



Proposed Roadhouse

Lot 200 (No. 2) Cowle St, Landsdale

Transport Impact Assessment

PREPARED FOR:
Liberty Oil

March 2019

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1.0 Summary

This Transport Impact Assessment (TIA) is prepared by Transcore with respect to the proposed Roadhouse comprising an integrated light and heavy vehicle canopy with an associated retail building to be located on Lot 200 (No. 2) Cowle Street, Landsdale, in the City of Wanneroo.

As a part of development, it is proposed to modify the existing left turn lane into Cowle Street to extend the left turn lane across the frontage of the subject site so that it also provides left turn in only access into the development site. This crossover has been developed through liaison with City of Wanneroo. It is also proposed to provide a full movement crossover on Cowle Street which is on the south west corner of the subject site.

The net additional traffic as a result of the proposed development allowing for passing trade is estimated to be approximately 88 and 98 trips during the critical weekday AM and PM peak hours. This level of traffic generation is relatively minimal and as such would have insignificant impact on the surrounding road network.

The proposed development layout has been assessed with respect to the largest size trucks which are permitted on Gnangara Road and Cowle Street in this vicinity, fuel tankers and service vehicles with respect to entry, egress and circulation. Swept path analysis confirms that the proposed entry and egress arrangements and the site layout facilitate safe and efficient vehicle circulation through the site.

The SIDRA Network analysis undertaken as part of the Transport Impact Assessment confirms satisfactory operation of the subject site proposed crossovers on Gnangara Road and on Cowle Street and the T- intersection of Gnangara Road/Cowle Street for the post development and 10 years post-development scenarios.

2.0 Introduction

This Transport Impact Assessment has been prepared by Transcore on behalf of Liberty Oil with regards to the proposed Roadhouse with an associated retail building development on Lot 200, at 2 Cowle Street, Landsdale, in the City of Wanneroo.

The subject site is bound by Gnangara Road to the north, Cowle Street to the west and industrial properties to the south and east as shown in **Figure 1**. The site is located at the south eastern corner of the intersection of Gnangara Road and Cowle Street. The subject site is currently vacant and is located in a predominant industrial area.

Key issues that will be addressed in this report include the traffic generation of the proposed development, capacity analysis of the existing T-intersection of Gnangara Road / Cowle Street and proposed site crossovers, access and egress system for light and heavy vehicle, and site circulation for the largest size trucks, which are permitted on Gnangara Road and Cowle Street.



Figure 1: Location of the subject site

3.0 Existing Situation

3.1 Existing Site Use, Access and Parking

The existing site is vacant and does not generate any traffic.

As shown in **Figure 2**, the subject site is classified as General Industrial Zone in the City of Wanneroo Town Planning Scheme (District Planning Scheme 2).

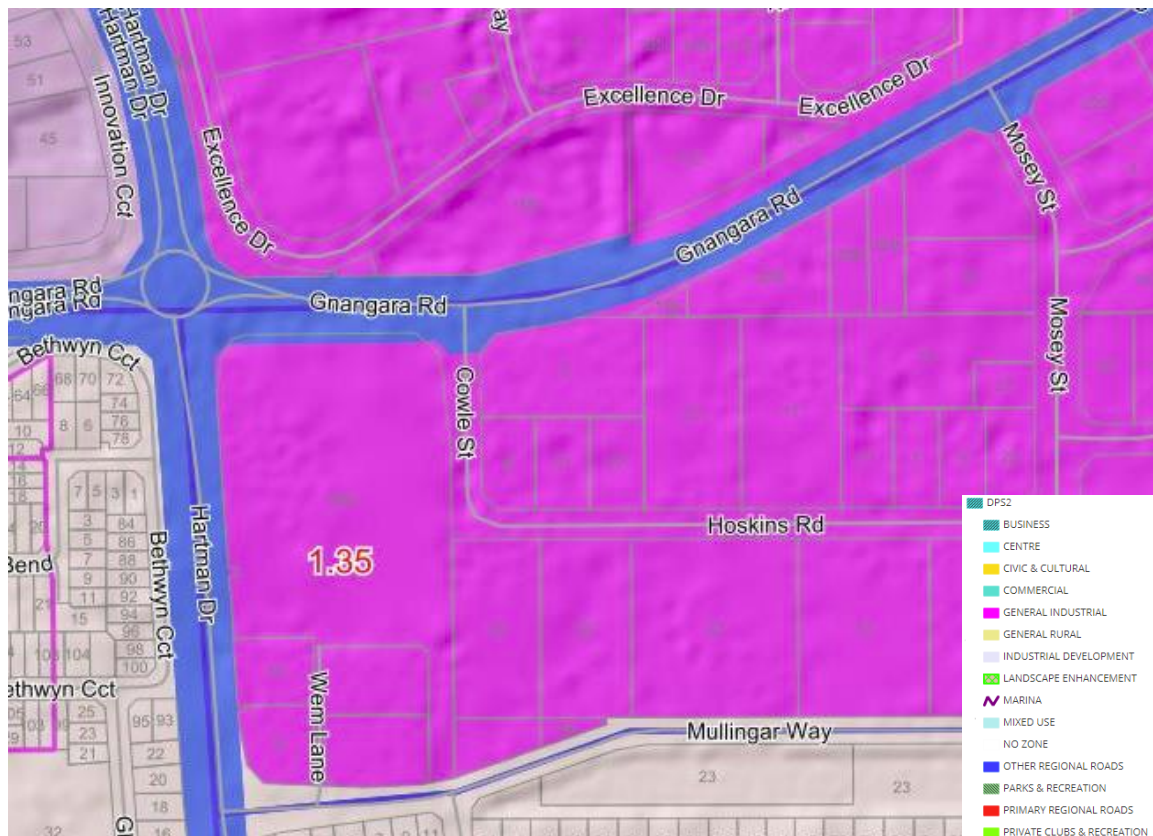


Figure 2: Existing Zoning (Exact from City of Wanneroo Intramaps)

3.2 Surrounding Road Network and Traffic Management on Frontage Roads

Gnangara Road

Gnangara Road, immediately fronting the subject site, is a single undivided carriageway (one lane in each direction) with no pedestrian path in the immediate vicinity of subject site.

Gnangara Road is classified as a *Distributor A* in the Main Roads WA *Functional Road Hierarchy* and operates under the speed limit of 70km/h in the vicinity of the

subject site. It is covered by an *Other Regional Roads Reservation (Blue Road)* in the Metropolitan Region Scheme (MRS) as shown in **Figure 2**.

Cowle Street

Cowle Street, west of the subject site, is a single undivided carriageway (one lane in each direction) with no pedestrian path in the immediate vicinity of the subject site.

Cowle Street is classified as an *Access Road* in Main Roads WA *Functional Road Hierarchy* and operates under the speed limit of 50km/h in the vicinity of the subject

Gnangara Road and Cowle Street form a T-intersection with a left turn pocket on Gnangara Road.

3.3 Existing Traffic Volumes on Roads and Major Intersections

Gnangara Road

Traffic count data obtained from Main Roads WA indicates that Gnangara Road west of Mosey Street carried the most traffic over the weekdays and the average weekday traffic flow was 11,273vpd in 2017/2018. The same data indicates that the weekday peak hour occurred between 8:00AM and 9:00AM in the morning and between 15:15PM and 16:15PM in the afternoon with 952vph and 1,173vph. The same Main Roads WA classified counts indicates 22.1% heavy vehicles on Gnangara Road.

Hoskins Road

Traffic count data obtained from City of Wanneroo indicates that Hoskins Road carried the highest traffic on weekdays and the average weekday traffic flow was 1,101vpd in 2011. The same traffic count also indicates 11% heavy vehicles on Hoskins Road.

3.4 Heavy Vehicles

Restricted Access Vehicle (RAV) Network routes are designated for access by large heavy vehicle combinations, which is managed by Main Roads WA. Gnangara Road and Cowle Street adjacent to the subject site are classified as RAV Network 4 as shown in **Figure 3**.

The RAV 4 Network classification permits a variety of prime mover and trailer combinations, up to a maximum length of 27.5m.

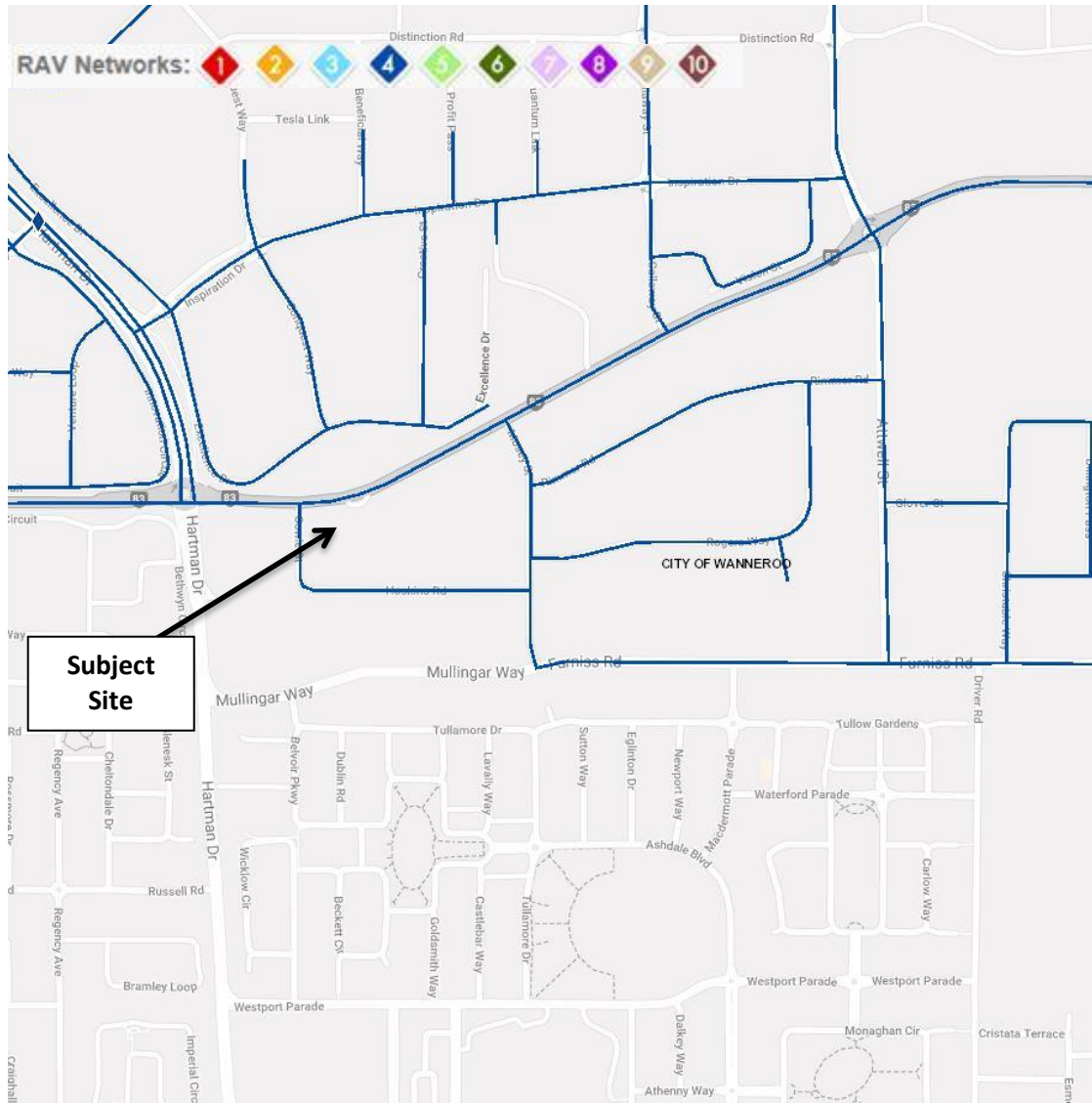


Figure 3: Existing heavy vehicle road network (RAV 4 Network)

3.5 Public Transport Access

The closest existing bus route to the development area is Bus Route No. 355, which provides opportunities to transfer to other connecting bus services as shown in Figure 4.



Figure 4: Existing bus routes

3.6 Pedestrian and Cyclist Facilities

Cowle Road, west of the subject site, is classified as a good road riding environment. There are no pedestrian paths on Cowle Street and Gngangara Road in the vicinity of the subject site.

The Department of Transport's *Perth Bike Map* series shows a good cyclist connectivity near the subject site as shown in Figure 5.

