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Hawkesbury-Nepean Valley Flood Evacuation Road Resilience Program Improvements on The Northern Road and Londonderry Road Flood Evacuation Routes

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SMEC Company Details

Approved by	Awie Malan
Address	Level 7, 40 Mount Street, North Sydney, NSW, 2060
Phone	+61 2 9925 5555
Email	sydney@smec.com
Website	www.smec.com
Signature	

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Contents

1. Introduction 1
1.1 Background 1
1.2 Proposal description 1
1.3 Study purpose 5
1.4 Site location 5
1.5 Methodology overview 5

2. Existing transport conditions 7
2.1 Road network 7
2.2 Public transport 10
2.3 Active transport 13
2.4 Crash data analysis 15
2.5 Traffic volumes 20
2.6 Parking 26

3. Existing capacity and level of service 27
3.1 Interrupted flows 27
3.2 Uninterrupted flows 30

4. Assessment scenarios 33
4.1 Construction phase scenario 33
4.2 Normal operational scenario (post-improvement) 37
4.3 Flood evacuation scenario (post-improvement) 37

5. Impact assessment 48
5.1 Construction phase 48
5.2 Operation phase (normal mode) 57
5.3 Operation phase (flood evacuation) 58

6. Mitigation measures 59
6.1 Construction Traffic Management Plan 59
6.2 Communications strategy 59
6.3 Road network 59
6.4 Site access 60
6.5 Local road access 60
6.6 Property access 60
6.7 Pedestrian and cyclist access 60
6.8 Public transport 60
6.9 Unplanned events 60
6.10 Adjacent projects and cumulative impacts 61

7. Conclusion 62

8. References 63

Appendices

Appendix A	**List of impacted bus routes**
Appendix B	**Impacted bus stop locations**

Figures

Figure 1-1 Proposal area 4
Figure 1-2 Regional context of the Proposal (Scape, 2024) 5
Figure 2-1 Key road corridors within the study area 9
Figure 2-2 Bus routes along The Northern Road and Londonderry Road (1 of 2) (Transport 2023a) 11
Figure 2-3 Bus Routes along The Northern Road (2 of 2) (Transport 2023a) 12
Figure 2-4 Existing bicycle network along The Northern Road and Londonderry Road (1 of 2) (Transport 2023b) 14
Figure 2-5 Existing bicycle network along The Northern Road – (2 of 2) (Transport 2023b) 15
Figure 2-6 Crash severity and locations along The Northern Road during 2018-2022 (Transport) 16
Figure 2-7 Crash locations and severity of crashes along Londonderry Road during 2018-2022 (Transport) 18
Figure 2-8 ATC locations for mid-block traffic volumes 21
Figure 2-9 Mid-block locations for which SCATS data was used to derive traffic volumes 24
Figure 3-1 LoS criteria for two-lane highways in Class I 30
Figure 3-2 Average Travel Speed (ATS) relationship for directional segments 31
Figure 3-3 Percent time spent following (PTSF) relationship for directional segments 31
Figure 4-1 Detour routes during 56-hour weekend closure on The Northern Road [Northern Section] 34
Figure 4-2 Detour routes during 56-hour weekend closure on Londonderry Road 34
Figure 4-3 Detour routes during 56-hour weekend closure on The Northern Road [Southern Section] 34
Figure 4-4 Detour routes during 56-hour weekend road closure on Fifth Avenue 35
Figure 4-5 Detour routes during 56-hour weekend road closure at Vincent Road 35
Figure 4-6 Detour routes during 56-hour weekend eastbound closure of Carrington Road 36
Figure 4-7 Detour routes during 56-hour weekend westbound closure of Carrington Road 36
Figure 4-8 Flood evacuation route map (SES) with convergence points added 38
Figure 4-9 Evacuation scenarios at the start of The Northern Road evacuation route 40
Figure 4-10 Convergence of the Londonderry Road and The Northern Road evacuation routes 41
Figure 4-11 Convergence of the Castlereagh and The Northern Road evacuation routes at Vincent Road 42
Figure 4-12 Convergence of the Llandilo and The Northern Road evacuation routes at Ninth Avenue 43
Figure 4-13 Exit of The Northern Road evacuation route at the Parker Street and Great Western Highway intersection 44
Figure 4-14 Opening in median with removable kerb at The Northern Road / Londonderry Road roundabout – Normal operation 45
Figure 4-15 Opening in median with removable kerb at The Northern Road / Londonderry Road roundabout – Flood evacuation scenario 45
Figure 4-16 Opening in median with removable kerbs at The Northern Road / Vincent Road intersection – Normal operation 46
Figure 4-17 Opening in median with removable kerbs at The Northern Road / Vincent Road intersection – Flood evacuation scenario 46
Figure 4-18 Traffic islands in the southbound shoulder at the pedestrian crossing on Londonderry Road 47

