M^CLAREN TRAFFIC ENGINEERING

Address: Shop 7, 720 Old Princes Highway Sutherland NSW 2232
Postal: P.O Box 66 Sutherland NSW 1499

Telephone: (02) 9521 7199
Web: www.mclarentraffic.com.au
Email: admin@mclarentraffic.com.au

Division of RAMTRANS Australia ABN: 45067491678 RPEQ: 19457

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

16 October 2023 Reference: 220509.04FA

Precinct Capital Pty Ltd
Level 1, 2 Barrack Street
Sydney NSW 2000
Attention: Dylan

SUPPLEMENTARY TRAFFIC ADVICE FOR THE APPROVED BUSINESS PARK AT OLD CASTLEREAGH ROAD & LUGARD STREET, PENRITH

Dear Dylan,

Reference is made to your request to provide supplementary traffic advice for the Approved Business Park at Old Castlereagh Road & Lugard Street, Penrith. This letter is in response to the following documents:

- *Removal of a left turn lane on Castlereagh Road at Lugard Street (*TfNSW reference: SYD23/00324/02) dated 16 August 2023 prepared by *Transport for NSW* (complete letter presented in **Annexure A**), hereafter referred to as the TfNSW Letter.
- *Request for Information – DA 9876 MOD 1* dated 17 August 2023 prepared by *Department of Planning and Environment* (complete letter presented in **Annexure B**)**,** hereafter referred to as the DPIE Letter.

This letter should be read in conjunction with *M^CLaren Traffic Engineering*'s (MTE) letter dated 1 June 2023 (document reference: 220509.03FA), hereafter referred to as the MTE.03 Letter.

1 Transport for NSW (TfNSW) – SYD23/00324/02

The comments made within the TfNSW Letter relevant to traffic are reproduced in the sections below, with MTE's response thereafter.

1.1 Matter One – Traffic Distribution

> *Considering the location of the site in relation to the layout of the road network and the available routes that traffic would use to access the development, TfNSW disagree with the traffic distribution provided in the analysis and is of the opinion that 50 to 70% of the development traffic would use Castlereagh Road from the south because:*
>
> - *Castlereagh Road/Mulgoa Road provides the main direct state road connection from the M4 Motorway and is the most likely route that would be used by traffic originating from are to the east, south and west of the site.*

- *Andrews Road is a regional road with a single lane in each direction and only likely to be used by traffic originating from residential areas immediately to the east or north of the site.*

- *It is unlikely that 5% of development traffic would continue southbound through the roundabout from Castlereagh Road and then turn right into Lugard Street to access the development and more likely that traffic would turn right to access the development directly from Access Point 2 in Old Castlereagh Road.*

An updated SIDRA INTERSECTION 9.1 assessment has been undertaken assuming 50% to 70% of the development traffic would utilise Castlereagh Road. The updated assessments disregard traffic from the north approach. The updated traffic distribution is shown in **Table 1**.

TABLE 1: TRAFFIC DISTRIBUTION

Peak Hour	Direction	North Approach Castlereagh Rd		South Approach Castlereagh Rd		West Approach Lugard St	
		Right Turn	Through	Through	Left Turn	Right Turn	Left Turn
50% Scenario							
AM	**IN**	0%		0%	50%		
	OUT		0%			50%	0%
PM	**IN**	0%		0%	50%		
	OUT		0%			50%	0%
70% Scenario							
AM	**IN**	0%		0%	70%		
	OUT		0%			70%	0%
PM	**IN**	0%		0%	70%		
	OUT		0%			70%	0%

The results of the revised model of the intersection of Castlereagh Road / Lugard Street utilising the above traffic distribution are shown in **Table 2** and **Table 3** with the complete results of the SIDRA INTERSECTION 9.1 assessment presented in **Annexure C**.

TABLE 2: INTERSECTION PERFORMANCE - OVERALL

Intersection	Peak Hour	Degree of Saturation[1]	Average Delay[2] (sec/vehicle)	Level of Service[3]	Control Type	Worst Movement	95th Percentile Queue
PERFORMANCE – 50% Distribution – No Left Turn Lane							
Castlereagh Road / Lugard Street	AM	1.01	10.5	**A**	Signals	RT from Lugard Street (W)	25.4 veh (194.6m) Castlereagh Road (S)
	PM	3.44	372.2	**F**		RT from Lugard Street (W)	178.1 veh (1357.8m) Lugard Street (W)
PERFORMANCE – 50% Distribution – with Left Turn Lane							
Castlereagh Road / Lugard Street	AM	1.01	10	**A**	Signals	RT from Lugard Street (W)	12.7 veh (107.5m) Lugard Street (W)
	PM	3.40	368.1	**F**		RT from Lugard Street (W)	177.5 veh (1352.9m) Lugard Street (W)
PERFORMANCE – 70% Distribution – No Left Turn Lane							
Castlereagh Road / Lugard Street	AM	1.28	22.5	**B**	Signals	RT from Lugard Street (W)	29.3 veh (240.6m) Castlereagh Road (S)
	PM	4.82	698	**F**		RT from Lugard Street (W)	276.8 veh (2112.1m) Lugard Street (W)
PERFORMANCE – 70% Distribution – with Left Turn Lane							
Castlereagh Road / Lugard Street	AM	1.28	21.9	**B**	Signals	RT from Lugard Street (W)	28.3 veh (240.6m) Lugard Street (W)
	PM	4.76	688.6	**F**		RT from Lugard Street (W)	276.1 veh (2106.4m) Lugard Street (W)

TABLE 3: INTERSECTION PERFORMANCE – LEFT TURN FROM SOUTH ONLY

Case	AM			PM		
	Left Turn Demand (veh)	Left Turn Delay (s)	Left Turn Queue (m)[1]	Left Turn Demand (veh)	Left Turn Delay (s)	Left Turn Queue (m)[1]
50% Distribution – No LT Lane	975	6.4	73.0	169	6.2	156.5
50% Distribution – LT Lane	975	6.4	54.0	169	8.1	4.8
70% Distribution – No LT Lane	1342	7.7	185.6	228	6.2	179
70% Distribution – LT Lane	1342	7.7	185.6	228	6.2	6.8

Notes:

(1) Where no left turn lane is provided, the queue expressed is for the kerbside lane which serves both left turn and through movements.

As shown in **Table 2**:

- There is a minor decrease in the average delay of 0.5 seconds in the AM peak hour and 3.9 seconds in the PM peak hour if the left turn lane is constructed and the 50% distribution of traffic into and out of the site from the south is adopted.
- There is a minor decrease in the average delay of 0.6 seconds in the AM peak hour and 9.4 seconds in the PM peak hour if the left turn lane is constructed and the 70% distribution of traffic into and out of the site from the south is adopted. It is noted that the 9.4 second change represents a 1.3% change in average delay.

Focusing on the performance of the left turn movement, as shown in **Table 3**:

- There is no change in the AM peak hour and a minor increase of 1.9 in delay in the PM peak hour for vehicles turning left from Castlereagh Road to Lugard Street if the left turn lane is constructed and the 50% distribution of traffic into and out of the site from the south is adopted.
- There is no change in the AM peak hour or in the PM peak hour for vehicles turning left from Castlereagh Road to Lugard Street if the left turn lane is constructed and the 70% distribution of traffic into and out of the site from the south is adopted.

Overall, the results of the updated assessments indicate that there is negligible change to the overall performance of the intersection of Castlereagh Road / Lugard Street if a left turn lane is provided.

1.2 Matter Two – Traffic Generation

> *TfNSW agrees with DPE's comments that the traffic impact assessment of the modification should use the land use percentage split and GFA split recommended in the GHD report, and the traffic generation results shown in the following table.*

The traffic generation outlined within the GHD report were used for the purpose of the updated modelling and intersection performance assessments, for which results are presented in **Tables 1**, **2** & **3**.

1.3 Matter Three – Traffic Impact on Road Network

> *The impact of queueing of not providing the left turn lane as conditioned from Castlereagh Road into Lugard Street is significant with queues of 84.6m in the AM peak and 136.1m in the PM peak. Once again it is important to note that this is based on trip distribution of 30% of development traffic turning left which TfNSW do not agree with. The queuing is likely to be much higher should more traffic be distributed to the left into Lugard Street.*
>
> *The provision of the left turn lane as conditioned from Castlereagh Road into Lugard Street would reduce the AM peak hour queue for the left turn to 22.4m in the AM peak which represents a 74% reduction in queue length. Similarly, the PM peak hour queue for the left turn is reduced to 8.6m which represents a 94% reduction. This is due to the traffic signal phasing which allows the left turn movement to be given a green signal when Lugard Street is given a green signal.*

The RTA Guide to Traffic Generating Developments Section 4.2.2 states the following:

> *"The best indicator of the level of service at an intersection is the average delay experienced by vehicles at that intersection. For traffic signals, the average delay over all movements should be taken."*

As such, the length of the queues is not the best indicator for judging the performance of an intersection or a relevant consideration to whether the construction of a left turn lane is warranted.

After review of the model, it is noted that the right turn into Lugard Street from Castlereagh Road is also significantly impacted by the traffic generated by the development with queues of 179.5m in the AM peak which indicates it queues out of the right turn bay significantly and would impact traffic flow in the southbound direction of Castlereagh Road. This results from distributing 5% of the development traffic to turn right to enter the development from Lugard Street. As previously indicated TfNSW do not agree that 50% of traffic would turn right into Lugard Street from Castlereagh.

This is noted and the 5% distribution has been removed from the model.

