BEFORE THE DUNEDIN CITY COUNCIL

IN THE MATTER OF of the Resource Management Act 1991

AND

IN THE MATTER OF A Notice of Requirement by the Otago Regional Council for a designation pursuant to section 168 of the Act in relation to a Central City Bus Hub (DCC Notice of Requirement: DIS-2017-1)

STATEMENT OF EVIDENCE BY ANDREW METHERELL ON BEHALF OF THE OTAGO REGIONAL COUNCIL

9 OCTOBER 2017

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1. INTRODUCTION

Qualifications and Experience

1.1 My name is Andrew Alan Metherell. I hold a Bachelor of Engineering (Civil) with Honours degree from the University of Canterbury, obtained in 1997. I am a Chartered Professional Engineer, a Chartered Member of Engineering New Zealand (formerly the Institute of Professional Engineers of New Zealand), and am included on the International Professional Engineers Register. For the period of the last nineteen years I have worked as a transportation engineer with the firm of TDG (Traffic Design Group Limited), practicing as a traffic engineering and transportation planning specialist.

1.2 I currently hold the position of Senior Associate and am responsible for providing traffic engineering advice, assessment and design for a wide range of activities. TDG itself continues to be engaged by many local authorities and private developers across New Zealand to advise on traffic and transportation issues related to central, suburban and regional development.

1.3 I have undertaken transportation modelling for a range of roading and landuse development studies, addressing transport network, road corridor, and intersection performance. I regularly lead projects to develop traffic engineering layouts for road networks, corridors and intersections, including responsibility for analysis and traffic engineering design from concept to detailed design. These projects cover the different travel modes in environments from CBD local streets through to rural motorways.

1.4 I confirm my obligations in terms of the Environment Court's Code of Conduct for Expert Witnesses contained in the Practice Note 2014. I re-confirm that the issues addressed in this brief of evidence are within my area of expertise. I re-confirm that I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

1.5 I have been engaged by the Otago Regional Council (ORC) to prepare transportation engineering evidence in relation to wider network effects of the Notice of Requirement for a central city bus hub.

2. SCOPE OF EVIDENCE

2.1 Within this evidence I provide an assessment of transportation related operational effects that the altered bus routes could have on the wider central city transport network. Within my scope, I cover:

2.1.1 The new inner-city routes that have been assessed;

2.1.2 The ability of surrounding CBD intersections to physically accommodate the vehicle swept path requirements of new bus turning movements;

2.1.3 The change in traffic volumes at intersections; and

2.1.4 The change in performance and extent of mitigation works expected to be required.

2.2 I have led investigations into the performance of the intersections where the new bus routes are proposed through the central city area. This has involved observations and data collection at intersections of interest, intersection modelling of performance, traffic engineering assessment of bus swept paths, and concept design for potential intersection modifications.

2.3 Other experts are covering different transportation related effects of the bus hub, including:

2.3.1 Suitability of the bus hub location to accommodate the public transport demands;

2.3.2 The layout and operation of the bus hub for road and public transport users, and effects on immediately adjacent intersections; and

2.3.3 The local transport effects of the bus hub, including those on parking, pedestrian routes, and access to properties.

2.4 I have identified two submissions that have raised concerns in relation to wider transport network impacts covered by my scope of evidence. Within my evidence I address those concerns.

2.5 I have also read the Dunedin City Council (DCC) Council Officer assessment of the wider transport network effects and respond to those comments.

3. EXECUTIVE SUMMARY

3.1 I have carried out transport planning and traffic engineering concept design work to assess the network effects of the Dunedin Bus Hub beyond the immediate area of the bus hub.

3.2 The proposed bus hub will result in the re-routing of several bus services away from George Street and Princes Street between Moray Place (south) and St Andrew Street. The new primary route will be along St Andrew Street, Great King Street and Moray Place. The changes in bus volumes along the new route are in the order of 20 to 35 buses per hour in each direction. In my opinion, these changes in traffic volumes at each of the key intersections along the new route are small in terms of the operational capacity of the intersections.

3.3 I have analysed the impact of the small volume changes on the efficiency of the intersections. My assessment demonstrates that all intersections can continue to operate with good levels of service. This will minimise any flow on impact to the operation and efficiency of the wider transport network.

3.4 It is important for bus route reliability and general network performance that buses can efficiently make the turning manoeuvres at intersections along the new inner-city routes. With the existing intersection configurations, there are some left and right turning movements where the design-sized bus operating on the network could not make a turning movement efficiently within the assigned turning lanes.

