TRAFFIC AND PARKING IMPACT ASSESSMENT OF

PROPOSED RESOURCE RECOVERY FACILITY

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Transport Planning, Traffic Impact Assessments, Road Safety Audits, Expert Witness

Development Type: **Resource Recovery Facility**

Site Address: **2F The Crescent, Kingsgrove NSW**

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1 INTRODUCTION

M^CLaren Traffic Engineering (MTE) was commissioned by *Combined Skips* to provide a Traffic and Parking Impact Assessment of the proposed Resource Recovery Facility at 2F The Crescent, Kingsgrove NSW.

1.1 Description and Scale of Development

The proposed development, shown in **Annexure A**, involves the construction of a Resource Recovery Facility for dry, non-putrescible recyclable material, with an intended capacity of 35,000 tonnes per annum. The proposed scale and operation are listed below:

- Sorting Shed 1000m^2 GFA;
- The maximum amount of material to be imported is 35,000 tonnes per annum;
    - The incoming material will be primarily sourced from the construction and demolition, commercial, industrial and residential sectors;
    - The facility will sort and dispatch waste and recyclable materials.
- The site provides 12 on-site car parking spaces including one disabled space;
- The largest vehicle to the site will be a 17m Truck and Dog;
- The facility will operate 6 days a week with the proposed hours of operation between Monday to Saturday, 6:00am to 5:30pm for recovery processing and 24 hours a week for receipt of materials. The facility will operate 6 days a week and operating 24 hours per day for the receipt of material loads;
    - The site will be closed on Sundays and public holidays.
- The site will have 10 employees, including 7 permanent and 3 casual staff; and
- Vehicular access to the site will be via a modified two-way driveway for access by up to 17m length Truck and Dog combinations from The Crescent. A separate vehicle access will be provided from the newly amalgamated land to the west, which seeks to retain the existing driveways.

1.2 Secretary's Environmental Assessment Requirements (SEARs) & RMS Requirements

The proposed development is both designated and integrated development under Part 4 of the *Environmental Planning and Assessment Act 1979* and requires and approval under the *Protection of the Environment Operations Act 1997*. As such an assessment against the Secretary's Environmental Assessment Requirements (SEARs).

The comments made from the relevant authorities in relation to traffic and parking within the *Key Issues* section of the SEARs dated *13th November 2018* are outlined below:

- Details of road transport routes and access to the site (**Section 3.3.1**);
- Details of car parking required on site (**Section 3**);
- Road traffic predictions for the development during construction and operation (**Section 4** & **5**);
- An assessment of impacts to the safety and function of the road network and the details of any road upgrades required for the development (**Section 4**).

All recycling facilities must be referred to the RMS, as such the proposal qualifies as a traffic generating development with relevant size and/or capacity and shall be assessed in accordance with Clause 104 of State Environmental Planning Policy (Infrastructure) 2007. Accordingly, formal referral to the Roads and Maritime Services (RMS) is necessary.

The comments made by the RMS as part of the SEARs are summarised below:

- Daily and peak traffic movements likely to be generated by the proposed development including the impact on nearby intersections and the need / associated funding for upgrading or road improvement works (if required, **Section 4**);
    - Key intersections to be modelled include but should not be limited to:
        - Vanessa Street / The Crescent;
        - Kingsgrove Road / Commercial Road.
- Details of the proposed access and parking provisions associated with the proposed development including compliance with the requirement of the relevant Australian Standards (**Section 3**).
- Proposed number of car parking spaces and compliance with the appropriate parking codes (**Section 3**).
- Details of light and heavy vehicle movements (including vehicle type and likely arrival and departure times, (**Section 4**).

- Details of service vehicle movements (including vehicle type and likely arrival and departure times, (**Section 3**)

This traffic and parking report address all the SEARs requirements. In addition, further comments have been provided by the RMS in an email dated the 26th of March 2019 which are reproduced in **Annexure B** for reference, along with the SEARs requirements. The additional RMS requirements are outlined below:

- Current and representative traffic counts need to be used (**Section 2**);
- The existing base models needs to be calibrated with on-site observations, for instance queue lengths and / or delays. Details of this calibration should be provided (**Section 2**);
- AM and PM peak volumes need to be used (**Section 2**);
- Existing traffic volumes with and without the proposed development need to be considered (**Section 2** & **Section 4**);
- A 10-year future growth scenario needs to be provided; and
- Electronic copies of all SIDRA files need to be provided to RMS for review.

The assessment of the 10-year growth is outside the scope of this report and it is also considered unnecessary for the proposed development to undertake this considering the site generates some 11 and 8 vehicle trips in the AM and PM peak hour periods

1.3 Site Description

The subject site is currently unoccupied and is legally identified as Lot 2 DP 1237586. The site is within the newly formed Georges River Council LGA however, the Hurstville City Council Local Environmental Plan 2012 remains applicable for the site until superseded. The LEP zones site as *IN2 – Light Industrial*.

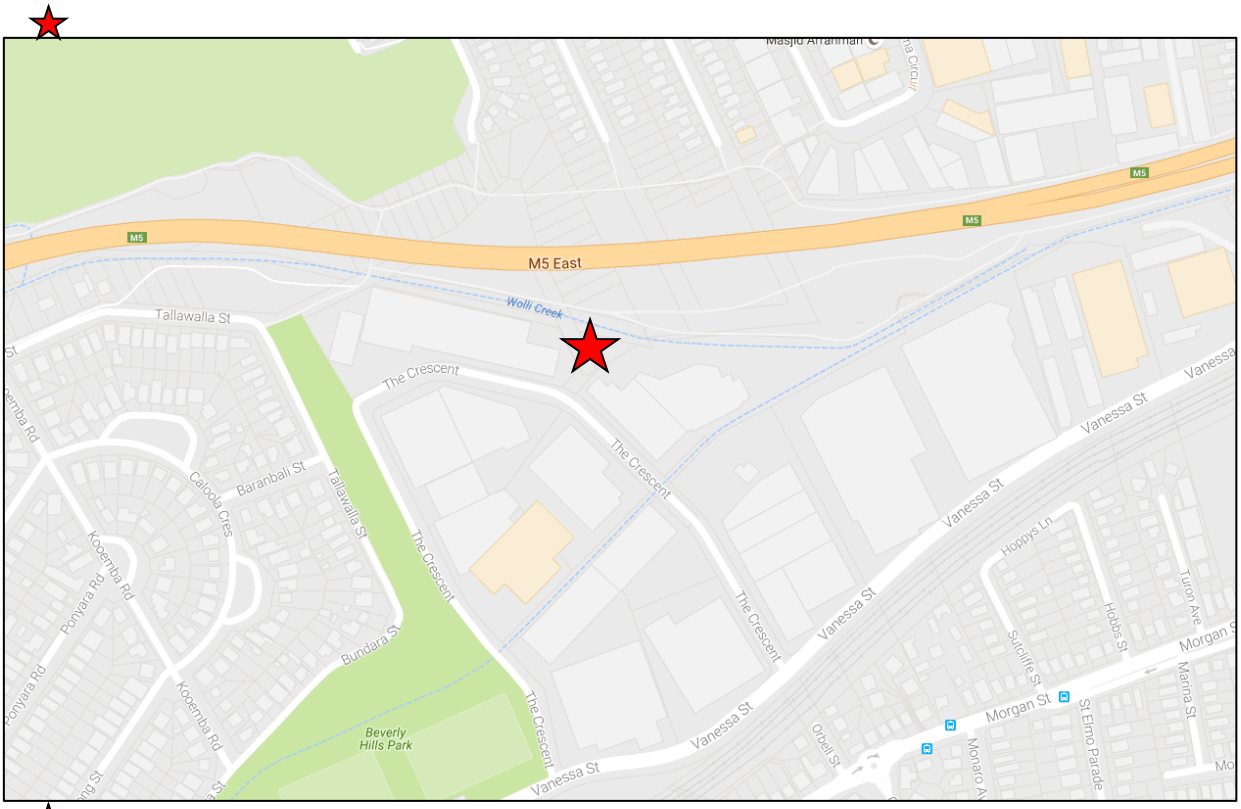
The newly amalgamated lot has a total area of 4,586m^2 with vehicular access to the site made by three separate two-way driveways fronting The Crescent. The site is part of an industrial precinct, with low to medium density residential dwellings to the east and south of the site. Kingsgrove Train Station is located approximately 1km to the east of the site.

1.4 Site Context

The site location is shown on aerial imagery and a map in **Figure 1** & **Figure 2** respectively.

Site Location

FIGURE 1: SITE CONTEXT – AERIAL PHOTO



Site Location

FIGURE 2: SITE CONTEXT – STREET MAP

2 EXISTING TRAFFIC AND PARKING CONDITIONS

2.1 Road Hierarchy

The Crescent has the following characteristics within close proximity to the site:

- Unclassified LOCAL road;
- Approximately 12m in width facilitating two way passing;
- Signposted at 50km/h speed; and
- Unrestricted kerbside parking permitted on both sides of the carriageway.

Vanessa Street/Commercial Road has the following characteristics within close proximity to the site:

- Unclassified LOCAL road;
- Approximately 8m in width facilitating one traffic lane in each direction;
- Signposted 50km/h speed limit; and
- Unrestricted kerbside parking permitted on both sides of the carriageway.

Kingsgrove Road has the following characteristics within close proximity to the site:

- RMS Classified REGIONAL Road (No. 2021);
- Generally, 13m in width facilitating two lanes in each direction.
- Signposted 50km/h speed limit.

Kingsgrove Avenue has the following characteristics within close proximity to the site:

- Unclassified COLLECTOR road;
- Approximately 12m in width facilitating one traffic lane in each direction and kerbside parking on both sides of the road;
- Signposted 50km/h speed limit; and
- Unrestricted kerbside parking permitted on both sides of the carriageway.

2.2 Existing Traffic Management

- Priority controlled intersection of The Crescent and Vanessa Street;
- Signal controlled intersection of Commercial Road / Kingsgrove Road / Kingsgrove Avenue;
- Provision of "*No Right Turn"* signage for "*Vehicles over 6m"* at the priority-controlled intersection of The Crescent and Vanessa Street.
- Provision of *"No B-Doubles Permitted on Vanessa Street & The Crescent"* signage located at the intersection of The Crescent and Vanessa Street (western intersection)

2.3 Existing Traffic and Parking Environment

Traffic counts were completed at the intersections of Vanessa Street / The Crescent and Kingsgrove Road / Commercial Road on Wednesday the 12th of June 2019 between 7:00am – 10:00am and 2:30pm – 6:00pm, representing a typical weekday. The detailed results of the traffic survey results are reproduced in **Annexure C** for reference.

2.3.1 Intersection Summary

Existing intersection performances have been assessed using SIDRA INTERSECTION 8.0. The analysis is summarised in **Table 1** below with detailed results reproduced in **Annexure D** for reference.

It should be noted that as requested by the RMS, the existing intersection performances have been calibrated with on-site observations. To calibrate the SIDRA will real like operations the following on-site observations were made:

- Queue lengths at the signalised intersection of Kingsgrove Road / Commercial Road / Kingsgrove Avenue;
- Signal phase and cycle time at the signalised intersection of Kingsgrove Road / Commercial Road / Kingsgrove Avenue based upon actual peak operations (TCS plan reproduced in **Annexure E**);
- Maximum queue lengths at the priority-controlled intersection of Vanessa Street and The Crescent;
- Average delays associated with critical turning movements (right in / right out) at the priority-controlled intersection of Vanessa Street and The Crescent.

The summary of the above data is reproduced in **Annexure C** for reference. The adopted phasing of the signalised intersection based upon the TCS Plan reproduced in **Annexure E** is A (no right turn filter from Commercial Road), D, E and F. It should be noted that SIDRA cannot 100% accurately replicate real life simulations and is just a statistical simulation tool.

TABLE 1: EXISTING INTERSECTION PERFORMANCES (SIDRA INTERSECTION 8.0)

Intersection	Peak Hour	Degree of Saturation[1]	Average Delay[2] (sec/veh)	Level of Service[3]	Control Type	Worst Movement
EXISTING PERFORMANCE						
Vanessa St / The Crescent	AM	0.37	1.8 (Worst: 16.7)	**NA** (Worst: B)	Give Way	RT from The Crescent
	PM	0.35	0.8 (Worst: 12.5)	**NA** (Worst: A)		RT from The Crescent
Kingsgrove Road / Commercial Road / Kingsgrove Avenue	AM	0.84	33.5	**C**	Signals	N/A
	PM	0.78	31.4	**C**		N/A

NOTES:

(1) Degree of Saturation is the ratio of demand to capacity for the most disadvantaged movement.

(2) Average delay is the delay experienced on average by all vehicles. The value in brackets represents the delay to the most disadvantaged movement.

(3) Level of Service is a qualitative measure of performance describing operational conditions. There are six levels of service, designated from A to F, with A representing the best operational condition and level of service F the worst. The LoS of the intersection is shown in bold, and the LoS of the most disadvantaged movement is shown in brackets.

As shown above, the existing priority-controlled intersection of Vanessa Street / The Crescent is operating with worst turning movement of Level of Service (LoS) “B” and “A” during the AM and PM peak hour period respectively. LoS “B” indicates a good operation with acceptable delays and additional spare capacity. To ensure the SIDRA model is validated with the actual on-site observations, **Table 2** below compares the SIDRA average delays to the on-site observation average delays.

TABLE 2: COMPARISON OF TURNING MOVEMENT DELAYS

Turn Movement	SIDRA Output Average Delay		On-site Observed Average Delay	
	AM	PM	AM	PM
Right turn into The Crescent	9.6	7.8	11	5
Right Turn out of the Crescent	16.7	12.5	14	13
Left Turn out of the Crescent	9.4	6	13	7

As shown above, the SIDRA output results for the priority-controlled intersection of Vanessa Street / The Crescent is operating relatively in line with the on-site observations. The largest SIDRA delay is the right turn out the Crescent, operating at 16.7 seconds, while the on-site observation showed this movement operated at 14 seconds on average. Hence, it can be concluded that the intersection of Vanessa Street / The Crescent can be relied upon to forecast future traffic impacts as a result of the proposed development.

The signalised intersection of Commercial Road / Kingsgrove Road / Kingsgrove Avenue is operating at LoS "C" during both the AM and PM peak periods. This represents a "Satisfactory Level of Service". These SIDRA results have been calibrated with the actual cycle time and phase time, as such the signalised intersection has been validated and can be relied upon for future traffic forecasts.

It is reiterated that SIDRA is incapable of modelling exact observed vehicle delays and queues due to the inability of the program to consider human driver behaviour patterns. SIDRA attempts to model the random probability distribution patterns of human driver behaviour by analysing it statistically and as a result SIDRA cannot predict precisely the actual average delays or queues but can come close. The SIDRA outputs results are generally similar to the on-site observations and can be relied upon for future forecasts assessments.

