down review of previous studies on Alkimos by GHD and Kinesis, a review of other masterplanned community projects in other states, and a bottom up review of practical initiatives possible at Central Alkimos (following South Alkimos initiatives) has helped define the following objectives and targets:

- 50-55% savings in potable water demand for both residential and commercial/retail/community land uses
 - Residential internal use from average 175 lpppd to 130 lpppd, external use from 116 lpppd to 58 lpppd (equates to approx. 35% saving).
 - Non-residential water efficiency saving approximately 35%.
 - Bore water supply to public open space areas to save approximately 15%

Ongoing negotiation with the Water Corporation will occur to identify if a recycled effluent scheme is achievable to supply a third pipe system to Central Alkimos. If this option is available total project drinking water scheme savings would be 60-70%.

4.3 Water strategic initiatives

4.3.1 Residential community

Table 7: Water initiatives for residential community

INITIATIVE	DESCRIPTION	POTENTIAL ACTIONS TO BE CONSIDERED	DATE OF COMPLETION
EL27: Water efficient fixtures and appliances	Mandate inclusion of highly rated water efficient appliances in every dwelling	<ul style="list-style-type: none"> ▪ Water efficient taps (5 star), shower heads (8l/s) and toilets (4 star) mandatory ▪ Subsidy or discount deal to purchase water efficient (within 1 star of highest rating) washing machines and dishwashers 	Central Alkimos Building Design Guidelines
EL28: Water efficient landscapes – residential and public domain	Mandate requirement for low water demand landscapes	<ul style="list-style-type: none"> ▪ Specify landscapes, using predominantly endemic species, that typically require no extra water than supplied by typical local rainfall patterns ▪ WSUD design criteria to direct water to large trees to support street tree growth and canopy cover 	Landscape Plan
EL29: Water demand management	Provide combination of behavioural change education and monitoring devices to promote reduced average consumption. Minimise public domain irrigation wastage	<ul style="list-style-type: none"> ▪ Extend South Alkimos water conservation behavioural change module – simple messages, cost focused, supporting by cost of living advantages and home user guide ▪ Provide soil moisture meters and shower timers to all homes as welcome gift and supported by behavioural change education ▪ Install moisture meters on any public domain irrigation systems to avoid wasted irrigation after rain events 	Central Alkimos Building Design Guidelines Landscape Plan

INITIATIVE	DESCRIPTION	POTENTIAL ACTIONS TO BE CONSIDERED	DATE OF COMPLETION
EL30: Alternative water supply	Provide for preferred alternative water supply as utilised by South Alkimos	<ul style="list-style-type: none"> ▪ Determine preferred alternative water source in line with recommendations of the IWCMS from South Alkimos <ul style="list-style-type: none"> – Continue negotiation of a recycled effluent scheme with the Water Corporation 	Landscape Plan (Irrigation component) Engineering Plans
EL31: IWCMS measurement process	Utilise PRECINX as the key tool to track potable water savings from the IWCMS	<ul style="list-style-type: none"> ▪ Work with Kinesis to set up tailored PRECINX model using localised Perth data 	PRECINX modelling

4.3.2 Commercial, retail and community facilities

Table 8: Water initiatives for commercial, retail and community facilities

INITIATIVE	DESCRIPTION	POTENTIAL ACTIONS TO BE CONSIDERED	DATE OF COMPLETION
EL32: Water efficient fixtures and appliances	Use a combination of minimum rating tool outcomes and facility specific fixture measures to improve water efficiency	<ul style="list-style-type: none"> ▪ Determine a Greenstar rating target minimum for large retail centres and commercial buildings (>5000 sqm NLA) ▪ Develop design guidelines for all retail and commercial buildings: <ul style="list-style-type: none"> – Water efficient taps (flow and timers), shower heads and toilets, urinals (waterless), water efficient cooling systems, fire water testing systems 	Commercial Building Design Guidelines
EL33: Water efficient landscapes	Include alternative water supply and plant selection so that zero potable water is required for irrigation	<ul style="list-style-type: none"> ▪ Softscape plan to be zoned into xeriscape and irrigated areas – supported with suitable plant selections <ul style="list-style-type: none"> – Irrigation to be supported by local third pipe (servicing lot scale irrigation needs only) or other alternative water supply 	Commercial Building Design Guidelines Landscape Plan
EL34: Water Demand management	Provide education, fixtures and incentives for tenants to reduce water demand	<ul style="list-style-type: none"> ▪ Include water consumption targets and rate incentives as part of Green leases for tenants in larger buildings 	Commercial Building Design Guidelines

5 Materials and waste

5.1 An integrated waste and materials management strategy



Figure 5: Building blocks for materials and waste management at Central Alkimos

Materials and waste management at Central Alkimos are being considered in the same section due to the increasing integration required to produce cradle to cradle outcomes - where 'waste' streams become direct or indirect inputs to products used in property development rather than being lost to landfill. At Alkimos all phases of development and community operation are considered as indicated in Figure 5. Strategic waste and materials initiatives will be delivered with the aid of a locally based preferred materials list (an 'Eco-materials list), a construction waste management plan and community operation waste management plan.

5.2 Objectives

Proposed objectives and targets that will be embodied in the preferred materials list and waste management plans are:

- Reuse 100% of cleared vegetation onsite (as mulch or moisture holding medium)
- Reuse all topsoil on site
- Recycle >80% of civil construction waste
- Recycle >60% of built form waste
- >25% reduction in domestic waste to landfill
- 100% of domestic waste to landfill with methane capture
- Maximise specification and recommendation of materials with lower than average environmental impact – target materials with recycled content, that can be reused and with responsible manufacture (independent certification)
- Maximise specification and recommendation of locally sourced materials
- Maximise specification and recommendation of ‘healthy internal materials’ for home and office fitouts

5.3 Strategic initiatives

Table 9: Strategic Initiatives for Materials and Waste

INITIATIVE	DESCRIPTION	POTENTIAL ACTIONS TO BE CONSIDERED	DATE OF COMPLETION
EL35: Civil and built form construction waste management plans	Review South Alkimos management plans to be utilized in tender documentation for civil contractors and potentially building covenants/building design guidelines	<ul style="list-style-type: none"> ▪ Draft separate Central Alkimos civil and dwelling construction waste management plans <ul style="list-style-type: none"> – Waste plan suitable for inclusion in tender and contract documentation – Waste plan to include 100% veg, topsoil, concrete, steel, pipe and packaging material recycling requirement (envisaged through MRC) – Dwelling plan to include bin splitting system and trade induction requirements (envisaged through MRC) 	Prior to civil works
EL36: Continue implementation of materials recycling facility (MRC) as part of civil compound	Continue utilising the MRC model from South Alkimos, if proven feasible in South Alkimos trial	<ul style="list-style-type: none"> ▪ Co-locate MRC with civil compound in Central Alkimos – one larger compound consolidating civil materials handling, materials recycling and landscape materials handling <ul style="list-style-type: none"> – Assumed that a small number of temporary facilities will be required 	Prior to civil works

INITIATIVE	DESCRIPTION	POTENTIAL ACTIONS TO BE CONSIDERED	DATE OF COMPLETION
EL37: Continue dwelling construction waste splitting plan	Extension of cost assessment, implementation plan and partnership plan with preferred builders on dwelling site waste splitting process	<ul style="list-style-type: none"> Assess ongoing viability of dwelling construction waste splitting plan based on the landfill tariffs – will be informed by trial period at South Alkimos 	Prior to civil works
EL38: Community operation waste management plan and behavioural change	Extension of community operation waste management plan for incorporation with Alkimos behavioural change strategy (energy, water, waste, transport, carbon)	<ul style="list-style-type: none"> Draft plan in partnership with City of Wanneroo waste service. To include: <ul style="list-style-type: none"> mandatory provision of compost bin/worm farm/bakashi bin depending on lot size, kitchen splitting bin system negotiate provision of 120l landfill bins to smaller dwellings (with reduced cost) and as an option for larger dwellings certification that waste is going to landfill sites with methane capture in place 	Prior to first resident
EL39: Preferred materials selection	Extension of 'Alkimos Eco Materials list' targeting highest priority materials in civil and dwelling construction	<ul style="list-style-type: none"> Update the 'Alkimos Eco Materials' list to include any new materials or technology 	Prior to built form construction
EL40: Commercial, retail waste management	Extension of commercial waste management plans addressing built form construction and operation stages	<ul style="list-style-type: none"> Extension of City Centre plan that addresses the same key areas as that for residential areas but including: <ul style="list-style-type: none"> Australian Packaging Covenant certification for > 80% retailers Green lease waste splitting and reuse criteria 	Commercial Building Design Guidelines

6 Sustainable transport

6.1 An integrated transport strategy

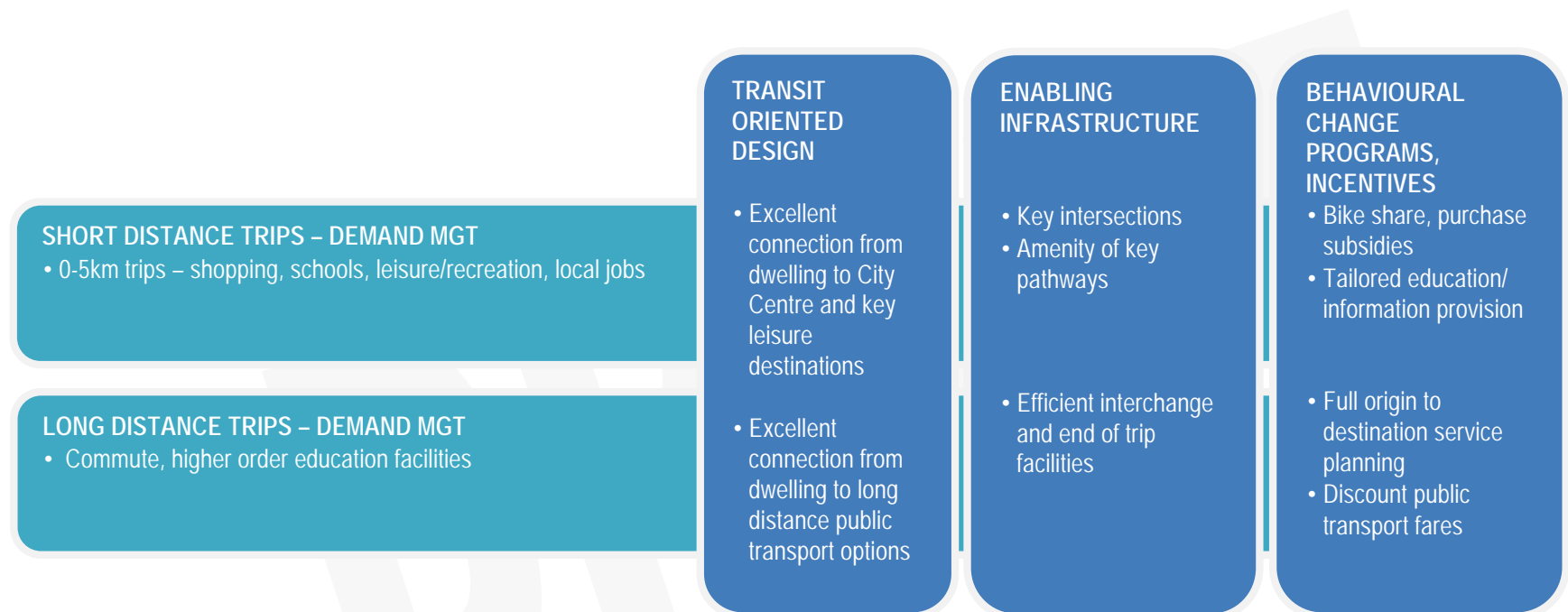


Figure 6: Building blocks for sustainable transport strategy at Central Alkimos

At ultimate development the Alkimos community will consist of a large regional centre with major train based transit node, multiple employment types and retail services, a large recreation and entertainment precinct centred on the beach and marina (situated approx. 2.5 km to the west of the Alkimos City Centre). Parks for active and passive recreation will also be in walking distance of all dwellings.