Tables

Table 2-1 Key segments along The Northern Road 7
Table 2-2 Key segments along Londonderry Road 8
Table 2-3 Bus service frequency 12
Table 2-4 Types of crashes per year and number of casualties on The Northern Road 17
Table 2-5 Severity of crashes on The Northern Road 17
Table 2-6 Casualties by road user type on The Northern Road) 17
Table 2-7 Number of crashes per year and casualties on Londonderry Road 19
Table 2-8 Severity of crashes on Londonderry Road 19
Table 2-9 Casualties by road user type on Londonderry Road 19
Table 2-10 Summary of traffic data used for the Working Paper 20
Table 2-11 Mid-block peak hour traffic volumes (weekday) of MB-1 to MB-6 22
Table 2-12 Mid-block peak hour traffic volumes (weekday) of MB-7 to MB-15 25
Table 2-13 Traffic split at The Northern Road/Londonderry Road/Cranebrook Road roundabout 25
Table 3-1 Typical mid-block capacities for urban roads with interrupted flow 27
Table 3-2 Mid-block level of service criteria 28
Table 3-3 Mid-block assessment for interrupted flow segments – Base Case Weekday 29
Table 3-4 Mid-block level of service for uninterrupted flow segments – Base Case Weekday 32
Table 3-5: Mid-block level of service for uninterrupted flow segments – Base Case Saturday 32
Table 4-1 Potential evacuation scenarios 39
Table 5-1 Mid-block assessment for interrupted flow segments – Base Case and Base Case with Construction Traffic – weekday AM peak 49
Table 5-2 Mid-block assessment for interrupted flow segments – Base Case and Base Case with Construction Traffic (weekday PM peak) 50
Table 5-3 Mid-block level of service for uninterrupted flow segments – Base Case and Base Case with Construction Traffic – weekday AM peak 51
Table 5-4 Mid-block level of service for uninterrupted flow segments – Base Case and Base Case with Construction Traffic – weekday PM peak 51
Table 5-5 Mid-block level of service for interrupted flow segments – Construction Scenario 2 – Saturday peak 52
Table 5-6 Mid-block level of service for uninterrupted flow segments – Construction Scenario 2 – Saturday peak 53
Table 5-7 Mid-block level of service for interrupted flow segments – Construction Scenarios 5 – Saturday peak 55
Table 5-8 Mid-block level of service for MB-15 – Construction Scenarios 5 – Weekday 55

1. Introduction

1.1 Background

The NSW and Australian Governments have committed $33 million towards planning for more than 100 improvements that will make the Hawkesbury Nepean Valley flood evacuation network more resilient. Road infrastructure improvements have been identified across four Western Sydney local government areas: Penrith, Hawkesbury, Blacktown, and The Hills. The proposed improvements include road shoulder widening, culvert upgrades, new bridge structure, road raising, pinch point upgrades and drainage improvements. These improvements will make evacuation routes better able to withstand local flash flooding which can cause early closure of evacuation routes.

The Hawkesbury-Nepean Valley has the highest flood risk in NSW due to its unique landscape and large existing population. Floods in the Hawkesbury-Nepean Valley can and have had a significant impact on people's lives, livelihoods, and homes.