2.3.2 Relevant On-site Observations

Whilst the above SIDRA models have been calibrated with on-site observations and the actual performance of the un-signalised and signalised intersection, SIDRA cannot account for human error / human behaviour. As such, the following site observations are relevant for the signalised intersection of Commercial Road / Kingsgrove Road / Kingsgrove Avenue.

- Commercial Road:
    - The right turn lane on Commercial Road does not extend back to block the through and left movement lane;
    - The through and left movement lane extended back past the curve in Commercial Road;
    - Heavy Vehicles (19m Articulated Vehicles) turning into Kingsgrove Road to the north either mount the inside kerb, travel on the other side of the road (right turn lane on Kingsgrove Road) or require reverse manoeuvres to make the turn. Further, it was observed that in some cases a 19m AV turning left into Kingsgrove Road (north) travelled partially on the southern side of Commercial Road (over the BB lines) to make the turn.
- Kingsgrove Avenue:
    - This leg was not observed to queue frequently, with the largest queue being around 50-70m (slight curve in the road);

- The right turn lane did not overflow into the through lane.

- Kingsgrove Road (north)
  - The right turn lane overflowed into the through movement lane on occasions. Vehicles generally arrived in quick bunches. This queue on some occasions queued back to the signalised intersection of Kingsgrove Road / the M5 East on Ramp. Although this was infrequent.
  - The through movement queue, even with the overflow of the right turn lane did not queue back to the signalised intersection of Kingsgrove Road / the M5 East on Ramp;
  - The right turn into the M5 overflowed into the through movement lane.

- Kingsgrove Road (South)
  - The queue extended back past the signalised intersection of Kingsgrove Road / Shaw Street / Mashman Avenue;
  - Generally, the signalised intersection of Kingsgrove Road / Shaw Street / Mashman Avenue would go green allowing vehicles to travel north and then the Kingsgrove Road south leg at the signalised intersection would get green time;
  - The right turn lane into Kingsgrove Avenue did not queue back to disrupt the through traffic flow movement.

2.4 Public Transport

The nearest bus stop is approximately 1km walking distance east on Kingsgrove Road providing access to bus routes 490 and 492. Kingsgrove Train Station, approximately 1km east of the site, providing train services on the T2 Airport Line. The station has associated bus stop services providing access to Hurstville, Drummoyne, Rockdale, and Bexley North. **Figure 3** below shows the site location with respect to nearby public transport infrastructure.

★ **Site Location**

FIGURE 3: PUBLIC TRANSPORT

3 PARKING ASSESSMENT

3.1 Council Parking Provision

The Hurstville City Council LEP 2012 identifies that processing and recycling are an industrial activity, therefore the car parking requirement identified in Hurstville City Councils DCP 2012, DCP1 Section 3, for Light Industry is considered appropriate. Councils DCP states the following:

Office Area – 1 space per 40m^2 GFA

Manufacturing (factory) – 1 space per 100m^2 GFA

Warehouse (storage) – 1 space per 300m^2 GFA

Hurstville City Council until superseded by Georges River Council, does not provide a specific rate for Recycling Centres. The most similar listed development type, Industry (Not Warehouse), has a requirement of 1 space per 100m^2 GFA and has been adopted.

The parking requirement for the site based on the industrial rate outlined in Hurstville City Council's DCP 2012 it outlined in **Table 3** below.

TABLE 3: PARKING REQUIREMENT

Land Use	Rate	Scale	Spaces Required	Spaces Provided
Industry	1/100m^2	1000m^2	10	12
Total	**-**	**-**	**10**	**12**

As shown above the site requires the provision of **10** car parking spaces. The site provides **12** car parking spaces resulting in a surplus of two (2) car parking spaces from Council's DCP. It should be noted that these car parking rates do not strictly apply for the Recycling Centre and that the actual parking demand can be reasonably estimated based upon the operation of the site (i.e. the likely staff parking demand).

The proposed operation of the Recycling Facility will require a maximum of 10 staff. Based on the requirement of 10 staff and due to the location of the site subject to public transport, the site is likely to demand 10 car parking spaces. Journey to Work data provides a car driver mode of 79%. Based on the maximum of 10 staff on site, the resulting parking demand based upon the Journey to Work Data is **8** car parking spaces. The provision of twelve (12) car parking spaces therefore exceeds the likely car parking demand of the site by two (2) spaces and exceeds the Journey to Work demand by four (4) spaces.

3.2 Bicycle & Motorcycle parking Requirements

Council's DCP does not provide bicycle or motorcycle parking rates for industrial land uses and, as such, no on-site parking has been provided.

3.3 Servicing & Loading

The Hurstville City Council DCP 2012, provides the following requirements with regards to loading and servicing

> *Provision shall be made for all loading and unloading to take place wholly within the designated loading area.*
>
> *No loading or unloading shall be carried out across parking spaces, landscaped areas, pedestrian aisles or on roadways.*
>
> *Each industrial building/unit having a gross floor area more than 1500 square metres shall provide a loading area to allow for a heavy rigid vehicle to manoeuvre on site.*

The proposed development requires access for vehicles of up to and including a 17m length Truck and Dog (no 19m Articulated Vehicles to be used). The proposed design includes loading and access facilities sufficient to meet each of Council's above requirements, with swept paths provided in **Annexure F** for reference.

The site has the following delivery constraints:

- Two (2) loading bays for 9m length rigid vehicles; or
- A single loading bay for a vehicle up to 17m in length (Truck and Dog Combination)

The peak number of vehicles to the site within a one-hour period is 4 trucks, this is approximately one truck every 15 minutes. The estimated service rate of trucks to load / unload is 10-15 minutes. The Resource Recovery Facility will stagger trucks such that two trucks (9m trucks) will enter 5-minutes apart, utilise the loading bays, and leave before additional trucks arrive to the site. This process will take approximately 20 minutes based on a loading / unloading time of 15 minutes to service two trucks, hence it is envisaged that no queueing will occur on site under this staggered operation. Under this operation there would also be no requirement to have two-way passing at the site driveway as the operation results in tidal flow (i.e. 2 inbound vehicles and then 20 minutes later 2 outbound vehicles and so on).

It should be noted that the above operation would only be sufficient for 9m length trucks, as a 17m length Truck and Dog requires a greater manoeuvring area to enter, load and exit the site. As shown in **Table 5**, the number of 17m length trucks required on a daily basis is considerably less compared to 9m trucks and the site will require to manage their deliveries so to ensure the full loading area is vacant for the use of a 17m length vehicle.

If a delivery vehicle turns up when there are already two (2) delivery vehicles on-site or a single 17m length delivery vehicle, they can be directed to utilise the adjacent hardstand

area on the amalgamated site which will be used as a waiting area. This will ensure that no queuing of heavy vehicles occurs on The Crescent. Whilst this hardstand area is provided, it is considered unnecessary to be relied upon by the site considering the site can effectively managed their arrival and departure of trucks to and from the site.

Swept path testing of vehicles turning around within the hardstand area has been undertaken and reproduced in **Annexure F**. It is noted that a Driver Code of Conduct is to be enforced as a Condition of Consent to ensure this operation.

Further, it is noted that two-way passing of a 17m Truck and Dog Vehicle passing a 9m length Rigid Vehicle is unsuccessful at the site driveway, but is not required to be designed as such considering the site does not have the loading space for both a 17m length Truck and Dog and a 9m length rigid vehicle to be completed at the same time. Further *Section 3.2.3.2 of AS2890.2:2018* allows the entire width of a two-way access driveway to be used for entering and exiting vehicle when the road is a minor road.

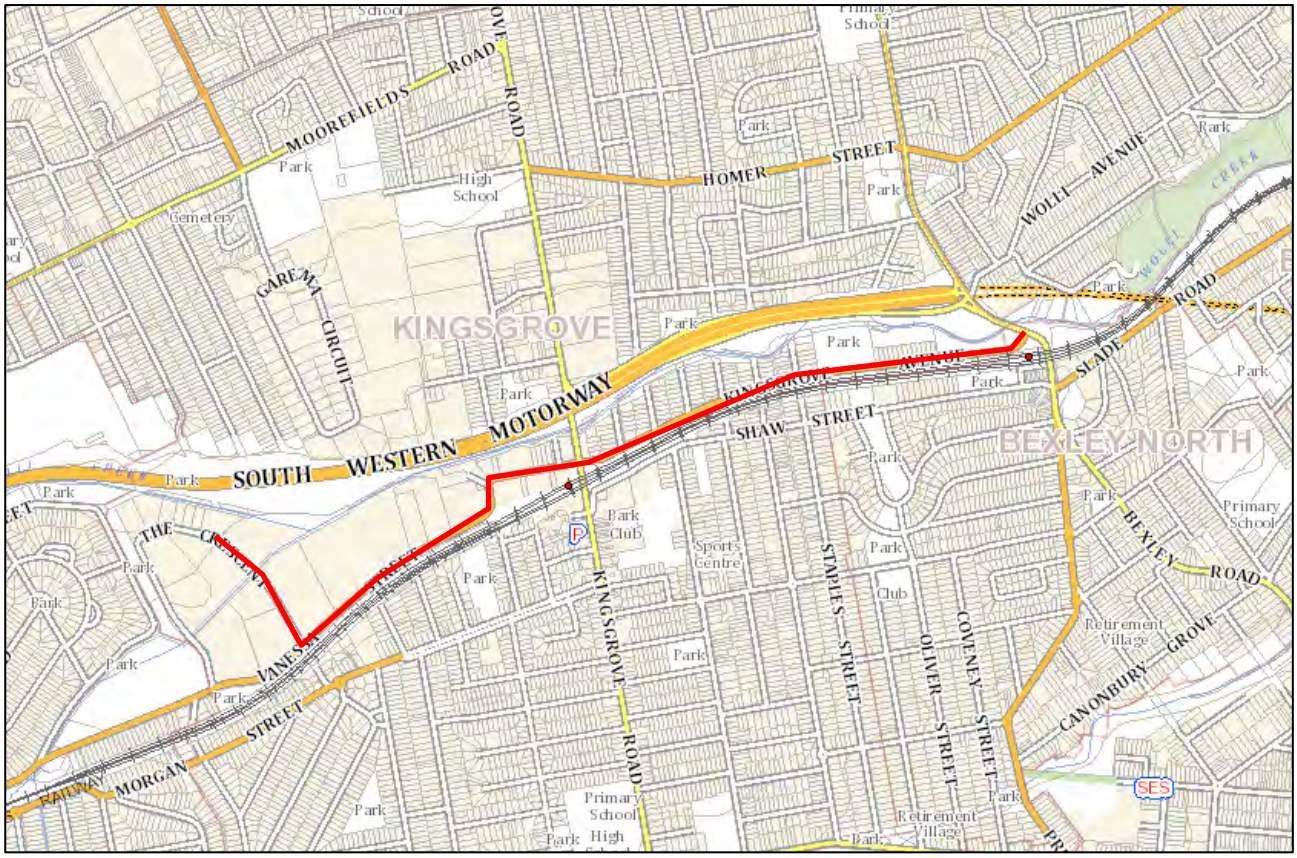
It is expected that waste collection will be undertaken by a private waste contractor. Waste collection is expected to occur on-site outside of the peak operating periods of the site.

3.3.1 Proposed Truck Routes & Vehicle Size

The operation of the site is to operate with vehicles up to a 9m length Rigid Vehicle for the import of materials, while the export of materials will be undertaken by vehicles up to 17m length Truck and Dog combinations.

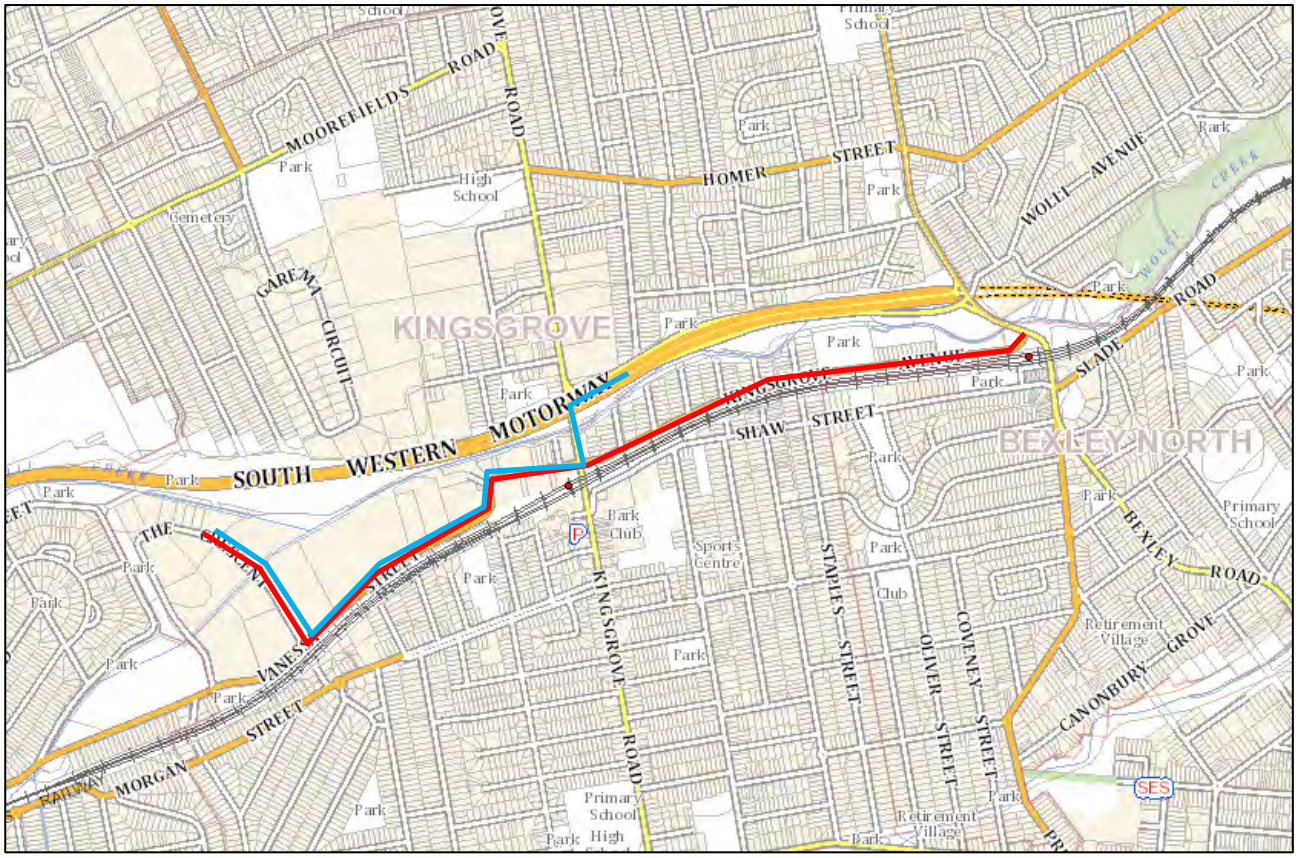
The import of materials will occur 24 hours for 6 days, as such two (2) haulage routes have been provided for the delivery of materials by 9m length Rigid Vehicles.

