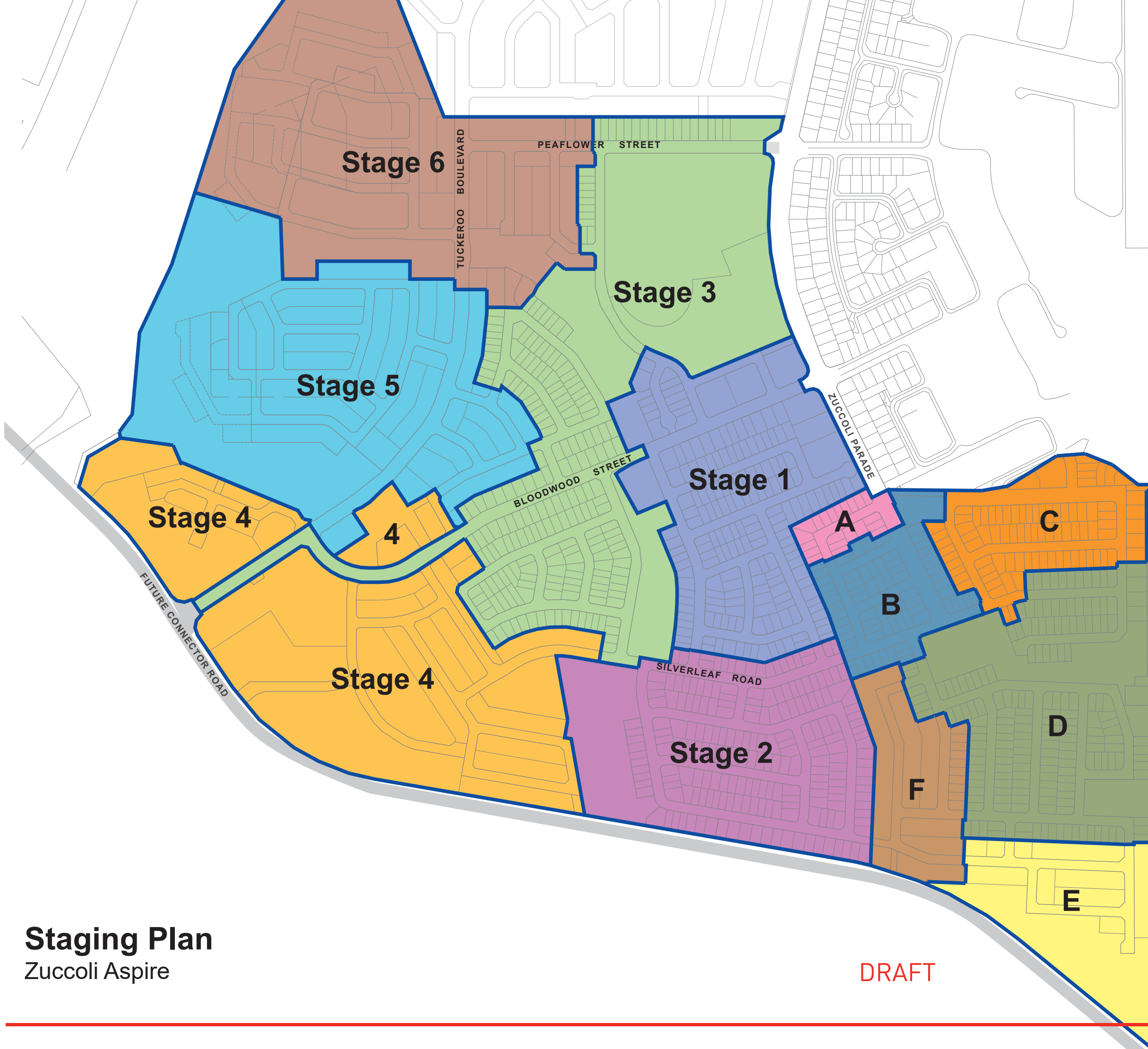




Staging Plan

Zuccoli Aspire

DRAFT

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Date: 26 April 2018

Scale: 1:6,000 @ A3 1:3,000 @ A1

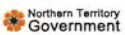
Drawing No. 716-358 CP-18 A



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Zuccoli



0 50 100 150 200 250m
Scale 1:2500

Date: July 21
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Drawing Name: Zuccoli Apple.dgn

Zuccoli Aspire Stage 5B

Zuccoli, Northern Territory

Engineering Services Report

Costojic Pty Ltd

7 November 2023

DOCUMENT VERIFICATION

Job Title **Zuccoli Aspire Stage 5B**

Job Number 20969

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Date	Document	Revision No.	Author	Reviewer
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APPROVAL FOR ISSUE

Authority	Name	Signature	Date
Author	Harris Davidson		7 November 2023
Reviewer	Jonathan Lanyon		7 November 2023

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APPENDICES

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Appendix B Bulk Earthworks Layout Plan
Appendix C Stage 5B Functional Layout Plan
Appendix D Traffic Impact Assessment, Traffic Impact Statement & Road Hierarchy Sketch
Appendix E Zuccoli Road Classification Assessment
Appendix F Zuccoli Aspire High Voltage Power Masterplan
Appendix G Stormwater 100 Year Flood Schematic

EXECUTIVE SUMMARY

ADG Engineers (Aust.) Pty Ltd was engaged by Costojic Pty Ltd to prepare an Engineering Services Report for Stage 5B of the Zuccoli Aspire subdivision. Zuccoli Aspire is a multi-staged subdivision located at the southern end of Zuccoli Parade within the Palmerston municipality. The development covers approximately 171 hectares and is broken into 12 stages. Stage 5B is located to the **central-western region** of the Zuccoli Aspire subdivision and comprises of multiple residential allotments and internal roads.

The proposed development can be adequately serviced by all essential infrastructure (roads, water, sewer, stormwater, power, and telecommunications) through the installation of new infrastructure and connection to existing infrastructure. The works discussed within this report are subject to detailed design and authority approval. The design of all infrastructure shall be completed in accordance with all relevant authority guidelines/standards. Detailed engineering documentation shall be submitted to and approved by all relevant authorities prior to commencement of works onsite.

1 INTRODUCTION

ADG Engineers (Aust.) Pty Ltd was engaged by Costojic Pty Ltd to prepare an Engineering Services Report for Stage 5B of the Zuccoli Aspire subdivision. Zuccoli Aspire is a multi-staged subdivision located at the southern end of Zuccoli Parade within the Palmerston municipality. The development covers approximately 171 hectares and is broken into 12 stages as shown in Figure 1; Stages 1-6 and Precincts A-F. Stage 5B, outlined in red in Figure 1, is 4.1 hectares, located in the central-western region of the Zuccoli Aspire subdivision between Stages 3D, 4D, 5A, 5C, 5D, and 6B, and comprises of the following:

- 52 residential allotments; and
- 5 internal roads.

Refer to Appendix A for the Stage 5B subdivision layout plan.



Figure 1 - Zuccoli Aspire Overall Yield Plan with Sub-Staging

2 BULK EARTHWORKS

A conceptual bulk earthworks design has been developed for Stage 5B and shall be refined during the detailed design of the stage. The earthworks strategy for the development was to follow the natural contours of the land with the intention of minimising the extent of cutting in rock while aiming to achieve a cut and fill balance for the overall Zuccoli Aspire development. The conceptual earthworks design has been developed in accordance with the Zuccoli Aspire Bulk Earthworks Masterplan Update by ADG Engineers (dated 28 September 2022) and the Northern Territory Subdivision Development Guidelines. The design ensures all allotments are graded to fall towards the road reserve along the allotment frontage. All disturbed areas shall be stabilised upon completion of the bulk earthworks activities. Refer to Appendix B for the conceptual bulk earthworks plans.

3 ROADWORKS & ACCESS

The proposed internal road network for Stage 5B consist of a combination of collector roads and local access roads. The internal road network is shown on the Functional Layout Plan in Appendix C and consists of

- Bridal Tree Street which is an extension from Stage 5A;
- Screwpalm Court which is an extension from Stage 5A;
- Tuckeroo Boulevard which is an extension from Stage 4D through 5B and into Stage 6B;
- Ivy Palm Street which is a new internal road; and
- Honeygem Circuit which will extend into Stage 5C and Stage 5D.

Formal access to Stage 5B is provided via connection to Tuckeroo Boulevard located in the southern boundary of the stage and via Stage 4D. Access can also be obtained through Screwpalm Court and Bridal Tree Street located in the eastern boundary of the stage and via Stage 5A.

The hierarchy of the internal road network has been assigned based on the Traffic Impact Assessment prepared by Flanagan Consulting Group (refer to Appendix D), the Zuccoli Aspire Masterplan Traffic Impact Statement prepared by ARCCOS (refer to Appendix D), the Zuccoli Road Classification Assessment report prepared by GHD (refer to Appendix E) and NT Subdivision Development Guidelines. It is noted that since the completion of the Traffic Impact Assessments, the NT Subdivision Development Guidelines have been introduced. The new guidelines differ from the previous City of Palmerston Development Guidelines in terms of road reserve definitions. Based on the information provided within the Traffic Impact Assessments and Table 5, Table 6 and Table 8 of the NT Subdivision Development Guidelines, the road reserve widths in Table 1 are proposed.

Table 1 - Proposed Road Reserve Widths

SDG Road Class	Road Reserve Width (m)	Carriageway Width (m)	Verge Width (m)	Typ. Max Annual Daily Traffic Volumes	Typ. Max. no. of allotments
Bridal Tree Street, Screwpalm Court, and Honeygem Circuit (Local Access)	16.0	7.0	2 x 4.5m	3,000	60
Ivypalm Street (Local Access)	18.0	7.0	2 x 5.5m	3,000	60
Tuckeroo Boulevard Local Access*	24.0*	11.6*	2 x 6.2m*	3,000	60

*Based on the traffic volume anticipated, Tuckeroo Boulevard is defined as Local Access under the NT Subdivision Development Guidelines. However, as this is an extension of an existing road, the existing road reserve is proposed to be maintained.

Based on the Traffic Impact Assessments and Road Classification Assessments, in accordance with the NT Subdivision Guidelines, Bridal Tree Street, Screwpalm Court, Honeygem Circuit, Ivypalm Street and Tuckeroo Boulevard are classed as Local Access roads. As Tuckeroo Boulevard is an existing road, it has been proposed that the existing road reserve be maintained as defined in Table 1 above.

The structural design of the road pavements shall be developed in accordance with the NT Subdivision Development Guidelines and the Austroads Guide to Road Design Part 2: Pavement Structural Design. The pavement designs shall be conducted based on the minimum design traffic defined within the City of Palmerston Development Guidelines and summarised in Table 2. CoP Development Guidelines standards have been adopted as the NT Subdivision Development Guidelines do not specify design traffic data for each road class.

Table 2 - Design Traffic

SDG Road Class	Residential Design Traffic (ESA)	Industrial Design Traffic (ESA)
Local Access (Bridal Tree Street, Screw palm Court, Honeygem Circuit, Ivypalm Street, and Lollybush Street)	5.0×10^4	8.0×10^5
Local Access* (Tuckeroo Boulevard)	5.0×10^5	2.0×10^6

*Based on the traffic volume anticipated, Tuckeroo Boulevard is defined as Local Access under the NT Subdivision Development Guidelines. However, under City of Palmerston Development Guidelines, the road is defined as a Primary Collector. As the road is an extension of the existing, the road pavement has been maintained in accordance with the City of Palmerston Development Guidelines.

4 STORMWATER DRAINAGE

The proposed stormwater drainage system for Stage 5B has been developed in accordance with the NT Subdivision Development Guidelines. The stormwater system has been designed to collect and discharge minor storm flows via an underground drainage network while the major storm system has been designed to convey flows via overland flow paths (within the road reserve and public open space) to the lawful point of discharge. The minor and major design storm events for the development are the 50% AEP and 1% AEP events, respectively. As per the Zuccoli Aspire Stormwater Masterplan Report Update completed by ADG Engineers (dated 28 February 2022), Stage 5B is part of Catchment 3.1. All stormwater runoff generated within Stage 5B shall ultimately discharge to Mitchell Creek via an existing ephemeral drainage line. Refer to the Functional Layout Plans in Appendix C for details regarding the proposed stormwater drainage network.

Initially lakes were proposed within the Zuccoli Aspire development are to provide both water quality treatment and flow mitigation. However, upon review of the Mitchell Creek Flood Study Modelling and Mapping reported prepared by Equatic (dated 15th of September 2009) and in accordance with the Zuccoli Aspire Stormwater Masterplan Update it was decided that, given the proximity to Mitchell Creek and the development being located within the bottom of the Mitchell Creek catchment, it is considered beneficial to release flows quickly rather than detaining them within the lakes and releasing flows with the peak of the Mitchell Creek catchment flows. As such, no detention measures are required for Catchment 2 and 3 which is where Stage 5B is located. Refer to the Zuccoli Aspire Stormwater Masterplan Report Update prepared by ADG Engineers dated 28 February 2022 (20696 C R017 Rev 06 28.02.2022) for details regarding the overall stormwater strategy for the Zuccoli Aspire development. ADG have completed 100-year flood modelling (Q100) as part of the stormwater drainage masterplan. The Q100 modelling demonstrates that overland flows during the Q100 storm event are contained within the road reserve network. Refer Appendix G for the 100 Year Flood Schematic drawing for Stage 5.

5 SEWER

A Sewer Masterplan has been developed for the Zuccoli Aspire subdivision. As part of the sewer masterplan development, network modelling was completed for the revised Zuccoli Aspire lot arrangement in 2023. The proposed masterplan has been developed in accordance with the Power and Water Corporation requirements. For further details regarding the development of the sewer masterplan, refer to the revised Zuccoli Aspire Sewer Masterplan (MC0004-DSG-RP-CIV-001) prepared by Muir Consulting dated 3 May 2023 which included the revised lot layouts for the Zuccoli Aspire Subdivision.

Stage 5B shall discharge sewage flows to the existing Zuccoli West Sewerage Pump Station (SPS). A preliminary sewer layout for Stage 5B has been developed based on the sewer masterplan and is shown on the Functional Layout Plans in Appendix C. Sewer reticulation mains and allotment connections shall be designed during the detailed design phase of the development in accordance with the Sewerage Code of Australia and Power and Water Corporation supplement to the Sewerage Code of Australia.

There has been no change in the number of lots since the development of the draft Zuccoli Aspire Sewer Masterplan completed by Muir Consulting dated 3 May 2023. As detailed in the report, whilst there has been increase in the overall load to the Zuccoli West SPS, upgrades to the impeller size in the pumps will enable the pump station to accommodate the additional flows. Refer to the revised Zuccoli Aspire Sewer Masterplan (MC0004-DSG-RP-CIV-001) prepared by Muir Consulting dated 3 May 2023 for further information.

6 WATER

A water masterplan has been developed for the Zuccoli Aspire subdivision. As part of the water masterplan development, network modelling was completed to assess the proposed water network regarding pressure and flow requirements and determine water main sizing. The proposed masterplan has been developed in accordance with the Power and Water Corporation requirements. For further details regarding the development of the water masterplan, refer to the Zuccoli Aspire Water and Sewer Masterplan Report dated 11 July 2018 (20696 C R002 Rev 03 11.07.2018) prepared by ADG Engineers for the current water masterplan.

A preliminary water layout for Stage 5B has been developed based on the Zuccoli Water and Sewer Masterplan by ADG Engineers dated 11 July 2018 and is shown on the Functional Layout Plans in Appendix C. The potable water reticulation networks and allotment connections will be refined during the detailed design phase of the development in accordance with the Water Supply Code of Australia and Power and Water Corporation supplement to the Water Supply Code of Australia.

Stage 5B shall connect to three mains to supply the development. This includes the existing DN450 main on Tuckeroo Boulevard, the proposed DN225 on Screwpalm Street (as part of Stage 5A) and a proposed DN150 on Bridal Street (as part of Stage 5A). It is expected that Stage 5B will be constructed prior to Stage 5A as Stage 5B contains infrastructure critical to the facilitation of Stage 5A. A series of new water service mains are proposed to be constructed as part of Stage 5B. This includes:

- A new trunk DN450 main on Tuckeroo Boulevard which extends from Stage 4D through the development to future Stage 6B;
- A DN225 from Screwpalm Street in Stage 5A which also travels south along Tuckeroo Boulevard to supply future Stage 5C; and
- A new series of DN150 mains along Tuckeroo Boulevard, Ivypalm Street, Bridal Tree Street and Honeygem Circuit. The new DN150 main on Tuckeroo Boulevard is for future Stage 6B whilst the new DN150 main on Honeygem Circuit is for future Stage 5C and 5D.

A preliminary water layout for Stage 5B has been developed based on the Water and Sewer Masterplan and is shown on the Functional Layout Plan in Appendix C. The potable water reticulation networks and allotment connections will be refined during the detailed design phase of the development in accordance with the Water Supply Code of Australia and Power and Water Corporation supplement to the Water Supply Code of Australia.

A comparison of the allotment yield and EP from the current Zuccoli Aspire water masterplan against the proposed allotment arrangement as per the proposed development plan is presented in Table 3. The EP for the stage has been determined using 3.5 EP per Single Dwelling (SD) allotment and 2.2 EP per 300m² for Multiple Dwelling (MD) as per Power Water Corporation standards.

A comparison of the EP and yield from the current water masterplan to the current allotment for Stage 5 has a slight overall reduction. As per the table below, there is sufficient capacity to accommodate the Stage 5 development for water demand based on the current Zuccoli Aspire water masterplan (Zuccoli Aspire Water and Sewer Masterplan Report dated 11 July 2018 (20696 C R002 Rev 03 11.07.2018)) prepared by ADG Engineers.

Table 3 - Allotment Yield Comparison

Stage	Masterplan Lot Yield	Masterplan EP	Current Lot Yield	Current EP
Stage 5 (Stage 5A, 5B, 5C, 5D & 5E)	239 SD + 21.05 units (MD) +0.538 ha (Commercial)	897.8	244 SD + 9.6 units (MD)	875.1

7 POWER & TELECOMMUNICATIONS

The design of the power and telecommunication networks shall be undertaken by Ashburner and Francis. The design of the electrical infrastructure shall be in accordance with the Power and Water Corporation requirements. The High Voltage (HV) electrical master plan has been developed by Aurecon and approved by Power and Water Corporation. Refer to Appendix F for the HV masterplan. The design of the street lighting shall be undertaken in accordance with the NT Subdivision Development Guidelines.

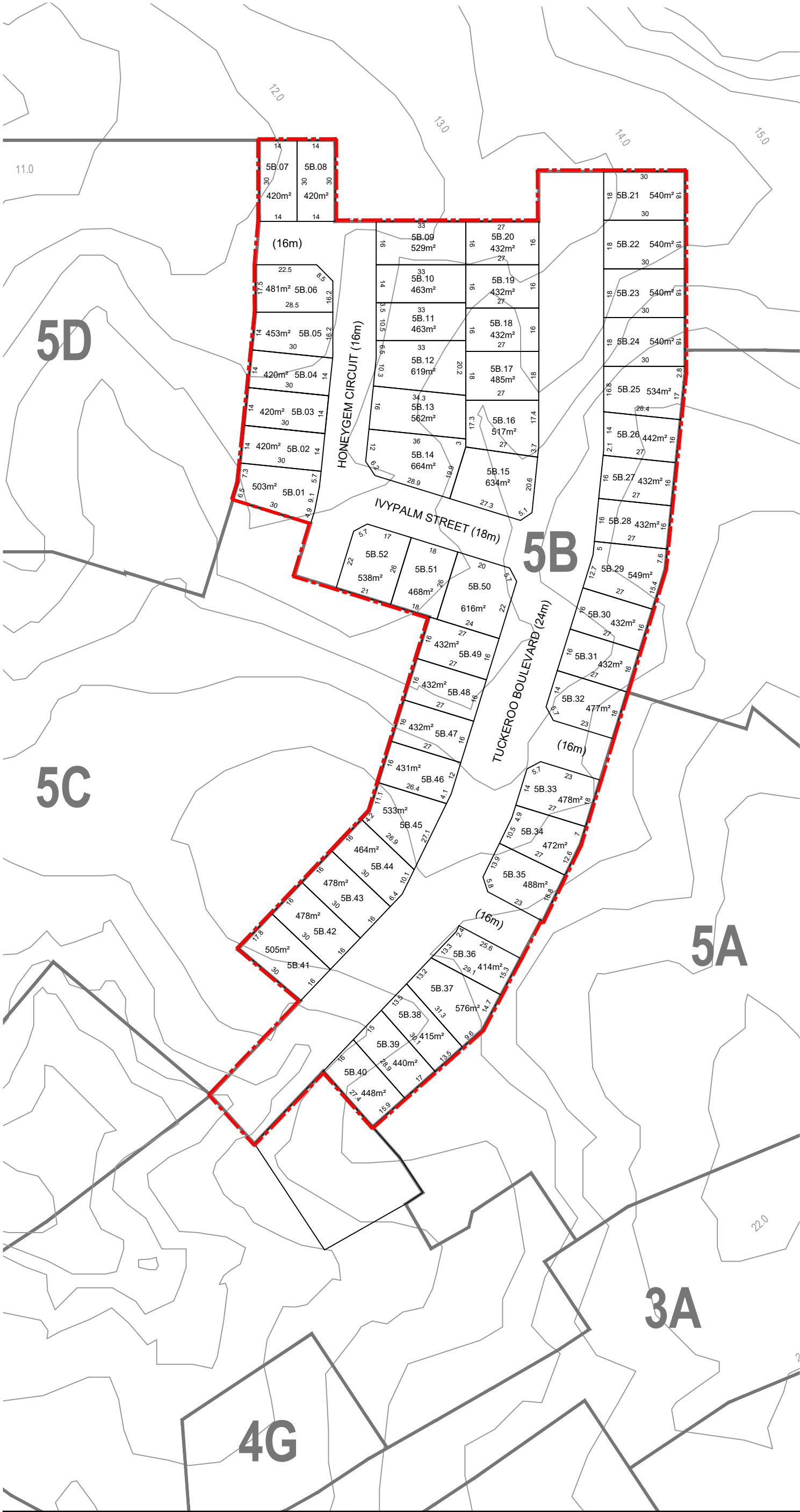
The Zuccoli area falls within the current NBN Co fibre footprint. Thus, NBN reticulation is to be installed throughout the proposed subdivision. The required telecommunications infrastructure for Zuccoli Aspire shall be provided in accordance with NBN Co standards.

8 CONCLUSION

ADG Engineers have undertaken an engineering services assessment for Stage 5B of the proposed Zuccoli Aspire subdivision. Stage 5B can be adequately serviced by all essential infrastructure through the installation of new infrastructure and connection to existing infrastructure. The works discussed within this report are subject to detailed design and authority approval. The design of all infrastructure shall be completed in accordance with all relevant authority guidelines/standards. Detailed engineering documentation shall be submitted to and approved by all relevant authorities prior to commencement of works onsite.

Appendix A

Stage 5B Subdivision Layout Plan



Legend

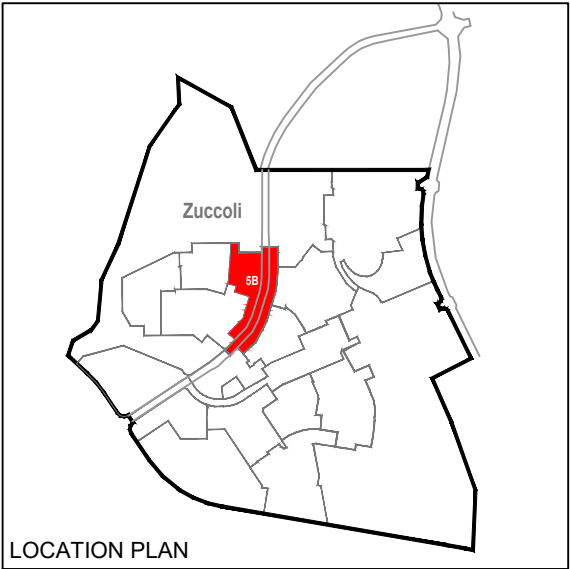
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- Existing Contours
- Proposed Lot Boundary
- Proposed Stage Boundary
- 5A Proposed Stage Number

Lot Summary - Stage 5A

Site Area	3.9738ha
Single Residential Lots	52

Single Dwelling Lot Summary

Average Area of Lots	485m²
Minimum Lot Area	414m²
Maximum Lot Area	664m²



Subdivision Plan

Zuccoli Aspire Stage 5B

Date: 6 Oct 2023 Scale: 1:1500 @ A3 1:750 @ A1 File: 716-358 SU05B Staff: AH GW Checked: AH



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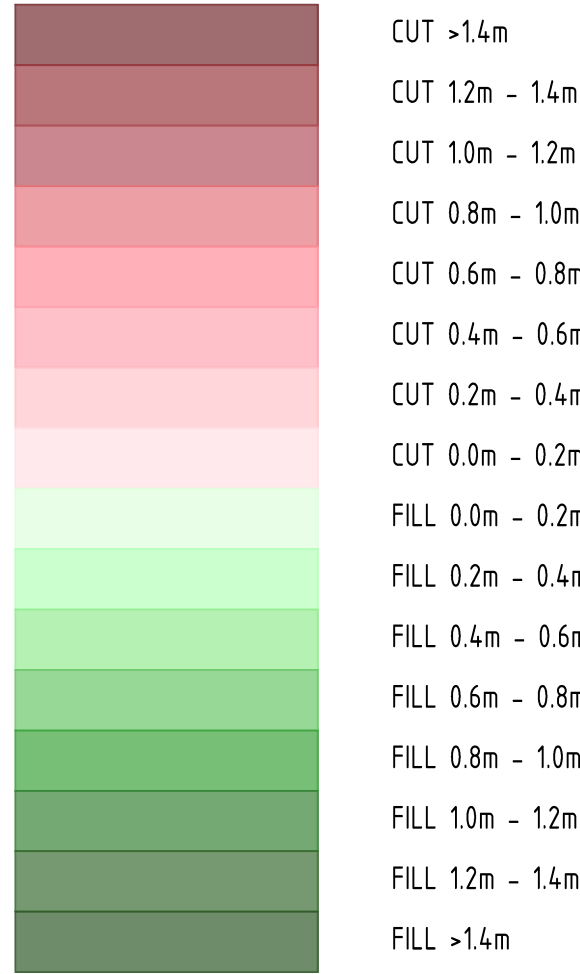
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Appendix B

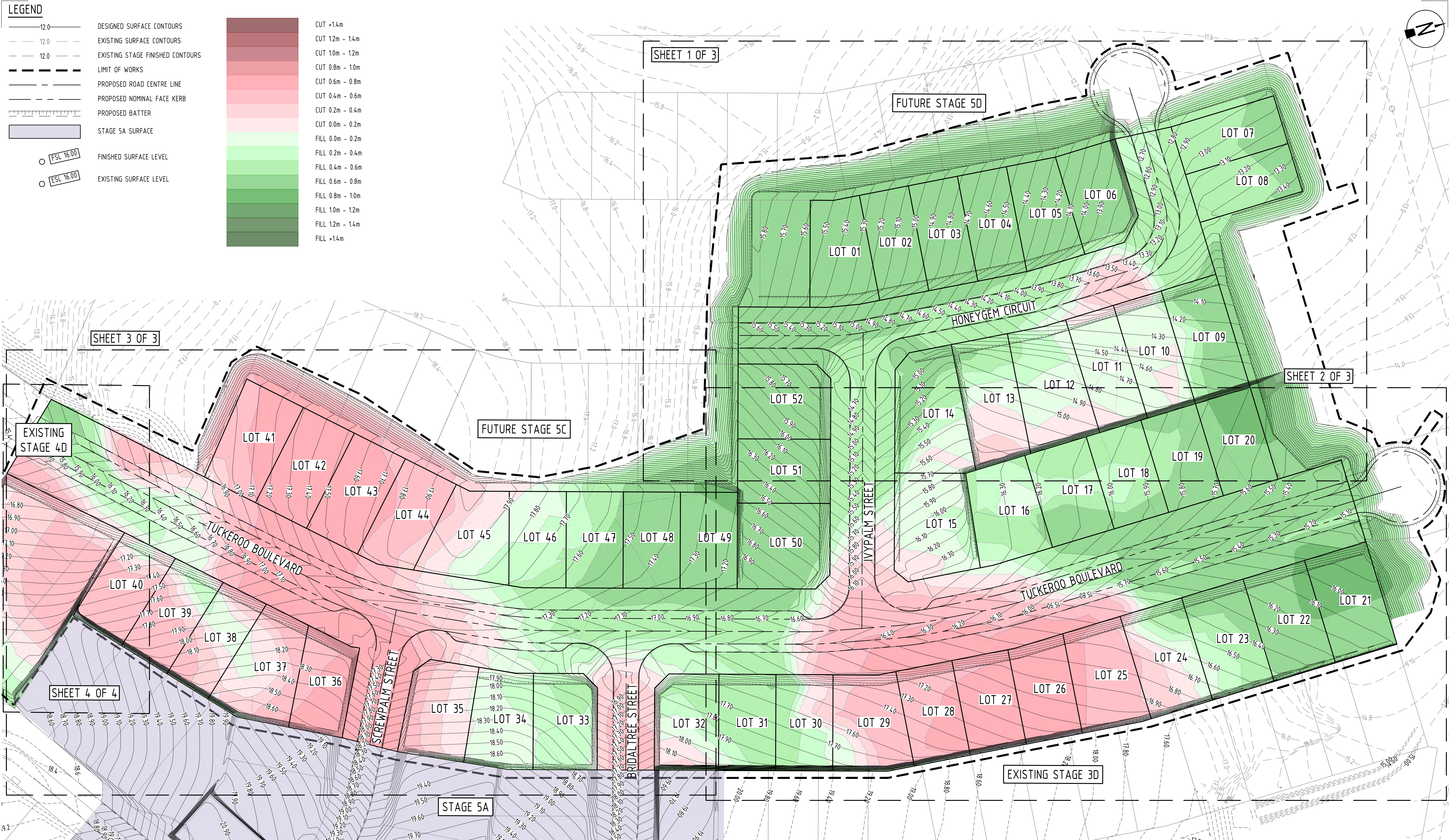
Bulk Earthworks Layout Plan

LEGEND

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- - - 12.0 - - - EXISTING SURFACE CONTOURS
- - - 12.0 - - - EXISTING STAGE FINISHED CONTOURS
- - - LIMIT OF WORKS
- - - PROPOSED ROAD CENTRE LINE
- - - PROPOSED NOMINAL FACE KERB
- - - PROPOSED BATTER
STAGE 5A SURFACE
○ FSL 16.00 FINISHED SURFACE LEVEL
○ ESL 16.00 EXISTING SURFACE LEVEL



- CUT >1.4m
CUT 1.2m - 1.4m
CUT 1.0m - 1.2m
CUT 0.8m - 1.0m
CUT 0.6m - 0.8m
CUT 0.4m - 0.6m
CUT 0.2m - 0.4m
CUT 0.0m - 0.2m
FILL 0.0m - 0.2m
FILL 0.2m - 0.4m
FILL 0.4m - 0.6m
FILL 0.6m - 0.8m
FILL 0.8m - 1.0m
FILL 1.0m - 1.2m
FILL 1.2m - 1.4m
FILL >1.4m



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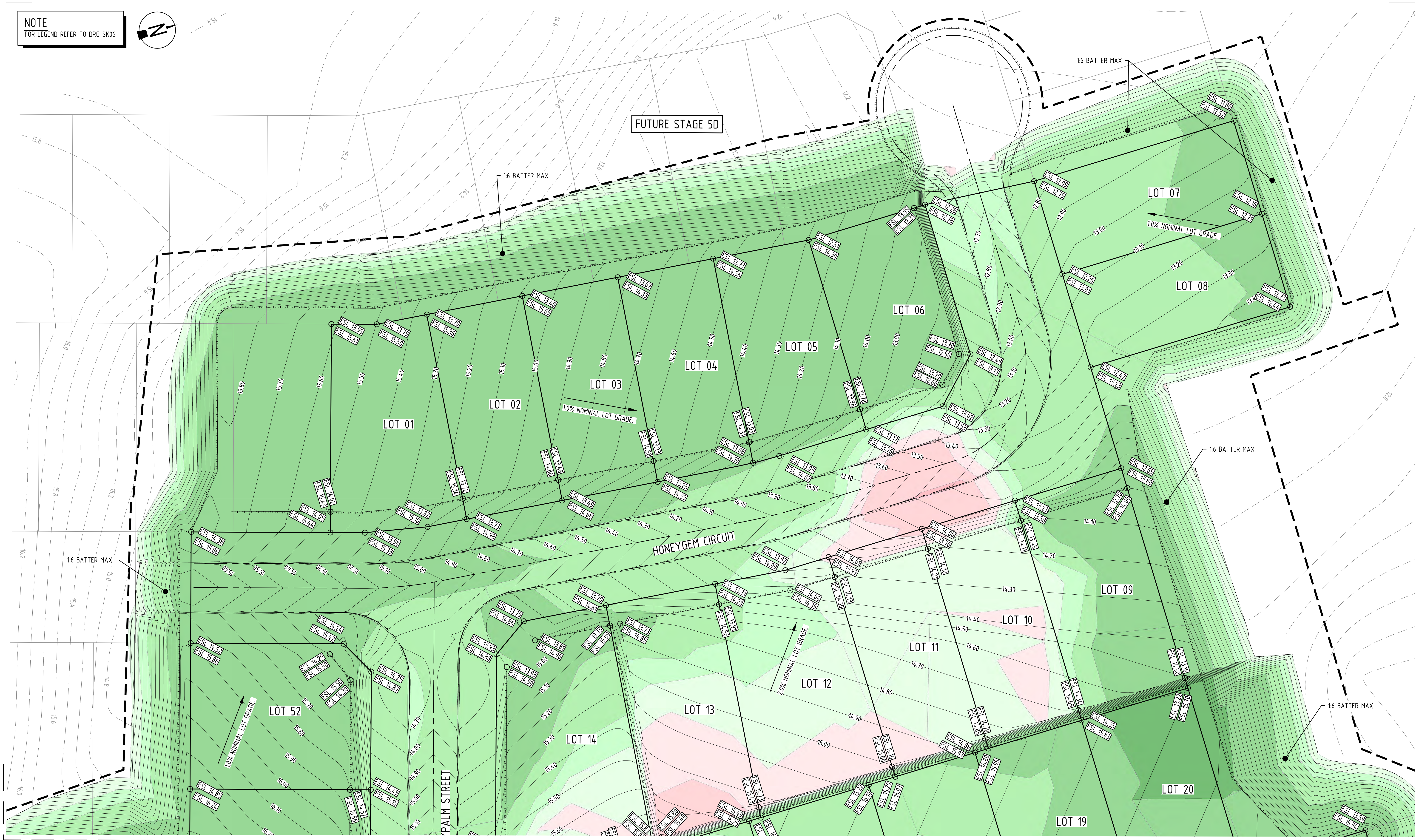
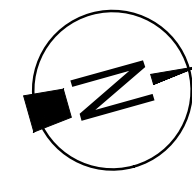
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	Project No. 20696_5B	Drawn By DL	Scale at A1 1:500
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			Revision A

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NOTE
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REFER DRG SK08 & SK09 FOR CONTINUATION

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Project Name:
ZUCCOLI ASPIRE
STAGE 5B
CIVIL WORKS

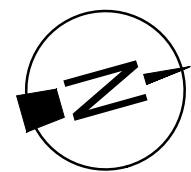
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Drawing No. SK07	Revision A

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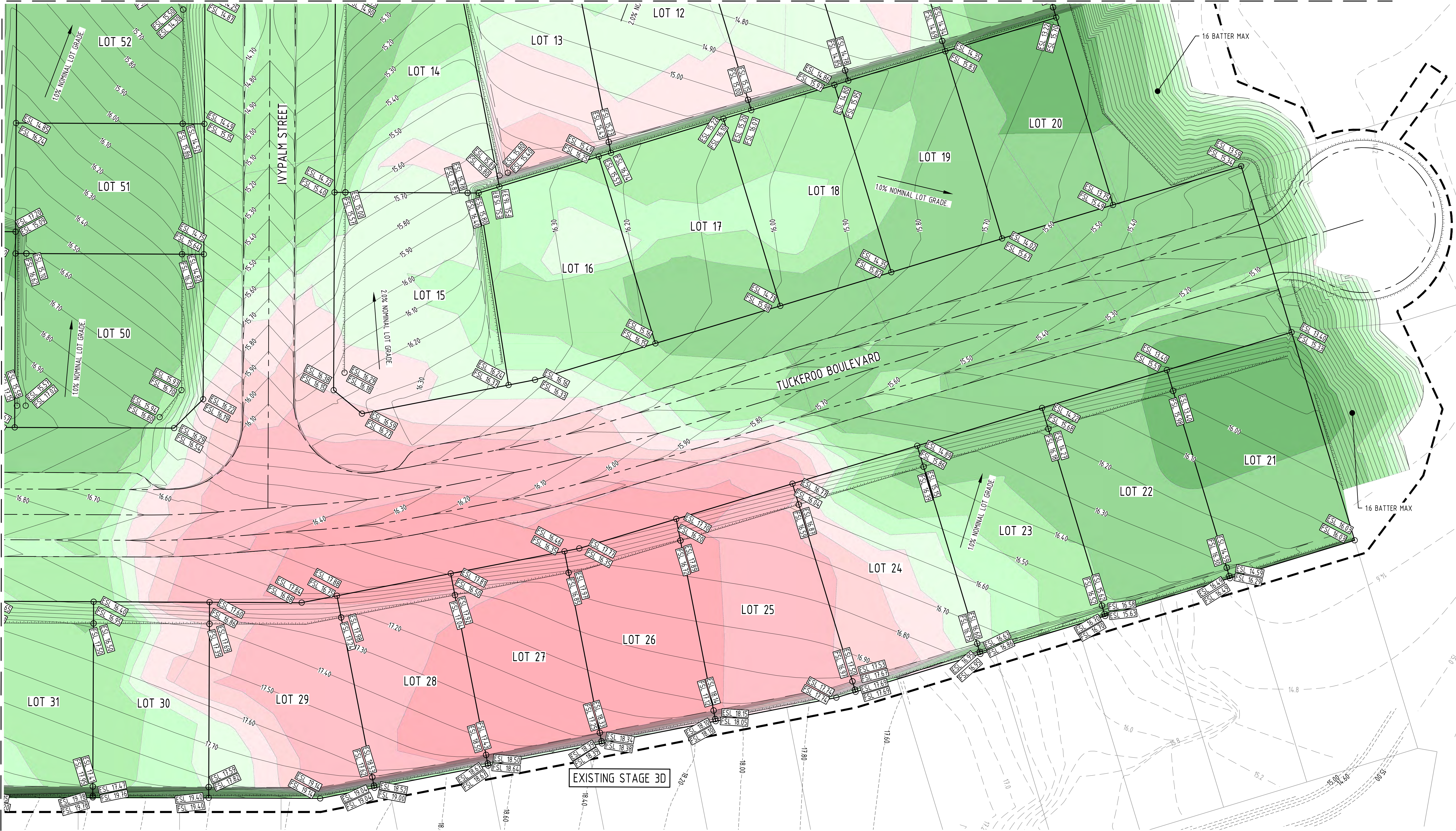
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REFER DRG SK07 FOR CONTINUATION

REFER DRG SK09 FOR CONTINUATION



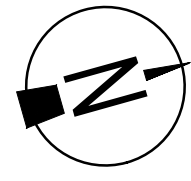
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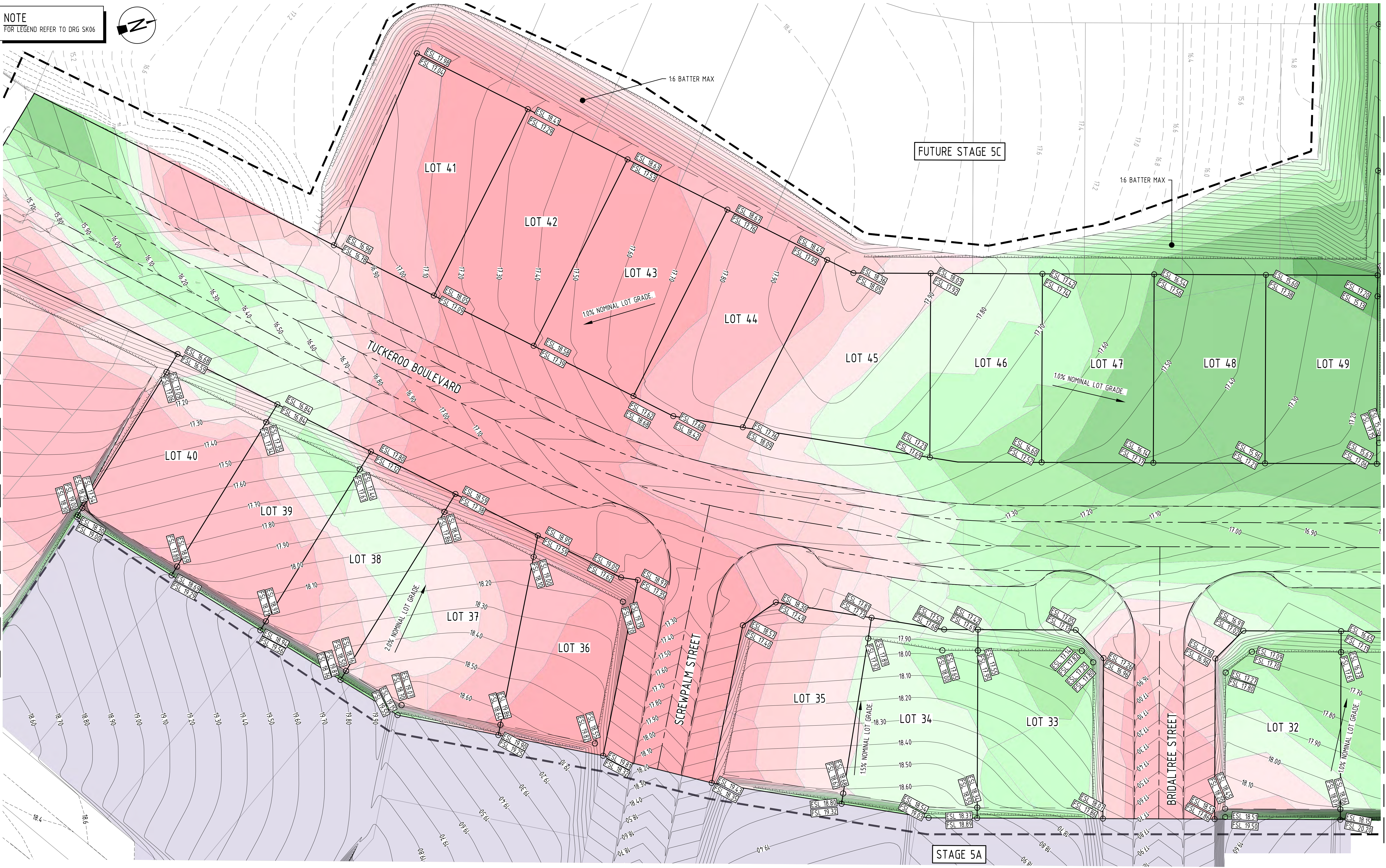