The key objective of Hawkesbury-Nepean Valley Flood Evacuation Road Resilience Program is to improve drainage on the road network to better withstand local flash flooding and to increase capacity to evacuate by road during major flood events.

The Hawkesbury-Nepean Valley Flood Evacuation Road Resilience Program has two components – State Road Improvements (on the Transport managed roads of The Northern Road and Londonderry Road) and Regional/Local Road Improvements (on the mostly local council managed road network). This proposal addresses the State Road Improvements only, being The Northern Road and Londonderry Road flood evacuation routes.

1.2 Proposal description

The proposal area generally includes the road corridors of The Northern Road, Londonderry Road, Andrews Road and Vincent Road, as follows:

- The Northern Road between the intersection with Richmond Road/Blacktown Road, Bligh Park in the north, and Borrowdale Way, Cranebrook in the south
- Londonderry Road from 270m south of Southee Road, Hobartville to the intersection with The Northern Road, Llandilo, excluding approximately 270m north and 300m south of the existing intersection at The Driftway, Londonderry
- Route A9 (The Northern Road/Richmond Road) from 130m north of Andrews Road, Cranebrook to Boomerang Place, Cambridge Gardens in the south
- Andrews Road, Cranebrook from The Northern Road to the Andrews Road Baseball Complex west of Greygums Road, Cranebrook
- Vincent Road, Cranebrook for approximately 70m west of The Northern Road
- Identified isolated areas along Route A9 (Richmond Road/Parker Street) between Gascoigne Street and Great Western Highway, Kingswood for the installation of flood evacuation signage.

The proposal area includes a buffer from the outer edge of the designed works to facilitate construction work. The buffer is generally 10m in width but is reduced to 6m or less in specific areas to minimise impacts on sensitive areas.

The Proposal is divided into two main components, namely the evacuation capacity improvements and drainage improvements. The Proposal is not intended to provide additional capacity for everyday use.

Key features of the Proposal include:

- Widening of the southbound shoulder pavement on the following roads, a total of approximately 20km, to provide a second outbound lane reserved for drivers to use during emergency flood evacuations. This will include culvert and drainage extensions to accommodate a wider road corridor, and connecting drainage:
  - Londonderry Road between 270m south of Southee Road and The Northern Road, Londonderry

  - The Northern Road between Richmond Road and Borrowdale Way, in Londonderry, Berkshire Park, Cranebrook, Llandilo, and Jordan Springs

- Drainage improvements including upgrades to culvert crossings, drainage channels, and pit and pipe networks at identified locations to improve resilience in localised flooding events. Work would include:
  - Culvert upgrades, and associated drainage channel work:
    - Along sections of The Northern Road associated with raising of low points as outlined below
    - On Carrington Road at the intersection with The Northern Road, Londonderry
    - At two locations on The Northern Road approximately 50m and 130m north of the intersection of Carrington Road, Londonderry
    - On The Northern Road approximately 250m north of Toorah Road, Londonderry
    - On Vincent Road at the intersection with The Northern Road, Cranebrook
    - On Fifth Avenue at the intersection with The Northern Road, Llandilo.
  - New roadside drainage channels (including vegetated and concrete of various widths):
    - Along Londonderry Road (adjacent to the southbound shoulder), from 270m south of Southee Road, Hobartville to the intersection with The Northern Road, Llandilo
    - Along The Northern Road (adjacent to the southbound shoulder), from the intersection with Blacktown Road/Richmond Road, Bligh Park to Ninth Avenue, Llandilo
    - Along The Northern Road (adjacent to the northbound shoulder) at road raising areas
  - Underground drainage network upgrades:
    - Along The Northern Road (southbound), Cleeve Place and Star Crescent, Cambridge Gardens from Trinity Drive to Boomerang Place, including approximately 60m along Trinity Drive, Cambridge Gardens
    - Along The Northern Road, Cranebrook (northbound) from approximately 115m north of Andrews Road, Cranebrook to Trinity Drive, Cambridge Gardens including new drainage crossings underneath The Northern Road
    - Along Andrews Road from The Northern Road up to the Andrews Road Baseball Complex in Cranebrook
- Raising of low points along sections of The Northern Road, affecting all road lanes:
  - Starting from around 120m north of Whitegates Road, Londonderry heading northwards (about 345m length)
  - Starting from around 200m north of Spinks Road, Llandilo heading northwards (about 920m length)
  - Starting from around 270m north of Fifth Avenue to around 435m south of Fifth Avenue, Llandilo
  - Starting from around 185m north of Vincent Road to around 105m south of Vincent Road, Cranebrook
  - Starting from around 50m south of Ninth Avenue to about 365m south of Ninth Avenue, Cranebrook
- Extend, replace or add new culverts at selected locations along Londonderry Road and The Northern Road to maintain property access (e.g. driveways) as required.
- Realignment of The Northern Road, Cranebrook (within the road corridor), between around 330m north of Seventh Avenue, Llandilo to around 280m south of Vincent Road, Cranebrook to reduce project impacts on adjacent sensitive receivers and improve road safety.
- Adjustments to the following intersections to facilitate a secondary outbound lane for drivers to use during a flood evacuation event. These may include changes to existing median, traffic islands, kerbs and line markings at:
  - The Northern Road and Richmond Road and Blacktown Road, Bligh Park
  - Londonderry Road and The Northern Road and Cranebrook Road, Cranebrook