The export of deliveries undertaken by 17m length Truck and Dog Combinations will occur between 6:00am to 5:30pm and considering the constraints of the public road network and the requirement to have no delivery vehicle use Vanessa Street to the west of The Crescent, there is only one available route option. **Figure 3** and **Figure 4** below details the required route options for the site.



17m length Truck and Dog Haulage Route to / from the site

FIGURE 3: 17M LENGTH TRUCK AND DOG COMBINATION HAULAGE ROUTE



Route 1 - 9m length Rigid Vehicle Haulage Route to / from the site

Route 2 - 9m length Rigid Vehicle Haulage Route to / from the site

FIGURE 4: 9M LENGTH RIGID VEHICLE HAULAGE ROUTES

Vehicles up to 17m length Truck and Dog Combination will access the site via Bexley Road and turn left into Kingsgrove Avenue, continue onto Commercial Road, continue onto Vanessa Street and turn right into the Crescent. This route will also be the exit route for vehicles up to 17m length Truck and Dog Combinations and is also one of the 9m length Rigid Vehicle routes.

An alternative haulage route for vehicles up to 9m length Rigid Vehicles will be to exit onto the Kingsgrove Road from the M5 East, turn right into Commercial Road, continue onto Vanessa Street and turn right into the Crescent. This route will also be the exit route for vehicles up to 9m length Heavy Rigid Vehicle.

It is relevant to note that Bexley Road is an RMS approved B-double route and will be the primary access and departure route. Whilst the facility is proposed to operate between 6:00am to 5:30pm, peak truck traffic movements will generally occur between 9:00am to 3:00PM.

Swept paths have been undertaken at critical intersections and on site and are reproduced in **Annexure F** for reference.

3.4 Disabled Parking

Council's DCP requires the provision of one disabled space for every 20 spaces or part thereof for industrial premises. As such the site requires one (1) disabled parking space in accordance with the design requirements of AS2890.6:2009. The site provides one (1) disabled car parking space complying with this requirement.

3.5 Car Park Design & Compliance

The proposed car park has been designed to comply with the relevant objectives and requirements of AS2890.1, AS2890.2 & AS2890.6. The site achieves the following:

- Parking spaces with minimum dimensions of 2.4m in width by 5.4m in length applicable for staff parking;
- Disabled car parking spaces with minimum dimension of 2.4m in width by 5.4m in length, with an adjacent shared space of the same dimension.
- Access and egress for vehicles up to 17m length truck and dogs;
- Two loading areas appropriate for a single truck and dog or two (2) Heavy Rigid Vehicle (9m length).

While we have assessed the plans to be compliant with the relevant clauses of the Australian Standards, it is usual that a design certificate is required as part of a consent condition due to any changes throughout the DA process.

Any required changes for compliance are also shown in **Annexure F** for reference.

Further, the existing concrete yard can be used by staff parking informally and it is considered unnecessary to linemark dedicated parking spaces or circulating roadways within the site as the entire concrete yard can be used for parking and circulation of vehicles. The plan in **Annexure A** demonstrates that there is sufficient space on-site to provide the staff car parking.

4 TRAFFIC ASSESSMENT

4.1 Traffic Generation

The Roads and Maritime Services (RMS) *Guide to Traffic Generating Developments* does not provide specific traffic generation for recycling facilities. The estimated traffic generation can be considered as reasonable based on the operation of the development which proposes the importation of an intended maximum 35,000 tonnes per annum operating 6 days, 52 weeks a year.

4.1.1 Daily Traffic Generation

The average weekly and daily tonnage is presented in **Table 4** below.

TABLE 4: AVERAGE TONNAGE

Annual Toonage	Weekly Tonnage	Daily Tonnage
35,000	673	112.2

Note: 6 working days, 52 weeks a year

Imported material are delivered to the site by 9m length Rigid Vehicles with an average load of 6 tonnes per trip. Exported materials are removed from the site by 17m length Truck and Dog with a capacity of 35 tonnes per trip.

It is expected that delivery traffic and staff traffic will generally not coincide within the same one-hour peak hour period, as typical staff will arrive to the site prior to delivery vehicles and leave the site after the last delivery vehicle. In any case, to be conservative it is assumed that 50% of staff arrivals will occur during the same peak hour period of delivery vehicles.

The estimated heavy vehicle traffic generation based upon the daily operation is estimated in **Table 5** below:

TABLE 5: ESTIMATED DAILY TRAFFIC GENERATION

Type of Movement	Daily Vehicle Tonnage	Vehicle Type	Loading Capacity	Daily Delivery Vehicles Required	Daily Traffic Movements (2,3)
Inbound / outbound delivery trucks per day (1)	112.2	9m Rigid Vehicle	6 tonnes	19	38 (19 in, 19 out)
Inbound / Outbound removal trucks per day (2)		17m Truck and Dog	35 tonnes	3.2 (4)	8 (4 in, 4 out)
Subtotal	**-**	**-**	**-**	**23**	**46 (23 in, 23 out)**

1) Removal are to be conducted in 35 tonne loads by truck and dog vehicles
2) Assume 6 day per week operation and 52-week operation per year
3) Delivery Truck Payload, example: 95 / 6 tonne using Heavy Rigid Vehicles = 16 Loaded Trips or 32 movements in total (inbound and outbound).

Based upon the proposed maximum 35,000 tonnes to be imported annually and the unchanged rate of extracted materials leaving the site (35,000 tonnes), the site will generate 46 (23 in, 23 out) daily truck movements. This level of traffic is over the daily hours of operation, being 6:00AM to 5:30PM. *McLaren Traffic Engineering* has been advised that the peak number of truck movements will be between the hours of 9:00AM – 3:00PM. A comparison study has been undertaken below to estimate the peak hourly traffic flows associated with the site.

4.1.2 Comparison Study

Traffic data over a 2-month period in 2003 for a recycling facility in Moorebank operated by Concrete Recyclers has been used to estimate the hourly distribution of truck movements for the proposed facility. The estimated number of truck movements per hour on a typical day when the Moorebank facility is generating 324 trucks movements is shown in **Table 6** below.

TABLE 6: COMPARISON TRUCK DISTRIBUTION

Time	Number of trucks movements	Percent of total
7:00AM – 7:30AM	10	3
7:30AM – 9:00AM	57	17.5
9:00AM – 12:00PM	115	35.5
12:00PM – 3:00PM	100	31
3:00PM – 5:00PM	42	13
Total	**324**	**100**

Following the same distribution for the proposed recycling centre the number of trucks within the AM and PM peak commute times can be estimated as perceived in **Table 7** below.

TABLE 7: ESTIMATED HOURLY AND DAILY TRUCK MOVEMENTS

Time	Percent of total	Number of truck movements	Movements per Hour
7:00AM – 7:30AM	3	1.4 (2)	2 (1 in, 1 out)
7:30AM – 9:00AM	17.5	8.05 (8)	6 (3 in, 3 out)
9:00AM – 12:00PM	35.5	16.35 (17)	6 (3 in, 3 out)
12:00AM – 3:00PM	31	14.25 (13)	5 (3 in, 2 out)
3:00PM – 5:00PM	13	6	3 (1 in, 2 out)
Total	**100**	**46**	**-**

As shown above, the site is expected to generate 6 and 3 heavy vehicle movements during the AM (3 in, 3 out) and PM (1 in, 2 out) peak hour period.

As stated previously, the staff traffic for the site will not generally coincide with heavy vehicle traffic. To be conservative it is assumed that half the staff traffic will arrive / depart during the same AM and PM peak hour period as heavy the heavy vehicle. A summary of the peak hour AM and PM vehicle trips (heavy vehicle and staff) generated from the proposed development is summarised in **Table 8** below.

TABLE 8: SUMMARY OF PEAK HOUR TRAFFIC GENERATION

Period	Staff Peak Hour Movements	Heavy Vehicles Peak Hour Movements	Sum of Peak Hour Movements
AM	5 in	6 (3 in, 3 out)	11 (8 in, 3 out)
PM	5 out	3 (1 in, 2 out)	8 (1 in, 7 out)

As shown above, the site is expected to generate 11 and 8 vehicle trips during the AM (8 in, 3 out) and PM (1 in, 7 out) peak hour period. This is well within daily peak hour traffic fluctuations at intersections and the proposed development will not have any adverse impacts upon the surrounding road network in terms of traffic flow efficiency or road safety considerations. Regardless of this, future traffic modelling has been undertaken which is detailed in the following subsections.

4.2 Traffic Assignment

The traffic assignment for the proposed development and associated vehicle trips has been based on assessment of the surrounding traffic network, the routes to and from the site and the existing vehicle movements at intersections and is shown below:

Resource Recovery Facility

Truck Route

- Inbound / Outbound:
    - 100% to / from Kingsgrove Avenue

Staff Route

- Inbound / Outbound
    - 20% from Kingsgrove Road south;
    - 17% from Kingsgrove Road north;
    - 13% from Kingsgrove Avenue;
    - 50% King Georges Road / Vanessa Street.

4.3 Traffic Impact

The estimated traffic generation of the site has been added to the existing volumes and analysed to determine the future performances of the surrounding intersection onto the road network. Analysis was carried out using the SIDRA 8.0 with the results summarised in **Table 9** and detailed movement summaries reproduced in **Annexure D** for reference.

TABLE 9: FUTURE INTERSECTION PERFORMANCES

Intersection	Peak Hour	Degree of Saturation [1]	Average Delay[2] (sec/vehicle)	Level of Service[3]	Control Type	Worst Movement
EXISTING PERFORMANCE						
Vanessa St / The Crescent	AM	0.37	1.8 (Worst: 16.7)	**NA** (Worst: B)	Give Way	RT from The Crescent
	PM	0.35	0.7 (Worst: 12.5)	**NA** (Worst: A)		RT from The Crescent
Kingsgrove Road / Commercial Road / Kingsgrove Avenue	AM	0.84	33.5	**C**	Signals	N/A
	PM	0.78	31.4	**C**		N/A
FUTURE PERFORMANCE						
Vanessa St / The Crescent	AM	0.37	2 (Worst: 17)	**NA** (Worst: B)	Give Way	RT from The Crescent
	PM	0.36	0.8 (Worst: 12.6)	**NA** (Worst: A)		RT from The Crescent
Kingsgrove Road / Commercial Road / Kingsgrove Avenue	AM	0.84	34.6	**C**	Signals	N/A
	PM	0.78	31.5	**C**		N/A

As shown above, the nearby intersections remain unaltered under the future scenario with the additional traffic generated by the proposed Recycling Centre. The existing LoS has been retained with minor increases to vehicle saturation and delays. The development is therefore fully supportable with respect to traffic flow considerations.

5 Construction Traffic

Typically, detailed construction traffic management plans are provided during the construction certificate stage prior to construction and as part of a Council consent condition. Once a builder has been engaged, confirmation of the number of staff and construction vehicles can be provided and assessed (if required). Construction vehicular traffic is temporary in nature and is not expected to exceed the operating capacities of nearby intersections or be substantially greater than the assessed operation of the proposed development as detailed within this report.

Generally during construction, staff traffic will arrive to the site around 7:00am and depart the site around 3:00pm, with construction deliveries provided throughout the day. Considering the location and size of the site, all staff and construction vehicles will be fully contained on-site. It is not expected that heavy construction traffic will exceed forty-six (46) vehicle movements per day.

Clarification on construction vehicle movements and staff numbers can be confirmed during the submission of a detailed construction traffic management plan during construction certificate stage as part of a consent condition as mentioned previously.

6 CONCLUSION

In view of the foregoing, the subject proposal (as depicted in **Annexure A** for reference) is fully supportable in terms of its traffic and parking impacts. The following outcomes of this traffic impact assessment are relevant to note:

- Based upon Council's DCP the site requires the provision of ten (10) car parking spaces. The proposed development provides 12 car parking spaces (including a disabled space), exceeding this requirement by two spaces.

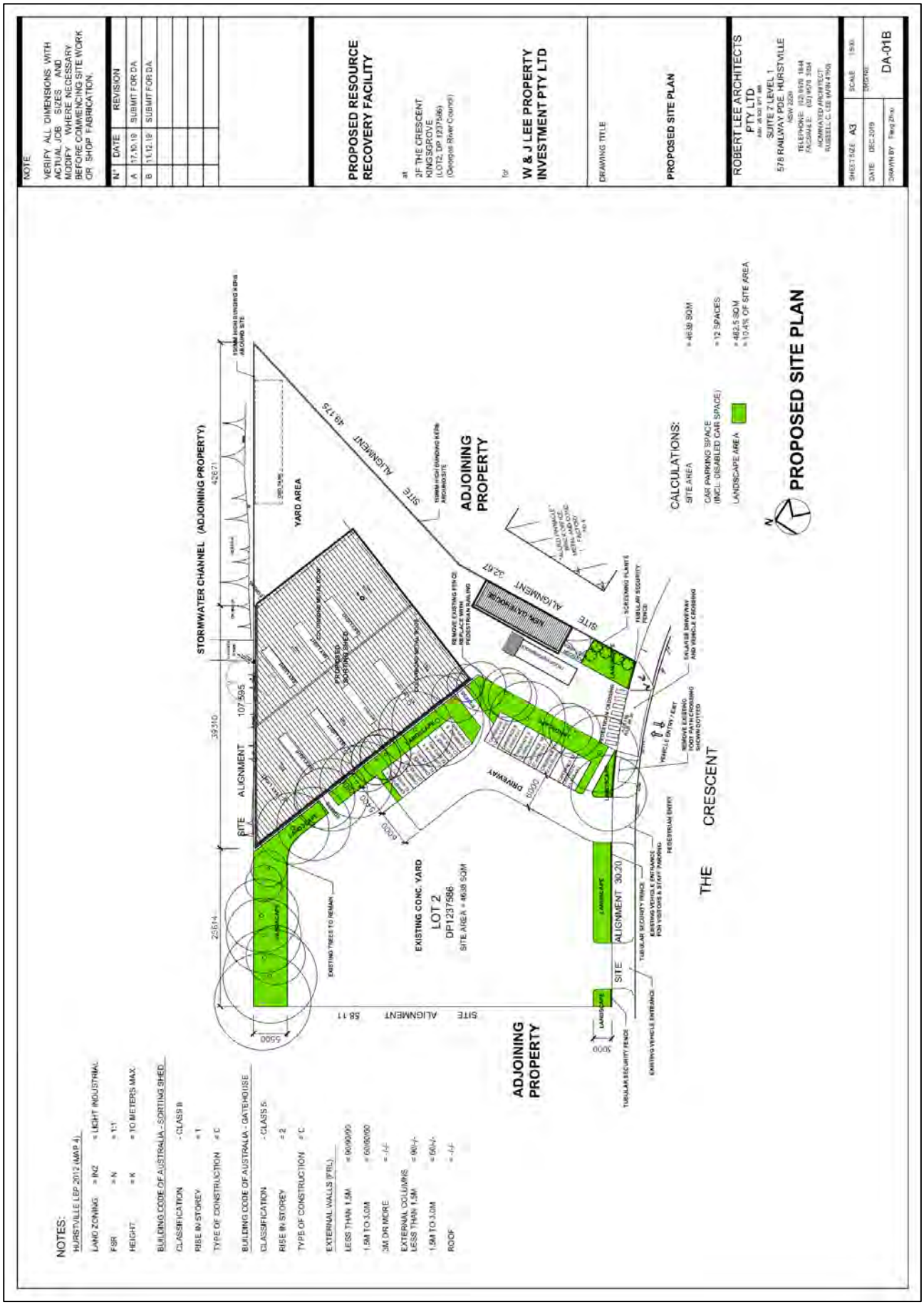
- The largest vehicle expected to travel to the site will be a 17m length Truck and Dog combination. All delivers and loading requirements will be undertaken on-site. The site will be required to operate the site under a driver code of conduct and manage their arrival and departure delivery vehicles so to ensure there is adequate room on-site for loading / unloading.