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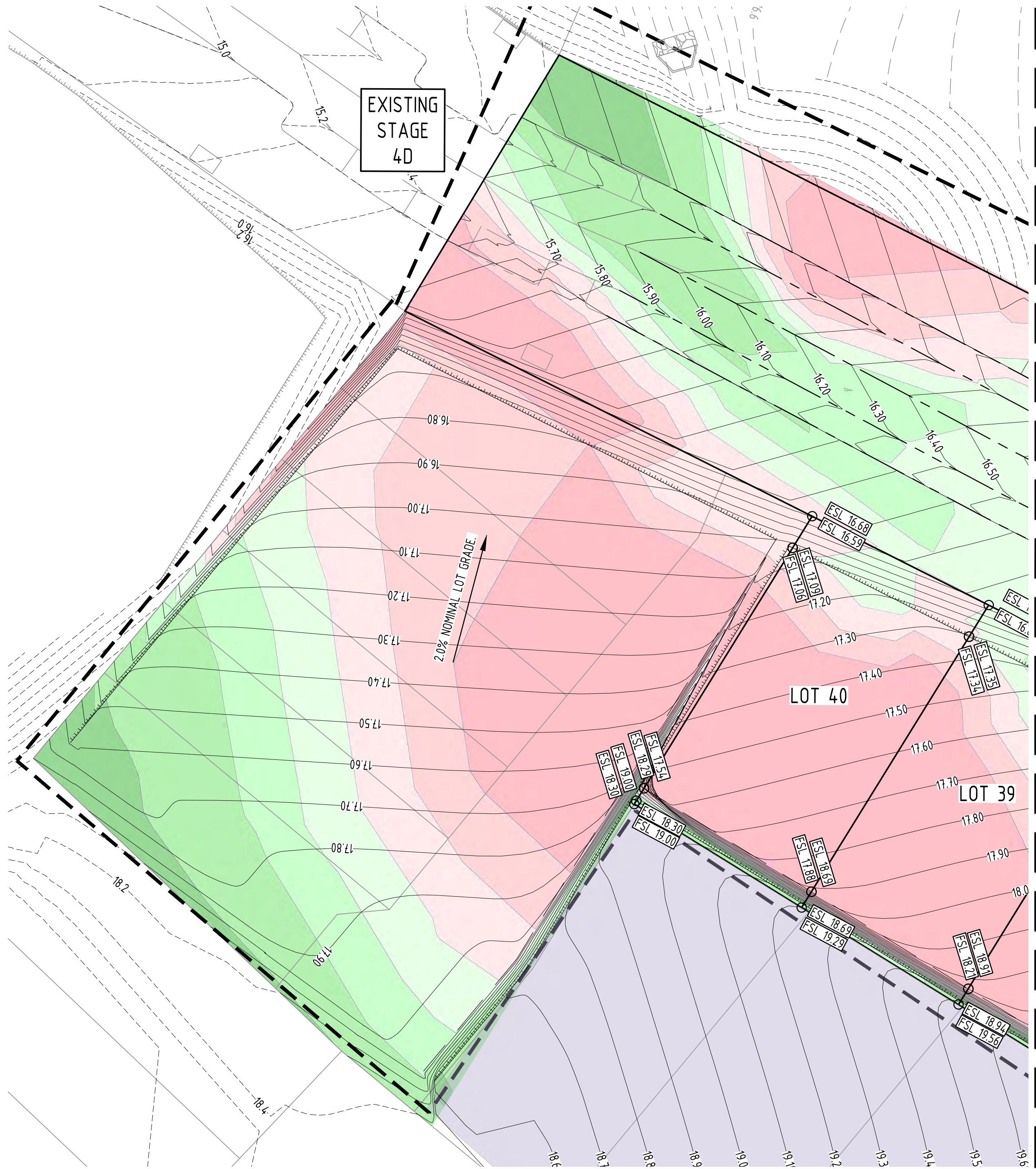
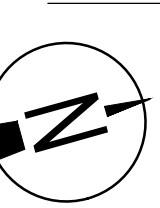
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Project Name: ZUCCOLI ASPIRE STAGE 5B CIVIL WORKS	Designed By: HD	Checked By: HD	Approved By: DG
	Project No.: 20696_5B	Drawn By: DL	Scale at A1: 1:250
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NOTE
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Appendix C

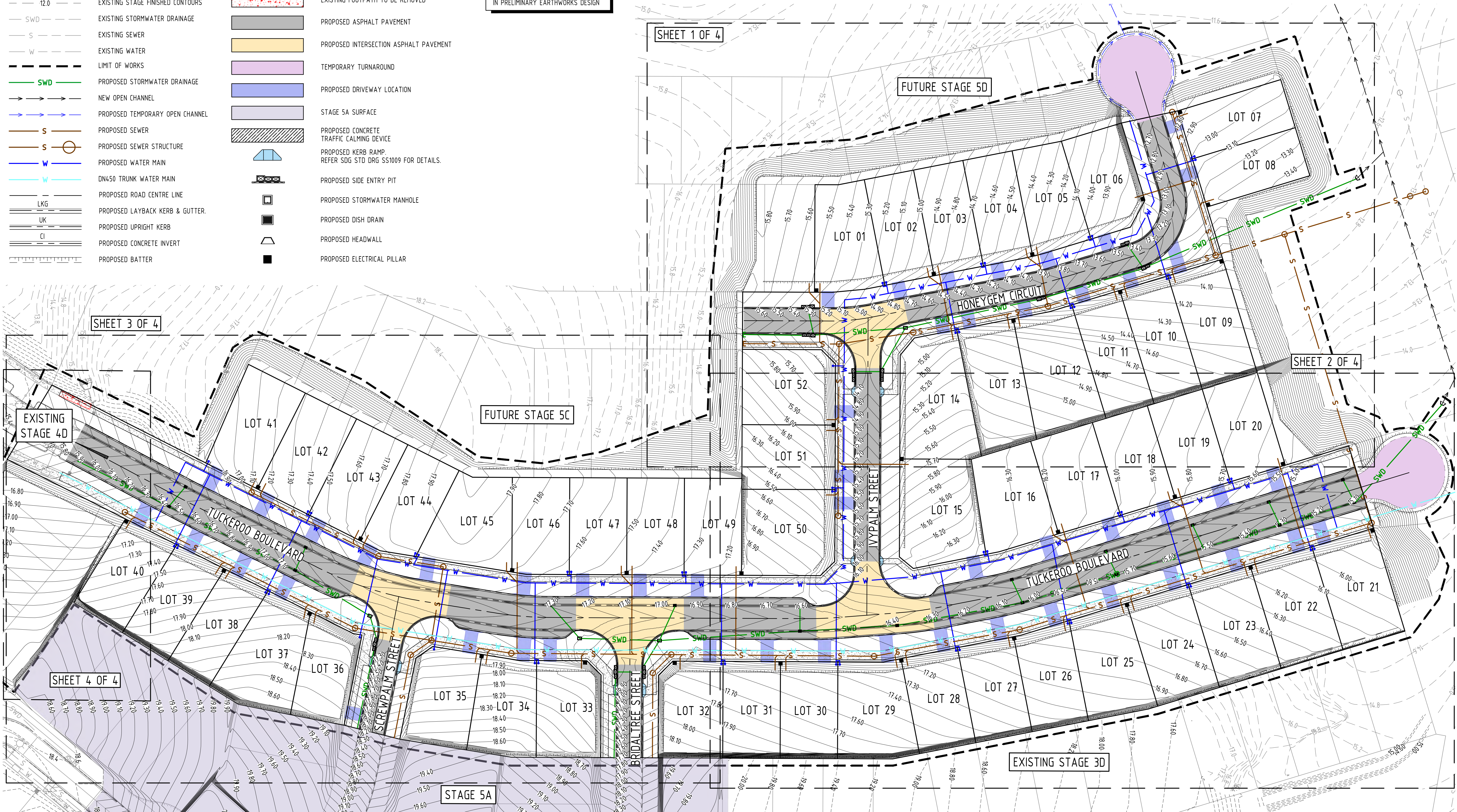
Stage 5B Functional Layout Plan

LEGEND

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12.0	EXISTING STAGE FINISHED CONTOURS		PROPOSED ASPHALT PAVEMENT
SWD	EXISTING STORMWATER DRAINAGE		PROPOSED INTERSECTION ASPHALT PAVEMENT
S	EXISTING SEWER		TEMPORARY TURNAROUND
W	EXISTING WATER		PROPOSED DRIVEWAY LOCATION
---	LIMIT OF WORKS		STAGE 5A SURFACE
SWD	PROPOSED STORMWATER DRAINAGE		PROPOSED CONCRETE TRAFFIC CALMING DEVICE
→	NEW OPEN CHANNEL		PROPOSED KERB RAMP REFER SDG STD DRG SS1009 FOR DETAILS.
→	PROPOSED TEMPORARY OPEN CHANNEL		PROPOSED SIDE ENTRY PIT
S	PROPOSED SEWER		PROPOSED STORMWATER MANHOLE
S	PROPOSED SEWER STRUCTURE		PROPOSED DISH DRAIN
W	PROPOSED WATER MAIN		PROPOSED HEADWALL
W	DN450 TRUNK WATER MAIN		PROPOSED ELECTRICAL PILLAR
LKG	PROPOSED ROAD CENTRE LINE		
UK	PROPOSED LAYBACK KERB & GUTTER		
CI	PROPOSED UPRIGHT KERB		
	PROPOSED CONCRETE INVERT		
	PROPOSED BATTER		

NOTE

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Rev	Date	Description	By	Chk
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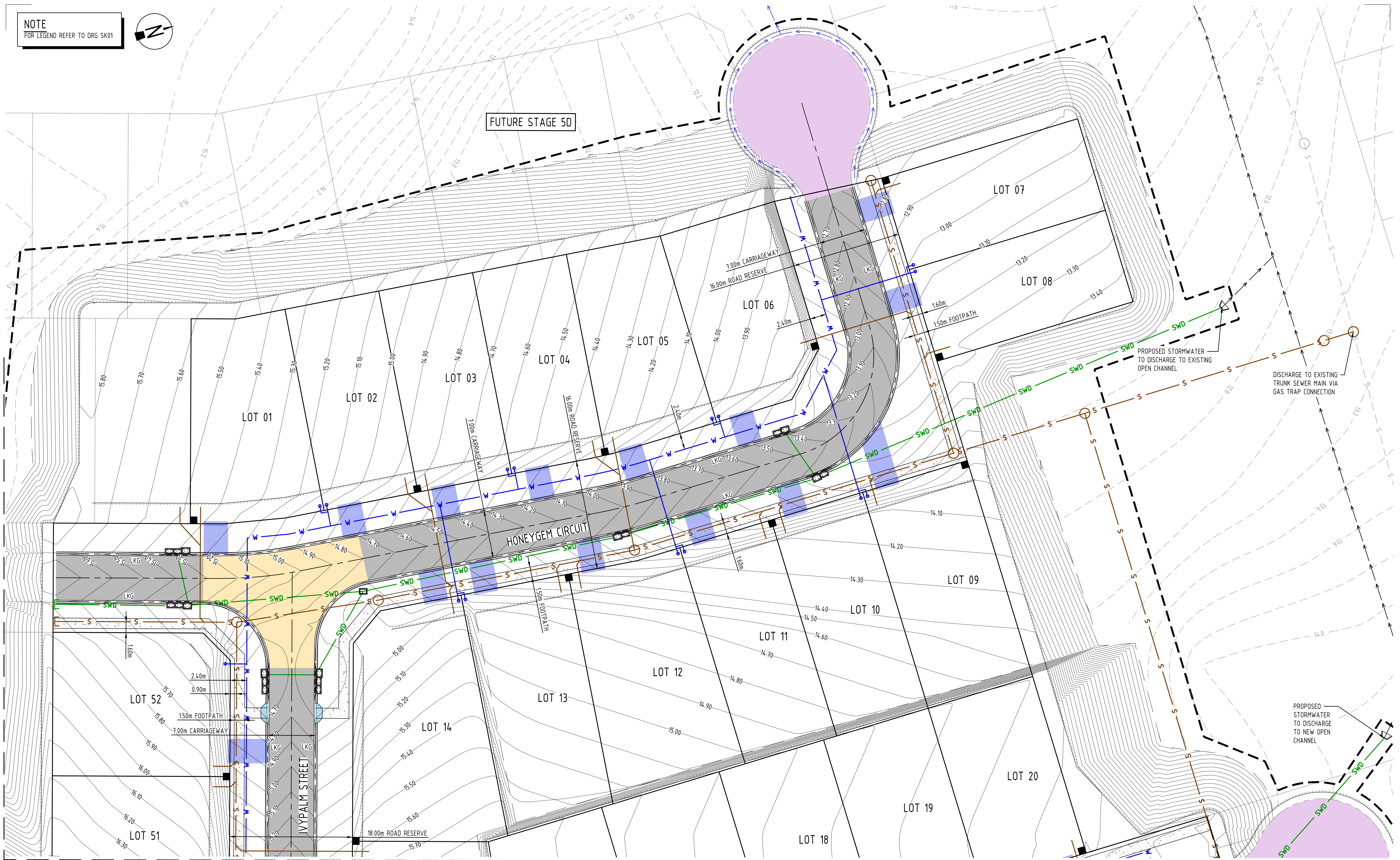
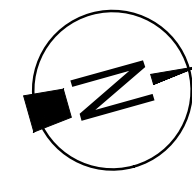
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Client COSTOJIC PTY LTD	Discipline CIVIL	Status INFORMATION	Title FUNCTIONAL LAYOUT PLAN OVERALL LAYOUT PLAN
Project Name ZUCCOLI ASPIRE STAGE 5B CIVIL WORKS	Designed By HD	Checked By HD	Approved By DG
	Project No. 20696_5B	Drawn By DL	Scale at A1 1:500
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COSTOJIC PTY LTD
Project Name:
ZUCCOLI ASPIRE
STAGE 5B
CIVIL WORKS

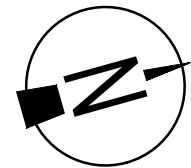
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Drawing No. SK02	Revision A

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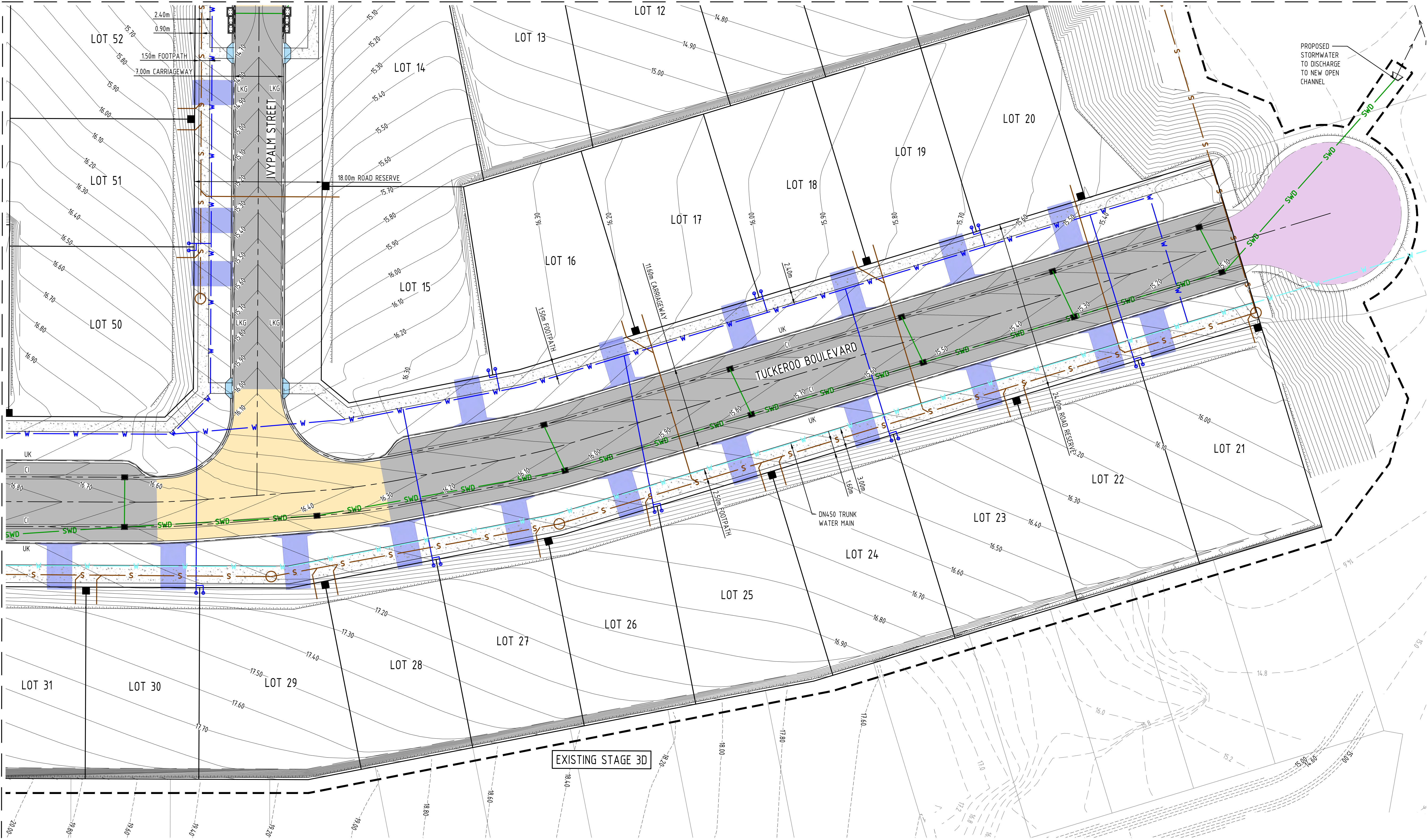
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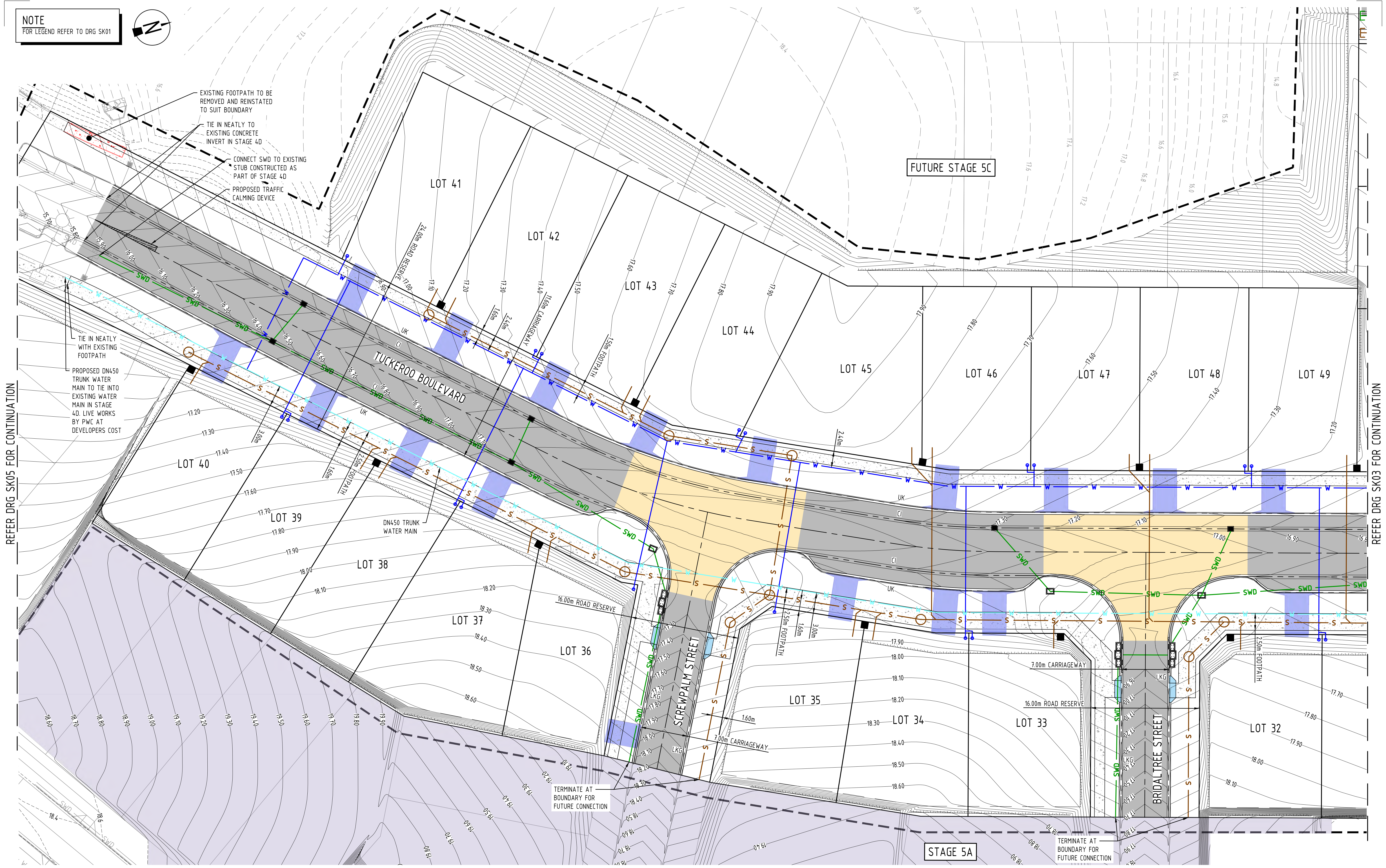
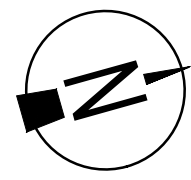


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Project Name:
ZUCCOLI ASPIRE
STAGE 5B
CIVIL WORKS

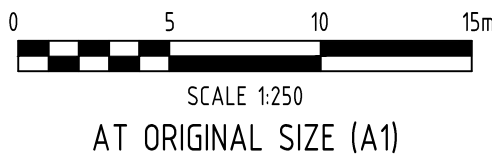
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Drawing No. SK03	Revision A

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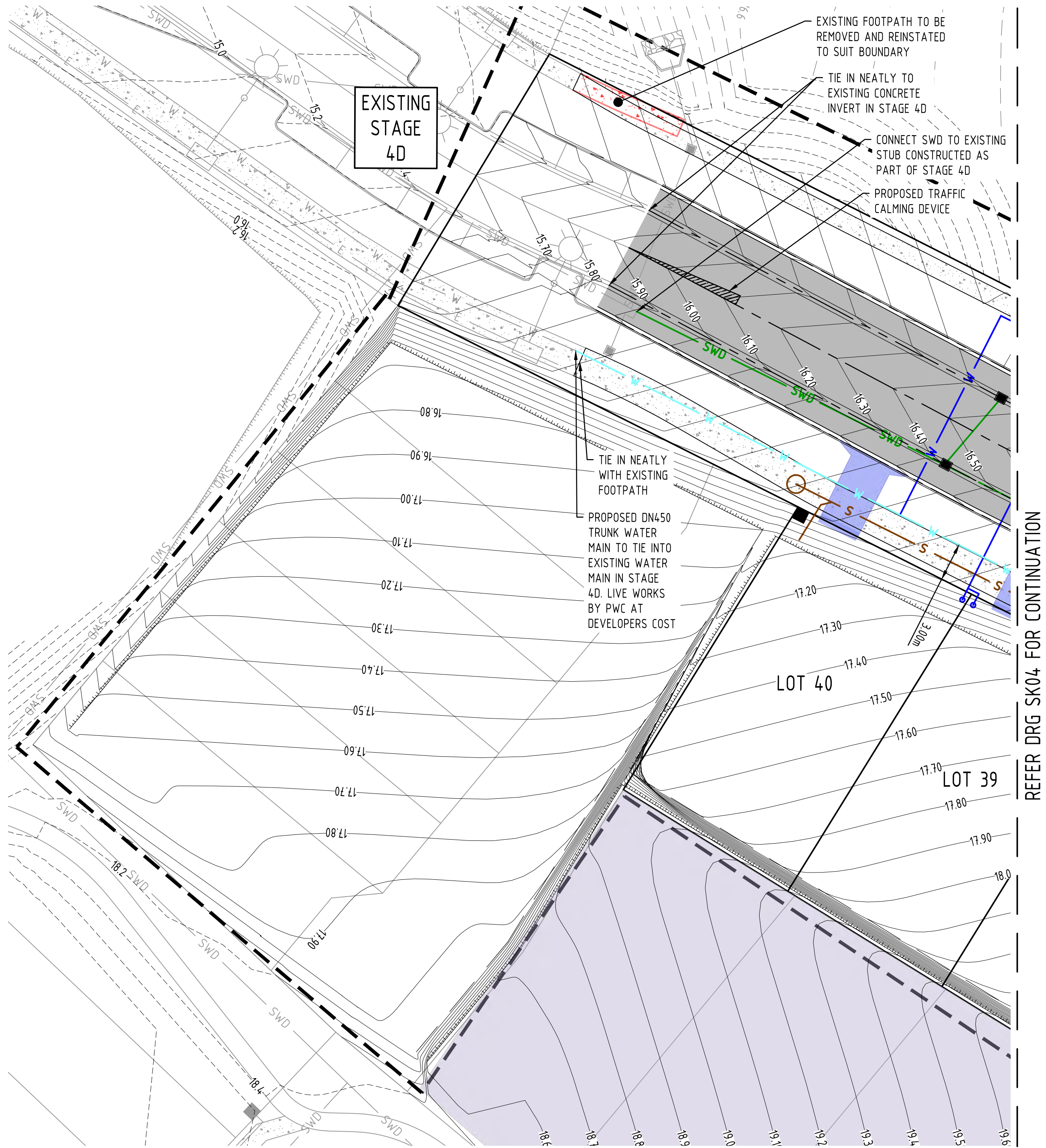
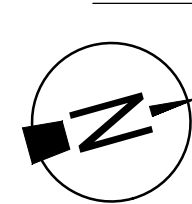
Client: COSTOJIC PTY LTD
Project Name: ZUCCOLI ASPIRE
STAGE 5B
CIVIL WORKS

Discipline		Status	
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Project Name ZUCCOLI ASPIRE STAGE 5B CIVIL WORKS	Designed By HD Checked By HD Project No. 20696_5B Drawn By DL	Approved By DG Scale at A1 1:250	Drawing No. SK05 Revision A

Appendix D

Traffic Impact Assessment, Traffic Impact Statement & Road Hierarchy Sketch

10/3/2023
Louise Human
Costojic Pty Ltd
PO Box 2014
Darwin, NT 0801

ZUCCOLI ASPIRE MASTERPLAN– TRAFFIC IMPACT STATEMENT

This letter provides a summary of the likely traffic impacts resulting from proposed changes to the Zuccoli Aspire masterplan. There has been a shift in the overall development yield due to the alteration in land usage from MR and MD to SD and also from overall development expansion.

The proposed masterplan is shown in Figure 1 below.

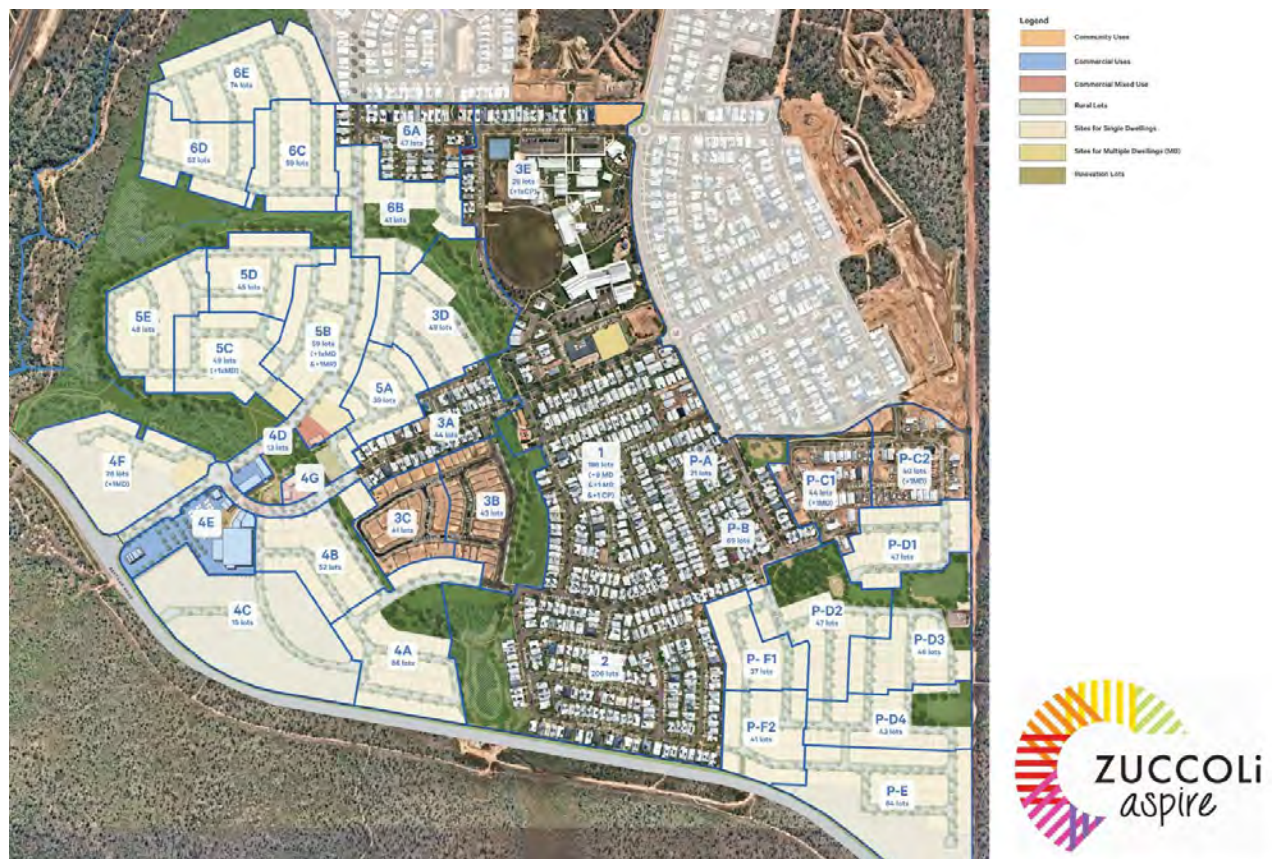


Figure 1 Zuccoli Aspire Stages Masterplan

Background

Flannagan Consulting conducted the initial Traffic Impact Assessment (TIA) report, dated November 30, 2016, titled "Traffic Impact Assessment Report Zuccoli Aspire Stages 3 to 5." The assessment evaluated the impact of the proposed development and associated transportation issues in the Zuccoli Aspire area. The objective of this review is to assess the changes made to the land use and evaluate their impact on the traffic flow of the surrounding road network.

Access

The new masterplan has modified certain aspects of the internal road layout, but the access to the arterial road network remains unaltered.

These changes include a slight alignment and road extension in 4C, and a complete reconfiguration of internal roads in 4B, 5E, 5C 6C, 6D, and 6E. These modifications involve altering the road layout, as well as adding or removing sections of roadway to better serve the needs of the area. Figures 2, 3, 4 and 5 provide a side-by-side comparison of the previous and new masterplan. The lots in stages 4F and 4C are proposed to change their land use from rural to single dwelling lots.



Figure 2 Stage 4C and 4B Internal Road Changes (Previous Masterplan on Left, Proposed on Right)



Figure 3 Stage 5E and 5C Internal Road Changes (Previous Masterplan on Left, Proposed on Right)

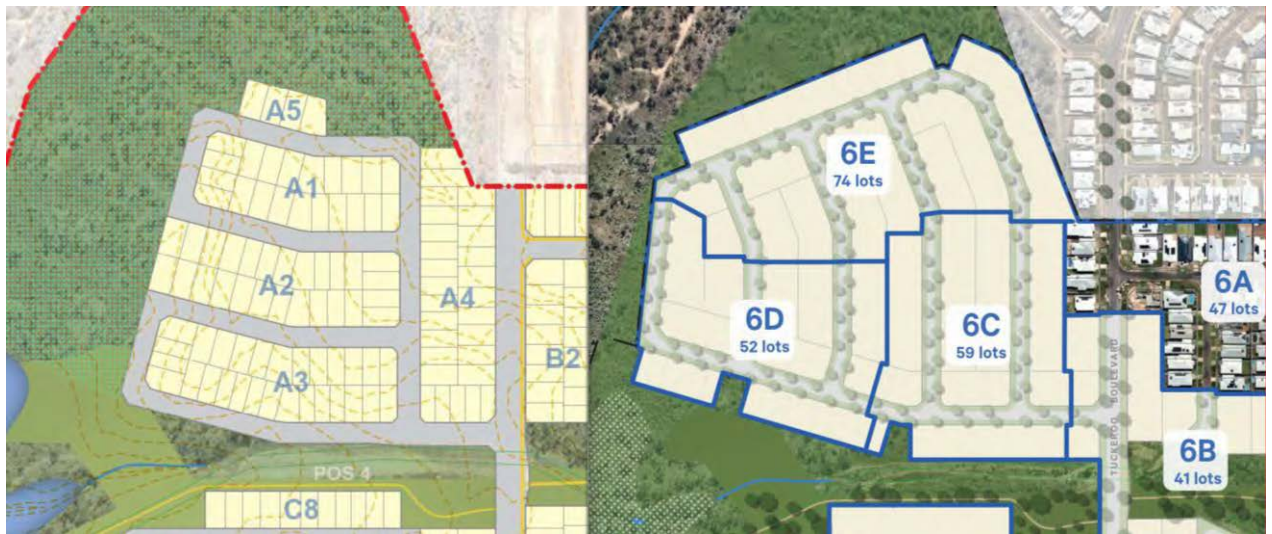


Figure 4 6C, 6D and 6E Internal Road Changes (Previous Masterplan on Left, Proposed on Right)



Figure 5 P-F1, P-F2, P-D1, P-D2, P- D3 and P- D4 Internal Road Changes (Previous Masterplan on Left, Proposed on Right)

Traffic Generation

This assessment has employed the same methodology as the previous TIA with regards to traffic generation and modeling.

Table 1 has been sourced from the previous TIA, as indicated on page 8 of the report. The table has been updated with the proposed development yield to show the differences between the

previous analysis and the current one. This revised table offers a comprehensive comparison between the projected traffic generation from the proposed development prior to and following the proposed alterations.

Table 1 Identified Lot Yield / Land Use Comparison

	Land Use						
	Single Dwelling SD	Med Density Res MR	Multiple Dwelling MD	Rural Res (RR)	Commercial /Retail	Service Station	School/ Child Care
Unit	Dwellings	Dwellings	Dwellings	Dwellings	m ²	m ²	Students
Previous Masterplan	1557	148	142	26	9500	3600	1160
Proposed Masterplan	1711	2	13	26	9000	3525	1160
Difference	154	-146	-129	0	-500	-75	0

The trip generation rates adopted for the current assessment are the same as those used in the previous TIA report, which are listed below:

- SD: 9 trips/dwelling
- MR: 5 trips/dwelling
- MD: 6.5 trips/dwelling
- RR: 9 trips/dwelling
- Commercial: 10 trips/100m² GFA
- Service Station: 6 trips/100m² GFA
- School/Day Care: 1.38 trips/Student

Based on the proposed development yield in Table 1 and the adopted trip generation rates, the total daily traffic generation by Zuccoli Aspire Stages 3-5 has been estimated to be approximately 20,343 trips. This total daily traffic generation is expected to be composed of the following composition of daily trips by land use:

- Dwellings: 15,728
- Commercial: 900
- Service Station: 2115
- School/Day Care: 1601

Table 2 Traffic Generation Comparison

	Land Use						
	Single Dwelling SD	Med Density Res MR	Multiple Dwelling MD	Rural Res (RR)	Commercial /Retail	Service Station	School/ Child Care
Previous Masterplan Traffic Generation	14,013	740	923	234	950	2,160	1,601
Proposed Masterplan Traffic Generation	15,399	10	85	234	900	2,115	1,601
<i>Difference</i>	1,386	-730	-839	0	-50	-45	0

Using the same discount methodology as the previous report to account for trips internal to the subdivision, the estimated total daily trips generated by the new masterplan is 17,285vpd, which is slightly lower than the previous plan's 17,721vpd.

Traffic Impacts

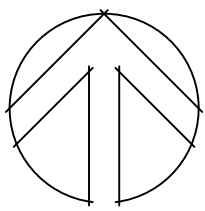
The modifications to the internal road network are not anticipated to have a substantial impact on traffic patterns, and the intersections to the arterial road network will remain unaltered.

The proposed new masterplan for Zuccoli Aspire is projected to produce less traffic overall than what was originally estimated in the previously approved TIA. The reduction in traffic is not expected to have a significant impact on traffic flow and safety on surrounding routes beyond what was previously considered and is unlikely to compromise the safe movement of vehicles. Furthermore, the anticipated effects on NTG controlled roads are expected to be less significant than what was previously indicated in the approved TIA. Therefore, based on the modelling it appears that the proposed changes can be implemented without compromising the safe movement of vehicles and without causing significant disruptions to the surrounding transportation network.

Sincerely,



Pero Peric
Road Safety Specialist
Arccos Consulting



ROAD HIERARCHY LEGEND		
Legend	Road Hierarchy - CoP Guidelines 2015	Road Hierarchy - NT SDG 2020
	Sub Arterial 21m Road Reserve 11m Carriageway >3,000 vpd	Secondary Collector 21.6m Road Reserve 7m Carriageway 5,000 vpd
	Primary Collector 21m Road Reserve 11m Carriageway 3,000 vpd	Local Access 16m Road Reserve 7m Carriageway 3,000 vpd
	Secondary Collector 18m Road Reserve 8m Carriageway 2,500 vpd	
	Local Access 16m Road Reserve 7m Carriageway 1,000 vpd	
	Minor Road 16m Road Reserve 7m Carriageway 150 vpd	Minor Street / Cul-de-sac 15m Road Reserve 6m Carriageway 1,500 vpd
	Minor Road 15m Road Reserve 6m Carriageway 150 vpd	

- LEGEND
- Site Boundary
 - Community Uses
 - Single Dwelling
 - Multiple Dwelling (MD)
 - Multiple Dwelling (MR)
 - Rural Residential
 - Town Centre Location
 - Public Open Space
 - Drainage/Public Open Space



TRAFFIC IMPACT ASSESSMENT REPORT

ZUCCOLI ASPIRE STAGES 3 TO 5

COSTOJIC PTY LTD

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APPENDIX B – TRIP CALCULATION AND DISTRIBUTION

APPENDIX C –SKETCH SK04 : ZUCCOLI ASPIRE ROAD HIERARCHY

APPENDIX D - “Pedestrian Gap Acceptance at Mid Block Crossings” (Yannis, Papadimitriou and Theofilatos 2010)

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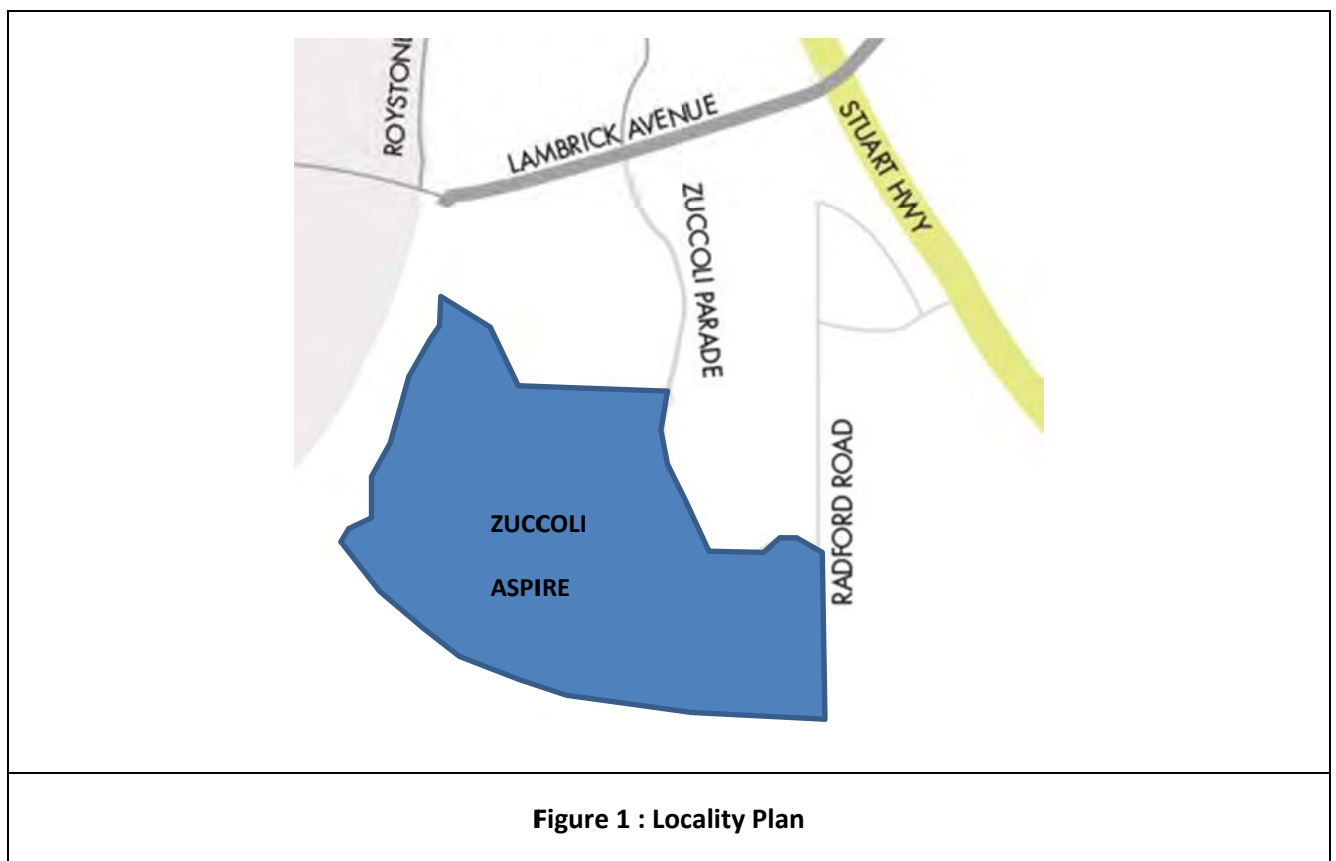
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1.0 INTRODUCTION AND BACKGROUND

Costojic Pty Ltd has been successful in securing the development rights for Zuccoli Stages 3 to 5, situated in Palmerston, Northern Territory. Zuccoli forms part of the strategy by the Northern Territory Government in releasing land for residential development across the Territory to assist with meeting housing demands. Zuccoli is the largest suburb to be developed in the Palmerston East residential growth corridor. At more than 400 hectares, the entire suburb of Zuccoli will deliver more than 2000 homes upon completion.