It is noted that Andrews Road is a regional road with a single lane in each direction and provides residential access to Cranbrook. The existing traffic volumes in Andrews Road are 623 vehicles in the AM peak and 704 vehicles in the PM peak. The distribution of the traffic generated by the development adds 732 vehicles to the existing traffic volume in the AM peak to a total of 1355 vehicles and 646 vehicles in the PM peak to a total of 1350 vehicles.

This is noted, but again not relevant to the assessment criteria.

It is important to note than an assessment of the roundabout at Andrew Road / Old Castlereagh Road / Castlereagh Road has not been provided in the report to determine the impact of operation of the roundabout.

The review of the model indicates that the roundabout performance is severely impacted and reduces from a level of service A to a level of service F in both the AM and PM peak hours. Of primary concern is the queuing in each of the side roads. The results are summarised in the tables below. (Table has been reproduced below)

Roundabout Model Results - AM Peak			
Approach	Queue Length		Average delay
	Existing (m)	Post Development (m)	
Castlereagh Road (south)	20.1	351.1	97s increase
Andrews Road (east)	30.1	1517.3	487s increase
Castlereagh Road (north)	26.4	148.3	15.7s increase
Old Castlereagh Road (west)	3.7	14.0	4.5s decrease

The performance of the roundabout at Andrew Road / Old Castlereagh Road / Castlereagh Road is not relevant to the modification. In any case, the performance of the roundabout is an approved impact as the Court ruled as follows:

"57 The entry into a voluntary planning agreement, and the certification of the Secretary dated 25 February 2022, means that the potential impacts on the surrounding state road network have been accommodated by the provision of a contribution for state and regional roads and do not need to be further considered."

It is important to note that Andrews Road is a bus corridor, and the impact of the development will lead to an 8 minute delay to buses as well as general traffic in the AM peak approaching the roundabout.

As noted above, the impacts of the site on the surrounding state road network are approved and this is not relevant to the subject modification.

It is also important to note that the 1202.8m queue in Old Castlereagh Road extends to the access road into the development which means that it is difficult to even enter Old Castlereagh Road in the PM peak hour.

As noted above, the impacts of the site on the surrounding state road network are approved and this is not relevant to the subject modification.

> *The review of the model also shows that the approach lanes in Lugard Street are modelled as two lanes, 500m long which is incorrect as kerb side parking is permitted in Lugard Street on approach to Castlereagh Road with only the last 20m signposted as 'No Stopping'. This means that the modelling results for the Lugard Street in terms of delays and queue lengths are also incorrect.*

The model has been updated to reflect the existing geometry of Lugard Street. An updated SIDRA INTERSECTION 9.1 assessment has been undertaken with the corrected model with the complete results presented in **Annexure C**. There is no relevant change in the results as a consequence of this slight adjustment of the model.

2 Department of Planning and Environment (DPIE) – DA 9876 MOD 1

The comments made within the DPIE Letter relevant to traffic are reproduced in the sections below, with MTE's response thereafter.

2.1 Matter Four – Traffic Distribution

> *It appears that 65% of traffic is proposed to enter the precinct via the Andrews Road roundabout and Old Castlereagh Road (as opposed to the 55% previously modelled). The report has not substantiated the rationale for the change but attributed it to 'the existing poor performance of the road corridor'. The traffic report has not explored the impacts of this traffic distribution to the roundabout or surrounding road network.*
>
> *No rationale for the changes in traffic distribution has been provided, noting that no changes are proposed to the subdivision layout that could influence a change in vehicle movements. The traffic report should also include an assessment of the impacts on the roundabout, including queue lengths for Andrews Road, Castlereagh Road and Old Castlereagh Road.*

The traffic distribution has been updated to incorporate the comments within the TfNSW Letter, assuming 50% to 70% of the development traffic utilising Castlereagh Road. Refer to **Section 1.1** for the detailed summary of the updated modelling. The updated SIDRA INTERSECTION 9.1 assessment results are presented in **Annexure C**.

2.2 Matter Five – Queue Lengths and Intersection Performance

> *The submitted Traffic Report prepared by McLaren Traffic Engineering dated 1 June 2023 indicates that the introduction of the left turn lane would result in a significant reduction in queue lengths (84.6m to 22.4m in AM and 136.1m to 8.6m in PM), yet it was concluded that "the addition of a dedicated left turn lane provides no performance improvements for either the left turn or the overall performance of the intersection.*
>
> *The Department does not support this finding and contends the significant reduction in queue lengths would result in an improvement of the intersection performance.*

This has been addressed in **Section 1.2**.

2.3 Matter Six – Traffic Generation

> *The use of the traffic volumes by TTPA is not supported. Whilst the figures have been utilised for 'sensitivity testing', the traffic volumes generate significantly less traffic volumes than the other figures which stem from a Roads and Maritime Services Technical Direction (RMS TDT2013/04a).*

The TTPA figures represent a significant underestimation beyond the standard industry measures used in traffic modelling and the Department requires that these figures are not used in any further report submitted.

The traffic volumes within the GHD Report have been used for the updated modelling and assessment.

Please contact the undersigned on 9521 7199 should you require further information or assistance.

Yours faithfully,
McLaren Traffic Engineering

Tom Steal
Senior Traffic Engineer
BE Civil AMAITPM MIEAust
TfNSW Accredited Level 2 Road Safety Auditor

ANNEXURE A: TFNSW LETTER

(8 SHEETS)

Transport for NSW

16 August 2023

TfNSW Reference: SYD23/00324/02
Council's Reference: DA 9876 MOD 1
Planning Portal Reference: CNR-52322

Chris Eldred
Key Sites & Regional Assessments
Department of Planning and Environment
Locked Bag 5022
PARRAMATTA NSW 2150

REMOVAL OF A LEFT TURN LANE ON CASTLEREAGH ROAD AT LUGARD STREET

Dear Chris,

Reference is made to the additional information provided by the applicant dated 1 June 2023, and the meeting held on 3 July 2023 regarding the abovementioned modification application which was referred to Transport for NSW (TfNSW) for assessment in accordance with clause 2.122 of the State Environmental Planning Policy (Transport and Infrastructure) 2021.

TfNSW has reviewed the submitted information including the traffic modelling and provides detailed comments in **TAB A.**

TfNSW notes that the development will significantly increase the volume of traffic turning left into Lugard Street from Castlereagh Road;

- from 54 vehicles per hour to 607 vehicles per hour in the AM peak hour which represents a 1024% increase, and
- from 19 vehicles per hour to 110 vehicles per hour in the PM peak hour which represents a 479% increase.

Considering the intensification of the left turn traffic volume into Lugard Street from Castlereagh Road, TfNSW reiterates the previous advice that TfNSW does not support the modification to remove development consent condition 23(b) which requires the developer to provide the left turn lane from Castlereagh Road into Lugard Street as the proposed road works are considered warranted and necessary to mitigate the impact on traffic flow and queuing in Castlereagh Road.

Furthermore, TfNSW has reviewed the existing intersection layout and notes that a left turn lane could be provided within the existing road reserve by reconstructing the central median, and reallocation of lane space between the kerbs of Castlereagh Road to allow the lateral shift of all lanes on both the approach and departure side of the intersection.

For more information of further details regarding the design requirements of the left turn lane, please contact Nav Prasad, Land Use Planner via email at development.sydney@transport.nsw.gov.au.

Yours sincerely,

David Rohloff
Senior Manager, Land Use Assessment West and Central
Planning and Programs Greater Sydney

TAB A

TfNSW has reviewed the submitted traffic report and traffic modelling and provides the following comments.

Traffic Distribution

- There are only two access points into the development:
    - Access 1 - Lugard Street via the traffic signal controlled intersection at Castlereagh Road and,
    - Access 2 - Old Castlereagh Road via roundabout controlled intersection at Andrews Road/Old Castlereagh Road/Castlereagh Road.
- The traffic report indicates that the traffic distribution for the development will be as shown in the table below.

TABLE 2: TRAFFIC DISTRIBUTION

Peak Hour	Direction	North Approach Castlereagh Rd		South Approach Castlereagh Rd		West Approach Lugard St	
		Right Turn	Through	Through	Left Turn	Right Turn	Left Turn
AM	IN	5%		0%	30%		
	OUT		0%			30%	5%
PM	IN	5%		0%	30%		
	OUT		0%			30%	5%