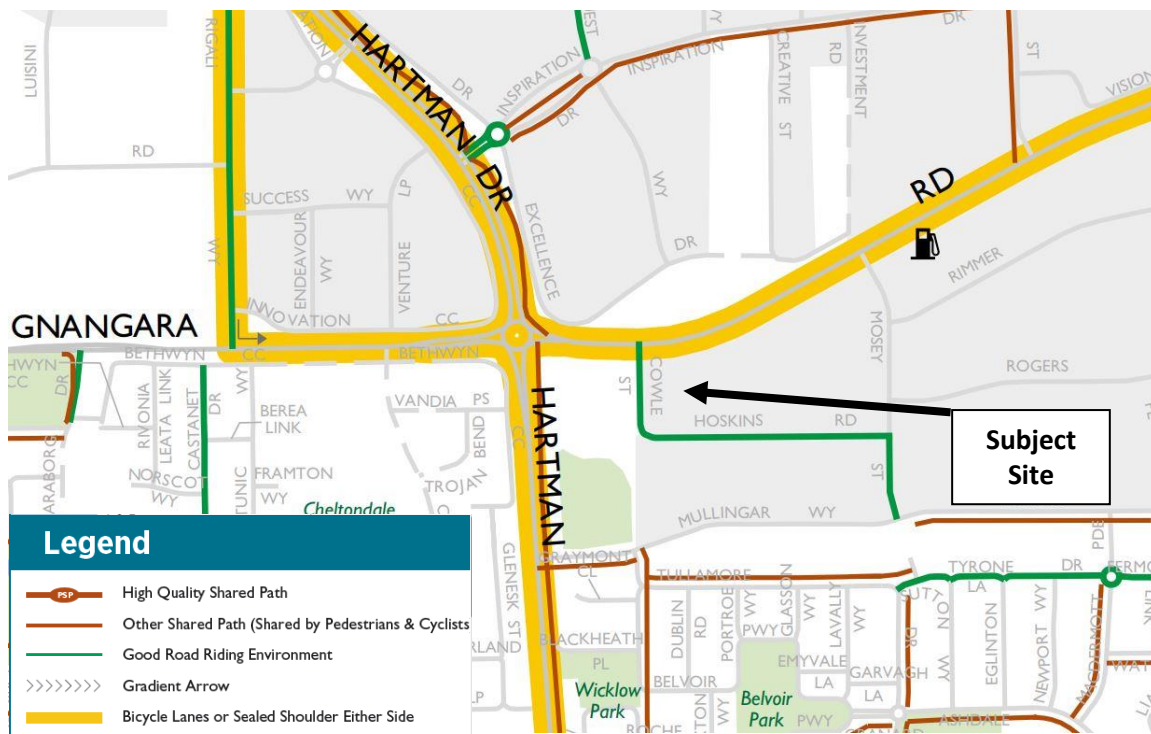


Figure 5: Bike map (source: Department of Transport)

3.7 Crash Data

Information available on the Main Roads WA website indicates that there was no crash recorded at the intersection of Gngangara Road and Cowle Street from 2013 to 2017.

4.0 Development Proposal

4.1 Proposed Site Use

According to the proposed development plan in **Appendix A** of this report, the proposal includes a road house comprising:

- ✚ 435 sqm retail building;
- ✚ 16 fuelling points for light vehicles;
- ✚ 2 high flow diesel fuelling points for heavy vehicles;
- ✚ A loading zone;
- ✚ An Air & pump bay;
- ✚ One service yard; and,
- ✚ 17 car parking spaces including one ACROD bay.

The development site has allowed for the additional land take required by the City as part of the proposed upgrades to the intersection of Gnangara Road and Cowle Street.

As a part of development, it is proposed to modify the existing left turn lane into Cowle Street to extend the left turn lane across the frontage of the subject site so that it also provides left turn in only access into the development site. Details of this crossover was developed through liaison with the City of Wanneroo and is in accordance with their requirement. It is also proposed to provide a full movement crossover on Cowle Street which is on the south west corner of the subject site.

4.2 Proposed Access for all Modes

It is proposed that crossover 1 operates as a left in only crossover on Gnangara Road and crossover 2 operates as a full-movement crossover on Cowle Street. Fuel tanker access to the proposed development is via proposed left in only crossover on Gnangara Road and exit via proposed full-movement crossover on Cowle Street.

The proposed left in only access from Gnangara Road provides the convenient and efficient access for west bound traffic on Gnangara Road which will be the major source of customer traffic into the site. All traffic will exit via Cowle Street which is lower volume and safer exit route from the site. All right turn movements will be accommodated by the existing Gnangara Road/Cowle Street T-intersection, which will ensure satisfactory, efficient and safe traffic operations with minimal impact on Gnangara Road traffic flows.

Figure 6 shows the location of the proposed development crossovers.

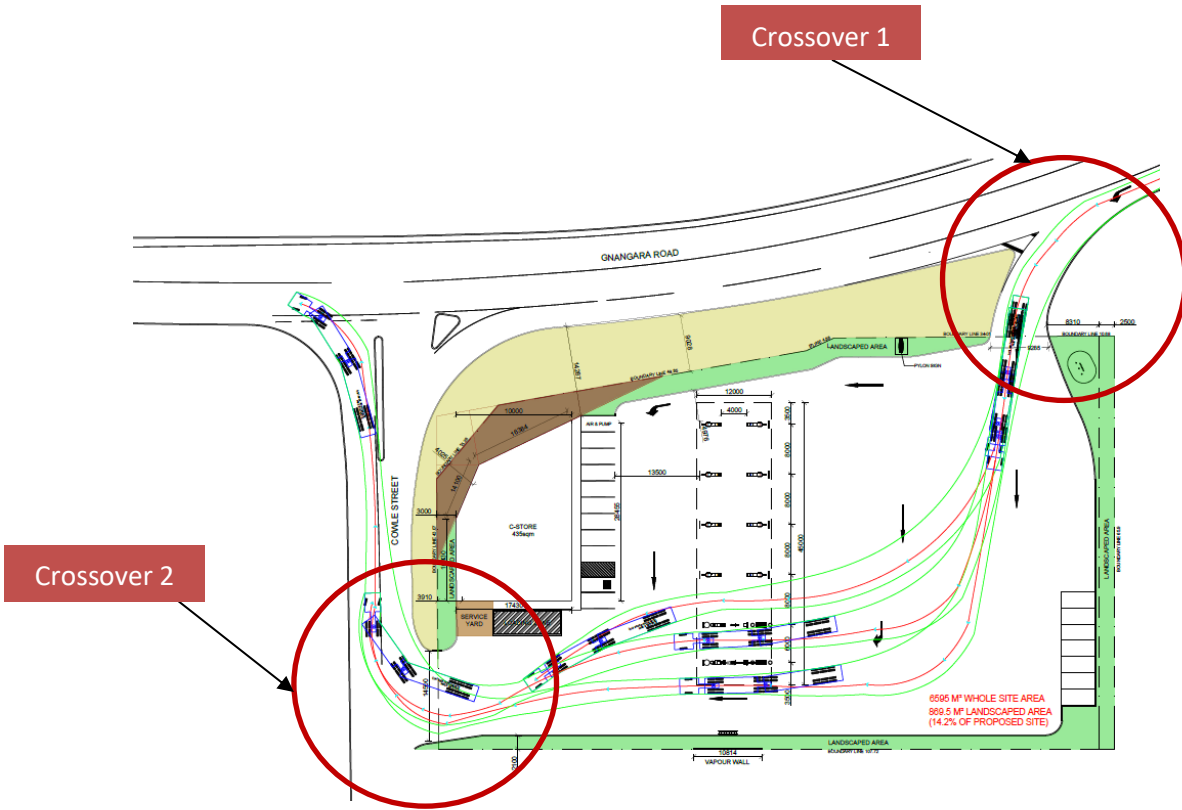


Figure 6: Proposed development crossovers

5.0 Changes to Surrounding Transport Networks

As a part of development, it is proposed to modify the existing left turn lane into Cowle Street to extend the left turn lane across the frontage of the subject site so that it also provides left turn in only access into the development site.

The location of subject site in the context of the Metropolitan Region Scheme is shown in **Figure 7**. Gnangara Road is classified as an *Other Regional Road* in the Metropolitan Region Scheme. The Blue Road Reservation for Gnangara Road allows for Gnangara Road to be upgraded to dual carriageway standard in future when required.



Figure 7: Location of the development site in context of the Metropolitan Region Scheme

6.0 Integration with Surrounding Area

The proposed service station is compatible with the surrounding industrial land uses in this vicinity. The proposed development will be connected to Gnamara Road and Cowle Street, which provides excellent service to passing vehicles.

7.0 Traffic Assessment

7.1 Assessment Years and Time Periods

The assessment years that have been adopted for this analysis are immediately post-development for the interim scenario (2019) and 2029 for the 10-year post development scenario.

The proposed development is expected to generate highest traffic movements during the weekday peak hour periods of the adjacent road network.

Traffic count data obtained from Main Roads WA indicates that Gngangara Road west of Mosey Street carried the most traffic over the weekdays and the peak hours occurred between 8:00AM and 9:00AM in the morning and between 15:15PM and 16:15PM in the afternoon. Transcore undertook traffic surveys at the intersection of Gngangara Road/Cowle Street on 19th February 2019 between 8:00AM to 9:00AM and 15:15PM to 16:15PM.

The established peak hours were selected for traffic analysis.

7.2 Development Generation and Distribution

7.2.1 Proposed Development Traffic Generation

The traffic volume that would be generated by the proposed development has been estimated using trip generation rates derived from:

- ✚ ITE Trip Generation Manual 10th Edition

The trip rates which were used to estimate the proposed development traffic generation are as following:

Gasoline/Service Station with Convenience Market (945) – Regular Fuelling Points

- ✚ AM Peak hour: 12.47 trips per fuelling point
- ✚ PM Peak hour: 13.99 trips per fuelling point
- ✚ Weekday: 206 trips per fuelling point

Gasoline/Service Station with Convenience Market (945) – Heavy Vehicle Fuelling Point Adjusted Trip Rates

The trip rates provided in the ITE Manual are for regular fuelling points. It is expected that the heavy vehicle fuelling points will generate significantly less traffic.

As the majority of service station patronage relies on passing trade (conservatively assumed to be 60% in this instance), the trip generation of the truck fuelling points will be influenced by the percentage of heavy vehicles on the adjacent road

network. As detailed in Section 3.3 of this report, Gnangara Road comprises about 22.1% heavy vehicles in the vicinity of the subject site.

The passing trade component of trip generation for regular fuelling points was multiplied by 22.1% to establish the passing trade trips for heavy vehicles. No adjustment is proposed to the 40% non-passing trips associated with heavy vehicles. Accordingly, the adjustment factor to trip rate is calculated as following:

(Eq1) $Adjustment\ Factor = (0.6 \times 0.221) + (0.4 \times 1) = \underline{0.532}$

The adjustment factor derived in Equation 1 implies that the heavy vehicle fuelling points are estimated to generate 53.2% of the regular fuelling points traffic. Accordingly, the adjusted trip rates for the heavy vehicle fuelling points are as following:

- ✚ AM peak hour: 6.63 trips per fuelling point.
- ✚ PM peak hour: 7.44 trips per fuelling point.
- ✚ Weekday: 110 trips per fuelling point.

The net addition of traffic generated by this development when accounting for passing trade is **+1450 daily trips, +88 trips (AM peak hour) and +98 trips (PM peak hour)** on the surrounding road network.

The directional split of inbound and outbound trips for the proposed development is estimated to be about 50/50 for inbound/outbound trips during the peak hours.

Two traffic distributions have been modelled for the weekday AM and PM peak hours:

- ✚ Passing trade traffic as detailed in **Figure 8**.
- ✚ Non-passing trade traffic as detailed in **Figure 9**.

The total proposed development traffic is detailed in **Figure 10**. The development traffic distribution modelled in this report has been established by considering the catchment area of the proposed development, existing traffic patterns and the traffic routes.