- The Resource Recovery Facility will operate with a maximum importation of 35,000 tonnes per annum, operating 52 weeks a year, 6 days a week. This equates to an average requirement of 23 trucks per day, or 46 two-way heavy vehicle movements. With the inclusion of staff traffic, the site is expected to generate 11 and 8 vehicle trips during the AM (8 in, 3 out) and PM (1 in, 7 out) peak hour period. This is well within daily peak hour traffic fluctuations at intersections and the proposed development will not have any adverse impacts upon the surrounding road network in terms of traffic flow efficiency or road safety considerations. The existing LoS has been retained with minor increases to vehicle saturation and average delays.

- The on-site car park has been designed in accordance with AS2890.1:2004, AS2890.6:2009 and AS2890.2:2018 design requirements. The existing concrete yard can be used by staff parking informally and it is considered unnecessary to linemark dedicated parking spaces or circulating roadways within the site as the entire concrete yard can be used for parking and circulation of vehicles (inclusive of turning area for a waiting delivery vehicle).

- Construction vehicular traffic is temporary in nature and is not expected to exceed the operating capacities of nearby intersections or be substantially greater than the assessed operation of the proposed development as detailed within this report. It is not expected that heavy construction traffic will exceed forty-six (46) vehicle movements per day.

ANNEXURE A: PROPOSED PLAN



ANNEXURE B: SEAR REQUIREMENTS AND RMS REQUIREMENTS

(Sheet 1 of 4)

	dangerous goods and hazardous materials associated with the development. Should preliminary screening indicate that the project is "potentially hazardous" a Preliminary Hazard Analysis (PHA) must be prepared in accordance with Hazardous Industry Planning Advisory Paper No. 6 - Guidelines for Hazard Analysis (DoP, 2011) and Multi-Level Risk Assessment (DoP, 2011). • **fire and incident management** – including: – technical information on the environmental protection equipment to be installed on the premises such as air, water and noise controls, spill clean-up equipment, fire management (including the location of fire hydrants and water flow rates at the hydrants) and containment measures – details of the size and volume of stockpiles and their arrangements to minimise fire spread and facilitate emergency vehicle access. • **air quality** – including: – a description of all potential sources of air and odour emissions – an air quality impact assessment in accordance with relevant Environment Protection Authority guidelines – a description and appraisal of air quality impact mitigation and monitoring measures. • **noise and vibration** – including: – a description of all potential noise and vibration sources during construction and operation, including road traffic noise – a noise and vibration assessment in accordance with the relevant Environment Protection Authority guidelines – a description and appraisal of noise and vibration mitigation and monitoring measures. • **soil and water** – including: – an assessment of potential impacts to soil and water resources, topography, hydrology, drainage lines, watercourses and riparian lands on or nearby the site – a detailed site water balance, including identification of water requirements for the life of the project, measures that would be implemented to ensure an adequate and secure water supply is available for the proposal and a detailed description of the measures to minimise water use at the site – details of any groundwater extraction and any works with potential to intercept the groundwater table – characterisation of water quality at the point of discharge to surface and/or groundwater against the relevant water quality criterial, including details of the contaminants of concern that may leach from the waste into the wastewater and proposed mitigation measures to manage any impacts to receiving waters – details of stormwater/wastewater/leachate/firewater management systems, including details of the flood liability of the site and changes to flooding behaviour – details of sediment and erosion controls – consideration of salinity and acid sulfate soil impacts – characterisation of the nature and extent of any contamination on the site and surrounding area – a description and appraisal of impact mitigation and monitoring measures. • **traffic and transport** – including: – details of road transport routes and access to the site – details of car parking required on site – road traffic predictions for the development during construction and operation – an assessment of impacts to the safety and function of the road network and the details of any road upgrades required for the development. • **biodiversity** – including a description of any potential vegetation clearing needed to undertake the proposal and any impacts to flora and fauna.

2

Transport Roads & Maritime Services

31 October 2018

Our Reference: SYD18/01696
DPE Ref: SEAR 1270

Team Leader
Industry Assessments
Department of Planning and Environment
GPO Box 39
SYDNEY NSW 2001

Attention: Bianca Thornton

Dear Sir/Madam,

REQUEST FOR SEARS FOR RESOURCE RECOVERY FACILITY
2D THE CRESCENT, KINGSGROVE

Reference is made to the Department of Planning and Environment (DPE) email dated 23 October 2018 requesting Roads and Maritime Services (Roads and Maritime) to provide details of key issues and assessment requirements regarding the abovementioned development for inclusion in the Secretary's Environmental Assessment Requirements (SEARs).

Roads and Maritime require the following information to be included in the transport and traffic impact assessment component of the Environmental Impact Statement:

1. Daily and peak traffic movements likely to be generated by the proposed development including the impact on nearby intersections and the need/associated funding for upgrading or road improvement works (if required).

   Key intersections to be modelled include but should not be limited to:

   - Vanessa Street/The Crescent
   - Kingsgrove Road/Commercial Road

2. Details of the proposed accesses and the parking provisions associated with the proposed development including compliance with the requirements of the relevant Australian Standards (ie: turn paths, sight distance requirements, aisle width, etc).

3. Proposed number of car parking spaces and compliance with the appropriate parking codes.

Roads and Maritime Services

27-31 Argyle Street, Parramatta NSW 2150 |
PO Box 973 Parramatta NSW 2150 |

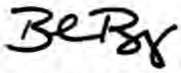
www.rms.nsw.gov.au | 131 782

4. Details of light and heavy vehicle movements (including vehicle type and likely arrival and departure times).

5. Details of service vehicle movements (including vehicle type and likely arrival and departure times).

Any inquiries in relation to this application can be directed to Zhaleh Alamouti on 8849 2331 or by email at development.sydney@rms.nsw.gov.au.

Yours sincerely



Brendan Pegg
A/Senior Manager Land Use Assessment
South East Precinct, Sydney Division

ANNEXURE B: SEAR REQUIREMENTS AND RMS REQUIREMENTS

(Sheet 4 of 4)

From: LISSENDEN Andrew <andrew.lissenden@rms.nsw.gov.au>
Sent: Tuesday, 26 March 2019 9:54 AM
To: Allan Young <ayoung@emmconsulting.com.au>
Cc: Susan May-Raynes <smayraynes@emmconsulting.com.au>
Subject: Proposed waste facility at The Crescent, Kingsgrove - RMS Response to Additional Email

Hi Allan,

With reference to your email below, Roads and Maritime Services (Roads and Maritime) wishes to advise that the comments it provided in its letter dated 31 October 2018 are still applicable to the proposed development (copy attached) on the basis that it has not changed from what was previously advised as part of the Secretaries Environmental Assessment (SEAR) requirements. RMS does however provide the following additional guidance:

- In relation to Point 1 of the Roads and Maritime letter that relates to key intersections to be modelled.

- Current and representative traffic counts need to be used;

- The existing base models needs to be calibrated with on-site observations, for instance queue lengths and/or delays. Details of this calibration should be provided;

- AM and PM peaks volumes need to be used;

- Existing traffic volumes with and without the proposed development need to be considered;

- A 10 year future growth scenario needs to be provided; and

- Electronic copies of all SIDRA files needs to be provided to RMS for review.

- In relation to Points 2, 3, 4 and 5 of the Roads and Maritime letter, the supporting Traffic Impact Study (TIS) prepared should have regard for the details contained in Table 2.1 of the *RTA Guide to Traffic Generating Developments* which outlines the key issues that should be considered in preparing a TIS.

Should you have any further inquiries in relation to this matter, please do not hesitate to contact the undersigned, by email at development.sydney@rms.nsw.gov.au .

Yours sincerely,

Andrew Lissenden

Acting Senior Land Use Planner

South East Precinct, Sydney Division

ANNEXURE C: TRAFFIC SURVEYS
(SHEET 1 OF 7)

TRANS TRAFFIC SURVEY trafficsurvey.com.au

TURNING MOVEMENT SURVEY

Intersection of Commercial Rd and Kingsgrove Rd, Kingsgrove

GPS -33.939936, 151.100916

Date:	Wed 12/06/19
Weather:	Overcast
Suburban:	Kingsgrove
Customer:	McLaren

North:	Kingsgrove Rd
East:	Commercial Rd
South:	Kingsgrove Rd
West:	Commercial Rd

Survey Period	AM:	7:00 AM-10:00 AM
	PM:	2:30 PM-6:00 PM
Traffic Peak	AM:	7:45 AM-8:45 AM
	PM:	4:15 PM-5:15 PM

All Vehicles

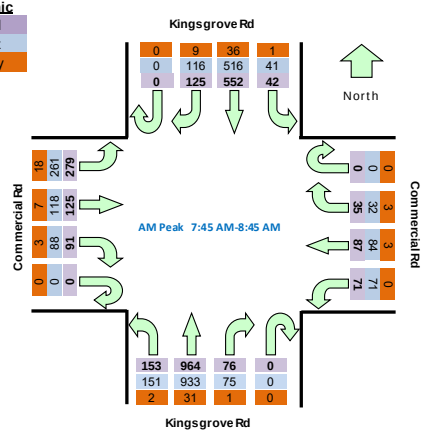
Time		North Approach Kingsgrove Rd				East Approach Commercial Rd				South Approach Kingsgrove Rd				West Approach Commercial Rd				Hourly Total	
Period Start	Period End	U	R	SB	L	U	R	WB	L	U	R	NB	L	U	R	EB	L	Hour	Peak
7:00	7:15	0	20	77	14	0	4	18	4	0	13	208	17	0	15	20	78	2217	
7:15	7:30	0	26	70	8	0	8	12	14	0	17	182	21	0	14	26	81	2390	
7:30	7:45	0	22	85	15	0	9	29	19	0	19	222	22	0	16	39	74	2532	
7:45	8:00	0	30	140	12	0	13	20	22	0	25	272	25	0	21	42	57	2600	Peak
8:00	8:15	0	40	129	18	0	2	25	13	0	15	259	36	0	14	32	78	2560	
8:15	8:30	0	28	128	7	0	7	21	22	0	12	212	41	0	35	31	77	2495	
8:30	8:45	0	27	155	5	0	13	21	14	0	24	221	51	0	21	20	67	2435	
8:45	9:00	0	46	121	6	0	6	29	13	0	16	258	40	0	14	28	62	2305	
9:00	9:15	0	29	108	10	0	5	21	7	0	17	219	30	0	27	31	92	2101	
9:15	9:30	0	29	91	3	0	7	20	13	0	8	247	28	0	19	33	63		
9:30	9:45	0	26	86	2	0	7	17	12	0	6	229	25	0	16	23	60		
9:45	10:00	0	24	73	2	0	6	17	11	0	6	201	19	0	13	17	46		
14:30	14:45	0	48	139	2	0	6	21	13	0	6	217	25	0	35	17	52	2256	
14:45	15:00	0	49	156	3	0	11	22	9	0	5	193	38	0	19	15	33	2263	
15:00	15:15	0	24	152	8	0	12	30	10	0	4	191	41	0	25	13	29	2331	
15:15	15:30	0	38	147	3	0	5	28	19	0	4	219	38	0	25	17	40	2413	
15:30	15:45	0	41	140	5	0	4	40	13	0	10	213	27	0	28	20	47	2448	
15:45	16:00	0	27	154	13	0	9	37	13	0	5	199	56	0	32	17	59	2545	
16:00	16:15	0	45	165	10	0	11	28	10	0	6	213	48	0	23	18	44	2549	
16:15	16:30	0	27	166	2	0	8	40	13	0	5	238	46	0	14	20	39	2587	Peak
16:30	16:45	0	48	170	9	0	8	41	14	0	5	228	32	0	43	25	62	2571	
16:45	17:00	0	38	168	2	0	6	32	16	0	13	205	41	0	20	26	58	2504	
17:00	17:15	0	50	173	7	0	7	34	14	0	16	199	36	0	26	29	68	2447	
17:15	17:30	0	43	144	10	0	13	31	16	0	10	191	43	0	42	19	40		
17:30	17:45	0	40	126	10	0	13	29	13	0	9	221	32	0	38	25	62		
17:45	18:00	0	32	150	3	0	21	25	16	0	10	161	23	0	38	30	59		

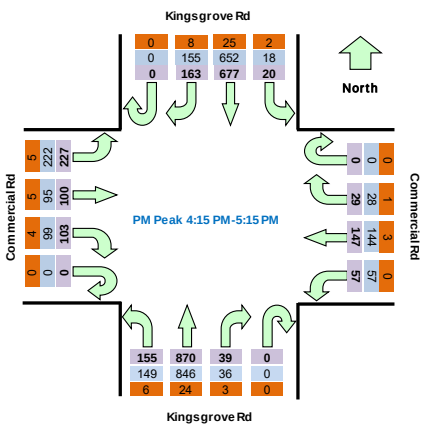
Peak Time		North Approach Kingsgrove Rd				East Approach Commercial Rd				South Approach Kingsgrove Rd				West Approach Commercial Rd				Peak
Period Start	Period End	U	R	SB	L	U	R	WB	L	U	R	NB	L	U	R	EB	L	total
7:45	8:45	0	125	552	42	0	35	87	71	0	76	964	153	0	91	125	279	2600
16:15	17:15	0	163	677	20	0	29	147	57	0	39	870	155	0	103	100	227	2587

Note: Site sketch is for illustrating traffic flows. Direction is indicative only, drawing is not to scale and not an exact streets configuration.