Zuccoli Stages 3 to 5, referred to as “Zuccoli Aspire” will comprise primarily of single dwelling lots with a small mix of medium density residential, multiple dwellings, rural residential lots, a town centre and service station and 2 schools with associated child care facilities.

Figure 1 illustrates the location of the Zuccoli Aspire precinct with respect to the broader Zuccoli development and proximity to adjacent transport routes.



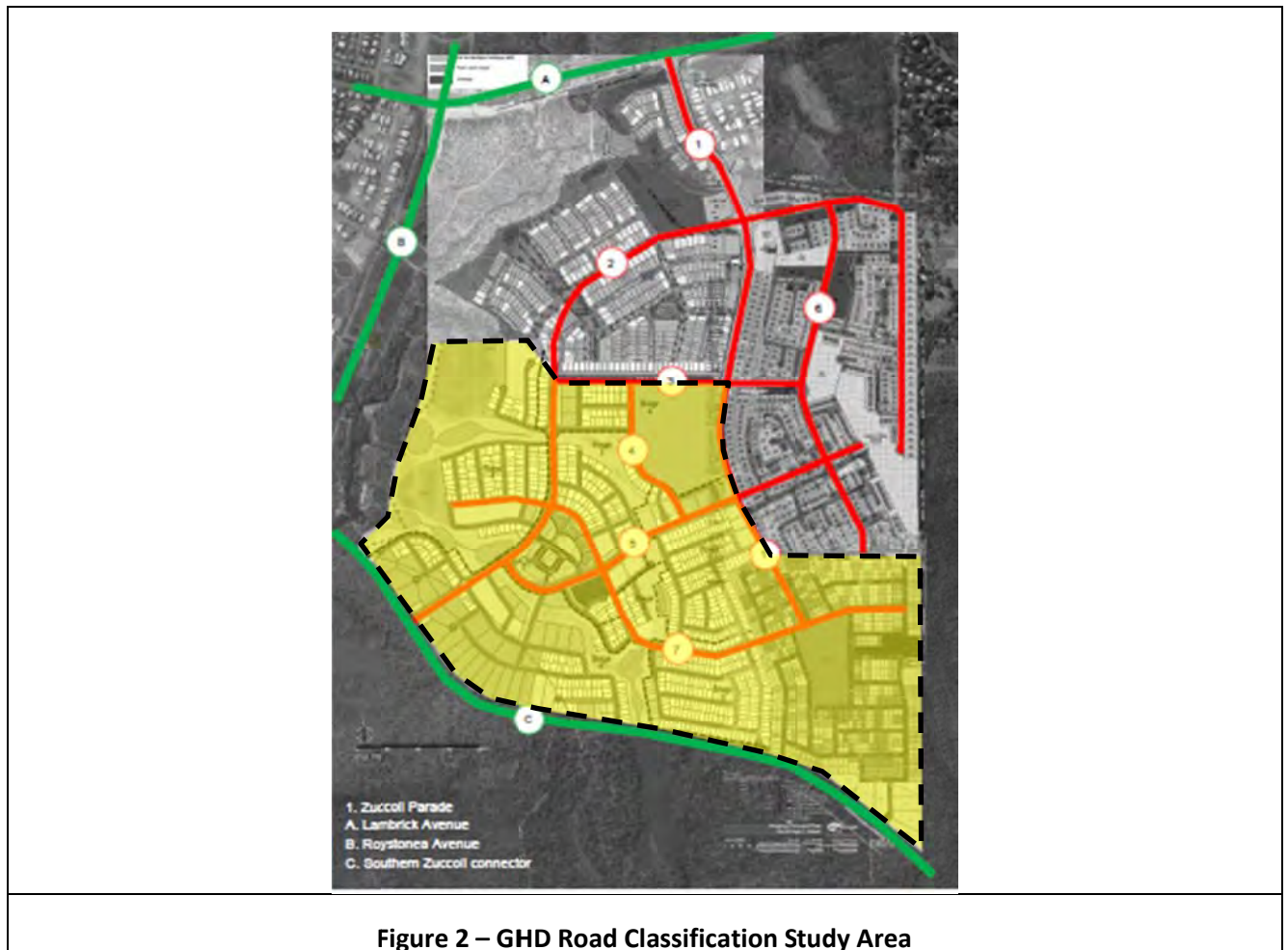
To support the development application for Zuccoli Aspire, Costojic have commissioned Flanagan Consulting Group to prepare this Traffic Impact Assessment Report. This report will consider the following traffic and transport related aspects of the development:

- Traffic Generation and Distribution onto the network
- Road Hierarchy
- Intersection Treatments
- Public Transport Routes
- Active Transport Provisions
- Parking Requirements

2.0 NETWORK PLANNING AND FEATURES

In the context of Traffic and Transport Planning for the entire Zuccoli development, GHD were commissioned by the NT Government to prepare a Road Classification Assessment report which defined the anticipated development yields for Zuccoli and the associated traffic generation and supporting road hierarchy. In September 2015, GHD released a second addendum to the report which responded to ongoing changes to the development yields that were emerging for Zuccoli.

Figure 2 illustrates the extents of the GHD study area, and the assumed development layouts, with the Zuccoli Aspire footprint overlayed (yellow shading) to provide spatial context.



Key road network elements with respect to Zuccoli Aspire are:

- Zuccoli Parade (1.)
- Lambrick Avenue (A)
- Roystonea Avenue (B)
- Southern Zuccoli Connector (C)
- West Loop Road (2)
- South Loop Road (5)
- East – West Connection Road (7)
- Road 3
- Road 4

2.1 Existing Road Network Elements

2.1.1 Zuccoli Parade

Zuccoli Parade is posted at 60km/h operating speed and traverses in a north-south direction, intersecting with Lambrick Avenue to the north at a signalised intersection. From Lambrick Avenue to the future West Loop Road, Zuccoli Parade is a four lane, two-way divided road, and south of the West Loop Road, Zuccoli Parade transitions to a two lane, two-way road. South of the proposed future South Loop Road, Zuccoli Parade is constructed with indented parking lanes on both sides of the carriageway.

Zuccoli Parade is used to access/ egress the various stages of the Zuccoli development and along this section there are four controlled roundabout intersections that will provide future connections into the stages of the Zuccoli development. Zuccoli Parade is currently a 'no through road' as it terminates at a cul-de-sac approximately 1.8 km south of Lambrick Avenue, but will extend further south into Stage 5 in the future.

2.1.2 Lambrick Avenue

Lambrick Avenue is aligned from Stuart Highway to the east and Roystonea Avenue to the west and is configured as a two lane, two-way undivided sub arterial road. Lambrick Avenue is currently the sole point of connectivity for the Zuccoli development via Zuccoli Parade to the external trunk road network

2.2 Planned Road Network Elements

2.2.1 Roystonea Avenue

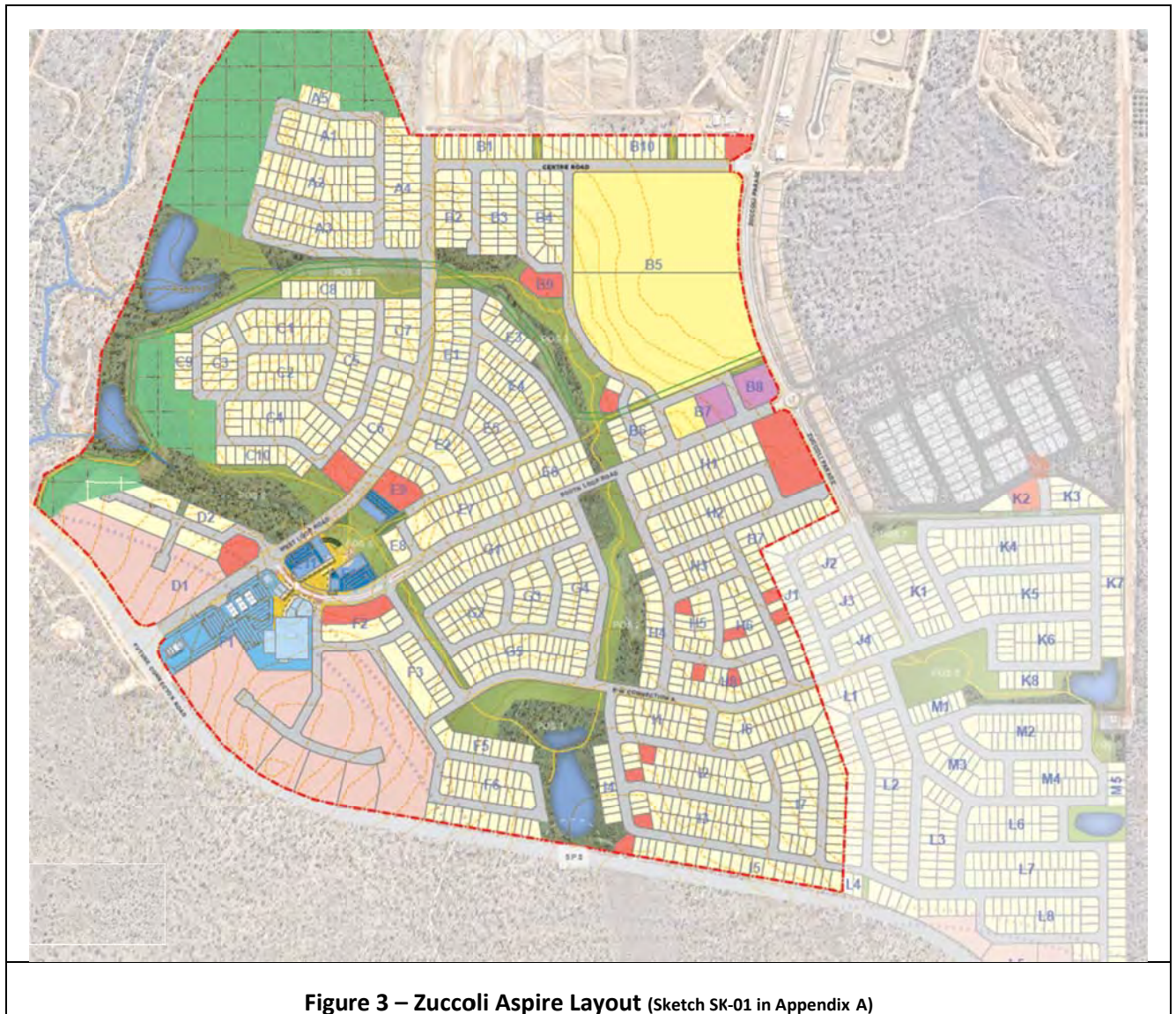
Roystonea Avenue is a two lane, two way road that operates in a notional north – south direction and forms the terminating leg of a signalised T-intersection with Lambrick Avenue. The NT Government plans to upgrade to 2 lane divided and extend Roystonea Avenue further south connecting with the planned Southern Zuccoli Connector road.

2.2.2 Southern Zuccoli Connector Road

The NT Government plans to provide for the Zuccoli Southern Connector Road, configured as a 4 lane divided sub-arterial, which is aligned to wrap around the southern boundary of the Zuccoli development and will intersect with Roystonea Avenue to the west.

3.0 DEVELOPMENT YIELD AND TRAFFIC GENERATION

The proposed development yield for Zuccoli Aspire is based upon the layout provided in **Figure 3** (and included complete with Legend in **Appendix A** as **Sketch SK-01**)



3.1 Development Yield

Development yields have been estimated based upon the above layout with following development densities adopted:

- Single Dwellings (SD) : 1 lot per 450m²
- Medium Density Res (MR) : Avg 1/90m²
- Multiple Dwelling (MD) : Avg 1/300m²
- Rural Residential (RR) : Lots sizes no less than 2Ha

Table 1 is a summary of the proposed yield for Zuccoli Aspire.

	Land Use						
	Single Dwellings (SD)	Med Density Res (MR)	Multiple Dwelling (MD)	Rural Res (RR)	Commercial / Retail	Service Station	School / Child Care
Unit	Dwellings	Dwellings	Dwellings	Dwellings	m2	m2	Students
TOTAL	1,557	148	142	26	9,500	3,600	1,160

Table 1: Zuccoli Aspire Proposed Yield

3.2 Daily Traffic Generation

Estimation of the daily traffic generation arising from above yield forms the basis for establishing the road hierarchy and associated road network needs. Daily trip generation for the suite of land uses is derived based upon published guidelines. The primary reference document utilised in Australia is the **RTA (now RMS) Guide to Traffic Generating Developments (2002)**. Further supplements to this guideline have been published as updates to historic traffic surveys that inform the guidelines are undertaken. The most recent being the “Technical Direction TDT 2013/04a” which reduced traffic generation rates for various uses including low and high density residential dwellings. It is noted in the GHD report that they have argued not to use the reduced rates on the basis that the rates are based on regional area surveys in NSW and are not relevant to capital cities. Notwithstanding that Darwin is a capital city, it is not unreasonable to consider that the urban development and associated traffic network patterns of Darwin are more closely aligned to that of a major regional centre rather than a capital city like Sydney, Melbourne or Brisbane.

For the purpose of this report, traffic generation rates adopted by GHD have been retained, so as to maintain a comparative level of assessment, however as a general philosophy, it can be argued that the traffic generation is overstated perhaps by as much as 10%.

Daily trip generation rates adopted for the assessment are based upon the RTA 2002 Guidelines and Institute of Transport Engineers, Trip Generation (1991) and are summarised as follows:

- SD : 9 trips/dwelling
- MR : 5 trips/dwelling
- MD : 6.5 trips /dwelling
- RR : 9 trips/dwelling
- Commercial : 10 trips/100m² GFA
- Service Station : 6 trips/ 100m² GFA
- School / Day Care : 1.38 trips/student

Based upon the yield in Table 1 and the adopted traffic generation rates, total daily traffic generation by Zuccoli Stages 3 to 5 has been estimated to be 21,171 trips. This comprises of the following composition of daily trips by land use:

- Dwellings : 16,226
- Commercial : 950
- Service Station : 2,160
- School/Daycare : 1,601

Recognising that the trip rates will include a proportion of trips that will be contained within Stages 3 to 5 associated with local trips to schools and town centre, and that some trips will be for multiple purposes, it has been assumed that 80% of trips to the schools/daycare and the commercial/retail uses are generated from within the development and therefore are “double counted”. In addition, the service station is situated adjacent to the future Southern Zuccoli Connector Road, and hence it will realise a reasonable proportion of its trade from vehicles passing on the connector road. Therefore it was assumed that 50% of trips associated with the service station operation will be from within the Zuccoli Aspire Development and 50% from external.

Hence the net development trips have been discounted as follows:

- Dwellings : 16,226 (Internal generated trips)
- Commercial/Retail : 95 (External generated trips)
- Service Station : 1,080 (External generated trips)
- School/Daycare : 320 (External generated trips)

Total daily trips generated by the Zuccoli Aspire development is estimated to be 17,721 vpd.

3.3 Peak Hour Traffic Generation

The RTA guide nominates that 10% of daily traffic movements for residential uses, 20% for commercial uses and 50% for school/daycare uses occur in the AM and PM peaks. Hence the peak hour volumes in the AM and PM peaks are estimated to be:

- Dwellings : 1,623
- Commercial / Service Station: 235
- School/Daycare : 160

4.0 NETWORK DISTRIBUTION OF TRAFFIC GENERATION

Distribution of traffic within and across the precinct will be effected along 8 high order trunk road links as shown in **Figure 4**.

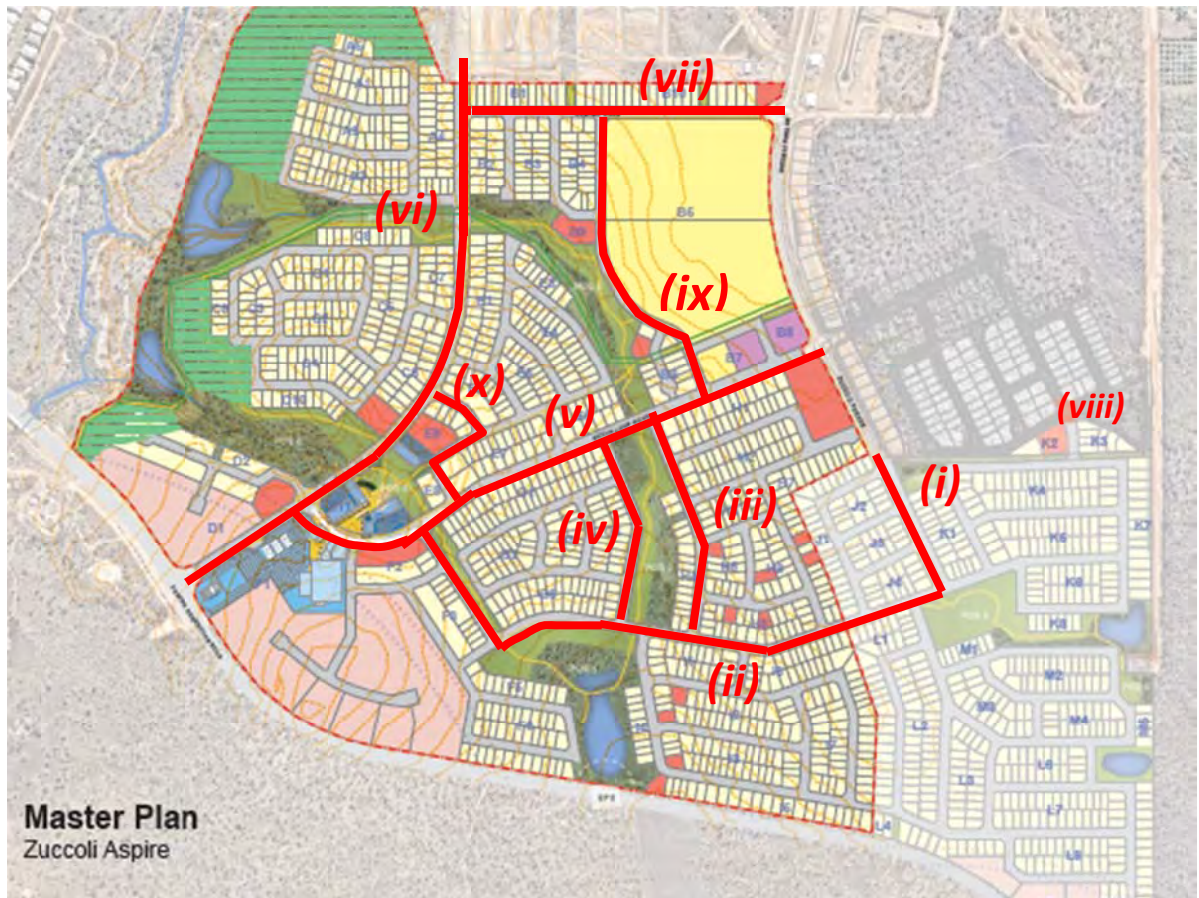


Figure 4 – Trunk Road Network

The road network links are described as following:

- | | |
|--|--|
| <ul style="list-style-type: none">• Link (i) : Extension of Zuccoli Parade into Stage 5• Link (ii) : East – West Connection Road• Link (iii) : Local Link Road 1• Link (iv) : Local Link Road 2• Link (v) : South Loop Road | <ul style="list-style-type: none">• Link (vi) : West Loop Road• Link (vii) : Centre Road• Link (viii) : Local Access to Zuccoli Stage 1• Link (ix) : Rear of School Link Road• Link (x) : Local Link Road 3 |
|--|--|

In allocating the traffic generation to the trunk road network, the development layout was divided into sub catchments. **Figure 5** illustrates the boundaries of the sub-catchments.

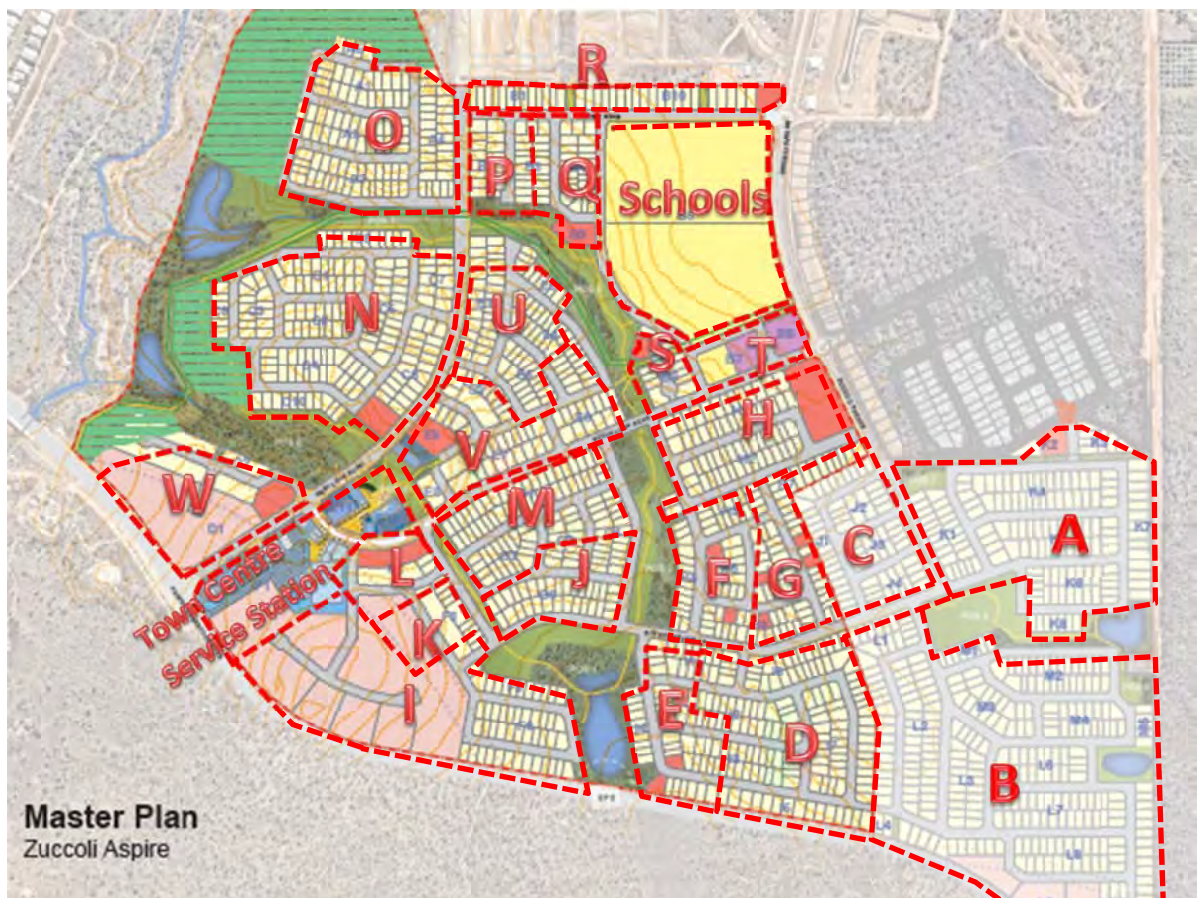


Figure 5 – Traffic Generation Sub-Catchments

The sub-catchments represent a point of connectivity and distribution of traffic onto the trunk road network.

4.1 Daily Trip Allocations

It is recognised that the primary destination for employment and entertainment for Zuccoli Aspire will be situated in the greater Darwin area to the north west of the development, and hence there will be a general bias towards traffic movements accessing the external network in the westerly and northerly direction. The town centre situated to the western side of the development reinforces a general bias as an “attractant” for trips towards the west. In addition the placement of the schools towards the north east of the development will create a trip destination equating to about 8% of the total internal trips generated.

Based upon anticipated desire lines to local destinations (retail, schools and service station) and distance of travel to access the external network, an assessment was made as to the likely route selection and proportion of trips from the residential sub-catchments, along the internal trunk road network towards each of the external nodes. This was undertaken by breaking the internal trunk road network down into 33 sub-segments. Each segment defined by a section of road between adjacent catchments. It is understood that the proposed schools will have primary access and pullover areas on the Zuccoli Parade Frontage. Full detail of the proportional allocation of trips to the internal trunk road network from each catchment is provided in **Appendix B**.

Figure 6 illustrates the estimated distribution of internally generated daily traffic movements across the local street network.

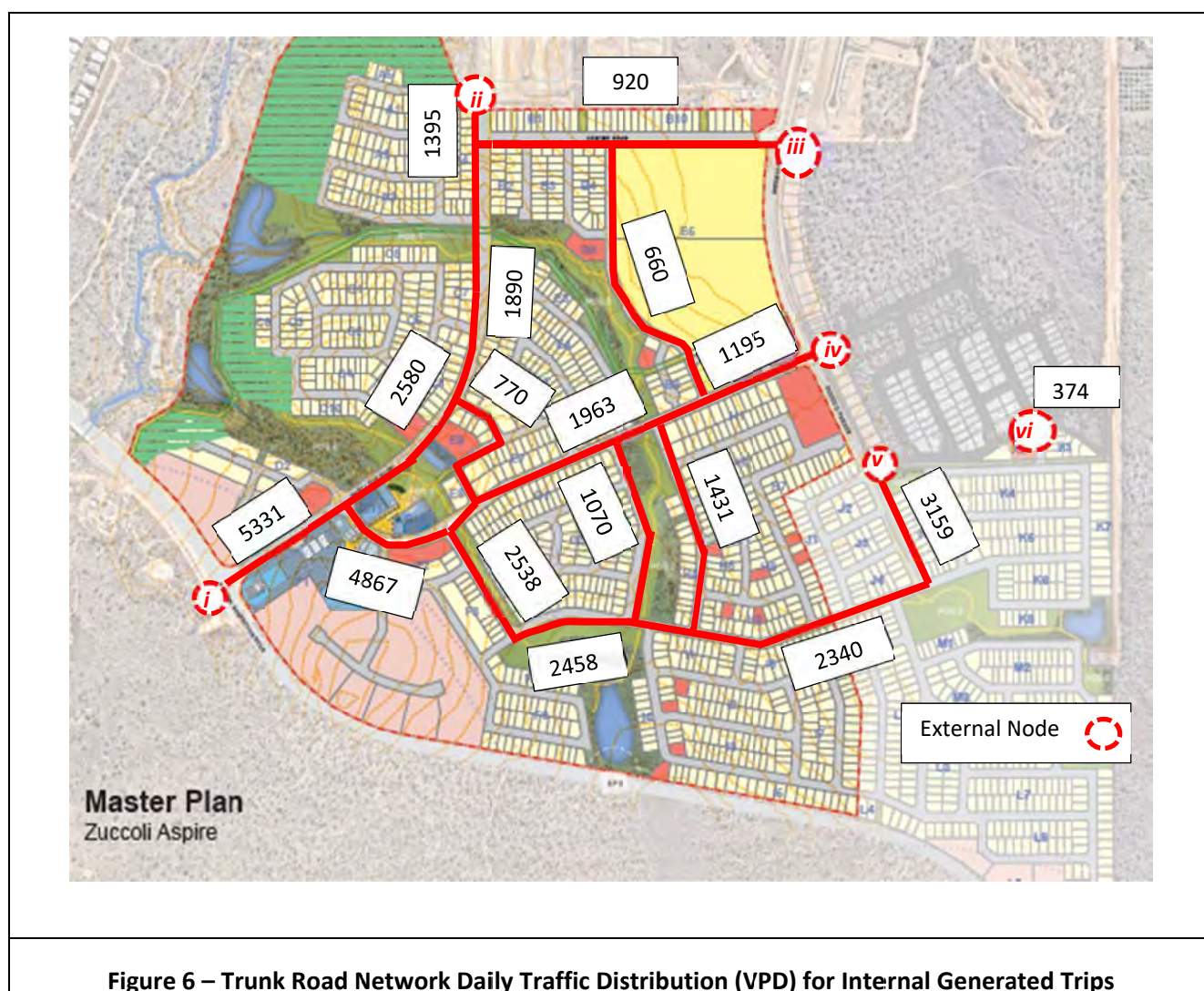


Table 2 summarises the net allocation of daily trips to each of the external nodes. This provides for the internally generated trips arising from the development and external sourced trips that would be generated by the schools, service station and retail uses. By way of comparison the allocation of traffic derived from the GHD model is also shown.

Node	Description	Internal Generated Trips exiting/entering the precinct	External Generated Trips	Total Trips	GHD Modelled
i	Intersection of West Loop Road and Zuccoli Southern Connector Road	5,331	400	5,731	5,200
ii	Entry of West Loop Road into the precinct	1,395	250	1,645	2,400
iii	Intersection of Zuccoli Parade and Centre Road (3)	1040	260	1,300	1,100
iv	Intersection of Zuccoli Parade and South Loop Road	1,478	430	1,908	1,700
v	Southern extent of Zuccoli Parade	3,159	0	3,159	3,200
vi	Connection in Zuccoli Stage 1	374	0	374	NA

Table 2 : Daily Traffic Distributions

The traffic volumes and distribution of traffic across the Zuccoli Aspire development is generally consistent with the modelling undertaken by GHD for the entire Zuccoli Development. This provides some confidence that the modelling assumptions and approach are generally consistent.

4.2 Directional Peak Trip Movements

Allowing that approximately 80% of trips exit and 20% enter in the AM peak, and 40% exit and 60% enter in the PM peak, the following directional splits are allocated in **Table 3** to the external nodes.

Node	Description	AM / PM Peak Trips	AM Exit	AM Enter	PM Exit	PM Enter
i	Intersection of West Loop Road and Zuccoli Southern Connector Road	548	439	109	219	329
ii	Entry of West Loop Road into the precinct	165	132	33	66	99
iii	Intersection of Zuccoli Parade and Local Link Road 3	130	104	26	52	78
iv	Intersection of Zuccoli Parade and South Loop Road	191	153	38	76	115
v	Southern extent of Zuccoli Parade	316	258	61	123	193
vi	Connection in Zuccoli Stage 1	38	34	4	18	26
TOTAL TRIPS		1,400	1,120	280	560	840

Table 3 : Peak Hour Directional Splits at External Nodes

5.0 ROAD HIERARCHY

The traffic generations estimated in Section 4 of this report will be used as the basis for deriving the appropriate road hierarchy for Zuccoli Aspire.

5.1 City of Palmerston Development Guideline

The City of Palmerston Development Guideline (June 2015), sets out definitions that describe the functional criteria for Arterial Roads, Sub-Arterial Roads, Collector Roads, Secondary Collectors, Primary Collectors and Local Access Roads and Minor Roads. In addition, Table 2.1 of the Guideline sets out the Street and Road Hierarchy Design Criteria as shown in **Figure 7**.

Road Hierarchy Classification		Catchment Size ¹ (dwellings)	AADT ¹ (vpd)	Road Reserve Width (Min)	Carriageway Width (Min)	Verge Width (Min)	Footpath	Design Speed (km/h)
Minor Road	P > 17 note ³			15m	6.0m	4.5m		
	P < 17 note ³	< 25	150	18m	7.0m	4.5m	1 side	50
Local Access Road		< 60	1000	18m	7.0m	4.5m	1 side (min)	60
Collector	Secondary	< 250	2500	18m	8.0m	5.0m	Both sides	60
	Primary	< 400	3000	21m	11.0m	5.0m	Both sides	60
Sub Arterial ²	Single Lane			21m	11.0m	5.0m	Both sides, 1 side as a shared ped/cycle	Note ²
	Dual Lane	> 400	> 3000	27m	17.0m	5.0m		
Industrial Access		< 8Ha		21m	11.0m	5.0m	1 side	60
Industrial Collector		< 30Ha		23m	13.0m	5.0m	Both sides	60

Figure 7 – Table 2.1 of CoPDG Street and Road Hierarchy Design Criteria

It is noted that the Guidelines state that the primary criteria is the Road Function (as described in the guideline definitions) , and road hierarchy catchment and traffic are guides only.

5.2 Road Hierarchy

Based upon the CoPDG, the estimated traffic allocations, and functional definitions, the hierarchical classifications and configurations for the higher order roads within Zuccoli Aspire have been determined as follows:

Road Segment	Daily Traffic Volume (vpd)	Directional Peak Hour Volume (vph)	Road Hierarchy Classification	Configuration
West Loop Road (Northern Boundary to Public Open Space)	1395 to 2580	198	Primary Collector	2 lane undivided 11m Roadway 21m Road Reserve
West Loop Road (Public Open to South Zuccoli Connector Rd)	2580 to 5369	439	Sub-Arterial	2 lane divided 11m Roadway 21m Road Reserve
South Loop Road (Zuccoli Parade to East – West Connection Road)	1744 - 2487	199	Primary Collector	2 lane undivided 11m Roadway 21m Road Reserve
South Loop Road (East – West Connection Road to West Loop Road)	2,065 – 2,854	228	Sub-Arterial	2 lane divided 11m Roadway 21m Road Reserve
E-W Connection Road	1,399 – 1,478	120	Secondary Collector	2 lane undivided 8m Roadway 18m Road Reserve
Centre Road	1,040	84	Secondary Collector	2 lane undivided 8m Roadway 18m Road Reserve
Local Link Road 1	1431	115	Secondary Collector	2 lane undivided 8m Roadway 18m Road Reserve
Local Link Road 2	1143	92	Secondary Collector	2 lane undivided 8m Roadway 18m Road Reserve
Local link Road 3	700	56	Local Access	2 lane undivided 7m roadway 16m road reserve
Rear of School Link	660	48	Local Access	2 lane undivided 7m roadway 16m road reserve

Table 4 – High Order Road Hierarchy

Austroroads design guidelines indicate that maximum lane capacity is typically 900 vph on a median side lane and 600 vph against a parking lane. The above lane peak hours are well below the lane capacity thresholds.

Figure 8 illustrates the proposed road hierarchy for Zuccoli Aspire. A copy of sketch SK-04 is provided in **Appendix C**.

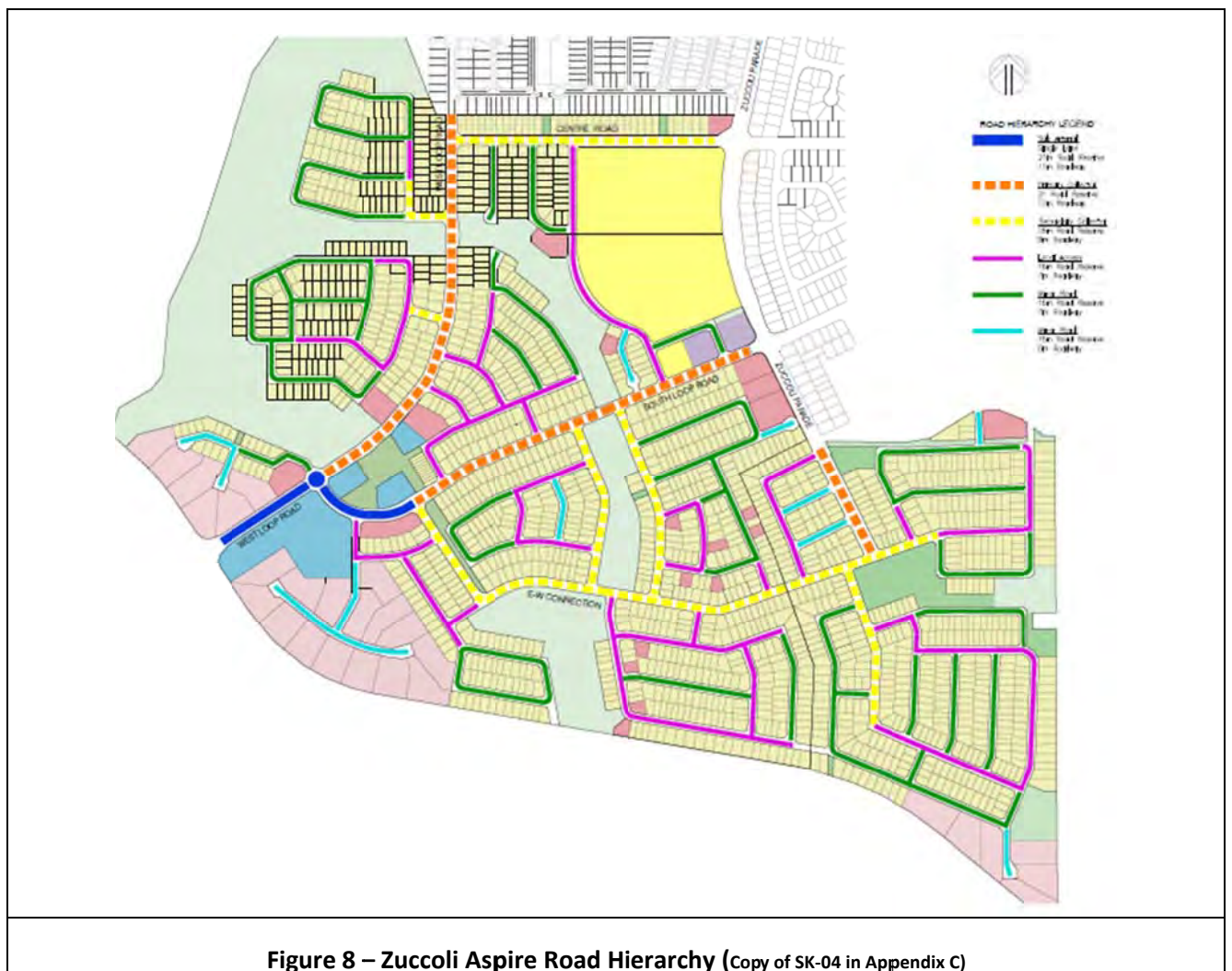


Figure 8 – Zuccoli Aspire Road Hierarchy (Copy of SK-04 in Appendix C)

6.0 INTERSECTION TREATMENTS

In accordance with the City of Palmerston Development Guideline, intersections shall be configured generally as follows:

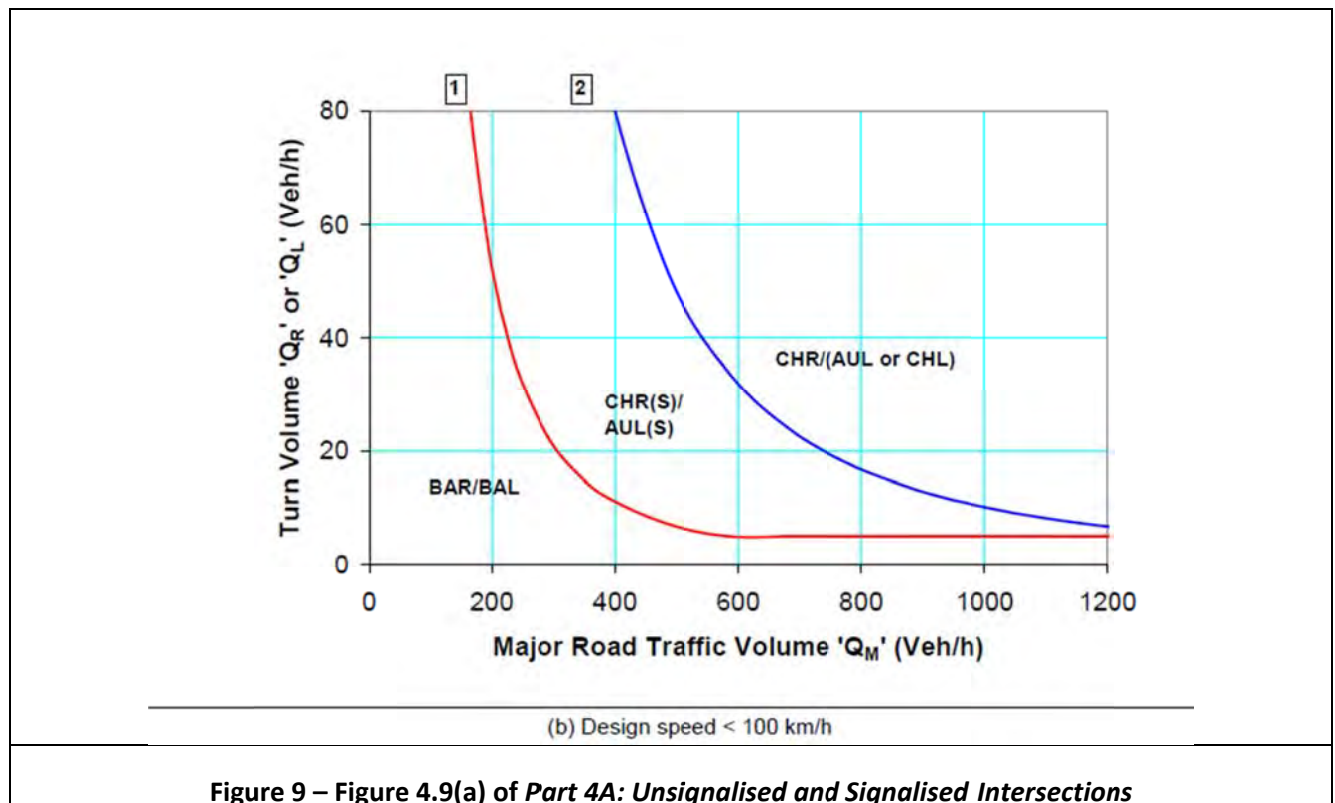
- Three way intersection : T-intersections
- Four way intersections : Roundabouts

The volume of traffic passing through the T-intersections at the junction of higher order roads may warrant the provision of protected right and left turn lanes. Following is an assessment of the warrants for protected turning movements at the intersection of the high order roads within the internal network.

6.1 Assessment of Turn Warrants

Austrroads Guide to Road Design **Part 4A: Unsignalised and Signalised Intersections** sets out the warrants that apply to major road turn treatments for the basic, auxiliary lane and channelised configurations.

Figure 9 provides an extract of Figure 4.9(b) from the Austrroads Guide.



Internal intersections that have been assessed for these warrants are shown in **Figure 10**.

