PROPOSED RESIDENTIAL DEVELOPMENT

101 NUWARRA ROAD, MOOREBANK

Revised Assessment of Traffic and Parking Implications

Feb 2019
(Rev D)

Reference 16055

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TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

1. INTRODUCTION

This report has been prepared to supplement revised plans a Development Application to Liverpool City Council for a proposed residential apartment development on a site in Nuwarra Road at Moorebank (Figure 1).

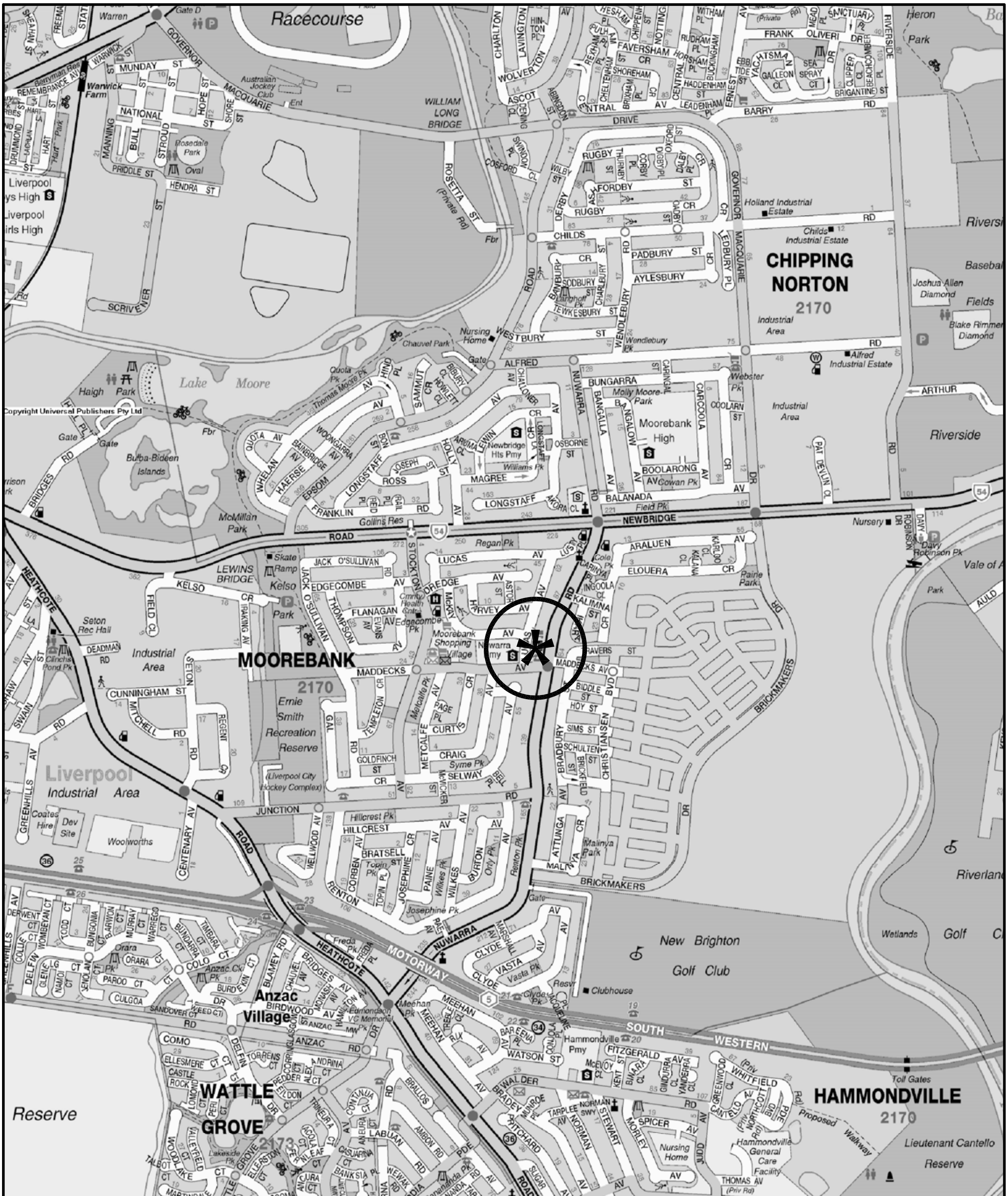
The Moorebank area provides appropriate circumstances for new residential apartments due to the presence of retail and educational facilities as well as the ready access to the arterial road system.

The proposed development is located immediately to the north of the M5 motorway and comprises:

76 residential apartments
7 commercial tenancies
basement carparking

The purpose of this revised report is to:

* describe the site, its context and the proposed development scheme
* describe the road network and traffic conditions in the area
* assess the adequacy of the proposed parking provision
* assess the potential traffic implications
* assess the proposed vehicle access, internal circulation and servicing arrangements
* respond to traffic issues raised by Council



LEGEND

LOCATION

FIG 1

2. PROPOSED DEVELOPMENT SCHEME

2.1 SITE, CONTEXT AND EXISTING USE

The development site (Figure 2) is a consolidation of Lot 101 in DP601256 and Lot 1 in DP230908 occupying an area of some 5,210m² with frontages to the western side of Nuwarra Road and the eastern side of Lucas Avenue being located just to the north of Maddecks Avenue.

The surrounding uses comprise:

- the residential dwellings which adjoin to the north and Council library which adjoins to the south
- the large new apartment building on the eastern side of Nuwarra Road
- the new residential area which extends to the east
- the Moorebank Shopping Village and school to the west
- the existing uses on the site comprise:
  - 8 retail tenancies (1,375m^2)
  - 9 residential units
  - extensive at-grade car parking
  - vehicle accesses on Nuwarra Road and Lucas Avenue

2.2 PROPOSED DEVELOPMENT

It is proposed to demolish the existing buildings and excavate the site to provide for the basement carpark and a level building platform. Two new 6 level buildings will comprise:

12 x One-bedroom apartments	Commercial 1,348.24m^2 (7 units)
56 x Two-bedroom apartments	
8 x Three-bedroom apartments	
Total 76 apartments	

LEGEND

SITE

FIG 2

There will be a total of 215 parking spaces provided within the basement with vehicle access located on the Lucas Avenue Road frontage.

Details of the proposed development are provided on the revised prepared by Kennedy and Associates which are reproduced in part in Appendix A.

3. ROAD NETWORK AND TRAFFIC CONDITIONS

3.1 ROAD NETWORK

The road network in the vicinity of the development site (Figure 3) comprises:

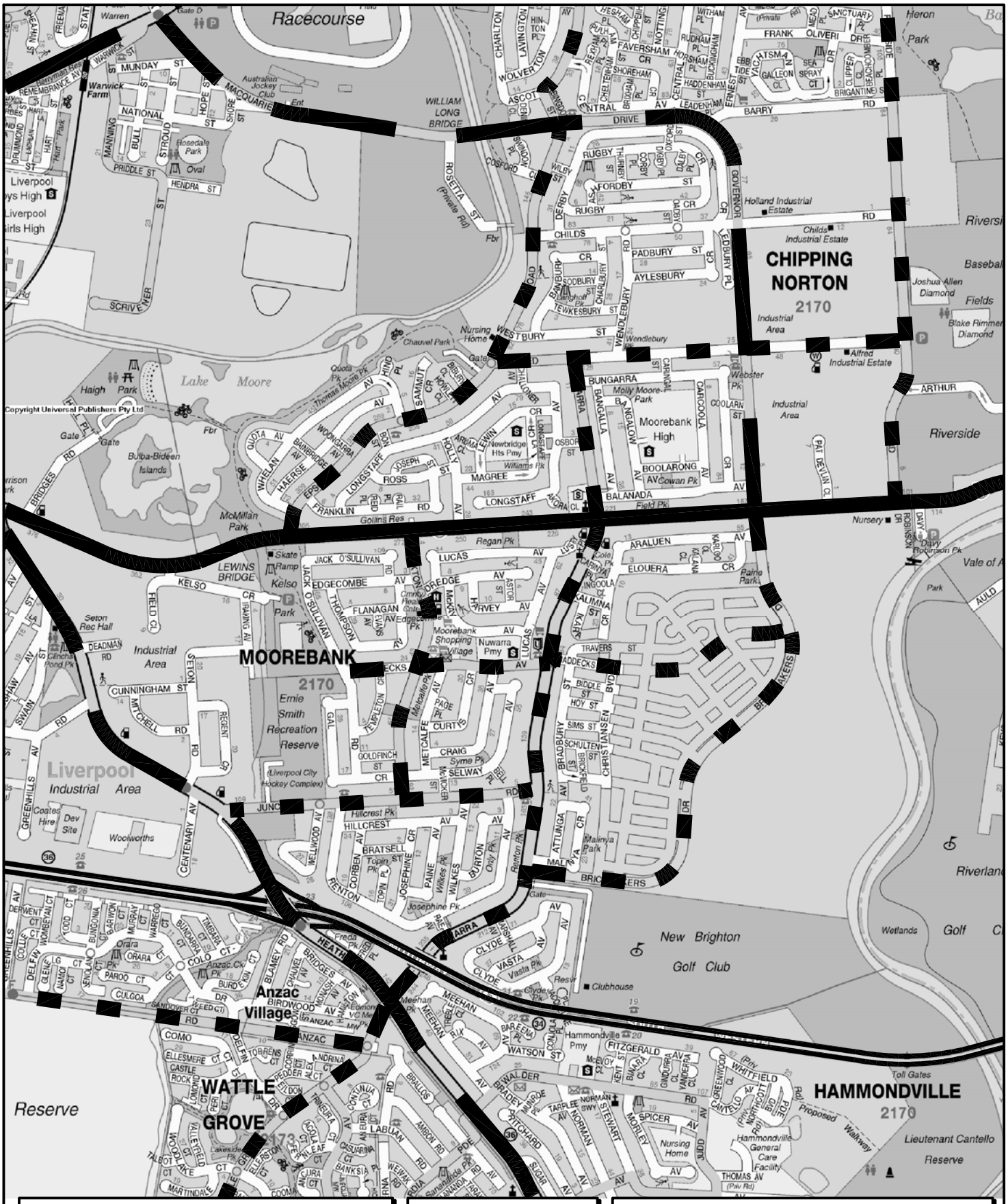
- *M5 Motorway* – a State Road and arterial route which connects between Liverpool and Mascot in the east
- *Newbridge Road* – a State Road and arterial route which connects between Liverpool and Bankstown
- *Heatcote Road – a* State Road and sub arterial route connects between Liverpool and Engadine
- *Nuwarra Road* – a collector road route connecting Chipping Norton and Wattle Grove
- *Junction Road/Stockton Ave and Maddecks Ave* - minor collector road routes

Nuwarra Road in the vicinity of the site has a 12.8 metre roadway with one traffic lane in each direction while Lucas Avenue is some 9.5 metres wide.