3.5 Concept engineering design modifications have been developed with input from ORC and DCC to allow the design-sized bus to turn efficiently. The design process has balanced network operating objectives for different travel modes, as far as practicable given the limited scope of the changes. I consider that appropriate layout options are available that address the bus turning requirements. These can typically be considered minor works, and will require approval from DCC (as road controlling authority).

3.6 In my opinion, the change in bus volumes along the inner-city routes are small, and intersection modifications will allow the road network around the city centre to operate with a good level of service that is similar to the level of service currently provided.

4. PROPOSED CHANGE IN CENTRAL CITY BUS ROUTES

4.1 The bus hub is proposed on Great King Street between Moray Place and St Andrew Street. The location of the bus hub will result in routes to and through the central city relocating.

4.2 The key change will be the removal of buses from George Street and Princes Street between St Andrew Street and Moray Place (south). Buses will instead divert through the new Great King Street bus hub via St Andrew Street, Great King Street and Moray Place. Some buses already use part of the route (such as Moray Place between Princes Street and Lower Stuart Street), albeit at lower frequency.

4.3 The change has required investigation of effects of new or increased turning movements for buses at the following intersections on the primary route to and from the bus hub:

4.3.1 George Street / St Andrew Street;

4.3.2 Great King Street / St Andrew Street;

4.3.3 Great King Street / Moray Place;

4.3.4 Lower Stuart Street / Moray Place;

4.3.5 Burlington Street / Moray Place; and

4.3.6 Princes Street / Moray Place.

4.4 Those primary intersections are highlighted by red circles on **Figure 1** attached to my evidence. Mr Lightowler addresses the change in operation and effects of the Great King Street / St Andrew Street and Great King Street / Moray Place intersections (adjacent to the bus hub) in his evidence.

4.5 Other lesser changes in bus movements will also result at nearby intersections where new secondary routes will be used to access the bus hub via new turning movements. Preliminary assessment work identified a need to also investigate potential effects at those intersections. Those secondary intersections are shown by the green circles in Figure 1, and are:

4.5.1 Frederick Street / Great King Street;

4.5.2 Frederick Street / Gowland Street / Castle Street;

4.5.3 Cumberland Street / St Andrew Street;

4.5.4 Upper Stuart Street / Moray Place; and

4.5.5 Lower Stuart Street / Castle Street.

4.6 The forecast numbers of bus movements through the city centre intersections are still low compared to the total traffic carried at the intersections. Bus movements are approximately 3%-7% of all movements through the intersections on the primary route.

5. EXISTING ENVIRONMENT

5.1 To assess the effects of the altered routes on the central city network, intersection performance modelling has been carried out at each of the intersections for the existing and proposed traffic volumes.

5.2 Firstly, a detailed data collection exercise was undertaken at 14 intersections across the city centre. The surveys across the morning and evening peak hours included video recording and analysis of each turning movement, by each major vehicle type, and recorded non-vehicular users.

5.3 In addition, observers recorded typical levels of queuing at each intersection, and data was obtained from the Dunedin City Council traffic signal software system (SCATS) to identify the time splits being used for each signal phase at the traffic signals.

5.4 SIDRA Intersection models were developed for each intersection, and calibrated to the surveyed data. The models allow assessment of key performance indicators, such as intersection capacity, movement and lane delays and queues, and levels of service[1].

5.5 The observations and models confirmed that intersections of interest along the proposed key bus route in the central city are currently operating with good levels of service.

5.6 The unsignalised Burlington Street / Moray Place intersection is one intersection where the existing performance is marginal, with occasional long delays on Moray Place (north approach) during the evening peak period. On occasion, there is also some localised short duration queuing from other intersections which can influence the intersections being assessed.

6. TRANSPORT NETWORK PERFORMANCE

Preliminary Assessment

6.1 Once the existing performance of intersections was established, I investigated the changes in transport network performance resulting from the bus hub.

[1] Level of service is a qualitative measure describing operational conditions within a traffic stream, and their perception by motorists and/or passengers. There are six levels of service, designated A to F, with level of service A representing the best operating condition (i.e. free-flow) and level of service F the worst (i.e. forced or breakdown flow). At intersections, the key performance measure is delay to vehicles.

This addressed both the changes in performance due to additional bus volumes, and the changes to the transport network that will be required.

6.2 The addition of the bus volumes to the calibrated models resulted in negligible change in performance at the intersections. Levels of service are within the range LOS B and LOS C which represents stable operating conditions for an intersection, such that there would be no more than low levels of change to wider route choice. Only the Moray Place / Burlington Street intersection in the evening peak showed any notable sensitivity to the increased traffic volumes. On that basis, it was determined and agreed with DCC transport staff that there was no need to undertake assessment of wider traffic redistribution effects given the very small traffic volume changes involved.