Graphic

Total
Light
Heavy



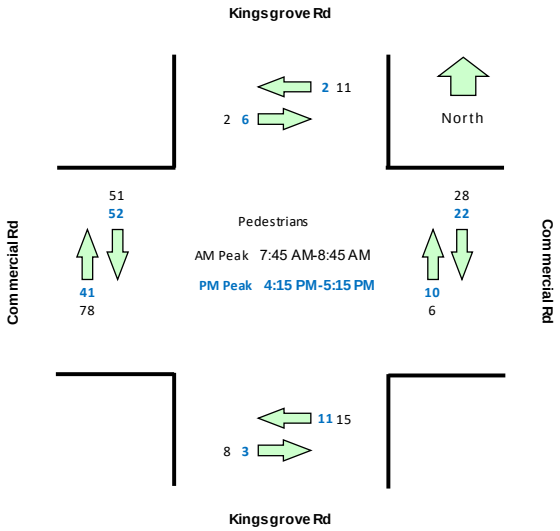


ANNEXURE C: TRAFFIC AND PARKING SURVEYS
(SHEET 2 OF 7)

Pedestrians Crossing

Time		North Approach Kingsgrove R		East Approach Commercial R		South Approach Kingsgrove I		West Approach Commercial I		Hourly Total
Period Star	Period End	Westbound	Eastbound	Southbound	Northbound	Westbound	Eastbound	Southbound	Northbound	
7:00	7:15	2	2	2	0	1	0	5	8	130
7:15	7:30	1	0	2	1	2	1	7	9	150
7:30	7:45	4	0	5	2	4	0	11	14	197
7:45	8:00	1	0	10	0	4	1	10	21	199
8:00	8:15	1	2	3	2	0	0	14	18	193
8:15	8:30	9	0	9	2	9	3	17	21	187
8:30	8:45	0	0	6	2	2	4	10	18	140
8:45	9:00	4	0	3	2	3	1	9	19	117
9:00	9:15	4	0	7	1	1	0	6	15	93
9:15	9:30	1	1	3	0	3	0	5	10	
9:30	9:45	1	1	3	0	2	0	4	8	
9:45	10:00	1	1	3	0	2	0	4	6	
14:30	14:45	0	0	2	1	3	2	13	5	176
14:45	15:00	0	1	2	3	2	2	30	13	188
15:00	15:15	0	0	5	7	3	0	17	16	180
15:15	15:30	0	0	7	4	1	5	18	14	175
15:30	15:45	0	1	3	5	4	0	13	12	166
15:45	16:00	0	5	5	2	1	1	12	19	162
16:00	16:15	6	1	9	2	3	2	12	8	147
16:15	16:30	0	1	8	5	3	2	14	7	147
16:30	16:45	0	3	6	4	1	1	8	11	141
16:45	17:00	0	1	2	0	4	0	13	10	135
17:00	17:15	2	1	6	1	3	0	17	13	137
17:15	17:30	1	8	0	3	2	0	14	6	
17:30	17:45	0	2	1	4	3	1	7	10	
17:45	18:00	0	1	5	5	2	1	5	13	

Peak Time		North Approach Kingsgrove Rd		East Approach Commercial Rd		South Approach Kingsgrove Rd		West Approach Commercial Rd		Peak hour total
Period Star	Period End	Westbound	Eastbound	Southbound	Northbound	Westbound	Eastbound	Southbound	Northbound	
7:45	8:45	11	2	28	6	15	8	51	78	199
16:15	17:15	2	6	22	10	11	3	52	41	147



ANNEXURE C: TRAFFIC AND PARKING SURVEYS
(SHEET 3 OF 7)

TRANS TRAFFIC SURVEY

trafficsurvey.com.au

TURNING MOVEMENT SURVEY

Intersection of Vanessa St and The Crescent, Kingsg

GPS	*-33.944161, 151.093208*

Date:	Wed 12/06/19
Weather:	Overcast
Suburban:	Kingsgrove
Customer:	McLaren

North:	The Crescent
East:	Vanessa St
South:	N/A
West:	Vanessa St

Survey Period	AM:	7:00 AM-10:00 AM
	PM:	2:30 PM-6:00 PM
Traffic Peak	AM:	8:15 AM-9:15 AM
	PM:	4:30 PM-5:30 PM

All Vehicles

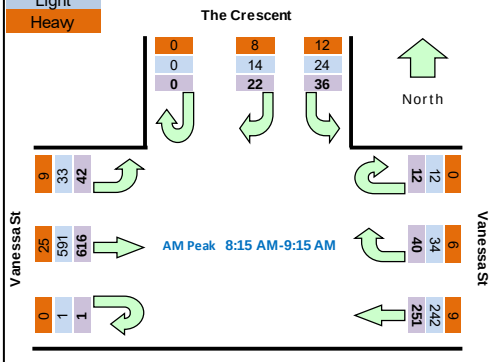
Time		orth Approach The Crescel			East Approach Vanessa St			West Approach Vanessa St			Hourly Total	
Period Star	Period End	U	R	L	U	R	WB	U	EB	L	Hour	Peak
7:00	7:15	0	3	8	0	5	34	0	131	9	857	
7:15	7:30	0	2	10	0	11	28	0	137	8	914	
7:30	7:45	0	7	10	0	6	43	0	136	6	951	
7:45	8:00	0	3	10	0	7	39	0	196	8	982	
8:00	8:15	0	2	4	0	9	59	0	159	14	1008	
8:15	8:30	0	6	9	3	6	51	1	152	5	1020	Peak
8:30	8:45	0	7	6	3	8	65	0	138	12	981	
8:45	9:00	0	3	7	5	12	70	0	174	18	933	
9:00	9:15	0	6	14	1	14	65	0	152	7	842	
9:15	9:30	0	6	5	0	12	61	0	103	7		
9:30	9:45	0	10	10	3	16	50	0	91	11		
9:45	10:00	0	7	15	1	13	56	0	90	16		
14:30	14:45	0	9	11	2	5	99	0	78	6	806	
14:45	15:00	0	6	8	0	9	101	0	65	4	822	
15:00	15:15	0	4	7	0	7	104	0	68	12	861	
15:15	15:30	0	5	5	0	6	116	0	65	4	892	
15:30	15:45	0	5	12	0	9	114	0	81	5	902	
15:45	16:00	0	4	11	0	7	123	0	81	6	922	
16:00	16:15	0	7	6	0	7	154	0	57	2	929	
16:15	16:30	0	3	9	0	8	120	0	69	2	999	
16:30	16:45	0	8	11	0	6	138	0	82	1	1029	Peak
16:45	17:00	0	4	8	1	4	138	0	78	6	1020	
17:00	17:15	0	3	10	1	6	189	0	90	4	1005	
17:15	17:30	0	5	5	0	1	147	0	81	2		
17:30	17:45	0	3	5	0	2	129	1	95	2		
17:45	18:00	0	2	8	0	5	111	0	98	0		

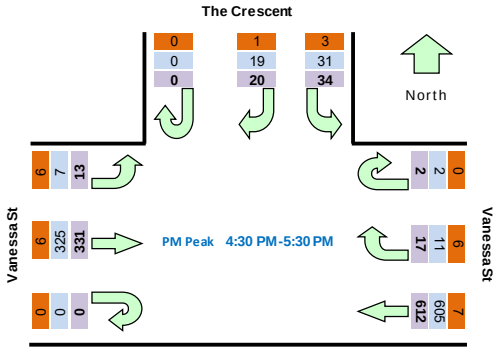
Peak Time		orth Approach The Crescel			East Approach Vanessa St			West Approach Vanessa St			Peak
Period Star	Period End	U	R	L	U	R	WB	U	EB	L	total
8:15	9:15	0	22	36	12	40	251	1	616	42	1020
16:30	17:30	0	20	34	2	17	612	0	331	13	1029

Note: Site sketch is for illustrating traffic flows. Direction is indicative only, drawing is not to scale and not an exact streets configuration.

Graphic

Total
Light
Heavy





ANNEXURE C: TRAFFIC AND PARKING SURVEYS
(SHEET 4 OF 7)

Vanessa Street & The Crescent

It should be noted that not all vehicles turning right or left have been considered in the below sample sizes, this is as a result of no delays associated with these movements (i.e. it took a vehicle less than one second to turn). The additional of these vehicles within the sample would result in a lower average delay and would likely skew the data set.

AM Peak (8:45AM – 9:45AM)

Right Turn from Vanessa Street into The Crescent

Sample Size	33
Number of Vehicles Turning Right in the Hour	52
Average Delay Time:	11 seconds
Maximum Queue Length (Vehicles):	3 vehicles

Note: The maximum queue observed above occurred as a result of a heavy vehicle blocking the informal passing lane. Based upon on-site observations, a queue sometimes forms when a heavy vehicle blocks the passing, which clears quickly once the vehicle has turned. When this does not occur, the queue for a right turning vehicle is typically only one vehicle.

Right Turn from The Crescent into Vanessa Street

Sample Size	18
Number of Vehicles Turning Right in the Hour	20
Average Delay Time:	14 seconds
Maximum Queue Length (Vehicles):	1

Left Turn from The Crescent into Vanessa Street

Sample Size	22
Number of Vehicles Turning Left in the Hour	38
Average Delay Time:	13 seconds
Maximum Queue Length (Vehicles):	3 vehicles

ANNEXURE C: TRAFFIC AND PARKING SURVEYS AND ON-SITE OBSERVATION SUMMARY
(SHEET 5 OF 7)

Vanessa Street & The Crescent

It should be noted that not all vehicles turning right or left have been considered in the below sample sizes, this is as a result of no delays associated with these movements (i.e. it took a vehicle less than one second to turn). The additional of these vehicles within the sample would result in a lower average delay and would likely skew the data set.

PM Peak (4:30PM – 5:30PM)

Right Turn from Vanessa Street into The Crescent

Sample Size	6
Number of Vehicles Turning Right in the Hour	11
Average Delay Time:	5 seconds
Maximum Queue Length (Vehicles):	7 vehicles

Note: Queue occurred as a result of a heavy vehicle blocking the passing lane, which had following vehicles behind. This queue occurred over 10 seconds and was removed once the heavy vehicle turned which took 10 seconds (i.e. all following vehicles were going through). Outside this maximum queue length, the right turn queue into The Crescent was only observed to be one (1) vehicle. I.e. the vehicle turning.

Right Turn from The Crescent into Vanessa Street

Sample Size	20
Number of Vehicles Turning Right in the Hour	23
Average Delay Time:	13 seconds
Maximum Queue Length (Vehicles):	2 vehicles

Left Turn from The Crescent into Vanessa Street

Sample Size	14
Number of Vehicles Turning Left in the Hour	36
Average Delay Time:	7 seconds
Maximum Queue Length (Vehicles):	2 vehicles

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ANNEXURE C: TRAFFIC AND PARKING SURVEYS
(SHEET 6 OF 7)
Observed On-Site Phasing Assessed against the TCS Plan (Annexure E)
AM Peak Period Sample Size 3

Phase	AM Peak (7:45 to 8:45)
A[(1)]	34 seconds
D	10 seconds
E	48 seconds
F	11 seconds
A[(1)]	35 seconds
D	10 seconds
E	41 seconds
F	11 seconds
A[(1)]	23 seconds
D	10 seconds
E	64 seconds
F	16 seconds
Average Cycle Time (including Red Time)	116 seconds

Note: 1 - Phase A did not run with a right turn filter from Commercial Road into Kingsgrove Road (south)
2 – Orange time and red time was 3 seconds each.

ANNEXURE C: TRAFFIC AND PARKING SURVEYS
(SHEET 7 OF 7)
Observed On-Site Phasing Assessed against the TCS Plan (Annexure E)
PM Peak Period Sample Size 3

Phase	PM Peak 4:15 – 5:15
A(1)	18 seconds
D	11 seconds
E	38 seconds
F	12 seconds
A(1)	22 seconds
D	12 seconds
E	52 seconds
F	11 seconds
A(1)	33 seconds
D	14 seconds
E	53 seconds
F	21 seconds
Average Cycle Time (including Red Time)	109 seconds

Note: 1 - Phase A did not run with a right turn filter from Commercial Road into Kingsgrove Road (south)
2 – Orange time and red time was 3 seconds each.

Whilst the TCS plan details the right turn filter from Commercial Road, it is likely that this was removed from the signal on safety grounds. That is, sight lines to opposing vehicles from the right turn lane along Commercial Road are obstructed due to the grade and potentially right turning vehicles from Kingsgrove Avenue. It should be noted that that it was observed that there were times when there were no opposing vehicles during Phase A on Kingsgrove Avenue, such that vehicles turning right from Commercial Road could make this turn, but this is not the actual operation due to road safety concerns. The inclusion of the right turn filter would improve traffic flow efficiency but is likely to compromise road safety. Based upon the above, the modelled SIDRA will run with phases A (no right turn filer from Commercial Road), D, E and F under the optimal phase time scenario (range of 110 to 140 seconds).

MOVEMENT SUMMARY

Site: 101 [The Crescent/ Vanessa St EX AM]

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

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
East: Vanessa St												
5	T1	264	3.6	0.217	1.8	LOS A	0.9	6.8	0.33	0.12	0.33	48.0
6	R2	55	11.5	0.217	9.6	LOS A	0.9	6.8	0.33	0.12	0.33	46.9
Approach		319	5.0	0.217	3.1	NA	0.9	6.8	0.33	0.12	0.33	47.8
North: The Crescent												
7	L2	38	33.3	0.148	9.4	LOS A	0.5	4.4	0.69	0.85	0.69	42.2
9	R2	23	36.4	0.148	16.7	LOS B	0.5	4.4	0.69	0.85	0.69	41.8
Approach		61	34.5	0.148	12.2	LOS A	0.5	4.4	0.69	0.85	0.69	42.1
West: Vanessa St												
10	L2	44	21.4	0.369	4.8	LOS A	0.0	0.0	0.00	0.03	0.00	48.9
11	T1	648	4.1	0.369	0.0	LOS A	0.0	0.0	0.00	0.03	0.00	49.8
Approach		693	5.2	0.369	0.4	NA	0.0	0.0	0.00	0.03	0.00	49.7
All Vehicles		1073	6.8	0.369	1.8	NA	0.9	6.8	0.14	0.11	0.14	48.6

MOVEMENT SUMMARY

Site: 101 [The Crescent/ Vanessa St EX PM]

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

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
East: Vanessa St												
5	T1	644	1.1	0.353	0.2	LOS A	0.3	2.3	0.05	0.02	0.05	49.8
6	R2	18	35.3	0.353	7.8	LOS A	0.3	2.3	0.05	0.02	0.05	48.2
Approach		662	2.1	0.353	0.4	NA	0.3	2.3	0.05	0.02	0.05	49.7
North: The Crescent												
7	L2	36	8.8	0.088	6.0	LOS A	0.3	2.2	0.49	0.68	0.49	44.4
9	R2	21	5.0	0.088	12.5	LOS A	0.3	2.2	0.49	0.68	0.49	44.0
Approach		57	7.4	0.088	8.4	LOS A	0.3	2.2	0.49	0.68	0.49	44.2
West: Vanessa St												
10	L2	14	46.2	0.191	5.0	LOS A	0.0	0.0	0.00	0.02	0.00	48.7
11	T1	348	1.8	0.191	0.0	LOS A	0.0	0.0	0.00	0.02	0.00	49.9
Approach		362	3.5	0.191	0.2	NA	0.0	0.0	0.00	0.02	0.00	49.9
All Vehicles		1081	2.8	0.353	0.7	NA	0.3	2.3	0.05	0.05	0.06	49.5