3.2 TRAFFIC CONTROLS

The existing traffic controls in the vicinity of the site (Figure 4) include:

- The traffic signals at the Newbridge Road and Nuwarra Road intersection
- The traffic signals at Maddecks Avenue along the Nuwarra Road and intersection
- the roundabouts at intersections along Maddecks Avenue
- the 60 kmph speed restriction on Nuwarra Road and 50 kmph on the local/collector road system with a 40kmph School Speed restriction near the School



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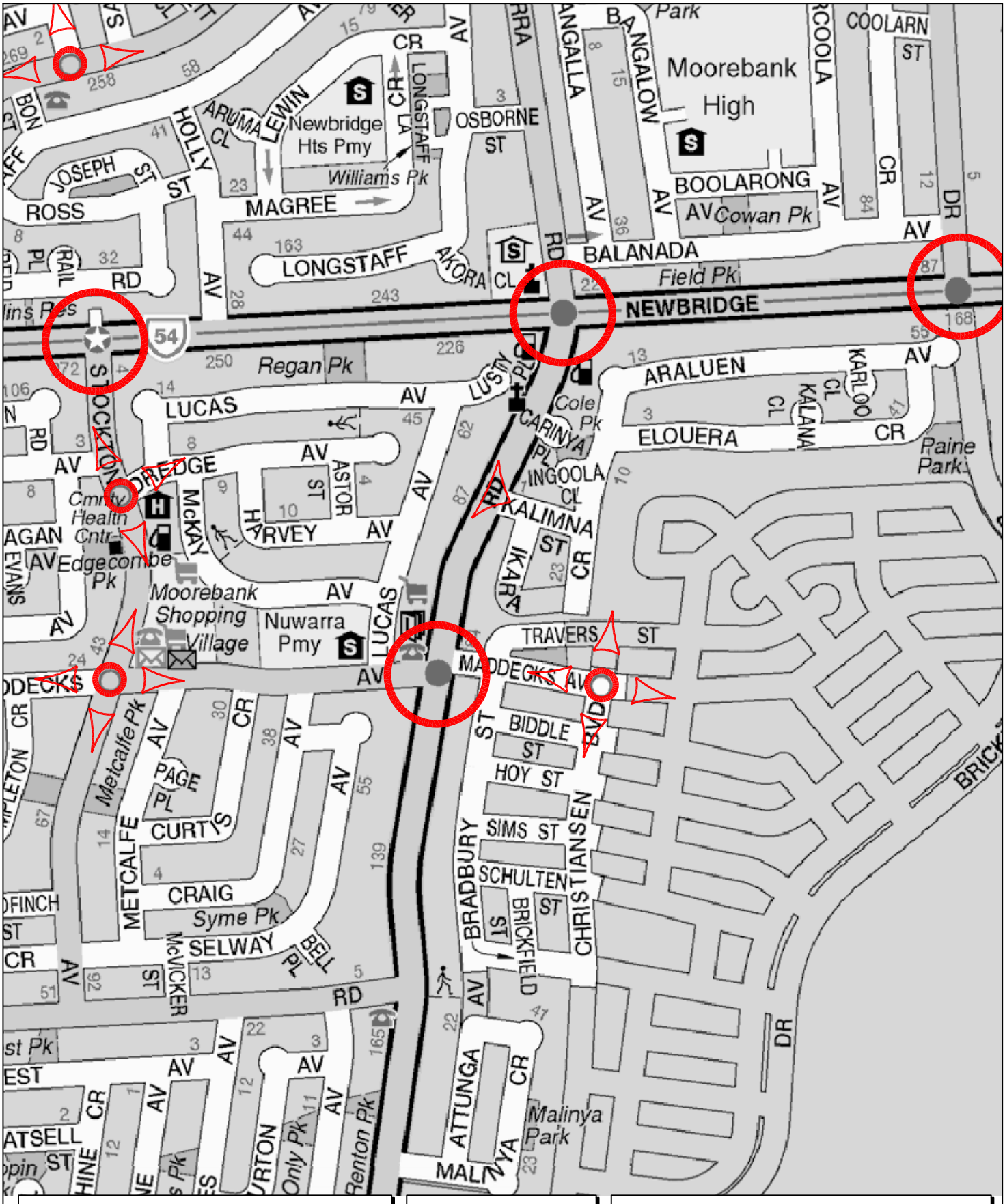
- ARTERIAL
- SUB-ARTERIAL
- COLLECTOR

ROAD NETWORK

FIG 3



LEGEND

- TRAFFIC SIGNAL CONTROL
- ROUNDABOUT
- RESTRICTED TURNING MOVEMENT

TRAFFIC CONTROLS

FIG 4

- the 'seagull' treatment at the Nuwarra Road and Kalima Street intersection
- the traffic signal control at the Newbridge Road and Governor Macquarie Drive intersection

3.3 TRAFFIC CONDITIONS

An indication of traffic conditions on the road system serving the site is provided by data published by the Roads and Maritime Services. The RMS data[1] is expressed in terms of average annual daily traffic (AADT) as follows:

	AADT
Nuwarra Road North of Heathcote Road	22,031

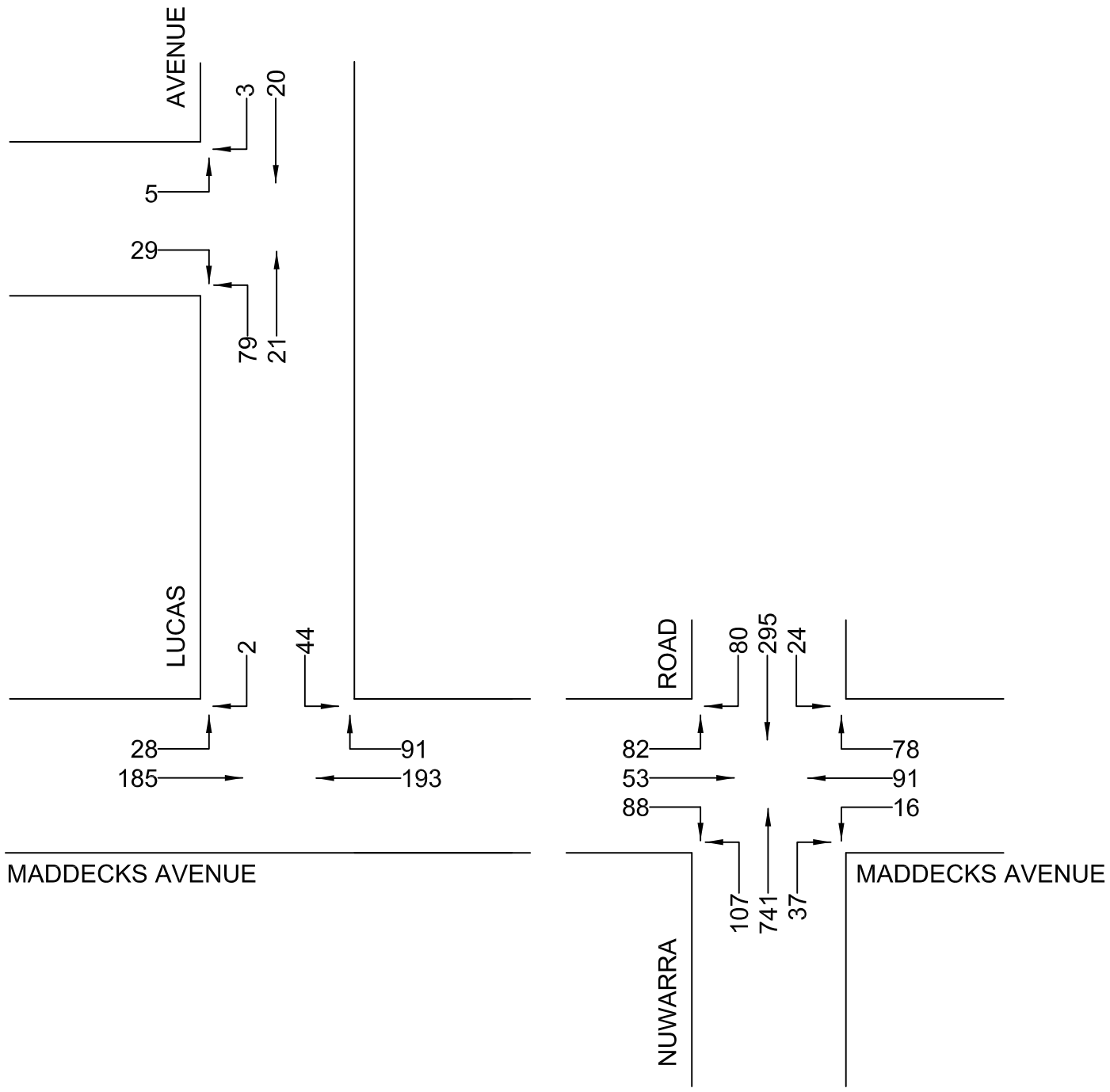
The results of the traffic surveys undertaken during the AM and PM peak periods at the intersections in the vicinity of the site are provided in Appendix B and the results summarised on the diagrams overleaf.

Regular gaps are provided in the traffic flow by the operation of the traffic signals at intersections to the north (Newbridge Road) and south (Maddecks Avenue) while the traffic flow along Lucas Avenue is quite minor.

The results of SIDRA assessment for the access intersections are provided in Appendix C and summarised in the following while the criteria for interpreting SIDRA output is reproduced overleaf.

	AM		**PM**	
	LOS	**AVD**	**LOS**	**AVD**
Nuwarra/Maddecks	B	11.3	B	13.8
Maddecks/Lucas	A	1.8	A	0.9
Lucas/McKay	A	4.2	A	3.1

[1] *Traffic Volume Data for Sydney Region*
Roads and Maritime Services



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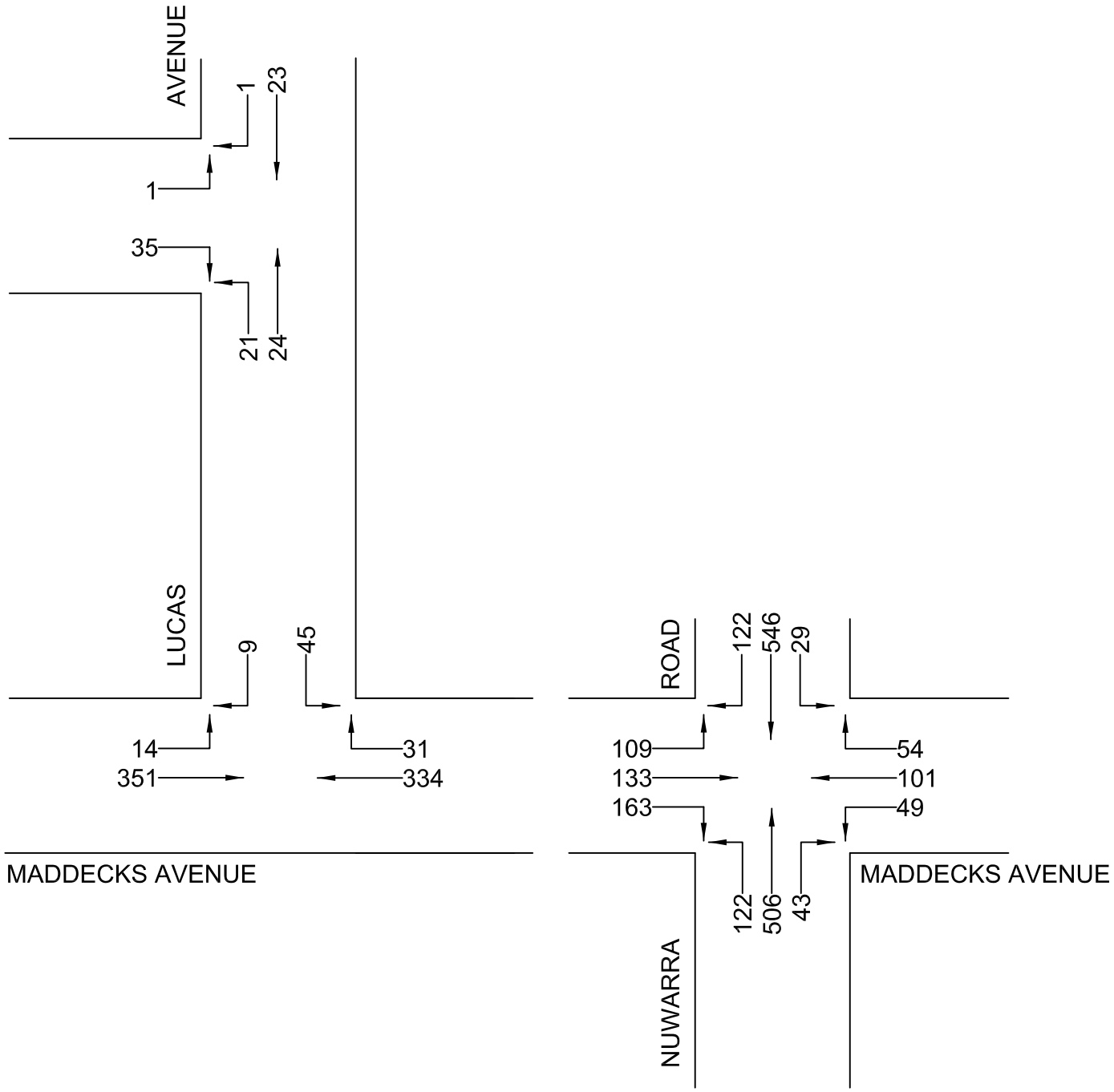
PEAK EXITING TRAFFIC VOLUMES (AM)

FIG 5



LEGEND

N

PEAK EXITING TRAFFIC VOLUMES (PM)

FIG 6

The intersections in the vicinity generally operate satisfactorily during the morning and afternoon peak periods although there is some queuing and congestion along the Newbridge Road and Heathcote Road arterial routes.