6.3 Computer-based heavy vehicle swept paths were also tested following measurement and field testing of the largest bus operating on the city network (which could feasibly be required on the new routes). The analysis identified that where the bus would be making a left or right turn at an intersection, there was generally a need to consider some minor lane layout modifications to efficiently accommodate the vehicle swept path of a large design-sized bus.

6.4 Changes are proposed at the Great King Street / St Andrew Street and Great King Street / Moray Place intersections as part of integration with the bus hub, and are discussed by Mr Lightowler. Those movements at intersections in the wider network where modifications are required to ensure a reliable bus service are set out in **Attachment A** of my evidence. The seven CBD intersections in the wider area are:

6.4.1 George Street / St Andrew Street:

6.4.2 Moray Place / Lower Stuart Street

6.4.3 Moray Place / Burlington Street

6.4.4 Moray Place / Princes Street

6.4.5 Great King / Frederick Street

6.4.6 Moray Place / Upper Stuart Street

6.4.7 Castle Street / Lower Stuart Street

6.5 The minimum changes required typically include set back of a right turn lane limit line, and some adjustment of approach lane widths and/or discipline. At this stage of the assessment, it was also identified that changing the priority at the Moray Place / Burlington Street intersection would be a good solution to improve bus service reliability along Moray Place.

Refined Assessment

6.6 Various design options exist to ensure that any changes appropriately balance other important operating conditions, such as network legibility, safety, convenience, pedestrian movement, and promotion of reliable and efficient bus access to the proposed bus hub. A series of options have been tested and refined in consultation with Dunedin City Council engineering staff.

6.7 Potential altered layouts have also been retested in the intersection modelling software. Again, the intersection performance after the modifications is essentially providing the same level of service at each intersection as existing. Resultant refined layouts have then been the subject of peer review and safety audit. The intersection performance table appended as **Attachment B** to my evidence demonstrates the intersections can operate in the stable LOS B and LOS C range, even if the ultimate improvements include some dedicated right turn phases to support efficient bus movement.

6.8 In my opinion, the assessment and design process demonstrates that changes to accommodate the bus routes are readily achievable, and can generally be considered minor works. They are typical of the sort of changes a road controlling authority would consider in refining an evolving transport network, and appropriate given the importance of promoting reliability of the bus services.

6.9 I consider the assessment and design processes for the wider transport network have not highlighted any concerns that cannot be addressed in future detailed engineering design. As set out in the Council Officer report by Robert Buxton, the final form of modifications will require the DCC approval as road controlling authority. I agree with the advice of Council's Transport Strategy Manager Nick Sargent that there will be acceptable solutions for each intersection.

Other Wider Transport Network Matters

6.10 The proposed bus hub location also allows the removal of buses from parts of George Street and Princes Street, between St Andrew Street and Moray Place. That will provide for some reduced heavy vehicle use on those streets.

6.11 The development of the bus hub may result in some low levels of traffic being diverted away from Great King Street. The surveys and observations show that the volumes of traffic on Great King Street are low, and the bus hub layout does not preclude traffic from using it. I agree with the Council Officer assessment that drivers can find alternative routes if they prefer not to use this portion of Great King Street. Because of the low volumes involved, and available capacity at surrounding intersections I consider any redistribution will have only a minor impact on the function of the wider area transport network.

6.12 As described by Mr. Lightowler, the bus hub layout and intersection proposal at Great King Street / Moray Place allows for the removal of the right turn from Great King Street to Moray Place. Mr Lightowler has described the need for those changes which include promotion of pedestrian safety and efficient movement to and from the bus hub. The surveyed traffic volume for the right turn movement was 42 vehicles per hour in the morning peak, and 73 vehicles per hour in the evening peak (only just more than a vehicle a minute). Movement to and from Moray Place west is a minor movement in comparison with movement to and from Moray Place east. While the banned movement will cause some inconvenience, particularly for short trips to destinations in the immediate area, I anticipate most drivers will readily find alternative

routes once the bus hub is opened. Based on some sensitivity testing with the intersection models, I consider other intersections in the area will continue to operate with spare traffic carrying capacity such that they can efficiently accommodate the small amount of redistributed traffic.

7. SUBMISSIONS

Athol Parks, City Walks

7.1 The submission of Athol Parks for City Walks has raised concerns in relation to congestion on Great King Street, and difficulty for large buses to access the bus hub.

7.2 As I have outlined, a comprehensive assessment of existing and proposed traffic conditions has been undertaken for the new route that bypasses George Street and Princes Street. The change in volumes caused by the altered bus routes is not significant in itself. My analysis shows that appropriate levels of service can be maintained at intersections that will be used for access to the bus hub.