The travel patterns likely to be displayed by these populations, particularly residents, are generally understood based on past travel surveys in the Joondalup area. These travel patterns are also similar to those in comparable urban environments elsewhere in Australia – recognising that that most greenfield development elsewhere in Australia does not have a beach and potential marina as a major trip destination less than 5km away.

A focused sustainable transport strategy, with an ultimate aim to reduce car dependency at Alkimos, needs to integrate elements of urban design, active living initiatives and multiple modes of transport. Sustainable transport at Alkimos should also benefit from the high level of self containment offered by developing diverse housing product directly adjacent to Alkimos City Centre. The District Structure Plan for the Alkimos-Eglinton area essentially works on Transit Oriented Design principles.

Alkimos station will be a catalyst for activity in the Alkimos City Centre supported by intermodal transfer. While many of the Transit Oriented Design principles apply to the Alkimos City Centre, the initiatives at Central Alkimos must provide for efficient, comfortable and safe connections to the future Alkimos City Centre and also beach located activity areas.

Practically the sustainable transport strategy will need to focus on the most common short distance trips and longer distance trips. For each of these broad trips types travel demand management, enabling infrastructure and transit services will need to be considered. This is illustrated in Figure 6.

Short distance trips can be categorized into trips with a distance less than 5 km predominantly for shopping, leisure and recreation and travel to nearby primary and high schools. Studies of Joondalup indicate that over 50% of trips under 1 km will be made by car increasing to 85% for trips up to 5 km. Previous studies by the Department of Planning indicate that at least half of these car trips are unconstrained and can potentially be switched to non car modes. The focus for sustainable transport for shorter distance trips is converting trips under 1 km into walk trips from car trips, and trips between 1 km and 5 km into bike trips from car trips.

Longer distance trips can be categorized into trips with a distance greater than 5 km predominantly for commute to work or education (Tafe, university). The focus for sustainable transport for longer distance trips is converting single occupant car trips into some amount of public transport or shared car trip. Transport planning for Central Alkimos will focus predominantly on excellent connection to the future Alkimos train stations/transport interchange in the City Centre. This critical piece of local infrastructure will have a marked effect on car use for the commute by removing the need for long distance car travel and often any car leg if walking and bike riding options to the station are attractive.

Integration of transport planning for Central Alkimos, South Alkimos and the City Centre is essential to ensure movement into and from the centre is seamless and efficient, safe and interesting for walkers and bike riders.

6.2 Objectives

The following objectives and targets are proposed for Central Alkimos consistent with the existing strategy being implemented for South Alkimos.

- Reduction in VKT of >20% post Alkimos train station
- For trips 1-5 km bike trips to make up 10-20% of trips compared to estimate of <5% (estimate based on Joondalup)
- For trips <1km walk trips to make up >55% of trips compared to estimate of <45% (estimate based on Joondalup)
- Reduce the need to travel to work by connecting high speed broadband services to all homes capable of supporting high work from home outcomes for office workers that typically commute long distances to the CBD

6.3 Strategic initiatives

Table 10: Sustainable Transport initiatives for the residential community at Central Alkimos

INITIATIVE	DESCRIPTION	POTENTIAL ACTIONS TO BE CONSIDERED	DATE OF COMPLETION
EL41: Reduced car dependence for commute and long distance education trips	Negotiate and/or part subsidise public transport services providing connectivity to the nearest rail station	Pre Alkimos station <ul style="list-style-type: none"> Assess the viability of a hail and ride service verses in early stages (pre public bus services) Confirm preferred service level of Eglinton-Alkimos coastal loop as frequent bus service (STS) providing excellent connection to station and employment for majority of dwellings 	Before first residents Agreement as part of STS negotiation
EL42: Reduced car dependence for trips less than 5km	Provide supportive urban design, physical infrastructure and incentive programs to shift short distance car trips into walking and bike riding trips	<ul style="list-style-type: none"> Targeted enabling infrastructure for key walking and bike riding desire lines – optimized for directness, safety and interest/amenity Incorporate cycling program funding (events and education) as an extension of the initiatives implemented at South Alkimos 	Incorporated in street design and construction program
EL43: Reduced car dependence through car share and car pool programs	Extension of South Alkimos Web based car pool scheme set up to match commute and education trips to Perth CBD, universities etc	<ul style="list-style-type: none"> Negotiate provision of web based car pool system – Western Sydney Car Pool as benchmark for functionality 	First stage of Central Alkimos
EL44: Reduced vehicle emissions through support and promotion of electric vehicles	Extension of South Alkimos basic infrastructure to future proof for electric car operation at Alkimos	<ul style="list-style-type: none"> Build on the South Alkimos initiative to obtain local area charge network design and requirements from Better Place (or other EV network provider) – request cost estimates for installing conduits and tie ins as required from electrical services engineer 	First stage of Central Alkimos
EL45: Support work from home outcomes at Alkimos	Provide in home telecommunications services and local office support services capable of supporting business needs to reduce the need to travel to work	<ul style="list-style-type: none"> Mandatory fibre to home infrastructure and access to high speed broadband – NBN or other 	First stage of Central Alkimos

INITIATIVE	DESCRIPTION	POTENTIAL ACTIONS TO BE CONSIDERED	DATE OF COMPLETION
EL46: Targeted behavioural change program	Sustainable transport module to be included as part of larger Energy, Water, Waste, Sustainable Transport and Carbon program at Alkimos	<ul style="list-style-type: none"> ▪ Short trip planning and long trip planning web tool to be developed specifically for Alkimos residents and workers 	First stage of Central Alkimos
EL47: End of trip walk and bike facilities	Encourage commercial and retail buildings to provide sufficient end of trip facilities	<ul style="list-style-type: none"> ▪ Establish covenants (or similar) for commercial and retail buildings that require bike storage, shower and change facilities with capacity as a proportion of workers/ travellers (10% of workers target, travellers to be determined) 	Commercial Building Design Guidelines

DRAFT

7 Carbon optimization and management strategy

7.1 An integrated carbon strategy

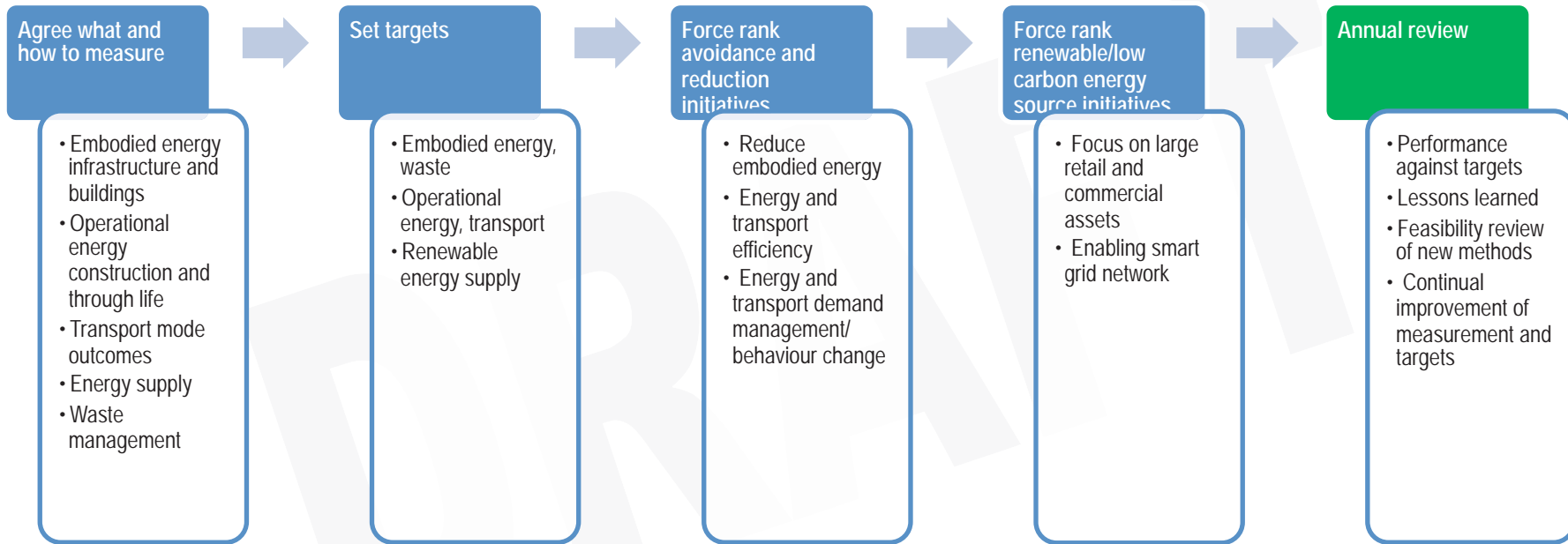


Figure 7 - Carbon management key processes

The ultimate carbon objective at Alkimos is 'towards carbon neutral'. South Alkimos established a robust and comprehensive approach towards measuring and managing down carbon emissions for a developing community. Central Alkimos will extend on this process, as set out in Figure 7.

Carbon management is a 'sum of the parts'. Carbon impacts cut across embodied energy, operational energy demand, energy supply options, transport patterns, waste management and even landscape choices. The carbon strategy therefore needs to consider the net impact of initiatives on all of these levels. **Error! Reference source not found.** sets out the preferred approach to manage the 'towards carbon neutral' aspiration at Alkimos. The following sections set out the preferred approach to measure carbon, set objectives and targets, set avoidance and reduction initiatives and renewable and low carbon energy initiatives.