Passing Trade Traffic

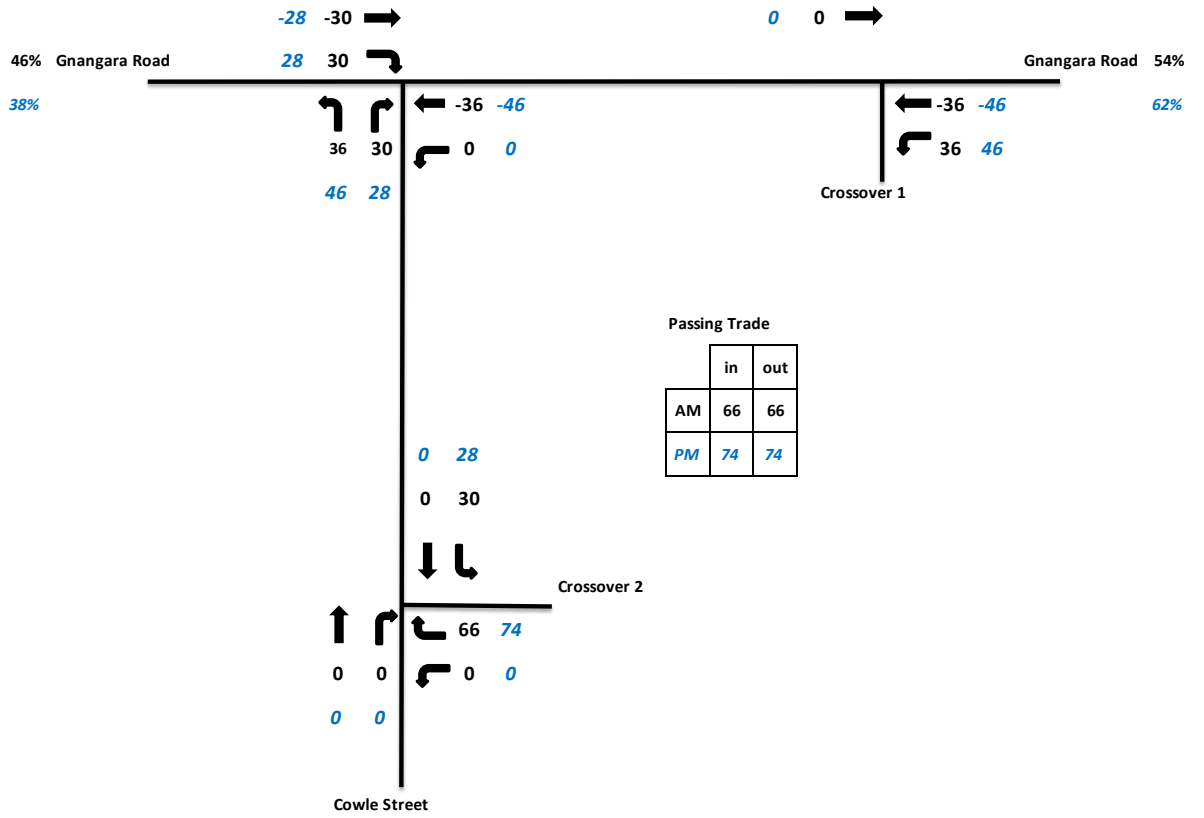


Figure 8: Passing trade component - AM & PM peak hour traffic for the proposed development

Non Passing Trade Traffic

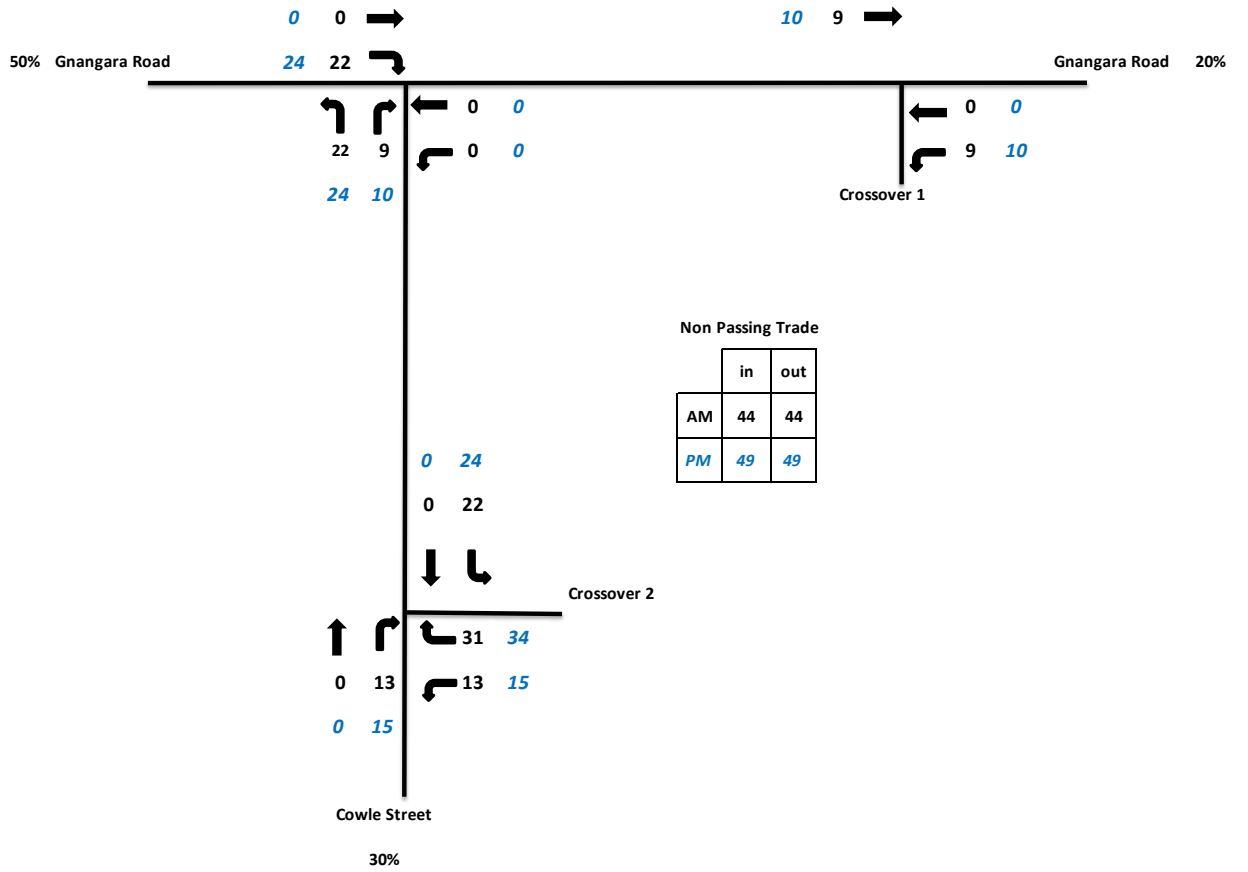


Figure 9: Additional (non-passing trade) component - AM & PM peak hour traffic for the proposed development

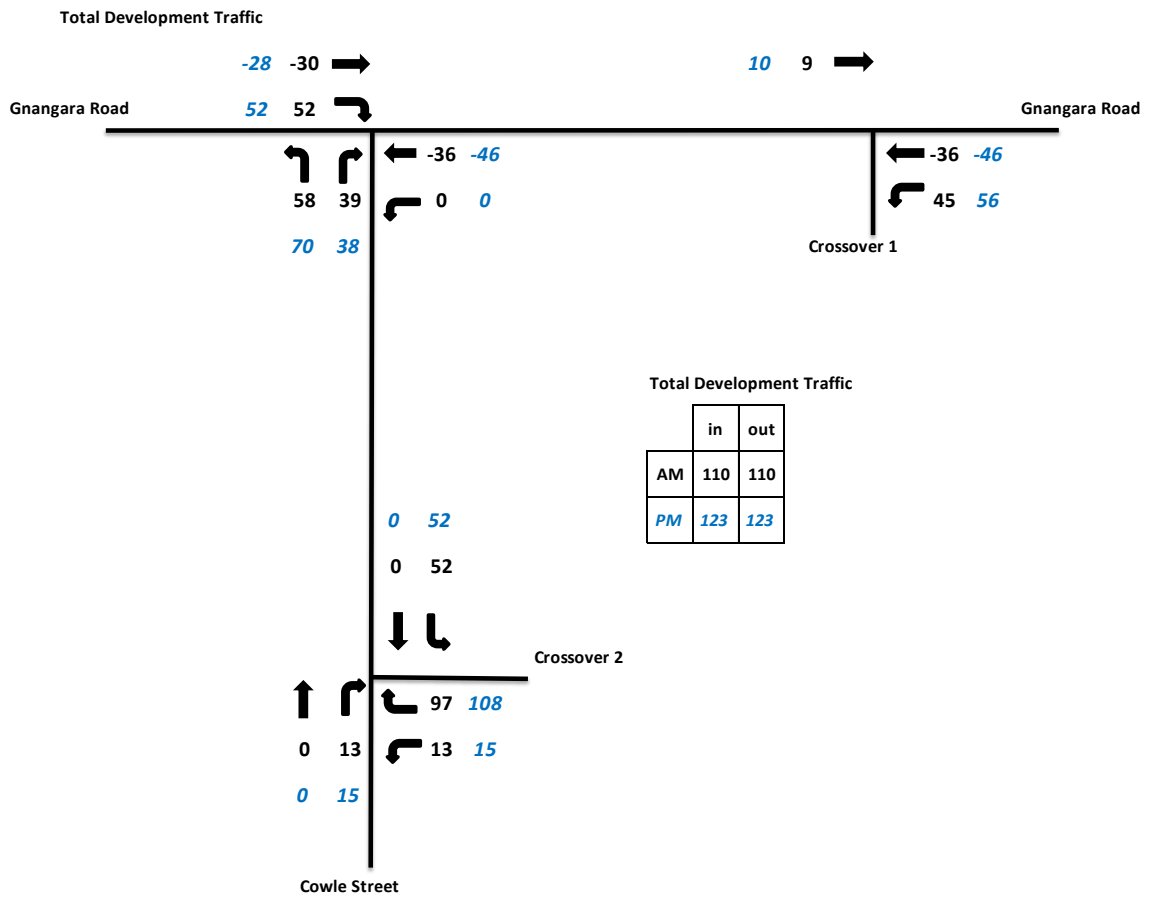


Figure 10: Total peak hour traffic generated by the proposed development –AM and PM peak hours

7.3 Traffic Flows

The existing traffic flows used as a base for traffic assessment are presented in **Figure 11**. The existing traffic volumes were derived from the traffic surveys conducted by Transcore on 19th February 2019 and traffic counts available from Main Roads WA.

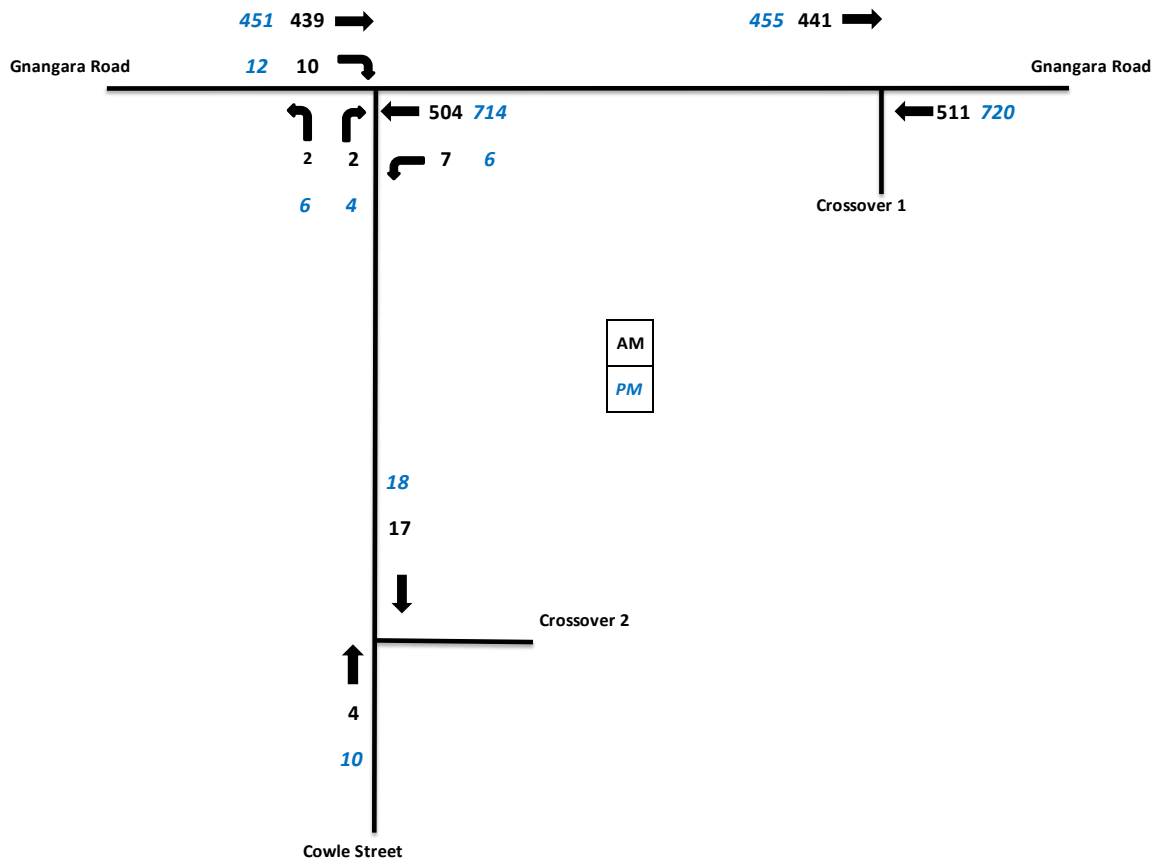


Figure 11: Existing traffic flows near the subject site –AM & PM peak hours

The combined base and development traffic volumes for the post-development scenario are presented in **Figure 12**.