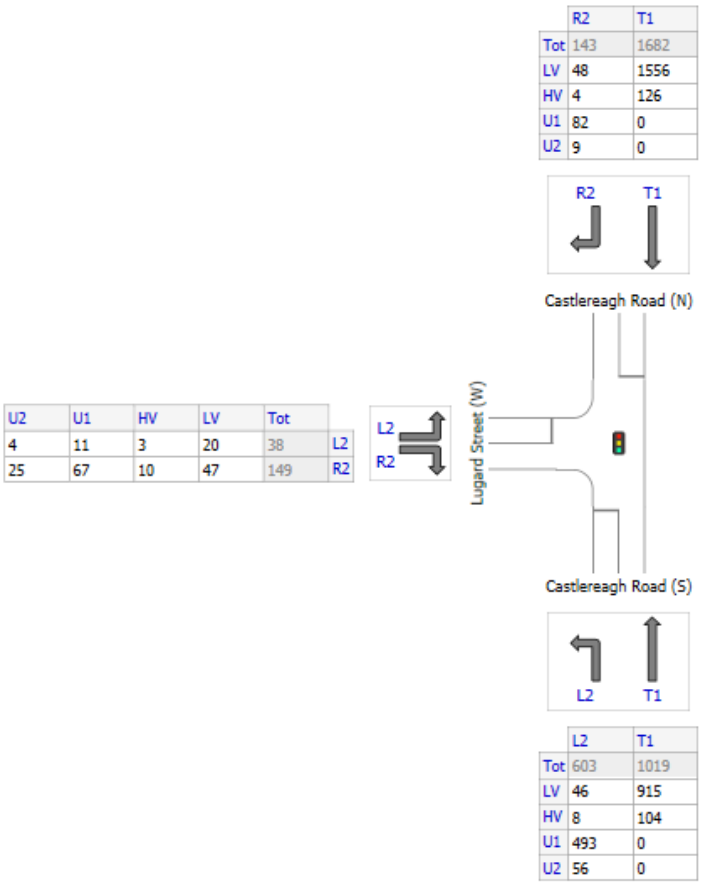
- Considering the location of the site in relation to the layout of the road network and the available routes that traffic would use to access the development, TfNSW disagree with the traffic distribution provided in the analysis and is of the opinion that 50 to 70% of development traffic would use Castlereagh Road from the south because:
    - Castlereagh Road/Mulgoa Road provides the main direct state road connection from the M4 Motorway and is the most likely route that would be used by traffic originating from area to the east, south and west of the site.
    - Andrews Road is a regional road with a single lane in each direction and only likely to be used by traffic originating from residential areas immediately to the east or north of the site.
    - It is unlikely that 5% of development traffic would continue southbound through the roundabout from Castlereagh Road and then turn right into Lugard Street to access the development and more likely that traffic would turn right to access the development directly from Access Point 2 in Old Castlereagh Road.

Traffic Generation

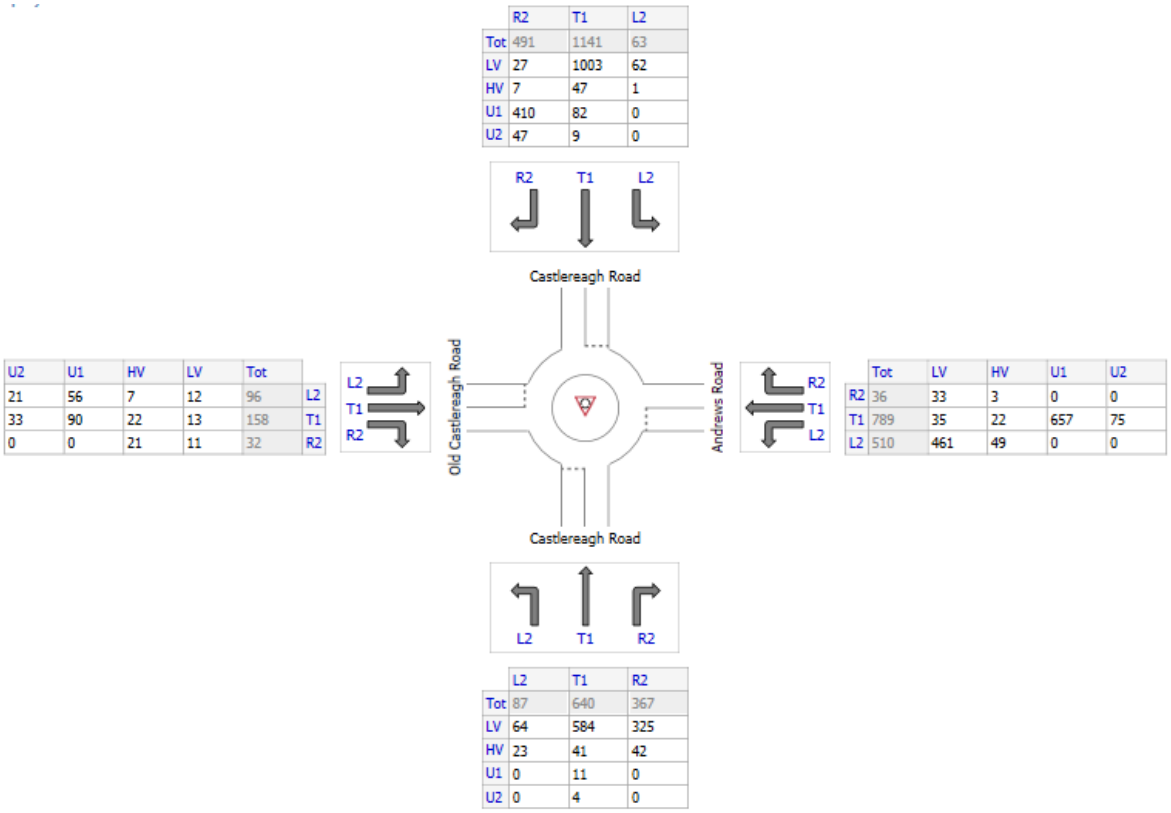
- TfNSW agrees with DPE's comments that the traffic impact assessment of the modification should use the land use percentage spilt and GFA spilt recommended in the GHD report, and the traffic generation results shown in the following table.

Precinct ID	Indicative Land Use	AM peak hour period Trip Generation			PM peak hour period Trip Generation			Weekend Peak hour period Trip Generation			Zoning / Use Status	Assumptions and Source
		In	Out	Total	In	Out	Total	In	Out	Total		
Employment Land	Industrial	749	187	**936**	202	807	**1,008**	0	0	**0**	Zoned land Likely use known	GFA is 55% of total land area, based on an economic report by the developer of the employment land detailing the likely development of the site 80% of the Area is industrial uses and 20% of the Area is office GFA were provided by DPIE: 75,000m2 for office and 180,000 for industrial Business parks and industrial estates peak hour trip generation rates for AM (0.52) and PM (0.56) from Page 2 in RMS TDT2013/04a Office blocks peak hour trip generation rates for AM (1.6) and PM (1.2) from Page 2 in RMS TDT2013/04a Assume no weekend trips due to land use type *Important note: previously DPE advised a 70% and 30% split of industrial and office. In the current revision supplied to GHD it was updated to 80% and 20%, hence updating total trips.*
	Office	1,080	120	**1,200**	90	810	**900**	0	0	**0**		
	Total	1,829	307	**2,136**	292	1,617	**1,908**	0	0	**0**		

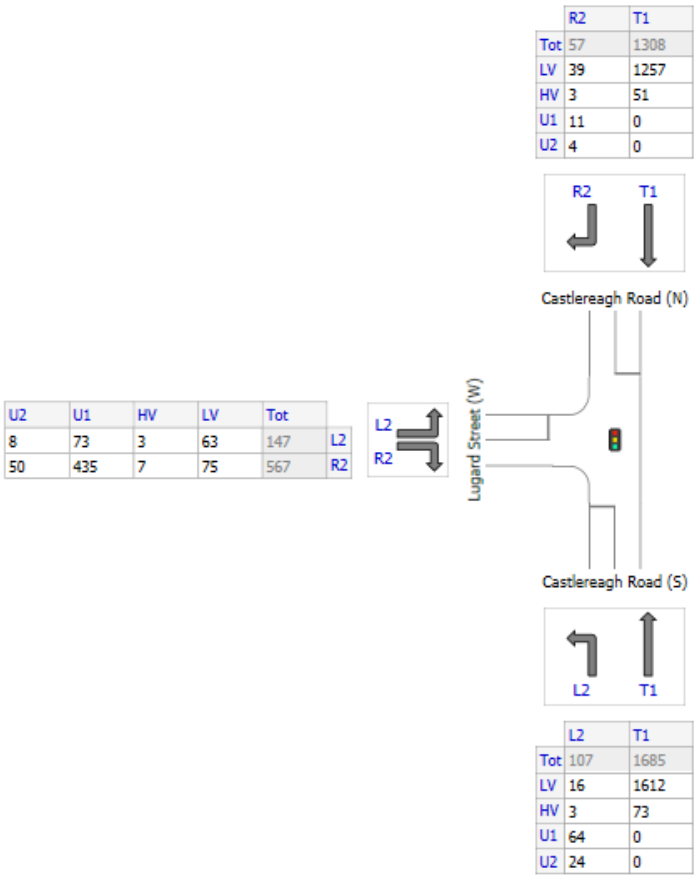
- From the table above the proposed development will generate:
  - 1829 inbound and 307 outbound vehicle trips in the AM peak hour and,
  - 292 inbound and 1617 outbound vehicle trips in the PM peak hour.
- The post development traffic volumes for the traffic signal controlled intersection at Lugard Street/Castlereagh Road and the roundabout controlled intersection at Andrews Road/Old Castlereagh Road/Castlereagh Road Andrews are shown in the following figures for the AM and PM peak periods.