MOVEMENT SUMMARY

Site: 101 [Kingsgrove Ave/ Commercial Rd EX AM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 110 seconds (Site Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: Kingsgrove Road												
1	L2	161	1.3	0.823	38.0	LOS C	32.8	234.7	0.95	0.91	1.01	33.7
2	T1	1015	3.2	0.823	33.2	LOS C	32.8	234.7	0.91	0.87	0.99	34.2
3	R2	80	1.3	0.476	26.9	LOS B	2.7	19.4	0.67	0.71	0.67	36.2
Approach		1256	2.8	0.823	33.4	LOS C	32.8	234.7	0.90	0.87	0.97	34.3
East: Kingsgrove Ave												
4	L2	75	0.0	0.432	42.9	LOS D	7.6	53.9	0.89	0.75	0.89	32.0
5	T1	92	3.4	0.432	38.4	LOS C	7.6	53.9	0.89	0.75	0.89	32.2
6	R2	37	8.6	0.196	35.2	LOS C	1.4	10.2	0.95	0.72	0.95	33.5
Approach		203	3.1	0.432	39.5	LOS C	7.6	53.9	0.90	0.75	0.90	32.4
North: Kingsgrove Road												
7	L2	44	2.4	0.385	20.4	LOS B	11.4	84.1	0.63	0.57	0.63	40.5
8	T1	581	6.5	0.385	15.6	LOS B	11.4	84.1	0.61	0.54	0.61	41.1
9	R2	132	7.2	0.707	32.8	LOS C	4.2	31.3	0.99	0.85	1.12	34.1
Approach		757	6.4	0.707	18.8	LOS B	11.4	84.1	0.68	0.60	0.70	39.6
West: Commercial Road												
10	L2	294	6.5	0.837	51.5	LOS D	23.8	175.2	1.00	0.95	1.15	29.4
11	T1	132	5.6	0.837	46.9	LOS D	23.8	175.2	1.00	0.95	1.15	29.7
12	R2	96	3.3	0.760	64.6	LOS E	5.6	40.1	1.00	0.89	1.23	26.4
Approach		521	5.7	0.837	52.8	LOS D	23.8	175.2	1.00	0.94	1.16	28.9
All Vehicles		2737	4.4	0.837	33.5	LOS C	32.8	234.7	0.86	0.80	0.93	34.2

MOVEMENT SUMMARY

Site: 101 [Kingsgrove Ave/ Commercial Rd EX PM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 110 seconds (Site Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: Kingsgrove Road												
1	L2	163	3.9	0.776	36.6	LOS C	27.3	196.4	0.94	0.86	0.96	34.0
2	T1	916	2.8	0.776	31.9	LOS C	27.3	196.4	0.91	0.84	0.95	34.6
3	R2	41	7.7	0.097	27.5	LOS B	1.4	10.4	0.66	0.70	0.66	36.0
Approach		1120	3.1	0.776	32.4	LOS C	27.3	196.4	0.91	0.84	0.94	34.6
East: Kingsgrove Ave												
4	L2	60	0.0	0.635	48.3	LOS D	10.6	75.4	0.96	0.80	0.96	30.8
5	T1	155	2.0	0.635	43.7	LOS D	10.6	75.4	0.96	0.80	0.96	31.0
6	R2	31	3.4	0.142	35.5	LOS C	1.2	8.4	0.93	0.71	0.93	33.5
Approach		245	1.7	0.635	43.8	LOS D	10.6	75.4	0.95	0.79	0.95	31.2
North: Kingsgrove Road												
7	L2	21	10.0	0.430	19.3	LOS B	13.4	97.0	0.62	0.56	0.62	41.1
8	T1	713	3.7	0.430	14.3	LOS A	13.4	97.0	0.60	0.53	0.60	41.8
9	R2	172	4.9	0.586	26.7	LOS B	4.8	34.9	0.95	0.81	0.95	36.2
Approach		905	4.1	0.586	16.8	LOS B	13.4	97.0	0.66	0.58	0.66	40.6
West: Commercial Road												
10	L2	239	2.2	0.757	48.4	LOS D	17.9	128.8	0.99	0.89	1.05	30.2
11	T1	105	5.0	0.757	43.9	LOS D	17.9	128.8	0.99	0.89	1.05	30.4
12	R2	108	3.9	0.768	63.9	LOS E	6.3	45.4	1.00	0.89	1.23	26.5
Approach		453	3.3	0.768	51.1	LOS D	17.9	128.8	0.99	0.89	1.09	29.3
All Vehicles		2723	3.3	0.776	31.4	LOS C	27.3	196.4	0.84	0.76	0.87	34.9

MOVEMENT SUMMARY

Site: 101 [The Crescent/ Vanessa St FU AM]

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

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
East: Vanessa St												
5	T1	264	3.6	0.229	2.1	LOS A	1.1	8.0	0.36	0.13	0.38	47.7
6	R2	60	15.8	0.229	10.0	LOS A	1.1	8.0	0.36	0.13	0.38	46.6
Approach		324	5.8	0.229	3.6	NA	1.1	8.0	0.36	0.13	0.38	47.5
North: The Crescent												
7	L2	41	38.5	0.157	9.8	LOS A	0.5	4.8	0.69	0.86	0.69	42.1
9	R2	23	36.4	0.157	17.0	LOS B	0.5	4.8	0.69	0.86	0.69	41.7
Approach		64	37.7	0.157	12.4	LOS A	0.5	4.8	0.69	0.86	0.69	42.0
West: Vanessa St												
10	L2	47	20.0	0.370	4.8	LOS A	0.0	0.0	0.00	0.04	0.00	48.9
11	T1	648	4.1	0.370	0.1	LOS A	0.0	0.0	0.00	0.04	0.00	49.8
Approach		696	5.1	0.370	0.4	NA	0.0	0.0	0.00	0.04	0.00	49.7
All Vehicles		1084	7.3	0.370	2.0	NA	1.1	8.0	0.15	0.11	0.15	48.5

MOVEMENT SUMMARY

Site: 101 [The Crescent/ Vanessa St FU PM]

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

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
East: Vanessa St												
5	T1	644	1.1	0.355	0.2	LOS A	0.4	2.6	0.05	0.02	0.06	49.8
6	R2	19	38.9	0.355	8.0	LOS A	0.4	2.6	0.05	0.02	0.06	48.1
Approach		663	2.2	0.355	0.4	NA	0.4	2.6	0.05	0.02	0.06	49.7
North: The Crescent												
7	L2	41	12.8	0.099	6.1	LOS A	0.3	2.5	0.49	0.68	0.49	44.3
9	R2	23	4.5	0.099	12.6	LOS A	0.3	2.5	0.49	0.68	0.49	44.0
Approach		64	9.8	0.099	8.4	LOS A	0.3	2.5	0.49	0.68	0.49	44.2
West: Vanessa St												
10	L2	14	46.2	0.191	5.0	LOS A	0.0	0.0	0.00	0.02	0.00	48.7
11	T1	348	1.8	0.191	0.0	LOS A	0.0	0.0	0.00	0.02	0.00	49.9
Approach		362	3.5	0.191	0.2	NA	0.0	0.0	0.00	0.02	0.00	49.9
All Vehicles		1089	3.1	0.355	0.8	NA	0.4	2.6	0.06	0.06	0.06	49.4

MOVEMENT SUMMARY

Site: 101 [Kingsgrove Ave/ Commercial Rd FUT AM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 110 seconds (Site Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: Kingsgrove Road												
1	L2	162	1.3	0.842	40.7	LOS C	34.2	245.2	0.97	0.94	1.06	32.9
2	T1	1015	3.2	0.842	36.0	LOS C	34.2	245.2	0.92	0.91	1.03	33.3
3	R2	80	1.3	0.495	27.6	LOS B	2.8	19.7	0.68	0.71	0.68	36.0
Approach		1257	2.8	0.842	36.1	LOS C	34.2	245.2	0.91	0.90	1.01	33.4
East: Kingsgrove Ave												
4	L2	75	0.0	0.433	42.1	LOS C	7.6	55.2	0.88	0.75	0.88	32.2
5	T1	95	6.7	0.433	37.6	LOS C	7.6	55.2	0.88	0.75	0.88	32.4
6	R2	37	8.6	0.189	34.4	LOS C	1.3	10.1	0.94	0.72	0.94	33.7
Approach		206	4.6	0.433	38.6	LOS C	7.6	55.2	0.89	0.75	0.89	32.6
North: Kingsgrove Road												
7	L2	44	2.4	0.392	21.1	LOS B	11.7	85.8	0.64	0.58	0.64	40.2
8	T1	581	6.5	0.392	16.2	LOS B	11.7	85.8	0.62	0.55	0.62	40.8
9	R2	133	7.1	0.729	33.9	LOS C	4.4	32.5	1.00	0.87	1.15	33.8
Approach		758	6.4	0.729	19.6	LOS B	11.7	85.8	0.69	0.61	0.71	39.3
West: Commercial Road												
10	L2	294	6.5	0.821	49.4	LOS D	23.4	173.1	1.00	0.94	1.12	30.0
11	T1	135	7.8	0.821	44.8	LOS D	23.4	173.1	1.00	0.94	1.12	30.2
12	R2	96	3.3	0.760	64.6	LOS E	5.6	40.1	1.00	0.89	1.23	26.4
Approach		524	6.2	0.821	51.0	LOS D	23.4	173.1	1.00	0.93	1.14	29.3
All Vehicles		2745	4.6	0.842	34.6	LOS C	34.2	245.2	0.87	0.81	0.94	33.9

MOVEMENT SUMMARY

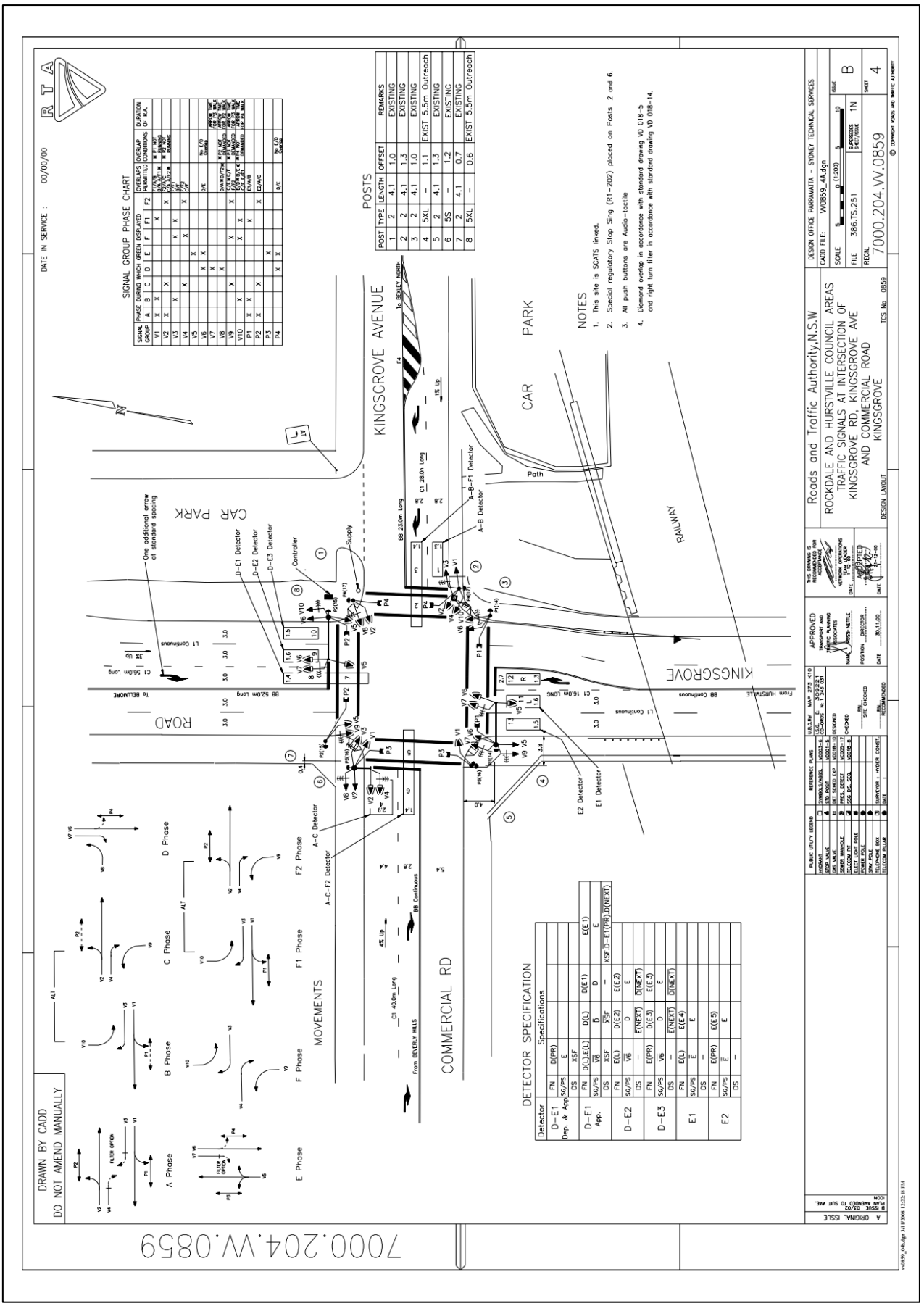
Site: 101 [Kingsgrove Ave/ Commercial Rd FUT PM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 110 seconds (Site Optimum Cycle Time - Minimum Delay)