  - The Northern Road and Vincent Road, Cranebrook
  - The Northern Road and Ninth Avenue, Jordan Springs
- Installation of new signage to be displayed during emergency flood evacuations to facilitate a second left turn at the existing Parker Street/Great Western Highway intersection in Penrith under traffic control.
- Adjustments as required to connect Londonderry Road and The Northern Road to local roadways, side roads and access roads.
- Relocation and/or adjustments of various road furniture (such as signage, road safety barriers, street lighting, kerb and island adjustment etc) throughout the proposal area.
- Relocation of bus stops at:
  - The Northern Road (northbound) approximately 30m south of Vincent Road. To relocate this bus stop approximately 130m to the south
  - The Northern Road (southbound) approximately 210m south of Ninth Avenue. To relocate this bus stop approximately 20m to the north
- Utility and driveway adjustments as required within the proposal area.
- Landscaping as required.
- Provision of temporary ancillary facilities to support the construction works, including office and staff amenities, site compound and laydown areas:
  - Road reserve adjacent to the Francis Greenway Correctional Complex, Berkshire Park (site 1)
  - Road reserve adjacent to 245 The Northern Road, Berkshire Park (site 2)
  - 557 The Northern Road, Berkshire Park (site 3)
  - Road reserve adjacent to 107 Fifth Avenue, Llandilo (site 4)
  - Road reserve adjacent to 902 The Northern Road, Llandilo (site 5)
  - 1042 The Northern Road, Llandilo (site 6)
  - Council reserve, Greenwood Parkway, Jordan Springs (site 7)
  - Part of the Richmond Race Club, Londonderry Road, Londonderry (site 8)
  - Council reserve, Andrews Road, Penrith (site 9)
  - Council reserve, Parker Street, Penrith (site 10)

The final construction staging of the proposal would be determined by Transport and the construction contractor, however it is anticipated that the permanent works would be carried out in stages, with an early works component. Subject to funding availability, the construction is expected to commence in 2026 and completed in 2030. Refer to Figure 1-1 for the proposal area.

Note that in consideration of the highly constrained environment at Parker Street/Great Western Highway intersection, no modifications are proposed at this intersection. Dual lane evacuation is expected to be facilitated under traffic control without any physical changes to the intersection geometry.