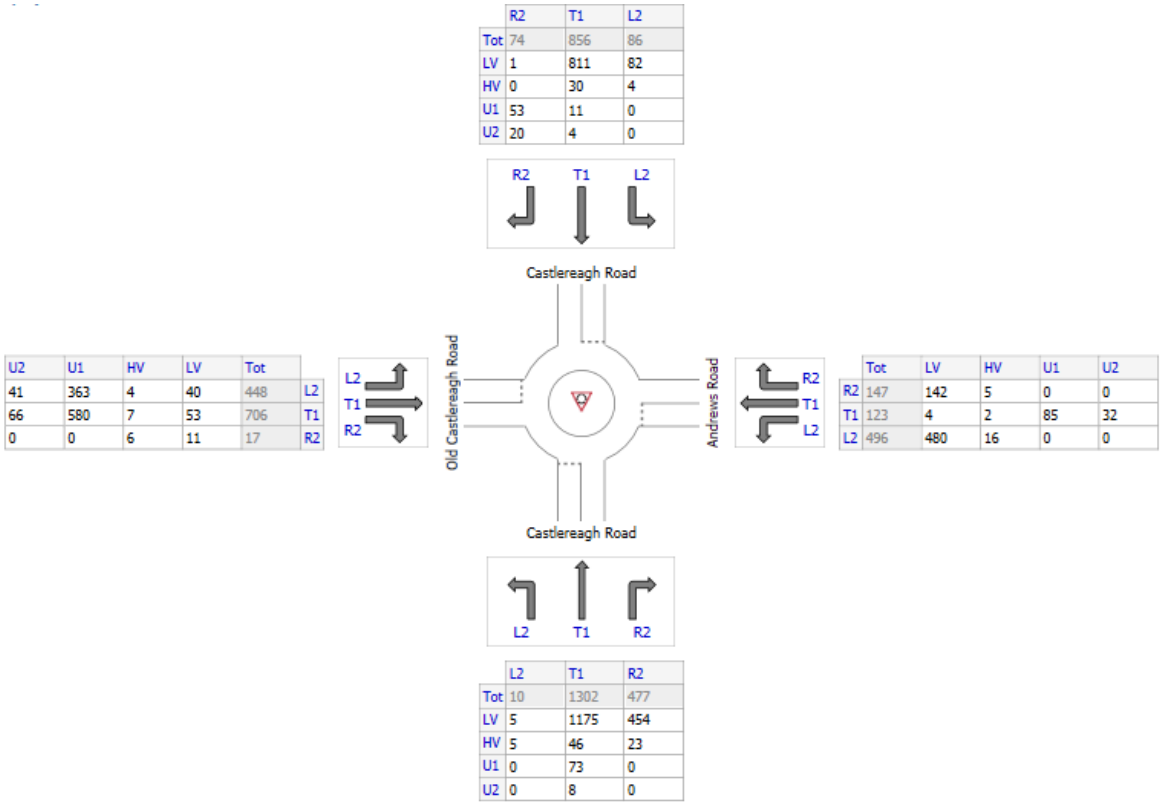
AM Peak - Lugard Street/Castlereagh Road



AM Peak - Andrews Road/Old Castlereagh Road/Castlereagh Road



PM Peak - Lugard Street/Castlereagh Road



PM Peak - Andrews Road/Old Castlereagh Road/Castlereagh Road

- Analysis of the traffic generation distribution to the two intersections is provided in the table below.

AM Peak Development Inbound Traffic Distribution					
Access Point	Movement	Volume		Total	
		Cars	Trucks	Number	%
Access Point 1	LT into Lugard Street from Castlereagh Road	493	56	549	30
	RT into Lugard Street from Castlereagh Road	82	9	91	5
Access Point 2	Through movement from Andrews Road into Old Castlereagh Road	657	75	732	40
	RT from Castlereagh Road into Old Castlereagh Road	410	47	457	25
Total		1642	187	1829	100

PM Peak Development Outbound Traffic Distribution					
Access Point	Movement	Volume		Total	
		Cars	Trucks	Number	%
Access Point 1	LT from Lugard Street into Castlereagh Road	73	8	81	5
	RT from Lugard Street into Castlereagh Road	435	50	485	30
Access Point 2	LT from Old Castlereagh Road into Castlereagh Road	363	41	404	25
	Through movement from Old Castlereagh Road into Andrews Road	580	66	646	40
Total		1451	165	1616	100

Traffic Impact on Road Network

- The impact of the traffic generated on the road network is significant and will lead to extensive queuing and congestion of Castlereagh Road at both Lugard Street and the roundabout at Andrews Road/Old Castlereagh Road/Castlereagh Road in both the AM and PM peak periods and evident in the traffic model results.
- Table 4 in the traffic report (extract in the figure below) shows the future left tune traffic demand (based on the traffic modelling and a distribution that 30% of inbound trips and existing trips would turn left into Lugard Street) indicates that 607 vehicles in the AM peak hour and 110 vehicles in the PM peak hour would turn left at Lugard Street.

TABLE 4: INTERSECTION PERFORMANCE – LEFT TURN FROM SOUTH ONLY

Case	AM			PM		
	Left Turn Demand (veh)	Left Turn Delay (s)	Left Turn Queue (m)(1)	Left Turn Demand (veh)	Left Turn Delay (s)	Left Turn Queue (m)(1)
GHD Volumes – No LT Lane	607	6.4	84.6	110	6.1	136.1
GHD Volumes – LT Lane	607	6.2	22.4	110	8.1	8.6
TTPA Volumes – No LT Lane	191	6.2	76.8	94	6.1	130.8
TTPA Volumes – LT Lane	191	6.1	5.1	94	8.1	7.3

Notes:

(1) Where no left turn lane is provided, the queue expressed is for the kerbside lane which serves both left turn and through movements.

- The impact of queuing of not providing the left turn as conditioned from Castlereagh Road into Lugard Street is significant with queues of 84.6m in the AM peak and 136.1m in the PM peak. Once again it is important to note that this is based on trip distribution of 30% of development traffic turning left which TfNSW do not agree with. The queuing is likely to be much higher should more traffic be distributed to turn left into Lugard Street.
- The provision of the left turn lane as conditioned from Castlereagh Road into Lugard Street would reduce the AM peak hour queue for the left turn to 22.4m in the AM peak which represents a 74% reduction in queue length. Similarly, the PM peak hour queue for the left turn is reduced to 8.6m which represents a 94% reduction. This is due to the traffic signal phasing which allows the left turn movement to be given a green signal when Lugard Street is given a green signal.
- After review of the model, it is noted that the right turn into Lugard Street from Castlereagh Road is also significantly impacted by the traffic generated by the development with queues of 179.5m in the AM peak which indicates it queues out of the right turn bay significantly and would impact traffic flow in the southbound direction of Castlereagh Road. This results from distributing 5% of the development traffic to turn right to enter the development from Lugard Street. As previously indicated TfNSW do not agree that 5% of traffic would turn right into Lugard Street from Castlereagh Road.
- It is noted that Andrews Road is a regional road with a single lane in each direction and provides residential access to Cranbrook. The existing traffic volumes in Andrews Road are 623 vehicles in the AM peak and 704 vehicles in the PM peak. The distribution of the traffic generated by the development adds 732 vehicles to the existing traffic volume in the AM peak to a total of 1355 vehicles and 646 vehicles in the PM peak to a total of 1350 vehicles.
- It is important to note that an assessment of the roundabout at Andrews Road/Old Castlereagh Road/Castlereagh Road has not been provided in the report to determine the impact of operation of the roundabout.
- The review of the model indicates that the roundabout performance is severely impacted and reduces from a level of service A to a level of service F in both the AM and PM peak hours. Of primary concern is the queuing in each of the side roads. The results are summarised in the tables below.

Roundabout Model Results - AM Peak			
Approach	Queue Length		Average delay
	Existing (m)	Post Development (m)	
Castlereagh Road (south)	20.1	351.1	97s increase
Andrews Road (east)	30.1	1517.3	487s increase
Castlereagh Road (north)	26.4	148.3	15.7s increase
Old Castlereagh Road (west)	3.7	14.0	4.5s decrease

Roundabout Model Results - PM Peak			
Approach	Queue Length		Average delay
	Existing (m)	Post Development (m)	
Castlereagh Road (south)	5.5	94.7	5.3s increase
Andrews Road (east)	8.4	33	0.9s increase
Castlereagh Road (north)	6.5	166.7	38.8s increase
Old Castlereagh Road (west)	11.7	1202.8	415.3s increase

- It is important to note that Andrews Road is a bus corridor, and the impact of the development will lead to an 8 minute delay to buses as well as general traffic in the AM peak approaching the roundabout.
- It is also important to note that the 1202.8m queue in Old Castlereagh Road extends to the access road into the development which means that it is difficult to even enter Old Castlereagh Road in the PM peak hour.
- The review of the model also shows that the approach lanes in Lugard Street are modelled as two lanes, 500m long which is incorrect as kerb side parking is permitted in Lugard Street on approach to Castlereagh Road with only the last 20m signposted as 'No Stopping'. This means that the modelling results for the Lugard Street in terms of delays and queue lengths are also incorrect.

ANNEXURE B: DPIE LETTER

(3 SHEETS)

Department of Planning and Environment

Our ref: DA 9876 MOD 1

Great River NSW Pty Ltd
Edward Sutton
12 Barrack Street,
Sydney NSW 2000

17 August 2023

Subject: Request for Information – DA 9876 MOD 1

Dear Mr Sutton,

I refer to the above modification application to the Penrith Lakes Employment Lands Subdivision and Construction Works (DA 9876).

The Department has reviewed the RtS package and has received advice from Transport for NSW (TfNSW) on the RtS package (letter dated 16 August 2023).

The Department raise concern with the assumptions made within the traffic modelling, as well as the conclusions reached, as detailed in **Appendix A**.

Please note, that at this stage the Department does not support the modification as it is currently presented, and it is recommended that the application be withdrawn as further assessment would likely result in a refusal. Alternatively, additional information can be provided to address the issues raised in **Appendix A** and the issues TfNSW raised in their letter dated 16 August 2023.

TfNSW have advised that the left turn deceleration lane could be delivered within the existing road reserve without the need for land acquisitions via a lateral shift of the existing lanes on Castlereagh Road. It is recommended that this be explored.

The Department requests a response by 31 August 2023 via the NSW Planning Portal. If you cannot meet this deadline or do not intend to withdraw or provide the additional information, please advise the Department via the NSW planning portal. At the date of this letter, 119 days in the assessment period have elapsed.