3.4 TRANSPORT SERVICES

Bus services operate along Nuwarra Road and Newbridge Road which provide connection to the Metropoitan Transport Network. As a consequence, the site is considered to be well serviced in relation to accessibility to public transport.

Criteria for Interpreting Results of SIDRA Analysis

1. Level of Service (LOS)

LOS	Traffic Signals and Roundabouts	Give Way and Stop Signs
'A'	Good	Good
'B'	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
'C'	Satisfactory	Satisfactory but accident study required
'D'	Operating near capacity	Near capacity and Accident Study required
'E'	At capacity; at signals incidents will cause excessive delays. Roundabouts require other control mode	At capacity and requires other control mode
'F'	Unsatisfactory and requires additional capacity	Unsatisfactory and requires other control mode

2. Average Vehicle Delay (AVD)

The AVD provides a measure of the operational performance of an intersection as indicated on the table below, which relates AVD to LOS. The AVD's listed in the table should be taken as a guide only as longer delays could be tolerated in some locations (ie inner city conditions) and on some roads (ie minor side street intersecting with a major arterial route).

Level of Service	Average Delay per Vehicle (secs/veh)	Traffic Signals, Roundabouts	Give Way and Stop Signs
A	Less than 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity; at signals incidents will cause excessive delays. Roundabouts require other control mode	At capacity and requires other control mode

3. Degree of Saturation (DS)

The DS is another measure of the operational performance of individual intersections.

For intersections controlled by **traffic signals**[1] both queue length and delay increase rapidly as DS approaches 1, and it is usual to attempt to keep DS to less than 0.9. Values of DS in the order of 0.7 generally represent satisfactory intersection operation. When DS exceeds 0.9 queues can be anticipated.

For intersections controlled by a **roundabout or GIVE WAY or STOP signs**, satisfactory intersection operation is indicated by a DS of 0.8 or less.

[1] *the values of DS for intersections under traffic signal control are only valid for cycle length of 120 secs*

4. PARKING

Council's DCP specifies "minimum" parking requirements relevant to the proposed development as follows:

One-bedroom	1 space
Two-bedroom	1.5 space
Three-bedroom	2.0 space
Visitor	1 space per 4 apartments
Commercial/Business	1 space per 35m^2

Application of this criteria to the proposed development scheme indicates the following:

Residential	
12 x One-bedroom	12 spaces
56 x Two-bedroom	84 spaces
8 x Three-bedroom	16 spaces
Visitor (76)	19 spaces
Total:	**131 spaces**
Commercial	
1,348m^2	38.5 spaces (39)
TOTAL:	**170 spaces**

It is proposed to provide a total of 215 spaces, including 15 assessable spaces, in satisfaction of the DCP criteria and having regard to potential uses in the commercial units that may have a higher parking demand.

It is also proposed to provide 28 bicycle spaces.

5. TRAFFIC

VEHICLES

The peak traffic generation of the existing development on the site (i.e. when fully occupied) can be established by application of RMS criteria as follows:

9 residential units @ 0.29 vtph	2 vtph
1,375m^2 retail (8 tenancies) @ 55 vtph per 1,000m^2 *****	76 vtph
Total:	**78 vtph**

****** Specialty shops/secondary retail*

The projected traffic generation of the proposed development can similarly be derived from the RMS criteria.

76 apartments @ 0.29 vtph	22 vtph
1,348m^2 Commercial @ 1.6 vtph per 100m^2	22 vtph
Total:	**44 vtph**

Thus, even if the traffic generation of the existing use were somewhat lower and that of the proposed development somewhat higher, the generation of the proposal will be less than that of the existing. It follows that the operational performance of the access intersections will be better (or very similar to) that which prevailed with the former uses.

PEDESTRIANS

Council requested that an assessment be made in relation to the need for a pedestrian crossing facility in Lucas Avenue (presumably at the site frontage). The recorded peak traffic flows along Lucas Avenue with the projected added vehicle movements resultant to the development are as follows:

	AM	**PM**
Northbound	127	68
Southbound	72	66

The RMS warrant for a pedestrian crossing is as follows:

> *A pedestrian (Zebra) Crossing is warranted where:*
> *In each of three separate one hour periods in a typical day*
> *(a) the pedestrian flow per hour (P) crossing the road is greater than or equal to 30 AND*
> *(b) the vehicular flow per hour (V) through the site is greater than or equal to 500 AND*
> *(c) the product PV is greater than or equal to 60,000*

There are negligible pedestrian movements across Lucas Avenue at any point at the present time and this is unlikely to alter with the proposed residential apartment development. The pedestrian crossing movements may have been prevalent when the shops existed, however the peak traffic flows along Lucas Avenue are substantially less than that required by the RMS warrant.

There is no published warrant for the provision of a pedestrian refuge island, however as the proposed development will not result in any perceptible increase in pedestrian crossing movements there will be no 'nexus' between the development and the need for a refuge island or any other pedestrian crossing facility.

6. ACCESS, INTERNAL CIRCULATION AND SERVICING

ACCESS

The vehicular access arrangements for the development will comprise a 6.0 metre wide combined ingress/egress driveway on the Lucas Avenue frontage at the southern site boundary (where there is an existing driveway). The access will comply with the design requirements of AS2890.1 & 2 and will accommodate all vehicles requiring to access the site.

There are excellent sight distances available at this access point and the proposed driveway will be suitably located away from the Maddecks Avenue intersection.

INTERNAL CIRCULATION

Flexible two-way circulation arrangements will be provided in the basement carpark area. The design for these areas including aisles, bays, ramps etc will comply with AS2890.1 & 6 and Council's DCP.

SERVICING

Refuse will be removed from the street by Council's collection service using the bay provided adjacent to the bin store room which will also accommodate any occasional larger service vehicles (e.g. furniture removal). Small service and delivery vehicles (e.g. service personnel) will also be able to use the bay as well as the visitor spaces.

7. CONCLUSION

The proposed residential apartment development at Moorebank will be suitably located with convenient access to the arterial road system. Assessment has concluded that:

* the development will not present any unsatisfactory traffic implications (vehicle or pedestrian) on the access road (and intersection) system serving the site

* the proposed parking provision will be suitable and appropriate for the needs of the development

* the proposed internal circulation and parking arrangements will be satisfactory

* the proposed access and loading arrangements for service vehicles will be suitable and appropriate

APPENDIX A

DEVELOPMENT PLANS

NUWARRA - street elevation

NUWARRA - building elevation

0 2.5 5 12.5m
1:250 @ A2

nuwarra rd elevations

1	2	3	4	5	6	7	8	9	10	11	12

balcony - painted render: Dulux 'Endless Dusk' (PG1F3)

painted render: Dulux 'Gasgoyne Grey' (PG1H6)

balcony - metal: Powdercoated handrail and bars
Colour: Colorbond 'Monument' (C29)

awning cladding: metal cladding edge and underside of awning. Provider TBA colour: 'monument' (C29)

facade screen / framing: Trend windows, powdercoated aluminium frame. Colour: Colorbond 'Monument' (C29)

painted render: Dulux 'wayward grey' (PG1G8)

louvres: Dulux Duralloy powdercoated louvres Colour: Anotec off-white (51271)

painted render: Dulux "Goanna Grey" (PG2C8)

painted render: Dulux "Tranquil Retreat' (PG1F1)

painted render: dulux 'lexicon' (PN2F1)

roofing: Prepainted Colorbond Custom Orb 'Accent' metal sheet cladding. Vertical profile. Colour: 'Monument' (C29)

metal fence: 1800mm Colorbond metal fence.
Colour: Colorbond 'Monument' (C29)

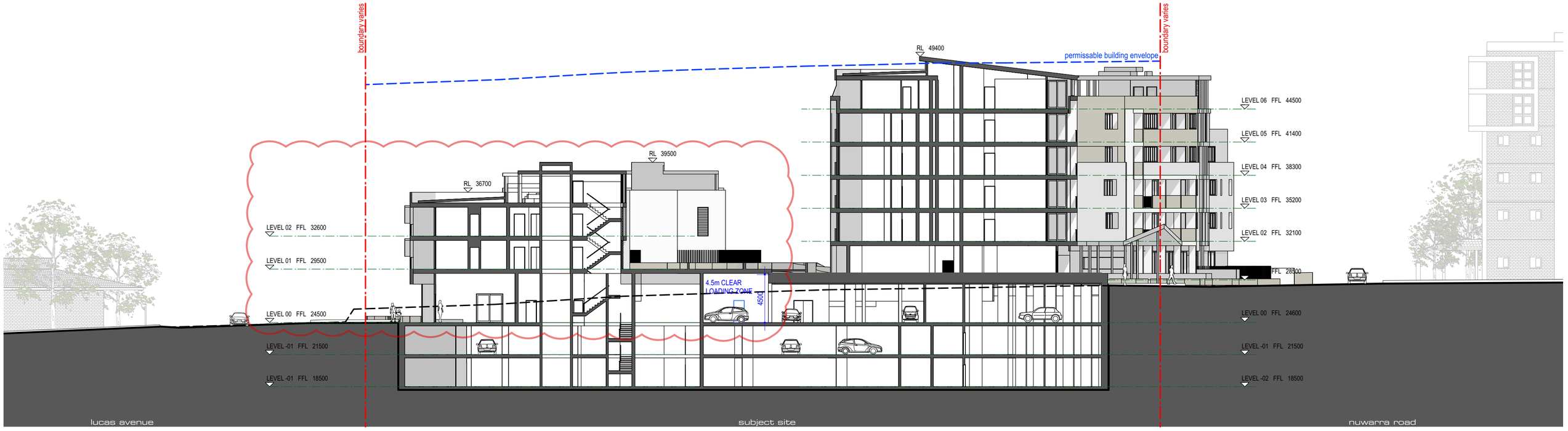
permissable building envelope

E 21/12/18 revised DA issue

101 nuwarra road, MOOREBANK

kennedy associates architects level 3 / 1 booth street annandale 2038 p + 61 2 9557 6466 f + 61 2 9557 6477 nominated architect - steve kennedy - registration no. 5828