7.1.1 Measurement - identifying the carbon emission processes to include

To determine the preferred carbon management strategy a decision is required on those activities and processes to include and not to include. The following table breaks the Central Alkimos development process down into stages and lists the key carbon emissions processes that are proposed to be included.

Table 11: Measurements for identifying the carbon emission process

Civil and Landscape works	Built form works	Community operation – living and working
<ul style="list-style-type: none"> Direct carbon from works – diesel, electricity, gas consumption etc 	<ul style="list-style-type: none"> Direct carbon from works – diesel, electricity, gas consumption etc 	<ul style="list-style-type: none"> Stationary energy consumption in dwellings and non-residential buildings
<ul style="list-style-type: none"> Embodied carbon in materials – concrete, steel, asphalt, other 	<ul style="list-style-type: none"> Embodied carbon in materials – concrete, steel, other 	<ul style="list-style-type: none"> Transport related energy based on average VKT, public transport use and walking/bike riding Carbon outcomes from the waste management practices employed

After avoidance and reduction strategies for each of these processes are identified renewable or low carbon energy sources need to be considered and sequestration strategies need to be considered.

PRECINX (a specialised carbon measurement tool at the precinct and built form level developed by Landcom and Kinesis) is proposed as the key measurement tool to capture and model data. Additional assumptions in regard to behavioural change, waste management and onsite sequestration will need to be overlaid on the PRECINX tool.

7.1.2 Avoidance and reduction

Avoidance and reduction will be focused on the five key areas of development. In each case carbon reduction initiatives have already been defined in the sustainability initiatives discussed in other sections of this strategy. These initiatives are listed against each of the development stages in the table below.

Table 12: Avoidance and reduction of carbon with targets and savings

Development stage	Relevant carbon avoidance or reduction initiatives	Proposed target
Embodied energy in civil and built form	Section 3	20% saving civil, 30% saving built form on standard practice
Operational energy residential and non-residential buildings	Section 3	30-40% saving on Perth average
Transport related carbon	Section 6	10% saving pre train, 20% saving post train on Perth average

Development stage	Relevant carbon avoidance or reduction initiatives	Proposed target
Carbon emissions from waste to landfill	Section 5	100% landfill waste to methane capture facility

Behavioural change in relation to energy consumed in the home and transport activities is both a large opportunity and unknown. Ongoing monitoring (through tailored surveys and data collection) will be carried over every second year at Central Alkimos to continue assessment of whether behavioural change initiatives are making a material difference (this is an extension of process established at South Alkimos).

7.1.3 Renewable energy

Renewable or low carbon energy initiatives have been proposed for consideration across all development stages in Section 3 of the report. These initiatives are set out in the table below. Successful implementation of these initiatives at South Alkimos will ultimately determine the feasibility of continued implementation into Central Alkimos.

Table 13: Renewable energy targets

Renewable or low carbon energy source (section 3)	Target
Solar – PV array <ul style="list-style-type: none"> ▪ 1.1 – 1.25 kW to approximately 80% of dwellings ▪ Large scale arrays for school, large retail, commercial and industrial buildings 	20% saving on Perth average
Solar thermal <ul style="list-style-type: none"> ▪ Instantaneous gas boosted solar hot water 	12% saving on Perth average
Enabling infrastructure trials <ul style="list-style-type: none"> ▪ Set up green circuit in dwellings (washing machine, dishwasher etc) to align with wind turbine energy entering the grid after the evening peak – to ideally benefit from a favourable off peak tariff ▪ Design local network infrastructure (mainly transformers) to cope with PV array voltage and harmonic issues ▪ Pilot dwelling scale and potentially local grid scale (with grant funding) storage to load shift PV array output – combine with 3-4kW PV capacity at dwelling level 	Establish Central Alkimos as a continuation of the pilot at South Alkimos project for key smart grid infrastructure enhancements

7.1.4 Sequestration

Due to the challenging environment growing and maintaining large canopy trees on site it is not anticipated that sequestration will be a major contributor to carbon reductions. Central Alkimos can demonstrate leadership however by using USDA Forest Service developed software, 'i-tree' (to be trialled at South Alkimos), to measure the sequestration benefit, air pollution and air cooling benefits of different plant species proposed for the Central Alkimos soft landscape areas.

7.1.5 Assessment of net carbon emission outcome

Following the steps described above, and measuring separately at each stage, will lead to an assessment of absolute carbon emissions for the construction phases of the development and an annual assessment of carbon emissions for the residential and non residential communities. Presentation of results will be based on the PRECINX model outputs and compared against a 'business as usual' assessment of the average Perth outcome for precincts with similar land uses.

7.2 Strategic initiatives – carbon management and optimization

Table 14: Strategic initiatives for carbon management and optimization

INITIATIVE	DESCRIPTION	POTENTIAL ACTIONS TO BE CONSIDERED	DATE OF COMPLETION
EL48: Finalise Carbon Optimality Assessment Strategy and Tool	Agree sum of parts approach including various energy and transport categories	<ul style="list-style-type: none"> ▪ Continuation of approach established at South Alkimos (agree carbon measurement, initial reduction targets for Central Alkimos, across parts, pilot initiatives, review process and PRECINX as underlying model) 	First stage of Central Alkimos
EL49: Set up carbon capture tool	Tailor the PRECINX tool and create a Central Alkimos version ready for use	<ul style="list-style-type: none"> ▪ Develop PRECINX model using online tool 	First stage of Central Alkimos
EL50: Set up ongoing carbon reduction measurement and governance process	Put initial data capture processes in place and agree ongoing process and governance arrangements	<ul style="list-style-type: none"> ▪ Extend existing South Alkimos model <ul style="list-style-type: none"> – Set up database to store all necessary carbon measurement data for civil works and built form construction – Agree travel and home energy consumption survey process to provide inputs for ongoing transport pattern carbon and home energy consumption – Appoint ESD manager to project manage process and provide annual report – Set up steering group for annual review 	First stage of Central Alkimos

8 Project Management and governance

8.1 Project Manager

A part time Central Alkimos ESD Manager will be required to project manage the considerable number of environmental sustainability initiatives and carbon management requirement. It is suggested that this role is combined with any existing ESD Manager role operating over South Alkimos and Alkimos City Centre.

8.2 Program Steering Committee

A Sustainability Steering Group to help oversee and guide all Alkimos sustainability initiatives is proposed for establishment as part of the South Alkimos project. It is proposed that this Steering Committee expand to include Alkimos City Centre and Central Alkimos due to the interdependencies of most initiatives.

8.3 Strategic initiatives – governance

Table 15: Strategic initiatives for Environmental leadership governance

INITIATIVE	DESCRIPTION	POTENTIAL ACTIONS TO BE CONSIDERED	DATE OF COMPLETION
EL51: Set up Environmental leadership Governance structure	Put in place required operational and project control roles and program – expand the existing South Alkimos process	<ul style="list-style-type: none"> Expand job description of existing South Alkimos ESD project manager and terms of reference of Steering Committee 	First stage of Central Alkimos



APPENDIX I
COMMUNITY
DEVELOPMENT STRATEGY

(ARID GROUP, MAY 2012)



LOCAL COMMUNITY DEVELOPMENT STRATEGY

CENTRAL ALKIMOS LOCAL STRUCTURE PLAN

ALKIMOS SECONDARY ACTIVITY CENTRE STRUCTURE PLAN

Prepared by: **ARID GROUP**

Prepared for: **LEND LEASE COMMUNITIES**

Version/Date: Final 21 May 2012

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LIST OF ABBREVIATIONS

ACSP	Activity Centre Structure Plan
IAP2	International Association of Public Participation
LSP	Local Structure Plan
NCGC	Northern Coastal Growth Corridor

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EXECUTIVE SUMMARY

The purpose of the Community Development Strategy is to outline key strategies to achieve community outcomes in the Local Structure Plan (LSP) and Activity Centre Structure Plan (ACSP) areas. The LSP area will be primarily residential whereas the ACSP area will include commercial, retail and mixed-use space that provide opportunities for employment and economic diversification. While the residential and business communities will require different specific initiatives the framework for delivery and core program areas of participation, partnerships and governance are applicable to both.

LandCorp and Lend Lease's vision for Central Alkimos and the Alkimos Secondary Activity Centre is a community of citizens that are:

- Connected and engaged
- Creative and innovative
- Diverse and inclusive
- Healthy and safe

The approach to implementing the Community Development Strategy will be facilitative, responsive, contextual, adaptive, integrated and aligned with local priorities. Consultation with key stakeholders has informed the development of the strategy, including identification of early services and infrastructure for delivery, and opportunities to develop partnerships and build on existing programs and initiatives.