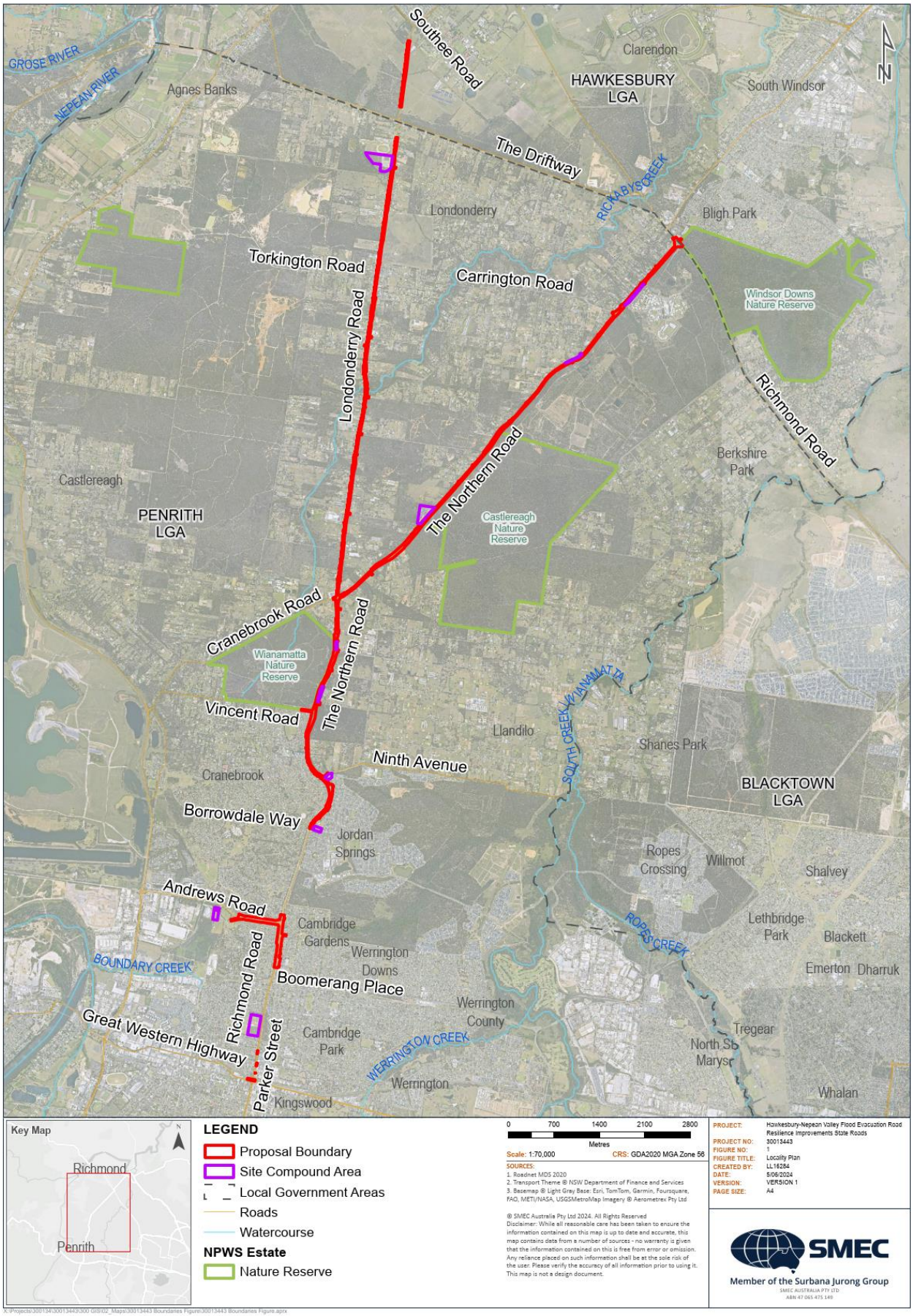


Figure 1-1 Proposal area

1.3 Study purpose

This Traffic and Transport Impact Assessment Working Paper was prepared to inform the Review of Environmental Factors (REF) for the Proposal described in Section 1.2. This Working Paper is limited to commentary on the proposed works from a traffic and transport perspective and includes a high-level qualitative assessment of traffic operations in both normal operating conditions, as well as during a flood evacuation event. The Working Paper also provides a high-level qualitative assessment of impacts during the construction phase of the Proposal.