If you have any questions, please contact Chris Eldred on 02 8289 6855 or via email at christopher.eldred@planning.nsw.gov.au .

Yours sincerely,

Keiran Thomas
Director
Regional Assessments

as delegate for the Planning Secretary

APPENDIX A

1. Traffic Distribution

- There appears to have been a significant change in the assumptions around traffic distribution between the January 2023 Report and June 2023 Report prepared by McLaren Traffic Engineering:

January 2023 Report

TABLE 4: TRAFFIC DISTRIBUTION

Peak Time	Direction	North Approach Castlereagh Rd		South Approach Castlereagh Rd		West Approach Lugard St	
		Right Turn	Through	Through	Left Turn	Right Turn	Left Turn
AM	IN	15%		5%	25%		
	OUT		5%			15%	25%
PM	IN	15%		5%	25%		
	OUT		5%			15%	25%

June 2023 Report

TABLE 2: TRAFFIC DISTRIBUTION

Peak Hour	Direction	North Approach Castlereagh Rd		South Approach Castlereagh Rd		West Approach Lugard St	
		Right Turn	Through	Through	Left Turn	Right Turn	Left Turn
AM	IN	5%		0%	30%		
	OUT		0%			30%	5%
PM	IN	5%		0%	30%		
	OUT		0%			30%	5%

- It appears that 65% of traffic is proposed to enter the precinct via the Andrews Road roundabout and Old Castlereagh Road (as opposed to the 55% previously modelled). The report has not substantiated the rationale for the change but attributed it to *'the existing poor performance of the road corridor'*. The traffic report has not explored the impacts of this traffic distribution to the roundabout or surrounding road network.
- No rationale for the changes in traffic distribution has been provided, noting that no changes are proposed to the subdivision layout that could influence a change in vehicle movements. The traffic report should also include an assessment of the impacts on the roundabout, including queue lengths for Andrews Road, Castlereagh Road and Old Castlereagh Road.

2. Queue Lengths and Intersection Performance

- The submitted Traffic Report prepared by McLaren Traffic Engineering dated 1 June 2023 indicates that the introduction of the left turn lane would result in a significant reduction in queue lengths (84.6m to 22.4m in AM and 136.1m to 8.6m in PM), yet it was concluded that *"the addition of a dedicated left turn lane provides no performance improvements for either the left turn or the overall performance of the intersection".*
- The Department does not support this finding and contends the significant reduction in queue lengths would result in an improvement of the intersection performance.

3. Traffic Generation

- The use of the traffic volumes by TTPA is not supported. Whilst the figures have been utilised for 'sensitivity testing', the traffic volumes generate significantly less traffic volumes than the other figures which stem from a Roads and Maritime Services Technical Direction (RMS TDT2013/04a).
- The TTPA figures represent a significant underestimation beyond the standard industry measures used in traffic modelling and the Department requires that these figures are not used in any further report submitted.

4. TfNSW Advice 16 August 2023

- The Department concurs with all comments raised by TfNSW.

ANNEXURE C: SIDRA INTERSECTION 9.1 RESULTS
(16 SHEETS)

LANE SUMMARY

Site: 101 [AM EX - Lugard / Castlereagh (Site Folder: Existing + DEV (GHD Vols) (50%))]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [AM EX (Network Folder: Existing + DEV (GHD Vols) (50%))]

New Site
Site Category: Existing Design
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 120 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Castlereagh Road (S)															
Lane 1	1039	11.0	1039	11.0	1526	0.681	100	6.4	LOS A	9.5	73.0	Full	425	0.0	0.0
Lane 2	981	11.0	981	11.0	1441	0.681	100	6.0	LOS A	25.4	194.6	Full	425	0.0	0.0
Approach	2019	11.0	2019	11.0		0.681		6.2	LOS A	25.4	194.6				
North: Castlereagh Road (N)															
Lane 1	890	8.8	890	8.8	1461	0.610	100	2.0	LOS A	11.3	85.1	Full	450	0.0	0.0
Lane 2	890	8.8	890	8.8	1461	0.610	100	2.0	LOS A	11.3	85.1	Full	450	0.0	0.0
Lane 3	53	8.3	53	8.3	79	0.674	100	39.3	LOS C	2.9	22.0	Short	80	0.0	NA
Approach	1834	8.7	1834	8.7		0.674		3.1	LOS A	11.3	85.1				
West: Lugard Street (W)															
Lane 1	39	19.4	39	19.4	177	0.220	100	87.8	LOS F	2.1	17.5	Short (P)	20	0.0	NA
Lane 2	152	24.6	152	24.6	151[1]	1.005	100	138.4	LOS F	12.7	107.5	Full	500	0.0	0.0
Approach	191	23.5	191	23.5		1.005		128.1	LOS F	12.7	107.5				
All Vehicles	4044	10.6	4044	10.6		1.005		10.5	LOS A	25.4	194.6				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Delay and stops experienced by drivers upstream of short lane entry have been accounted for.

Approach Lane Flows (veh/h)

South: Castlereagh Road (S)

Mov. From S To Exit:	L2 W	T1 N	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	975	63	1039	11.0	1526	0.681	100	NA	NA
Lane 2	-	981	981	11.0	1441	0.681	100	NA	NA
Approach	975	1044	2019	11.0		0.681			

North: Castlereagh Road (N)

Mov. From N To Exit:	T1 S	R2 W	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	890	-	890	8.8	1461	0.610	100	NA	NA

Lane 2	890	-	890	8.8	1461	0.610	100	NA	NA
Lane 3	-	53	53	8.3	79	0.674	100	0.0	2
Approach	1781	53	1834	8.7		0.674			
West: Lugard Street (W)									
Mov. From W To Exit:	L2 N	R2 S	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	39	-	39	19.4	177	0.220	100	0.0	2
Lane 2	-	152	152	24.6	151[1]	1.005	100	NA	NA
Approach	39	152	191	23.5		1.005			
	Total	%HV	Deg.Satn (v/c)						
All Vehicles	4044	10.6	1.005						

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Delay and stops experienced by drivers upstream of short lane entry have been accounted for.

Merge Analysis

	Exit Lane Number	Short Lane Length m	Percent Opng in Lane %	Opposing Flow Rate veh/h	Opposing Flow Rate pcu/h	Critical Gap sec	Follow-up Headway sec	Lane Flow Rate veh/h	Capacity veh/h	Deg. Satn v/c	Min. Delay sec	Merge Delay sec
There are no Exit Short Lanes for Merge Analysis at this Site.												

Variable Demand Analysis

	Initial Queued Demand veh	Residual Queued Demand veh	Time for Residual Demand to Clear sec	Duration of Oversatn sec
South: Castlereagh Road (S)				
Lane 1	0.0	0.0	0.0	0.0
Lane 2	0.0	0.0	0.0	0.0
North: Castlereagh Road (N)				
Lane 1	0.0	0.0	0.0	0.0
Lane 2	0.0	0.0	0.0	0.0
Lane 3	0.0	0.0	0.0	0.0
West: Lugard Street (W)				
Lane 1	0.0	0.0	0.0	0.0
Lane 2	0.0	0.4	9.2	NA

LANE SUMMARY

Site: 101 [PM EX - Lugard / Castlereagh (Site Folder: Existing + DEV (GHD Vols) (50%))]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [PM EX (Network Folder: Existing + DEV (GHD Vols) (50%))]

New Site
Site Category: Existing Design
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 120 seconds (Site User-Given Phase Times)

Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Castlereagh Road (S)															
Lane 1	999	7.9	999	7.9	1319	0.758	100	5.3	LOS A	20.9	156.5	Full	425	0.0	0.0
Lane 2	1031	4.1	1031	4.1	1361	0.758	100	2.9	LOS A	18.6	134.9	Full	425	0.0	0.0
Approach	2030	6.0	2030	6.0		0.758		4.1	LOS A	20.9	156.5				
North: Castlereagh Road (N)															
Lane 1	966	5.0	822	4.7	776	1.060	100	112.5	LOS F	83.1	605.2	Full	450	-42.8 N3	32.0
Lane 2	804	5.0	684	4.7	645 1	1.060	100	117.2	LOS F	70.5	513.7	Full	450	-42.8 N3	17.0
Lane 3	46	6.8	41	6.6	82	0.498	100	28.1	LOS B	1.7	12.9	Short	80	0.0	NA
Approach	1816	5.0	1547	4.8		1.060		112.3	LOS F	83.1	605.2				
West: Lugard Street (W)															
Lane 1	154	7.5	154	7.5	103 1	1.504	100	571.0	LOS F	27.8	207.1	Short (P)	20	0.0	NA
Lane 2	578	10.4	578	10.4	168 1	3.440	100	2307.9	LOS F	178.1	1357.8	Full	500	-42.8 N3	99.5
Approach	732	9.8	732	9.8		3.440		1941.9	LOS F	178.1	1357.8				
All Vehicles	4579	6.2	4310	6.6		3.440		372.2	LOS F	178.1	1357.8				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Delay and stops experienced by drivers upstream of short lane entry have been accounted for.
N3 Capacity Adjustment due to downstream lane blockage determined by the program.

Approach Lane Flows (veh/h)

South: Castlereagh Road (S)

Mov. From S To Exit:	L2 W	T1 N	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	169	830	999	7.9	1319	0.758	100	NA	NA
Lane 2	-	1031	1031	4.1	1361	0.758	100	NA	NA
Approach	169	1861	2030	6.0		0.758			

North: Castlereagh Road (N)

Mov. From N To Exit:	T1 S	R2 W	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.