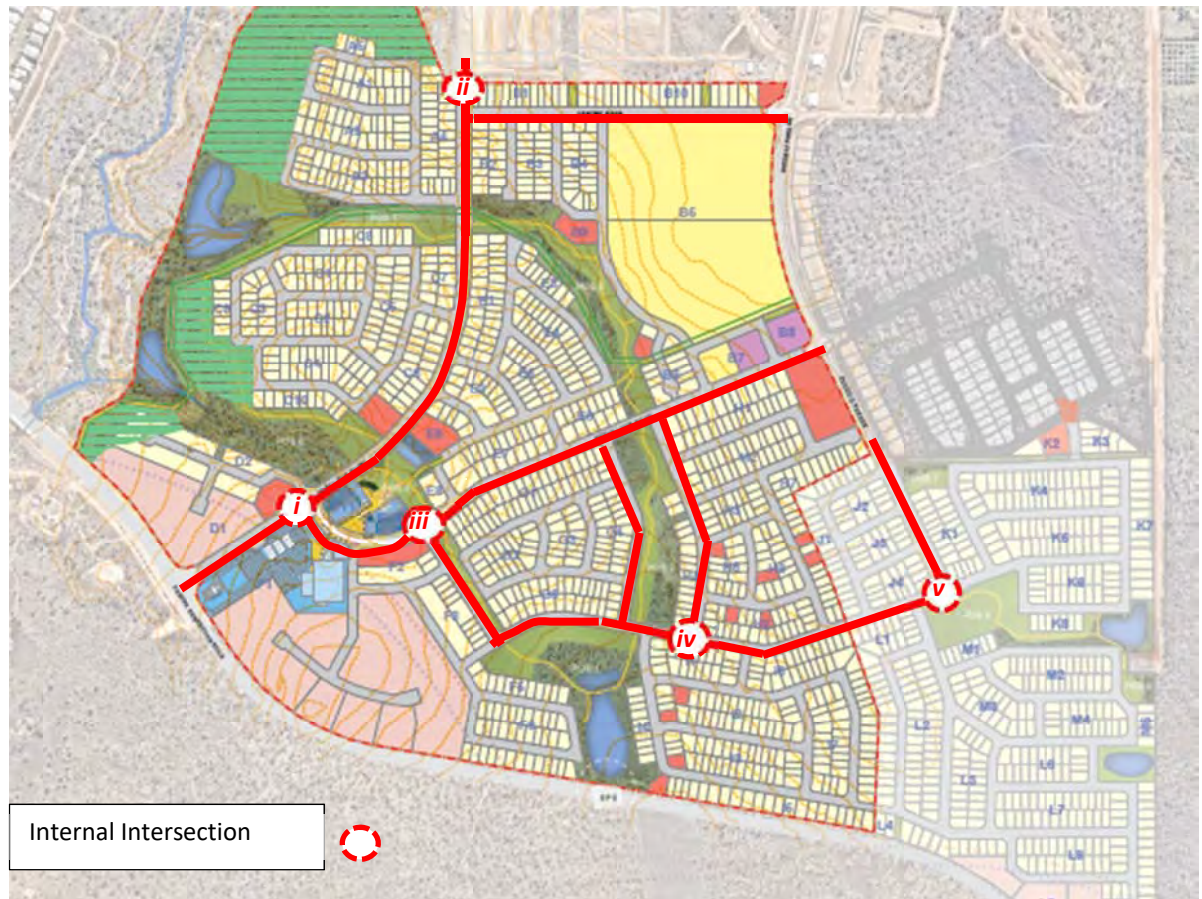


Figure 10 – Internal Intersections

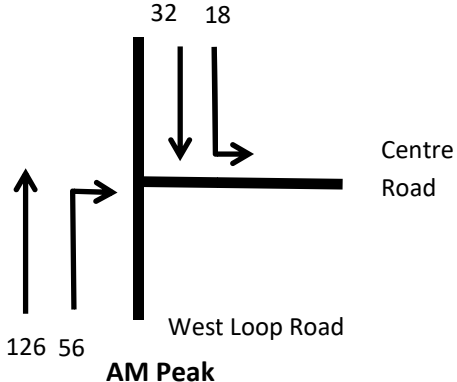
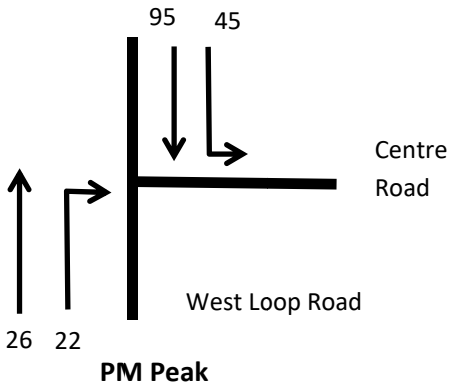
The other lower order, lower volume roads will not trigger the need for turn movement treatments.

Based upon the derivation of the AM and PM peaks in Section 4 and the traffic distribution in Figure 7, approximate AM and PM peak turn movements have been estimated and turn lane provisions assessed. (refer **Figures 11 to 15**)

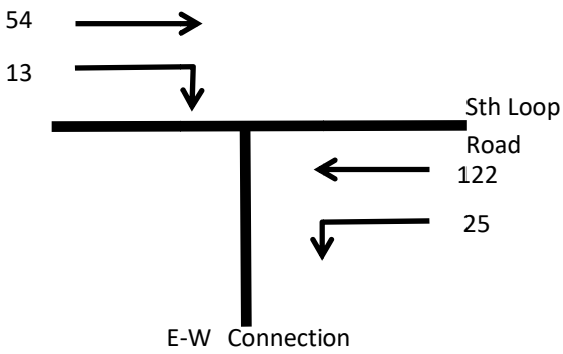
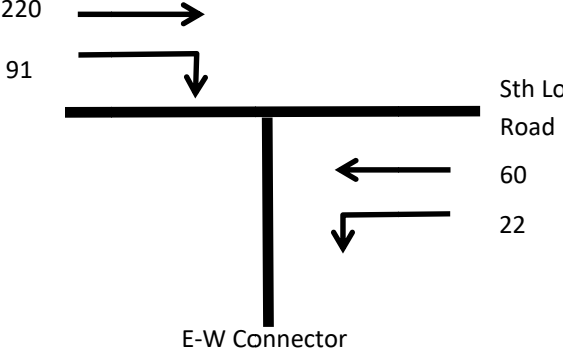
6.1.1 Intersection (i): West Loop Road and South Loop Road

Intersection (i) will be a 4 way intersection and will be configured as a roundabout.

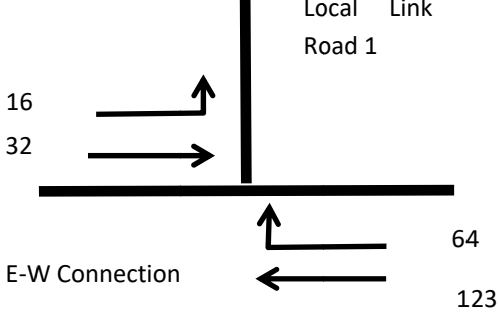
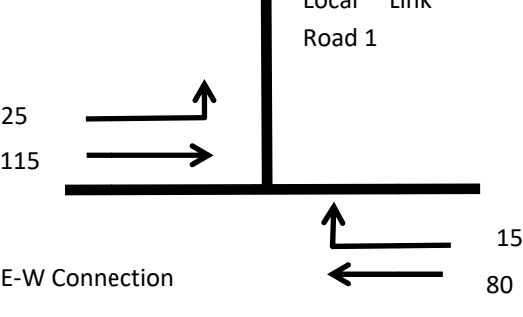
6.1.2 Intersection (ii): West Loop Road and Centre Road

 AM Peak	 PM Peak
Right Turn • $Q_r = 56$ and $Q_m = 126 + 32 + 18 = 176$ • By Figure 4.9(a) warrant = No Treatment Required Left Turn • $Q_l = 18$ and $Q_m = 32$ • By Figure 4.9(a) warrant = No treatment	Right Turn • $Q_r = 22$ and $Q_m = 26 + 95 + 45 = 166$ • By Figure 4.9(a) warrant = o Treatment Left Turn • $Q_l = 63$ and $Q_m = 145$ • By Figure 4.9(a) warrant = No Treatment
Figure 11 – Intersection (ii) - AM and PM Peak Movements and Turn Lane Requirements	

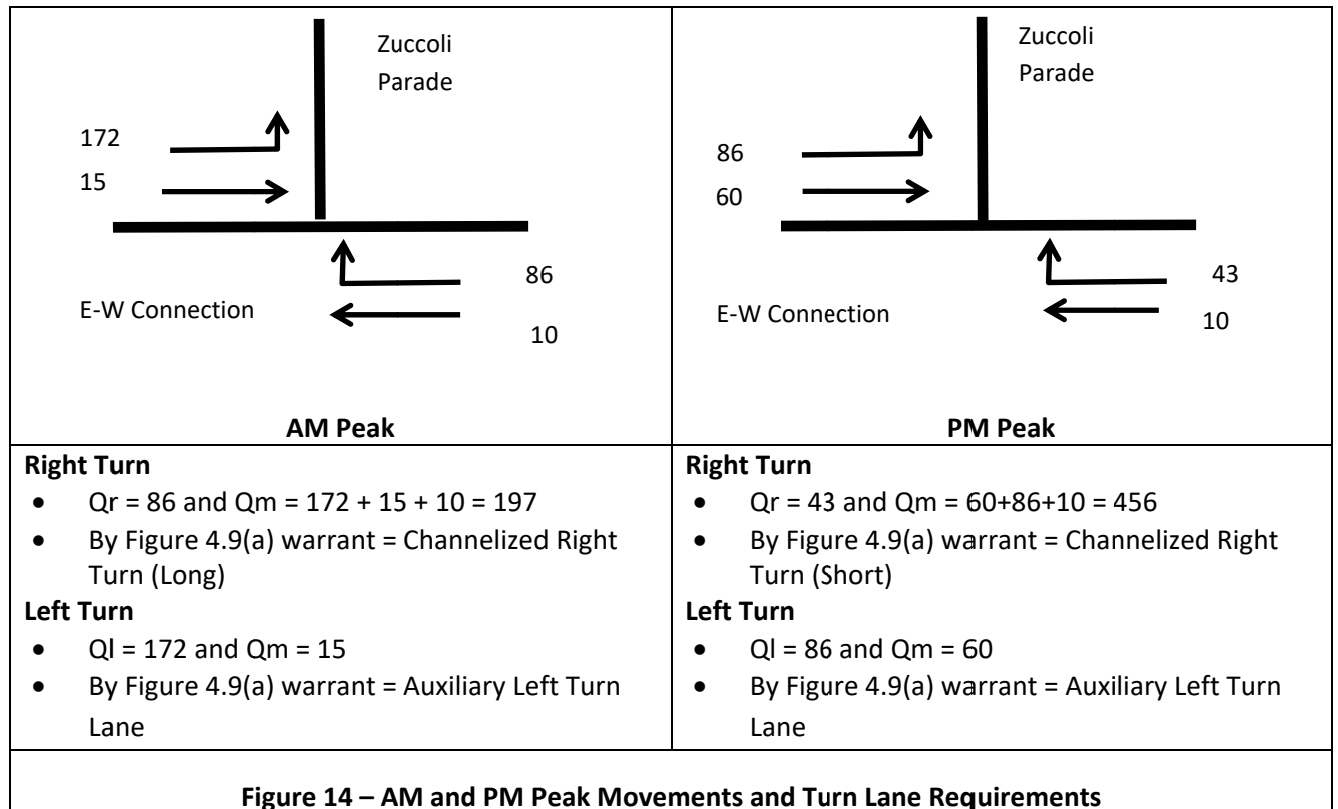
6.1.3 Intersection (iii): South Loop Road and E-W Connection Road

 AM Peak	 PM Peak
Right Turn • $Q_r = 13$ and $Q_m = 54 + 122 + 25 = 201$ • By Figure 4.9(a) warrant = No Treatment Left Turn • $Q_l = 25$ and $Q_m = 122$ • By Figure 4.9(a) warrant = No Treatment	Right Turn • $Q_r = 91$ and $Q_m = 220 + 60 + 22 = 302$ • By Figure 4.9(a) warrant = Channelized Right Turn (Short) Left Turn • $Q_l = 22$ and $Q_m = 60$ • By Figure 4.9(a) warrant = No Treatment
Figure 12 – Intersection (iii) - AM and PM Peak Movements and Turn Lane Requirements	

6.1.4 Intersection (iv): E-W Connector Road and Local Link Road 1

 AM Peak	 PM Peak
Right Turn • $Q_r = 64$ and $Q_m = 123 + 32 + 16 = 171$ • By Figure 4.9(a) warrant = Channelized Right Turn (Short) Left Turn • $Q_l = 16$ and $Q_m = 32$ • By Figure 4.9(a) warrant = No Treatment	Right Turn • $Q_r = 15$ and $Q_m = 115 + 25 + 80 = 220$ • By Figure 4.9(a) warrant = No Treatment Left Turn • $Q_l = 25$ and $Q_m = 115$ • No treatment
Figure 13 – AM and PM Peak Movements and Turn Lane Requirements	

6.1.5 Intersection (v): Zuccoli Parade and E-W Connection Road



6.1.6 Summary of Intersection Turn Treatments

In summary the turn treatments proposed are as follows:

Intersection	Left Turn	Right Turn
West Loop Road and South Loop Road	Roundabout	Roundabout
West Loop Road and Centre Road	No Treatment	No Treatment
South Loop Road and E-W Connection Road	No Treatment	Channelised Right Turn (Short)
E-W Connector Road and Local Link Road 1	No Treatment	Channelised Right Turn (Short)
Zuccoli Parade and E-W Connection Road	Auxiliary Left Turn Lane	Channelised Right Turn

7.0 TOWN CENTRE NETWORK FUNCTION

The proposed town centre is of specific interest in the context of the mixing of pedestrian and vehicle movements and the potential conflict that arises in the objectives of these two functions on the South Loop Road.

Figure 15 shows the current proposed arrangement in plan.

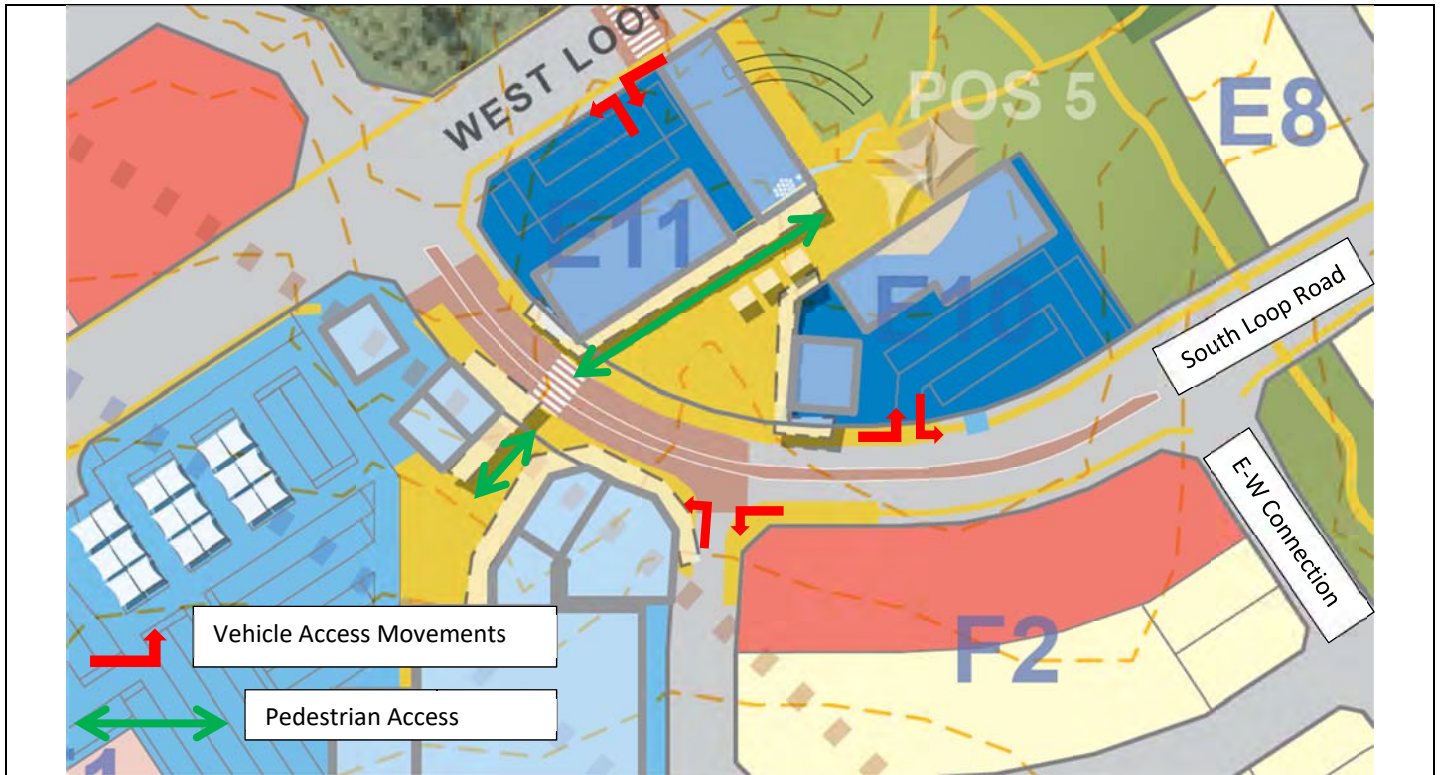


Figure 15 – Town Centre Network Configuration

Figure 16 illustrates a proposed type section and imagery of similar treatments in other centres in Australia.

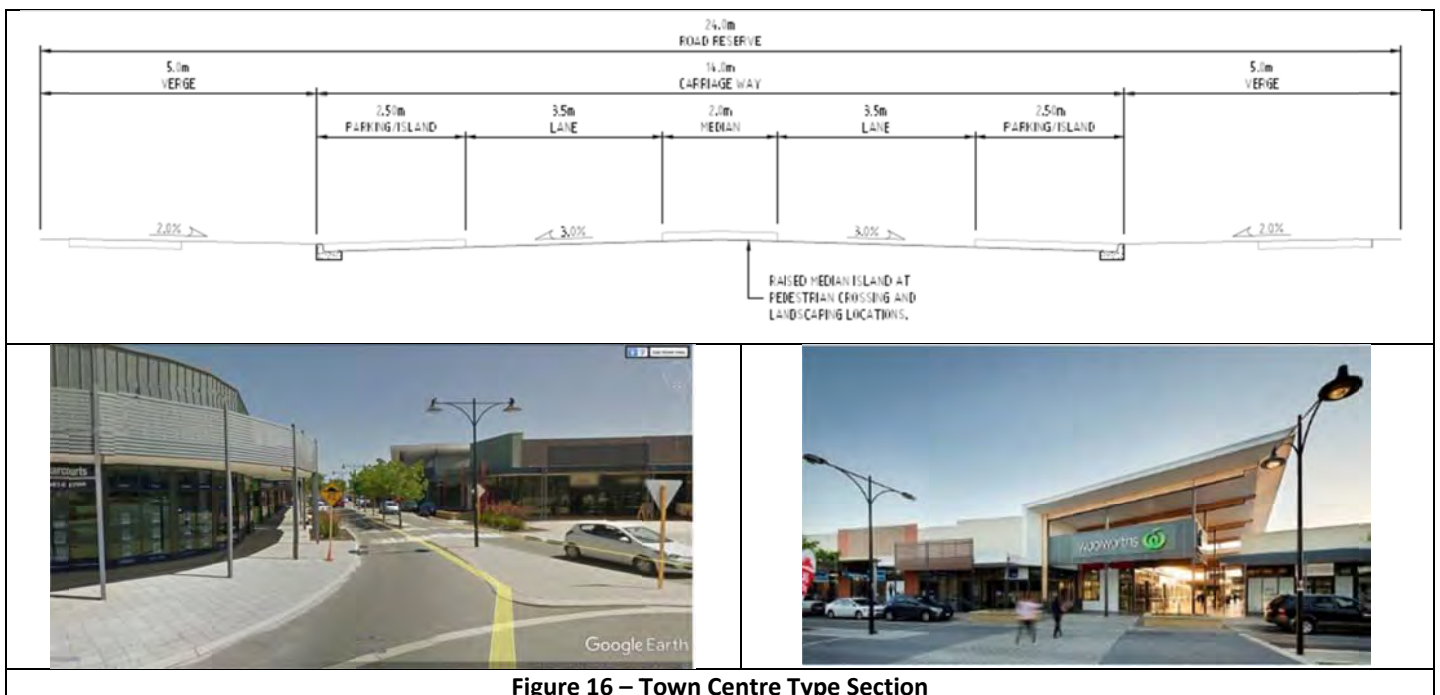


Figure 16 – Town Centre Type Section

7.1 Pedestrian Movements

The proposed type section is configured to allow pedestrian refuge half way across the carriageway and hence the crossing can be made in two movements.

The proposed pedestrian access through the town centre has the potential to create conflict with the functional objectives of South Loop Road as a sub-arterial link. To provide some context to this issue, it is of value to understand the likely regularity of conflict between pedestrian and vehicle movements and whether this translates to either an unsafe or functional impact on the movement of traffic and pedestrians.

In the AM peak the estimated movements of traffic on the South Loop Road leg is 388 east bound and 97 west bound.

On the east bound carriageway this equates in the peak hour to a single vehicle movement on average every 10 seconds. At a 50km/h operating speed this equates to a gap of 140m. “Pedestrian Gap Acceptance at Mid Block Crossings” study conducted in Europe (Yannis, Papadimitriou and Theofilatos 2010 : **Appendix ??**) , established that 100% of pedestrians are likely to make mid-block crossings with gap acceptance of 5 seconds, 60% with 3 seconds gap acceptance and 20% at 1.5 seconds. Hence the 10 second average gap available on the South Loop Road is more than double the minimum needed to allow safe movement of pedestrians.

The above demonstrates that safe pedestrian movement can be achieved through unregulated movements at designated pedestrian crossing points.

The configuration of the crossing point as designated pedestrian (zebra) crossing will result in potentially unwarranted delay to vehicles in the South Loop Road. It is recommended that the crossing be established such that priority is to the movement of vehicles requiring pedestrians to give right of way. A similar configuration is provided on Palmer Street in Townsville, a urban arterial road that provides access to the Port of Townsville via a dining precinct. **Figure 17** shows the pedestrian crossing arrangement that is in place:



Figure 17 – Palmer Street, Townsville - Pedestrian Crossing Point

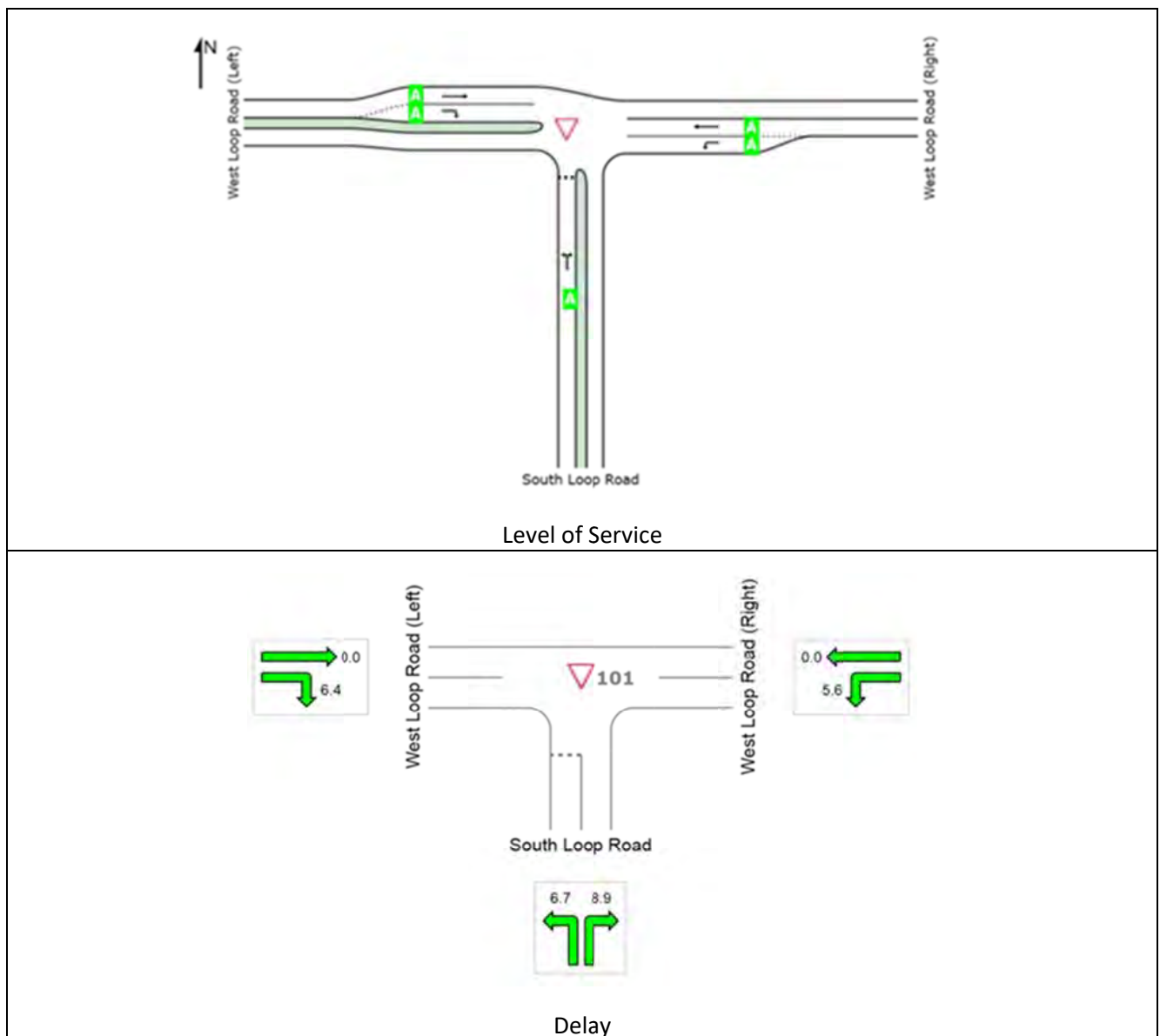
7.2 Vehicle Access and Egress to Commercial / Retail Precincts

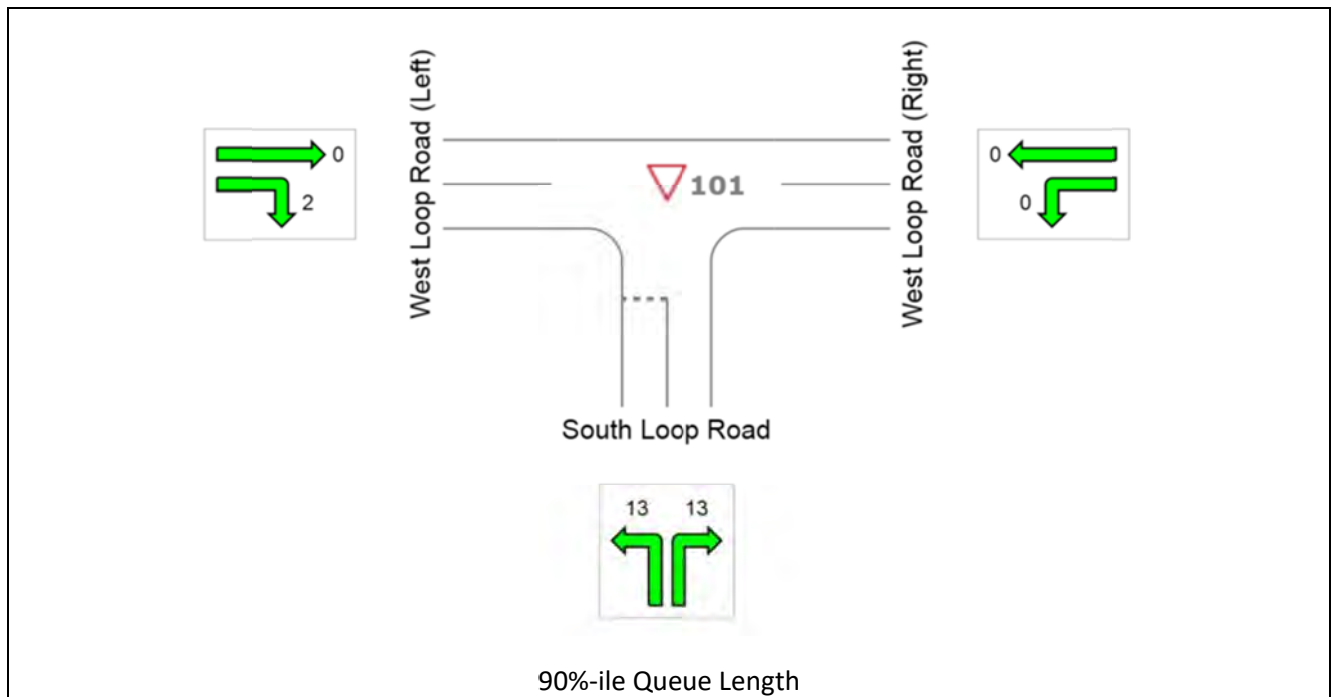
As demonstrated in **Figure 15** the proposed access and egress of vehicle movements from South Loop Road are limited to one location at Lot E10 and will be constrained to left-in and left-out manoeuvres only. Hence the movement of vehicles from South Loop Road into the property will be efficient and the access, and internal parking, will be configured to allow unrestricted entry. Likewise for vehicles exiting there will have clear visibility. In the PM peak the average gap will be approximately 200m and will be more than sufficient to allow entry of vehicles from the access without excessive delay.

7.3 Intersection of South Loop Road and West Loop Road

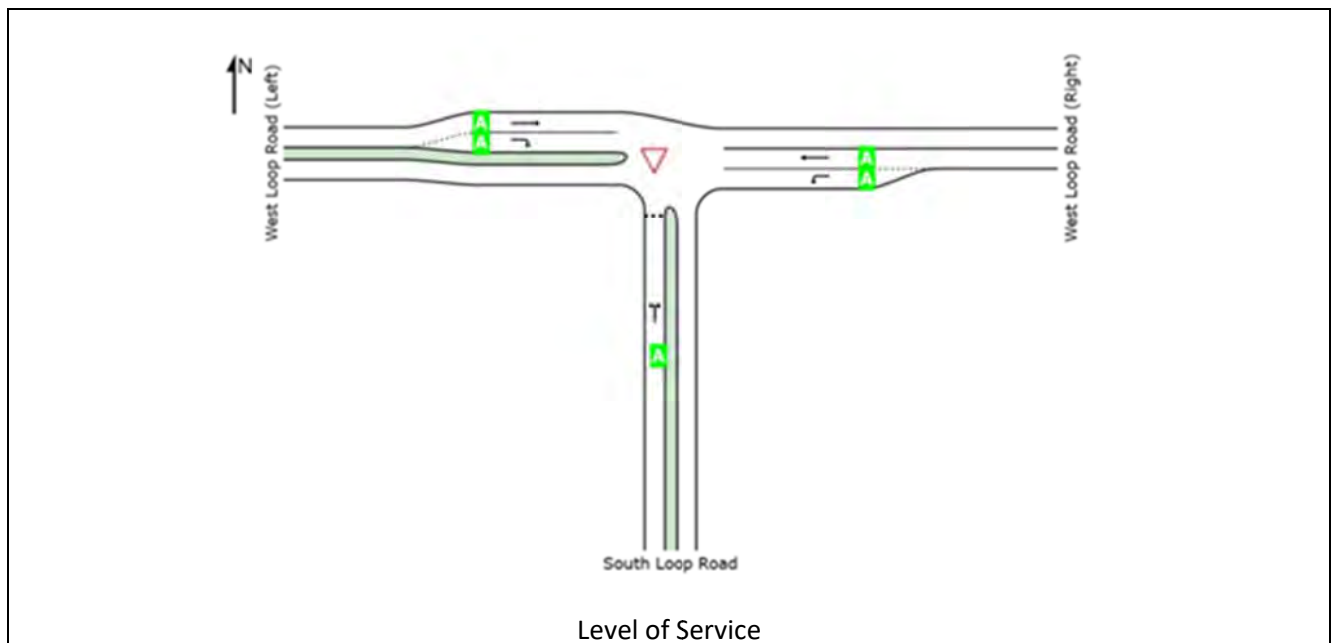
In order to better understand the functional performance of the intersection of the South Loop Road and West Loop Road, a Sidra analysis was performed to determine likely Level of Service, Queuing and Delay at ultimate development. The modelled AM and PM peak performance at ultimate development is summarised below:

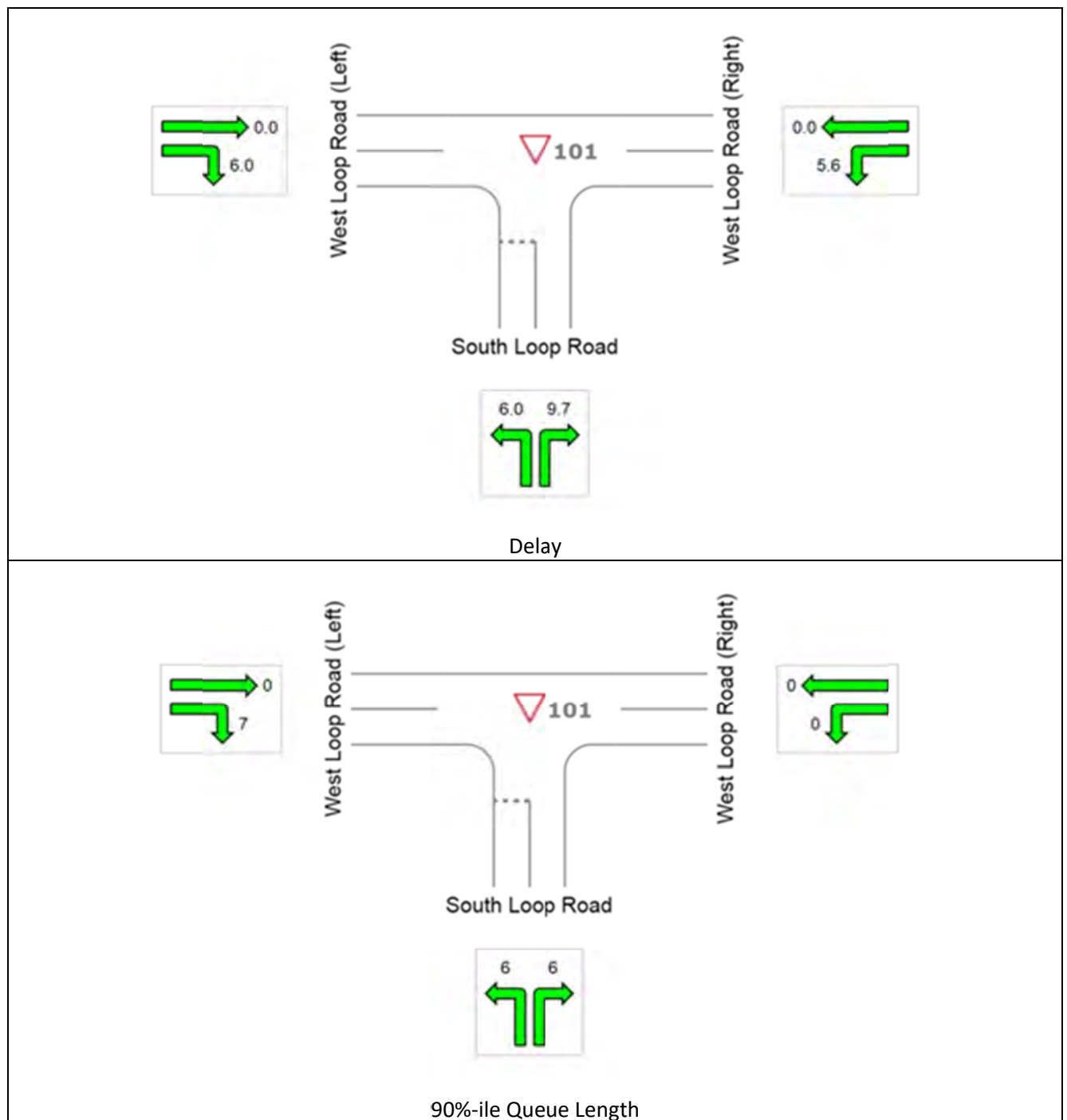
AM Peak





PM Peak

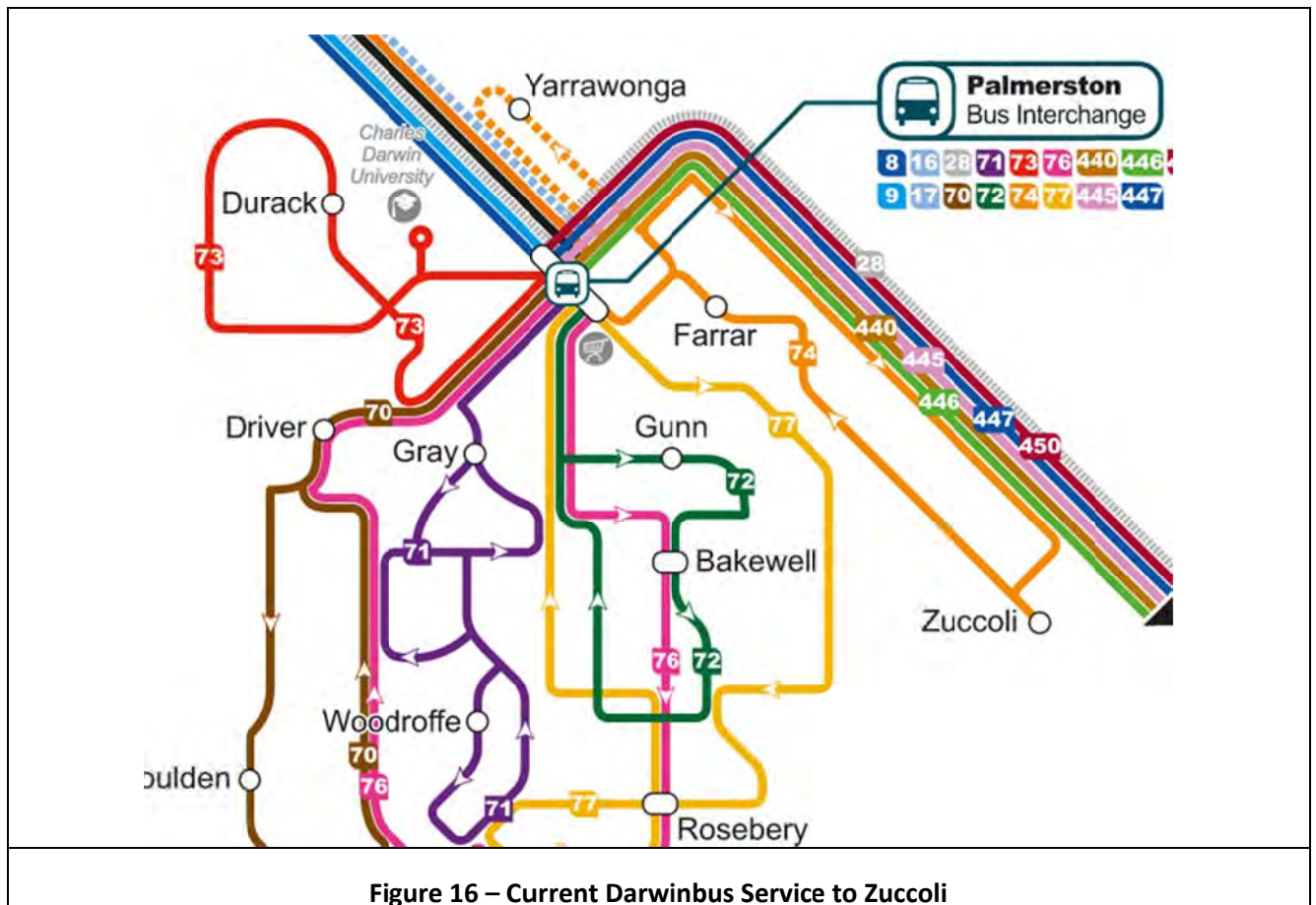




The intersection of South Loop Road and West Loop Road will operate efficiently and safely, with no excessive delay or queuing.

8.0 PUBLIC TRANSPORT

Public transport needs for Zuccoli Aspire will be fulfilled through the provision of taxis and the services offered by the Darwinbus network. An extract from the Darwinbus website is provided in **Figure 16** which shows the current route available to Zuccoli.



Darwinbus currently operates a service to Zuccoli which commences and terminates at the Palmerston Bus Interchange. It is anticipated that as the Zuccoli development proceeds the bus service will be extended to meet the demand.

It is understood that the NT Government will accept a maximum walkability distance of 600m, and have issued advice that it is not mandatory for Zuccoli Stage 5 to be within the walkability criteria.

Figure 17 (following page) provides an extract from a prior SMEC TIA report which demonstrates the proposed route for the Darwinbus service through the Zuccoli development.

The proposed bus route will meet the above objectives.

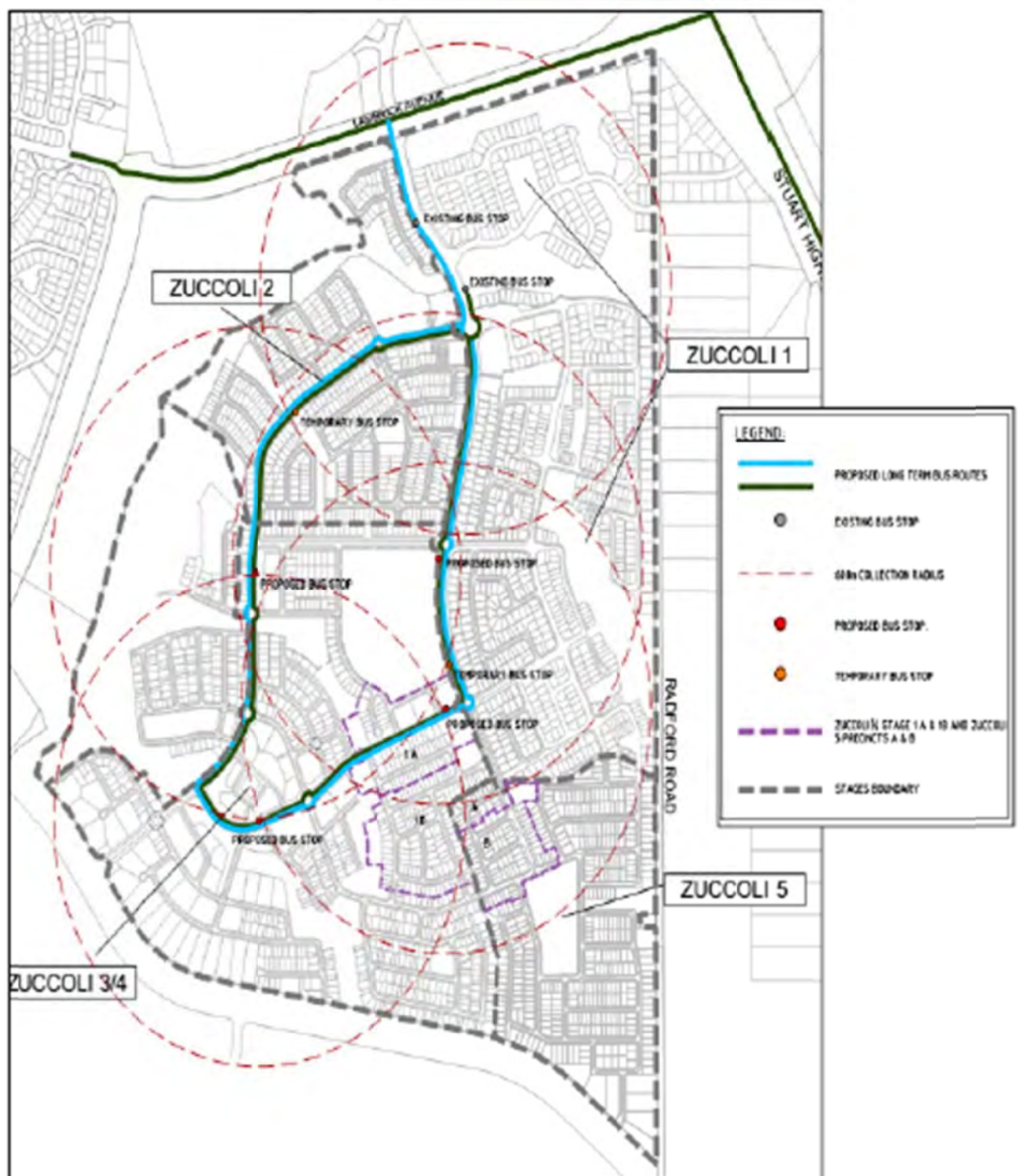


Figure 17 – Darwinbus Route through Zuccoli (Source SMEC Stage 5 TIA July 2015)

9.0 ACTIVE TRANSPORT

The layout of the Zuccoli Aspire development with open parkland, the town centre and the school facilities will generate the demand for the provision of active transport facilities to cater for walking and cycling to and from these facilities.