1.4 Site location

The Proposal includes improvements along the following State Roads:

- Londonderry Road from 270m south of Southee Road, Hobartville to the intersection at The Northern Road and Cranebrook Road, Cranebrook, and
- The Northern Road from Richmond Road, Bligh Park to Great Western Highway, Penrith.

The roads outlined above form part of the study area that is the subject of this Working Paper. Figure 1-2 shows the approximate location of the study area relative to the Sydney metropolitan area.

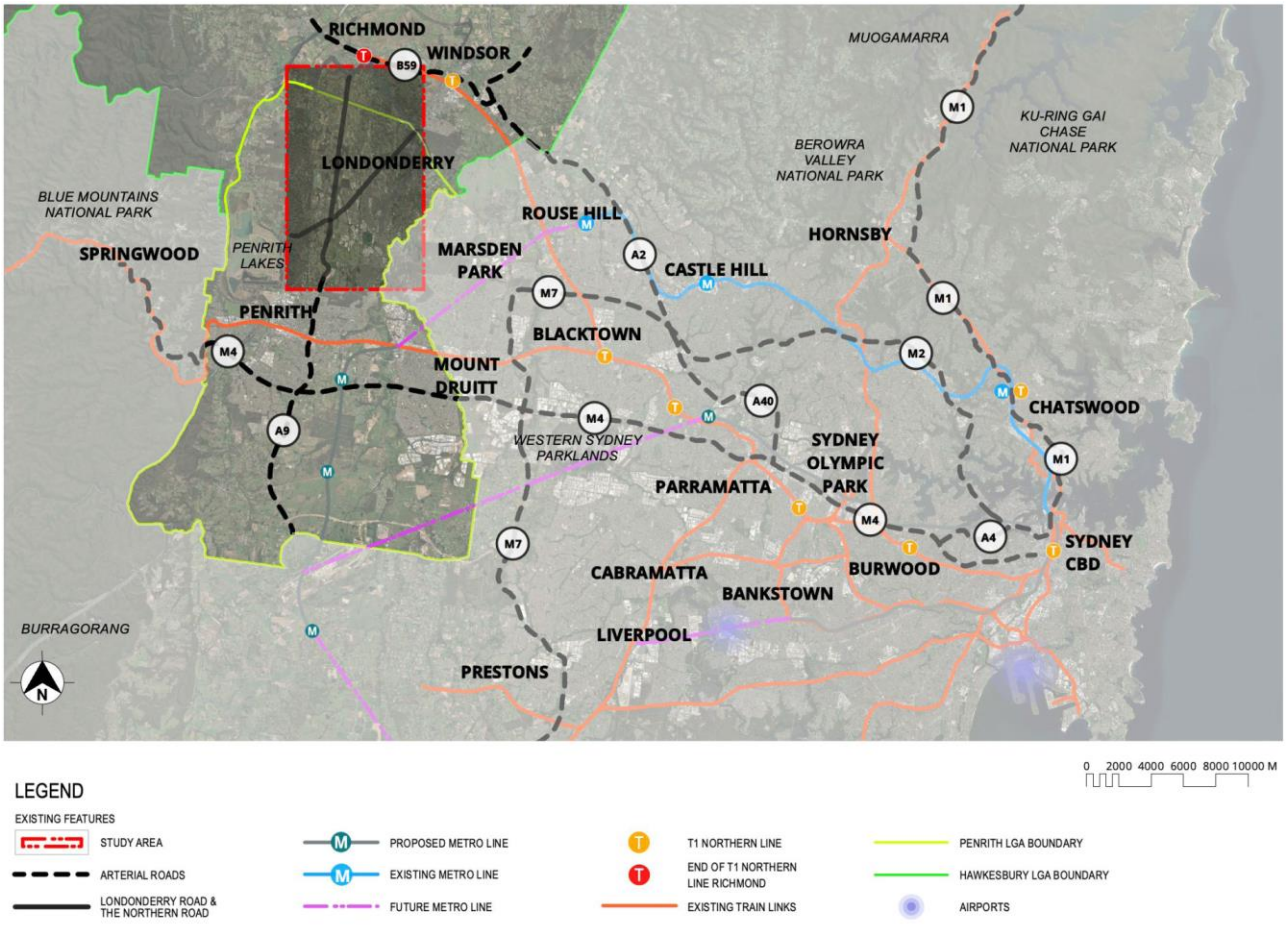


Figure 1-2 Regional context of the Proposal (Scape, 2024)

1.5 Methodology overview

An initial assessment of existing transport conditions within the study area was carried out during the preparation of this Working Paper. This assessment included consideration of the road network, traffic patterns and volumes, high-level crash data analysis, active transport, public transport and parking.