To approximate the 10-year post development traffic on relevant roads, a traffic growth of 20% has been applied to through traffic on Gngangara Road and Cowle Street.

The total ten-year post-development traffic volumes are presented in **Figure 13**.

Total Post Development Traffic

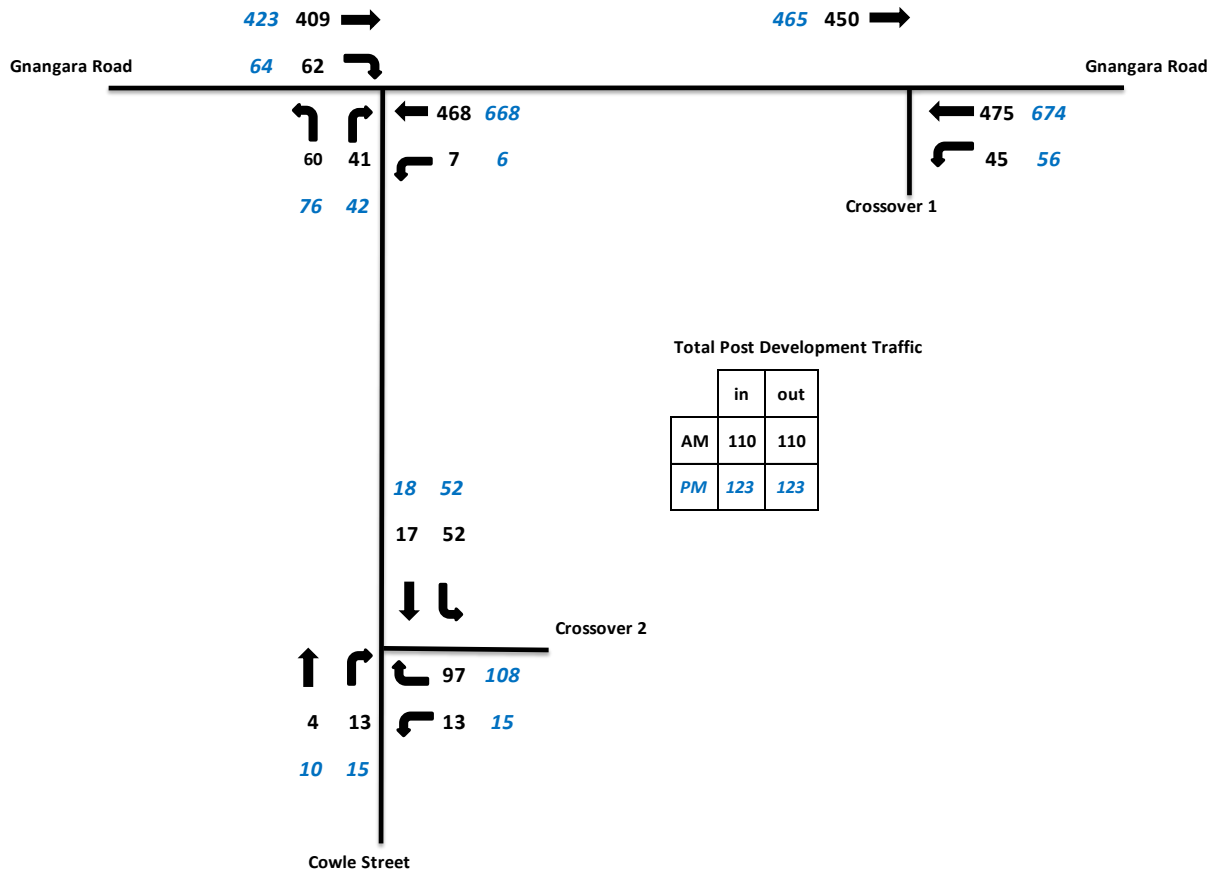


Figure 12: Post-development traffic flows near the subject site –AM and PM peak hours

10-year Post Development Traffic

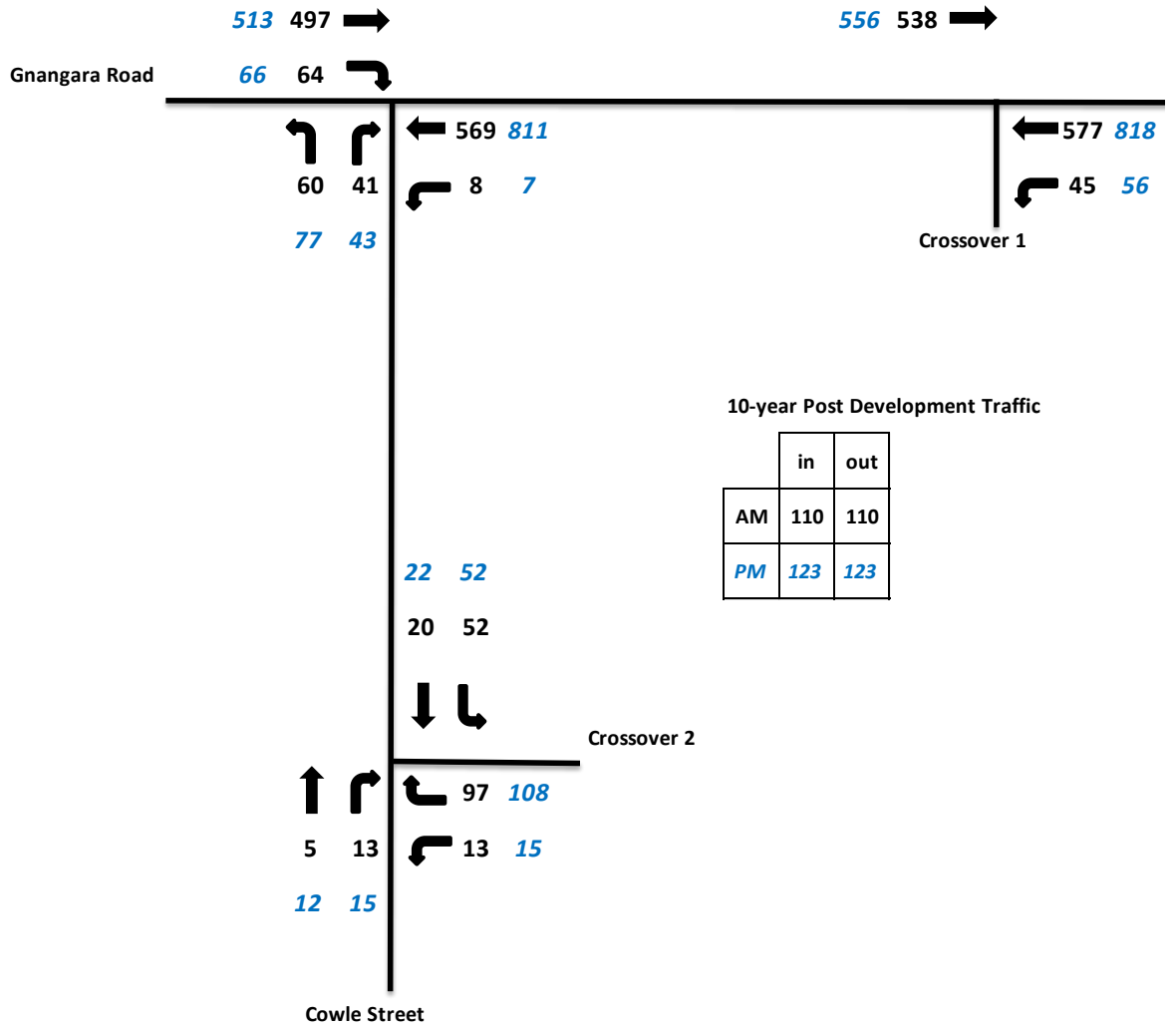


Figure 13: Estimated 10-year total post-development traffic flows near the subject site –AM and PM peak hours

7.4 Analysis of Development Accesses

The operation of the T-intersection of Gnangara Road/Cowle Street and the proposed two crossovers on Gnangara Road and Cowle Street were analysed for post development and 10-year post development scenarios, for the weekday AM and PM peak hours.

A SIDRA Network model was developed for the proposed development crossovers and the existing intersection of Gnangara Road/Cowle Street in order to assess their operations in the post-development and 10-year post development scenarios, for the weekday AM and PM hours. The modelled network geometry is shown in **Figure 14**.

SIDRA is an intersection modelling tool commonly used by traffic engineers for all types of intersections. SIDRA outputs are presented in the form of Degree of Saturation, Level of Service, Average Delay and 95% Queue. These characteristics are defined as follows:

- ✚ **Degree of Saturation (DoS):** is the ratio of the arrival traffic flow to the capacity of the approach during the same period. The Degree of Saturation ranges from close to zero for varied traffic flow up to one for saturated flow or capacity.
- ✚ **Level of Service (LoS):** is the qualitative measure describing operational conditions within a traffic stream and the perception by motorists and/or passengers. In general, there are 6 levels of service, designated from A to F, with Level of Service A representing the best operating condition (i.e. free flow) and Level of Service F the worst (i.e. forced or breakdown flow).
- ✚ **Average Delay:** is the average of all travel time delays for vehicles through the intersection.
- ✚ **95% Queue:** is the queue length below which 95% of all observed queue lengths fall.

The results of the SIDRA analysis are attached in **Appendix B** and briefly discussed in following paragraphs.

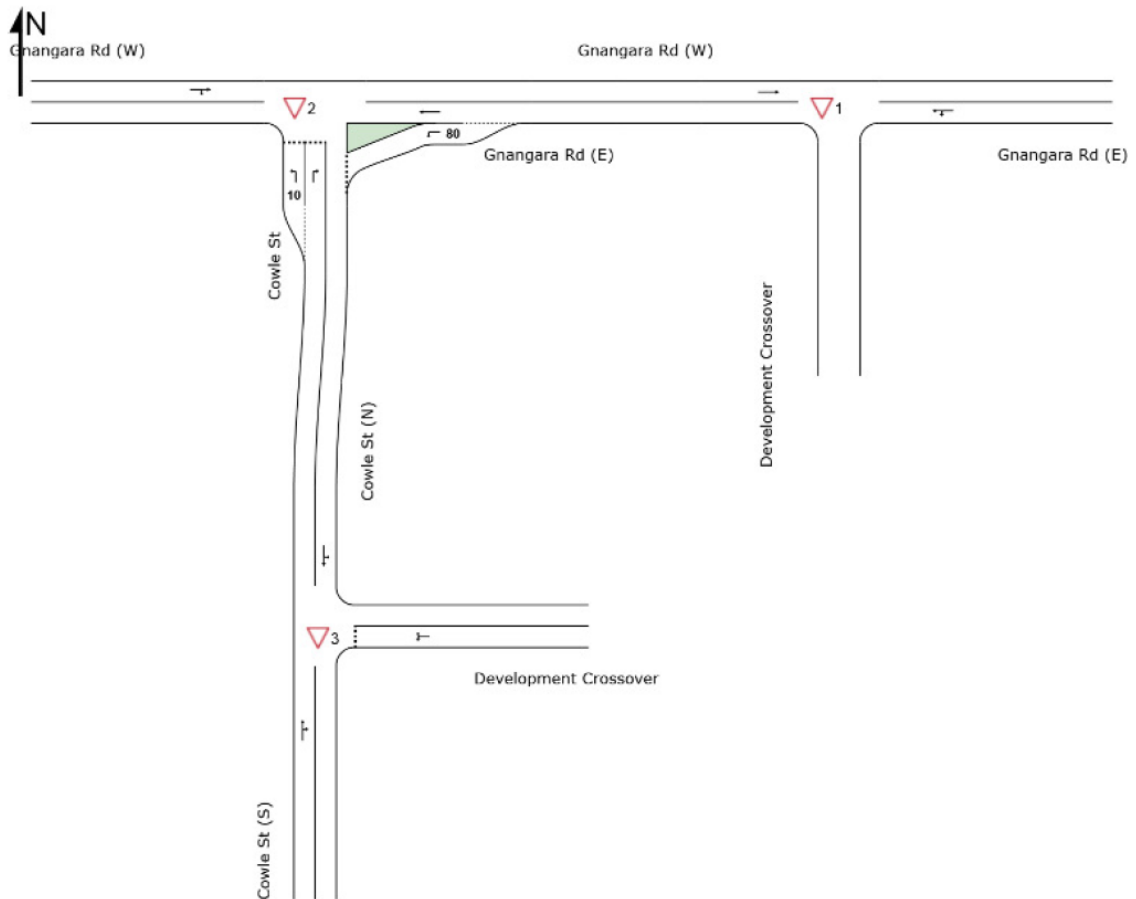


Figure 14: Network Model for Gngangara Road/Cowle Street intersection and Gngangara Road and Cowle Street Crossovers – SIDRA Network Layout

Gngangara Road/Cowle Street Intersection

The SIDRA analysis results indicate that the intersection of Gngangara Road/Cowle Street will operate satisfactorily in post development and 10-year post development scenarios during AM and PM peak periods.