1563 – DA18 E



CROSS SECTION C

0 2.5 5 12.5m
1:250 @ A2

cross section

permissable building envelope

E 21/12/18 revised DA issue

101 nuwarra road, MOOREBANK

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1563 – DA22 E

lucas ave

nuwarra rd

existing power pole

existing power pole

boundary 42.2m

boundary 36.9m

6m setback to 4 storeys

boundary 25.2m

bndry 1.5m

boundary 45.3m

16m building separation between habitable rooms / balconies

16m building separation between habitable rooms / balconies

boundary 19.7m

boundary 35.0m

no.90

no.88

no.109

no.97

01-01

01-02

01-03

01-04

01-05

01-06

01-07

01-08

01-09

01-10

RL29.500

COMMERCIAL 1

COMMERCIAL 2

COMMERCIAL 3

COMMERCIAL 4

COMMERCIAL 5

RL28.500

RL27.200

RL27.900

RL28.000

RL27.800

boundary 81.8m

outline of deep soil space

footprint building bellow

walkaway 1:20

walkaway 1:20

ramp 1:14

ramp 1:14

7350

3000

3000

7585

proposed substation location.
Refer drawing DA41 for details

A

B

C

0 2.5 5 12.5m

1:250 @ A2

proposed level 01 / nuwarra rd ground

E 21/12/18 revised DA issue

101 nuwarra road, MOOREBANK

kennedy associates architects level 3 / 1 booth street annandale 2038 p + 61 2 9557 6466 f + 61 2 9557 6477 nominated architect - steve kennedy - registration no. 5828

1563 – DA10 E

lucas ave

nuwarra rd

existing power pole

existing power pole

boundary 42.2m

boundary 25.2m

boundary 19.7m

boundary 81.8m

no.90

no.88

no.109

no.101

no.97

COMMERCIAL 6

COMMERCIAL 7

RL24.500

Elect/Switch

plant room

bicycle store
20 spaces

Loading

waste collection point

edge of 4.5m ceiling height

footprint building above

Commercial: 5 recycling bins
5 garbage bins

residential:
14 recycling bins
14 garbage bins

660L

bulky waste store

48 carspaces (23 visitors)
16 storage units

visitor

bicycle store
8 spaces

Pump Room

store 6m³

store 8.7m³

A

B

C

0 2.5 5 12.5m
1:250 @ A2

proposed level 00 / lucas ave ground

E 21/12/18 revised DA issue

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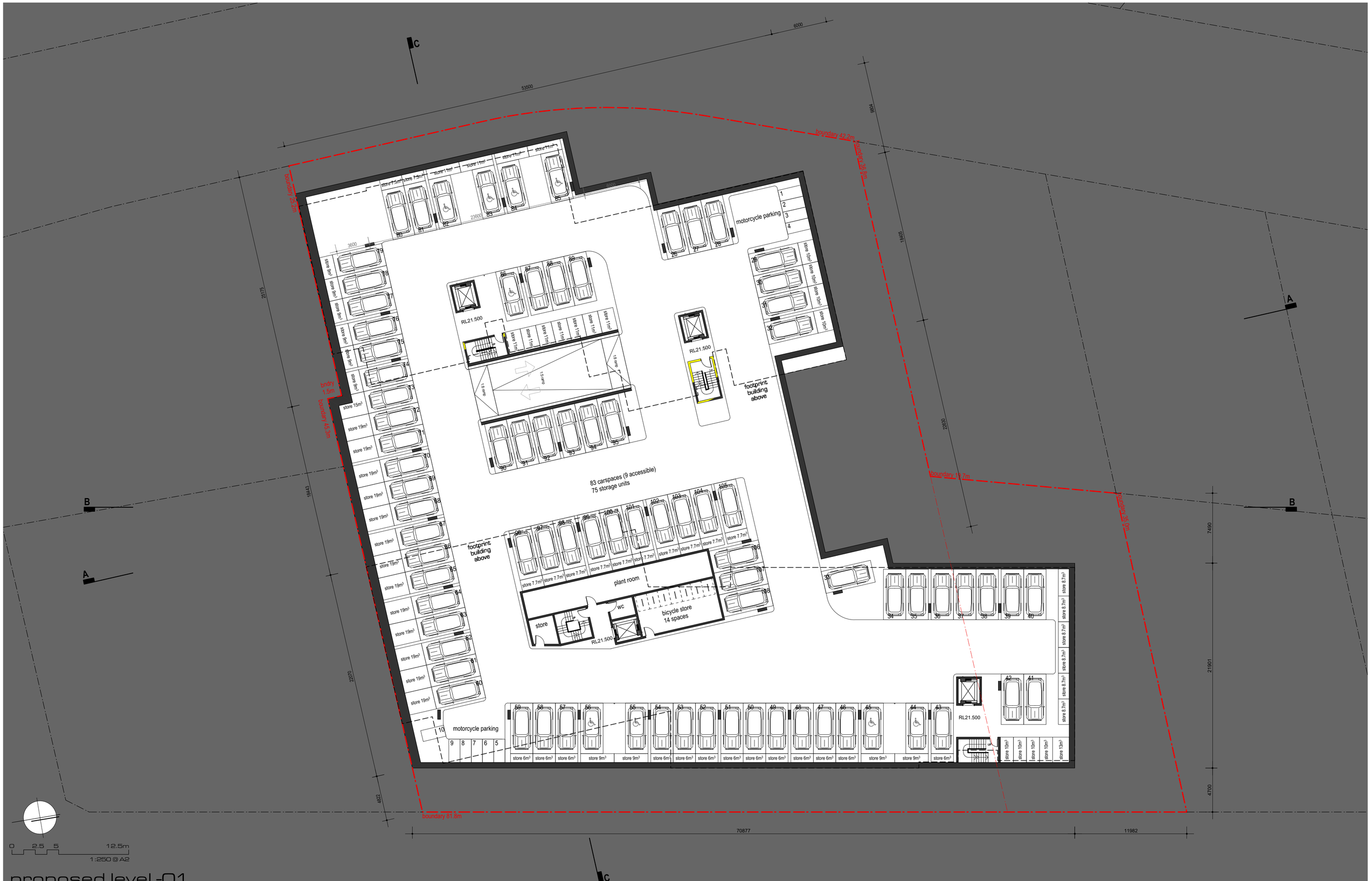
1563 – DA09 E



proposed level -01

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1563 – DA08 E

0 2.5 5 12.5m

1:250 @ A2

proposed level -02

E 21/12/18 revised DA issue

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1563 – DA07 E

APPENDIX B

TRAFFIC SURVEY RESULTS

Location	NUWARRA ROAD	Duration	0700 - 0900
	MADDECKS AVENUE		1600 - 1800
	NUWARRA ROAD		-
	MADDECKS AVENUE	Day/Date	Thursday, 25 May 2017
Suburb	MOOREBANK	Weather	FINE

All Vehicles	NORTH				EAST				SOUTH				WEST				
Time Per 15 Mins	NUWARRA ROAD				MADDECKS AVENUE				NUWARRA ROAD				MADDECKS AVENUE				
	L	T	R	TOTAL	L	T	R	TOTAL	L	T	R	TOTAL	L	T	R	TOTAL	TOTAL
7:00 - 7:15	5	75	11	91	3	7	12	22	9	187	4	200	9	17	7	23	336
7:15 - 7:30	2	86	6	94	5	12	10	27	6	222	1	229	11	13	16	40	390
7:30 - 7:45	3	74	8	85	2	15	9	26	16	213	5	234	8	15	14	37	382
7:45 - 8:00	1	71	17	89	3	27	9	39	18	197	5	220	15	26	24	72	420
8:00 - 8:15	3	71	10	84	6	16	5	27	15	196	9	220	14	14	22	50	381
8:15 - 8:30	2	80	20	102	2	13	15	30	32	210	18	260	23	9	22	54	446
8:30 - 8:45	8	75	27	110	4	29	34	67	25	170	4	199	21	12	23	56	432
8:45 - 9:00	11	69	23	103	4	33	24	61	35	165	6	206	24	18	21	63	433
Period End	35	601	122	758	29	152	118	299	156	1560	52	1768	125	124	149	395	3220
16:00 - 16:15	4	136	28	168	7	20	9	36	21	132	2	155	27	26	48	101	460
16:15 - 16:30	10	145	17	172	3	32	12	47	28	107	6	141	23	37	46	106	466
16:30 - 16:45	7	142	15	164	9	13	7	29	29	119	12	160	29	34	34	97	450
16:45 - 17:00	11	138	20	169	8	26	12	46	28	117	12	157	26	38	45	119	491
17:00 - 17:15	5	150	22	177	9	22	11	42	34	138	9	181	31	32	37	100	500
17:15 - 17:30	7	139	41	187	21	27	21	69	29	129	9	167	27	29	41	97	520
17:30 - 17:45	6	119	39	164	11	26	10	47	31	122	13	166	25	34	40	99	476
17:45 - 18:00	9	133	41	183	14	23	17	54	25	101	10	136	28	32	45	105	478
Period End	59	1102	223	1384	82	189	99	370	225	965	73	1263	216	262	336	824	3841

All Vehicles	NORTH				EAST				SOUTH				WEST				
Time Per HOUR	NUWARRA ROAD				MADDECKS AVENUE				NUWARRA ROAD				MADDECKS AVENUE				
	L	T	R	TOTAL	L	T	R	TOTAL	L	T	R	TOTAL	L	T	R	TOTAL	TOTAL
7:00 - 8:00	11	306	42	359	13	61	40	114	49	819	15	883	43	71	61	172	1528
7:15 - 8:15	9	302	41	352	16	70	33	119	55	828	20	903	48	68	76	199	1573
7:30 - 8:30	9	296	55	360	13	71	38	122	81	816	37	934	60	64	82	213	1629
7:45 - 8:45	14	297	74	385	15	85	63	163	90	773	36	899	73	61	91	232	1679
8:00 - 9:00	24	295	80	399	16	91	78	185	107	741	37	885	82	53	88	223	1692
Period End	67	1496	292	1855	73	378	252	703	382	3977	145	4504	306	317	398	1039	8101
16:00 - 17:00	32	561	80	673	27	91	40	158	106	475	32	613	105	135	173	423	1867
16:15 - 17:15	33	575	74	682	29	93	42	164	119	481	39	639	109	141	162	422	1907
16:30 - 17:30	30	569	98	697	47	88	51	186	120	503	42	665	113	133	157	413	1961
16:45 - 17:45	29	546	122	697	49	101	54	204	122	506	43	671	109	133	163	415	1987
17:00 - 18:00	27	541	143	711	55	98	59	212	119	490	41	650	111	127	163	401	1974
Period End	151	2792	517	3460	207	471	246	924	586	2455	197	3238	547	669	818	2074	9696

Location	LUCAS AVENUE	Duration	0700 - 0900
	MADDECKS AVENUE		1600 - 1800
	-		-
	MADDECKS AVENUE	Day/Date	Thursday, 25 May 2017
Suburb	MOOREBANK	Weather	FINE

All Vehicles Time Per 15 Mins	NORTH LUCAS AVENUE				EAST MADDECKS AVENUE				SOUTH -				WEST MADDECKS AVENUE				
	L	T	R	TOTAL	L	T	R	TOTAL	L	T	R	TOTAL	L	T	R	TOTAL	TOTAL
7:00 - 7:15	2		0	2		22	6	28	0	0	0	0	3	30	0	33	63
7:15 - 7:30	9		0	9		23	4	27	0	0	0	0	4	30	0	34	70
7:30 - 7:45	9		0	9		36	6	42	0	0	0	0	3	34	0	37	88
7:45 - 8:00	10		1	11		46	13	59	0	0	0	0	2	50	0	52	122
8:00 - 8:15	8		1	9		30	10	40	0	0	0	0	4	43	0	47	96
8:15 - 8:30	12		1	13		49	15	64	0	0	0	0	7	45	0	52	129
8:30 - 8:45	12		0	12		56	29	85	0	0	0	0	2	45	0	47	144
8:45 - 9:00	12		0	12		58	37	95	0	0	0	0	15	52	0	67	174
Period End	74	0	3	77	0	320	120	440	0	0	0	0	40	329	0	369	886
16:00 - 16:15	13		1	14		48	10	58	0	0	0	0	0	87	0	87	159
16:15 - 16:30	13		0	13		71	8	79	0	0	0	0	5	92	0	97	189
16:30 - 16:45	14		1	15		49	9	58	0	0	0	0	3	82	0	85	158
16:45 - 17:00	12		1	13		63	10	73	0	0	0	0	4	97	0	101	187
17:00 - 17:15	18		2	20		74	5	79	0	0	0	0	1	78	0	79	178
17:15 - 17:30	12		1	13		89	10	99	0	0	0	0	3	81	0	84	196
17:30 - 17:45	10		3	13		90	9	99	0	0	0	0	4	100	0	104	216
17:45 - 18:00	5		3	8		81	7	88	0	0	0	0	6	92	0	98	194
Period End	97	0	12	109	0	565	68	633	0	0	0	0	26	709	0	735	1477