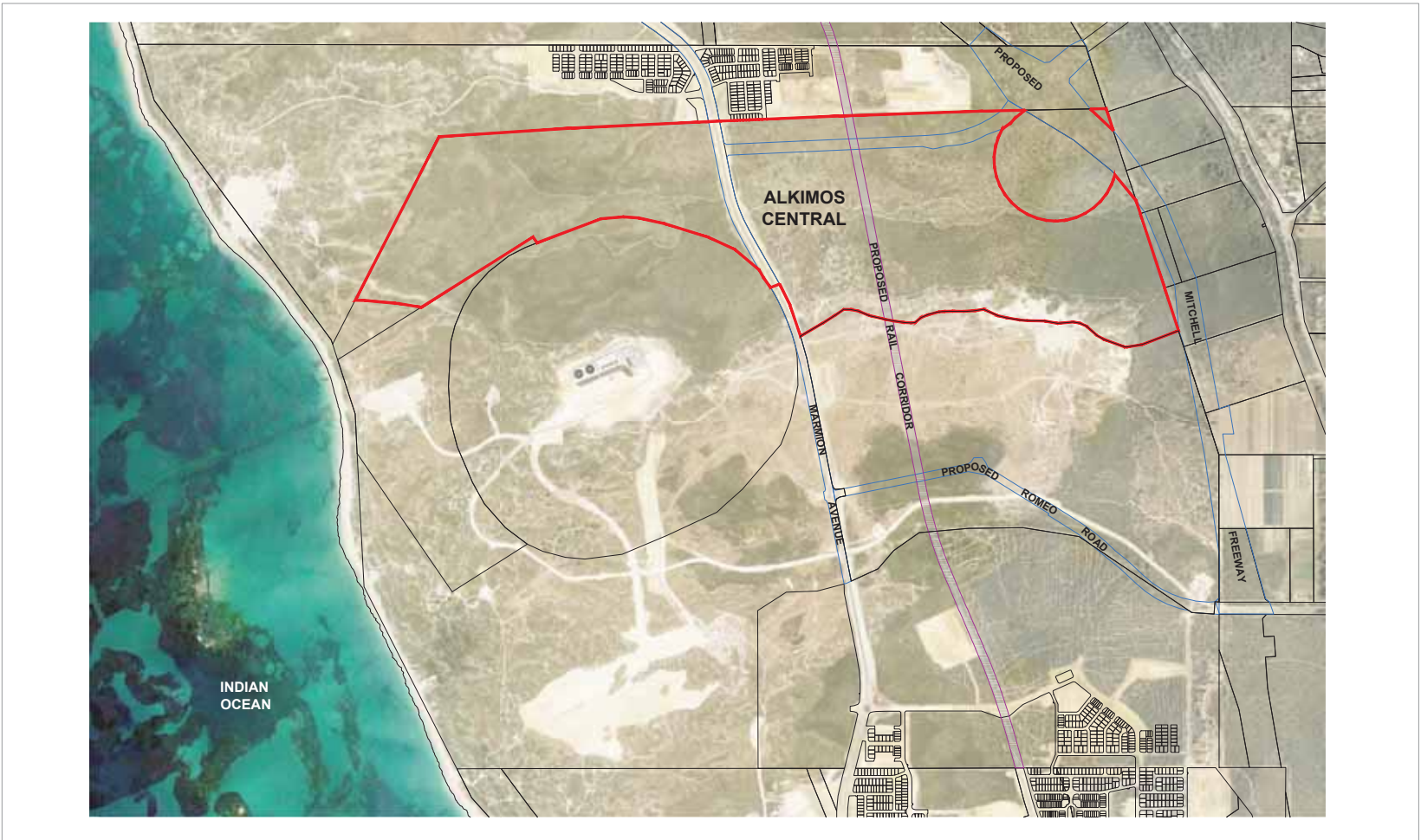
Two main strategies underpin the delivery of community development outcomes for the LSP and ACSP areas:

1. **Design and built form:** decisions regarding design and the built form play an important role in fostering community development. Design and built form have the potential to encourage interaction; promote health and wellbeing; provide amenity and services; and, increase safety. Transport, landscape design, affordable housing, environment and economic development furthermore contribution to community development outcomes.
2. **Programs and initiatives:** targeted programs and initiatives will be delivered that: encourage participation and interaction; support stakeholders to participate in decision making about the community; and promote partnerships.

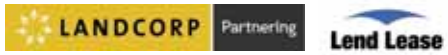
1 OVERVIEW

- The Central Alkimos Local Structure Plan (LSP) area is approximately 210 hectares (Figure 1). It will be developed primarily for residential purpose with an estimated 2000 lots. The area will include a small local centre and district playing fields in the Regional Open Space.
- The Alkimos Secondary Activity Centre Structure Plan (ACSP) area is approximately 115 hectares (Figure 2). It will include commercial, retail, recreation and mixed-use facilities as indicated in the Activity Centre Plan.
- The LSP and ACSP areas are situated within the greater Alkimos – Eglinton District. The Alkimos – Eglinton District consists of a 2,660 hectare parcel of land located 40 km northwest of the Perth Central Business District.
- These LSP and ACSP areas are within the Alkimos Eglinton District Structure Plan (DSP), which was approved by the City of Wanneroo in July 2008, and the West Australian Planning Commission in March 2011.
- The purpose of the Local Community Development Strategy for the LSP and ACSP areas is to outline key strategies to achieve community outcomes. The LSP area will be primarily residential whereas the ACSP area will be commercial, retail and mixed-use. While the residential and business communities will require different specific initiatives the framework for delivery and core program areas of participation, partnerships and governance are applicable to both.

Figure 1: Central Alkimos



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AERIAL PHOTO
Alkimos Central
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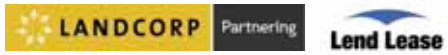
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REFERENCE NUMBER	DRAWING NUMBER	ISSUE
DLL CEN	RD1 002	A

Figure 2: Alkimos Secondary Activity Centre



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2 VISION AND OUTCOMES

LandCorp and Lend Lease's vision for Central Alkimos and the Alkimos Secondary Activity Centre is a community of citizens that are:

- Connected and engaged
- Creative and innovative
- Diverse and inclusive
- Healthy and safe

Our vision reflects current research¹ into community wellbeing and the strategy is designed to achieve the following intended outcomes:

- Social connections
- A sense of place and belonging
- Governance structures that enable local participation in decision making
- Physical amenity and services

3 APPROACH

This section describes the guiding principles, context analysis and framework for delivery that inform our approach to community development in the LSP and ACSP areas.

3.1 Guiding principles

Our approach to implementation of the community development strategy will be:

1. **Facilitative:** focusing on facilitating opportunities for resident and other stakeholder's involvement and participation, recognising that community development is often incidental.
2. **Responsive and iterative:** delivered by people on the ground, who are committed to building relationships with residents and other stakeholders through responsive and iterative approaches.
3. **Contextual:** building on the opportunities that exist in the region through partnership approaches with local government and existing service providers.
4. **Adaptive:** responding to the changing needs of the community as it begins to take shape.

¹ Hothi, M., Bacon, N., Brophy, M., and G. Mulgan. (2008). *Neighbourliness + Empowerment = Wellbeing*. The Young Foundation: London.

Kelly, J-F., Breadon, P., Davis, C., Hunter, A., Mares, P., Mullerworth, D. and B. Weidmann. (2012). *Social Cities*. Grattan Institute: Melbourne.

Lance, P. and G. Woodcock. (2003). *Building Sustainable Social Capital In New Communities*. Working Paper #1 A Case Study Analysis. University of Queensland and Delfin Lend Lease: Ipswich.

5. **Integrated:** acknowledging that this is taking place in the context of other developments that border the LSP and ACSP areas and that outcomes for communities will be facilitated by good integration with these development.
6. **Aligned:** working with local and state government to deliver programs and initiatives that are strategically aligned and consistent with local priorities.

3.2 Context analysis

In preparing this strategy LandCorp and Lend Lease have undertaken a context analysis identifying policies, programs and initiatives at the national, state and local levels across the themes of: environment and sustainability; diversity, affordability, disability, indigenous issues, youth, sports, health and wellbeing, the elderly, arts and culture, volunteering and civic engagement. The analysis highlighted the wide range of existing programs and initiatives operating locally and the national and state level priorities. The analysis informed our approach, particularly the importance of partnerships and alignment with existing programs. This will also be an important reference during implementation of the strategy. The full analysis is presented in Appendix 1, and will continue to be updated as new initiatives develop.

3.3 Framework for delivery

Two main strategies underpin the delivery of community development outcomes for the LSP and ACSP:

1. **Design and built form:** decisions regarding design and the built form play an important role in fostering community development. Design and built form have the potential to encourage interaction; promote health and wellbeing; provide amenity and services; and, increase safety.

Section Four elaborates on one specific strategy – the provision of community infrastructure and services. Other strategies, including landscape design, hike and bike, movement and transport, and economic development, are reported on elsewhere in the LSP and ACSP documents.

2. **Programs and initiatives:** targeted programs and initiatives will be delivered that: encourage participation and interaction; support stakeholders to participate in decision making about the community; and promote partnerships.

Section 5 expands on the potential programs and initiatives to be delivered.

4 DEMOGRAPHICS AND LOCAL CONTEXT

This section provides a summary of the current and projected local demographics. This information provides an understanding of the local context and the types of facilities and community development strategies that might be required.

4.1 The current and future community

The LSP and ACSP areas are currently undeveloped and have no permanent population. However, it is projected that the:

- Alkimos Eglinton District will experience regular and rapid growth, with a projected population of 52,048 by 2021².
- City of Wanneroo, which has a current population of 156,329, will experience similar rapid growth with an estimate population of 305,380 by 2021².
- Central Alkimos LSP area, based on a yield of 2000 lots, will have a build out population of 5600 – 6200 residents.
- It is estimated that the Alkimos Secondary ACSP area will accommodate 16,266 full time equivalent jobs when its catchment reaches residential population capacity.

Although this population does not exist, analysis of current demographic data and projections can provide us with insights into the future community. This data has been drawn from the City of Wanneroo Community Profile (2006), which is based on the Australian Bureau of Statistics (ABS) census data, and the City of Wanneroo Population and Household Forecasts (2010). The ABS 2011 census data will be released in June 2012 and will be reflected in subsequent versions of the strategy.

Population and age structure

The population of the City of Wanneroo is 156,329; this population when compared with Perth Statistical Division has a:

- Larger percentage persons aged 0 – 4 years (8.2 %, Perth 6.2 %)
- Larger percentage persons aged 5 – 15 years (21.8 %, Perth 18 %)
- Smaller percentage persons aged 65 – 84 years (8 %, Perth 10.5 %)
- Smaller percentage of Australian born residents (58.2 %, Perth average 61.7 %)

It is projected that by 2021:

- 0 – 4 year olds will be the most populous group
- The total number of people under 15 years will account for 24.4 % of the population
- The number of people over 65 years will increase over this period to 11 % of the population

² id.consulting pty ltd (2010). City of Wanneroo: Population and Household Forecasts. id.consulting: Melbourne.

Dwelling and household structure

The City of Wanneroo has 38,290 occupied private dwellings. The majority of these (83.1 %) are separate houses. In comparison with the Perth Statistical Division households have a:

- Larger percentage couple families with children (50.7 %, Perth 45.8 %)
- Smaller percentage couple families without children (33.1 %, Perth 37.1 %)
- Significantly smaller percentage single person households (16.2 %, Perth 23.8 %)
- Higher percentage persons purchasing their own homes (50.8 %, Perth, 37.6 %)
- Smaller percentage persons who own their home (22.2 %, Perth 29.7 %)
- Smaller percentage persons who rent their homes (19.2 %, Perth 24.7 %)

Household structures in the City of Wanneroo are projected to remain relatively stable. It is projected that by 2021:

- Couples with children will continue to make up the largest proportion of the population.
- There will be a slight increase in couples without dependents comprising 31 % of all households compared to 29.1 % in 2006.