Lane 1	822	-	822	4.7	776	1.060	100	NA	NA
Lane 2	684	-	684	4.7	645[1]	1.060	100	NA	NA
Lane 3	-	41	41	6.6	82	0.498	100	0.0	2
Approach	1506	41	1547	4.8		1.060			
West: Lugard Street (W)									
Mov. From W To Exit:	L2 N	R2 S	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	154	-	154	7.5	103[1]	1.504	100	100.0	2
Lane 2	-	578	578	10.4	168[1]	3.440	100	NA	NA
Approach	154	578	732	9.8		3.440			
	Total	%HV	Deg.Satn (v/c)						
All Vehicles	4310	6.6	3.440						

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Delay and stops experienced by drivers upstream of short lane entry have been accounted for.

Merge Analysis

	Exit Lane Number	Short Lane Length m	Percent Opng in Lane %	Opposing Flow Rate veh/h	Critical Gap pcu/h	Follow-up Headway sec	Lane Flow Rate sec	Capacity veh/h	Deg. Satn veh/h	Min. Delay v/c	Merge Delay sec	sec
There are no Exit Short Lanes for Merge Analysis at this Site.												

Variable Demand Analysis

	Initial Queued Demand veh	Residual Queued Demand veh	Time for Residual Demand to Clear sec	Duration of Oversatn sec
South: Castlereagh Road (S)				
Lane 1	0.0	0.0	0.0	0.0
Lane 2	0.0	0.0	0.0	0.0
North: Castlereagh Road (N)				
Lane 1	0.0	23.3	108.2	NA
Lane 2	0.0	19.4	108.2	NA
Lane 3	0.0	0.0	0.0	0.0
West: Lugard Street (W)				
Lane 1	0.0	25.9	907.5	NA
Lane 2	0.0	205.0	4392.6	NA

LANE SUMMARY

Site: 101 [AM EX - Lugard / Castlereagh (Site Folder: Existing + DEV (GHD Vols) (50%) - Lugard with LT Lane)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [AM EX w LT (Network Folder: Existing + DEV - Lugard with LT Lane (GHD Vols))]

New Site
Site Category: Existing Design
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 120 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Castlereagh Road (S)															
Lane 1	975	11.0	975	11.0	1549	0.630	100	6.4	LOS A	7.1	54.0	Short	60	0.0	NA
Lane 2	522	11.0	522	11.0	1441	0.362	100	3.8	LOS A	8.7	66.8	Full	425	0.0	0.0
Lane 3	522	11.0	522	11.0	1441	0.362	100	3.8	LOS A	8.7	66.8	Full	425	0.0	0.0
Approach	2019	11.0	2019	11.0		0.630		5.1	LOS A	8.7	66.8				
North: Castlereagh Road (N)															
Lane 1	890	8.8	890	8.8	1461	0.610	100	2.0	LOS A	11.3	85.1	Full	450	0.0	0.0
Lane 2	890	8.8	890	8.8	1461	0.610	100	2.0	LOS A	11.3	85.1	Full	450	0.0	0.0
Lane 3	53	8.3	53	8.3	77	0.694	100	33.5	LOS C	2.7	19.9	Short	80	0.0	NA
Approach	1834	8.7	1834	8.7		0.694		2.9	LOS A	11.3	85.1				
West: Lugard Street (W)															
Lane 1	39	19.4	39	19.4	109	0.357	100	94.7	LOS F	2.3	18.9	Short (P)	20	0.0	NA
Lane 2	152	24.6	152	24.6	151[1]	1.005	100	138.4	LOS F	12.7	107.5	Full	500	0.0	0.0
Approach	191	23.5	191	23.5		1.005		129.5	LOS F	12.7	107.5				
All Vehicles	4044	10.6	4044	10.6		1.005		10.0	LOS A	12.7	107.5				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Delay and stops experienced by drivers upstream of short lane entry have been accounted for.

Approach Lane Flows (veh/h)

South: Castlereagh Road (S)

Mov. From S To Exit:	L2 W	T1 N	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	975	-	975	11.0	1549	0.630	100	0.0	2
Lane 2	-	522	522	11.0	1441	0.362	100	NA	NA
Lane 3	-	522	522	11.0	1441	0.362	100	NA	NA
Approach	975	1044	2019	11.0		0.630			

North: Castlereagh Road (N)

Mov.	T1	R2	Total	%HV		Deg.	Lane	Prob.	Ov.

From N To Exit:	S	W			Cap. veh/h	Satn v/c	Util. %	SL Ov. %	Lane No.
Lane 1	890	-	890	8.8	1461	0.610	100	NA	NA
Lane 2	890	-	890	8.8	1461	0.610	100	NA	NA
Lane 3	-	53	53	8.3	77	0.694	100	0.0	2
Approach	1781	53	1834	8.7		0.694			
West: Lugard Street (W)									
Mov. From W To Exit:	L2 N	R2 S	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	39	-	39	19.4	109	0.357	100	0.0	2
Lane 2	-	152	152	24.6	151[1]	1.005	100	NA	NA
Approach	39	152	191	23.5		1.005			

	Total	%HV	Deg.Satn (v/c)
All Vehicles	4044	10.6	1.005

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Delay and stops experienced by drivers upstream of short lane entry have been accounted for.

Merge Analysis

Exit Lane Number	Short Lane Length m	Percent Opng in Lane %	Opposing Flow Rate veh/h	Critical Gap pcu/h	Follow-up Headway sec	Lane Flow Rate sec	Capacity veh/h	Deg. Satn veh/h	Min. Delay v/c	Merge Delay sec	sec
There are no Exit Short Lanes for Merge Analysis at this Site.											

Variable Demand Analysis

	Initial Queued Demand veh	Residual Queued Demand veh	Time for Residual Demand to Clear sec	Duration of Oversatn sec
South: Castlereagh Road (S)				
Lane 1	0.0	0.0	0.0	0.0
Lane 2	0.0	0.0	0.0	0.0
Lane 3	0.0	0.0	0.0	0.0
North: Castlereagh Road (N)				
Lane 1	0.0	0.0	0.0	0.0
Lane 2	0.0	0.0	0.0	0.0
Lane 3	0.0	0.0	0.0	0.0
West: Lugard Street (W)				
Lane 1	0.0	0.0	0.0	0.0
Lane 2	0.0	0.4	9.2	NA

LANE SUMMARY

Site: 101 [PM EX - Lugard / Castlereagh (Site Folder: Existing + DEV (GHD Vols) (50%) - Lugard with LT Lane)]

Output produced by SIDRA INTERSECTION Version: 9.1.4.221

Network: N101 [PM EX w LT (Network Folder: Existing + DEV - Lugard with LT Lane (GHD Vols))]

New Site
Site Category: Existing Design
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 120 seconds (Site User-Given Phase Times)

Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Castlereagh Road (S)															
Lane 1	169	26.8	169	26.8	1403	0.120	100	6.2	LOS A	0.6	4.9	Short	60	0.0	NA
Lane 2	931	4.1	931	4.1	1361	0.684	100	2.6	LOS A	13.9	100.6	Full	425	0.0	0.0
Lane 3	931	4.1	931	4.1	1361	0.684	100	2.6	LOS A	13.9	100.6	Full	425	0.0	0.0
Approach	2030	6.0	2030	6.0		0.684		2.9	LOS A	13.9	100.6				
North: Castlereagh Road (N)															
Lane 1	983	5.0	836	4.7	786	1.064	100	115.2	LOS F	85.1	619.4	Full	450	-42.1 N3	34.1
Lane 2	787	5.0	670	4.7	629 1	1.064	100	120.8	LOS F	69.8	508.3	Full	450	-42.1 N3	16.0
Lane 3	46	6.8	41	6.6	76	0.539	100	25.6	LOS B	1.7	12.7	Short	80	0.0	NA
Approach	1816	5.0	1547	4.7		1.064		115.2	LOS F	85.1	619.4				
West: Lugard Street (W)															
Lane 1	154	7.5	154	7.5	103 1	1.501	100	567.8	LOS F	27.7	206.5	Short (P)	20	0.0	NA
Lane 2	578	10.4	578	10.4	170 1	3.403	100	2274.3	LOS F	177.5	1352.9	Full	500	-42.1 N3	99.1
Approach	732	9.8	732	9.8		3.403		1914.7	LOS F	177.5	1352.9				
All Vehicles	4579	6.2	4309	6.6		3.403		368.1	LOS F	177.5	1352.9				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Delay and stops experienced by drivers upstream of short lane entry have been accounted for.
N3 Capacity Adjustment due to downstream lane blockage determined by the program.

Approach Lane Flows (veh/h)

South: Castlereagh Road (S)

Mov. From S To Exit:	L2 W	T1 N	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	169	-	169	26.8	1403	0.120	100	0.0	2
Lane 2	-	931	931	4.1	1361	0.684	100	NA	NA
Lane 3	-	931	931	4.1	1361	0.684	100	NA	NA
Approach	169	1861	2030	6.0		0.684			
North: Castlereagh Road (N)									

Mov. From N To Exit:	T1 S	R2 W	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	836	-	836	4.7	786	1.064	100	NA	NA
Lane 2	670	-	670	4.7	629[1]	1.064	100	NA	NA
Lane 3	-	41	41	6.6	76	0.539	100	0.0	2
Approach	1506	41	1547	4.7		1.064			
West: Lugard Street (W)									
Mov. From W To Exit:	L2 N	R2 S	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	154	-	154	7.5	103[1]	1.501	100	100.0	2
Lane 2	-	578	578	10.4	170[1]	3.403	100	NA	NA
Approach	154	578	732	9.8		3.403			

	Total	%HV	Deg.Satn (v/c)
All Vehicles	4309	6.6	3.403

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Delay and stops experienced by drivers upstream of short lane entry have been accounted for.