Proposed Gngangara Road Crossover

The SIDRA analysis result indicates that the proposed development crossover on Gngangara Road will operate at LoS A during AM and PM peak hours for both post-development and 10-year post development scenarios. Importantly, there will be no impact on Gngangara Road traffic flow.

Proposed Cowle Street Crossover

The SIDRA analysis result indicates that the proposed development crossover on Cowle Street will operate at LoS A during AM and PM peak hours for both post-development and 10-year post development scenarios. Importantly, there will be no practical impact on the Cowle Street traffic flow.

7.5 Impact on Surrounding Roads

The WAPC Transport Impact Assessment Guidelines (2016) provides guidance on the assessment of traffic impacts:

“As a general guide, an increase in traffic of less than 10 per cent of capacity would not normally be likely to have a material impact on any particular section of road, but increases over 10 per cent may. All sections of road with an increase greater than 10 per cent of capacity should therefore be included in the analysis. For ease of assessment, an increase of 100 vehicles per hour for any lane can be considered as equating to around 10 per cent of capacity. Therefore, any section of road where the structure plan traffic would increase flows by more than 100 vehicles per hour for any lane should be included in the analysis.”

The proposed development will not increase traffic flows anywhere near the quoted WAPC threshold to warrant further detailed analysis. As detailed in Section 7, the proposed development will not increase traffic on any lanes on the surrounding road network by more than 100vph. Therefore, the impact of the development traffic on surrounding road network is insignificant.

7.6 Impact on Neighbouring Areas

The traffic generated by the proposed development is not expected to significantly affect surrounding areas and the road network has been designed to accommodate this type of development traffic.

7.7 Traffic Noise and Vibration

It generally requires a doubling of traffic volumes on a road to produce a perceptible 3dB (A) increase in road noise. The proposed development will not increase traffic volumes on surrounding roads anywhere near this level.

8.0 Parking

The proposed development provides 17 car parking spaces including one ACROD bay, one loading zone, one service yard, 16 fuelling positions for light vehicles and 2 high flow fuelling positions for heavy vehicles.

It is therefore considered that the proposed parking provision is sufficient to accommodate the needs of the proposed development.

9.0 Provision for Heavy Vehicles

Heavy vehicles, fuel tankers and service vehicles are proposed to enter the site via left in only crossover on Gnangara Road and exit the site onto Cowle Street via the proposed full movement crossover on Cowle Street.

27.5m B-double truck

Gnangara Road fronting the subject site and Cowle Street, west of the subject site are classified as RAV Network 4 and as such it is anticipated that the largest trucks which might use this site would be 27.5m B-double truck.

Therefore, swept path analysis has been undertaken for the 27.5m B-double truck to enter the site via left in only crossover on Gnangara Road, circulate through the truck filling canopy and exit the site onto Cowle Street via full movement crossover. Swept path analysis shows satisfactory access, egress and circulation.

19m fuel tanker, 12.5m service truck

It is anticipated that 19m fuel tankers will be used for fuel deliveries and 12.5m service trucks will be used for other deliveries and waste collection. Swept path analysis confirms satisfactory circulation of these vehicles.

The results of the turn path analysis are included in **Appendix C**.

10.0 Conclusions

This Transport Impact Assessment (TIA) is prepared by Transcore on behalf of Liberty Oil with respect to the proposed Roadhouse comprising an integrated light and heavy vehicle canopy and an associated retail building to be located on Lot 200 (No. 2) Cowle Street, Landsdale, in the City of Wanneroo.

As a part of development, it is proposed to modify the existing left turn lane into Cowle Street to extend the left turn lane across the frontage of the subject site so that it also provides left turn in only access into the development site. It is also proposed to provide a full movement crossover on Cowle Street which is on the south west corner of the subject site.

The proposed crossovers and site layout facilitate efficient and convenient vehicular entry and egress to and from the subject site. Swept path analysis undertaken indicates that 27.5m B-double and 19.0m fuel tanker can access, egress and manoeuvre within the site satisfactorily. Also, swept path analysis for a 12.5m service vehicles shows satisfactory manoeuvrability, to, from and within the site.

The net additional traffic as a result of the proposed development after allowing for passing trade is estimated to be approximately 88 and 98 trips during the weekday AM and PM peak hours respectively. This level of traffic generation is relatively minimal and as such would have insignificant impact on the abutting road network.

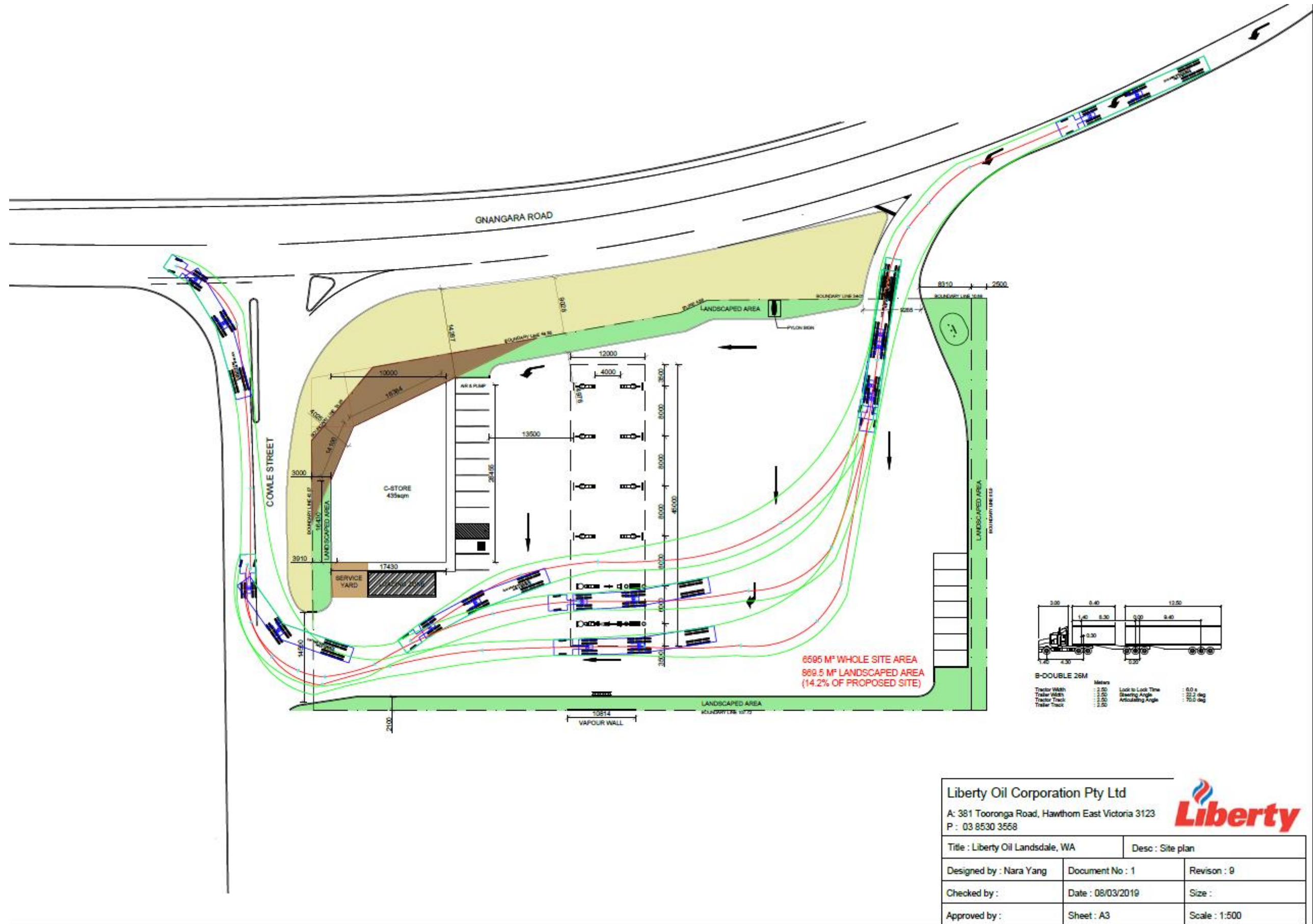
The operation of the T-intersection of Gnangara Road/Cowle Street and the proposed two crossovers on Gnangara Road and Cowle Street were analysed for post development and 10-year post development scenarios, for the weekday AM and PM peak hours. The analysis indicates that the development traffic does not have any significant impact on the operations of the surrounding roads and T-intersection.

The proposed car parking is considered to satisfactorily meet the needs of the proposed development.

In conclusion, the findings of this Transport Impact Assessment are supportive of the proposed development.

Appendix A

PROPOSED SITE PLAN



Liberty Oil Corporation Pty Ltd		
A: 381 Tooronga Road, Hawthorn East Victoria 3123		
P: 03 8530 3558		
Title : Liberty Oil Landsdale, WA		Desc : Site plan
Designed by : Nara Yang	Document No : 1	Revision : 9
Checked by :	Date : 08/03/2019	Size :
Approved by :	Sheet : A3	Scale : 1:500

Appendix B

SIDRA OUTPUTS

SIDRA Network model layout

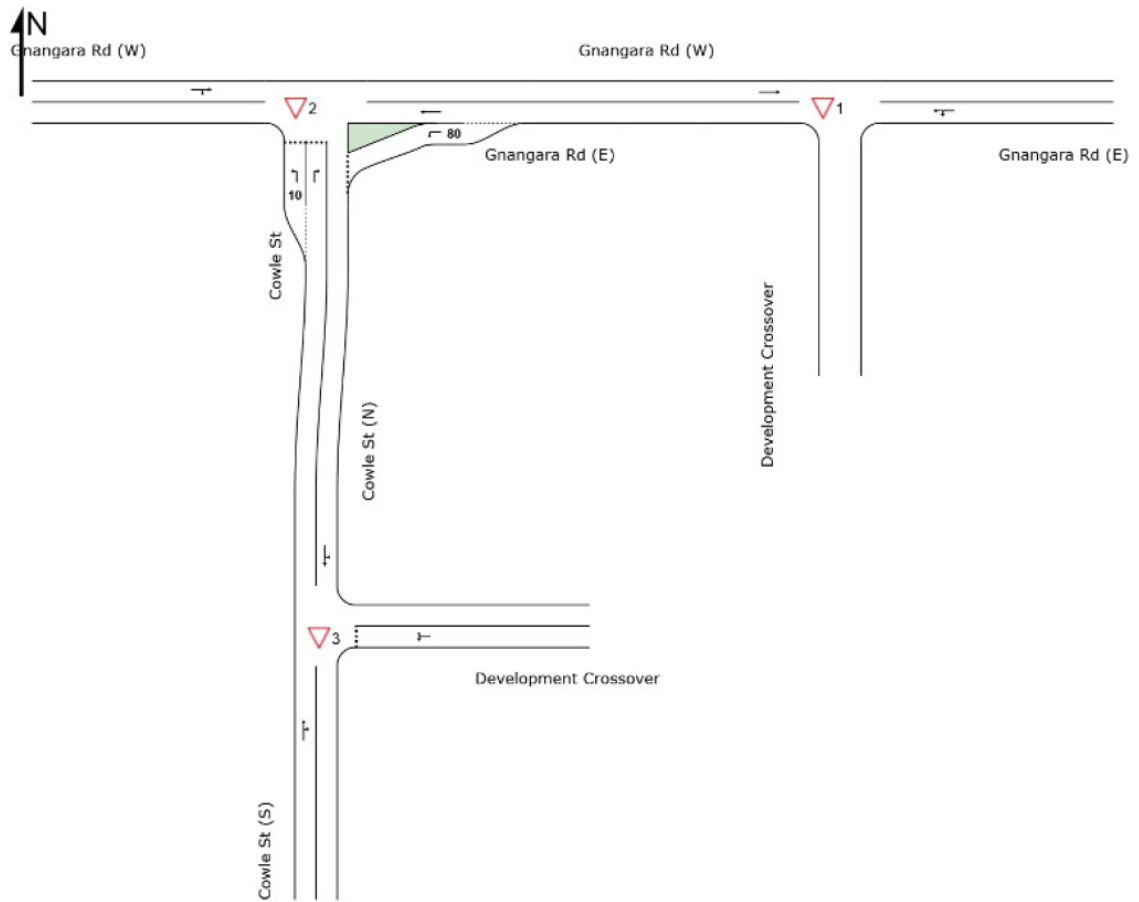


Table 1: SIDRA results for the Gngangara Road crossover – AM peak period – (2019 Post Development)