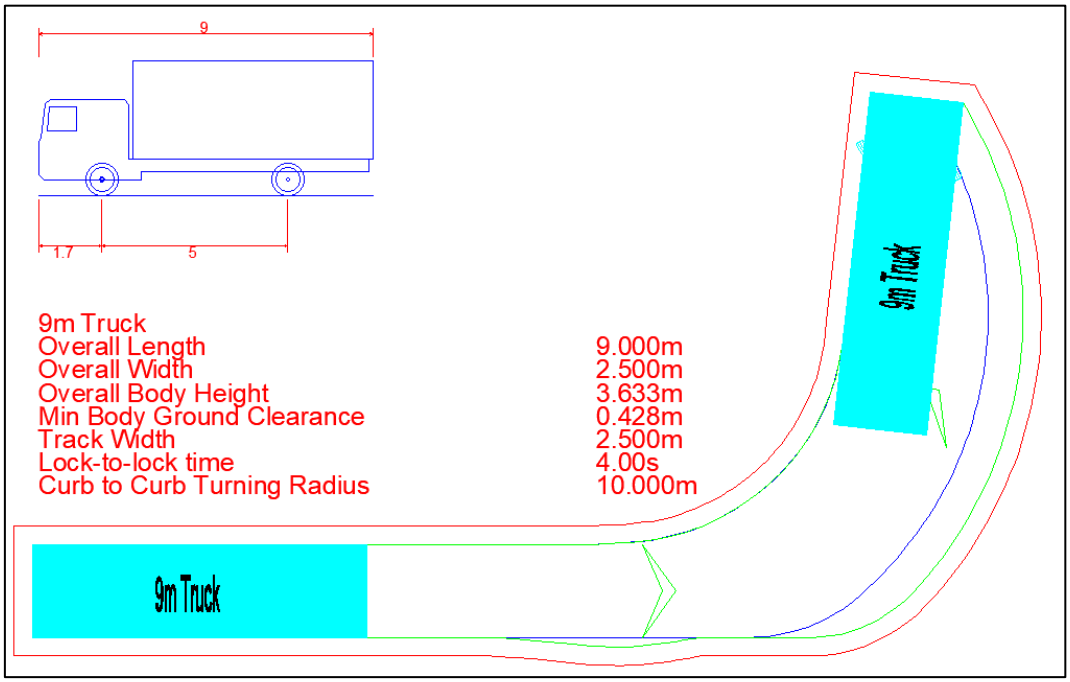
Movement Performance - Vehicles

Mov ID	Turn	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	Aver. No. Cycles	Average Speed km/h
South: Kingsgrove Road												
1	L2	163	3.9	0.776	36.6	LOS C	27.3	196.4	0.94	0.86	0.96	34.0
2	T1	916	2.8	0.776	31.9	LOS C	27.3	196.4	0.91	0.84	0.95	34.6
3	R2	41	7.7	0.097	27.5	LOS B	1.4	10.4	0.66	0.70	0.66	36.0
Approach		1120	3.1	0.776	32.4	LOS C	27.3	196.4	0.91	0.84	0.94	34.6
East: Kingsgrove Ave												
4	L2	60	0.0	0.629	48.3	LOS D	10.7	76.2	0.96	0.80	0.96	30.8
5	T1	156	2.7	0.629	43.8	LOS D	10.7	76.2	0.96	0.80	0.96	31.0
6	R2	31	3.4	0.144	35.8	LOS C	1.2	8.4	0.94	0.71	0.94	33.4
Approach		246	2.1	0.629	43.9	LOS D	10.7	76.2	0.96	0.79	0.96	31.2
North: Kingsgrove Road												
7	L2	21	10.0	0.430	19.3	LOS B	13.4	97.0	0.62	0.56	0.62	41.1
8	T1	713	3.7	0.430	14.3	LOS A	13.4	97.0	0.60	0.53	0.60	41.8
9	R2	172	4.9	0.586	26.7	LOS B	4.8	34.9	0.95	0.81	0.95	36.2
Approach		905	4.1	0.586	16.8	LOS B	13.4	97.0	0.66	0.58	0.66	40.6
West: Commercial Road												
10	L2	240	2.2	0.768	49.0	LOS D	18.3	131.9	0.99	0.90	1.07	30.1
11	T1	107	6.9	0.768	44.4	LOS D	18.3	131.9	0.99	0.90	1.07	30.3
12	R2	109	3.8	0.775	64.1	LOS E	6.4	46.0	1.00	0.90	1.24	26.5
Approach		457	3.7	0.775	51.5	LOS D	18.3	131.9	0.99	0.90	1.11	29.2
All Vehicles		2728	3.4	0.776	31.5	LOS C	27.3	196.4	0.85	0.76	0.88	34.9

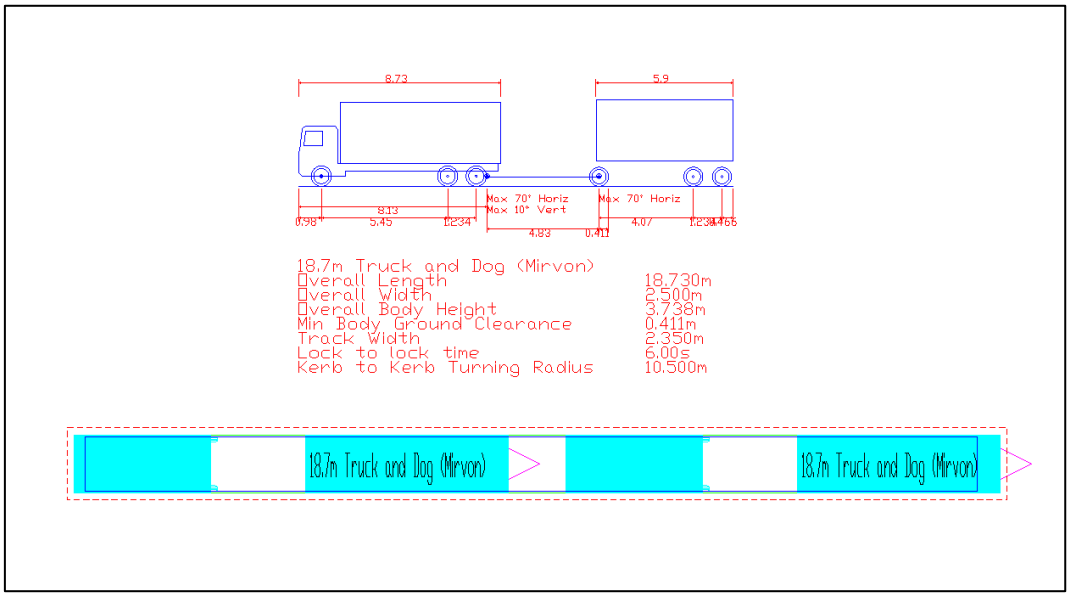
ANNEXURE E: TRAFFIC SIGNAL PLAN



ANNEXURE F: SWEPT PATH TESTING
(SHEET 1 OF 9)



9m length Rigid Truck

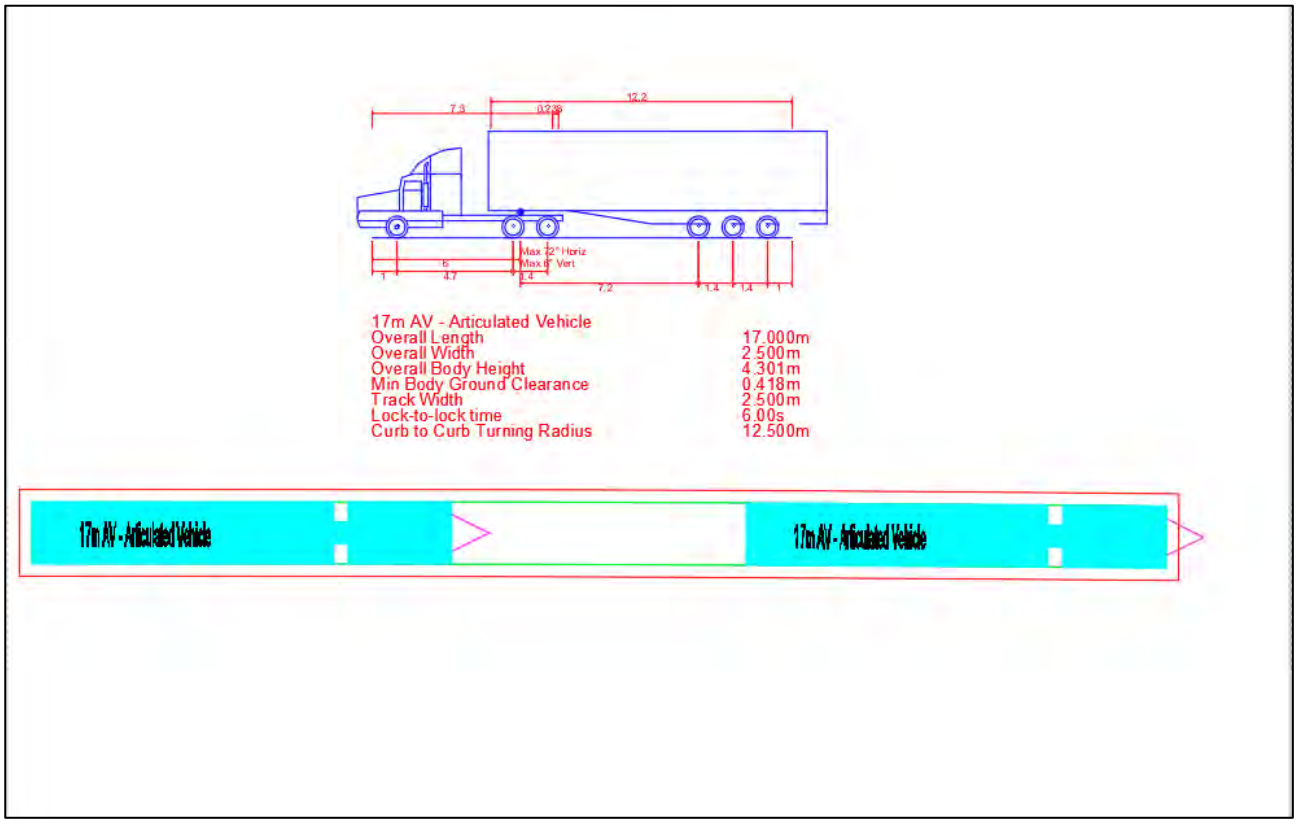


Truck and Dog (Mirvon) 19m

Blue – Vehicle Tyres
Green – Vehicle Body
Red – 500mm clearance

All tests performed at 5 km/h forwards and 2.5km/h reverse

ANNEXURE F: SWEPT PATH TESTING
(SHEET 2 OF 9)



17m Length Articulated Vehicle

Blue – Vehicle Tyres
Green – Vehicle Body
Red – 500mm clearance

All tests performed at 5 km/h forwards and 2.5km/h reverse

ANNEXURE F: SWEPT PATH TESTING
(SHEET 3 OF 9)

19m Truck and Dog Turn at The Crescent / Vanessa St

SUCCESSFUL

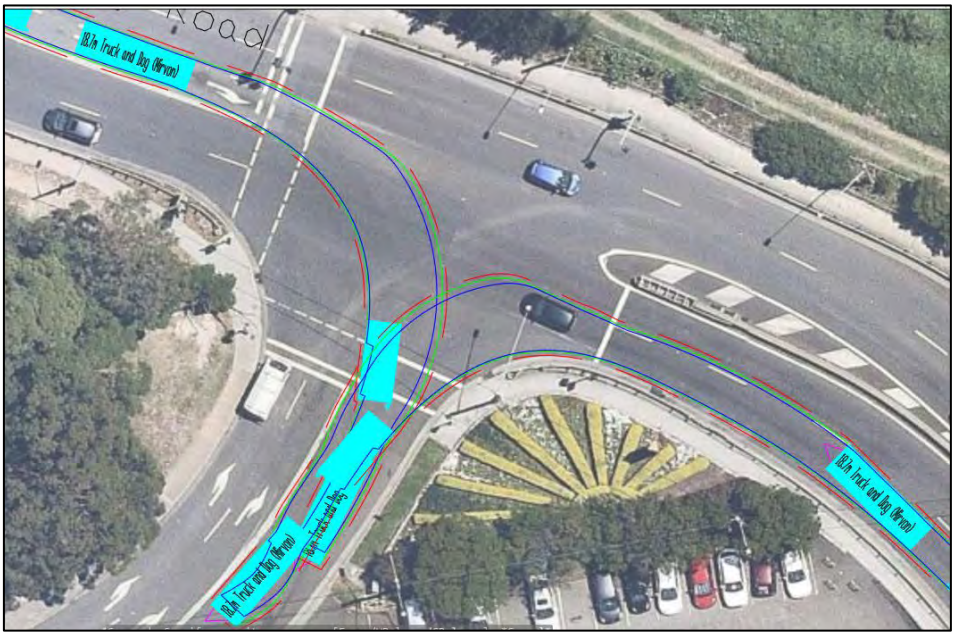
9m length Rigid Vehicle Turn at The Crescent / Vanessa St

SUCCESSFUL

ANNEXURE F: SWEPT PATH TESTING
(SHEET 4 OF 9)

19m Truck and Dog Exit (North and South) at Bexley Road/ Kingsgrove Ave

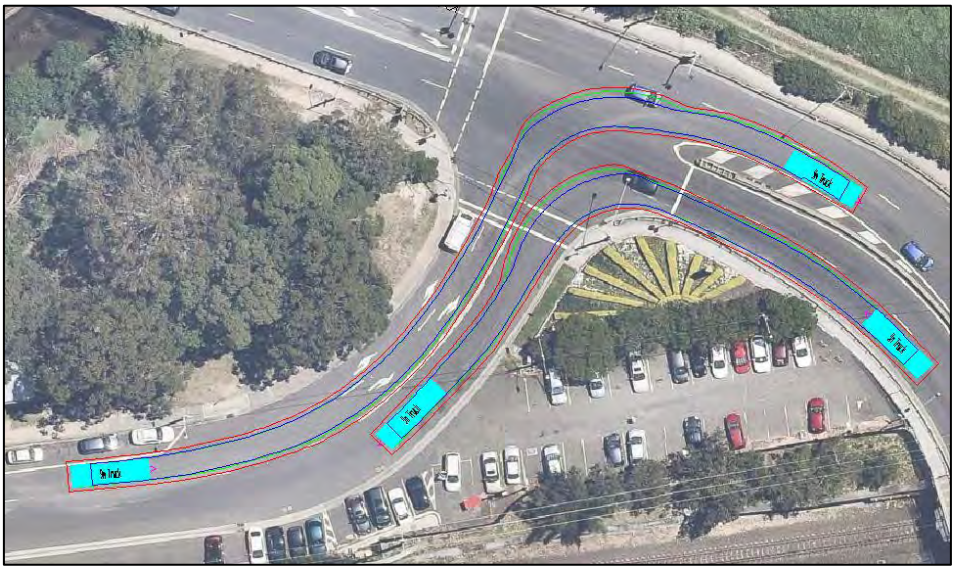
SUCCESSFUL



19m Truck and Dog Enter from Bexley Road onto Kingsgrove Ave

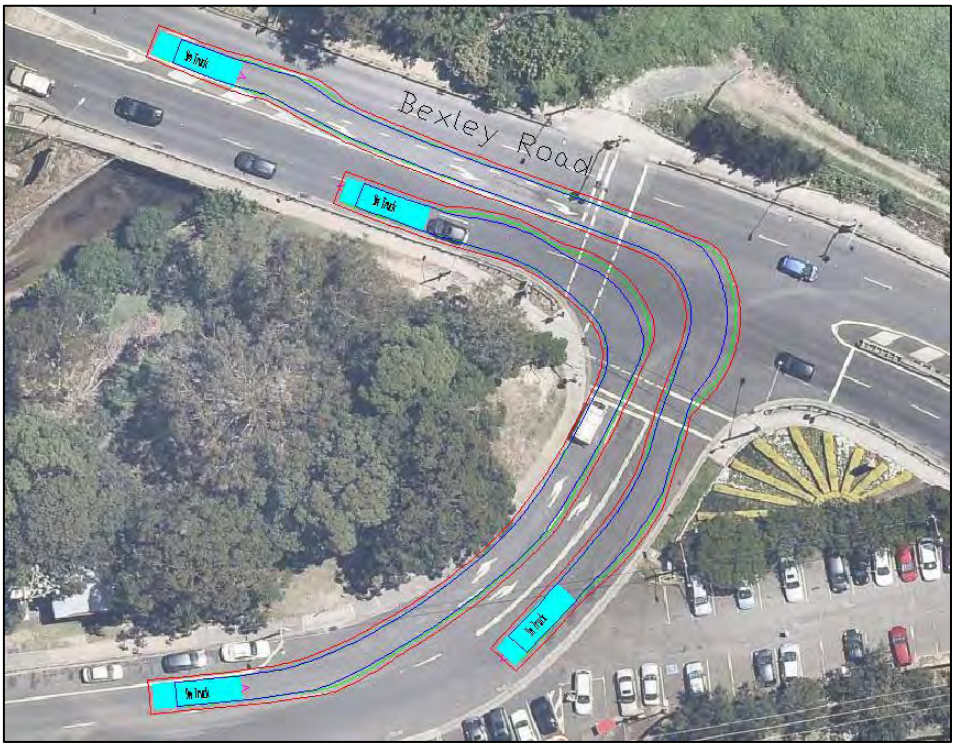
SUCCESSFUL

ANNEXURE F: SWEPT PATH TESTING
(SHEET 5 OF 9)