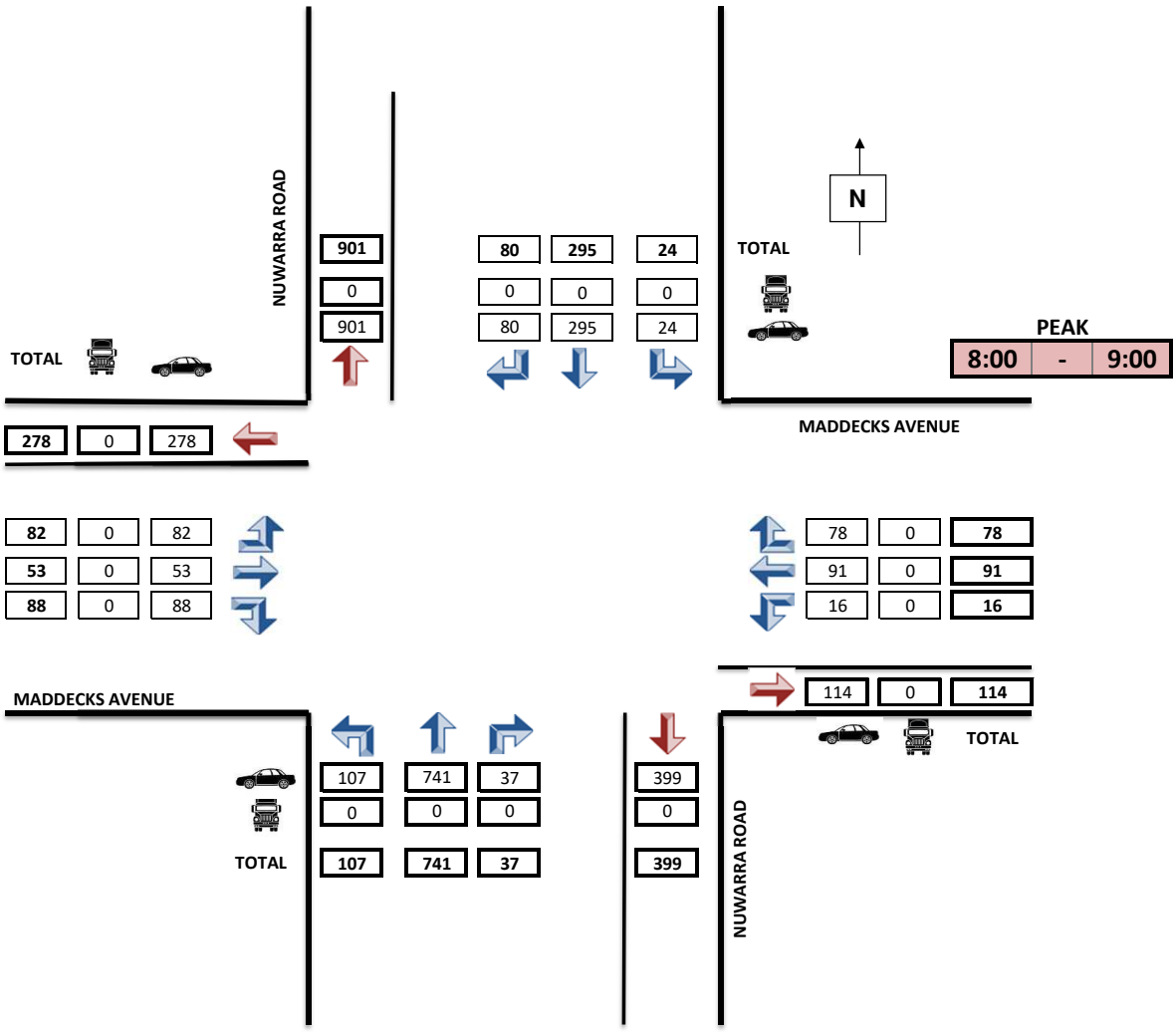
All Vehicles Time Per HOUR	NORTH LUCAS AVENUE				EAST MADDECKS AVENUE				SOUTH -				WEST MADDECKS AVENUE				
	L	T	R	TOTAL	L	T	R	TOTAL	L	T	R	TOTAL	L	T	R	TOTAL	TOTAL
7:00 - 8:00	30	0	1	31	0	127	29	156	0	0	0	0	12	144	0	156	343
7:15 - 8:15	36	0	2	38	0	135	33	168	0	0	0	0	13	157	0	170	376
7:30 - 8:30	39	0	3	42	0	161	44	205	0	0	0	0	16	172	0	188	435
7:45 - 8:45	42	0	3	45	0	181	67	248	0	0	0	0	15	183	0	198	491
8:00 - 9:00	44	0	2	46	0	193	91	284	0	0	0	0	28	185	0	213	543
Period End	191	0	11	202	0	797	264	1061	0	0	0	0	84	841	0	925	2188
16:00 - 17:00	52	0	3	55	0	231	37	268	0	0	0	0	12	358	0	370	693
16:15 - 17:15	57	0	4	61	0	257	32	289	0	0	0	0	13	349	0	362	712
16:30 - 17:30	56	0	5	61	0	275	34	309	0	0	0	0	11	338	0	349	719
16:45 - 17:45	52	0	7	59	0	316	34	350	0	0	0	0	12	356	0	368	777
17:00 - 18:00	45	0	9	54	0	334	31	365	0	0	0	0	14	351	0	365	784
Period End	262	0	28	290	0	1413	168	1581	0	0	0	0	62	1752	0	1814	3685

Location	LUCAS AVENUE	Duration	0700 - 0900
	-		1600 - 1800
	LUCAS AVENUE		-
	McKAY AVENUE	Day/Date	Thursday, 25 May 2017
Suburb	MOOREBANK	Weather	FINE

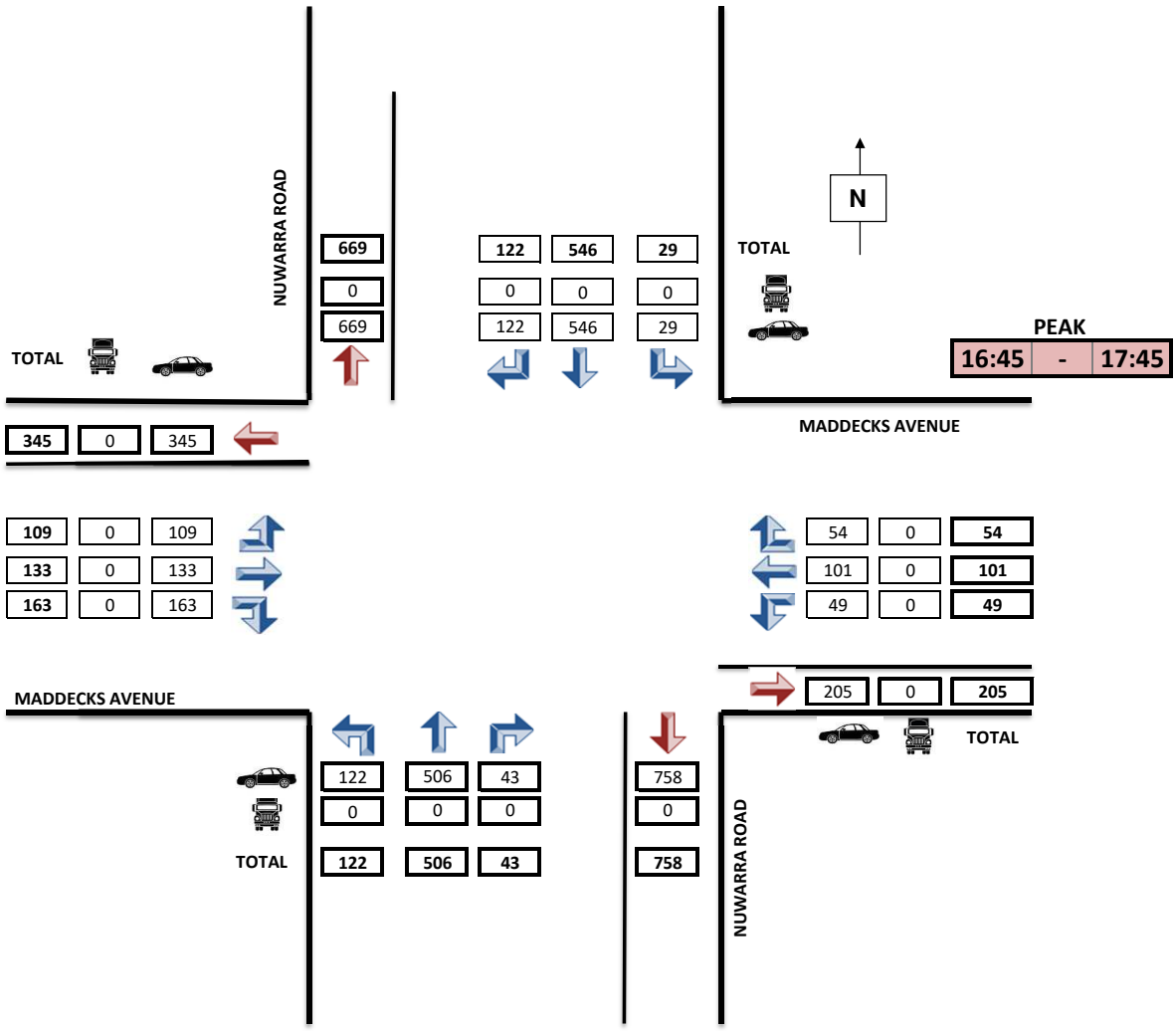
All Vehicles Time Per 15 Mins	NORTH LUCAS AVENUE				EAST -				SOUTH LUCAS AVENUE				WEST McKAY AVENUE				
	L	T	R	TOTAL	L	T	R	TOTAL	L	T	R	TOTAL	L	T	R	TOTAL	TOTAL
7:00 - 7:15		1	0	1				0	6	3	0	9	0	0	1	1	11
7:15 - 7:30		5	1	6				0	5	1	0	6	0	0	5	5	17
7:30 - 7:45		4	1	5				0	7	2	0	9	0	0	5	5	19
7:45 - 8:00		5	1	6				0	13	2	0	15	1	0	6	7	28
8:00 - 8:15		5	0	5				0	5	3	0	8	1	0	5	6	19
8:15 - 8:30		6	1	7				0	14	7	0	21	1	0	5	6	34
8:30 - 8:45		6	1	7				0	21	8	0	25	1	0	7	8	40
8:45 - 9:00		3	1	4				0	39	3	0	42	2	0	12	14	60
Period End	0	35	6	41	0	0	0	0	110	29	0	135	6	0	46	52	228
16:00 - 16:15		5	0	5				0	6	4	0	10	0	0	6	6	21
16:15 - 16:30		4	0	4				0	6	10	0	16	0	0	10	10	30
16:30 - 16:45		5	1	6				0	6	6	0	12	1	0	7	8	26
16:45 - 17:00		5	0	5				0	8	5	0	13	0	0	9	9	27
17:00 - 17:15		9	0	9				0	1	3	0	4	0	0	9	9	22
17:15 - 17:30		2	0	2				0	12	1	0	13	0	0	7	7	22
17:30 - 17:45		4	0	4				0	4	5	0	9	0	0	6	6	19
17:45 - 18:00		2	1	3				0	5	7	0	12	1	0	5	6	21
Period End	0	36	2	38	0	0	0	0	48	41	0	89	2	0	59	61	188