MOVEMENT SUMMARY

Site: 1 [2019 Gngangara Rd Crossover - AM Peak]

Network: N101 [2019 Post-development AM Peak]

New Site
 Site Category: (None)
 Giveway / Yield (Two-Way)

Movement Performance - Vehicles														
Mov ID	Turn	Demand Flows		Arrival Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		Total veh/h	HV % veh/h	Total	HV %				Vehicles	Distance m				
East: Gngangara Rd (E)														
1	L2	47	23.1	47	23.1	0.326	6.8	LOS A	0.0	0.0	0.00	0.05	0.00	64.3
2	T1	500	23.1	500	23.1	0.326	0.0	LOS A	0.0	0.0	0.00	0.05	0.00	68.4
Approach		547	23.1	547	23.1	0.326	0.6	NA	0.0	0.0	0.00	0.05	0.00	68.1
West: Gngangara Rd (W)														
8	T1	474	21.0	474	21.0	0.276	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	69.9
Approach		474	21.0	474	21.0	0.276	0.0	NA	0.0	0.0	0.00	0.00	0.00	69.9
All Vehicles		1021	22.1	1021	22.1	0.326	0.3	NA	0.0	0.0	0.00	0.03	0.00	69.0

Table 2: SIDRA results for the T-intersection of Gngangara Road / Cowle Street – AM peak period – (2019 Post Development)

MOVEMENT SUMMARY

Site: 2 [2019 T-intersection of Gngangara Rd/Cowle St- AM Peak]

Network: N101 [2019 Post-development AM Peak]

New Site
 Site Category: (None)
 Giveway / Yield (Two-Way)

Movement Performance - Vehicles														
Mov ID	Turn	Demand Flows		Arrival Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		Total veh/h	HV % veh/h	Total	HV %				Vehicles	Distance m				
South: Cowle St														
10	L2	63	11.0	63	11.0	0.074	6.5	LOS A	0.3	2.3	0.52	0.69	0.52	46.8
12	R2	43	11.0	43	11.0	0.126	12.8	LOS B	0.4	3.2	0.75	0.87	0.75	14.1
Approach		106	11.0	106	11.0	0.126	9.0	LOS A	0.4	3.2	0.61	0.77	0.61	39.7
East: Gngangara Rd (E)														
1	L2	7	23.1	7	23.1	0.005	5.5	LOS A	0.0	0.2	0.16	0.52	0.16	33.4
2	T1	493	23.1	493	23.1	0.292	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	69.9
Approach		500	23.1	500	23.1	0.292	0.1	LOS A	0.0	0.2	0.00	0.01	0.00	69.7
West: Gngangara Rd (W)														
8	T1	431	21.0	431	21.0	0.331	1.2	LOS A	1.3	11.5	0.25	0.10	0.30	64.0
9	R2	65	21.0	65	21.0	0.331	11.3	LOS B	1.3	11.5	0.25	0.10	0.30	64.0
Approach		496	21.0	496	21.0	0.331	2.5	NA	1.3	11.5	0.25	0.10	0.30	64.0
All Vehicles		1102	21.0	1102	21.0	0.331	2.1	NA	1.3	11.5	0.17	0.12	0.19	64.1

Table 3: SIDRA results for the Cowle Street crossover – AM peak period – (2019 Post Development)

MOVEMENT SUMMARY

Site: 3 [2019 Cowle St Crossover - AM Peak]

Network: N101 [2019 Post-development AM Peak]

New Site
 Site Category: (None)
 Giveway / Yield (Two-Way)

Movement Performance - Vehicles														
Mov ID	Turn	Demand Flows		Arrival Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		Total veh/h	HV %	Total veh/h	HV %				Vehicles	Distance m				
South: Cowle St (S)														
8	T1	4	11.0	4	11.0	0.011	0.2	LOS A	0.0	0.4	0.18	0.38	0.18	44.9
9	R2	14	11.0	14	11.0	0.011	4.9	LOS A	0.0	0.4	0.18	0.38	0.18	42.9
Approach		18	11.0	18	11.0	0.011	3.8	NA	0.0	0.4	0.18	0.38	0.18	43.3
East: Development Crossover														
10	L2	14	11.0	14	11.0	0.104	0.1	LOS A	0.4	3.3	0.12	0.05	0.12	43.6
12	R2	102	22.0	102	22.0	0.104	0.3	LOS A	0.4	3.3	0.12	0.05	0.12	18.5
Approach		116	20.7	116	20.7	0.104	0.3	LOS A	0.4	3.3	0.12	0.05	0.12	30.1
North: Cowle St (N)														
1	L2	55	22.0	55	22.0	0.044	3.9	LOS A	0.0	0.0	0.00	0.39	0.00	6.6
2	T1	18	11.0	18	11.0	0.044	0.0	LOS A	0.0	0.0	0.00	0.39	0.00	46.7
Approach		73	19.3	73	19.3	0.044	2.9	NA	0.0	0.0	0.00	0.39	0.00	16.0
All Vehicles		206	19.4	206	19.4	0.104	1.5	NA	0.4	3.3	0.09	0.20	0.09	23.4

Table 4: SIDRA results for the Gngangara Road crossover – PM peak period – (2019 Post Development)

MOVEMENT SUMMARY

Site: 1 [2019 Gngangara Rd Crossover - PM Peak]

Network: N101 [2019 Post-development PM Peak]

New Site
 Site Category: (None)
 Giveway / Yield (Two-Way)

Movement Performance - Vehicles														
Mov ID	Turn	Demand Flows		Arrival Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		Total veh/h	HV %	Total veh/h	HV %				Vehicles	Distance m				
East: Gngangara Rd (E)														
1	L2	59	23.1	59	23.1	0.458	6.8	LOS A	0.0	0.0	0.00	0.05	0.00	64.4
2	T1	709	23.1	709	23.1	0.458	0.1	LOS A	0.0	0.0	0.00	0.05	0.00	68.5
Approach		768	23.1	768	23.1	0.458	0.6	NA	0.0	0.0	0.00	0.05	0.00	68.2
West: Gngangara Rd (W)														
8	T1	489	21.0	489	21.0	0.285	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	69.9
Approach		489	21.0	489	21.0	0.285	0.0	NA	0.0	0.0	0.00	0.00	0.00	69.9
All Vehicles		1258	22.3	1258	22.3	0.458	0.4	NA	0.0	0.0	0.00	0.03	0.00	68.9

Table 5: SIDRA results for the T-intersection of Gngara Road / Cowle Street – PM peak period – (2019 Post Development)

MOVEMENT SUMMARY

Site: 2 [2019 T-intersection of Gngara Rd/Cowle St- PM Peak] Network: N101 [2019 Post-development PM Peak]

New Site
 Site Category: (None)
 Giveway / Yield (Two-Way)

Movement Performance - Vehicles														
Mov ID	Turn	Demand Flows		Arrival Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		Total veh/h	HV % veh/h	Total HV %	v/c				sec	Vehicles veh				
South: Cowle St														
10	L2	80	11.0	80	11.0	0.136	8.9	LOS A	0.5	4.0	0.65	0.83	0.65	44.3
12	R2	44	11.0	44	11.0	0.208	20.3	LOS C	0.6	5.2	0.86	0.94	0.91	10.0
Approach		124	11.0	124	11.0	0.208	13.0	LOS B	0.6	5.2	0.73	0.87	0.75	36.3
East: Gngara Rd (E)														
1	L2	6	23.1	6	23.1	0.005	5.5	LOS A	0.0	0.2	0.17	0.52	0.17	33.4
2	T1	703	23.1	703	23.1	0.417	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	69.8
Approach		709	23.1	709	23.1	0.417	0.1	LOS A	0.0	0.2	0.00	0.00	0.00	69.7
West: Gngara Rd (W)														
8	T1	445	21.0	445	21.0	0.382	3.0	LOS A	2.2	20.3	0.37	0.10	0.51	59.7
9	R2	67	21.0	67	21.0	0.382	15.7	LOS C	2.2	20.3	0.37	0.10	0.51	59.7
Approach		513	21.0	513	21.0	0.382	4.6	NA	2.2	20.3	0.37	0.10	0.51	59.7
All Vehicles		1346	21.2	1346	21.2	0.417	3.0	NA	2.2	20.3	0.21	0.12	0.26	62.2

Table 6: SIDRA results for the Cowle Street crossover – PM peak period – (2019 Post Development)

MOVEMENT SUMMARY

Site: 3 [2019 Cowle St Crossover - PM Peak] Network: N101 [2019 Post-development PM Peak]

New Site
 Site Category: (None)
 Giveway / Yield (Two-Way)

Movement Performance - Vehicles														
Mov ID	Turn	Demand Flows		Arrival Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		Total veh/h	HV % veh/h	Total HV %	v/c				sec	Vehicles veh				
South: Cowle St (S)														
8	T1	11	11.0	11	11.0	0.016	0.2	LOS A	0.1	0.6	0.17	0.30	0.17	45.7
9	R2	16	11.0	16	11.0	0.016	5.0	LOS A	0.1	0.6	0.17	0.30	0.17	43.6
Approach		26	11.0	26	11.0	0.016	3.1	NA	0.1	0.6	0.17	0.30	0.17	44.4
East: Development Crossover														
10	L2	16	11.0	16	11.0	0.117	0.1	LOS A	0.4	3.7	0.13	0.06	0.13	43.6
12	R2	114	22.0	114	22.0	0.117	0.4	LOS A	0.4	3.7	0.13	0.06	0.13	18.5
Approach		129	20.7	129	20.7	0.117	0.3	LOS A	0.4	3.7	0.13	0.06	0.13	30.2
North: Cowle St (N)														
1	L2	55	22.0	55	22.0	0.044	3.9	LOS A	0.0	0.0	0.00	0.39	0.00	6.6
2	T1	19	11.0	19	11.0	0.044	0.0	LOS A	0.0	0.0	0.00	0.39	0.00	46.8
Approach		74	19.2	74	19.2	0.044	2.9	NA	0.0	0.0	0.00	0.39	0.00	16.5
All Vehicles		229	19.1	229	19.1	0.117	1.5	NA	0.4	3.7	0.09	0.19	0.09	25.2

Table 7: SIDRA results for the Gngangara Road crossover – AM peak period – (2029 Post Development)

MOVEMENT SUMMARY

Site: 1 [2029 Gngangara Rd Crossover - AM Peak]

Network: N101 [2029 Post-development AM Peak]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles														
Mov ID	Turn	Demand Flows		Arrival Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		Total veh/h	HV %	Total veh/h	HV %				Vehicles	Distance m				
East: Gngangara Rd (E)														
1	L2	47	23.1	47	23.1	0.390	6.8	LOS A	0.0	0.0	0.00	0.05	0.00	64.5
2	T1	607	23.1	607	23.1	0.390	0.1	LOS A	0.0	0.0	0.00	0.05	0.00	68.6
Approach		655	23.1	655	23.1	0.390	0.6	NA	0.0	0.0	0.00	0.05	0.00	68.3
West: Gngangara Rd (W)														
8	T1	566	21.0	566	21.0	0.330	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	69.9
Approach		566	21.0	566	21.0	0.330	0.0	NA	0.0	0.0	0.00	0.00	0.00	69.9
All Vehicles		1221	22.1	1221	22.1	0.390	0.3	NA	0.0	0.0	0.00	0.02	0.00	69.1