7.3 Engineering measures are available to carry out minor intersection works to ensure that the design sized bus can access the bus hub efficiently. I note that some of the route is already used by buses, such as the southern portion of Moray Place. Any further changes will improve the ability of buses to access the area.

Michael Smith

7.4 Michael Smith is concerned that the location of the bus hub will disrupt and compromise parts of the roading network, and particularly the intersections that I have described and assessed in my preceding evidence. I disagree with the concerns of Mr Smith, and remain of the opinion that the assessment demonstrates that network effects are not significant.

7.5 Traffic can continue to use Great King Street as a through and access route, the change in traffic volumes along the access routes are small, the intersection

performance assessment shows only minor changes in performance at peak times, and engineering measures will allow for the efficient turning of design sized buses at intersections.

8. COUNCIL OFFICER REPORT

8.1 I have read the report by Mr Buxton. I agree with his comments in relation to the wider transport network effects at section 6.3.1. These include:

8.1.1 Changes to intersections in the wider network require DCC approval. Solutions for the wider network have been developed with the direct input of DCC transportation staff; and

8.1.2 Some changes to the intersections in the wider network need to be implemented to improve the efficiency of the bus movements to and from the hub. The improvements should be complete before buses accessing the bus hub use those intersections.

9. CONCLUSION

9.1 I have assessed the potential wider area transport network effects of the proposed bus hub. The potential effects relate to the ability of the intersections that will be used as part of new bus access routes to accommodate the bus turning requirements, both in terms of efficient vehicle tracking, and intersection performance.

9.2 My assessment has identified seven CBD intersections in the wider network (beyond the Great King Street bus hub intersections) that require some form of physical improvement to accommodate the new bus access routes into the bus hub. I consider that improvements are achievable and typical of the type of changes made as part of an evolving transport network.

9.3 DCC as road controlling authority will need to approve the final form of the intersection modifications. I agree with the Council Officer that the improvements should be complete at the time of opening of the bus hub to allow for efficient and reliable operation of the proposed bus routes.

9.4 With the change in bus volumes and minor intersection modifications, I consider the performance of intersections in the CBD will be maintained at levels of service similar to the existing levels.

Andrew Metherell

9 October 2017

Attachment A: Constrained Intersections

Movements at CBD Intersections with Physical Constraints to Efficient Bus Turning - with Existing Layouts:

(note that bus hub intersections St Andrew Street / Great King Street and Great King Street / Moray Place requiring adjustment are addressed by Andy Lightowler)

Primary Intersections

George Street / St Andrew Street:

- Right turn St Andrew Street (east) to George Street (north)
- Left turn George Street (north) to St Andrew Street (east)

Moray Place / Lower Stuart Street

- Right turn Stuart Street (east) to Moray Place (north)
- Left turn Moray Place (north) to Stuart Street (east)

Moray Place / Burlington Street

- Right turn Moray Place (north) to Moray Place (west)
- Left turn Moray Place (west) to Moray Place (north)

Moray Place / Princes Street

- Right turn Princes Street (south) to Moray Place (east)
- Left turn Moray Place (east) to Princes Street (south)

Secondary Intersections

Great King / Frederick Street

- Left turn Frederick Street (east) to Great King Street (south)

Moray Place / Upper Stuart Street

- Right turn Stuart Street (west) to Moray Place (south)
- Left turn Moray Place (south) to Stuart Street (west)

Castle Street / Lower Stuart Street

- Right turn Castle Street (north) to Stuart Street (west)

Attachment B: Wider Area Intersection Performance

Intersection	Peak Period	Intersection Volume (vph)	Average Delay	Level of Service	Queue 95% percentile
George St / St Andrew St	AM	1,110	14s	B	6 veh
	PM	1,324	14s	B	6 veh
Stuart St / Moray Pl	AM	741	13s	B	3 veh
	PM	973	14s	B	6 veh
Burlington St / Moray Pl	AM	860	20s*	C*	2 veh*
	PM	906	13s*	B*	6 veh
Princes St / Moray Pl	AM	1,355	16s	B	8 veh
	PM	1,538	16s	B	7 veh