The collector and sub-arterial network elements cater for the provision of on-road and off-road / shared bicycle facilities and the lower order roads provide for a pedestrian path on at least one verge. This in conjunction with shared pedestrian and bicycle paths through the conjoined park and drainage reserves will facilitate safe and attractive active transport activities across the development precinct.

10.0 PARKING PROVISIONS

Either kerbside parallel parking can be accommodated on all streets within the proposed development site.

The Primary Collector can accommodate 2.4m parking lanes on either side of the carriageway which are clear of through traffic. The provision of formal on-street parking will increase the capacity for through traffic and provide separation

All Minor roads can generally accommodate informal on-street parking, though on small lot with narrow frontages, consideration should be given to minimum building setbacks to ensure that at least two vehicles can be parked in a driveway and garage without projection beyond the property boundary.

The town centre will generate a need for off road parking. The Northern Territory Planning Scheme nominates a parking provision of 6 car parks per 100m² of net floor area. Assuming 70% of the GFA is net floor area, this translate to approximately 420 car parks to be accommodated off street. The land parcel nominated for the Town Centre will be sufficient to accommodate this need.

Likewise the schools will create a demand for car parking which will not be accommodated within the road corridor. The Northern Territory Planning Scheme nominates a parking provision of 1 carpark per class room plus two additional spaces. For 1000 students at 25 students per class room, the parking need equates to 42 car parks. It is expected that off street parking and pick up / drop off facilities will be provided to cater for this need within the school sites.

11.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions are made with respect to this Traffic Impact Assessment prepared for Zuccoli Aspire (Zuccoli Stages 3 to 5):

- Traffic generation for Zuccoli Aspire has prepared based upon the RTA (now RMS) Guide to Traffic Generating Developments (2002). These rates were modified in 2013 which reduces the dwelling traffic generation rates, however these have not been adopted, and thus the traffic generation is considered to be conservatively over stated.
- A Road Hierarchy has been prepared for the development based upon the City of Palmerston Development Guideline. The Guidelines reinforce that the functional definitions are the principal basis for assessment and this has been adopted as the primary criteria.
- Several of the T-Intersections of the high order roads within the development will require the provision of protected turn movements. This should be confirmed and designed consistent with industry design standards in the detailed design phase.
- There is an existing bus route to Zuccoli and it is anticipated that the range and frequency of the routes will increase as the development is rolled out. The road hierarchy accommodates the movement and stopping of buses along the West Loop Road and South Loop Road.
- For active transport there will be significant provisions made for pedestrian and cycle movements that will be both attractive and safe for users. This will be principally through the interconnecting public open space and drainage corridors that will include paved shared path facilities and lighting.
- Parking provisions will be met within the road corridor type section and on site for particular land uses including the Town Centre and the Schools.
- Provision for a pedestrian crossing point should be allowed on the South Loop Road through the proposed town centre. (The crossing should be configured to provide right of way to vehicle movements).

It is recommended that the Transport Impact Assessment be accepted and adopted as a guiding document in informing the ongoing planning and development of Zuccoli Aspire.

APPENDIX: A

Sketch Sk-01 - Zuccoli Aspire Master Plan Layout

Master Plan

Zuccoli Aspire

LEGEND

- Community Uses**
- Commercial Uses**
(Supermarket / Fast Food / Service Station)
- Commercial Mixed Use**
(Ground floor shop with residential above)
- Rural Lots**
- Sites for Single Dwellings**
- Sites for Multiple Dwellings (MD)**
- Sites for Multiple Dwellings (MR)**
- Connecting Roads**
- Public Open Space**
(unencumbered / encumbered)
- 1000m from mangrove margin**
- Indicative Lake**
- Urban Development Investigation Area**

0 60 120m

Project Manager: AH Date: 16 November 2016

Drawn: GW Scale: 1:6,000 @ A3 1:3,000 @ A1

Checked: OP Drawing No. 716-358 CP-1 A



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APPENDIX: B

Traffic Generation Calculations

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	Total Trips
1	80%	0%	0%																					1001
2	70%	60%	60%	30%	20%		10%																	3159
3	30%	40%	30%	30%	20%		10%																	2038
4	30%	40%	30%	30%	20%		10%																	2038
5	30%	40%	30%	30%	20%		10%																	2038
6	30%	40%	30%	30%	20%		50%																	2340
7	20%	30%	30%	60%	20%		50%																	2327
8	10%	20%	30%	50%	20%	50%	50%																	2099
9	10%	20%	20%	50%	80%	50%	50%		10%															2455
10	5%	20%	20%	30%	60%	50%	50%		10%															2039
11	5%	20%	20%	30%	60%	50%	40%		10%															1964
12	5%	10%	20%	30%	40%	40%	30%		90%	60%														2180
13	5%	20%	10%	30%	40%	40%	30%		80%	60%	50%	40%	40%											2786
14	5%	20%	10%	30%	40%	40%	30%	50%	80%	70%	90%	80%	80%						50%	50%		50%	80%	4867
15	5%	10%	5%	20%	30%	30%	20%	40%	70%	60%	80%	85%	80%	50%	40%	20%	10%	10%	40%	40%	50%	50%	20%	5331
16														60%	50%	30%	20%	20%			60%	50%	20%	2580
17														60%	50%	30%	20%	20%			40%		20%	1890
18														40%	30%	30%	20%	20%			40%		20%	1395
19														40%	30%	30%	20%	20%			40%		20%	1395
20														20%	20%	30%	20%	20%			20%		10%	861
21														20%	20%	40%	40%	40%			20%		10%	1040
22														20%	20%	40%	40%	40%			20%		10%	1040
23														20%	20%	40%	40%	40%			20%		10%	1040
24	5%	10%	5%				30%	50%			10%	5%	10%						50%	50%				1362
25						50%	30%	50%	10%	30%	10%	5%	10%						50%	50%				1477
26						50%	30%	50%	10%	30%	10%	5%	10%						50%	50%				1477
27	5%	10%	5%	10%	10%	50%	30%	50%																1393
28	5%	10%	5%	10%	10%	50%																		770
29	10%	10%	5%	20%	10%		30%		10%	30%														1098
30	10%	10%	5%	20%	10%		30%		10%	30%														1098
31	20%	5%																						374

	DAILY RESIDENTIAL TRAFFIC AT TRAFFIC NODE																							
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T		U	V	W
Block																								
	A1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	189	0	0	0	0	0	0	0	0
	A2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	234	0	0	0	0	0	0	0	0
	A3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	252	0	0	0	0	0	0	0	0
	A4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	252	0	0	0	0	0	0	0	0
	A5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	0	0	0	0	0	0	0	0
	B1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	270	0	0	0	0	0
	B2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	162	0	0	0	0	0	0	0
	B3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	95	95	0	0	0	0	0	0
	B4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	155	52	0	0	0	0	0
	B5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	126	0	0	0	0
	B7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	221	0	0	0
	B8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	267	0	0	0
	B9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	90	0	0	0	0	0	0
	B10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	108	0	0	0	0	0
	C1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	171	0	0	0	0	0	0	0	0
	C2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	144	0	0	0	0	0	0	0	0
	C3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	117	0	0	0	0	0	0	0	0
	C4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	234	0	0	0	0	0	0	0	0
	C5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	207	0	0	0	0	0	0	0	0
	C6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	279	0	0	0	0	0	0	0	0
	C7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	108	0	0	0	0	0	0	0	0
	C8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	99	0	0	0	0	0	0	0	0
	C9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	54	0	0	0	0	0	0	0	0
	C10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	99	0	0	0	0	0	0	0	0
	D1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	54
	D2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	153
	D3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	171
	D4																							
	E1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	198	0	0
	E2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	270	0
	E3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	54	0	0
	E4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	108	108	0
	E5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	126	0	0
	E6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	333	0
	E7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	475	0
	E8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F3	0	0	0	0	0	0	0	0	0	180	180	0	0	0	0	0	0	0	0	0	0	0	0	
F4	0	0	0	0	0	0	0	0	108	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
F5	0	0	0	0	0	0	0	0	144	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
F6	0	0	0	0	0	0	0	0	315	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
G1	0	0	0	0	0	0	0	0	0	0	0	0	414	0	0	0	0	0	0	0	0	0	0	
G2	0	0	0	0	0	0	0	0	0	0	0	0	171	0	0	0	0	0	0	0	0	0	0	
G3	0	0	0	0	0	0	0	0	0	63	0	0	63	0	0	0	0	0	0	0	0	0	0	
G4	0	0	0	0	0	0	0	0	0	95	0	0	95	0	0	0	0	0	0	0	0	0	0	
G5	0	0	0	0	0	0	0	0	0	261	0	0	0	0	0	0	0	0	0	0	0	0	0	
H1	0	0	0	0	0	0	0	513	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
H2	0	0	0	0	0	0	0	279	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
H3	0	0	0	0	0	162	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
H4	0	0	0	0	0	144	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
H5	0	0	0	0	0	135	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
H6	0	0	0	0	0	86	86	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
H7	0	0	0	0	0	0	297	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
H8	0	0	0	0	0	0	288	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
I1	0	0	0	95	95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
I2	0	0	0	205	137	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
I3	0	0	0	158	158	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
I4	0	0	0	0	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
I5	0	0	0	135	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
I6	0	0	0	378	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
I7	0	0	0	225	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
J1	0	0	130	0	0	0	86	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
J2	0	0	72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
J3	0	0	117	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
J4	0	0	108	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
K1	198	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
K2	54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
K3	81	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
K4	324	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
K5	252	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
K6	189	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
K7	108	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
K8	45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
L1	0	261	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
L2	0	162	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
L3	0	225	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
L4	0	108	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
L5	0	54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
L6	0	216	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
M1	0	81	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
M2	0	243	0	0																				

Block	Land Use							Daily Trip Generation						
	Single Dwelling	Med Density Res	Multiple Dwelling	Rural Res	Commercial / Retail	Servo	School	Single Dwelling	Med Density Res	Multiple Dwelling	Rural Res	Commercial / Retail	Servo	School
	No	No	No	No	m2	m2	Students	9/dwelling	6.5/dwelling	9/dwelling	9/dwelling	0.1/100m2 GFA	0.6/15* PM Peak	1.38/student
	No	No	No	No	m2	m2	Students	9/dwelling	6.5/dwelling	9/dwelling	9/dwelling	0.1/100m2 GFA	0.6/15* PM Peak	1.38/student
A1	21							189	0	0	0	0	0	0
A2	26							234	0	0	0	0	0	0
A3	28							252	0	0	0	0	0	0
A4	28							252	0	0	0	0	0	0
A5	4							36	0	0	0	0	0	0
B1	30							270	0	0	0	0	0	0
B2	18							162	0	0	0	0	0	0
B3	21							189	0	0	0	0	0	0
B4	23							207	0	0	0	0	0	0
B5							1160	0	0	0	0	0	0	1601
B6	11		3					99	0	27	0	0	0	0
B7		34						0	221	0	0	0	0	0
B8		41						0	267	0	0	0	0	0
B9			10					0	0	90	0	0	0	0
B10	6		6					54	0	54	0	0	0	0
C1	19							171	0	0	0	0	0	0
C2	16							144	0	0	0	0	0	0
C3	13							117	0	0	0	0	0	0
C4	26							234	0	0	0	0	0	0
C5	23							207	0	0	0	0	0	0
C6	21		10					189	0	90	0	0	0	0
C7	12							108	0	0	0	0	0	0
C8	11							99	0	0	0	0	0	0
C9	6							54	0	0	0	0	0	0
C10	11							99	0	0	0	0	0	0
D1			6					0	0	54	0	0	0	0
D2	17							153	0	0	0	0	0	0
D3	15		4					135	0	36	0	0	0	0
D4				4				0	0	0	36	0	0	0
E1	22							198	0	0	0	0	0	0
E2	18		12					162	0	108	0	0	0	0
E3	6							54	0	0	0	0	0	0
E4	24							216	0	0	0	0	0	0
E5	14							126	0	0	0	0	0	0
E6	37							333	0	0	0	0	0	0
E7		73						0	475	0	0	0	0	0
E8					1500			0	0	0	0	150	0	0
F1					6000	3600		0	0	0	0	600	2160	0
F2	11		10		2000			99	0	90	0	200	0	0
F3	40							360	0	0	0	0	0	0
F4				12				0	0	0	108	0	0	0
F5	16							144	0	0	0	0	0	0
F6	35							315	0	0	0	0	0	0
G1	36		10					324	0	90	0	0	0	0
G2	19							171	0	0	0	0	0	0
G3	14							126	0	0	0	0	0	0
G4	21							189	0	0	0	0	0	0
G5	29							261	0	0	0	0	0	0
H1	28		29					252	0	261	0	0	0	0
H2	31							279	0	0	0	0	0	0
H3	18							162	0	0	0	0	0	0
H4	16							144	0	0	0	0	0	0
H5	12		3					108	0	27	0	0	0	0
H6	16		3					144	0	27	0	0	0	0
H7	27		6					243	0	54	0	0	0	0
H8	26		6					234	0	54	0	0	0	0
I1	21							189	0	0	0	0	0	0
I2	32		6					288	0	54	0	0	0	0
I3	32		3					288	0	27	0	0	0	0
I4	10							90	0	0	0	0	0	0
I5	22		3					198	0	27	0	0	0	0
I6	42							378	0	0	0	0	0	0
I7	25							225	0	0	0	0	0	0
J1	24							216	0	0	0	0	0	0
J2	8							72	0	0	0	0	0	0
J3	13							117	0	0	0	0	0	0
J4	12							108	0	0	0	0	0	0
K1	22							198	0	0	0	0	0	0
K2	6							54	0	0	0	0	0	0
K3			9					0	0	81	0	0	0	0
K4	36							324	0	0	0	0	0	0
K5	28							252	0	0	0	0	0	0
K6	21							189	0	0	0	0	0	0
K7	12							108	0	0	0	0	0	0
K8	5							45	0	0	0	0	0	0
L1	29							261	0	0	0	0	0	0
L2	18							162	0	0	0	0	0	0
L3	25							225	0	0	0	0	0	0
L4	8				4			72	0	0	36	0	0	0
L5					6			0	0	0	54	0	0	0
L6	24							216	0	0	0	0	0	0
M1	9							81	0	0	0	0	0	0
M2	27							243	0	0	0	0	0	0
M3	25							225	0	0	0	0	0	0
M4	24							216	0	0	0	0	0	0
M5	28							252	0	0	0	0	0	0
M6	34							306	0	0	0	0	0	0
M7	13							117	0	0	0	0	0	0
								0	0	0	0	0	0	0
	1557	148	139	26	9500	3600	1160	14013	962	1251	234	950	2160	1601

APPENDIX: C

Sketch Sk-04 - Road Hierarchy



ROAD HIERARCHY LEGEND

- Sub Arterial**
Single Lane
21m Road Reserve
11m Roadway
- Primary Collector**
21 Road Reserve
11m Roadway
- Secondary Collector**
18m Road Reserve
8m Roadway
- Local Access**
16m Road Reserve
7m Roadway
- Minor Road**
16m Road Reserve
7m Roadway
- Minor Road**
15m Road Reserve
6m Roadway

LEGEND

- Site Boundary**
- Community Uses**
- Single Dwelling**
- Multiple Dwelling (MD)**
- Multiple Dwelling (MR)**
- Rural Residential**
- Town Centre Location**
- Public Open Space**
- Drainage/Public Open Space**

APPENDIX: Appendix D

“Pedestrian Gap Acceptance at Mid Block Crossings” (Yannis, Papadimitriou and Theofilatos 2010)

PEDESTRIAN GAP ACCEPTANCE FOR MID-BLOCK STREET CROSSING

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ABSTRACT

This research aims to investigate pedestrians traffic gap acceptance for mid-block street crossing in urban areas. In particular, two aspects of pedestrians crossing behaviour at mid-block locations are examined, namely the size of traffic gaps accepted by pedestrians and the decision or not to cross the street, as well as the related determinants. For this purpose, a field survey was carried out at an uncontrolled mid-block location in the centre of Athens, Greece. In this survey, pedestrians crossing decisions were videotaped in real traffic conditions. At the same time, the speed of incoming vehicles was measured by means of speed guns. The data collected included the number and the size of traffic gaps rejected or accepted by pedestrians, the related waiting times and number of crossing attempts, the vehicle's speed, as well as individual characteristics (gender, age etc.). A lognormal regression model was then developed in order to examine the effect of various parameters on pedestrian gap acceptance, defined as the size of traffic gaps accepted by pedestrians. It was found that pedestrian's gap acceptance was better explained by the distance from the incoming vehicle, rather than its speed. Moreover, the presence of illegally parked vehicles (which may affect pedestrians' visibility), the size of the incoming vehicle and the presence of other pedestrians were found to have important effect on the size of traffic gaps accepted by pedestrians. A binary logistic model was also developed in order to examine the effect of the traffic gaps available and of other parameters on the decision of pedestrians to cross the street or not. The modeling results reveal that this type of crossing decision is largely defined by the distance from the incoming vehicles and the waiting time of pedestrians.

KEY-WORDS:

pedestrian; mid-block crossing; gap acceptance; lognormal regression; binary logistic regression.

INTRODUCTION

Many researches correlate the minimum gap from the vehicle that is accepted by pedestrians who intend to cross streets at mid-block. These parameters may be associated with traffic conditions and with vehicle and pedestrian characteristics. In most of these researches (Oxley et al., 2005; Das et al., 2002) the distance between the vehicles and the pedestrians appears to influence the most the minimum gap accepted by pedestrians. In addition, an increase in traffic density leads to smaller accepted gaps. These gaps are often described by means of probability distributions or are estimated by means of linear regression modeling. Indicatively, it can be mentioned that the minimum accepted gap has been estimated at two seconds and the mean accepted gap at eight seconds (Das et al., 2002).

Another issue often examined concerns the decision of pedestrians to cross the road or not (Chu et al. 2002; Sun et al. 2003), which has been found to depends more on the distance between the vehicle and the pedestrian and not so much on the related time gap. As a result, pedestrians may choose inappropriate time gaps, because they are not able to estimate the actual speed of incoming vehicles. Other parameters that affect crossing decisions include the presence of police enforcement and the behaviour of other pedestrians (Lobjois & Cavallo, 2006; Oxley et al. 2005). Discrete choice modeling is used by most researchers in order to estimate whether pedestrians are going to cross a street at mid-block or not (Papadimitriou et al. 2009; Lassarre et al. 2007).

However, most of the above mentioned researches were carried out in Northern and Western Europe or in the United States, where transport systems and infrastructure correspond to improved levels of service of pedestrians, resulting in a generally compliant behaviour from the part of the pedestrians as well. As a consequence, the results of these researches cannot be transferred and used in a national setting like the one of Greece, because the Greek road and transport network has different characteristics and operational conditions. Not only is the road infrastructure and traffic control often inadequate for pedestrians, but also the behaviour of pedestrians is particularly non-compliant and often risk-taking. This is partly reflected in the increased proportion of road accidents involving pedestrians in Greece.

In this context, the aim of this research is to investigate pedestrians' traffic gap acceptance for mid-block street crossing in urban areas. In particular, the effect of several factors, such as pedestrians waiting time, the presence of illegal parked vehicles etc.), the vehicles' characteristics (speed, size) and finally pedestrians' characteristics (gender, age) affect the traffic gap acceptance of pedestrians and their decision to cross or not.

For this purpose, a field survey was carried out at an uncontrolled mid-block location in the center of Athens. Moreover, a lognormal regression model was then developed in order to examine the effect of various parameters on pedestrian gap acceptance, defined as the size of traffic gaps accepted by pedestrians. A binary logistic model was also developed, so that the effect of the traffic gaps available and of other parameters on the decision of pedestrians to cross the street or not is examined..

METHODOLOGY

A field survey was carried out in the center of Athens, in Solonos street. This location was chosen due to considerable volume of pedestrians. In this survey, pedestrians crossing decisions were videotaped in real traffic conditions. The data collected included the number and the size of gaps rejected or accepted by pedestrians, the related waiting times and number of crossing attempts, each vehicle's speed as well as some individual characteristics (gender, age etc.). It is important to mention that illegal parking in this area was very frequent and the presence of illegally parked vehicles was recorded during the data collection.

The aim of the survey was to videotape those pedestrians, who intended to cross vertically the Solonos street. More specifically, only pedestrians who actually crossed the street, either immediately or after several attempts (i.e. accepting the first traffic gap available or rejecting several gaps before crossing) were captured; pedestrians who abandoned the crossing task after some attempts, and sought for a crossing opportunity elsewhere, were not included in the sample. Particular care was taken that data were recorded only during the green signal of the nearby traffic lights, so that pedestrians would make an unprotected crossing by interacting with the incoming vehicles. Moreover, congestion conditions were not included in the data. The data collected were validated and after a thorough quality control, they were introduced into a specially designed database, so that it could be possible to calculate the traffic gap that was rejected or accepted by the pedestrian in centiseconds.

The data recording of traffic gaps accepted was based on two time points: At the first point, the pedestrian is just ready to set foot on the street. In the second point, the head of the vehicle has just passed through vertical virtual line indicating the pedestrian's crossing path. Therefore, the traffic gap accepted was calculated as the difference in centiseconds between the two time points. Moreover, the waiting time of the pedestrian started when someone approached the pavement until he set foot on the street. It is noted that these calculations included only the accepted gaps and not the rejected ones.

At the same time, the speed of incoming vehicles was measured by means of speed laser guns. The speed of the incoming vehicle was measured at the moment when the pedestrian just started to cross, and was considered to be constant during the pedestrians crossing time.

The continuous variables collected and their descriptive statistics are summarized in Table I, whereas the (mostly coded as binary) discrete variables considered are summarized in Table II.

Table I. Descriptive statistics of continuous variables

Variables	N	Minimum	Maximum	Mean	Standard Deviation
Waiting time (sec)	243	0	37,32	6,21	6,12
Speed (km/h)	243	4	48	25,21	7,82
Distance (m)	243	2,97	64,98	30,07	12,08
Traffic gap(sec)	243	0,50	11,11	3,29	1,76

Table II. Values and percentages of discrete variables

Variables	Value '0'	Value '1'	% of value '1' in the sample
gender	woman	man	56.8%
size	small vehicle	large vehicle	47.0%
crossing	did not cross	crossed	54.0%*
Illegal parking	no	yes	82.3%
Accompanied	pedestrian alone	pedestrian accompanied	11.5%
Lane	Vehicle in nearside lane	Vehicle in farside lane	25.0%
Vehicle type: Motorcycle	no	yes	34.6%
Vehicle type: Car	no	yes	26.3%
Vehicle type: Taxi	no	yes	23.0%
Vehicle type: Truck	no	yes	2.5%
Vehicle type: Bus	no	yes	8.2%
Age group: Young	no	Aged 18-35 years	39.5%
Age group: Middle	no	Aged 35-60 years	36.7%
Age group: Old	no	Aged >60 years	16.5%

*concerns more than one crossing attempts per pedestrian

It is noted that these variables are considered to be the most important ones affecting pedestrian crossing behaviour at mid-block, according to the literature (Papadimitriou et al. 2009). Additional variables that may be considered concern traffic flow and weather conditions, which were not meaningful in the present research, given that the survey took place in good weather conditions and during a period without any significant traffic variation.

RESULTS

Modelling traffic gaps

After a number of trials in order to statistically process the data and to develop mathematical models about the minimum pedestrians' gap acceptance, a lognormal regression model (Bradú & Mundlak, 1970) was selected, given that a normal distribution could be successfully fitted to the logarithm of the gaps (but not to the initial values of the gaps). It is noted that lognormal regression assumes a normal distribution for the logarithm of the dependent

variable, and was thus preferred over log-linear regression, which assumes a Poisson distribution for the dependent variable. The final model was the following:

$$\text{Log-Gap} = 0.262 + 0.009 * \text{distance} + 0.05 * \text{size} + 0.043 * \text{accompanied} + 0.048 * \text{parking} + 0.025 * \text{gender}$$

Where,

Distance: the space between the vehicle and the pedestrian

Size: the size of the vehicle that is small or big

Accompanied: the pedestrian is accompanied by another pedestrian or not

Parking: presence of illegally parked cars

Gender: gender of the pedestrian

The goodness of fit measure R^2 is equal to 0.455 for this model whereas all the above variables were statistically significant at 95%. A residual analysis took place in order to test the good fitness of the model. It was found that the residuals follow the normal distribution. Their mean value was almost zero and they had equal variances (homoscedasticity tests). It was also confirmed that the recorded log-gaps are normally distributed as well.

Moreover, an analysis of elasticities (e) was carried out, as shown in Table III. The relative effect (e^*), as a normalization of the estimated elasticities in relation to the lowest elasticity, was also calculated in order to show clearly to which extent each of the independent variables affects the dependent variable. Although elasticity is to be typically calculated for continuous variables, it was also estimated for discrete variables in order to compare the magnitude of effects of all independent variables. The point elasticity (e_i) of the dependent variable to the independent ones for each pedestrian (i) in the sample is calculated straightforward according to the following formula, whereas the overall elasticity (e) is calculated as the average of (e_i) in the sample:

$$e_i = (\Delta Y_i / \Delta X_i) (X_i / Y_i) = \beta_i (X_i / Y_i)$$

Table III. Parameter estimates, statistical significance and elasticities in the gap acceptance model

Independent variables	Log(gap)			
	β_i	p-value	Elasticities	
			e_i	e_i^*
Distance	0.009	0.000	0.423	51.62
Size of the vehicle	0.050	0.002	0.039	4.79
Accompanied	0.043	0.082	0.008	1.00
Illegal parking	0.048	0.019	0.065	7.92
Gender	0.025	0.116	0.023	2.86

The results suggest the following:

1. The distance between the vehicle and the pedestrian has the greatest effect on pedestrian log-gap acceptance. This appeared to be intuitive, because it was shown in the videotapes that those pedestrians who crossed the road when the vehicle was close to them had accepted smaller gaps than those who chose to cross the road when the vehicle was far away. Thus, the former pedestrians were more risky than the latter ones.
2. The presence of illegal parking has the second larger effect on log-gap acceptance. Illegal parking made pedestrians more careful and acceptant of larger gaps.
3. Vehicle size follows with the third higher elasticity. It appears that pedestrians accept larger gaps when facing larger vehicles.
4. Men appear to take fewer risks than women, as they generally accept larger gaps, a finding also reported by Hamed (2001).
5. The parameter that has the lowest effect on log-gap acceptance is the one indicating that accompanied pedestrians seem to accept relatively larger gaps.

The calculation of the value of e^* was straightforward. If the variable 'accompanied' has an elasticity of 1, then the variable 'gender' has an elasticity of 2,86, that is it effects the gap acceptance 2,86 times more than the 'accompanied' variable. Then the size of the vehicles will have a 4,79 greater effect on the gap and so on. It is noted, however, that the elasticities of continuous variables are not directly comparable with those of discrete variables, and consequently the estimated value of e^* for 'distance' should be compared to the other e^* values with particular caution. Nevertheless, the dominant effect of distance is confirmed when considering that an increase of 1% in the distance of the incoming vehicle results in an increase of 42% of the traffic gap accepted. On the other hand, all the other categorical variables' elasticities are less than 6%; although these can not be directly attributed to 'incremental changes' in the variables, they are almost 10 times lower than the elasticity of distance.

After all that a sensitivity analysis was carried out to comprehend the effect of the independent variables on the dependent variable even better. For example, in Figure 1 it can be seen that the sensitivity of the gaps accepted to the distance from the incoming vehicle increased with the size of the vehicle and with the presence of illegal parking.

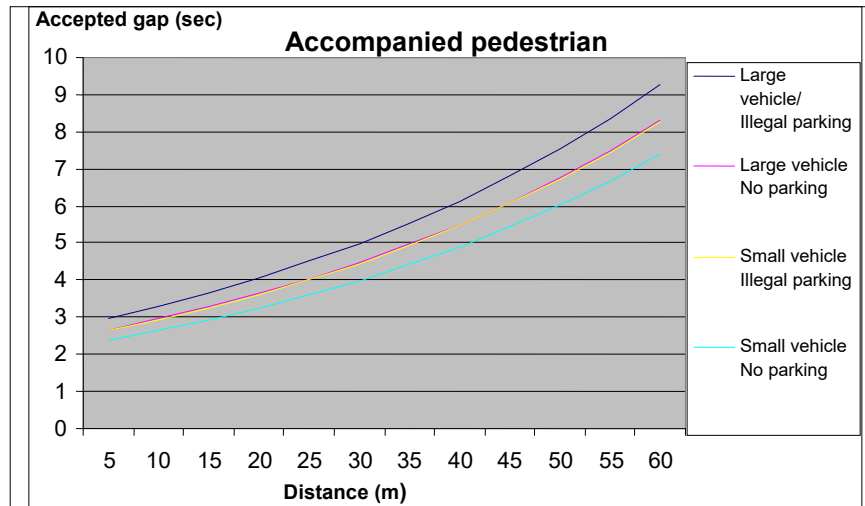


Figure 1. Sensitivity of gaps accepted to the distance from the incoming vehicle - Accompanied male pedestrians

Modelling mid-block crossing choice

A binary logistic regression (Washington et al. 2003) was selected in order to estimate the decision of the pedestrian to cross the street or not. The best model developed is the following:

$$U = -5.241 - 0.25 * \text{wait} + 2.161 * \text{gap} + 1.078 * \text{car} + 0.969 * \text{parking}$$

Where,

Wait: waiting time

Gap: the gap from the vehicle

Car: if the type of vehicle is passenger car

Parking: presence of illegal parking

It is important to outline two issues. The first is that the above equation corresponds to a Utility Function. So, the probability that a pedestrian crosses the street is:

$$P = e^u / (e^u + 1)$$

The second is a note that in this model both the accepted gaps and the largest one of the rejected gaps were used, whilst in the previous model only the accepted gaps were used.

The elasticity analysis for this model is presented in Table 4 and the results can be summarized as follows:

1. The traffic gap has the greatest effect on pedestrians' decision to cross the street or not. It was found that, as expected, the higher the available gaps, the easier the crossing.
2. The variable with the second greater effect is the waiting time. As pedestrians keep waiting to cross the road, the probability to cross is decreasing. That may seem

counter-intuitive, but can be explained as follows: those pedestrians who intend to wait for a long time to cross the street are most careful and they will not take risks.

3. The presence of illegal parked vehicles leads pedestrians to cross the road. This may be attributed to the fact that a crossing seems safer when part of the crossing distance is taken by parked vehicles. However, illegal parking seems to have two different effects on pedestrians gap acceptance and their decisions to cross or not. This is something which needs further investigation.
4. When the incoming vehicle is a passenger car, the crossing probability increases; however, this variable has the lowest effect. It is noted that vehicle type was found to be significant in this model, whereas vehicle size was significant in the gap acceptance model.

Table IV. Parameter estimates, statistical significance and elasticities for the crossing decision model

Independent variables	Crossing or not			
	β_i	p-value	Elasticities	
			e_i	e_i^*
Waiting time	-0.250	0.000	0.202	12.75
Traffic gap	2.161	0.000	0.764	48.26
Type of vehicle: car	1.078	0.013	0.015	1.00
Illegal parking	0.969	0.080	0.123	7.77

It is interesting to note that none of the pedestrians' individual characteristics tested were found to be significant in the crossing choice model; it is likely that these effects are included in the 'traffic gap' variable, given that this variable was found to be affected by certain characteristics of the pedestrian. A sensitivity analysis for this model is presented in Figure 2, showing that, in favourable conditions (i.e. passenger car incoming and presence of illegal parking) pedestrians probability to cross decreases with waiting time. It appears that the majority of pedestrians would accept a 6 seconds gap. The crossing probability when a gap is larger than 6 seconds is almost 100%. Moreover, waiting time increases the probability that a pedestrian crosses the street is falling. As mentioned before, pedestrians who are willing to wait for a long time do not intend to take high risks. Similar findings are reported by Hammed (2001) and Tiwari et al. (2007), who analysed the relationship between pedestrian waiting time and crossing probability by means of survival analysis.

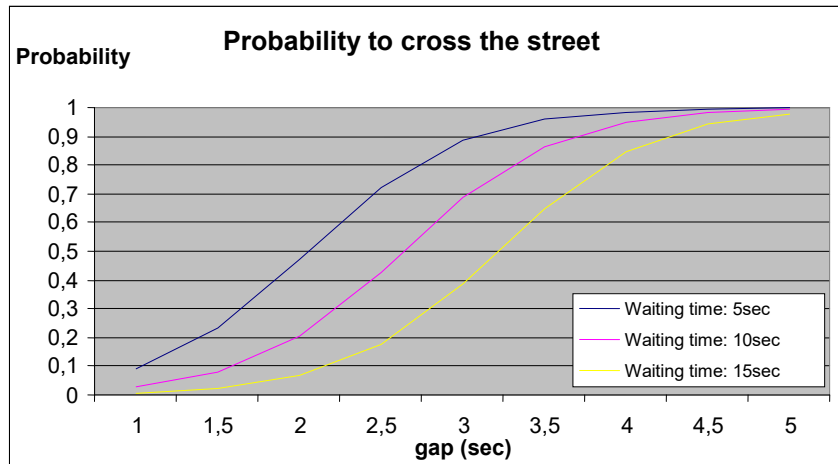


Figure 2. Sensitivity of crossing probability to traffic gaps for different waiting times

CONCLUSIONS

An experimental survey was carried out in Athens, Greece in order to investigate pedestrian traffic gap acceptance for Mid-block Street crossing in urban areas. The majority of the previous studies examined the issue of critical gap acceptance or the decision to cross the street by means of either simulation methods (Simpson, 2003; teVelde et al. 2005) or field surveys (Hine & Russel, 1996). In this research, a field survey was opted for, allowing to observe the actual crossing behavior.

With respect to analysis methods, a lognormal regression analysis was implemented for modeling pedestrians' traffic gap acceptance. It was found that the accepted gaps depend on the distance from the incoming vehicle, the size of the vehicle, the presence of illegal parking, the gender of the pedestrians and whether he is accompanied by another pedestrian. It seems that men select the highest and the safest gaps, especially when they are accompanied, when the incoming vehicle is large and when there is illegal parking.

The statistical analysis of the decision to cross the street or not was carried out by using binary logistic regression. The results suggest that pedestrians' decision to cross the street depends on the traffic gap, the waiting time, the type the incoming vehicle and the presence of illegally parked vehicles.

The results of this research confirm previous findings as regards the effects of basic roadway and traffic parameters on pedestrians crossing decisions. Moreover, it was found that pedestrians crossing decisions are strongly associated with the distance from the incoming vehicle, rather than its speed, possibly because vehicle distance can be more easily assessed by pedestrians. It is noted that in several studies report a dominant effect of distance rather than time for gap selection, whereas speed measurements are seldom available (Papadimitriou et al. 2009; Theofilatos, 2009).

Pedestrians' individual characteristics were not found to be significant in this research; only pedestrian's gender was found to affect gap acceptance. On the contrary, traffic conditions were found to be the most important determinants of crossing behaviour. This may be attributed to the fact that all survey participants can be considered to have a strong familiarity with the survey site, as this is located in a very central area, resulting in less uncertainty in the decisions of those groups of pedestrians that are often associated with particular behaviours (e.g. children, elderly).

REFERENCES

- Baltes M.R. and Chu X. (2002). Pedestrian level of service for mid-block street crossings. 81st Annual Meeting, Transportation Research Board, January 13-17, Washington DC, 2002.
- Bradu, D., Mundlak Y. (1970). Estimation in lognormal linear models. *Journal of the American Statistical Association* 65, pp. 198-211.
- Chu X., Gittenplan, M., Baltes M. (2002). Why People Cross Where They Do - The Role of the Street Environment. In the Proceedings of the TRB 81st Annual Meeting, Transportation Research Board, Washington, 2002.
- Das S., Manski C.F., Manuszak M. (2005). Walk or Wait? An Empirical Analysis of Street Crossing Decisions. *Journal of Applied Econometrics* 20 (4), pp. 445-577.
- Hamed M.M. (2001). Analysis of pedestrians' behaviour at pedestrian crossings. *Safety Science* 38, pp. 63-82.
- Hine J., Russel J. (1993). Traffic barriers and pedestrian crossing behaviour. *Journal of Transport Geography* 1 (4), pp. 230-239.
- Lassarre S., Papadimitriou E., Yannis G., Golias J. (2007). Measuring accident risk exposure for pedestrians in different micro-environments. *Accident Analysis and Prevention* 39, 1226-1238.
- Lobjois R., Cavallo V. (2006). Age-related differences in street crossing-decisions: The effects of vehicle speed and time constraints on gap selection in an estimation task. *Accident Analysis Prevention* 39 (5), 934-943.
- Oxley, J., Fildes, B., Ihsen, E., Charlton, J., and Days, R. (2005). Crossing roads safely: An experimental study of age differences in gap selection by pedestrians. *Accident Analysis and Prevention* 37, pp. 962-971.
- Papadimitriou E., Yannis G., Golias J. (2009). A critical assessment of pedestrian behaviour models. *Transportation Research Part F* 12, 242-255.
- Simpson G., Johnston L., Richardson M. (2003). An investigation of road crossing in a virtual environment. *Accident Analysis and Prevention* 35, pp. 787-796.
- Sun D., Ukkusuri S.V.S.K., Benekahal R.F., Waller S.T. (2003). Modeling of Motorist-Pedestrian Interaction at Uncontrolled Mid-block Crosswalks. In the Proceedings of the 82nd TRB Annual Meeting, Transportation Research Board, Washington, 2003.
- Te Velde A.F., van der Kamp J., Barela J.A., Savelsbergh G.J.P. (2005). Visual timing and adaptive behavior in a road-crossing simulation study. *Accident Analysis and Prevention* 37, pp. 399-406.
- Theofilatos A. (2009). Investigation of the minimum gap accepted by pedestrians for urban street mid-block crossing. Diploma Thesis. National Technical University of Athens,

School of Civil Engineering, Department of Transportation Planning and Engineering,
Athens, March 2009 (In Greek).

- Tiwari G., Bangdiwala S., Saraswat A., Gaurav S. (2007). Survival analysis: Pedestrian risk exposure at signalized intersections. *Transportation Research Part F* 10, pp. 77-89.
- Washington S.P., Karlaftis M.G., Mannering F.L. (2003). *Statistical and Econometric Methods for Transportation Data Analysis*. Chapman & Hall / CRC Press, Boca Raton, FL.

Appendix E

Zuccoli Road Classification Assessment



Northern Territory Government
Zuccoli Stage Development
Addendum 2 to road classification report

September 2015

Disclaimer

This report: has been prepared by GHD for Northern Territory Government and may only be used and relied on by Northern Territory Government for the purpose of determining road classifications in the proposed Zuccoli development.

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The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this Report are based on assumptions made by GHD when undertaking services and preparing the Report ("Assumptions"), including (but not limited to):

- *precinct development estimations, as detailed in Table 1 of this Report;*
- *traffic generation rates, as detailed in Table 2 of this Report;*
- *traffic generation splits, as detailed in Table 4 of this Report; and*
- *traffic distributions, as detailed in Table 6, Table 7, Table 14, Table 15 and Table 16 of this Report*

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Appendices

Appendix A Trip generation calculations

Appendix B External trip distribution

Appendix C Trip distribution matrices

Appendix D Model results

1. Introduction

This report is the second addendum to the existing Zuccoli stage development road classification assessment (GHD doc ref 214204) and should be read in conjunction with that report and the first addendum (GHD doc ref 231429).

This report assesses the impacts of a revised development and road network layout and compares it to the previous layout. The scope of works is to:

- Estimate traffic volumes on the 'main' road network at full occupation, the number of traffic lanes required and where turning lanes would be required at intersections; and
- Compare new mid-block volumes and discuss the impact of the new volumes compared to previous.