Table 8: SIDRA results for the T-intersection of Gngangara Road / Cowle Street – AM peak period – (2029 Post Development)

MOVEMENT SUMMARY

Site: 2 [2029 T-intersection of Gngangara Rd/Cowle St- AM Peak]

Network: N101 [2029 Post-development AM Peak]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles														
Mov ID	Turn	Demand Flows		Arrival Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		Total veh/h	HV %	Total veh/h	HV %				Vehicles	Distance m				
South: Cowle St														
10	L2	63	11.0	63	11.0	0.088	7.5	LOS A	0.3	2.6	0.57	0.76	0.57	45.8
12	R2	43	11.0	43	11.0	0.182	18.1	LOS C	0.5	4.5	0.83	0.93	0.86	10.9
Approach		106	11.0	106	11.0	0.182	11.8	LOS B	0.5	4.5	0.68	0.83	0.69	36.6
East: Gngangara Rd (E)														
1	L2	8	23.1	8	23.1	0.006	5.5	LOS A	0.0	0.2	0.17	0.52	0.17	33.4
2	T1	599	23.1	599	23.1	0.355	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	69.9
Approach		607	23.1	607	23.1	0.355	0.1	LOS A	0.0	0.2	0.00	0.01	0.00	69.7
West: Gngangara Rd (W)														
8	T1	523	21.0	523	21.0	0.405	1.8	LOS A	1.9	17.4	0.28	0.09	0.39	62.6
9	R2	67	21.0	67	21.0	0.405	13.8	LOS B	1.9	17.4	0.28	0.09	0.39	62.6
Approach		591	21.0	591	21.0	0.405	3.2	NA	1.9	17.4	0.28	0.09	0.39	62.6
All Vehicles		1304	21.2	1304	21.2	0.405	2.5	NA	1.9	17.4	0.19	0.11	0.24	63.4

Table 9: SIDRA results for the Cowle Street crossover – AM peak period – (2029 Post Development)

MOVEMENT SUMMARY

Site: 3 [2029 Cowle St Crossover - AM Peak]

Network: N101 [2029 Post-development AM Peak]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles														
Mov ID	Turn	Demand Flows		Arrival Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		Total veh/h	HV % veh/h	Total	HV %				Vehicles	Distance				
South: Cowle St (S)														
8	T1	5	11.0	5	11.0	0.012	0.2	LOS A	0.1	0.4	0.18	0.36	0.18	45.1
9	R2	14	11.0	14	11.0	0.012	5.0	LOS A	0.1	0.4	0.18	0.36	0.18	43.1
Approach		19	11.0	19	11.0	0.012	3.6	NA	0.1	0.4	0.18	0.36	0.18	43.6
East: Development Crossover														
10	L2	14	11.0	14	11.0	0.104	0.1	LOS A	0.4	3.3	0.13	0.05	0.13	43.6
12	R2	102	22.0	102	22.0	0.104	0.3	LOS A	0.4	3.3	0.13	0.05	0.13	18.4
Approach		116	20.7	116	20.7	0.104	0.3	LOS A	0.4	3.3	0.13	0.05	0.13	30.0
North: Cowle St (N)														
1	L2	55	22.0	55	22.0	0.045	3.9	LOS A	0.0	0.0	0.00	0.38	0.00	6.6
2	T1	21	11.0	21	11.0	0.045	0.0	LOS A	0.0	0.0	0.00	0.38	0.00	46.9
Approach		76	18.9	76	18.9	0.045	2.8	NA	0.0	0.0	0.00	0.38	0.00	17.3
All Vehicles		211	19.2	211	19.2	0.104	1.5	NA	0.4	3.3	0.09	0.20	0.09	24.2

Table 10: SIDRA results for the Gngangara Road crossover – PM peak period – (2029 Post Development)

MOVEMENT SUMMARY

Site: 1 [2029 Gngangara Rd Crossover - AM Peak]

Network: N101 [2029 Post-development AM Peak]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles														
Mov ID	Turn	Demand Flows		Arrival Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		Total veh/h	HV % veh/h	Total	HV %				Vehicles	Distance				
East: Gngangara Rd (E)														
1	L2	47	23.1	47	23.1	0.390	6.8	LOS A	0.0	0.0	0.00	0.05	0.00	64.5
2	T1	607	23.1	607	23.1	0.390	0.1	LOS A	0.0	0.0	0.00	0.05	0.00	68.6
Approach		655	23.1	655	23.1	0.390	0.6	NA	0.0	0.0	0.00	0.05	0.00	68.3
West: Gngangara Rd (W)														
8	T1	566	21.0	566	21.0	0.330	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	69.9
Approach		566	21.0	566	21.0	0.330	0.0	NA	0.0	0.0	0.00	0.00	0.00	69.9
All Vehicles		1221	22.1	1221	22.1	0.390	0.3	NA	0.0	0.0	0.00	0.02	0.00	69.1

Table 11: SIDRA results for the T-intersection of Gngara Road / Cowle Street – PM peak period – (2029 Post Development)

MOVEMENT SUMMARY

Site: 2 [2029 T-intersection of Gngara Rd/Cowle St- PM Peak] Network: N101 [2029 Post-development PM Peak]

New Site
 Site Category: (None)
 Giveway / Yield (Two-Way)

Movement Performance - Vehicles														
Mov ID	Turn	Demand Flows		Arrival Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		Total veh/h	HV % veh/h	Total HV %	v/c				sec	Vehicles veh				
South: Cowle St														
10	L2	81	11.0	81	11.0	0.192	11.9	LOS B	0.7	5.4	0.77	0.89	0.79	41.6
12	R2	45	11.0	45	11.0	0.376	38.3	LOS E	1.1	9.3	0.94	1.02	1.11	5.8
Approach		126	11.0	126	11.0	0.376	21.4	LOS C	1.1	9.3	0.83	0.94	0.90	29.8
East: Gngara Rd (E)														
1	L2	7	23.1	7	23.1	0.005	5.5	LOS A	0.0	0.2	0.17	0.52	0.17	33.4
2	T1	854	23.1	854	23.1	0.506	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	69.7
Approach		861	23.1	861	23.1	0.506	0.1	LOS A	0.0	0.2	0.00	0.00	0.00	69.6
West: Gngara Rd (W)														
8	T1	540	21.0	540	21.0	0.496	5.7	LOS A	4.1	37.7	0.48	0.10	0.74	54.5
9	R2	69	21.0	69	21.0	0.496	22.6	LOS C	4.1	37.7	0.48	0.10	0.74	54.5
Approach		609	21.0	609	21.0	0.496	7.6	NA	4.1	37.7	0.48	0.10	0.74	54.5
All Vehicles		1597	21.3	1597	21.3	0.506	4.6	NA	4.1	37.7	0.25	0.11	0.36	59.3

Table 12: SIDRA results for the Cowle Street crossover – PM peak period – (2029 Post Development)

MOVEMENT SUMMARY

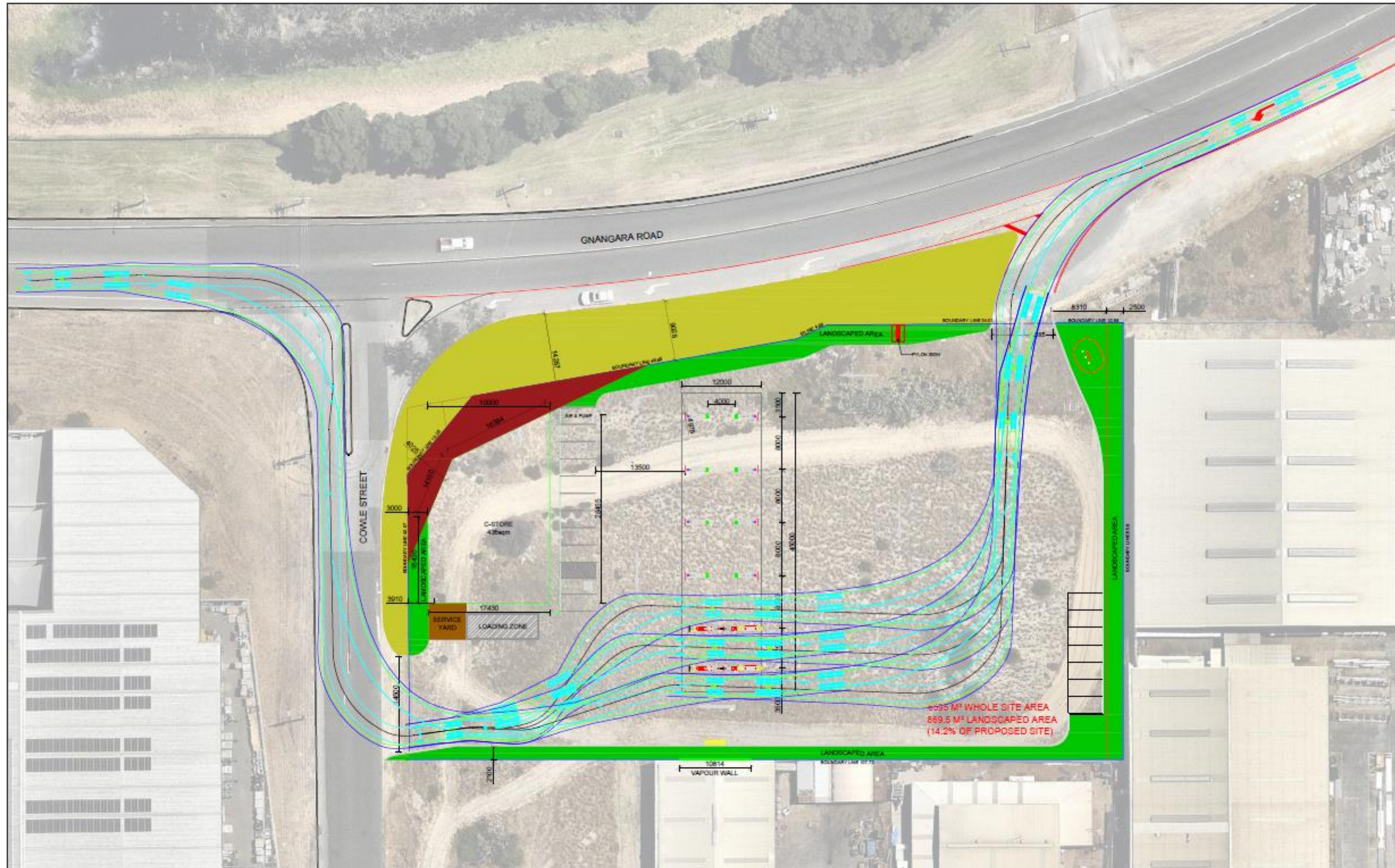
Site: 3 [2029 Cowle St Crossover - PM Peak] Network: N101 [2029 Post-development PM Peak]

New Site
 Site Category: (None)
 Giveway / Yield (Two-Way)

Movement Performance - Vehicles														
Mov ID	Turn	Demand Flows		Arrival Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
		Total veh/h	HV % veh/h	Total HV %	v/c				sec	Vehicles veh				
South: Cowle St (S)														
8	T1	13	11.0	13	11.0	0.017	0.2	LOS A	0.1	0.6	0.17	0.28	0.17	46.0
9	R2	16	11.0	16	11.0	0.017	5.0	LOS A	0.1	0.6	0.17	0.28	0.17	43.8
Approach		28	11.0	28	11.0	0.017	2.9	NA	0.1	0.6	0.17	0.28	0.17	44.7
East: Development Crossover														
10	L2	16	11.0	16	11.0	0.118	0.1	LOS A	0.4	3.8	0.15	0.06	0.15	43.5
12	R2	114	22.0	114	22.0	0.118	0.4	LOS A	0.4	3.8	0.15	0.06	0.15	18.3
Approach		129	20.7	129	20.7	0.118	0.4	LOS A	0.4	3.8	0.15	0.06	0.15	30.1
North: Cowle St (N)														
1	L2	55	22.0	55	22.0	0.046	3.9	LOS A	0.0	0.0	0.00	0.37	0.00	6.6
2	T1	23	11.0	23	11.0	0.046	0.0	LOS A	0.0	0.0	0.00	0.37	0.00	47.0
Approach		78	18.7	78	18.7	0.046	2.7	NA	0.0	0.0	0.00	0.37	0.00	18.1
All Vehicles		236	18.9	236	18.9	0.118	1.4	NA	0.4	3.8	0.10	0.19	0.10	26.1