9m length Rigid Vehicle right turn onto Bexley Road and left turn onto Kingsgrove Avenue

SUCCESSFUL



9m length Rigid Vehicle left turn onto Bexley Road and right turn onto Kingsgrove Avenue

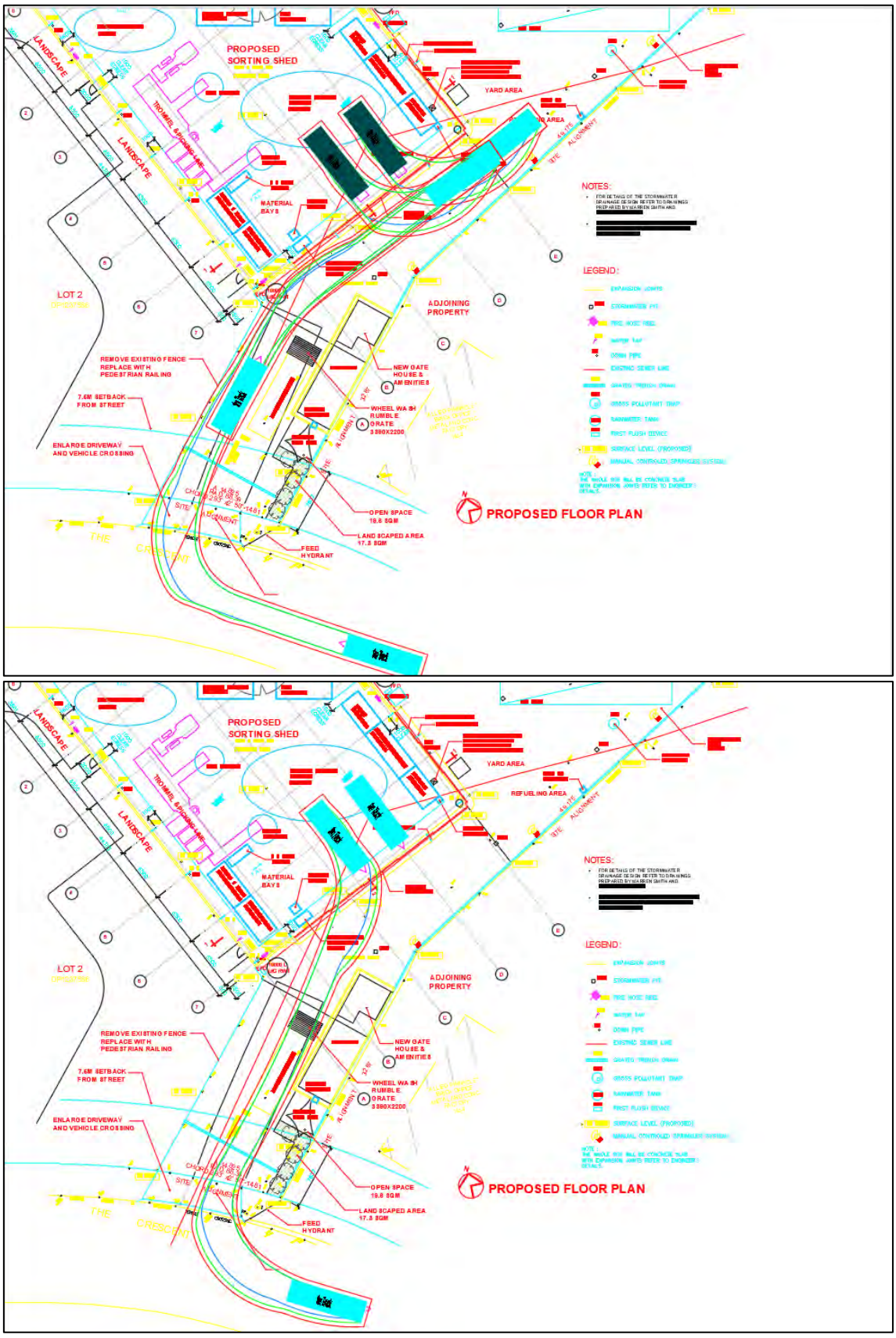
SUCCESSFUL

ANNEXURE F: SWEPT PATH TESTING
(SHEET 6 OF 9)

9m length Rigid Vehicle left onto Kingsgrove Road and right into Commercial Road

SUCCESSFUL

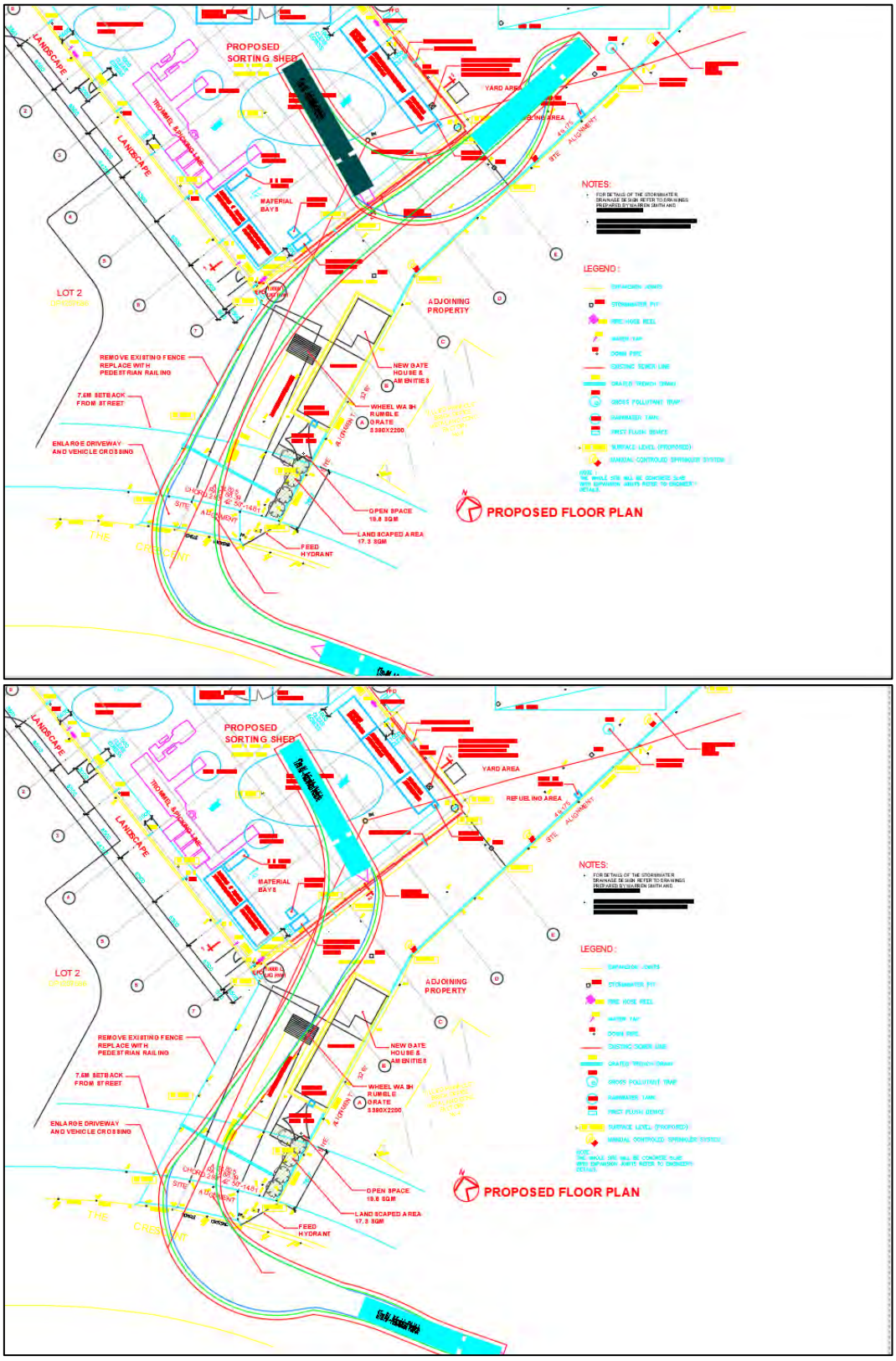
ANNEXURE F: SWEPT PATH TESTING
(SHEET 7 OF 9)



2 x 9m length Rigid Vehicle Entry & Exit from Site

SUCCESSFUL

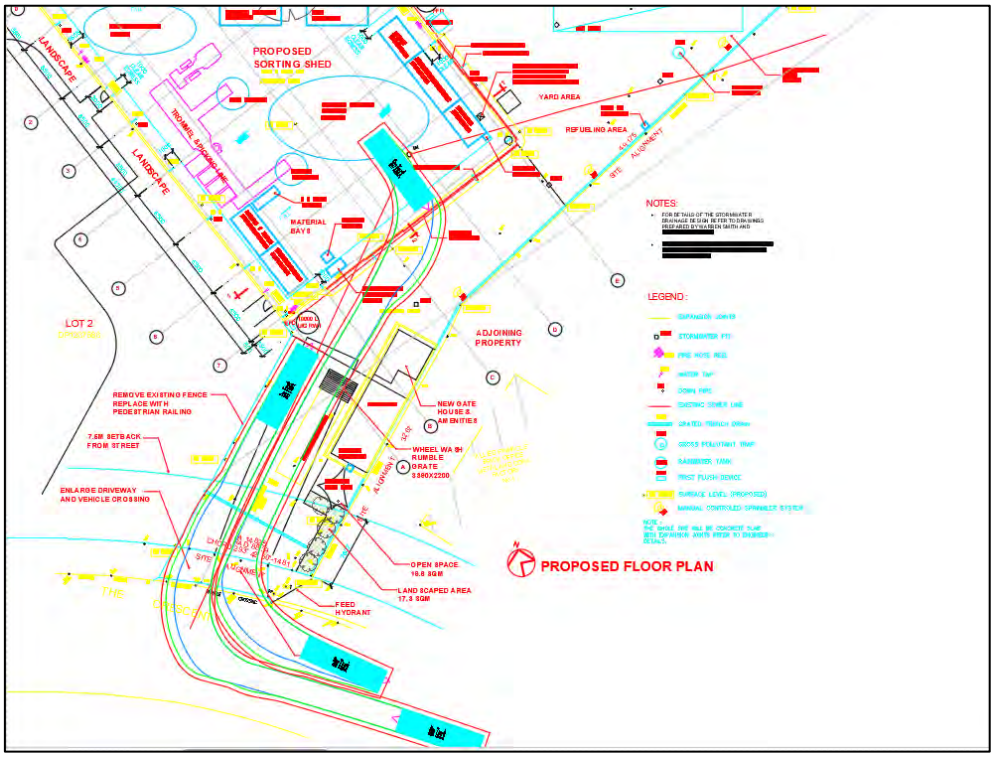
ANNEXURE F: SWEPT PATH TESTING
(SHEET 8 OF 9)



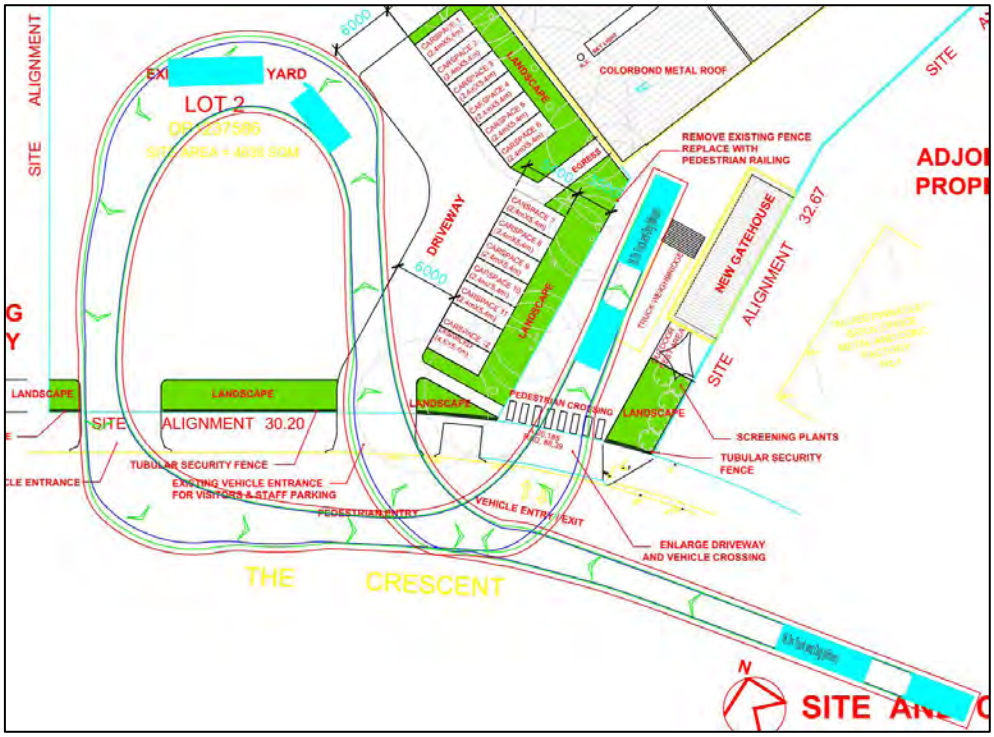
17m Length AV into site and out of site

SUCCESSFUL

ANNEXURE F: SWEPT PATH TESTING
(SHEET 9 OF 9)



Two-way passing at site driveway by 2 x 9m length rigid vehicles
Successful



19m Truck and Dog Vehicle turn around on neighbouring site

SUCCESSFUL