Background documents

In preparing this report, reference has been made to the following documents:

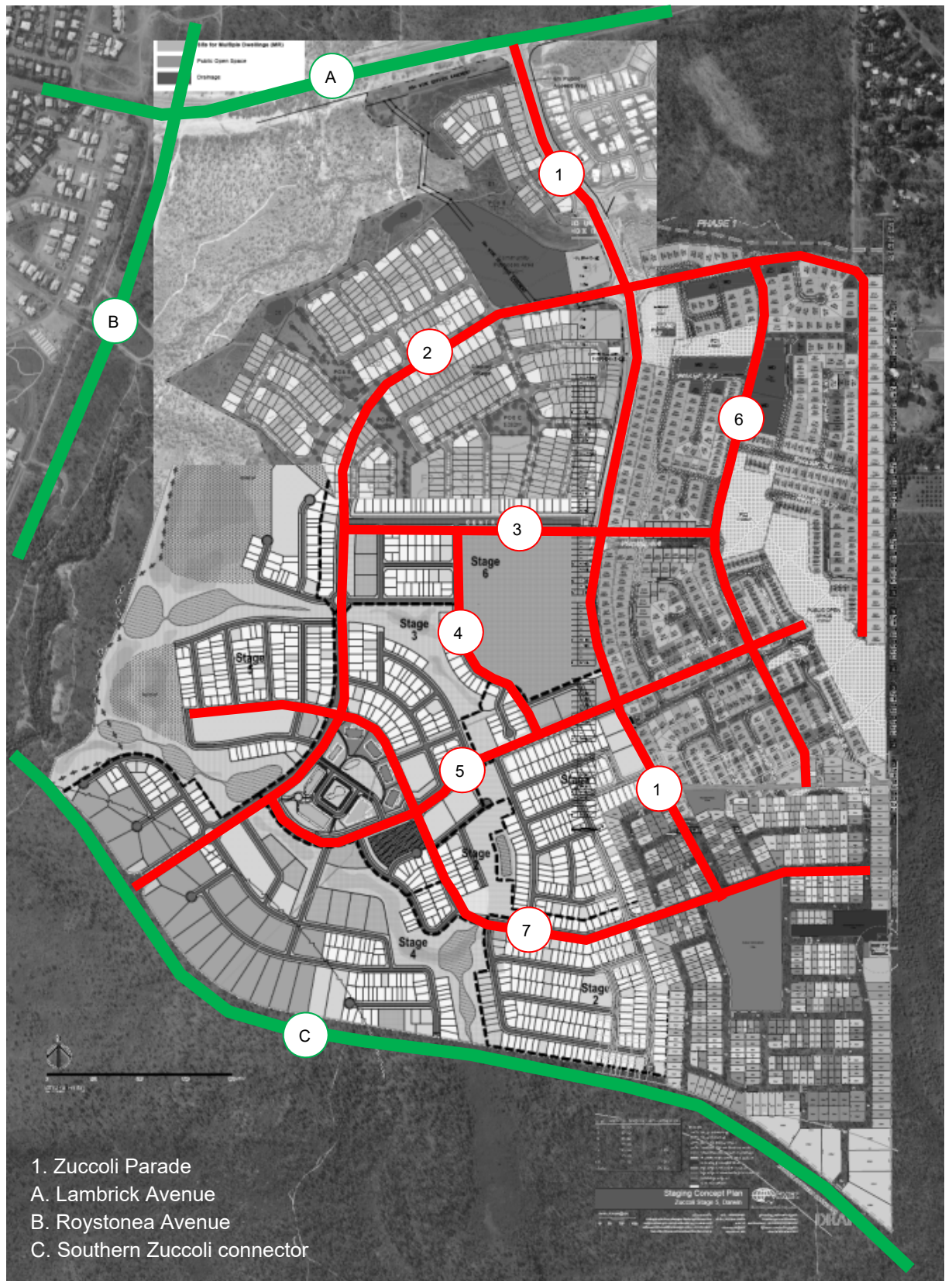
- Institute of Transportation Engineers, Trip Generation (Fifth Edition), 1991;
- City of Palmerston, Development Guidelines, June 2015;
- Road and Traffic Authority (NSW), Guide to Traffic Generating Developments (Version 2.2), October 2002; and the 2013 update TDT 2013/4a;
- The following lot yield and layout plans:
 - Zuccoli Stage 1 overall yield layout (drawing number B00049-DAP-Y01 rev J), BMD Consulting, 29/10/2014;
 - Development concept, Zuccoli Stage 2 (drawing number 714-030 CP01A), TPG, 30/01/2014;
 - Zuccoli Stage 3 and 4 Master Planning zone layout (drawing number 2 of 23, job number db2197), Bennett Design, May 2015; and
 - Staging concept plan, Zuccoli Stage 5 (drawing number 30080087P), SMEC, 25/06/2015.
- Lot yields provided by DLPE between 31 July and 4 August 2015.
- Austroads Guide to Traffic Management, Part 3 – Traffic Studies and Analysis, 2009;
- Department of Lands and Planning, The Greater Darwin Region Land Use Plan – Towards 2030 Consultation Paper, February 2011.

2. Revised development

2.1 Road network

The revised road network is shown in Figure 1. Generally the road network is similar to the previous version. The red roads are the internal roads which are the subject of this study, while the green roads are the external distributor roads.

Figure 1 – Revised Zuccoli road network



2.2 Lot yields

The revised lot yields are shown in Table 1.

Table 1 Revised lot yields for Zuccoli

Precinct	Residential dwellings					CM	ED
	RR	RL	SD	MD	MR		
1.1			141				
1.2.1			70	7			
1.2.2						32.66	
1.2.3			18				
1.2.4			43	3			
1.3.1-3			143				
1.3.4-5			84				
1.3.6			40	10			
1.3.7			28	19			
1.3.8			35				
1.3.9			43	5			
1.3.10			40	2			
1.3.11			43	25			
3/4.1			153	67	9		
3/4.2			191	6	11		
3/4.3			69	6	30	74.8	
3/4.4			106	7	17		
3/4.5			134	7	4		
5AB			90				
5C			88				
5DEF	7		266				
2A			46				
2B					1		
2C			98				
2D			62				
2E			49				
2F			123	2			
2G			54				
2H			58	3	1		
School							1000
Mitchell	260						
Radford			32				

Source: NTG, January 2014

RR = rural residential; RL = rural living; SD = single dwelling; MD = multiple dwelling; MR = medium density; CM = commercial (x 100 m²); ED = education (students)

3. Classification assessment

3.1 Trip generation

3.1.1 Daily trip generation

The trip generation rates that have been used are shown in Table 2.

Table 2 Trip generation rates

Land use		Daily vehicle trip rates		Source
Rural residential	RR	9	trips /dwelling	RTA 3.3.1
Rural living	RL	9	trips /dwelling	RTA 3.3.1
Single dwelling residential	SD	9	trips /dwelling	RTA 3.3.1
Multiple dwelling residential	MD	6.5	trips /dwelling	RTA 3.3.2
Medium density – 3 storey residential	MR	5	trips /dwelling	RTA 3.3.2
Commercial	CM	10	trips /100 m ² GFA	RTA 3.5
Education use	ED	1.38	trips /enrolment	ITE

An argument could be made to use the new trip generation rates given in the update to the RTA Guide to Trip Generating Developments (TDT 2013/4a) as these reflect the most recent research. However, the revised rates have not been used for the following reasons:

- The old rates maintain consistency with previous versions of this study;
- The new rates are based on a relatively small number of surveys; six for the Sydney urban area and five for regional towns (one in each).
- The regional rates are considered too low for use in capital city suburbs. The lower rates given in TDT 2013/4a (7.4 vpd vs 9.0 vpd) are for smaller regional towns such as Coffs Harbour, Orange and Wagga Wagga.
- The new rates do not include trips made wholly within the suburb. Such trips can often account for up to 25% of all trips generated by a suburb. The methodology used in previous versions of this study was based on the 2002 version of the RTA Guide, which does include these trips, so the new rates would need to be factored up by 25% to allow for this.
- The new rates represent a compromise between the new regional and urban rates.

Based on the distribution of land uses within Zuccoli as detailed in Table 1, the total daily trip generation at ultimate development of Zuccoli can be estimated, as shown in Table 3. A breakdown of the trip generation by development precinct and by land use is included in Appendix A.

Applying these trip generation rates to the lot yields shown in Table 1 produces the daily trip generation for the development. This is shown in Table 3.

Table 3 Vehicle trips per day

Land use	Expected development		Estimated daily trips
Residential	2,849	Dwellings	24,944
Education	1,000	Students	1,380
Commercial	107.46	100 sqm GFA	1,075
Total			27,399

The total of 27,399 daily trips is less than the previous total of 33,673 trips.

Assumptions made in determining the daily trip generation include:

- Dwelling estimates for each precinct have conservatively been assumed as the maximum density lot yield estimates;
- Due to the complexity of analysis, it has been assumed that there will be no trips between residential dwellings within Zuccoli; and
- The education land use in Stage 3 and 4 is assumed to accommodate two schools of 500 students each, similar to assumptions used for other subdivisions in City of Palmerston.

3.1.2 Peak hour traffic generation

The RTA *Guide to Traffic Generating Developments* indicates 10% of residential daily trips typically occur during the peak hour. It is assumed that 50% of school based trips occur in the AM peak hour and 30% in the PM peak hour. For commercial based trips, it is assumed that 10% occur in the AM peak hour and 20% occur in the PM peak hour.

Estimated directional splits for each of the land uses are listed in Table 4.

Table 4 Peak hour traffic generation splits

Land use	AM peak			PM peak		
	Per cent of daily trips in peak	Inbound	Outbound	Per cent of daily trips in peak	Inbound	Outbound
Residential	10%	20%	80%	10%	70%	30%
School	50%	55%	45%	30%	45%	55%
Commercial	20%	80%	20%	20%	20%	80%

Table 5 summarises peak hour trips associated with the various land uses at ultimate development of Zuccoli.

Table 5 Peak hour traffic generation – total site

Land use	AM peak			PM peak		
	Inbound	Outbound	Total	Inbound	Outbound	Total
Residential	499	1,996	2,494	1,746	748	2,494
School	380	311	690	186	228	414
Commercial	172	43	215	43	172	215
Total	1051	2,350	3,399	1,975	1148	3,123

3.1 Peak hour traffic distribution

A high level trip purpose distribution has been adopted for each of the AM peak and PM peak periods to understand the magnitude of trips along the internal road network and at the intersections with the external road network.

This is listed in Table 6 and Table 7 for the AM peak and PM peak, respectively. Complete details of the trip distribution are contained in Appendix B.

Table 6 High level trip purpose distribution (AM peak)

		TO			
		Residential	Education	Commercial	External
FROM	Residential	0%	15%	5%	80%
	Education	75%	0%	5%	20%
	Commercial	5%	0%	0%	95%
	External	45%	40%	15%	0%

Table 7 High level trip purpose distribution (PM peak)

		TO			
		Residential	Education	Commercial	External
FROM	Residential	0%	20%	3%	77%
	Education	40%	0%	3%	57%
	Commercial	55%	0%	0%	45%
	External	65%	25%	10%	0%

The trips originating or destined for external locations were further disaggregated by firstly assuming a trip purpose split and then a location split. Details of this analysis are tabulated in Table 8 and Table 9 overleaf.

It is noted that the assumptions of trip distribution are informed by a high level understanding of the existing and proposed land uses surrounding the Zuccoli subdivision.

As a result of this analysis, the estimated peak hour trips generated by each of the land uses are able to be split by origin and destination.

Table 8 Trip distribution by internal land use and external locations (AM peak)

			TO						
			Internal			External			
			Residential	Education	Commercial	Palmerston	Howard Springs	Weddell & South	Darwin
FROM	Internal	Residential		299	100	825	48	44	680
		Education	233		16	39	2	4	17
		Commercial	2			26	0	2	13
	External	Palmerston	174	49	45				
		Howard Springs	30	8	5				
		Weddell & South	16	8	6				
		Darwin	44	16	1				

Table 9 Trip distribution by internal land use and external locations (PM peak)

			TO						
			Internal			External			
			Residential	Education	Commercial	Palmerston	Howard Springs	Weddell & South	Darwin
FROM	Internal	Residential		150	22	383	37	39	116
		Education	91		7	83	10	13	23
		Commercial	95			48	3	7	19
	External	Palmerston	937	21	8				
		Howard Springs	27	1	0				
		Weddell & South	56	2	0				
		Darwin	540	12	6				

The distribution of peak hour trips as listed in Table 8 and Table 9 can be further disaggregated to a precinct level to estimate the movement along the four roads. Residential based trips as listed in Table 8 and Table 9 are split amongst the precincts based on the percentage of daily residential trips generated by each precinct. The same approach is adopted for education and commercial trips.

As a result of this precinct-level distribution, a trip distribution matrix for Zuccoli for each of the AM and PM peaks can be developed. These are presented in Appendix C.

3.2 Traffic modelling results

The volumes forecast by the traffic model in the heart of Zuccoli are shown in Figure 2 to Figure 4 overleaf. Larger plots of the whole network are shown in Appendix D.

As explained in the overarching road classification assessment report (to which this document is an addendum), the volumes shown on the figures are development volumes only; i.e. they do not show volumes on existing roads.

This means that on existing roads (such as Lambrick Avenue, Roystonea Avenue and Stuart Highway) the forecast development volumes should be added to existing volumes (adjusted for any background growth) to obtain the final forecast volumes on those roads.

Based on the forecast volumes, the following volumes will be added to the following roads:

Table 10 Forecast increases in traffic volumes on selected roads

Road	Forecast <i>increase</i> in AM peak volume (vph)	Forecast <i>increase</i> in PM peak volume (vph)
Stuart Highway	711 NB	559 SB
Roystonea Avenue	888 NB	966 SB
Lambrick Avenue	760 EB	592 EB

As these volumes are almost a full lane's worth of additional traffic (more than one lane's worth on Roystonea Avenue) this additional volume will need to be considered when planning for the future of these roads.

3.3 External through traffic

As there is no obvious or simple route north-south through Zuccoli from external areas, it is considered unlikely that traffic travelling between external destinations would travel through the development. It is far more likely that traffic would use the southern Zuccoli connector road and Roystonea Avenue to bypass Zuccoli. Therefore, an allowance for trips between external destinations has not been made in the traffic model and a separate assessment has not been undertaken.

The exception to this is for the future Mitchell development to the south of Zuccoli. It is anticipated that this area would eventually accommodate up to 260 rural living dwellings, although the timetable for development has not yet been set. Nevertheless, these have been allowed for in the Zuccoli model.

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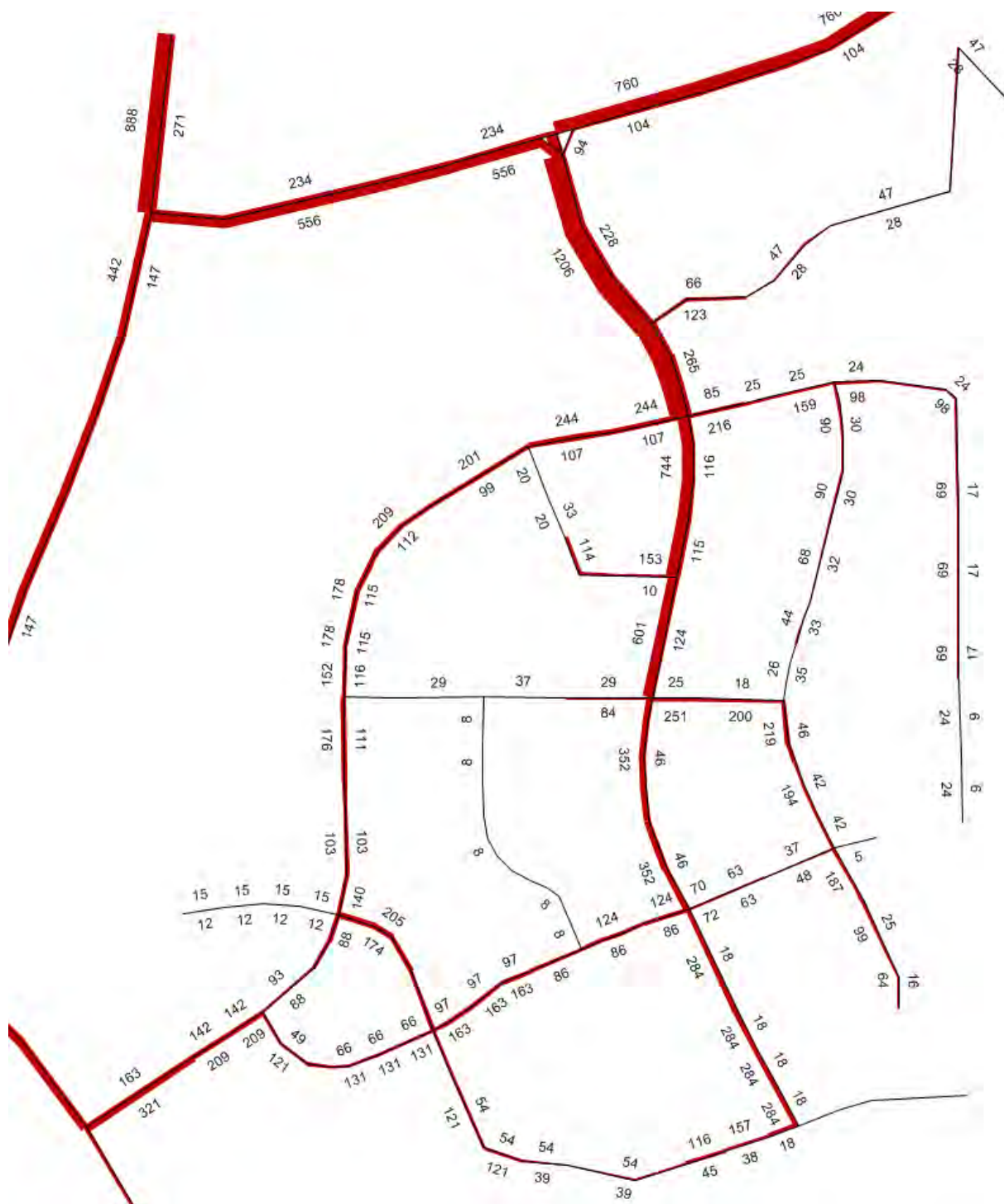
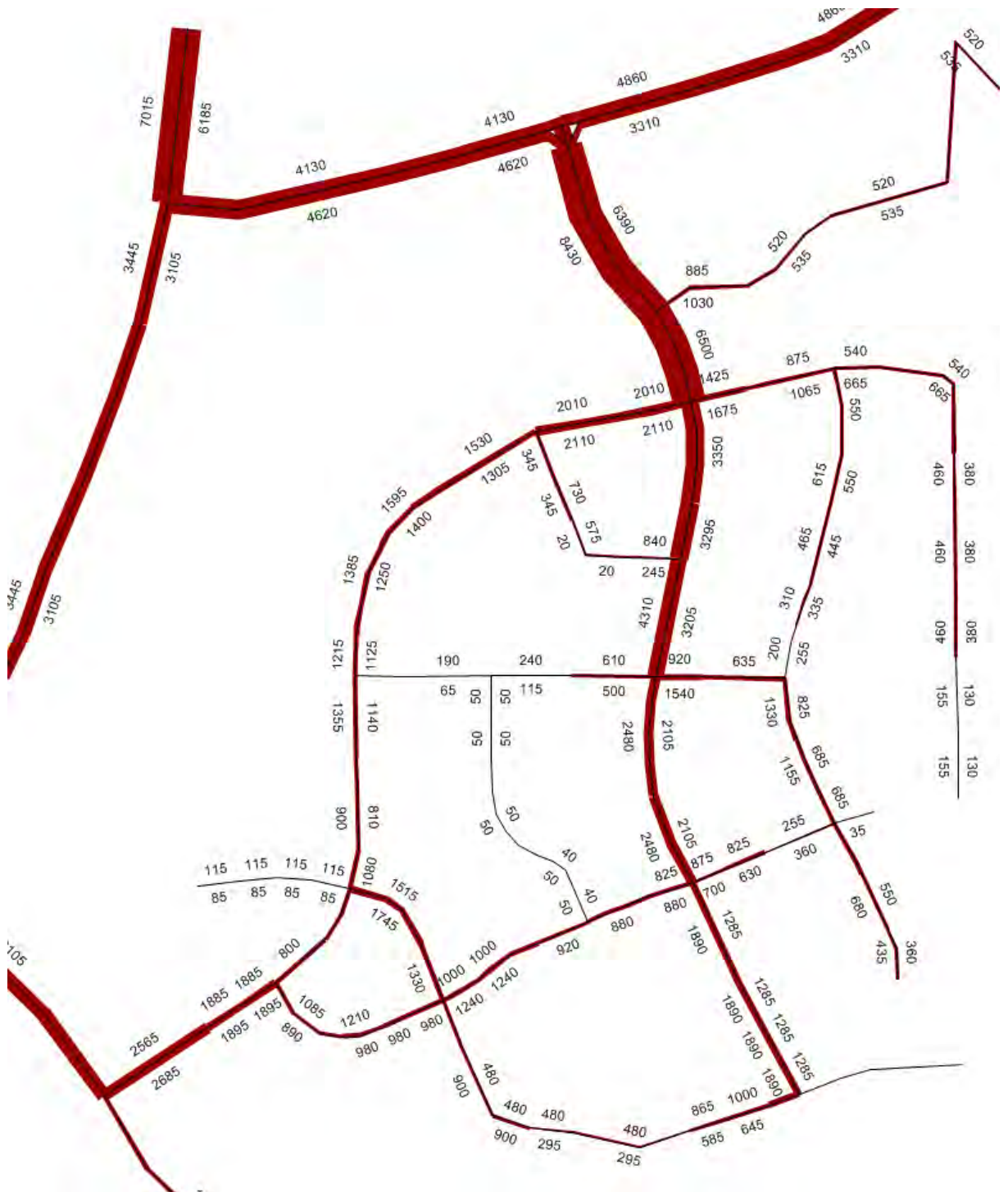


Figure 3 – PM peak forecasts (vph)



Figure 4 – ADT forecasts (vpd)



3.4 Road classification assessment

3.4.1 Austroads guidelines

In relation to the functional classification of roads, the Austroads Guide to Traffic Management, Part 4: Network Management states:

The main purpose of defining a road's functional class is to provide a basis for establishing the policies which will guide the management of the road, by grouping roads together into categories according to their intended service or qualities.

Classifying a road is a balance between two essential needs:

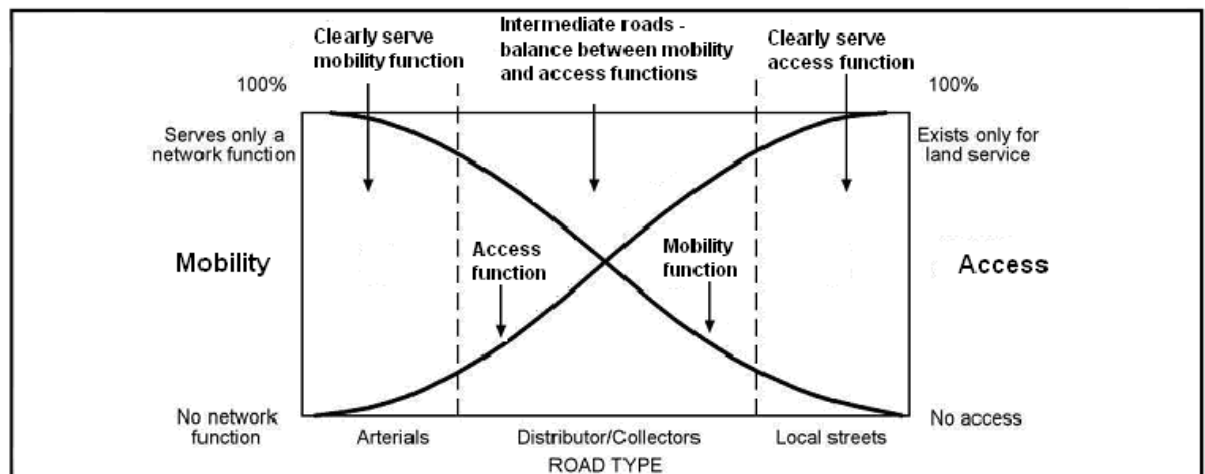
- Mobility, which is concerned with the movement of through traffic and is focused on the efficient movement of people and freight; and
- Access, which relates to the ease with which traffic from abutting land can enter or leave the road.

Functional classification systems vary between road authorities, but Austroads defines the following four-tier hierarchy:

- Freeways/motorways
- Arterial roads
- Distributor/collector roads
- Local roads and streets

Except for freeways, which provide exclusively for the mobility function and do not permit any access, these tiers must all strike a balance between mobility and access, with higher tiers generally (but not always) leaning more towards mobility and the lower tiers towards access. Figure 5 shows this balance.

Figure 5 – The balance between access and mobility (Austroads 2009)



The functions of these roads are described in Austroads as follows:

Arterial roads

Arterial roads provide for major regional and inter-regional traffic movement in a safe and operationally efficient manner. Commercial or industrial access requirements, or local public transport priorities, may need to be given significant weight in developing suitable traffic management strategies.

Distributor/collector roads

These are streets which do not easily fall into either the arterial or the local road category. They typically distribute traffic and bus services within the main residential, commercial and industrial built-up areas and link traffic on local roads to the arterial road network. They may be streets which have been designed as local streets, but which have additional traffic functions, usually serving major traffic generators or providing for some non-local traffic movements.

Problems often arise with intermediate streets, as their design usually promotes the traffic movement function, while the residents and sometimes the local council, consider the street to be a local street with emphasis on the need for low traffic speed and restricted width. Alternatively, in newer growth areas they may sometimes be under-designed in response to a desired emphasis on local road functions, resulting in operational and safety problems for the higher traffic volume that must use them.

Local roads and streets

Local roads may serve several functions to a greater or lesser degree. Some of the functions are at least partially incompatible. Typical functions include:

- Providing vehicular access to abutting property*
- Providing vehicular access to other properties within a local area*
- Providing access for emergency and service vehicles*
- Providing a network for the movement of pedestrians and cyclists*
- Providing a means to enable social interaction within a neighbourhood, e.g. serving as a play area or community open space*
- Contributing visually to the 'living' environment.*

The extent of each of these functions will vary within a local street network. For example, a street which provides access to several other streets will have a more prominent vehicle movement role than a small cul-de-sac.

Austroroads provides no guidance on the amount of traffic each type of road should carry; the function of the road defines its classification. This is in contrast to the City of Palmerston Development Guidelines (CPDG) which does assign an indicative volume for classification purposes, although it notes that the function is still the primary concern. The CPDG are discussed below.

3.4.2 City of Palmerston Development Guidelines

The road classification guidelines are given in Section 2 of CPDG (June 2015). The functions of the roads are defined as follows:

Sub-arterial roads

Sub arterial roads act as feeder or connecting roads, linking the residential areas with the arterial road system. They are typically dual lane.

Typically Sub arterial roads run external to the suburb, forming part of the suburb boundary and do not provide direct frontage to the residential lots. However they can provide access to larger traffic generating developments such as schools, public facilities and shopping centres

Collector roads

Collector roads' primary purpose is to connect the residential cells of a suburb to the traffic carrying sub arterial roads. The roads generally have a number of access roads branching

from them and can provide direct access to residential lots. Collector roads will typically be single.

Secondary collectors typically cater for catchments of up to 250 residences and provide access to one or more local access roads. Generally, secondary collector roads servicing more than 125 residences should have more than one access outlet. Typically, no schools, shops or bus routes are allowed on secondary collectors.

Primary collectors have the same definition and criteria as a secondary collector but have a stronger connectivity between suburbs and the distributor road system. Schools and shops may access the road and the cross section is wide enough to accommodate a bus route. Direct residential lot frontage access to primary collectors needs to be assessed in terms of impacts on function of the road.

Additionally, some guidance is provided in the form of ADT volume thresholds for each functional class. **Table 2.1 of CPDG sets out these thresholds, but notes that the primary criterion for selecting the classification within the hierarchy is the function of the road, not the volume of traffic it carries.** These thresholds are shown in Table 11. Once the classification is decided, the cross-section is selected based on the expected volume of traffic.

Table 11 Indicative ADT volume classification guidelines from CPDG

Road function	Indicative ADT range (vpd)
Sub-arterial	> 3,000
Collector	1,000 to 3,000
Local access	150 to 1,000
Minor	< 150

3.4.3 Comparison of Austroads and CPDG

It is considered that the two guidelines align well on a functional level and therefore may be used interchangeably (although CPDG uses the additional ‘minor road’ tier). Given the close alignment between Austroads and CPDG on the functional descriptions, and the fact that each document recommends assigning a classification based on the function of the road ahead of the volume of traffic it carries, it is considered that either document is suitable for selecting the road classifications. The Austroads guide has been used in this report as it is in use throughout Australia and is familiar to all road authorities.

Based on the level of connectivity provided by the ‘main’ roads within Zuccoli, it appears that no roads fulfil an arterial or sub-arterial function. All roads are located within the suburb and do not provide a bypass of it (a key feature of arterial and sub-arterial roads). It is considered that the southern Zuccoli connector road, Roystonea Avenue and Lambrick Avenue would fulfil these roles, while Zuccoli Parade and the west and south loop roads would fulfil a collector function by providing access from the residential cells to those roads.

As a comparison to the volume-based method of selecting a road classification, an assessment has been made against the thresholds in Table 11. A comparison of the road classifications resulting from the apparent functions of the roads and the expected ADT volumes is shown in Table 12.

Table 12 Comparison of road classifications based on CPDG guidelines

Location (see Figure 1 for reference)			Forecast ADT (two-way)	CPDG road classification	
On...	between...	and...		Based on function	Based on volume
Zuccoli Parade	Lambrick Avenue	Intersection 1	14,800	Collector	Sub-arterial
Zuccoli Parade	Intersection 1	Intersection 2	14,900	Collector	Sub-arterial
Zuccoli Parade	Intersection 2	Road 3	8,400	Collector	Sub-arterial
Zuccoli Parade	Road 3	Road 5	4,600	Collector	Sub-arterial
Zuccoli Parade	Road 5	Road 7	3,200	Collector	Sub-arterial
Road 3	Road 2	Zuccoli Parade	1,100	Collector	Collector
Road 5	Road 2	Zuccoli Parade	2,200	Collector	Collector
Road 7	Road 2	Zuccoli Parade	3,300	Collector	Sub-arterial
Road 2	Road 5	Road 3	2,500	Collector	Collector
Road 2	Road 3	Zuccoli Parade	4,100	Collector	Sub-arterial
Road 2	Road C	Road 5	5,300	Collector	Sub-arterial

As discussed above, both CPDG and Austroads recommend that the classification of a road be based on its intended function rather than the volume of traffic it carries. Therefore, the classifications of the roads within Zuccoli have been based on their intended functions, which are based on the descriptions given in Sections 3.4.1 and 3.4.2.

Based on the intended functions of the roads, all roads should be collectors. The sections of Zuccoli Parade north of Intersection 2 would need to have a four-lane carriageway, which would be more consistent with a primary collector.

Given the adjoining land uses (primarily residential with some retail) it is considered that a collector function is more appropriate (i.e. they have a strong access function), but the cross-section provided should be commensurate with the forecast traffic volumes. The cross-section is determined based on the one-way peak hourly volumes and this is discussed below.

3.5 Road cross-section assessment

The number of traffic lanes is normally selected based on one-way peak hour volumes, as this is the critical measure of demand. These volumes are shown in Figure 2 and Figure 3. The Austroads Guide to Traffic Management: Part 3 – Traffic Studies and Analysis provides capacities of mid-block lanes in interrupted flow conditions. The capacity of a kerbside lane with no parking is about 900 vehicles per hour (vph). The capacity of a kerbside lane with occasional parked vehicles is about 600 vph.

The traffic modelling indicates that one-way volumes on Zuccoli Parade between Lambrick Avenue and Intersection 2 are greater than 900 vehicles per hour, which means that a four-lane cross-section is needed there. All other roads have volumes less than 900 vph and therefore only require two-lane cross-sections.

Figure 6 shows the number of lanes required on each road.

Figure 6 – Number of lanes required on the roads in Zuccoli



4. Comparison to previous study

Table 13 shows the comparison of traffic volumes on the main internal roads between the previous layout and the current layout. Note that although the layout has changed, the network is similar enough that a comparison can be made, although there is a new road (Road 7) which is likely to be affecting traffic distribution.

Table 13 Comparison of previous and current peak hour volumes

Location			Max peak hour volume (vph)			
On...	between...	and...	Previous assessment		Current assessment	
			AM peak	PM peak	AM peak	PM peak
Zuccoli Parade	Lambrick Ave	Intersection 1	1,272 (NB)	999 (SB)	1,206 (NB)	1,050 (SB)
Zuccoli Parade	Intersection 1	Intersection 2	1,381 (NB)	1,157 (SB)	1,161 (NB)	1,035 (SB)
Zuccoli Parade	Intersection 2	Road 3	575 (NB)	468 (SB)	744 (NB)	554 (SB)
Zuccoli Parade	Road 3	Road 5	287 (NB)	201 (SB)	352 (NB)	375 (SB)
Road 3	Road 2	Zuccoli Parade	431 (EB)	285 (EB)	29 (EB)	93 (EB)
Road 5	Road 2	Zuccoli Parade	205 (EB)	243 (EB)	163 (WB)	168 (EB)
Road 2	Road 5	Road 3	378 (NB)	333 (SB)	176 (NB)	117 (SB)
Road 2	Road C	Road 5	381 (SB)	548 (NB)	321 (SB)	350 (NB)

The above analysis indicates a general reduction in traffic volumes throughout the development. This is not surprising, as there are 917 fewer dwellings than the previous layout.

The biggest change in volume is on Road 3 (previously referred to as the centre road) where volumes have dropped by 93% in the AM peak and 67% in the PM peak. This appears to be because traffic is favouring Road 2 (the west loop road) to access Zuccoli Parade.

There is also a fairly large increase on Zuccoli Parade between Road 3 and Road 2 in both peaks. Traffic here seems to be favouring Zuccoli Parade over Road 6 due to the higher speed limit (60 km/h rather than 50 km/h). Volumes on Zuccoli Parade remain within the 900 vph capacity limit, but are greater than the 600 vph limit for parked vehicles. This may limit the opportunity for parking during the AM peak unless separated parking lanes are provided.

5. Conclusions and recommendations

This study has considered the anticipated distribution of generated traffic volumes at ultimate completion of a revised layout of the proposed Zuccoli subdivision to inform the design of key roads within the development. Trip numbers have been built up from an understanding of lot yields, their distribution and corresponding trip rates. The distribution of trips between precincts and external destinations has been estimated by breaking the trips down by purpose and by proportion occurring in each peak period. This process produced a trip matrix for each peak period, which has been assigned to the road network using VISUM traffic modelling software. The resulting forecast traffic volumes have been used to select an appropriate cross-section for each of the key roads within the subdivision, based on Austroads guidelines.

Key findings of the assessment are:

- Based on the lot yield estimates for the proposed developable areas and the land uses proposed for the subdivision, it is estimated that a total of approximately 27,400 trips will be generated per day.
- It is estimated that approximately 10% of daily trips are expected to occur in each of the AM and PM peak periods.
- The busiest section of Zuccoli Parade is expected to be that between Intersection 2 and Lambrick Avenue in both peak periods. The dominant movements are north- and southbound in the AM and PM peaks respectively.
- Excluding LDC Stage 1, Zuccoli Stage 3/4 (comprising of seven sub areas) is expected to generate the largest number of trips of all precincts at approximately 9,000 trips per day.
- The anticipated ADT volumes include up to 20% of trips being internal to Zuccoli, which is consistent with assumptions for the generated traffic.
- The modelling indicates that, in general, the road network will be able to cope with the additional traffic, with the following exceptions, which will need to be tested in further studies:
 - It is likely that the intersection of Lambrick Avenue and Stuart Highway will need to be upgraded. It is understood that the upgrade of this intersection is currently underway and therefore the ultimate layout should be tested in a further study.
 - The intersection of Lambrick Avenue and Zuccoli Parade may need to be upgraded as the development continues and traffic volumes increase.
 - It is likely that Lambrick Avenue and Roystonea Avenue (north of Lambrick Avenue) will ultimately need to be duplicated as the development nears full occupation.
 - Large volumes of traffic will be added to Stuart Highway, Lambrick Avenue and Roystonea Avenue; this may require these roads to be upgraded in the future.
- Based on the Austroads Guide to Traffic Management, all roads within Zuccoli are considered to fulfil a collector function.
- Also based on the Austroads Guide to Traffic Management, the following cross-sections are recommended:
 - Zuccoli Parade north of Intersection 2 – four-lane two-way.
 - Zuccoli Parade south of Intersection 2 – two-lane two-way.
 - All other non-local roads – two-lane two-way.

Appendices

Appendix A Trip generation calculations

Daily, AM and PM peak trip generation by precinct and land use

Table 14 Daily, AM and PM peak trip generation by precinct and land use

VEHICLE TRIPS PER DAY	1.1	1.2.1	1.2.2	1.2.3	1.2.4	1.3.1-3	1.3.4-5	1.3.6	1.3.7	1.3.8	1.3.9	1.3.10	1.3.11	2A	2B	2C	2D	2E	2F	2G	2H	3/4.1	3/4.2	3/4.3	3/4.4	3/4.5	4.Comr	School	M	R	5AB	5C	5DEF	TOTAL
Residential	1269	630		162	407	1287	756	425	376	315	420	373	550	414	5	882	558	441	1120	486	547	1858	1813	810	1085	1272			2340	288	810	792	2457	24,944
Education			327																								748							1,380
Retail																																		1,075
TOTAL	1269	630	327	162	407	1287	756	425	376	315	420	373	550	414	5	882	558	441	1120	486	547	1858	1813	810	1085	1272	748	1380	2340	288	810	792	2457	27,399
AM PEAK TRIPS	1.1	1.2.1	1.2.2	1.2.3	1.2.4	1.3.1-3	1.3.4-5	1.3.6	1.3.7	1.3.8	1.3.9	1.3.10	1.3.11	2A	2B	2C	2D	2E	2F	2G	2H	3/4.1	3/4.2	3/4.3	3/4.4	3/4.5	4.Comr	School	M	R	5AB	5C	5DEF	TOTAL
Residential	127	63		16	41	129	76	43	38	32	42	37	55	41	1	88	56	44	112	49	55	186	181	81	108	127			234	29	81	79	246	2,494
Education																																		690
Commercial			65																								150							215
Inbound																																		TOTAL
Residential	25	13		3	8	26	15	9	8	6	8	7	11	8	0	18	11	9	22	10	11	37	36	16	22	25			47	6	16	16	49	499
Education																																		380
Commercial			52																								120							172
Outbound																																		TOTAL
Residential	102	50		13	33	103	60	34	30	25	34	30	44	33	0	71	45	35	90	39	44	149	145	65	87	102			187	23	65	63	197	1,996
Education																																		311
Commercial			13																								30							43
PM PEAK TRIPS	1	1.2.1	1.2.2	1.2.3	1.2.4	1.3.1-3	1.3.4-5	1.3.6	1.3.7	1.3.8	1.3.9	1.3.10	1.3.11	2A	2B	2C	2D	2E	2F	2G	2H	3/4.1	3/4.2	3/4.3	3/4.4	3/4.5	4.Comr	School	M	R	5AB	5C	5DEF	TOTAL
Residential	127	63		16	41	129	76	43	38	32	42	37	55	41	1	88	56	44	112	49	55	186	181	81	108	127			234	29	81	79	246	2,494
Education																																		414
Commercial			65																								150							215
Inbound																																		TOTAL
Residential	89	44		11	28	90	53	30	26	22	29	26	38	29	0	62	39	31	78	34	38	130	127	57	76	89			164	20	57	55	172	1,746
Education																																		186
Commercial			13																								30							43
Outbound																																		TOTAL
Residential	38	19		5	12	39	23	13	11	9	13	11	16	12	0	26	17	13	34	15	16	56	54	24	33	38			70	9	24	24	74	748
Education																																		228
Commercial			52																								120							172

Appendix B External trip distribution

AM and PM peaks – assumptions for external trip origins and destinations by trip type and assumed trip purpose

Table 15 Assumptions for external trip origins and destinations by trip type and assumed trip purpose (AM peak)

		ASSUMED PERCENTAGE SPLIT				RESULTANT TRIPS			
RESIDENTIAL TO EXTERNAL	To	Palmerston	H. Springs	Weddell & Sth	Darwin	Palmerston	H. Springs	Weddell & Sth	Darwin
Employment	80%	48%	0%	2%	50%	613	0	26	639
Education	10%	70%	20%	5%	5%	112	32	8	8
Commercial	5%	80%	0%	3%	17%	64	0	2	14
Other	5%	45%	20%	10%	25%	36	16	8	20
	TOTAL	52%	3%	3%	43%	825	48	44	680
		ASSUMED PERCENTAGE SPLIT				RESULTANT TRIPS			
EDUCATION TO EXTERNAL	To	Palmerston	H. Springs	Weddell & Sth	Darwin	Palmerston	H. Springs	Weddell & Sth	Darwin
Employment	70%	60%	0%	5%	35%	26	0	2	15
Education	10%	70%	20%	5%	5%	4	1	0	0
Commercial	10%	80%	0%	10%	10%	5	0	1	1
Other	10%	60%	10%	10%	20%	4	1	1	1
	TOTAL	63%	3%	6%	28%	39	2	4	17
		ASSUMED PERCENTAGE SPLIT				RESULTANT TRIPS			
Commercial TO EXTERNAL	To	Palmerston	H. Springs	Weddell & Sth	Darwin	Palmerston	H. Springs	Weddell & Sth	Darwin
Employment	80%	60%	0%	5%	35%	20	0	2	11
Education	10%	85%	5%	5%	5%	3	0	0	0
Commercial	0%	0%	0%	0%	0%	0	0	0	0
Other	10%	60%	5%	10%	25%	2	0	0	1
	TOTAL	63%	1%	6%	31%	26	0	2	13
		ASSUMED PERCENTAGE SPLIT				RESULTANT TRIPS			
EXTERNAL TO RESIDENTIAL	From	Palmerston	H. Springs	Weddell & Sth	Darwin	Palmerston	H. Springs	Weddell & Sth	Darwin
Employment	10%	48%	0%	2%	50%	13	0	1	13
Education	50%	70%	20%	5%	5%	92	26	7	7
Commercial	10%	80%	0%	3%	17%	21	0	1	4
Other	30%	60%	5%	10%	25%	47	4	8	20
	TOTAL	66%	12%	6%	17%	174	30	16	44
		ASSUMED PERCENTAGE SPLIT				RESULTANT TRIPS			
EXTERNAL TO EDUCATION	From	Palmerston	H. Springs	Weddell & Sth	Darwin	Palmerston	H. Springs	Weddell & Sth	Darwin
Employment	0%	0%	0%	0%	0%	0	0	0	0
Education	0%	0%	0%	0%	0%	0	0	0	0
Commercial	5%	80%	0%	10%	10%	3	0	0	0
Other	95%	60%	10%	10%	20%	46	8	8	15
	TOTAL	61%	10%	10%	20%	49	8	8	16
		ASSUMED PERCENTAGE SPLIT				RESULTANT TRIPS			
EXTERNAL TO Commercial	From	Palmerston	H. Springs	Weddell & Sth	Darwin	Palmerston	H. Springs	Weddell & Sth	Darwin
Employment	10%	75%	5%	15%	5%	4	0	1	0
Education	10%	85%	5%	5%	5%	5	0	0	0
Commercial	0%	0%	0%	0%	0%	0	0	0	0
Other	80%	80%	10%	10%	0%	36	5	5	0
	TOTAL	80%	9%	10%	1%	45	5	6	1

Table 16 Assumptions for external trip origins and destinations by trip type and assumed trip purpose (PM peak)