All Vehicles Time Per HOUR	NORTH LUCAS AVENUE				EAST -				SOUTH LUCAS AVENUE				WEST McKAY AVENUE				
	L	T	R	TOTAL	L	T	R	TOTAL	L	T	R	TOTAL	L	T	R	TOTAL	TOTAL
7:00 - 8:00	0	15	3	18	0	0	0	0	31	8	0	39	1	0	17	18	75
7:15 - 8:15	0	19	3	22	0	0	0	0	30	8	0	38	2	0	21	23	83
7:30 - 8:30	0	20	3	23	0	0	0	0	39	14	0	53	3	0	21	24	100
7:45 - 8:45	0	22	3	25	0	0	0	0	53	20	0	69	4	0	23	27	121
8:00 - 9:00	0	20	3	23	0	0	0	0	79	21	0	96	5	0	29	34	153
Period End	0	96	15	111	0	0	0	0	232	71	0	295	15	0	111	126	532
16:00 - 17:00	0	19	1	20	0	0	0	0	26	25	0	51	1	0	32	33	104
16:15 - 17:15	0	23	1	24	0	0	0	0	21	24	0	45	1	0	35	36	105
16:30 - 17:30	0	21	1	22	0	0	0	0	27	15	0	42	1	0	32	33	97
16:45 - 17:45	0	20	0	20	0	0	0	0	25	14	0	39	0	0	31	31	90
17:00 - 18:00	0	17	1	18	0	0	0	0	22	16	0	38	1	0	27	28	84
Period End	0	100	4	104	0	0	0	0	121	94	0	215	4	0	157	161	480

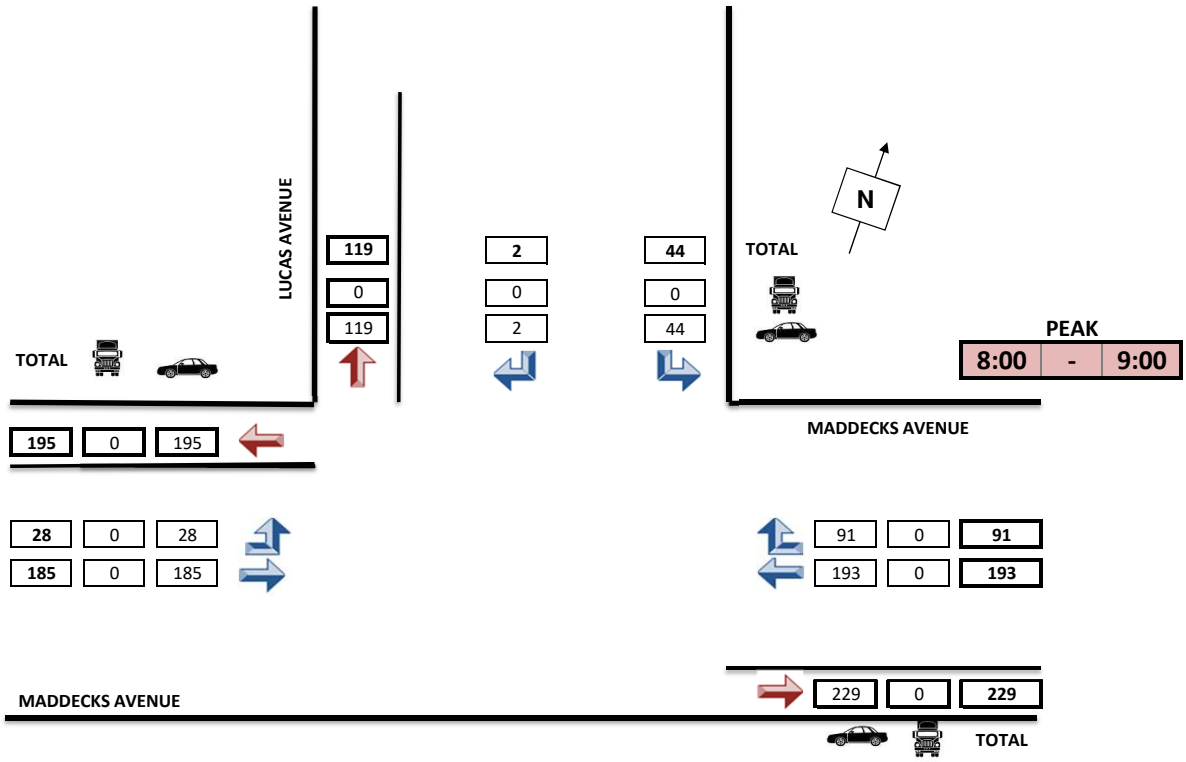
Location	NUWARRA ROAD	Duration	0700 - 0900
	MADDECKS AVENUE		1600 - 1800
	NUWARRA ROAD		-
	MADDECKS AVENUE	Day/Date	Thursday, 25 May 2017
Suburb	MOOREBANK	Weather	FINE



Location	NUWARRA ROAD	Duration	0700 - 0900
	MADDECKS AVENUE		1600 - 1800
	NUWARRA ROAD		-
	MADDECKS AVENUE	Day/Date	Thursday, 25 May 2017
Suburb	MOOREBANK	Weather	FINE

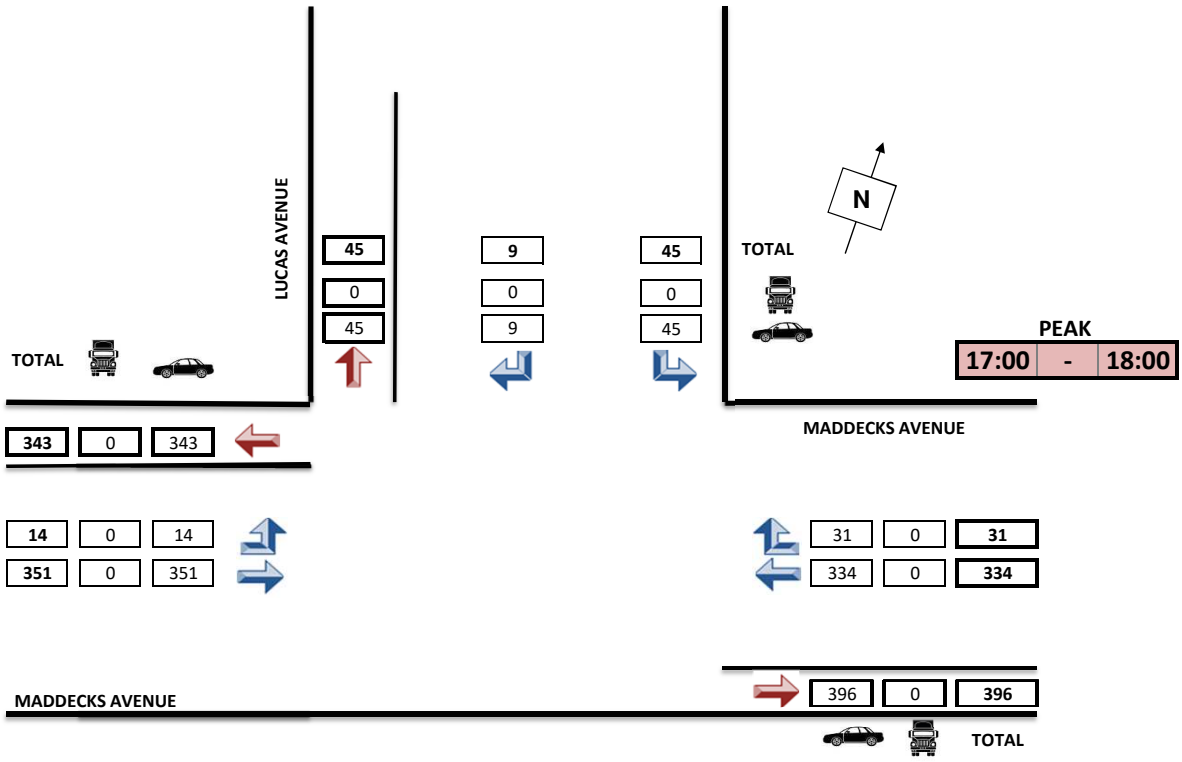


Location	LUCAS AVENUE	Duration	0700 - 0900
	MADDECKS AVENUE		1600 - 1800
	-		-
	MADDECKS AVENUE	Day/Date	Thursday, 25 May 2017
Suburb	MOOREBANK	Weather	FINE



Traffic Information Specialists
ABN: 42 613 389 923
Email info@trafficinfospecialist.com.au

Location	LUCAS AVENUE	Duration	0700 - 0900
	MADDECKS AVENUE		1600 - 1800
	-		-
	MADDECKS AVENUE	Day/Date	Thursday, 25 May 2017
Suburb	MOOREBANK	Weather	FINE



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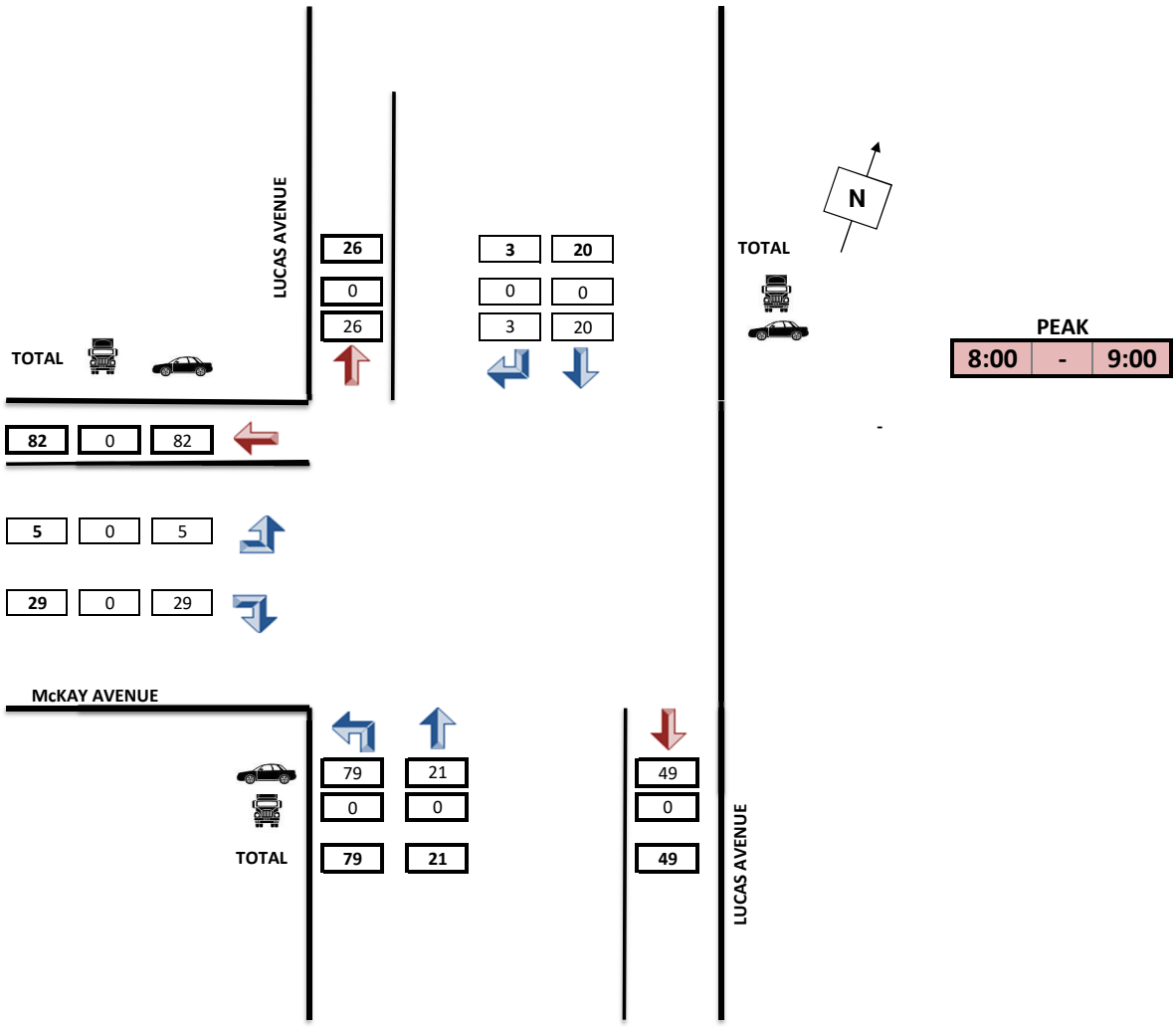
Location	LUCAS AVENUE	Duration	0700 - 0900
	-		1600 - 1800
	LUCAS AVENUE		-
	McKAY AVENUE	Day/Date	Thursday, 25 May 2017
Suburb	MOOREBANK	Weather	FINE