Merge Analysis

Exit Lane Number	Short Lane Length m	Percent Opng in Lane %	Opposing Flow Rate veh/h	Opposing Flow Rate pcu/h	Critical Gap sec	Follow-up Headway sec	Lane Flow Rate veh/h	Capacity veh/h	Deg. Satn v/c	Min. Delay sec	Merge Delay sec
There are no Exit Short Lanes for Merge Analysis at this Site.											

Variable Demand Analysis

	Initial Queued Demand veh	Residual Queued Demand veh	Time for Residual Demand to Clear sec	Duration of Oversatn sec
South: Castlereagh Road (S)				
Lane 1	0.0	0.0	0.0	0.0
Lane 2	0.0	0.0	0.0	0.0
Lane 3	0.0	0.0	0.0	0.0
North: Castlereagh Road (N)				
Lane 1	0.0	25.3	116.0	NA
Lane 2	0.0	20.3	116.0	NA
Lane 3	0.0	0.0	0.0	0.0
West: Lugard Street (W)				
Lane 1	0.0	25.7	901.2	NA
Lane 2	0.0	204.1	4325.7	NA

LANE SUMMARY

Site: 101 [AM EX - Lugard / Castlereagh (Site Folder: Existing + DEV (GHD Vols) (70%))]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [AM EX (Network Folder: Existing + DEV (GHD Vols) (70%))]

New Site
Site Category: Existing Design
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 120 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Castlereagh Road (S)															
Lane 1	1342	10.9	1342	10.9	1551	0.866	100	7.7	LOS A	24.2	185.6	Full	425	0.0	0.0
Lane 2	1044	11.0	1044	11.0	1441	0.724	84[5]	6.4	LOS A	29.3	224.1	Full	425	0.0	0.0
Approach	2386	11.0	2386	11.0		0.866		7.2	LOS A	29.3	224.1				
North: Castlereagh Road (N)															
Lane 1	898	9.0	898	9.0	1459	0.616	100	2.0	LOS A	11.6	87.1	Full	450	0.0	0.0
Lane 2	898	9.0	898	9.0	1459	0.616	100	2.0	LOS A	11.6	87.1	Full	450	0.0	0.0
Lane 3	53	8.3	53	8.3	66	0.804	100	65.3	LOS E	4.0	29.7	Short	80	0.0	NA
Approach	1850	9.0	1850	9.0		0.804		3.8	LOS A	11.6	87.1				
West: Lugard Street (W)															
Lane 1	39	19.4	39	19.4	177	0.220	100	94.5	LOS F	2.1	17.5	Short (P)	20	0.0	NA
Lane 2	199	25.2	199	25.2	155[1]	1.284	100	365.9	LOS F	28.3	240.6	Full	500	0.0	0.0
Approach	238	24.2	238	24.2		1.284		321.6	LOS F	28.3	240.6				
All Vehicles	4474	10.8	4474	10.8		1.284		22.5	LOS B	29.3	240.6				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Delay and stops experienced by drivers upstream of short lane entry have been accounted for.
5 Lane under-utilisation found by the program

Approach Lane Flows (veh/h)

South: Castlereagh Road (S)

Mov. From S To Exit:	L2 W	T1 N	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	1342	-	1342	10.9	1551	0.866	100	NA	NA
Lane 2	-	1044	1044	11.0	1441	0.724	84[5]	NA	NA
Approach	1342	1044	2386	11.0		0.866			

North: Castlereagh Road (N)

Mov. From N To Exit:	T1 S	R2 W	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.

Lane 1	898	-	898	9.0	1459	0.616	100	NA	NA
Lane 2	898	-	898	9.0	1459	0.616	100	NA	NA
Lane 3	-	53	53	8.3	66	0.804	100	0.0	2
Approach	1797	53	1850	9.0		0.804			
West: Lugard Street (W)									
Mov. From W To Exit:	L2 N	R2 S	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	39	-	39	19.4	177	0.220	100	0.0	2
Lane 2	-	199	199	25.2	155[1]	1.284	100	NA	NA
Approach	39	199	238	24.2		1.284			

	Total	%HV	Deg.Satn (v/c)
All Vehicles	4474	10.8	1.284

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Delay and stops experienced by drivers upstream of short lane entry have been accounted for.
5 Lane under-utilisation found by the program

Merge Analysis

	Exit Lane Number	Short Lane Length m	Percent Opng in Lane %	Opposing Flow Rate veh/h	Critical Gap pcu/h	Follow-up Headway sec	Lane Flow Rate sec veh/h	Capacity veh/h	Deg. Satn v/c	Min. Delay sec	Merge Delay sec
There are no Exit Short Lanes for Merge Analysis at this Site.											

Variable Demand Analysis

	Initial Queued Demand veh	Residual Queued Demand veh	Time for Residual Demand to Clear sec	Duration of Oversatn sec
South: Castlereagh Road (S)				
Lane 1	0.0	0.0	0.0	0.0
Lane 2	0.0	0.0	0.0	0.0
North: Castlereagh Road (N)				
Lane 1	0.0	0.0	0.0	0.0
Lane 2	0.0	0.0	0.0	0.0
Lane 3	0.0	0.0	0.0	0.0
West: Lugard Street (W)				
Lane 1	0.0	0.0	0.0	0.0
Lane 2	0.0	22.0	511.8	NA

LANE SUMMARY

Site: 101 [AM EX - Lugard / Castlereagh (Site Folder: Existing + DEV (GHD Vols) (70%) - Lugard with LT Lane)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [AM EX w LT (Network Folder: Existing + DEV - Lugard with LT Lane (GHD Vols) (70%))]

New Site
Site Category: Existing Design
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 120 seconds (Site User-Given Cycle Time)

Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Castlereagh Road (S)															
Lane 1	1342	10.9	1342	10.9	1551	0.866	100	7.7	LOS A	24.2	185.6	Short	120	0.0	NA
Lane 2	522	11.0	522	11.0	1441	0.362	100	3.8	LOS A	8.7	66.8	Full	425	0.0	0.0
Lane 3	522	11.0	522	11.0	1441	0.362	100	3.8	LOS A	8.7	66.8	Full	425	0.0	0.0
Approach	2386	11.0	2386	11.0		0.866		6.0	LOS A	24.2	185.6				
North: Castlereagh Road (N)															
Lane 1	898	9.0	898	9.0	1459	0.616	100	2.0	LOS A	11.6	87.1	Full	450	0.0	0.0
Lane 2	898	9.0	898	9.0	1459	0.616	100	2.0	LOS A	11.6	87.1	Full	450	0.0	0.0
Lane 3	53	8.3	53	8.3	66	0.808	100	65.1	LOS E	4.0	29.8	Short	80	0.0	NA
Approach	1850	9.0	1850	9.0		0.808		3.8	LOS A	11.6	87.1				
West: Lugard Street (W)															
Lane 1	39	19.4	39	19.4	109	0.357	100	101.3	LOS F	2.3	18.9	Short (P)	20	0.0	NA
Lane 2	199	25.2	199	25.2	155[1]	1.284	100	366.0	LOS F	28.3	240.6	Full	500	0.0	0.0
Approach	238	24.2	238	24.2		1.284		322.7	LOS F	28.3	240.6				
All Vehicles	4474	10.8	4474	10.8		1.284		21.9	LOS B	28.3	240.6				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Delay and stops experienced by drivers upstream of short lane entry have been accounted for.

Approach Lane Flows (veh/h)

South: Castlereagh Road (S)

Mov. From S To Exit:	L2 W	T1 N	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	1342	-	1342	10.9	1551	0.866	100	45.0	2
Lane 2	-	522	522	11.0	1441	0.362	100	NA	NA
Lane 3	-	522	522	11.0	1441	0.362	100	NA	NA
Approach	1342	1044	2386	11.0		0.866			

North: Castlereagh Road (N)

Mov.	T1	R2	Total	%HV		Deg.	Lane	Prob.	Ov.

From N To Exit:	S	W			Cap. veh/h	Satn v/c	Util. %	SL Ov. %	Lane No.
Lane 1	898	-	898	9.0	1459	0.616	100	NA	NA
Lane 2	898	-	898	9.0	1459	0.616	100	NA	NA
Lane 3	-	53	53	8.3	66	0.808	100	0.0	2
Approach	1797	53	1850	9.0		0.808			
West: Lugard Street (W)									
Mov. From W To Exit:	L2 N	R2 S	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	39	-	39	19.4	109	0.357	100	0.0	2
Lane 2	-	199	199	25.2	155[1]	1.284	100	NA	NA
Approach	39	199	238	24.2		1.284			

	Total	%HV	Deg.Satn (v/c)
All Vehicles	4474	10.8	1.284

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Delay and stops experienced by drivers upstream of short lane entry have been accounted for.

Merge Analysis

Exit Lane Number	Short Lane Length m	Percent Opng in Lane %	Opposing Flow Rate veh/h	Critical Gap pcu/h	Follow-up Headway sec	Lane Flow Rate sec	Capacity veh/h	Deg. Satn veh/h	Min. Delay v/c	Merge Delay sec	sec
There are no Exit Short Lanes for Merge Analysis at this Site.											