		ASSUMED PERCENTAGE SPLIT				RESULTANT TRIPS			
RESIDENTIAL TO EXTERNAL	To	Palmerston	H. Springs	Weddell & Sth	Darwin	Palmerston	H. Springs	Weddell & Sth	Darwin
Employment	20%	60%	0%	5%	35%	69	0	6	40
Education	30%	75%	15%	5%	5%	130	26	9	9
Commercial	10%	80%	0%	3%	17%	46	0	2	10
Other	40%	60%	5%	10%	25%	138	12	23	58
	TOTAL	67%	7%	7%	20%	383	37	39	116
		ASSUMED PERCENTAGE SPLIT							
EDUCATION TO EXTERNAL	To	Palmerston	H. Springs	Weddell & Sth	Darwin	Palmerston	H. Springs	Weddell & Sth	Darwin
Employment	0%	60%	0%	5%	35%	0	0	0	0
Education	0%	0%	0%	0%	0%	0	0	0	0
Commercial	20%	80%	0%	10%	10%	21	0	3	3
Other	80%	60%	10%	10%	20%	62	10	10	21
	TOTAL	64%	8%	10%	18%	83	10	13	23
		ASSUMED PERCENTAGE SPLIT							
Commercial TO EXTERNAL	To	Palmerston	H. Springs	Weddell & Sth	Darwin	Palmerston	H. Springs	Weddell & Sth	Darwin
Employment	20%	60%	0%	5%	35%	9	0	1	5
Education	10%	85%	5%	5%	5%	7	0	0	0
Commercial	0%	0%	0%	0%	0%	0	0	0	0
Other	70%	60%	5%	10%	25%	32	3	5	14
	TOTAL	63%	4%	9%	25%	48	3	7	19
		ASSUMED PERCENTAGE SPLIT							
EXTERNAL TO RESIDENTIAL	From	Palmerston	H. Springs	Weddell & Sth	Darwin	Palmerston	H. Springs	Weddell & Sth	Darwin
Employment	60%	48%	0%	2%	50%	449	0	19	468
Education	25%	85%	5%	5%	5%	332	20	20	20
Commercial	5%	80%	0%	3%	17%	62	0	2	13
Other	10%	60%	5%	10%	25%	94	8	16	39
	TOTAL	60%	2%	4%	35%	937	27	56	540
		ASSUMED PERCENTAGE SPLIT							
EXTERNAL TO EDUCATION	From	Palmerston	H. Springs	Weddell & Sth	Darwin	Palmerston	H. Springs	Weddell & Sth	Darwin
Employment	50%	48%	0%	2%	50%	9	0	0	9
Education	0%	0%	0%	0%	0%	0	0	0	0
Commercial	10%	80%	0%	10%	10%	3	0	0	0
Other	40%	60%	10%	10%	20%	9	1	1	3
	TOTAL	56%	4%	6%	34%	21	1	2	12
		ASSUMED PERCENTAGE SPLIT							
EXTERNAL TO Commercial	From	Palmerston	H. Springs	Weddell & Sth	Darwin	Palmerston	H. Springs	Weddell & Sth	Darwin
Employment	80%	48%	0%	2%	50%	5	0	0	5
Education	10%	85%	5%	5%	5%	1	0	0	0
Commercial	0%	0%	0%	0%	0%	0	0	0	0
Other	10%	80%	10%	10%	0%	1	0	0	0
	TOTAL	55%	2%	3%	41%	8	0	0	6

Appendix C Trip distribution matrices

Table 17 AM peak trip matrix

FROM/TO	Palmerston	H. Springs	Weddell & Sth	Darwin	1.1	1.2.1	1.2.2	1.2.3	1.2.4	1.3.1-3	1.3.4-5	1.3.6	1.3.7	1.3.8	1.3.9	1.3.10	1.3.11	2A	2B	2C	2D	2E	2F	2G	2H	3/4.1	3/4.2	3/4.3	3/4.4	3/4.5	/4.Comr	School	M	L	5AB	5C	5DEF		
Palmerston					9	4	14	1	3	9	5	3	3	2	3	3	4	3			6	4	3	8	3	4	13	13	6	8	9	32	49	16	2	6	6	17	
H. Springs					2	1	2			2	1	1			1		1	1			1	1	1	1	1	1	2	2	1	1	2	4	8	3		1	1	3	
Weddell & Sth					1		2			1											1			1			1	1	1	1	1	4	8	1		1	1	2	
Darwin					2	1			1	2	1	1	1	1	1	1	1	1	1		2	1	1	2	1	1	3	3	1	2	2		16	4	1	1	1	4	
1.1	42	2	2	35			2																									4	15						
1.2.1	21	1	1	17				1																								2	8						
1.2.2	8		1	4																																			
1.2.3	5			4																																			
1.2.4	13	1	1	11																																			
1.3.1-3	43	2	2	35			2																																
1.3.4-5	25	1	1	21				1																															
1.3.6	14	1	1	12				1																															
1.3.7	12	1	1	10																																			
1.3.8	10	1	1	9																																			
1.3.9	14	1	1	11				1																															
1.3.10	12	1	1	10																																			
1.3.11	18	1	1	15				1																															
2A	14	1	1	11				1																															
2B																																							
2C	29	2	2	24			1																																
2D	18	1	1	15			1																																
2E	15	1	1	12			1																																
2F	37	2	2	31			1																																
2G	16	1	1	13			1																																
2H	18	1	1	15			1																																
3/4.1	61	4	3	51			2																																
3/4.2	60	3	3	49			2																																
3/4.3	27	2	1	22			1																																
3/4.4	36	2	2	30			1																																
3/4.5	42	2	2	35			2																																
3/4.Comm	18		2	9																																			
School	39	2	4	17	12	6	5	2	4	12	7	4	4	3	4	3	5	4			8	5	4	10	5	5	17	17	8	10	12	11		22	3	8	7	23	
M	77	4	4	64			3																																
L	10	1	1	8																																			
5AB	27	2	1	22			1																																
5C	26	2	1	22			1																																
5DEF	81	5	4	67			3																																

Table 18 PM peak trip matrix

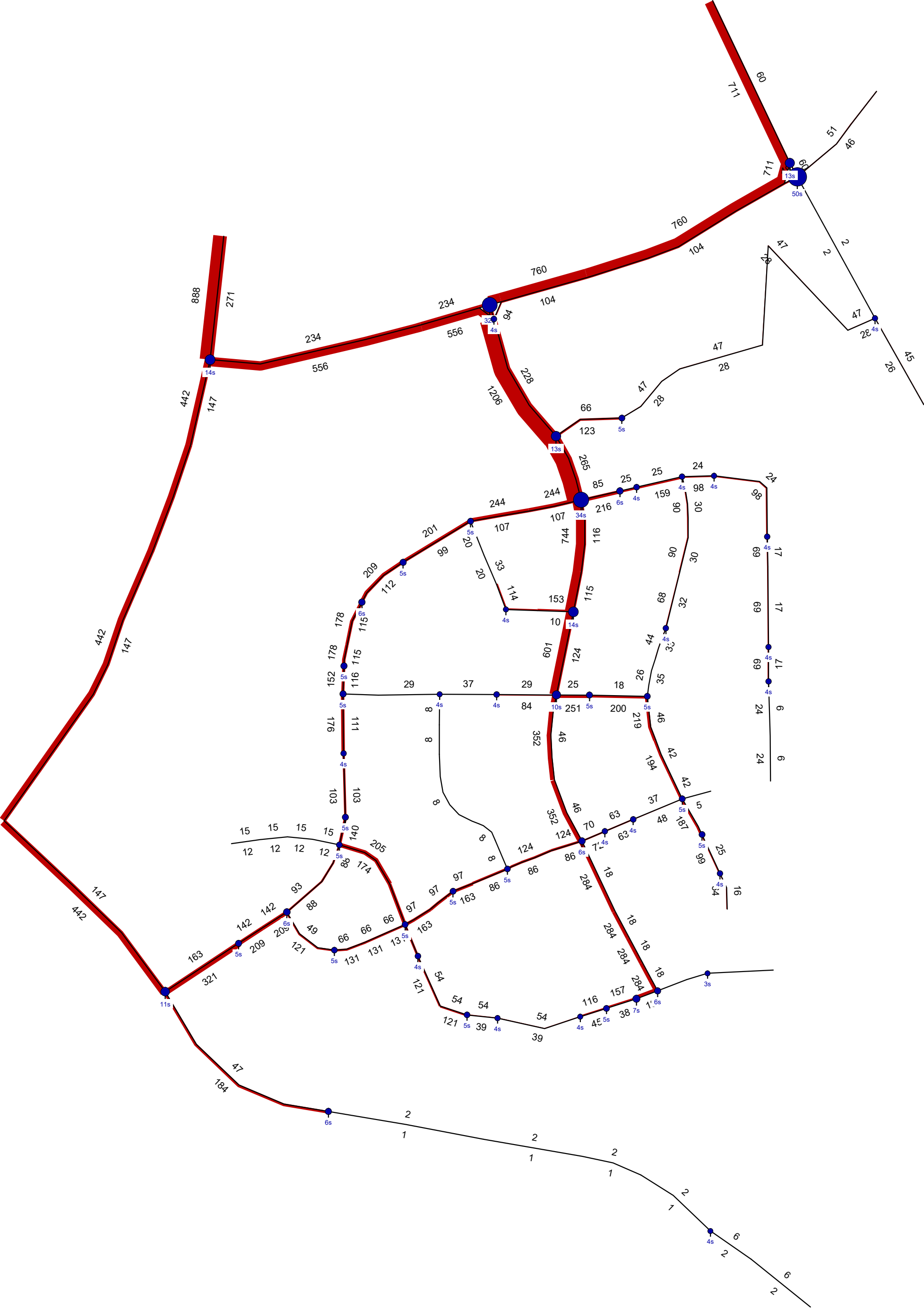
FROM/TO	Palmerston	H. Springs	Weddell & Sth	Darwin	1.1	1.2.1	1.2.2	1.2.3	1.2.4	1.3.1-3	1.3.4-5	1.3.6	1.3.7	1.3.8	1.3.9	1.3.10	1.3.11	2A	2B	2C	2D	2E	2F	2G	2H	3/4.1	3/4.2	3/4.3	3/4.4	3/4.5	3/4.Con	School	M	L	5AB	5C	5DEF	
Palmerston					48	24	2	6	15	48	28	16	14	12	16	14	21	16		33	21	17	42	18	21	70	68	30	41	48	5	21	88	11	30	30	92	
H. Springs					1	1				1	1						1			1	1	1	1	1	2	2	1	1	1		1	3		1	1	3		
Weddell & Sth					3	1			1	3	2	1	1	1	1	1	1	1		2	1	1	3	1	1	4	4	2	2	3	2	5	1	2	2	6		
Darwin					27	14	2	4	9	28	16	9	8	7	9	8	12	9		19	12	10	24	11	12	40	39	18	23	28	4	12	51	6	18	17	53	
1.1	19	2	2	6																																		
1.2.1	10	1	1	3																																		
1.2.2	15	1	2	6	1	1				1	1									1	1	1	1	1	1	2	2	1	1	1			3		1	1	3	
1.2.3	2			1																																		
1.2.4	6	1	1	2																																		
1.3.1-3	20	2	2	6																																		
1.3.4-5	12	1	1	4																																		
1.3.6	7	1	1	2																																		
1.3.7	6	1	1	2																																		
1.3.8	5			1																																		
1.3.9	6	1	1	2																																		
1.3.10	6	1	1	2																																		
1.3.11	8	1	1	3																																		
2A	6	1	1	2																																		
2B																																						
2C	14	1	1	4																																		
2D	9	1	1	3																																		
2E	7	1	1	2																																		
2F	17	2	2	5																																		
2G	7	1	1	2																																		
2H	8	1	1	3																																		
3/4.1	29	3	3	9			1																															
3/4.2	28	3	3	8																																		
3/4.3	12	1	1	4																																		
3/4.4	17	2	2	5																																		
3/4.5	20	2	2	6																																		
3/4.Comm	34	2	5	13	3	2			1	3	2	1	1	1	1	1	1	1		2	1	1	3	1	1	5	5	2	3	3								
School	83	10	13	23	5	2	2	1	1	5	3	2	1	1	2	1	2	2		3	2	2	4	2	2	7	7	3	4	5	5			6	1	2	2	6
M	36	4	4	11			1																															
L	4			1																																		
5AB	12	1	1	4																																		
5C	12	1	1	4																																		
5DEF	38	4	4	11		1																																

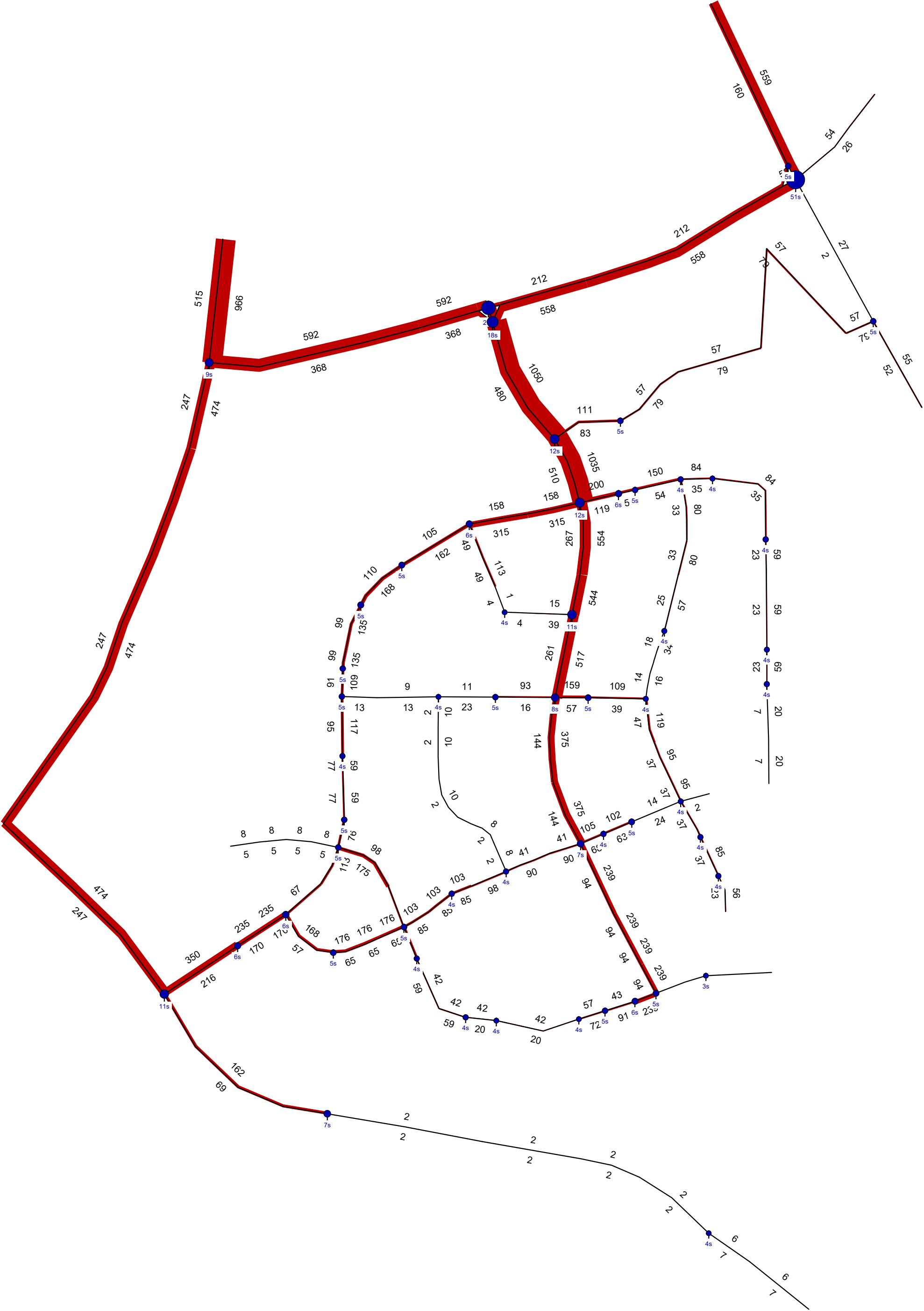
Appendix D Model results

AM peak forecasts – volumes and key intersection delay

PM peak forecasts – volumes and key intersection delay

ADT forecasts – volumes







GHD

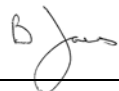
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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A	C. Hall	T. Frodsham	DRAFT	B. Jones	DRAFT	11/08/15
B	C. Hall	T. Frodsham	DRAFT	B. Jones	DRAFT	20/08/15
0	C. Hall	T. Frodsham		B. Jones		04/09/15

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Appendix F

Zuccoli Aspire High Voltage Power Masterplan

GIFTED ASSETS

WARNING

BEWARE OF UNDERGROUND SERVICES
The locations of underground services are approximate only and their exact position should be proven on site. No guarantee is given that all existing services are shown.

LEGEND

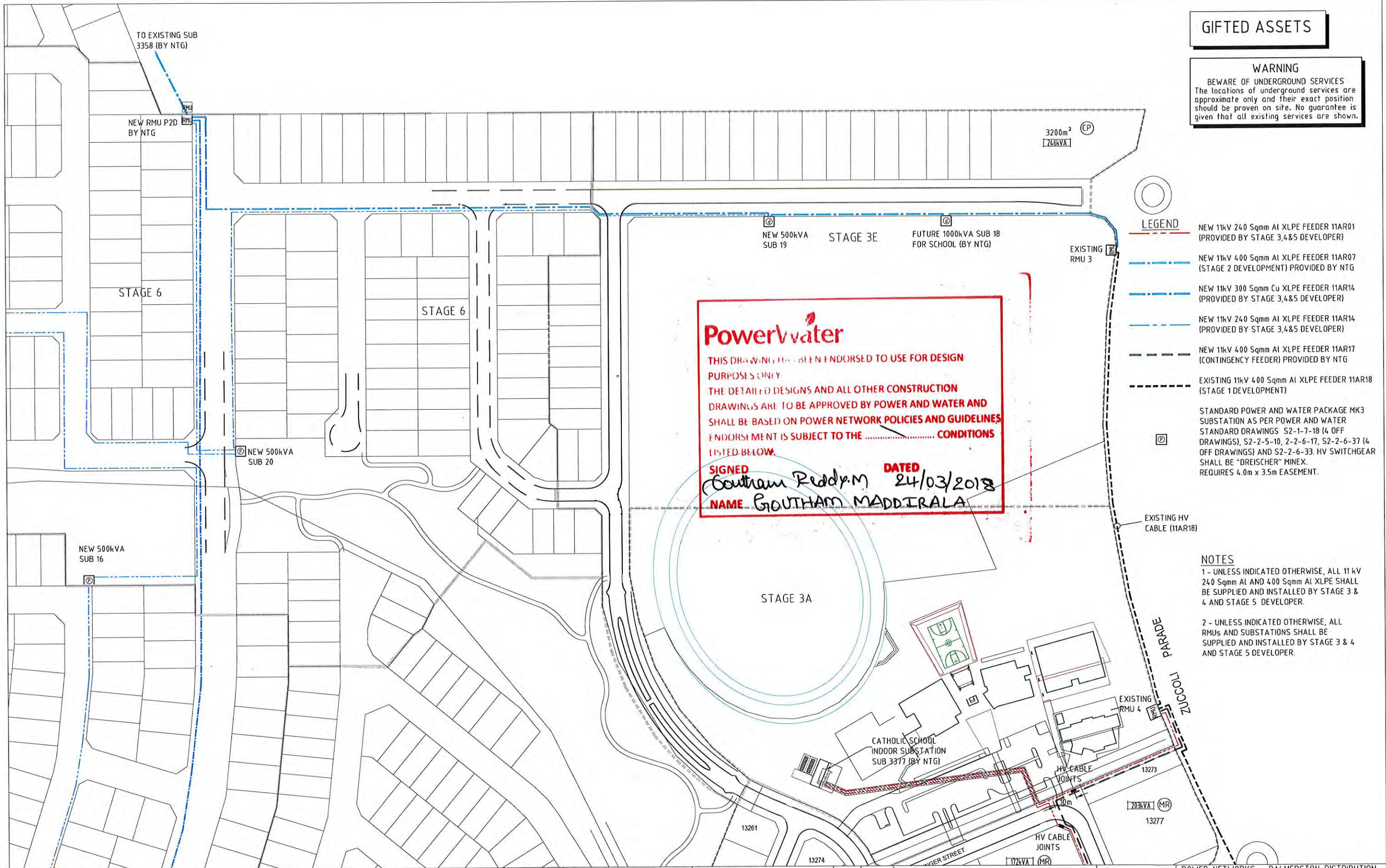
- NEW 11kV 240 Sqmm Al XLPE FEEDER 11AR01 (PROVIDED BY STAGE 3,4&5 DEVELOPER)
- NEW 11kV 400 Sqmm Al XLPE FEEDER 11AR07 (STAGE 2 DEVELOPMENT) PROVIDED BY NTG
- NEW 11kV 300 Sqmm Cu XLPE FEEDER 11AR14 (PROVIDED BY STAGE 3,4&5 DEVELOPER)
- NEW 11kV 240 Sqmm Al XLPE FEEDER 11AR14 (PROVIDED BY STAGE 3,4&5 DEVELOPER)
- NEW 11kV 400 Sqmm Al XLPE FEEDER 11AR17 (CONTINGENCY FEEDER) PROVIDED BY NTG
- EXISTING 11kV 400 Sqmm Al XLPE FEEDER 11AR18 (STAGE 1 DEVELOPMENT)

STANDARD POWER AND WATER PACKAGE MK3 SUBSTATION AS PER POWER AND WATER STANDARD DRAWINGS S2-1-7-18 (4 OFF DRAWINGS), S2-2-5-10, 2-2-6-17, S2-2-6-37 (4 OFF DRAWINGS) AND S2-2-6-33. HV SWITCHGEAR SHALL BE "DREISCHER" MINEX. REQUIRES 4.0m x 3.5m EASEMENT.

NOTES

1 - UNLESS INDICATED OTHERWISE, ALL 11 kV 240 Sqmm Al AND 400 Sqmm Al XLPE SHALL BE SUPPLIED AND INSTALLED BY STAGE 3 & 4 AND STAGE 5 DEVELOPER.

2 - UNLESS INDICATED OTHERWISE, ALL RMUs AND SUBSTATIONS SHALL BE SUPPLIED AND INSTALLED BY STAGE 3 & 4 AND STAGE 5 DEVELOPER.



Developer: Costojic Pty Ltd Contact: Mike Schokman M: 0418 62 63 E: mike@costaland.com.au Level 1, 48-50 Smith St Darwin, NT 0800 PO Box 2014, Darwin, NT 0801										aurecon Aurecon Australia Pty Ltd ABN 54 005 139 873 62 Cavenagh Street (PO Box 919) Darwin Northern Territory 0800 Australia Telephone: +61 8 8919 9777 Facsimile: +61 8 8919 9750 Email: darwin@ap.aurecongroup.com										<table><tr><td>04</td><td>ISSUED FOR PWC APPROVAL</td><td>JL</td><td>14/03/18</td><td>CT</td><td>B14-E10</td><td>HIGH VOLTAGE RETICULATION</td></tr><tr><td>03</td><td>ISSUED FOR PWC APPROVAL</td><td>JL</td><td>07/02/18</td><td>CT</td><td>B14-E09</td><td>HIGH VOLTAGE RETICULATION</td></tr><tr><td>02</td><td>ISSUED FOR PWC APPROVAL</td><td>JL</td><td>09/08/17</td><td>CT</td><td>B14-E08</td><td>HIGH VOLTAGE RETICULATION</td></tr><tr><td>01</td><td>PRELIMINARY ISSUE</td><td>JL</td><td>19/12/16</td><td>CT</td><td>B14-E07</td><td>HIGH VOLTAGE RETICULATION</td></tr><tr><td>00</td><td>PRELIMINARY ISSUE</td><td>JL</td><td>19/12/14</td><td>CT</td><td>B14-E06</td><td>HIGH VOLTAGE RETICULATION</td></tr><tr><td></td><td></td><td>JL</td><td></td><td>CT</td><td>B14-E05</td><td>HIGH VOLTAGE RETICULATION</td></tr><tr><td></td><td></td><td>JL</td><td></td><td>CT</td><td>B14-E04</td><td>HIGH VOLTAGE RETICULATION</td></tr><tr><td></td><td></td><td>JL</td><td></td><td>CT</td><td>B14-E03</td><td>HIGH VOLTAGE RETICULATION</td></tr><tr><td></td><td></td><td>JL</td><td></td><td>CT</td><td>B14-E02</td><td>HIGH VOLTAGE RETICULATION</td></tr></table>										04	ISSUED FOR PWC APPROVAL	JL	14/03/18	CT	B14-E10	HIGH VOLTAGE RETICULATION	03	ISSUED FOR PWC APPROVAL	JL	07/02/18	CT	B14-E09	HIGH VOLTAGE RETICULATION	02	ISSUED FOR PWC APPROVAL	JL	09/08/17	CT	B14-E08	HIGH VOLTAGE RETICULATION	01	PRELIMINARY ISSUE	JL	19/12/16	CT	B14-E07	HIGH VOLTAGE RETICULATION	00	PRELIMINARY ISSUE	JL	19/12/14	CT	B14-E06	HIGH VOLTAGE RETICULATION			JL		CT	B14-E05	HIGH VOLTAGE RETICULATION			JL		CT	B14-E04	HIGH VOLTAGE RETICULATION			JL		CT	B14-E03	HIGH VOLTAGE RETICULATION			JL		CT	B14-E02	HIGH VOLTAGE RETICULATION	<table><tr><th colspan="2">DRAWING STATUS</th><th>APPD</th><th>DATE</th></tr><tr><td>P</td><td>PRELIMINARY/PROPOSED</td><td></td><td></td></tr><tr><td>T</td><td>TENDERING PURPOSES ONLY</td><td></td><td></td></tr><tr><td>AC</td><td>APP. FOR CONSTRUCTION</td><td></td><td></td></tr><tr><td>AI</td><td>AS INSTALLED</td><td></td><td></td></tr><tr><td>C</td><td>CANCELLED/SUPERSEDED</td><td></td><td></td></tr></table>										DRAWING STATUS		APPD	DATE	P	PRELIMINARY/PROPOSED			T	TENDERING PURPOSES ONLY			AC	APP. FOR CONSTRUCTION			AI	AS INSTALLED			C	CANCELLED/SUPERSEDED													<table><tr><td>DES</td><td>JL</td><td colspan="10">POWER NETWORKS - PALMERSTON DISTRIBUTION</td></tr><tr><td>DRN</td><td>JL</td><td colspan="10">SUBDIVISION OF LOT</td></tr><tr><td>CKD</td><td>CT</td><td colspan="10">ZUCCOLI STAGE 3 AND 4</td></tr><tr><td>APPD</td><td></td><td colspan="10">HIGH VOLTAGE RETICULATION</td></tr><tr><td>SCALE</td><td>1:100 @A1</td><td colspan="10">MASTER PLANNING</td></tr><tr><td>ISSUED</td><td>14/03/18</td><td>A1</td><td>DRAWING NUMBER</td><td colspan="7">B14-E01</td><td></td></tr><tr><td>ALL DIM.</td><td>IN mm</td><td colspan="10"></td></tr><tr><td>DRAFTING STANDARD TO A.S.1100</td><td></td><td>FILE No.</td><td colspan="7">NE590 / 11820</td><td></td></tr></table>										DES	JL	POWER NETWORKS - PALMERSTON DISTRIBUTION										DRN	JL	SUBDIVISION OF LOT										CKD	CT	ZUCCOLI STAGE 3 AND 4										APPD		HIGH VOLTAGE RETICULATION										SCALE	1:100 @A1	MASTER PLANNING										ISSUED	14/03/18	A1	DRAWING NUMBER	B14-E01								ALL DIM.	IN mm											DRAFTING STANDARD TO A.S.1100		FILE No.	NE590 / 11820							
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NOTES

1- UNLESS INDICATED OTHERWISE, ALL 11kV 240 Sqmm Al AND 400 Sqmm Al XLPE SHALL BE SUPPLIED AND INSTALLED BY STAGE 3 & 4 AND STAGE 5 DEVELOPER.

2- UNLESS INDICATED OTHERWISE, ALL RMUs AND SUBSTATIONS SHALL BE SUPPLIED AND INSTALLED BY STAGE 3 & 4 AND STAGE 5 DEVELOPER.

3- AS PART OF PRECINCT C WORKS DISCONNECT AND REMOVE EXISTING POWER POLES P1 TO P5 AND THE OVERHEAD HV CONDUCTORS FROM P1 TO P6 INCLUDING HV CABLES FROM POLE P1 TO RMU 5 UPON COMPLETION OF THE INSTALLATION OF NEW UNDERGROUND HV FEEDER CABLE (11AR18) FROM EXISTING RMU No.6 TO RMU P4D AND FROM RMU P4D TO EXISTING RMU No.5

4- EXISTING 11AR01 HV FEEDER FROM EXISTING ZUCCOLI SWITCHING STATION TO RMU 8, RMU 8 TO RMU 9 (BY NTG). TEMP O/H LINE CONNECTED TO SWITCH 13381 AT THE MOMENT. 11AR01 CABLE HAS BEEN INSTALLED ONLY UP TO RMU 6. THIS CABLE WILL NEED TO BE EXTENDED FROM WHERE IT STOPPED (ADJACENT) TO RMU 6 TO RMU 8 AND TO RMU 9 (BY NTG)

STAGE 3D

STAGE 5

STAGE 3A

STAGE 1A

STAGE 1

STAGE 1B

STAGE 3B

STAGE 3C

PowerWater

THIS DRAWING HAS BEEN ENDORSED TO USE FOR DESIGN PURPOSES ONLY.

THE DETAILED DESIGNS AND ALL OTHER CONSTRUCTION DRAWINGS ARE TO BE APPROVED BY POWER AND WATER AND SHALL BE BASED ON POWER NETWORK POLICIES AND GUIDELINES. ENDORSEMENT IS SUBJECT TO THE CONDITIONS LISTED BELOW.

SIGNED

DATED

GOUTHAM REDDY M. 24/03/2018
NAME GOUTHAM MADDIRALA

GIFTED ASSETS

WARNING

BEWARE OF UNDERGROUND SERVICES
The locations of underground services are approximate only and their exact position should be proven on site. No guarantee is given that all existing services are shown.

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Northern Territory 0800 Australia
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Facsimile: +61 8 8919 9750
Email: darwin@ap.aurecongroup.com

03 ISSUED FOR PWC APPROVAL
02 ISSUED FOR PWC APPROVAL
01 PRELIMINARY ISSUE
00 PRELIMINARY ISSUE

NO DESCRIPTION DRN DATE APPD DRG NO TITLE

AMENDMENTS ASSOCIATED DRAWINGS

DRAWING STATUS

P PRELIMINARY/PROPOSED
T TENDERING PURPOSES ONLY
AC APP. FOR CONSTRUCTION
AI AS INSTALLED
C CANCELLED/SUPERSEDED

APPD DATE

PowerWater

DES JL
DRN JL
CKD CT
APPD
SCALE 1:100 @A1
ISSUED 14/03/18
ALL DIM. IN mm
DRAFTING STANDARD TO A.S.1100

POWER NETWORKS - PALMERSTON DISTRIBUTION
SUBDIVISION OF LOT
ZUCCOLI STAGE 3 AND 4
HIGH VOLTAGE RETICULATION
MASTER PLANNING

A1 DRAWING NUMBER B14-E02

FILE No. NE590 / 11820

03
AMDT

LEGEND

NEW 11kV 400 Sqmm Al XLPE FEEDER 11AR01 (PROVIDED BY STAGE 3,4&5 DEVELOPER). REFER NOTE 4

NEW 11kV 240 Sqmm Al XLPE FEEDER 11AR01. (PROVIDED BY STAGE 3,4&5 DEVELOPER)

NEW 11kV 300 Sqmm Cu XLPE FEEDER 11AR14. (PROVIDED BY STAGE 3,4&5 DEVELOPER)

NEW 11kV 240 Sqmm Al XLPE FEEDER 11AR14. (PROVIDED BY STAGE 3,4&5 DEVELOPER)

NEW 11kV 400 Sqmm Al XLPE FEEDER 11AR17 (CONTINGENCY FEEDER) PROVIDED BY NTG

NEW 11kV 400 Sqmm Al XLPE FEEDER 11AR18 (PROVIDED BY STAGE 3,4&5 DEVELOPER)

EXISTING 11kV 400 Sqmm Al XLPE FEEDER 11AR18 (STAGE 1 DEVELOPMENT)

EXISTING HV OVERHEAD RETICULATION

EXISTING HV CABLE (11AR18)

STANDARD POWER AND WATER PACKAGE MK3
SUBSTATION AS PER POWER AND WATER
STANDARD DRAWINGS S2-1-7-18 (4 OFF
DRAWINGS), S2-2-5-10, 2-2-6-17, S2-2-6-37 (4
OFF DRAWINGS) AND S2-2-6-33. HV SWITCHGEAR
SHALL BE "DREISCHER" MINEX.
REQUIRES 4.0m x 3.5m EASEMENT.

REFER NOTE 3

LEGEND

- NEW 11kV 400 Sqmm AL XLPE FEEDER 11AR01 (PROVIDED BY STAGE 3,4&5 DEVELOPER) REFER NOTE 4
- NEW 11kV 240 Sqmm AL XLPE FEEDER 11AR01 (PROVIDED BY STAGE 3,4&5 DEVELOPER)
- NEW 11kV 400 Sqmm AL XLPE FEEDER 11AR02 PROVIDED BY NTG
- NEW 11kV 240 Sqmm AL XLPE FEEDER 11AR02 (PROVIDED BY STAGE 3,4&5 DEVELOPER)
- EXISTING HV OVERHEAD RETICULATION

NOTES

1 - UNLESS INDICATED OTHERWISE, ALL 11 kV 240 Sqmm AL AND 400 Sqmm AL XLPE SHALL BE SUPPLIED AND INSTALLED BY STAGE 3 & 4 AND STAGE 5 DEVELOPER.

2 - UNLESS INDICATED OTHERWISE, ALL RMUs AND SUBSTATIONS SHALL BE SUPPLIED AND INSTALLED BY STAGE 3 & 4 AND STAGE 5 DEVELOPER.

3 - AS PART OF PRECINCT E WORKS CURRENTLY EXISTING SUB 3444 IS CONNECTED TO EXISTING RMU 9 TEMPORARILY. AT SUB 3444, DISCONNECT HV CABLES COMING FROM RMU 9, PULL BACK CABLES FROM SUB 3444, REROUTE HV CABLES AND JOIN ONTO HV CABLES COMING FROM SUB 6-ST5 IN PRECINCT E.

4 - EXISTING 11AR01 HV FEEDER FROM EXISTING ZUCCOLI SWITCHING STATION TO RMU 8, RMU 8 TO RMU 9 (BY NTG). TEMP O/H LINE CONNECTED TO SWITCH 13381 AT THE MOMENT. 11AR01 CABLE HAS BEEN INSTALLED ONLY UP TO RMU 6. THIS CABLE WILL NEED TO BE EXTENDED FROM WHERE IT STOPPED (ADJACENT TO RMU 6) TO RMU 8 AND TO RMU 9 (BY NTG)

WARNING
BEWARE OF UNDERGROUND SERVICES
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GIFTED ASSETS

WARNING
BEWARE OF UNDERGROUND SERVICES
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GIFTED ASSETS

purecon

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Email: darwin@ap.aurecongroup.com

A purecon company. Please refer to the AEC group's main ad.

1. using the company's name and other data to electronic mail without requesting and obtaining leave for security against the
2. using the company's name and other data to electronic mail without requesting and obtaining leave for security against the
3. using the company's name and other data to electronic mail without requesting and obtaining leave for security against the

04 03 02 01 00	ISSUED FOR PWC APPROVAL ISSUED FOR PWC APPROVAL ISSUED FOR PWC APPROVAL PRELIMINARY ISSUE PRELIMINARY ISSUE	JL JL JL JL JL	14/03/18 07/02/18 09/08/17 19/12/16 19/12/14	CT CT CT CT CT	B14-E10 HIGH VOLTAGE RETICULATION	P T AC AI C	PRELIMINARY/PROPOSED TENDERING PURPOSES ONLY APP. FOR CONSTRUCTION AS INSTALLED CANCELLED/SUPERSEDED	APPD	DATE		DES	JL	POWER NETWORKS - PALMERSTON DISTRIBUTION SUBDIVISION OF LOT ZUCCOLI STAGE 3 AND 4 HIGH VOLTAGE RETICULATION MASTER PLANNING	A1	DRAWING NUMBER	B14-E03	
					DRN						JL						
					CKD						CT						
					APPD												
					SCALE						1:100 @A1						
					ISSUED						14/03/18	FILE No.	NE590 / 11820	AMDT			
					ALL DIM. IN mm												
NO	DESCRIPTION	DRN	DATE	APPD	DRG NO	TITLE					DRAFTING STANDARD TO A.S.1100						
AMENDMENTS					ASSOCIATED DRAWINGS												

LEGEND

- NEW 11kV 400 Sqmm Al XLPE FEEDER 11AR07 (STAGE 2 DEVELOPMENT) PROVIDED BY NTG
- NEW 11kV 300 Sqmm Cu XLPE FEEDER 11AR14 (PROVIDED BY STAGE 3,4&5 DEVELOPER)
- NEW 11kV 240 Sqmm Al XLPE FEEDER 11AR14 (PROVIDED BY STAGE 3,4&5 DEVELOPER)



STANDARD POWER AND WATER PACKAGE MK3 SUBSTATION AS PER POWER AND WATER STANDARD DRAWINGS S2-1-7-18 (4 OFF DRAWINGS), S2-2-5-10, 2-2-6-17, S2-2-6-37 (4 OFF DRAWINGS) AND S2-2-6-33. HV SWITCHGEAR SHALL BE "DREISCHER" MINEX. REQUIRES 4.0m x 3.5m EASEMENT.

NOTES

1 - UNLESS INDICATED OTHERWISE, ALL 11 kV 240 Sqmm Al AND 400 Sqmm Al XLPE SHALL BE SUPPLIED AND INSTALLED BY STAGE 3 & 4 AND STAGE 5 DEVELOPER.

2 - UNLESS INDICATED OTHERWISE, ALL RMUS AND SUBSTATIONS SHALL BE SUPPLIED AND INSTALLED BY STAGE 3 & 4 AND STAGE 5 DEVELOPER.

GIFTED ASSETS

WARNING

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PowerWater

THIS DRAWING HAS BEEN ENDORSED TO USE FOR DESIGN PURPOSES ONLY.
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ENDORSEMENT IS SUBJECT TO THE CONDITIONS LISTED BELOW.

SIGNED *Goutham Reddy M* DATED *24/03/2018*
NAME *GOUTHAM MADDIRALA*

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24/3/56
I warrant that the drawings are true and correct to the best of my knowledge and belief and that I am not aware of any circumstances which might render them inaccurate or misleading.