Appendix C

SWEPT PATH ANALYSIS

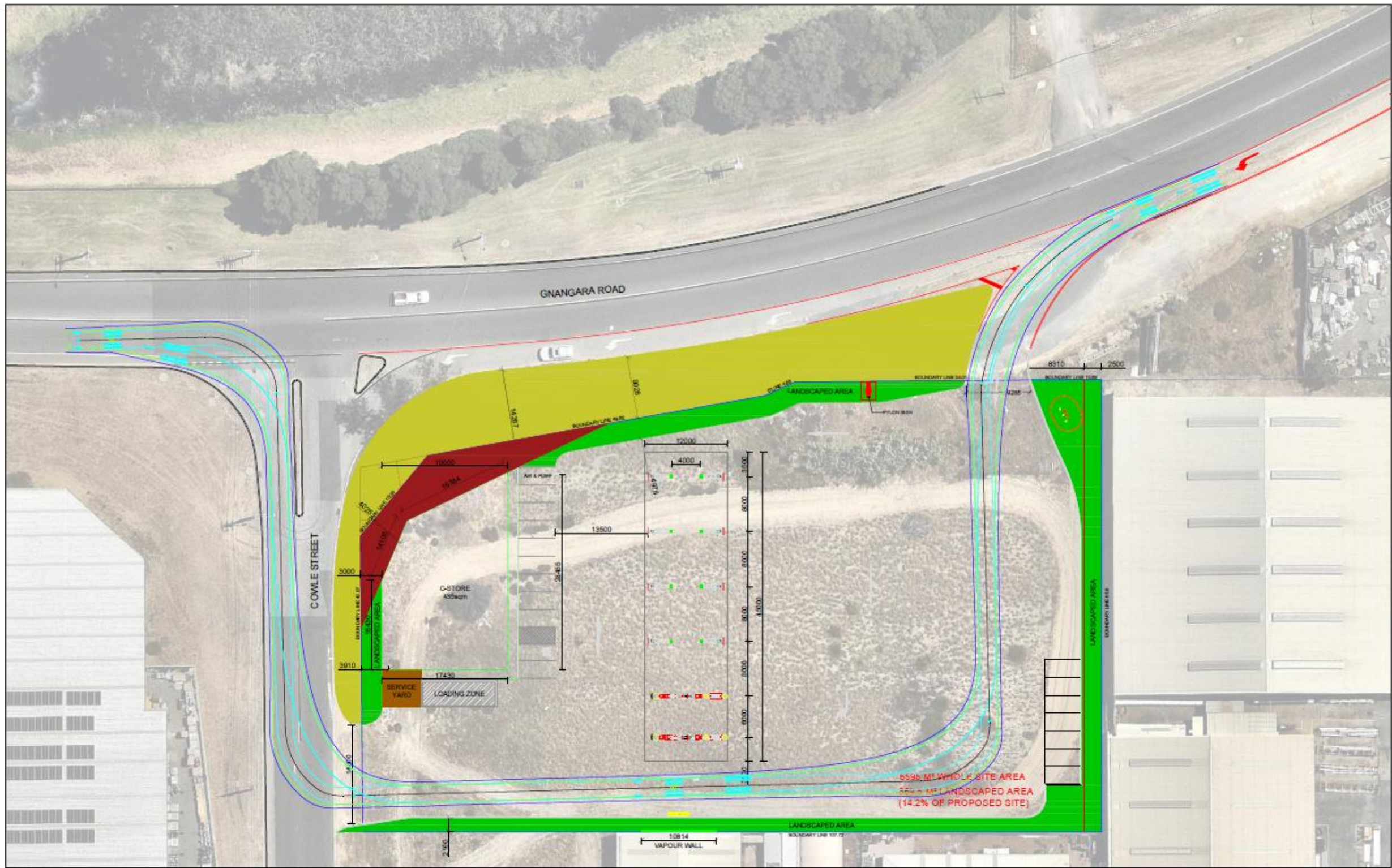


Lot 200 (2) Cowle Street, Landsdale
 Main Roads WA: 27.5m B-double Truck
 Truck Circulation

LEGEND
 Vehicle Body
 Wheel Path
 500mm Clearance

t19.027.sk01a
 11/03/2019
 Scale: 1:525 @ A3





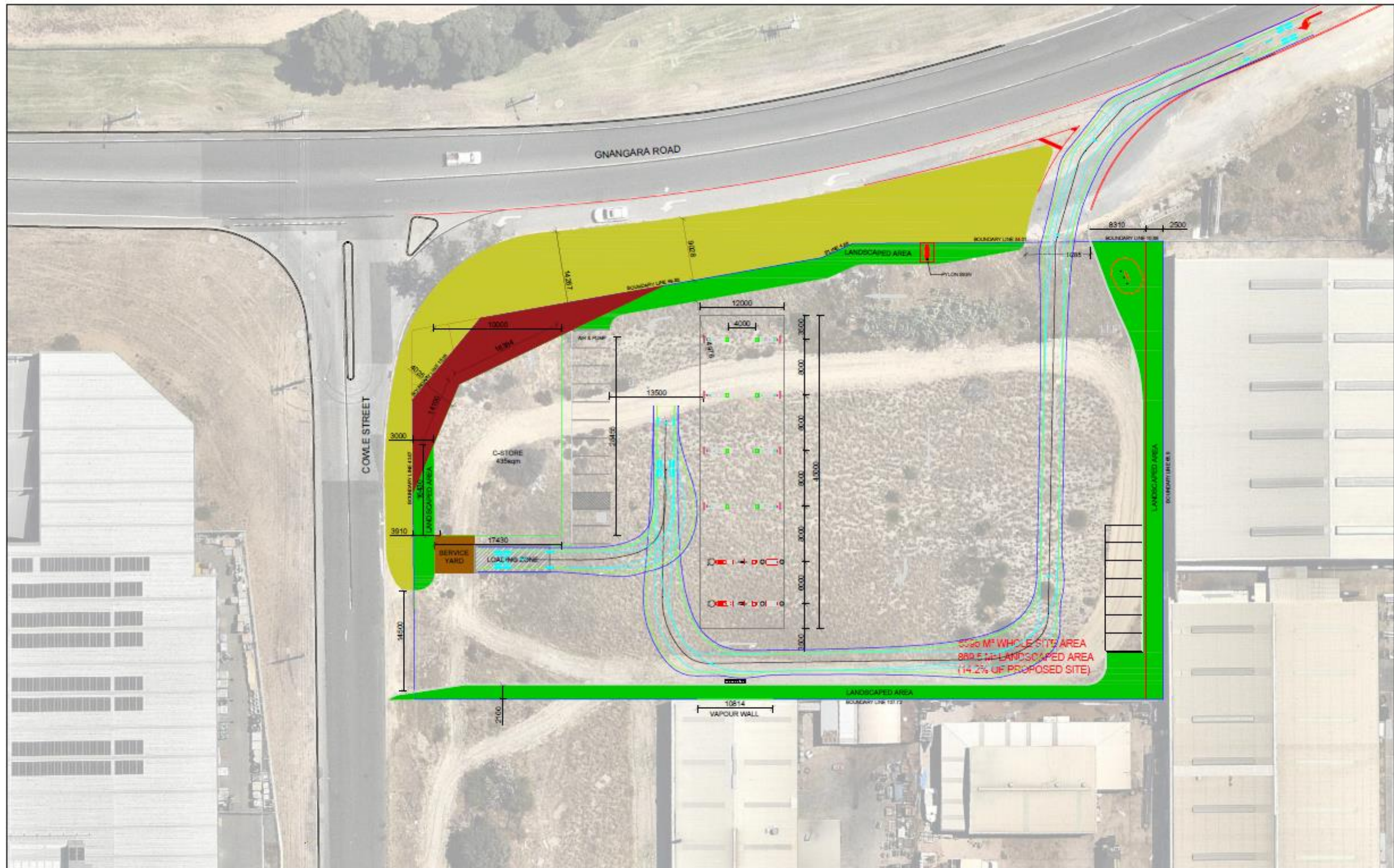
Lot 200 (2) Cowle Street, Landsdale
 Austrroads 2013: 19.0m Semi-Trailer
 Fuel Tanker Circulation

LEGEND
 Vehicle Body
 Wheel Path
 500mm Clearance






t19.027.sk02a
 11/03/2019
 Scale: 1:500 @ A3





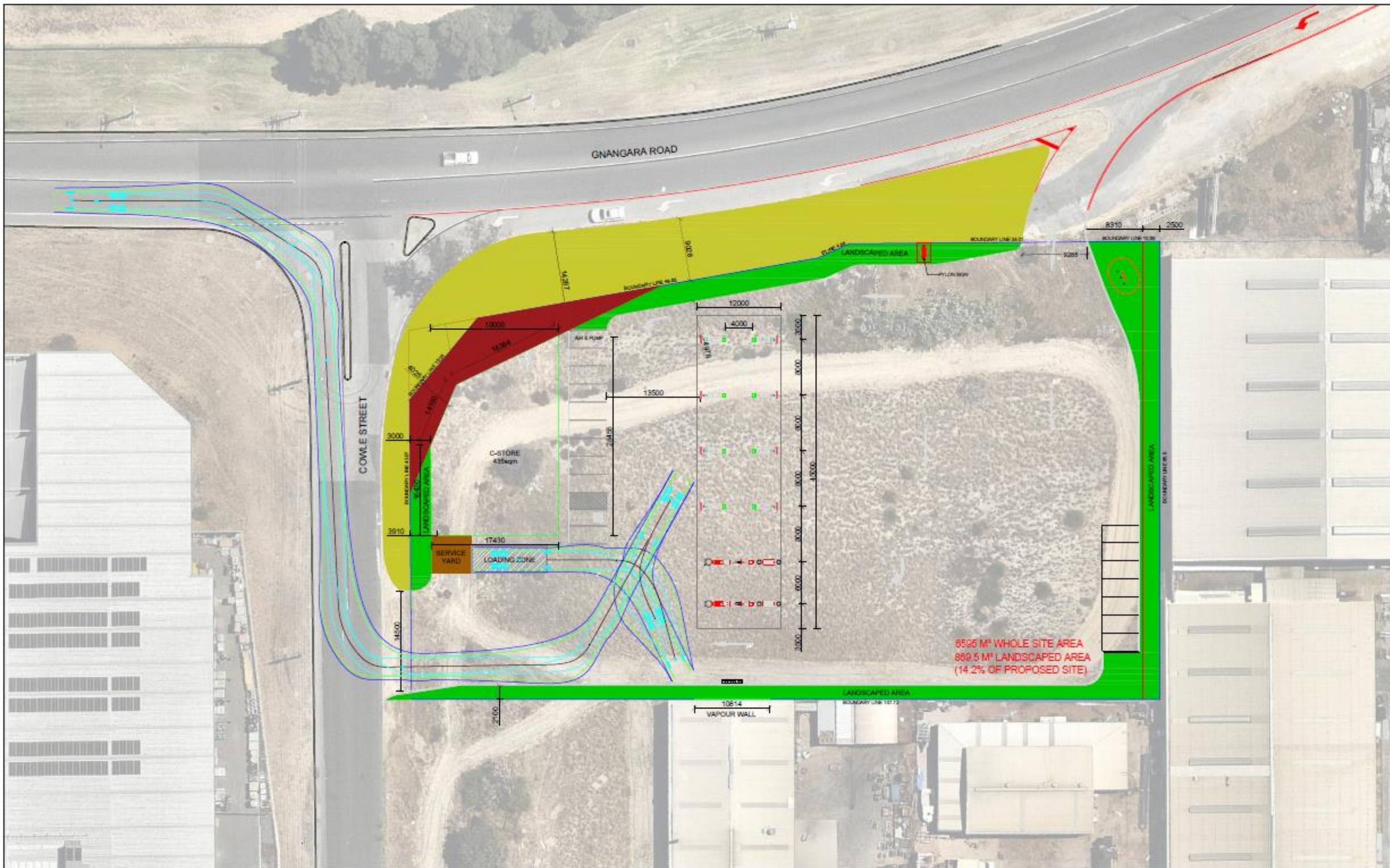
Lot 200 (2) Cowle Street, Landsdale
 Austrroads 2013: 12.5m SU Truck
 Service Truck Entry

LEGEND

Vehicle Body	
Wheel Path	
500mm Clearance	




t19.027.sk03a
 11/03/2019
 Scale: 1:500 @ A3





Lot 200 (2) Cowle Street, Landsdale
 Austroads 2013: 12.5m SU Truck
 Service Truck Exit

LEGEND

Vehicle Body	
Wheel Path	
500mm Clearance	

t19.027.sk04a
 11/03/2019
 Scale: 1:500 @ A3