Employment

In the City of Wanneroo, 95.9 % of the labour force is employed and 4.1 % unemployed. The industry sectors that employ the most number of people are construction, retail trade and manufacturing. The most popular occupations are technicians and trade workers, clerical and administrative workers and labourers. In comparison with the Perth Statistical Division this labour force has a:

- Larger percentage persons employed in construction (12.7 %, Perth 8.8 %)
- Smaller percentage persons employed in professional, scientific and technical services (4.8 %, Perth 7.4 %)
- Smaller percentage persons employed in education and training (5.7 %, Perth 7.9 %)
- Larger percentage persons employed as technicians and trades workers (20.0 %, Perth 15.8 %)
- Larger percentage persons employed as labourers (12.7 %, Perth 9.7 %)
- Smaller percentage persons employed as professionals (12.5 %, Perth 20.6 %)

Education and income

In the City of Wanneroo compared with the Perth Statistical Division a:

- Smaller percentage persons hold educational qualifications (36.2 %, Perth 41.2 %)
- Smaller percentage persons have no qualification (51.4 %, Perth 45.5 %)
- Smaller percentage persons hold a bachelor or higher degree (8.7 %, Perth 16.4 %)

- Weekly household incomes are similar: higher incomes (greater than \$1700 per week) 21.4 % (Perth 24.8 %) and lower weekly incomes (less than \$500 per week) 14.6 % (Perth 17%)

4.2 Interpretation

The data presented here indicates that the:

- **Residential community:** will to a large extent be made up of families and young people. New housing and affordable housing are also likely to attract retirees and young couples without children. This suggests there will be a focus on; the provision of schools, community services and recreational facilities; and, initiatives that encourage community connection and participation. A strong focus on youth is also likely to be required.
- **Business community:** the ACSP area will provide considerable opportunities for employment generation and self-sufficiency in the North West Coastal Corridor. The Local Economic Strategy indicates that provision of enabling infrastructure (such as road and rail infrastructure) and flexible and scalable approaches to land use planning and infrastructure will be required to facilitate economic development. Governance structures, mechanisms and facilities that support collaboration and innovation are also likely to be important.

5 STAKEHOLDER ENGAGEMENT AND CONSULTATION

The stakeholder³ engagement and consultation methods, findings and implications for the community development strategy are outlined in this section.

5.1 Methods of engagement and consultation

The stakeholder engagement strategy has utilised a range of methods designed to understand what the future community might look like and the expectations and needs of different stakeholders. The stakeholders engaged have been consistent with the project phase and requirements and included the City of Wanneroo, planning authorities, prospective future residents, and businesses.

The methods of engagement and consultation have included:

- **Hearts and minds sessions:** consultation workshops designed to understand the local and potential future communities' needs and aspirations.
- **Listening sessions:** meetings that provide an opportunity for local stakeholders (service providers, builders, residents and interested businesses) to learn about the development, ask questions, identify issues and explore opportunities.
- **Newsletter:** a quarterly newsletter distributed to stakeholders providing updates about the project.
- **Interviews and focus groups:** targeted research with key sectors such as businesses and investors to discuss opportunities, expectations and constructions.
- **Meetings and workshops:** meetings and workshops with local stakeholders (particularly local and state government) to inform the development of the project.

5.2 Key findings and implications for the community development strategy

Key findings from this process include the:

- Strong expressed need for early delivery of services and community infrastructure
- Importance of transition models for delivery of programs and services with local government to ensure sustainability of programs
- Value of establishing partnerships early with local government and service providers to avoid lag times in delivery of services to key sectors such as youth
- Need for innovative service delivery models and shared use agreements for shared facilities/infrastructure

³ The term stakeholder is used broadly to refer to any individuals, groups, organisations with an interest in the area, this includes, but is not limited to, future residents, surrounding residents, businesses, local and state government and potential service providers.

- Opportunities to develop partnerships with key service providers and build on existing programs
- Importance of aligning community development programs and initiatives with state and local government strategic planning
- Need for flexible and scalable infrastructure to be able to respond to an evolving local and regional environment

5.3 Ongoing stakeholder consultation and engagement

Stakeholder engagement will continue to be central to delivery of the community development strategy with increasing opportunities to involve stakeholders in decisions regarding the design and built form and delivery of programs and initiatives. To determine the appropriate level of stakeholder engagement, mapping will be undertaken to identify and classify key stakeholders based on their level of interest, likely impact and involvement.

Identification of stakeholders, and suitable engagement strategies, will be based on the International Association of Public Participation (IAP2) public participation spectrum model (see www.iap2.org.au). The IAP2 model ensures that stakeholders are engaged at a level appropriate to their interest, impact from and ability to influence decision-making. This avoids the potential for confusion about, or mismanagement of, stakeholder expectations.

6 DESIGN AND BUILT FORM

The community facilities to be delivered at a regional, district and local level are summarised in this section. This includes discussion of the supporting strategies and intended contributions to community development. Indicative timing for the delivery of facilities is also provided.

6.1 Existing and planned facilities

The Northern Coastal Growth Corridor (NCGC) Community Facilities Plan (2011) outlines the existing community facilities (Table 1) and “the extent of community infrastructure (including built facilities and public open space) required within the NCGC of the City of Wanneroo to meet the needs of the current and future population through to 2061”.

Table 1: Existing community facilities in the Northern Coastal Growth Corridor (NCGC Facilities Plan, 2011)

SUBURB	BUILDING	CATCHMENT
BUTLER	Butler Community Centre	District
	Kingsbridge Toilets/Changerooms	District
CLARKSON	Anthony Waring Park Community Facility	Local
	Clarkson Volunteer Bushfire Brigade Office	Regional
	Clarkson Library	District
	Clarkson Youth Centre	District
	Anthony Waring Park Toilets	Local
	Aldersea Park Toilets	Local
MERRIWA	Addison Park Toilets/Clubrooms	Local
	Jenolan Way Community Centre (incl. Child Health Centre)	District
	Merriwa Welfare Administration Centre	Local
MINDARIE	Mindarie Beachside Toilets	Regional
	Mindarie Quinns Surf Lifesaving Club (Building)	Regional
	Abberville Park Toilets	Local
	Quinns Caravan Park	N/A
	Portofinos (incl. public toilets and changerooms)	N/A
QUINNS ROCKS	Gumblossom Community Centre	District
	Gumblossom Clubrooms	Local/District
	Quinns Rocks Bowling Clubrooms	District
	Quinns Rocks Child Health Centre	District
	Quinns Rocks Fire Brigade Shed	District
	Quinns Rocks North Beach Toilets/Changerooms	Local
RIDGEWOOD	Ridgewood Park Clubrooms and Amenities Block	Local
TWO ROCKS	Charnwood Park Toilets/Changerooms	Local
	Phil Renkin Community Facility and Library	District
	Two Rocks Children’s Community Facility	Local
	Leemans Landing Toilets	Local
	The Spot Toilets	Local
YANCHEP	Mary Lindsay Homestead	District
	Oldham Park Clubrooms	Local
	St Andrews Park Clubrooms/Changerooms	Local
	Sun City Sports Club	District
	Yanchep Beach Facility (Building)	Local
	Yanchep Beach Kiosk	Local
	Yanchep Beach Toilets/Changerooms	Local
	Yanchep Community Centre	District
Yanchep Surf Lifesaving Club	Regional	

The regional and district facilities for the LSP and ACSP areas that will be delivered under the North Coastal Growth Corridor Community Facilities Plan are:

- District public open space (Central Alkimos⁴)
- Regional multisport hard courts (Central Alkimos)
- Regional indoor recreation centre (Alkimos Secondary Activity Centre)
- Regional library (Alkimos Secondary Activity Centre)
- Regional community centre (Alkimos Secondary Activity Centre)

These regional and district facilities are intended to serve catchment areas of 10+ km and 5 – 10 km respectively. While they may support and resource local facilities additional facilities are expected to meet the needs of the immediate surrounding community. The following facilities are proposed to be delivered across the LSP and ACSP areas:

- Urban retail core
- Government primary school
- Private high school
- TAFE
- Tavern/accommodation
- Fast food outlets
- Commercial/government buildings
- Church
- Childcare centres
- Medical centre
- Emergency services
- Hospital
- Retirement village
- Hotel
- State Swim
- Local playing fields for local use and corporate sports

6.2 Supporting strategies

Other design and built form contributions to community development are delivered through plans and mechanisms other than the Community Development Strategy. These include transport, landscape design, affordable housing, environment and economic development, and can be found elsewhere in the LSP and ASCP.

⁴ In the NCGC Community Facilities Plan Central Alkimos is referred to as East Alkimos.

6.3 Facilitating community development

In addition to the delivery of facilities and infrastructure items (Section 6.1), the following strategies⁵ will be employed to facilitate intended community development outcomes beyond amenity and service provision:

- **Place activation:** it is anticipated that facilities with a broader social value and high intensity uses will be located in the city centre. This will bring people into the city centre, activate the space on the weekend, be more accessible to public transport and facilitate additional social activities and access to other facilities/services (e.g. shopping and dining). Facilities that have district needs like organised sports are likely to be located in Central Alkimos as part of the Regional Open Space North of the city centre and co-located with the proposed Primary School. It is proposed that some of the sports facilities with higher use profiles will be co-located with the private high school in the Sports and Recreation precinct in the City Centre.
- **Early provision of services:** it is intended that key facilities will be delivered early to ensure adequate access to services and to help new community members establish connections and a sense of community. LandCorp and Lend Lease are exploring delivery of facilities based on the timeframe outlined in Table 2. However, to a large extent this will be dependent on the market and third party funding.
- **Co-location:** where appropriate community and other facilities will be co-located to increase usage levels, promote cost-sharing, encourage connection and facilitate collaboration. Co-location will also be supported in the early stages of development, for example to ensure that community organisations and business associations have access to meeting rooms and facilities. This could include the Technology and Information Centre and Collaborative Innovative Node to be delivered as part of the Local Economic Development Strategy.
- **High quality urban environment and economic environment:** LandCorp and Lend Lease will ensure that all areas are enhanced and have a sense of place to attract businesses. Flexibility will be a core principle to ensure that facilities can easily transition to accommodate the changing needs of the business community. This will be delivered primarily through the Temporary Commercial Land Uses, Ground Floor Activation and Pedestrian Permeability, Flexible Land Use Framework and Flexible Building Design Guidelines initiatives delivered as part of the Local Economic Development Strategy.

⁵ The delivery of all facilities will also take into account the guiding principles for facilities provision outlined in the Northern Coastal Corridor Growth Community Facilities Plan (Section 3).