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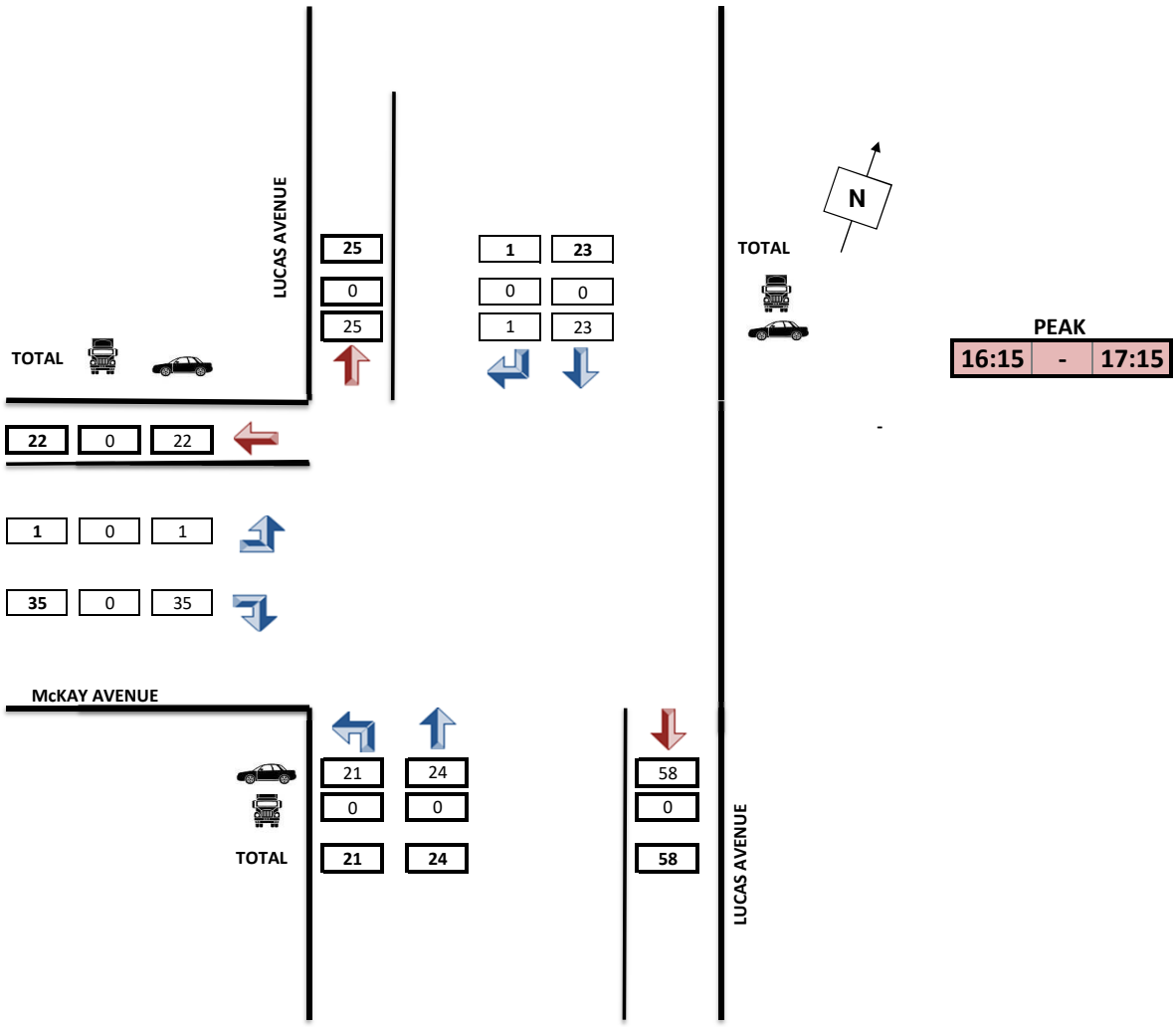
Location	LUCAS AVENUE	Duration	0700 - 0900
	-		1600 - 1800
	LUCAS AVENUE		-
	McKAY AVENUE	Day/Date	Thursday, 25 May 2017
Suburb	MOOREBANK	Weather	FINE



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APPENDIX C

SIDRA RESULTS

MOVEMENT SUMMARY

Site: [NUWARRA RD/MADDECKS AVE AM EX]

Signals - Fixed Time Coordinated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: NUWARRA RD											
1	L2	113	2.0	0.759	9.6	LOS A	12.3	87.3	0.45	0.45	54.1
2	T1	780	2.0	0.759	4.1	LOS A	12.3	87.3	0.45	0.45	55.6
3	R2	39	2.0	0.059	8.5	LOS A	0.3	1.9	0.21	0.63	51.1
Approach		932	2.0	0.759	4.9	LOS A	12.3	87.3	0.44	0.46	55.2
East: MADDECKS AVE											
4	L2	17	2.0	0.354	31.0	LOS C	3.5	24.6	0.93	0.73	41.0
5	T1	96	2.0	0.354	25.5	LOS C	3.5	24.6	0.93	0.73	41.9
6	R2	82	2.0	0.436	35.2	LOS D	2.7	19.4	0.97	0.75	37.2
Approach		195	2.0	0.436	30.0	LOS C	3.5	24.6	0.95	0.74	39.7
North: NUWARRA RD											
7	L2	25	2.0	0.276	8.2	LOS A	2.3	16.1	0.22	0.22	55.6
8	T1	311	2.0	0.276	2.6	LOS A	2.3	16.1	0.22	0.22	57.2
9	R2	84	2.0	0.297	15.8	LOS B	1.5	10.5	0.51	0.71	46.3
Approach		420	2.0	0.297	5.6	LOS A	2.3	16.1	0.28	0.32	54.5
West: MADDECKS AVE											
10	L2	86	2.0	0.457	31.6	LOS C	4.5	31.7	0.95	0.77	39.6
11	T1	56	2.0	0.457	26.1	LOS C	4.5	31.7	0.95	0.77	40.4
12	R2	93	2.0	0.440	34.1	LOS C	3.0	21.6	0.96	0.76	37.6
Approach		235	2.0	0.457	31.3	LOS C	4.5	31.7	0.95	0.77	39.0
All Vehicles		1781	2.0	0.759	11.3	LOS B	12.3	87.3	0.52	0.50	50.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	24.4	LOS C	0.1	0.1	0.90	0.90
P2	East Full Crossing	53	7.1	LOS A	0.0	0.0	0.48	0.48
P3	North Full Crossing	53	24.4	LOS C	0.1	0.1	0.90	0.90
P4	West Full Crossing	53	7.1	LOS A	0.0	0.0	0.48	0.48
All Pedestrians		211	15.7	LOS B			0.69	0.69

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: [NUWARRA RD/MADDECKS AVE PM EX]

Signals - Fixed Time Coordinated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: NUWARRA RD											
1	L2	128	2.0	0.578	10.2	LOS B	7.5	53.7	0.40	0.43	53.4
2	T1	533	2.0	0.578	4.6	LOS A	7.5	53.7	0.40	0.43	54.9
3	R2	45	2.0	0.107	12.3	LOS B	0.5	3.6	0.38	0.66	48.5
Approach		706	2.0	0.578	6.1	LOS A	7.5	53.7	0.40	0.44	54.2
East: MADDECKS AVE											
4	L2	52	2.0	0.417	29.1	LOS C	4.2	30.2	0.92	0.75	41.5
5	T1	106	2.0	0.417	23.6	LOS C	4.2	30.2	0.92	0.75	42.3
6	R2	57	2.0	0.361	36.0	LOS D	1.7	12.3	0.98	0.74	36.9
Approach		215	2.0	0.417	28.2	LOS C	4.2	30.2	0.93	0.75	40.5
North: NUWARRA RD											
7	L2	31	2.0	0.525	9.9	LOS A	6.4	45.6	0.37	0.35	54.2
8	T1	575	2.0	0.525	4.4	LOS A	6.4	45.6	0.37	0.35	55.7
9	R2	128	2.0	0.332	14.5	LOS B	1.9	13.7	0.49	0.71	47.2
Approach		734	2.0	0.525	6.4	LOS A	6.4	45.6	0.39	0.41	54.0
West: MADDECKS AVE											
10	L2	115	2.0	0.677	30.9	LOS C	7.3	52.2	0.98	0.82	40.4
11	T1	140	2.0	0.677	25.3	LOS C	7.3	52.2	0.98	0.82	41.2
12	R2	172	2.0	0.773	38.0	LOS D	5.7	40.5	1.00	0.87	36.2
Approach		426	2.0	0.773	31.9	LOS C	7.3	52.2	0.99	0.84	38.8
All Vehicles		2081	2.0	0.773	13.8	LOS B	7.5	53.7	0.57	0.55	48.5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	24.4	LOS C	0.1	0.1	0.90	0.90
P2	East Full Crossing	53	8.0	LOS A	0.0	0.0	0.52	0.52
P3	North Full Crossing	53	24.4	LOS C	0.1	0.1	0.90	0.90
P4	West Full Crossing	53	8.0	LOS A	0.0	0.0	0.52	0.52
All Pedestrians		211	16.2	LOS B			0.71	0.71

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: [MADDECKS AVE/LUCAS AVE AM EX]

Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: MADDECKS AVE											
5	T1	203	2.0	0.173	0.4	LOS A	0.6	4.1	0.15	0.19	56.8
6	R2	96	2.0	0.173	5.2	LOS A	0.6	4.1	0.15	0.19	54.1
Approach		299	2.0	0.173	2.0	NA	0.6	4.1	0.15	0.19	55.9
North: LUCAS AVE											
7	L2	46	2.0	0.034	6.2	LOS A	0.1	0.9	0.28	0.56	47.4
9	R2	2	2.0	0.002	7.2	LOS A	0.0	0.1	0.41	0.58	51.7
Approach		48	2.0	0.034	6.2	LOS A	0.1	0.9	0.29	0.56	47.7
West: MADDECKS AVE											
10	L2	29	2.0	0.117	5.6	LOS A	0.0	0.0	0.00	0.08	57.6
11	T1	195	2.0	0.117	0.0	LOS A	0.0	0.0	0.00	0.08	58.7
Approach		224	2.0	0.117	0.7	NA	0.0	0.0	0.00	0.08	58.5
All Vehicles		572	2.0	0.173	1.8	NA	0.6	4.1	0.10	0.18	56.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: [MADDECKS AVE/LUCAS AVE PM EX]

Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: MADDECKS AVE											
5	T1	352	2.0	0.210	0.2	LOS A	0.3	2.0	0.08	0.05	58.7
6	R2	33	2.0	0.210	6.1	LOS A	0.3	2.0	0.08	0.05	55.8
Approach		384	2.0	0.210	0.7	NA	0.3	2.0	0.08	0.05	58.5
North: LUCAS AVE											
7	L2	47	2.0	0.042	6.9	LOS A	0.2	1.1	0.41	0.62	46.8
9	R2	9	2.0	0.014	8.6	LOS A	0.0	0.3	0.50	0.69	50.7
Approach		57	2.0	0.042	7.2	LOS A	0.2	1.1	0.42	0.63	47.8
West: MADDECKS AVE											
10	L2	15	2.0	0.200	5.6	LOS A	0.0	0.0	0.00	0.02	58.0
11	T1	369	2.0	0.200	0.0	LOS A	0.0	0.0	0.00	0.02	59.6
Approach		384	2.0	0.200	0.2	NA	0.0	0.0	0.00	0.02	59.5
All Vehicles		825	2.0	0.210	0.9	NA	0.3	2.0	0.07	0.08	57.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: [LUCAS AVE/MCKAY AVE AM EX]

Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: RoadName											
1	L2	83	2.0	0.057	5.5	LOS A	0.0	0.0	0.00	0.46	51.4
2	T1	22	2.0	0.057	0.0	LOS A	0.0	0.0	0.00	0.46	53.6
Approach		105	2.0	0.057	4.4	NA	0.0	0.0	0.00	0.46	51.8
North: RoadName											
8	T1	21	2.0	0.013	0.1	LOS A	0.0	0.1	0.06	0.08	58.4
9	R2	3	2.0	0.013	5.8	LOS A	0.0	0.1	0.06	0.08	56.7
Approach		24	2.0	0.013	0.8	NA	0.0	0.1	0.06	0.08	58.1
West: RoadName											
10	L2	5	2.0	0.029	5.6	LOS A	0.1	0.7	0.12	0.57	53.2
12	R2	31	2.0	0.029	5.8	LOS A	0.1	0.7	0.12	0.57	48.2
Approach		36	2.0	0.029	5.7	LOS A	0.1	0.7	0.12	0.57	49.2
All Vehicles		165	2.0	0.057	4.2	NA	0.1	0.7	0.03	0.43	52.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: [LUCAS AVE/MCKAY AVE PM EX]

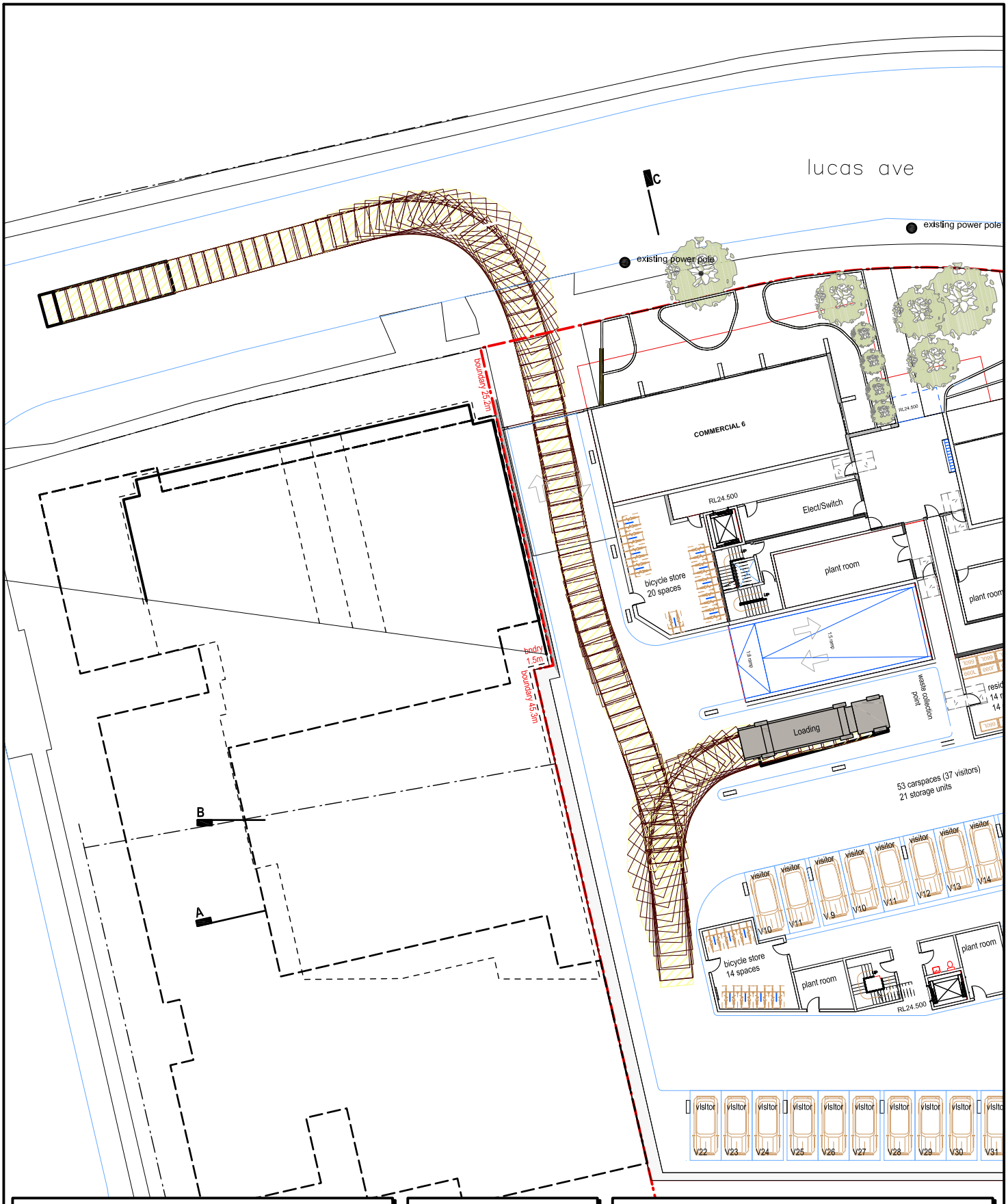
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: RoadName											
1	L2	22	2.0	0.025	5.5	LOS A	0.0	0.0	0.00	0.28	53.6
2	T1	25	2.0	0.025	0.0	LOS A	0.0	0.0	0.00	0.28	56.1
Approach		47	2.0	0.025	2.6	NA	0.0	0.0	0.00	0.28	54.9
North: RoadName											
8	T1	24	2.0	0.013	0.0	LOS A	0.0	0.0	0.01	0.03	59.5
9	R2	1	2.0	0.013	5.6	LOS A	0.0	0.0	0.01	0.03	57.4
Approach		25	2.0	0.013	0.2	NA	0.0	0.0	0.01	0.03	59.4
West: RoadName											
10	L2	1	2.0	0.031	5.6	LOS A	0.1	0.7	0.13	0.57	53.2
12	R2	37	2.0	0.031	5.7	LOS A	0.1	0.7	0.13	0.57	48.2
Approach		38	2.0	0.031	5.7	LOS A	0.1	0.7	0.13	0.57	48.4
All Vehicles		111	2.0	0.031	3.1	NA	0.1	0.7	0.05	0.32	53.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

APPENDIX D

TURNING PATH ASSESSMENT



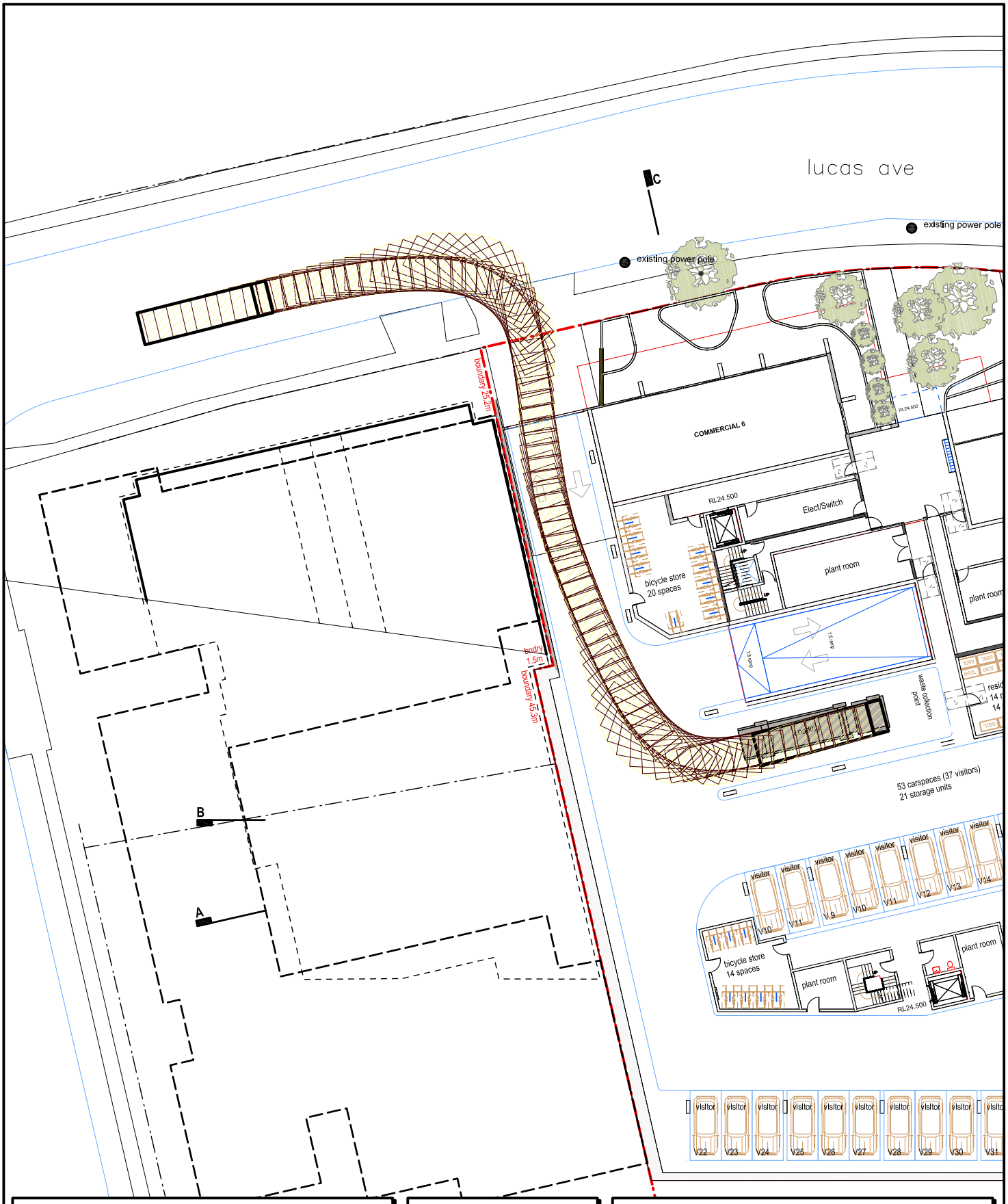
LEGEND

This drawing has been prepared using vehicle modelling computer software AutoTrack V9.21 in conjunction with AutoCAD 2013. The vehicle used is based upon vehicle data provided by Austroads and incorporates a reasonable degree of tolerance. However, it is not possible to account for all vehicle types/characteristics and/or driver ability.

N

SWEPT PATH ANALYSIS OF A 9.9m REFUSE VEHICLE ENTERING THE SITE

SP 1



LEGEND

This drawing has been prepared using vehicle modelling computer software AutoTrack V9.21 in conjunction with AutoCAD 2013. The vehicle used is based upon vehicle data provided by Austroads and incorporates a reasonable degree of tolerance. However, it is not possible to account for all vehicle types/characteristics and/or driver ability.

N

SWEPT PATH ANALYSIS OF A 9.9m REFUSE VEHICLE EXITING THE SITE

SP 2