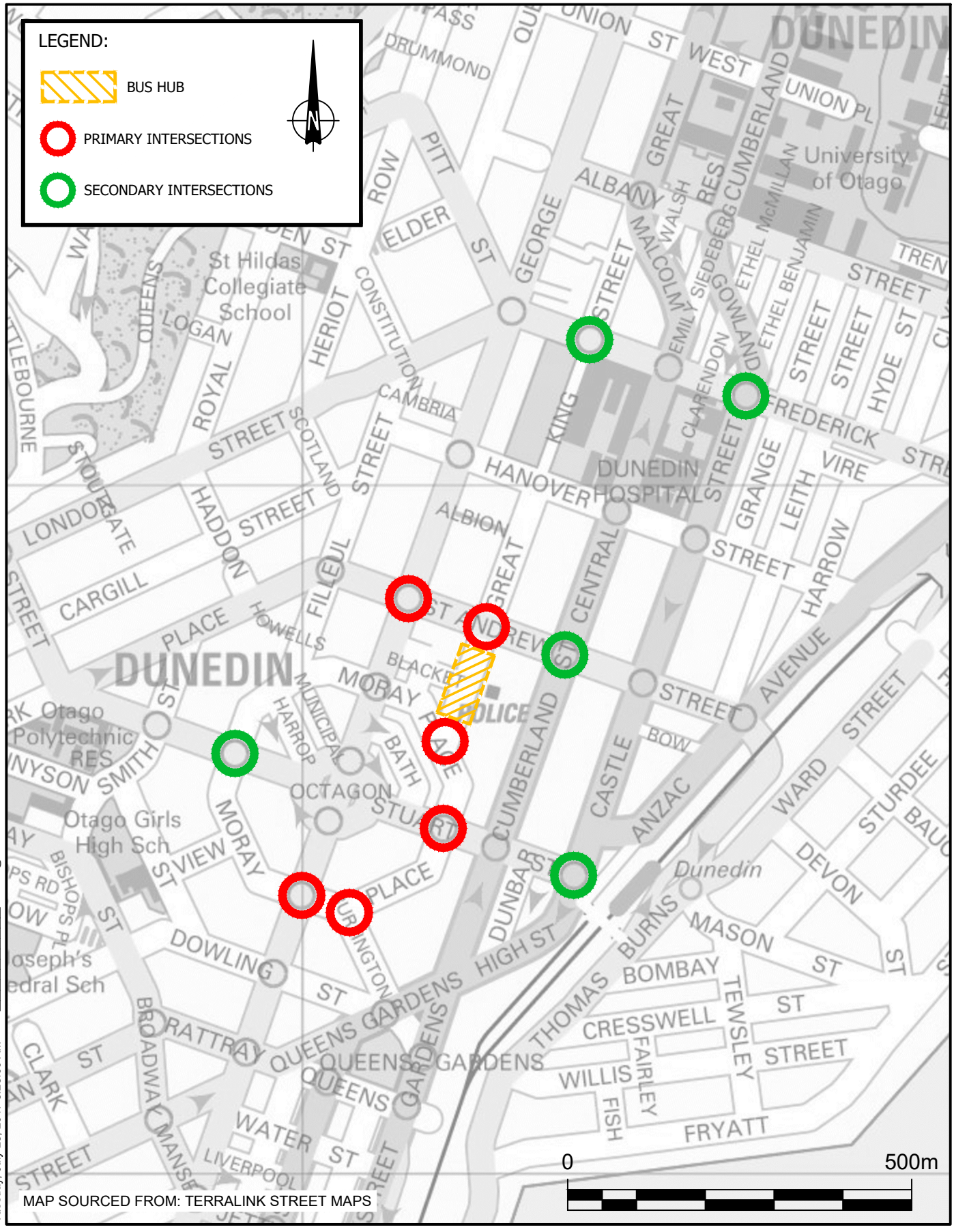
*for the un-signalised intersection, the statistics reported are for the right turn from the minor road

Table B1: SIDRA Analysis Summary – Existing Performance at Primary Intersections

Intersection	Peak Period	Intersection Volume (vph)	Average Delay	Level of Service	Queue 95% percentile
George St / St Andrew St	AM	1,102	18s	B	10 veh
	PM	1,315	19s	B	10 veh
Stuart St / Moray Pl	AM	799	19s	B	4 veh
	PM	1,035	22s	C	9 veh
Burlington St / Moray Pl	AM	906	14s*	B*	4 veh*
	PM	952	16s*	C*	2 veh*
Princes St / Moray Pl	AM	1,338	17s	B	7 veh
	PM	1,516	21s	C	12 veh

*for the un-signalised intersection, the statistics reported are for the right turn from the minor road

Table B2: SIDRA Analysis Summary – Future Performance (Allows for Possible Right Turn Phases) at Primary Intersections



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DUNEDIN BUS HUB

LOCATIONS OF INVESTIGATED INTERSECTIONS

TDG

1

SCALE: AS NOTED

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