Table 2: Indicative timing of delivery of facilities

2016 - 2017	2018 - 2021	2022 - 2026	2027 - 2031	2037 - 2041
Supermarket Speciality retail Personal services (e.g. accounting services) Fast food outlets Childcare centre Medical centre	Additional retail Lifestyle services (e.g. gymnasium) Private high school Tavern Accommodation Retirement village	Regional multisport hard courts District public open space Additional retail Government buildings Emergency services Church TAFE	District community centre District library	Regional indoor recreation centre

7 PROGRAMS AND INITIATIVES

The Community Development Strategy aims to facilitate a community that is connected and engaged; creative and innovative; diverse and inclusive; and, healthy and safe through programs and initiatives that:

- Support activities that foster connections and a sense of belonging
- Enable people to participate in decision making about their community
- Facilitate opportunities in education, localised research and enterprise
- Support people from different age groups cultures, faiths and abilities
- Encourage active living
- Promote safety and a sense of security

The community development strategy comprises three core program areas:

1. **Governance:** supporting communities to develop the capacity and structures to play a role in the decisions that will affect them.
2. **Participation:** ensuring that the community has the opportunity, resources and capacity to interact with each other.
3. **Partnerships:** delivering initiatives through a partnership approach that builds on existing programs and leverages resources and supporting partnerships that promote collaboration and innovation.

Within these three program areas LandCorp and Lend Lease will implement a range of initiatives that target specific groups (e.g. youth and elderly) and community outcomes (e.g. affordable housing and healthy living).

Sections 7.1 – 7.3 below outline the objectives and potential initiatives for the three core program areas.

7.1 Governance

Aim: to support the residential and business communities to establish governance structures that enable them to play a role in the decisions that will affect them.

Objectives:

- To support development of appropriate structures and mechanisms for the community to participate in decision making
- To develop community capacity to participate in decision making and develop leadership
- To enable local leaders to provide input to and guide decision making about their community and its identity

Potential initiatives:

- **Stakeholder engagement:** building on the stakeholder engagement strategy delivered during the planning stages this program this would provide stakeholders with an opportunity to engage in decision making during construction. Stakeholder mapping would be used to determine the level of engagement appropriate for different stakeholder groups.
- **Business association:** supporting local businesses to establish a governance framework (such as a business association) that meets the needs of the local economy and is flexible enough to respond to the changing needs of that economy. Subject to the requirements of the local business community this could be pursued in partnership with the existing Wanneroo Business Association and with input from the Alkimos Economic Development Committee to be established as part of the Local Economic Development Strategy.
- **Community advisory group:** supporting the community to establish governance structures that enable them to participate in decision making about their community. In the early stages of development, a community advisory group is suggested. This structure would be assessed on a regular basis to determine if it is meeting the needs of the community or if a different mechanism would be more appropriate. For example, the community advisory group could evolve into a community development association.
- **Youth leadership and advocacy:** a initiative for youth that encourages them to have a say in what is happening in community and the initiatives that are being delivered to youth. This would include supporting youth participation in the community advisory group and leadership training and involvement in the delivery of initiatives and events.
- **Leadership training:** providing community members with an opportunity to apply for financial support for leadership training that will help them develop leadership skills for the purpose of contributing to community outcomes.

Timing and implementation:

Early delivery of this program is crucial to ensure new residents and businesses are aware of the opportunity and able to be involved in decision making. Information would be provided to all new community members upon arrival and a Community Development Officer would identify and encourage people to participate.

7.2 Participation

Aim: to ensure that the community has the opportunity, resources and capacity to interact and connect with each other.

Objectives:

- To provide residents and businesses with opportunities to interact with each other and establish a shared sense of place
- To foster a sense of belonging and security
- To celebrate diversity

Potential initiatives:

- **Welcome package:** providing new residents with information and opportunities to be welcomed to the community (e.g. welcome functions).
- **Social media:** developing social media tools that meet the needs of the community such as a community portal and facebook page. These could be supported by free Wi-Fi access in the city centre in the ACSP area.
- **Newsletter:** distributing a quarterly newsletter that mirrors key content from the community portal such as updates on the deliver of services, how to get involved in initiatives, the upcoming events, recreation opportunities and local businesses.
- **Community events:** delivering an annual calendar of events that responds to different community needs, celebrates diversity and aligns with national events. This represents a further opportunity for collaboration with, and support for, local organisations. Where appropriate this would be delivered in conjunction with the Business Education Program and Business Connections Program delivered as part of the Local Economic Development Strategy designed to promote connections between the business community.
- **Local history:** a project that would invite community members to document the unique local history (coastal environment, maritime and indigenous).
- **Community garden:** supporting community members to develop a community garden if there is sufficient interest. Community ownership, governance and access to land are key issues for community gardens and LandCorp and Lend Lease would look for ways to assist in these areas.
- **Public arts:** delivery of public artworks by local artists in partnership with the community that explore the narratives of: maritime, water, energy, wellbeing and coastal ecology.

Timing and implementation:

It is proposed that a Community Development Officer will coordinate the initiatives. Decisions regarding the initiatives that are delivered will be informed by input from the community advisory group, business association and local partnership initiatives. Detailed implementation strategies will be developed for initiatives that require significant community buy-in and investment (e.g. community garden and public arts initiatives).

7.3 Partnerships

Aims: to build on existing programs and leverage resources through partnerships with key stakeholder groups; and, to support partnerships that promote collaboration and innovation in education, enterprise and research.

Objectives:

- To develop partnerships with local government and services providers for the delivery of community development initiatives
- To develop strategic partnerships with education providers, businesses and research centres for the purposes of encouraging co-location of education, enterprise and research centres

Potential initiatives:

- **Local partnerships:** developing a mechanism for delivering community development across the LSP and ACSP areas in partnership with local government and local service providers. This could potentially target key identified priority areas, such as youth engagement.
- **Education, enterprise and research hub:** pursuing the development of a hub that promotes innovation, collaboration and learning that capitalise on the unique location and design of the LSP and ACSP areas (e.g. sustainable urban design). This initiative should be delivered in conjunction with the Business – Education Program (Local Economic Development Strategy) which will be an important mechanism for connecting local businesses and education providers.

Timing and implementation:

The local partnerships initiative will need to be delivered early so that it can inform the development of other initiatives. Mechanisms to be explored will include innovative models for staffing the community development position in conjunction with the City of Wanneroo and local partnerships committee.

The development of an innovation or education hub is a significant project that requires considerable lead-time in establishing relationships. Conversations have been initiated with education providers and research centres.

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APPENDIX 1: CONTEXT ANALYSIS

NATIONAL POLICIES, PROGRAMS AND INITIATIVES (1 of 5) – Environment/Sustainability

Policy/Initiative/Program	Summary and reference
Our Cities, Our Future - A National Urban Policy for a productive, sustainable and liveable future	Our Cities, Our Future sets in place the Australian Government's objectives and directions for our cities as we prepare for the decades ahead. It recognises the critical roles that State, Territory and Local Governments, the private sector and individuals play in planning, managing and investing in cities. It also highlights that the Australian Government makes decisions that impact upon urban Australia. This is the first time that an Australian Government has sought to outline its overarching goals for the nation's cities and how we will play a role in making them more productive, sustainable and liveable. http://www.infrastructure.gov.au/infrastructure/mcu/urbanpolicy/index.aspx
Sustainable Australia – Sustainable Communities: A Sustainable Population Strategy for Australia	The 2011-12 Budget provides \$95 million to support a sustainable population in Australia through four measures: Suburban Jobs; Sustainable Regional Development; Promoting Regional Living; and Measuring Sustainability. http://www.environment.gov.au/sustainability/population/index.html The objective of the Suburban Jobs Program is to assist state and local governments to plan for and provide enduring employment opportunities in the growing outer suburbs of our major capital cities. http://www.environment.gov.au/sustainability/suburbanjobs/index.html
Living Sustainably: the Australian Government's National Action Plan for Education for Sustainability	The aim of Living Sustainably: the Australian Government's National Action Plan for Education for Sustainability, launched in April 2009, is to equip all Australians with the knowledge and skills required to live sustainably. The plan has been prepared in conjunction with the National Council on Education for Sustainability by the Australian Government Department of the Environment, Water, Heritage and the Arts. http://www.environment.gov.au/education/nap/index.html
Living Greener	The LivingGreener website provides a starting point for information about living more sustainably and reducing your environmental impact. It includes information on programs and financial support available from the Australian Government as well as state and territory governments. http://www.livinggreener.gov.au/
National Solar Schools Program	An annual grant scheme for schools to install solar power systems and a range of energy efficiency measures as they take action against climate change. http://www.climatechange.gov.au/government/initiatives/national-solar-schools.aspx
Australian Sustainable Schools Initiative	The Australian Sustainable Schools Initiative (AuSSI) is a partnership of the Australian Government and the states and territories that seeks to support schools and their communities to become sustainable. AuSSI engages participants in a whole-of-school approach, to explore through real-life learning experiences, improvements in a school's management of resources and facilities including energy, waste, water, biodiversity, landscape design, products and materials. It also addresses associated social and financial issues. http://www.environment.gov.au/education/aussi/
Green star	Green Star is a comprehensive, national, voluntary environmental rating system that evaluates the environmental design and construction of buildings. http://www.gbca.org.au/green-star/green-star-overview/

NATIONAL POLICIES, PROGRAMS AND INITIATIVES (2 of 5) – Environment/ Climate Change/Sustainability

Policy/Initiative/ Program	Summary and reference
Low carbon communities	<p>As part of the Clean Energy Legislation there are a number of initiatives and programs that aim to foster low carbon communities– however, many of them focus on retrofitting existing homes/buildings. For example:</p> <ul style="list-style-type: none"> • The \$200 million Community Energy Efficiency Program will support energy efficiency upgrades to council and community-use buildings, facilities and lighting. • The \$100 million Low Income Energy Efficiency Program will support consortia of community organisations, local councils and energy service companies to trial energy efficiency approaches in low income households. • The \$30 million Home Energy Saver Scheme will assist low income households find more sustainable ways to manage their energy consumption <p>http://www.climatechange.gov.au/government/initiatives/low-carbon-communities.aspx</p>
National Waste Policy	<p>This National Waste Policy builds on earlier commitments and responds to the new waste environment, the policy covers wastes, including hazardous wastes and substances, in the municipal, commercial and industrial, construction and demolition waste streams and covers gaseous, liquid and solid wastes. Priority strategies include: Improvements in waste avoidance and re-use of materials in the commercial and industrial waste stream. (State and territory led collaboration); and, Continued government encouragement of best practice waste management and resource recovery for construction and demolition projects.</p> <p>http://www.environment.gov.au/wastepolicy/about/index.html</p>
Raising National Water Standards Program	<p>This \$250 million program offers support for projects that are improving Australia's national capacity to measure, monitor and manage our water resources. Knowledge and Capacity Building and Integrated Urban Water Management are program elements.</p> <p>http://www.nwc.gov.au/rnws/knowledge</p>
Water for the Future	<p>Related policies and programs include :</p> <ul style="list-style-type: none"> • The Water Efficiency Opportunities Program: aims to support and encourage water efficiency in the commercial and industrial sectors of the community. • The Green Precincts Fund: objectives are to support project initiatives that encourage water and energy savings measures at the community level. <p>http://www.environment.gov.au/water/policy-programs/index.html</p>