Variable Demand Analysis

	Initial Queued Demand veh	Residual Queued Demand veh	Time for Residual Demand to Clear sec	Duration of Oversatn sec
South: Castlereagh Road (S)				
Lane 1	0.0	0.0	0.0	0.0
Lane 2	0.0	0.0	0.0	0.0
Lane 3	0.0	0.0	0.0	0.0
North: Castlereagh Road (N)				
Lane 1	0.0	0.0	0.0	0.0
Lane 2	0.0	0.0	0.0	0.0
Lane 3	0.0	0.0	0.0	0.0
West: Lugard Street (W)				
Lane 1	0.0	0.0	0.0	0.0
Lane 2	0.0	22.0	511.8	NA

LANE SUMMARY

Site: 101 [PM EX - Lugard / Castlereagh (Site Folder: Existing + DEV (GHD Vols) (70%))]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

Network: N101 [PM EX (Network Folder: Existing + DEV (GHD Vols) (70%))]

New Site
Site Category: Existing Design
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 120 seconds (Site User-Given Phase Times)

Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Castlereagh Road (S)															
Lane 1	1023	9.3	1023	9.3	1306	0.783	100	6.1	LOS A	23.7	179.0	Full	425	0.0	0.0
Lane 2	1066	4.1	1066	4.1	1361	0.783	100	3.0	LOS A	20.8	150.4	Full	425	0.0	0.0
Approach	2089	6.6	2089	6.6		0.783		4.5	LOS A	23.7	179.0				
North: Castlereagh Road (N)															
Lane 1	1006	5.2	853	5.0	770	1.108	100	147.3	LOS F	94.5	689.9	Full	450	-43.1 N3	44.1
Lane 2	846	5.2	718	5.0	648 1	1.108	100	151.3	LOS F	80.7	589.4	Full	450	-43.1 N3	29.6
Lane 3	46	6.8	40	6.7	78	0.521	100	32.0	LOS C	1.9	13.8	Short	80	0.0	NA
Approach	1898	5.3	1611	5.1		1.108		146.2	LOS F	94.5	689.9				
West: Lugard Street (W)															
Lane 1	154	7.5	154	7.5	97 1	1.598	100	657.0	LOS F	29.8	222.1	Short (P)	20	0.0	NA
Lane 2	822	10.5	822	10.5	171 1	4.817	100	3548.8	LOS F	276.8	2112.1	Full	500	-43.1 N3	100.0
Approach	977	10.0	977	10.0		4.817		3091.9	LOS F	276.8	2112.1				
All Vehicles	4963	6.8	4677	7.2		4.817		698.0	LOS F	276.8	2112.1				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Delay and stops experienced by drivers upstream of short lane entry have been accounted for.
N3 Capacity Adjustment due to downstream lane blockage determined by the program.

Approach Lane Flows (veh/h)

South: Castlereagh Road (S)

Mov. From S To Exit:	L2 W	T1 N	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	228	795	1023	9.3	1306	0.783	100	NA	NA
Lane 2	-	1066	1066	4.1	1361	0.783	100	NA	NA
Approach	228	1861	2089	6.6		0.783			

North: Castlereagh Road (N)

Mov. From N To Exit:	T1 S	R2 W	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.

Lane 1	853	-	853	5.0	770	1.108	100	NA	NA
Lane 2	718	-	718	5.0	648[1]	1.108	100	NA	NA
Lane 3	-	40	40	6.7	78	0.521	100	0.0	2
Approach	1571	40	1611	5.1		1.108			

West: Lugard Street (W)

Mov. From W To Exit:	L2 N	R2 S	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	154	-	154	7.5	97[1]	1.598	100	100.0	2
Lane 2	-	822	822	10.5	171[1]	4.817	100	NA	NA
Approach	154	822	977	10.0		4.817			

	Total	%HV	Deg.Satn (v/c)
All Vehicles	4677	7.2	4.817

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Delay and stops experienced by drivers upstream of short lane entry have been accounted for.

Merge Analysis

	Exit Lane Number	Short Lane Length m	Percent Opng in Lane %	Opposing Flow Rate veh/h	Critical Gap pcu/h	Follow-up Headway sec	Lane Flow Rate sec	Capacity veh/h	Deg. Satn veh/h	Min. Delay v/c	Merge Delay sec	sec

There are no Exit Short Lanes for Merge Analysis at this Site.

Variable Demand Analysis

	Initial Queued Demand veh	Residual Queued Demand veh	Time for Residual Demand to Clear sec	Duration of Oversatn sec
South: Castlereagh Road (S)				
Lane 1	0.0	0.0	0.0	0.0
Lane 2	0.0	0.0	0.0	0.0
North: Castlereagh Road (N)				
Lane 1	0.0	41.4	193.6	NA
Lane 2	0.0	34.8	193.6	NA
Lane 3	0.0	0.0	0.0	0.0
West: Lugard Street (W)				
Lane 1	0.0	28.9	1076.0	NA
Lane 2	0.0	325.8	6870.5	NA

LANE SUMMARY

Site: 101 [PM EX - Lugard / Castlereagh (Site Folder: Existing + DEV (GHD Vols) (70%) - Lugard with LT Lane)]

Output produced by SIDRA INTERSECTION Version: 9.1.4.221

Network: N101 [PM EX w LT (Network Folder: Existing + DEV - Lugard with LT Lane (GHD Vols) (70%))]

New Site
Site Category: Existing Design
Signals - EQUISAT (Fixed-Time/SCATS) Coordinated Cycle Time = 120 seconds (Site User-Given Phase Times)

Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Castlereagh Road (S)															
Lane 1	228	27.3	228	27.3	1400	0.163	100	6.2	LOS A	0.8	6.9	Short	120	0.0	NA
Lane 2	931	4.1	931	4.1	1361	0.684	100	2.6	LOS A	13.9	100.6	Full	425	0.0	0.0
Lane 3	931	4.1	931	4.1	1361	0.684	100	2.6	LOS A	13.9	100.6	Full	425	0.0	0.0
Approach	2089	6.6	2089	6.6		0.684		3.0	LOS A	13.9	100.6				
North: Castlereagh Road (N)															
Lane 1	1025	5.2	866	5.0	781	1.108	100	147.3	LOS F	95.8	699.1	Full	450	-42.3 N3	45.4
Lane 2	827	5.2	698	5.0	630 [1]	1.108	100	152.2	LOS F	78.8	575.0	Full	450	-42.3 N3	27.3
Lane 3	46	6.8	40	6.7	74	0.542	100	25.9	LOS B	1.7	12.6	Short	80	0.0	NA
Approach	1898	5.3	1604	5.1		1.108		146.3	LOS F	95.8	699.1				
West: Lugard Street (W)															
Lane 1	154	7.5	154	7.5	97 [1]	1.594	100	653.9	LOS F	29.7	221.6	Short (P)	20	0.0	NA
Lane 2	822	10.5	822	10.5	173 [1]	4.757	100	3494.6	LOS F	276.1	2106.4	Full	500	-42.3 N3	100.0
Approach	977	10.0	977	10.0		4.757		3045.8	LOS F	276.1	2106.4				
All Vehicles	4963	6.8	4670	7.2		4.757		688.6	LOS F	276.1	2106.4				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Override Site Data tab).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Green.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Delay and stops experienced by drivers upstream of short lane entry have been accounted for.
N3 Capacity Adjustment due to downstream lane blockage determined by the program.

Approach Lane Flows (veh/h)

South: Castlereagh Road (S)

Mov. From S To Exit:	L2 W	T1 N	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	228	-	228	27.3	1400	0.163	100	0.0	2
Lane 2	-	931	931	4.1	1361	0.684	100	NA	NA
Lane 3	-	931	931	4.1	1361	0.684	100	NA	NA
Approach	228	1861	2089	6.6		0.684			
North: Castlereagh Road (N)									

Mov. From N To Exit:	T1 S	R2 W	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	866	-	866	5.0	781	1.108	100	NA	NA
Lane 2	698	-	698	5.0	630[1]	1.108	100	NA	NA
Lane 3	-	40	40	6.7	74	0.542	100	0.0	2
Approach	1564	40	1604	5.1		1.108			
West: Lugard Street (W)									
Mov. From W To Exit:	L2 N	R2 S	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	154	-	154	7.5	97[1]	1.594	100	100.0	2
Lane 2	-	822	822	10.5	173[1]	4.757	100	NA	NA
Approach	154	822	977	10.0		4.757			

	Total	%HV	Deg.Satn (v/c)
All Vehicles	4670	7.2	4.757

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Delay and stops experienced by drivers upstream of short lane entry have been accounted for.

Merge Analysis

Exit Lane Number	Short Lane Length m	Percent Opng in Lane %	Opposing Flow Rate veh/h	Opposing Flow Rate pcu/h	Critical Gap sec	Follow-up Headway sec	Lane Flow Rate veh/h	Capacity veh/h	Deg. Satn v/c	Min. Delay sec	Merge Delay sec
There are no Exit Short Lanes for Merge Analysis at this Site.											

Variable Demand Analysis

	Initial Queued Demand veh	Residual Queued Demand veh	Time for Residual Demand to Clear sec	Duration of Oversatn sec
South: Castlereagh Road (S)				
Lane 1	0.0	0.0	0.0	0.0
Lane 2	0.0	0.0	0.0	0.0
Lane 3	0.0	0.0	0.0	0.0
North: Castlereagh Road (N)				
Lane 1	0.0	42.1	194.2	NA
Lane 2	0.0	34.0	194.2	NA
Lane 3	0.0	0.0	0.0	0.0
West: Lugard Street (W)				
Lane 1	0.0	28.8	1070.0	NA
Lane 2	0.0	324.7	6762.4	NA