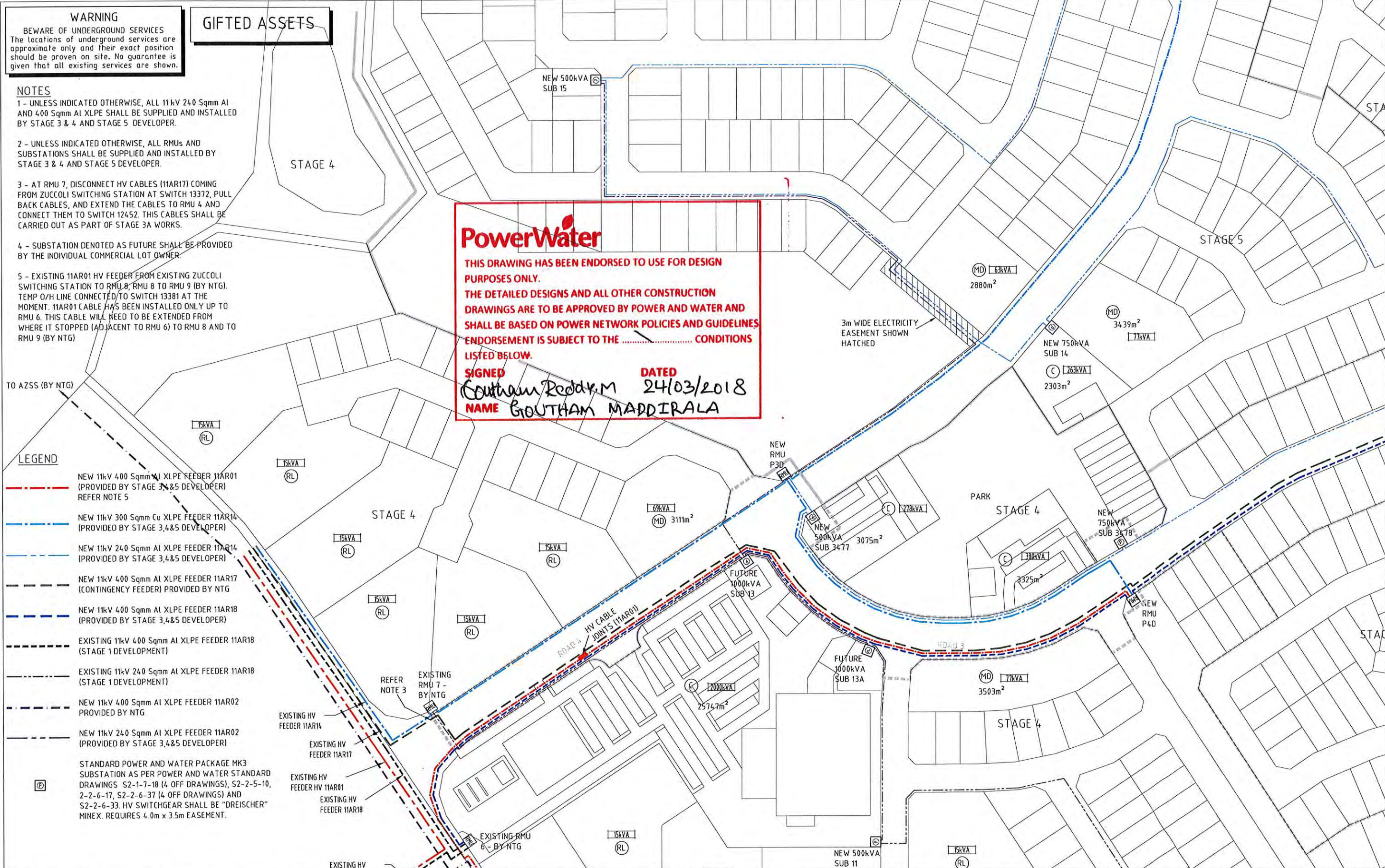
NO	DESCRIPTION	DRN	DATE	APPD	DRG NO	TITLE
04	ISSUED FOR POWER AND WATER APPROVAL	JL	14/03/18	CT	B14-E10	HIGH VOLTAGE RETICULATION
03	ISSUED FOR POWER AND WATER APPROVAL	JL	07/02/18	CT	B14-E09	HIGH VOLTAGE RETICULATION
02	ISSUED FOR PWC APPROVAL	JL	09/08/17	CT	B14-E08	HIGH VOLTAGE RETICULATION
01	PRELIMINARY ISSUE	JL	19/12/16	CT	B14-E07	HIGH VOLTAGE RETICULATION
00	PRELIMINARY ISSUE	JL	19/12/16	CT	B14-E06	HIGH VOLTAGE RETICULATION
					B14-E05	HIGH VOLTAGE RETICULATION
					B14-E04	HIGH VOLTAGE RETICULATION
					B14-E03	HIGH VOLTAGE RETICULATION
					B14-E02	HIGH VOLTAGE RETICULATION

DRAWING STATUS	APPD	DATE
P PRELIMINARY/PROPOSED		
T TENDERING PURPOSES ONLY		
AC APP. FOR CONSTRUCTION		
AI AS INSTALLED		
C CANCELLED/SUPERSEDED		

PowerWater

DES	JL
DRN	JL
CKD	CT
APPD	
SCALE	1:100 @A1
ISSUED	14/03/18
ALL DIM. IN mm	

POWER NETWORKS - PALMERSTON DISTRIBUTION	
SUBDIVISION OF LOT	
ZUCCOLI STAGE 3 AND 4	
HIGH VOLTAGE RETICULATION	
MASTER PLANNING	
A1	DRAWING NUMBER B14-E04
FILE No.	NE590 / 11820



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GIFTED ASSETS

- NOTES**
- 1 - UNLESS INDICATED OTHERWISE, ALL 11 kV 240 Sqmm AI AND 400 Sqmm AI XLPE SHALL BE SUPPLIED AND INSTALLED BY STAGE 3 & 4 AND STAGE 5 DEVELOPER.
 - 2 - UNLESS INDICATED OTHERWISE, ALL RMUs AND SUBSTATIONS SHALL BE SUPPLIED AND INSTALLED BY STAGE 3 & 4 AND STAGE 5 DEVELOPER.
 - 3 - AT RMU 7, DISCONNECT HV CABLES (11AR17) COMING FROM ZUCCOLI SWITCHING STATION AT SWITCH 13372, PULL BACK CABLES, AND EXTEND THE CABLES TO RMU 4 AND CONNECT THEM TO SWITCH 12452. THIS CABLES SHALL BE CARRIED OUT AS PART OF STAGE 3A WORKS.
 - 4 - SUBSTATION DENOTED AS FUTURE SHALL BE PROVIDED BY THE INDIVIDUAL COMMERCIAL LOT OWNER.
 - 5 - EXISTING 11AR01 HV FEEDER FROM EXISTING ZUCCOLI SWITCHING STATION TO RMU 8, RMU 8 TO RMU 9 (BY NTG). TEMP O/H LINE CONNECTED TO SWITCH 13381 AT THE MOMENT. 11AR01 CABLE HAS BEEN INSTALLED ONLY UP TO RMU 6. THIS CABLE WILL NEED TO BE EXTENDED FROM WHERE IT STOPPED (ADJACENT TO RMU 6) TO RMU 8 AND TO RMU 9 (BY NTG)

PowerWater
THIS DRAWING HAS BEEN ENDORSED TO USE FOR DESIGN PURPOSES ONLY.
THE DETAILED DESIGNS AND ALL OTHER CONSTRUCTION DRAWINGS ARE TO BE APPROVED BY POWER AND WATER AND SHALL BE BASED ON POWER NETWORK POLICIES AND GUIDELINES. ENDORSEMENT IS SUBJECT TO THE CONDITIONS LISTED BELOW.
SIGNED *Goutham Maddirala* DATED 24/03/2018
NAME GOUTHAM MADDIRALA

- LEGEND**
- NEW 11kV 400 Sqmm AI XLPE FEEDER 11AR01 (PROVIDED BY STAGE 3,4,5 DEVELOPER) REFER NOTE 5
 - NEW 11kV 300 Sqmm Cu XLPE FEEDER 11AR14 (PROVIDED BY STAGE 3,4,5 DEVELOPER)
 - NEW 11kV 240 Sqmm AI XLPE FEEDER 11AR14 (PROVIDED BY STAGE 3,4,5 DEVELOPER)
 - NEW 11kV 400 Sqmm AI XLPE FEEDER 11AR17 (CONTINGENCY FEEDER) PROVIDED BY NTG
 - NEW 11kV 400 Sqmm AI XLPE FEEDER 11AR18 (PROVIDED BY STAGE 3,4,5 DEVELOPER)
 - EXISTING 11kV 400 Sqmm AI XLPE FEEDER 11AR18 (STAGE 1 DEVELOPMENT)
 - EXISTING 11kV 240 Sqmm AI XLPE FEEDER 11AR18 (STAGE 1 DEVELOPMENT)
 - NEW 11kV 400 Sqmm AI XLPE FEEDER 11AR02 PROVIDED BY NTG
 - NEW 11kV 240 Sqmm AI XLPE FEEDER 11AR02 (PROVIDED BY STAGE 3,4,5 DEVELOPER)
 - STANDARD POWER AND WATER PACKAGE MK3 SUBSTATION AS PER POWER AND WATER STANDARD DRAWINGS S2-1-7-18 (4 OFF DRAWINGS), S2-2-5-10, 2-2-6-17, S2-2-6-37 (4 OFF DRAWINGS) AND S2-2-6-33. HV SWITCHGEAR SHALL BE "DREISCHER" MINEX. REQUIRES 4.0m x 3.5m EASEMENT.

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24.34.56

NO	DESCRIPTION	DRN	DATE	APPD	DRG NO	TITLE
03	ISSUED FOR POWER AND WATER APPROVAL	JL	14/03/18	CT	B14-E10	HIGH VOLTAGE RETICULATION
02	ISSUED FOR POWER AND WATER APPROVAL	JL	07/02/18	CT	B14-E09	HIGH VOLTAGE RETICULATION
01	PRELIMINARY ISSUE	JL	19/12/16	CT	B14-E08	HIGH VOLTAGE RETICULATION
00	PRELIMINARY ISSUE	JL	19/12/16	CT	B14-E07	HIGH VOLTAGE RETICULATION

NO	DESCRIPTION	DRN	DATE	APPD	DRG NO	TITLE
					B14-E06	HIGH VOLTAGE RETICULATION
					B14-E05	HIGH VOLTAGE RETICULATION
					B14-E04	HIGH VOLTAGE RETICULATION
					B14-E03	HIGH VOLTAGE RETICULATION
					B14-E02	HIGH VOLTAGE RETICULATION

DRAWING STATUS		APPD	DATE
P	PRELIMINARY/PROPOSED		
T	TENDERING PURPOSES ONLY		
AC	APP. FOR CONSTRUCTION		
AI	AS INSTALLED		
C	CANCELLED/SUPERSEDED		

PowerWater

DES	JL
DRN	JL
CKD	CT
APPD	
SCALE	1:1000 @A1
ISSUED	14/03/18
ALL DIM. IN mm	
DRAFTING STANDARD TO	A.S.1100

POWER NETWORKS - PALMERSTON DISTRIBUTION
SUBDIVISION OF LOT
ZUCCOLI STAGE 3 AND 4
HIGH VOLTAGE RETICULATION
MASTER PLANNING
A1
DRAWING NUMBER B14-E05
FILE No. NES90 / 11820
AMDT

NOTES

1 - UNLESS INDICATED OTHERWISE, ALL 11 kV 240 Sqmm Al AND 400 Sqmm Al XLPE SHALL BE SUPPLIED AND INSTALLED BY STAGE 3 & 4 AND STAGE 5 DEVELOPER.

2 - UNLESS INDICATED OTHERWISE, ALL RMUs AND SUBSTATIONS SHALL BE SUPPLIED AND INSTALLED BY STAGE 3 & 4 AND STAGE 5 DEVELOPER.

3 - AT RMU 7, DISCONNECT HV CABLES (11AR17) COMING FROM ZUCCOLI SWITCHING STATION AT SWITCH 13372, PULL BACK CABLES, AND EXTEND THE CABLES TO RMU 4 AND CONNECT THEM TO SWITCH 12452. THIS CABLES SHALL BE CARRIED OUT AS PART OF STAGE 3A WORKS.

4 - SUBSTATION DENOTED AS FUTURE SHALL BE PROVIDED BY THE INDIVIDUAL COMMERCIAL LOT OWNER.

5 - EXISTING 11AR01 HV FEEDER FROM EXISTING ZUCCOLI SWITCHING STATION TO RMU 8, RMU 8 TO RMU 9 (BY NTG). TEMP O/H LINE CONNECTED TO SWITCH 13381 AT THE MOMENT. 11AR01 CABLE HAS BEEN INSTALLED ONLY UP TO RMU 6. THIS CABLE WILL NEED TO BE EXTENDED FROM WHERE IT STOPPED (ADJACENT TO RMU 6) TO RMU 8 AND TO RMU 9 (BY NTG)

LEGEND

- NEW 11kV 400 Sqmm Al XLPE FEEDER 11AR01 (PROVIDED BY STAGE 3,4&5 DEVELOPER) REFER NOTE 5
- NEW 11kV 300 Sqmm Cu XLPE FEEDER 11AR14 (PROVIDED BY STAGE 3,4&5 DEVELOPER)
- NEW 11kV 240 Sqmm Al XLPE FEEDER 11AR14 (PROVIDED BY STAGE 3,4&5 DEVELOPER)
- NEW 11kV 400 Sqmm Al XLPE FEEDER 11AR17 (CONTINGENCY FEEDER) PROVIDED BY NTG
- NEW 11kV 400 Sqmm Al XLPE FEEDER 11AR18 (PROVIDED BY STAGE 3,4&5 DEVELOPER)
- EXISTING 11kV 400 Sqmm Al XLPE FEEDER 11AR18 (STAGE 1 DEVELOPMENT)
- NEW 11kV 400 Sqmm Al XLPE FEEDER 11AR02 PROVIDED BY NTG
- EXISTING HV OVERHEAD RETICULATION

STANDARD POWER AND WATER PACKAGE MK3 SUBSTATION AS PER POWER AND WATER STANDARD DRAWINGS S2-1-7-18 (4 OFF DRAWINGS), S2-2-5-10, 2-2-6-17, S2-2-6-37 (4 OFF DRAWINGS) AND S2-2-6-33. HV SWITCHGEAR SHALL BE "DREISCHER" MINEX. REQUIRES 4.0m x 3.5m EASEMENT.

GIFTED ASSETS

WARNING

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Email: darwin@ap.aurecongroup.com

NO	DESCRIPTION	DRN	DATE	APPD	DRG NO	TITLE
04	ISSUED FOR POWER AND WATER APPROVAL	JL	14/03/18	CT	B14-E10	HIGH VOLTAGE RETICULATION
03	ISSUED FOR POWER AND WATER APPROVAL	JL	07/02/18	CT	B14-E09	HIGH VOLTAGE RETICULATION
02	ISSUED FOR PWC APPROVAL	JL	09/08/17	CT	B14-E08	HIGH VOLTAGE RETICULATION
01	PRELIMINARY ISSUE	JL	19/12/16	CT	B14-E07	HIGH VOLTAGE RETICULATION
00	PRELIMINARY ISSUE	JL	19/12/14	CT	B14-E06	HIGH VOLTAGE RETICULATION
					B14-E05	HIGH VOLTAGE RETICULATION
					B14-E04	HIGH VOLTAGE RETICULATION
					B14-E03	HIGH VOLTAGE RETICULATION
					B14-E02	HIGH VOLTAGE RETICULATION
AMENDMENTS		ASSOCIATED DRAWINGS				

DRAWING STATUS

- P PRELIMINARY/PROPOSED
- T TENDERING PURPOSES ONLY
- AC APP. FOR CONSTRUCTION
- AI AS INSTALLED
- C CANCELLED/SUPERSEDED

APPD	DATE

PowerWater

DES	JL
DRN	JL
CKD	CT
APPD	
SCALE	1:100 @A1
ISSUED	14/03/18
ALL DIM. IN mm	
DRAFTING STANDARD TO A.S.1100	

POWER NETWORKS - PALMERSTON DISTRIBUTION
SUBDIVISION OF LOT
ZUCCOLI STAGE 3 AND 4
HIGH VOLTAGE RETICULATION
MASTER PLANNING

A1 DRAWING NUMBER B14-E06

FILE No. NE590 / 11820

AMDT

GIFTED ASSETS

WARNING

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LEGEND

- NEW 11kV 400 Sqmm Al XLPE FEEDER 11AR01 (PROVIDED BY STAGE 3,4&5 DEVELOPER) REFER NOTE 5
- NEW 11kV 240 Sqmm Al XLPE FEEDER 11AR01 (PROVIDED BY STAGE 3,4&5 DEVELOPER)
- NEW 11kV 400 Sqmm Al XLPE FEEDER 11AR18 (PROVIDED BY STAGE 3,4&5 DEVELOPER)
- EXISTING 11kV 400 Sqmm Al XLPE FEEDER 11AR18 (STAGE 1 DEVELOPMENT)
- EXISTING HV OVERHEAD RETICULATION
- STANDARD POWER AND WATER PACKAGE MK3 SUBSTATION AS PER POWER AND WATER STANDARD DRAWINGS S2-1-7-18 (4 OFF DRAWINGS), S2-2-5-10, 2-2-6-17, S2-2-6-37 (4 OFF DRAWINGS) AND S2-2-6-33. HV SWITCHGEAR SHALL BE "DREISCHER" MINEX. REQUIRES 4.0m x 3.5m EASEMENT.

NOTES

- 1 - UNLESS INDICATED OTHERWISE, ALL 11 kV 240 Sqmm Al AND 400 Sqmm Al XLPE SHALL BE SUPPLIED AND INSTALLED BY STAGE 3 & 4 AND STAGE 5 DEVELOPER.
- 2 - UNLESS INDICATED OTHERWISE, ALL RMUs AND SUBSTATIONS SHALL BE SUPPLIED AND INSTALLED BY STAGE 3 & 4 AND STAGE 5 DEVELOPER.
- 3 - AS PART OF PRECINCT C WORKS DISCONNECT AND REMOVE EXISTING POWER POLES P1 TO P5 AND THE OVERHEAD HV CONDUCTORS FROM P1 TO P6 INCLUDING HV CABLES FROM POLE P1 TO RMU 5 UPON COMPLETION OF THE INSTALLATION OF NEW UNDERGROUND HV FEEDER CABLE (11AR18) FROM EXISTING RMU No.6 TO RMU P4D AND FROM RMU P4D TO EXISTING RMU No5
- 4 - AS PART OF PRECINCT C WORKS DISCONNECT HV CABLES COMING FROM SUB 3394 AT POLE P2, HV LINKS 13573 AND REROUTE CABLES TO EXISTING RMU No5. SUPPLY AND INSTALL NEW HV CABLES FROM EXISTING RMU No5 AND JOIN ONTO EXISTING HV CABLES COMING FROM SUB 3394.
- 5 - EXISTING 11AR01 HV FEEDER FROM EXISTING ZUCCOLI SWITCHING STATION TO RMU 8, RMU 8 TO RMU 9 (BY NTG). TEMP O/H LINE CONNECTED TO SWITCH 13381 AT THE MOMENT. 11AR01 CABLE HAS BEEN INSTALLED ONLY UP TO RMU 6. THIS CABLE WILL NEED TO BE EXTENDED FROM WHERE IT STOPPED (ADJACENT TO RMU 6) TO RMU 8 AND TO RMU 9 (BY NTG)

PowerWater

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ENDORSEMENT IS SUBJECT TO THE CONDITIONS LISTED BELOW.

SIGNED *Goutham Reddy.m* DATED *24/03/2018*
NAME *GOUTHAM MADDIRALA*



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03 ISSUED FOR POWER AND WATER APPROVAL
02 ISSUED FOR POWER AND WATER APPROVAL
01 ISSUED FOR PWC APPROVAL
00 PRELIMINARY ISSUE

NO DESCRIPTION DRN DATE APPD DRG NO TITLE

AMENDMENTS ASSOCIATED DRAWINGS

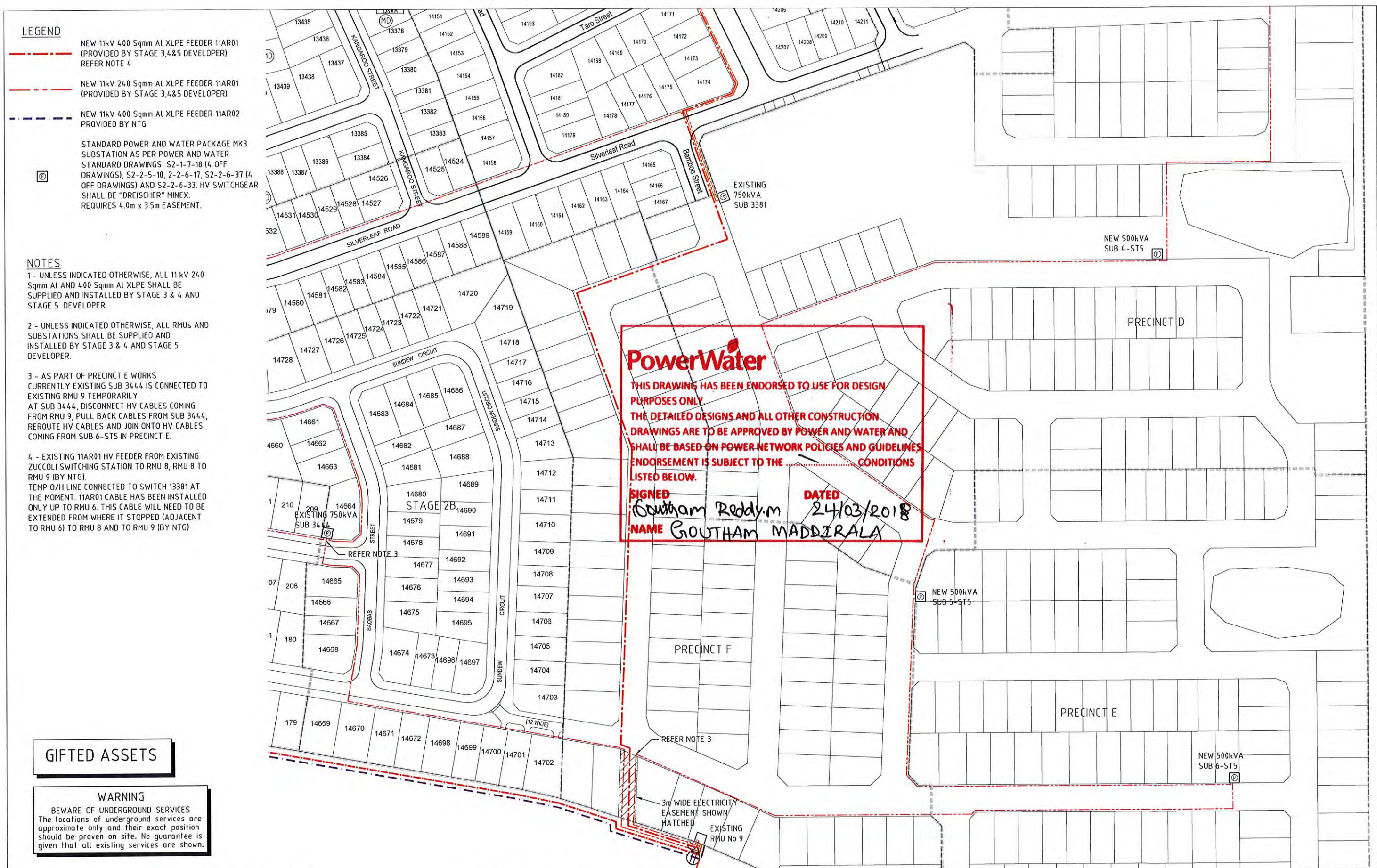
DRAWING STATUS	APPD	DATE
P PRELIMINARY/PROPOSED		
T TENDERING PURPOSES ONLY		
AC APP. FOR CONSTRUCTION		
AI AS INSTALLED		
C CANCELLED/SUPERSEDED		

PowerWater

DES	IL
DRN	IL
CKD	CT
APPD	
SCALE	1:1000 @A1
ISSUED	14/03/18
ALL DIM. IN mm	
DRAFTING STANDARD TO A.S.1100	

POWER NETWORKS - PALMERSTON DISTRIBUTION
SUBDIVISION OF LOT
ZUCCOLI STAGE 5
HIGH VOLTAGE RETICULATION
MASTER PLANNING

A1 DRAWING NUMBER B14-E07
FILE No. NE590 / 11820
AMDT



- LEGEND**
- NEW 11kV 400 Sqmm AL XLPE FEEDER 11AR01 (PROVIDED BY STAGE 3,4&5 DEVELOPER) REFER NOTE 4
 - NEW 11kV 240 Sqmm AL XLPE FEEDER 11AR01 (PROVIDED BY STAGE 3,4&5 DEVELOPER)
 - NEW 11kV 400 Sqmm AL XLPE FEEDER 11AR02 PROVIDED BY NTG
- STANDARD POWER AND WATER PACKAGE MK3 SUBSTATION AS PER POWER AND WATER STANDARD DRAWINGS S2-1-7-18 (4 OFF DRAWINGS), S2-2-5-10, 2-2-6-17, S2-2-6-37 (4 OFF DRAWINGS) AND S2-2-6-33. HV SWITCHGEAR SHALL BE "DREISCHER" MINEX. REQUIRES 4.0m x 3.5m EASEMENT.

- NOTES**
- 1 - UNLESS INDICATED OTHERWISE, ALL 11 kV 240 Sqmm AL AND 400 Sqmm AL XLPE SHALL BE SUPPLIED AND INSTALLED BY STAGE 3 & 4 AND STAGE 5 DEVELOPER.
- 2 - UNLESS INDICATED OTHERWISE, ALL RMUs AND SUBSTATIONS SHALL BE SUPPLIED AND INSTALLED BY STAGE 3 & 4 AND STAGE 5 DEVELOPER.
- 3 - AS PART OF PRECINCT E WORKS CURRENTLY EXISTING SUB 3444 IS CONNECTED TO EXISTING RMU 9 TEMPORARILY. AT SUB 3444, DISCONNECT HV CABLES COMING FROM RMU 9, PULL BACK CABLES FROM SUB 3444, REROUTE HV CABLES AND JOIN ONTO HV CABLES COMING FROM SUB 6-ST5 IN PRECINCT E.
- 4 - EXISTING 11AR01 HV FEEDER FROM EXISTING ZUCCOLI SWITCHING STATION TO RMU 8, RMU 8 TO RMU 9 (BY NTG). TEMP O/H LINE CONNECTED TO SWITCH 13381 AT THE MOMENT. 11AR01 CABLE HAS BEEN INSTALLED ONLY UP TO RMU 6. THIS CABLE WILL NEED TO BE EXTENDED FROM WHERE IT STOPPED (ADJACENT TO RMU 6) TO RMU 8 AND TO RMU 9 (BY NTG)

GIFTED ASSETS

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NO	DESCRIPTION	DRN	DATE	APPD	DRG NO	TITLE
03	ISSUED FOR POWER AND WATER APPROVAL	JL	14/03/18	CT	B14-E08	HIGH VOLTAGE RETICULATION
02	ISSUED FOR POWER AND WATER APPROVAL	JL	07/02/18	CT	B14-E09	HIGH VOLTAGE RETICULATION
01	ISSUED FOR PWC APPROVAL	JL	09/08/17	CT	B14-E07	HIGH VOLTAGE RETICULATION
00	PRELIMINARY ISSUE	JL	19/12/16	CT	B14-E05	HIGH VOLTAGE RETICULATION
					B14-E04	HIGH VOLTAGE RETICULATION
					B14-E03	HIGH VOLTAGE RETICULATION
					B14-E02	HIGH VOLTAGE RETICULATION
					B14-E01	HIGH VOLTAGE RETICULATION

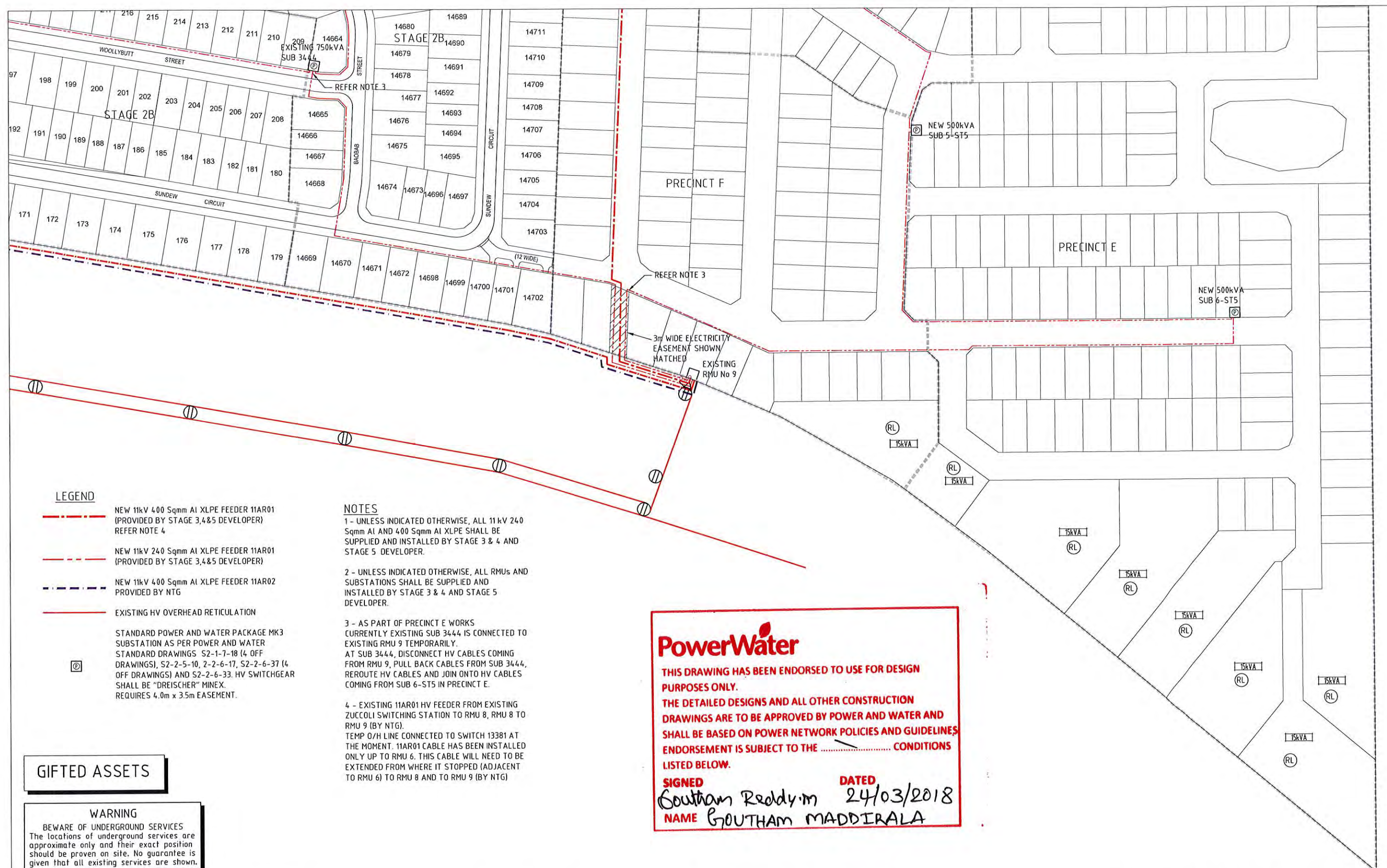
AMENDMENTS	ASSOCIATED DRAWINGS

DRAWING STATUS	APPD	DATE
P PRELIMINARY/PROPOSED		
T TENDERING PURPOSES ONLY		
AC APP. FOR CONSTRUCTION		
AI AS INSTALLED		
C CANCELLED/SUPERSEDED		

PowerWater

DES JL	POWER NETWORKS - PALMERSTON DISTRIBUTION SUBDIVISION OF LOT ZUCCOLI STAGE 5 HIGH VOLTAGE RETICULATION MASTER PLANNING	
DRN JL		
CKD CT		
APPD		
SCALE 1:100 @A1		
ISSUED 14/03/18	A1	DRAWING NUMBER B14-E08
ALL DIM. IN mm		
DRAFTING STANDARD TO A.S.1100		FILE No. NE590 / 11820

AMDT



Developer: **Costojic Pty Ltd**
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I agree that Aurecon Australia Pty Ltd may design the seal as:
• using the drawings and notes set in electronic form without rescaling or creating them for accuracy against the original drawing; and/or
• using the drawings or other data for any purpose not agreed to in writing by Aurecon.
I understand that the use of the seal is limited to the project described above and I shall indemnify the Principal (Company) from all claims.

								DRAWING STATUS	APPD	DATE
					B14-E10 HIGH VOLTAGE RETICULATION		P	PRELIMINARY/PROPOSED		
					B14-E08 HIGH VOLTAGE RETICULATION		T	TENDERING PURPOSES ONLY		
					B14-E07 HIGH VOLTAGE RETICULATION		AC	APP. FOR CONSTRUCTION		
					B14-E06 HIGH VOLTAGE RETICULATION		AI	AS INSTALLED		
					B14-E05 HIGH VOLTAGE RETICULATION		C	CANCELLED/SUPERSEDED		
					B14-E04 HIGH VOLTAGE RETICULATION					
					B14-E03 HIGH VOLTAGE RETICULATION					
					B14-E02 HIGH VOLTAGE RETICULATION					
					B14-E01 HIGH VOLTAGE RETICULATION					
03	ISSUED FOR PWC APPROVAL	J	14/03/18	CT						
02	ISSUED FOR PWC APPROVAL	J	07/02/18	CT						
01	ISSUED FOR PWC APPROVAL	J	09/07/18	CT						
00	PRELIMINARY ISSUE	J	19/12/16	CT						
NO	DESCRIPTION	DRN	DATE	APPD	DRG NO	TITLE				
AMENDMENTS						ASSOCIATED DRAWINGS				



PowerWater

DES	JL	POWER NETWORKS - PALMERSTON DISTRIBUTION SUBDIVISION OF LOT ZUCCOLI STAGE 5 HIGH VOLTAGE RETICULATION MASTER PLANNING	
DRN	JL		
CKD	CT		
APPD			
SCALE	1:100 @A1		
ISSUED	14/03/18	A1	DRAWING NUMBER B14-E09
ALL DIM. IN mm			
DRAWING STANDARD TO A.S.1100		FILE No.	NE590 / 11820

Appendix G

Stormwater 100 Year Flood Schematic

Adelaide
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Adelaide SA 5000
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Email: info@adgce.com

Brisbane
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North Sydney, NSW, 2060
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Toowoomba QLD 4350
Phone: 1300 657 402



From: [Julie Hillier](#)
To: ["drozario@ozemail.com.au"](mailto:drozario@ozemail.com.au)
Subject: PA2024/0147 - Deferral under delegation s46(4)(b)
Date: Friday, 9 August 2024 4:50:00 PM
Attachments: [image001.jpg](#)

Hello June,

I refer to your application PA2024/0148 for Subdivision to create 38 lots and building setback plan (Zuccoli Aspire Stage 5A) at Lot 12433 and Lot 12432 Town of Palmerston.

Please be advised that the application has been deferred pursuant to s46(4)(b) of the *Planning Act 1999* by a delegate of the Palmerston division of the Development Consent Authority to allow you to provide the following additional information that the consent authority considers necessary in order to enable proper consideration of the application:

- A response to the technical assessment; and
- Submission from City of Palmerston.

The reasons for the deferral are:

- The technical assessment identifies non-compliances that the deferral period enables the applicant to address. The submission from City of Palmerston raises matters of concern which the deferral period enables the applicant to address.

Pursuant to s46(6) of the *Planning Act 1999*, the information required is to be provided within 30 days of receipt of this correspondence. You may request the consent authority extend the time to provide the additional information. A request must be made before the expiry of the period referred to in section 46(6) (i.e. within 30 days of receipt of this email) and it must be made in writing by reply email, or to das.ntg@nt.gov.au.

Please contact me if you have any queries.

Julie Hillier

A/Manager, Palmerston and East Arm Planning
Development Assessment Services
Department of Infrastructure, Planning and Logistics

Floor 1, Energy House, 18-20 Cavenagh Street, Darwin
GPO Box 1680, Darwin, NT 0801

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SDPP image



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10 June 2026

Development Assessment Services
Department of Lands, Planning and Environment
GPO Box 1680
DARWIN NT 0801

Attention: Daniel Herlihy

Dear Daniel

RE: Response to Submissions – PA2024/0148

At: Lots 12433 and 12432 Town of Palmerston (Zuccoli Aspire Stage 5B)

Cunnington Rosse Town Planning and Consulting have been engaged by the proponent in the above matter, being a development application for *subdivision to create 38 lots and building setback plan* comprising stage 5B of the Zuccoli Aspire housing estate, to respond to the deferral decision of Development Assessment Services (DAS). Via email dated 9 August 2024 to the (then) applicant, DAS advised of the deferral requiring the applicant provide additional information to enable proper consideration of the application, specifically:

- *A response to the technical assessment; and*
- *Submission from City of Palmerston.*

The deferral notice is included in **Attachment A**. This submissions comprises the applicants response to both items.

1.0 Matters From Technical Assessment

The technical assessment referred to in the deferral notice is dated 8 August 2024 and included in **Attachment B**. As the deferral notice is unclear on precisely what aspects of the technical assessment need responding to, this responses addresses items identified as **requiring further information**. This submission does not address matters in the technical assessment identified as “does not comply,” noting that these matters will be considered by the Development Consent Authority. Matters raised in the Technical Assessment are summarised in italics below, with the applicant’s response immediately thereafter.

Dwelling Type and Density: The application refers to the development of components of the neighbourhood centre provided in Stage 4D (now within Zone C – Commercial) and further sites to be developed as part of Stage 4E. It is noted that the submitted Master Plan identifies three lot types: single dwellings, multiple dwellings and rural lots however does not clearly reflect how dwelling density is being maximised within 400m to the neighbourhood centre in relation to the current stage. The Compact Urban Growth Policy considers medium density as a locality where densities are approximately 60 dwellings per hectare.

Notwithstanding the changes to the Master Plan, the application demonstrates a compact residential subdivision that is generally in accordance with the Area Plan and planning principles, however the change proposed exclude a larger lot in Stage 5B reduces the mix of dwelling types and lots sizes adjacent to a future neighbourhood centre.

The proposed future LMR zoning will facilitate residential development of up to two storeys in a manner consistent with the built form and character of residential development delivered to date throughout Zuccoli. Within the immediate precinct, future mixed-use residential and commercial lots are identified on adjoining land (Stages 4E, 4F, 4G and 5C). These developments will provide a graduated transition in scale and intensity between the standardised residential estate lots, including those proposed as part of this subdivision, and the neighbourhood centre. The notation on Plan 2 of the Area Plan to “...maximise the number of dwellings within a 400m walk from the neighbourhood centre and bus stop” cannot be taken as the maximum possible density under the applicable Planning Scheme Zones (noting the proposed lots are intended for Zone LMR). Rather, *maximise* must be considered in context with the applicable planning principles (including 1(c) and 3), and the inclusion of increased densities in these areas in a manner that reasonably responds to dwelling demands, integrates with dwellings adjacent / opposite, and provides an appropriate transition of dwelling types, densities and intensities. Likewise, the intention to maximise the number of dwellings cannot be applied to the proposed stage in isolation of the master plan.

The relevance of the definition of ‘medium density’ in the Compact Urban Growth Policy is unclear. The Area Plan does not stipulate medium density development in the location of stage 5B (only identified above commercial space per planning principle 1(c)).

Stormwater: Further information may be required to demonstrate how the development will preserve the environment and apply principles of water sensitive urban design (preservation of natural hydrological flow regimes, retention of natural Waterways, selection of stormwater drainage infrastructure to slow down flows, maximise groundwater recharge, and filter out nutrients and other pollutants and management of stormwater quality).

There are no natural or cultural features within the subdivision footprint, however the subdivision will include stormwater drainage discharge into Mitchell Creek. Further information on stormwater design may assist to address how the subdivision works will protect significant natural features.

The subdivision footprint excludes natural drainage lines and any distinctive landform features or stands of natural vegetation that would otherwise be incorporated into public open space, however the associated works to provide stormwater drainage impacts on drainage features and the land is not identified as part of any stages of the subdivision on the Master Plan, however is partly included on the Staging Plan as part of Stage 5.

The Aspire stormwater management approach has been developed and advanced in consultation with the relevant service authorities in a manner designed to preserve the Mitchell Creek environment and apply Water Sensitive Urban Design principles reflecting the sites' location at the bottom-of-catchment. Natural hydrological flow regimes and waterways are retained and protected, infrastructure has been selected to dissipate energy and limit erosion, recharge pathways are maintained, and pollutant and quality risks are managed through gross-pollutant traps, retained vegetation and erosion and sediment controls.

Zuccoli Aspire is the most downstream urban development that contributes stormwater to the Mitchell Creek system, and the development sits within the bottom third of the Mitchell Creek catchment. Stage 5B is situated within one of the three western catchments that discharge to Mitchell Creek via existing ephemeral drainage lines and overland flow paths. Land within the Mitchell Creek corridor outside the subdivision is identified as natural open space for the protection of Mitchell Creek, with associated drainage lines retained for open space incorporating drainage features, natural habitats and passive recreation. The subdivision footprint itself contains no significant features and is not located within 1% AEP flood or storm surge area.

Since the original deferral, ongoing consultation and submissions direct to the City of Palmerston and other applicable service authorities have occurred, including a supplementary report on the project Stormwater Management Plan prepared by Muir Consultants (and incorporating flood modelling by WRM). In addition, a Part 1 Stormwater Management Plan was prepared by ADG Engineers in March 2026.

These documents are in addition to Revision 6 of the Stormwater Master Plan (February 2022), Stage 5B Engineering Services Report (November 2023), Stormwater Management Approach Report (August 2021), and the original WSUD Strategy and Mitchell Creek Flood Study (2009).

The Engineering Services Report and the Stormwater Masterplan confirm that all runoff generated within Stage 5B ultimately discharges to Mitchell Creek via an existing ephemeral drainage line, and that it is "beneficial to release flows quickly" rather than to detain them. Noting the sites' location at the end of the catchment, detaining the development's runoff would delay its release so that the development peak coincides with the later-arriving peak of the much larger upstream Mitchell Creek catchment. Releasing local runoff quickly allows it to clear the system before the main creek peak arrives, reducing the risk of compounding peak flows. This approach has been verified in the Muir Consultants / WRM flood modelling, which found:

- There is no predicted change in peak flood depths in the vicinity of the proposed minor drainage system outfall locations and confluence with Mitchell Creek;

- Peak flood depths will be reduced within the natural drainage lines upstream of the proposed minor drainage system outfall locations;
- An increase in peak flow velocities within the natural drainage lines post-development is generally limited to the localised section between the proposed minor drainage system outfalls and Mitchell Creek (up to 1.0m/s increase for the 50% AEP event, and up to 0.5m/s increase for the 1% AEP event at localised locations);
- There are no predicted changes to peak flood velocities within Mitchell Creek; and
- Peak flood velocities will be reduced within the natural drainage lines upstream of the proposed minor drainage system outfall locations.

With regard to stormwater quality, the design incorporates Gross Pollutant Traps at pipe outfall headwalls to capture litter and coarse sediment, retained vegetated bushland and natural drainage lines provide natural filtration before discharge, and Erosion and Sediment Control Plans (ESCP) will be implemented to manage construction-phase sediment and nutrient export. The retention of natural pervious drainage corridors rather than lining or fully piping, and discharge is to natural ground surface and ephemeral drainage lines maintains infiltration and recharge pathways across the riparian interface.

On this basis the proposed stormwater system avoids the detention of development peak flows for the western catchments, and the omission of lakes / detention basins in this location reflects a water-sensitive response to the receiving environment rather than a departure from it. The aforementioned documents and studies can be provided on request.

Public Open Space: *The application refers to the submitted Master Plan to respond to the minimum requirements of public open space and to examples of the proportion of public open space provided in other stages of subdivision in Zuccoli Aspire including:*

- *Stage 3 – 22.5%*
- *Stage 4A – 17.8%*
- *Stage 4D – 47%*
- *Precinct D – 24%*

However a plan that identifies the available area of unencumbered public open space (existing vs proposed) would support the assessment to confirm compliance, noting the space is also required to accommodate drainage.

The updated Zuccoli Aspire Public Open Space Master Plan indicates a total development area of 171.15 hectares, unencumbered public open space area of 27.985 hectares (16.35%) and encumbered public open space area of 1.01 hectares (0.59%). Of the unencumbered areas of public open space, lakes represent 1.2044 hectares, equivalent to 0.7% of the total subdivision area.

The revised Public Open Space Master Plan (issued 10 March 2026) is not included as part of this application as PA2024/0148 does not include public open space areas, however can be provided on request.

2.0 City of Palmerston Submission

The City of Palmerston's submission (refer **Attachment C**) is dated 5 July 2024 and raised concerns that the application was incomplete and did not meet the minimum lodgement requirements under **Section 46(3)** of the Northern Territory Planning Act. Since Council's original submission, ongoing consultation and submissions direct to the City of Palmerston have occurred, including a supplementary report on the project Stormwater Management Plan prepared by Muir Consultants (and incorporating flood modelling by WRM). In addition, a Part 1 Stormwater Management Plan was prepared by ADG Engineers in March 2026.

These documents are in addition to Revision 6 of the Stormwater Master Plan (February 2022), Stage 5B Engineering Services Report (November 2023), Stormwater Management Approach Report (August 2021), and the original WSUD Strategy and Mitchell Creek Flood Study (2009).

In addition to the stormwater investigations and further submissions referred above, the proponent has progressed the Public Open Space Master Plan and made further submissions to the City of Palmerston. Based on discussions with Council, it is understood that all outstanding matters have been resolved the extent that the City of Palmerston has no concerns with a development permit being issued, subject to conditions precedent confirming stormwater, open space and road infrastructure design and approval from the City of Palmerston.

Finally, it is noted that Council's submission also identifies non-compliance with the building envelope requirements in **Clause 6.2.1(6)** of the NT Planning Scheme (relating the minimum building envelope requirements). Council's assertion that this results in "minimum setbacks cannot be achieved" is incorrect. The proposed subdivision includes minor variations to the minimum building envelope requirements for a small number of lots, however this does not preclude the achievement of compliance with the residential building setback requirements in **Clause 5.4.3** of the Planning scheme. The variations are identified in the technical assessment.

I confirm my client and/or representative will be present in person to respond to matters relating to the proposed development at the relevant hearing of the consent authority. Please do not hesitate to contact the undersigned with any further queries on that contained herein.



Brad Cunnington

Cunnington Rosse Town Planning and Consulting

Attachment A: Deferral Notice

Attachment B: Technical Assessment

Attachment C: City of Palmerston Submission