NATIONAL POLICIES, PROGRAMS AND INITIATIVES (3 of 5) – Diversity/Affordability/Disability

Policy/Initiative/ Program	Summary and reference
National Rental Affordability Scheme Housing Affordability Fund	<p>The government has committed about \$20 billion to understanding and addressing issues affecting housing affordability in Australia. Major investments administered by the Department of Sustainability, Environment, Water, Population and Communities include:</p> <ul style="list-style-type: none"> • The National Rental Affordability Scheme seeks to address the shortage of affordable rental housing by offering financial incentives to the business sector and community organisations to build and rent dwellings to low and moderate income households at rents at least 20 per cent below market rates. • The Housing Affordability Fund is a five year, \$450 million investment by the Australian Government that is helping to reduce the cost of new homes for homebuyers. The program is focussed on reducing housing-related infrastructure and planning costs, and passing savings onto new home purchasers http://www.environment.gov.au/housing/index.html
National Housing Supply Council – State of Supply Report 2011	<p>Most affordability measures tend to focus on relatively narrow definitions of housing costs; that is, on direct housing outlays. They ignore the wider costs of living, such as electricity, water and transport costs, which are part of overall living affordability and which have increased significantly in recent years (p.6). The report also talks about affordability for different groups i.e., elderly and migrants. http://www.nhsc.org.au/supply.html</p>
National Disability Strategy	<p>The National Disability Strategy sets out a ten year national plan for improving life for Australians with disability, their families and carers. It represents a commitment by all levels of government, industry and the community to a unified, national approach to policy and program develop. The Strategy is a ten year plan that sets out six priority areas for action to improve the lives of people with disabilities, their families and carers:</p> <ol style="list-style-type: none"> 1. Inclusive and accessible communities—the physical environment including public transport; parks, buildings and housing; digital information and communications technologies; civic life including social, sporting, recreational and cultural life. 2. Rights protection, justice and legislation—statutory protections such as anti-discrimination measures, complaints mechanisms, advocacy, the electoral and justice systems. 3. Economic security—jobs, business opportunities, financial independence, adequate income support for those not able to work, and housing. 4. Personal and community support—inclusion and participation in the community, person-centred care and support provided by specialist disability services and mainstream services; informal care and support. 5. Learning and skills—early childhood education and care, schools, further education, vocational education; transitions from education to employment; life-long learning. 6. Health and wellbeing—health services, health promotion and the interaction between health and disability systems; wellbeing and enjoyment of life. <p>http://www.fahcsia.gov.au/sa/disability/progserv/govtint/Pages/nds.aspx</p>
Sports CONNECT	<p>Sports CONNECT is a national framework which encompasses a range of initiatives to increase the number of people with disability involved in sport and physical recreation. The Australian Sports Commission coordinates a network of agencies around the country that are working to connect sporting organisations with disability service organisations to build sustainable and inclusive communities. http://www.ausport.gov.au/participating/disability/get_involved/sports_connect_hubs</p> <p>NOTE: WA and SA are the only states that don't have a SportsCONNECT Hub.</p>

NATIONAL POLICIES, PROGRAMS AND INITIATIVES (4 of 5) – Diversity/Indigenous

Policy/Initiative/Program	Summary and reference
Diverse Australia Program	The Diverse Australia Program is a community-based engagement initiative that aims to address issues of cultural, racial and religious intolerance through community activities that break down barriers and engender respect. The Program is administered by the Department of Immigration and Citizenship and provides funding and support to help organisations create a spirit of inclusiveness and to help ensure all Australians are treated fairly regardless of their cultural, racial or religious background or circumstance. The Diverse Australia Program also administers Harmony Day on 21 March every year. http://www.harmony.gov.au/about/
Indigenous Employment Program	Under the reformed IEP, support is available for activities that increase employment opportunities and participation for Indigenous Australians and that which will offer value for money. This could include activities that: <ul style="list-style-type: none"> • encourage and support employers to provide sustainable employment opportunities for Indigenous Australians • encourage and prepare and support Indigenous Australians to take up training and employment opportunities, stay in jobs and enhance their future employment prospects help Indigenous communities, industry bodies and groups of employers to develop Indigenous workforce and economic development strategies that support local and regional economic growth • help Indigenous Australians to develop sustainable businesses and economic opportunities in urban, regional and remote areas. Individuals, communities and organisations can access assistance directly from DEEWR, or indirectly from the two panels of providers. http://www.deewr.gov.au/Indigenous/Employment/Programs/IEP/Pages/default.aspx
Indigenous Cadetship Support	This program (which is part of the Indigenous Employment Program) links full-time Indigenous students undertaking a diploma, an advanced diploma or their first undergraduate degree with employers who can give them work placements and ongoing employment once they finish their studies. http://www.deewr.gov.au/Indigenous/Employment/Programs/IEP/Pages/IndigenousCadetshipSupport.aspx
Indigenous Opportunities Policy	Not directly applicable, but there maybe lessons learned for implementing this kind of program. For the purpose of promoting employment and training opportunities for Indigenous Australians, where projects involve expenditure over \$5 million (\$6 million for construction) in regions where there are significant Indigenous populations, officials must: http://www.deewr.gov.au/Indigenous/Employment/Pages/IndigOpportunitiesPolicy.aspx#iop
Australian Apprenticeships Access Program	The Australian Apprenticeships Access Program provides vulnerable job seekers who experience barriers to entering skilled employment with nationally recognised pre-vocational training, support and assistance. The Access Program is delivered locally by brokers and providers who work closely with employers to deliver training that meets industry needs. http://www.deewr.gov.au/Skills/Programs/PreVoc/AAAP/Pages/default.aspx
Australian Indigenous Minority Supplier Council	Australian Indigenous Minority Supplier Council (AIMSC) is Australia’s premier business-to-business membership body dedicated to growing diversity within the supply chain. AIMSC’s goal is to connect Australian corporate and government organisations with Indigenous business suppliers who are already achieving success or have the potential to develop into vibrant, vital businesses. (Lend Lease has an existing partnership) http://www.aimsc.org.au/about_us

NATIONAL POLICIES, PROGRAMS AND INITIATIVES (5 of 5) – Youth/ Sport/Health/Elderly/Arts

Policy/Initiative/ Program	Summary and reference
Career Trackers	CareerTrackers is a national non-profit organisation that creates private sector internship opportunities for talented Indigenous university students. (Lend Lease has an existing partnership) http://www.careertrackers.org.au/about-us.html
Australian Apprenticeships	http://www.australianapprenticeships.gov.au/Home.asp
Government Youth Portal	Provides details of government initiatives targeting youth http://youth.gov.au/Pages/default.aspx
Trade Training Centres	The Trade Training Centres in Schools Program (the Program) is providing \$2.5 billion over 10 years from 2008 to enable secondary schools to seek funding for Trade Training Centres (TTC). http://www.deewr.gov.au/Schooling/TradeTrainingCentres/Pages/default.aspx
Stephanie Alexander Kitchen Garden National Program – A Healthy and Active Australia Campaign	The Australian Government has committed \$12.8 million for up to 190 primary schools across Australia to participate in the roll-out of the Stephanie Alexander Kitchen Garden National Program. The Program focus is for students to learn to grow, harvest, prepare and share fresh food in the belief this will provide a better chance of positively influencing children’s food choices. http://www.kitchengardenfoundation.org.au/
Active After-school Communities Program – A Healthy and Active Australia Campaign	The Australian Government's Active After-school Communities (AASC) program is a national initiative that provides primary school children with access to free sport and other structured physical activity programs in the after-school time slot of 3.00pm to 5.30pm. The Australian Sports Commission manages the AASC program nationally through a network of locally based regional coordinators. The coordinators assist schools and after-school care centres to facilitate the program, recruit/train community coaches and work with local sporting clubs and organisations to increase junior membership http://www.ausport.gov.au/participating/aasc/get_involved/clubs_and_organisations
Healthy Communities Initiative – A Healthy and Active Australia Campaign	Through the National Partnership Agreement on Preventive Health the Australian Government is providing \$71.8 million over four years from 2009-10 under the Healthy Communities Initiative (HCI) to support Local Government Areas (LGAs) in delivering effective community-based physical activity and healthy eating programs, as well as developing a range of local policies that support healthy lifestyle behaviours. http://www.healthylife.gov.au/internet/healthylife/publishing.nsf/Content/healthy-communities (the City of Wanneroo received a grant in the first phase)

STATE POLICIES, PROGRAMS AND INITIATIVES (1 of 3) – Environment/Sustainability/Health

Policy/Initiative/Program	Summary and reference
Golden Gurus	The Golden Gurus Program (the Program) provides Mature Age Australians (aged 50 years and over) with a range of opportunities to support community organisations and small businesses. This national Program aims to recognise the valuable contribution that Mature Age people make to Australian communities and small businesses. http://www.deewr.gov.au/Employment/Programs/GoldenGurus/Pages/default.aspx
Australia Council for the Arts	The Australia Council for the Arts offers a broad range of grants for Australian artists and arts organisations. For example: the Creative Communities Partnerships Initiative which initiative is an ongoing program with an annual allocation of \$2.5 million to enable more Australians to participate in the arts and cultural activities in the places where they live. http://www.australiacouncil.gov.au/grants/creative_communities
Liveable Neighbourhoods WA	Liveable Neighbourhoods has been adopted by the WAPC as operational policy, and is to be followed in the design and approval of urban development. Liveable Neighbourhoods applies to structure planning and subdivision for greenfield sites and for the redevelopment of large brownfield and urban infill sites. http://www.planning.wa.gov.au/650.asp
Living Smart Household	Living Smart Household is an innovative community-based behaviour change program (supported by the Department of Transport) that engages with households on a personal level and encourages them to reduce their energy and water use, waste disposal and car-based transport. http://www.transport.wa.gov.au/livingsmart/15723.asp
WA Solar Schools Program	Western Australian (WA) Solar Schools Program supports solar power systems installed in WA schools. http://www.energy.wa.gov.au/2/3417/64/wa_solar_schools_program.pm
Australian Sustainable Schools Initiative - WA	http://www.det.wa.edu.au/curriculumsupport/sustainableschools/detcms/portal/
The Waterwise Schools Program	The Waterwise Schools Program aims to educate students, their families and wider communities about the need to value, protect and conserve our precious water resources. http://www.watercorporation.com.au/Education/education_schools_what.cfm?uid=5569-5249-7246-6661
Watercorp – Water Saving Programs	Watercorp has a range of programs targeted a water conservation e.g., Showerhead Swap, H2ome Smart, Toilets to go and Rainwater Reward. Potentially relevant (if program continues) is H2ome Smart which is a joint initiative between the Water Corporation and the Federal Government, and is a completely free, and completely voluntary, 12 month program aimed at helping households to reduce water use and encourage water efficiency. The program commenced in August 2011 and to date approximately 12,000 households are participating. Participants are currently receiving free information and one-to-one advice about where water can be saved in and around the house. http://h2omesmart.com.au/
Affordable Housing Strategy 2010 – 2020	The Affordable Housing Strategy; Opening Doors 2010 - 2020 gives the Department of Housing a mandate to lead vital changes in our housing system and, through new partnerships (including public-private), start opening more doors for more people more quickly. http://www.housing.wa.gov.au/aboutus/aboutthedepartment/StrategicDirection/Pages/default.aspx

STATE POLICIES, PROGRAMS AND INITIATIVES (2 of 3) – Youth/Arts

Policy/Initiative/Program	Summary and reference
Be Active WA	Active Living for All: A Framework for Physical Activity in Western Australia 2012-2016 represents the strategic direction for increasing and improving opportunities for physical activity in Western Australia (WA) over the next five years. http://www.beactive.wa.gov.au/index.php?id=249
Healthway	Healthway provides grants to health and research organisations, as well as sponsorships to sport, arts, racing and community groups which encourage healthy lifestyles and advance health promotion programs. http://www.healthway.wa.gov.au/profile/core-business
Department of Communities - Youth Development Program	Youth Development Program funded services include: <ul style="list-style-type: none"> • Duke of Edinburgh's Award • Fairbridge • Guides Western Australia • Kids Help Line • Leeuwin Ocean Adventure Foundation • Scout Association of WA • The Boy's and Girl's Brigades of Western Australia • Youth Affairs Council of WA • YMCA Eastern Goldfields • Youth Focus http://www.communities.wa.gov.au/Youth/programs/ydp/Pages/default.aspx
WA Youth focused Arts Programs	Youth based art programs (supported by Department of Culture and Arts): <ul style="list-style-type: none"> • Awesome Arts Australia Ltd • Propel Youth Arts WA • WA Youth Theatre Company • WA Circus School Inc (annual) • Children's Book Council of Australia (WA) • Western Australian Youth Music • WA Youth Jazz Orchestra • Musica Viva Australia • Steps Youth Dance Company • Buzz Dance Theatre Limited. http://www.dca.wa.gov.au/DCA-Initiatives/young-people-and-the-arts/
CAN WA	Community Arts Network Western Australia (CAN WA) is the peak body for community arts and cultural development in Western Australia. We inspire and mobilise communities to explore and express their own unique culture through art production, cultural programs, skills development and funding opportunities. http://www.canwa.com.au/

STATE POLICIES, PROGRAMS AND INITIATIVES (3 of 3) – Diversity/Elderly/Indigenous/Volunteering

Policy/Initiative/ Program	Summary and reference
Department of Communities - Age Friendly Communities	The Department for Communities is encouraging local government authorities to embrace the World Health Organisation’s Age-friendly Communities concept which is part of an international effort to prepare for the ageing of our community. As local government authorities are best placed to explore the issues faced by seniors as they age, the Department is providing grant funding to WA local government authorities to assist them in adopting an age-friendly approach to their strategic planning. (not sure if funding is still available, but lessons learnt from past recipients will be available) http://www.communities.wa.gov.au/serviceareas/seniors/Pages/AgeFriendlyWA.aspx
Kidsport	Enabling WA children to participate in community sport and recreation, no matter their financial circumstances. KidSport will allow eligible youth aged 5-18 years to apply for financial assistance to contribute towards club fees. The fees will go directly to the registered KidSport clubs participating in the project through their participating local government (City of Wanneroo is a participant). http://clubsonline.dsr.wa.gov.au/kidsport
Department of Communities - Volunteering	The Department for Communities fosters the development of volunteering in Western Australia through policy development and the provision of specialised programs. For example: providing funding to Volunteer Resource Centres and Volunteering WA to support the development of volunteering. http://www.communities.wa.gov.au/serviceareas/volunteering/Pages/default.aspx
Department of Communities - Grants	The Department for Communities provides ongoing funding and one-off grants. For example for Youth Activities and Community Activities. http://www.communities.wa.gov.au/grantsandfunding/Grants/Pages/default.aspx
Business Growth Centre	The Business Growth Centre is a West Australian state government initiative to encourage the success of small business. Research has shown that established small businesses are looking for guidance and training which is more specific than that of new business owners. http://bgc.wa.gov.au

LOCAL GOVERNMENT AREA POLICIES, PROGRAMS AND INITIATIVES (1 of 3)

Policy/Initiative/ Program	Summary and reference
City of Wanneroo's Strategic Plan 2006 - 2021	The City's Strategic Plan – updated in 2010 http://www.wanneroo.wa.gov.au/Council/Publications
City of Wanneroo's Smart Growth Strategy 2005	The official road map now guiding and supporting sustainable development within the city. http://www.wanneroo.wa.gov.au/Council/Publications
City of Wanneroo's Local Housing Strategy 2005	The aim of the strategy is to guide the future form and types of housing within the City of Wanneroo. http://www.wanneroo.wa.gov.au/Council/Publications
City of Wanneroo's Disability and Inclusion Plan 2012 – 2015 (DRAFT)	Outlines how the Council is encouraging the participation of all community members through practical strategies, designed to address barriers people with disabilities experience when they access our City's community services and programs. Community feedback currently being reviewed. http://www.wanneroo.wa.gov.au/Residents/Access_and_Inclusion_Plan/Draft_Disability_Access_and_Inclusion_Plan_2012-2015
Pre-funding of community infrastructure 2001 policy – doesn't appear to have been reviewed since	Provision of community infrastructure within the City is of key importance to Wanneroo and its community. Infrastructure will be provided in an equitable manner subject to the City's financial constraints. Offers of pre-funding by external parties will be considered within the framework of this policy. Any offer accepted to pre-fund community infrastructure will take the form of an interest free loan and will be repaid over a prescribed period. Council may consider the pre-funding by developers or other agencies of community infrastructure in priority as follows but not limited to: <ul style="list-style-type: none"> • Essential: Local multipurpose community centres; Active open space, including public toilets and changerooms; and, Playgrounds • Desirable: Tennis courts/hardstands; Aquatic centres; BMX tracks; Skateparks; Child health centres; Amphitheatres (parks); and, Parking areas http://www.wanneroo.wa.gov.au/files/cb0b456b-96b3-4fed-b418-9e2b00c1d6d4/PrefundingOfCommunityInfrastructure.pdf

LOCAL GOVERNMENT AREA POLICIES, PROGRAMS AND INITIATIVES (2 of 3)

Policy/Initiative/ Program	Summary and reference
City of Wanneroo – Sustainable Living Programs	Sustainable living initiatives include: <ul style="list-style-type: none"> • Adopt a Bushland: Environmental education program • Your eco-print: a set of online tools to help people measure how many resources they use households, workplaces and gardens. • Ecovision Display Homes: government supported initiative to showcase two sustainable homes in the Kestrels Estate. • Building and renovating sustainability: information resources http://www.wanneroo.wa.gov.au/Lifestyle/Sustainable_Living
City of Wanneroo – Community Programs	Community programs include: <ul style="list-style-type: none"> • Healthy communities program: The Healthy Communities program consists of 36 specialized physical activity sessions and healthy eating workshops that will encourage and support healthy lifestyle changes. • Community centres program: four centres provide community programs promote and provide all-inclusive programs to enable our community to connect, learn, develop skills and participate whilst improving their health and wellbeing. • GOLD (Growing Older Living Dangerously) is an activity based leisure lifestyle program that provides a range of exciting and challenging activities for people aged 50 years and over, living in the City of Wanneroo. http://www.wanneroo.wa.gov.au/Lifestyle/Community_Programs
City of Wanneroo – Disability Programs	Initiatives for people with disabilities: <ul style="list-style-type: none"> • SPORTSLINK : for children aged 7 – 16 with a disability, but good physical ability. http://www.wanneroo.wa.gov.au/Residents/Aged_and_Disability/Sportlink • Centre Based Day Centres: six centres for the functionally disabled, frail, aged and younger people with disabilities.
City of Wanneroo – Children’s Services	Parenting Place – one stop for parenting resources, information and support. http://www.wanneroo.wa.gov.au/Residents/Childrens_Services
City of Wanneroo Youth Programs	Youth programs supported and run by the city include: <ul style="list-style-type: none"> • Adopt a Bushland – environmental education program for primary school students aged 3 – 7 • Skate Parks and BMX Tracks – six skate parks and seven BMX tracks • Youth Activities and Facilities – seven community and/or youth centres with a range of programs for young people e.g., chill out, Game ON, GEMS, Just Jammin • YMCA Mobile Youth Bus http://www.wanneroo.wa.gov.au/Residents/Youth
Act, Belong, Commit	Act-Belong-Commit is a community-based health promotion campaign that encourages people to take action to improve their mental health and wellbeing. An Act-Belong-Commit partner is an organisation that works collaboratively http://www.actbelongcommit.org.au/ with Mentally Healthy WA or one of the project officers around the state to promote positive mental health. City of Wanneroo is a participating community. http://www.actbelongcommit.org.au/

LOCAL GOVERNMENT AREA POLICIES, PROGRAMS AND INITIATIVES (3 of 3)

Policy/Initiative/ Program	Summary and reference
Coortt Coolong Program Kurlangas Aboriginal Playgroups	The Coortt Coolong program is an Aboriginal early support service for families with children aged 0-3. The Kurlangas Aboriginal Playgroups (Balga, Banksia Grove and Merriwa) are for Aboriginal and Torres Strait Islander children between 0 and 5 years of age and their families. Fruit, juice and morning tea provided. http://patgilescentre.org.au/what-we-do/aboriginal-services/
Wanneroo Business Association	The WBA is now recognised as the premier business association representing business within the COW and a mature respected relationship exists between the WBA and the COW. http://www.wanneroobusiness.com/
Small business centre	The Small Business Centre North West Metro is a free service to new and established businesses. http://www.sbcnorthwestmetro.com.au/index.php
Online learning gateway	In 2008, the City of Wanneroo has developed an innovative online training gateway in conjunction with the Cyberinstitute. This is a highly flexible, cost effective way to ensure that you still up skill, but in the convenience of your own home/office and at a time that suits you! http://www.wanneroo.wa.gov.au/Business/Training_Development/Online_Learning
Wanneroo Community Men's Shed	http://www.wcmenshed.org/index2.html