A baseline qualitative assessment of mid-block capacity considered the current effectiveness of the two key corridors within the study area. Mid-block level of service (LoS) has also been used to define operating conditions or service quality. This assessment considered both interrupted flow facilities and uninterrupted flow facilities.

A detailed assessment of the construction and operational (normal and flood evacuation) traffic scenarios was carried out. This detailed scenario assessment included consideration of impacts to the surrounding road network, as well as impacts to active transport, public transport and parking.

Mitigation measures were developed, primarily relating to the construction phase, including a recommendation for the preparation of a Construction Traffic Management Plan by the appointed Contractor prior to commencement of construction. The mitigation measures include safeguards to reduce impacts on the road network, property accesses, pedestrian and cyclist infrastructure, and public transport, as well as cumulative impacts to the road network and concurrent projects in the region.

2. Existing transport conditions

This section focuses on the existing transport conditions within the study area, including analysis of relevant road network, public transport, active transport (including pedestrians and cyclists), parking, traffic patterns and volumes, and high-level crash data.

This analysis establishes a clear understanding of the baseline conditions to assess the impacts of the proposal during construction, during normal operation, and during flood evacuations, as discussed in Section 5. By establishing a clear baseline, the aim is to ensure transparency and rigor in the assessment of the anticipated impacts of the proposal.

Multiple site visits have been undertaken in the study area, including at the five major convergence points, to better understand the existing conditions and existing public and active transport provisions.

2.1 Road network

The two main corridors within the study area are sections of The Northern Road and Londonderry Road presented in Figure 2-1 and discussed further in Sections 2.1.1 and 2.1.2 respectively.

2.1.1 The Northern Road

The Northern Road is classified by Transport as a main road (MR 154) under the NSW *Roads Act 1993*. Within the study area, The Northern Road runs in a generally north-south direction from Bligh Park in the north to Penrith in the south. Details of each segment along The Northern Road as referenced in Figure 2-1 are summarised in Table 2-1.

Table 2-1 Key segments along The Northern Road

Segment ID	Posted speed (km/h)	Number of lanes (per direction)
SG-1	70	3
SG-2	70	2
SG-3	70	1
SG-4	80	1

The Northern Road also has 11 signalised intersections between Londonderry Road / Cranebrook Road and Great Western Highway, as follows:

- A9 The Northern Road / Andromeda Drive
- A9 The Northern Road / Ninth Avenue
- A9 The Northern Road / Greenwood Parkway
- A9 The Northern Road / Jordan Springs Boulevard
- A9 The Northern Road / Sherringham Road
- A9 The Northern Road / Andrews Road
- A9 The Northern Road / Boomerang Place
- A9 The Northern Road / Dunheved Road
- A9 The Northern Road / Coreen Avenue
- A9 The Northern Road / Copeland Street, and
- A9 The Northern Road / Great Western Highway.

2.1.2 Londonderry Road

Londonderry Road is classified as a Main Road (MR 630) under the NSW *Roads Act 1993* and forms a link between The Northern Road and Southee Road within the study area. The road generally has a posted speed limit of 80 km/h along most of its length, with a segment that passes through the Londonderry village having a 60 km/h speed limit, from approximately 335m north of Namatjira Avenue to approximately 100m south of Spencer Road. Within this segment there is also a 40 km/h school zone from approximately 70m north of Carrington Road to approximately 70m south of Kenmare Road. In addition, the posted speed limit from approximately 600m south of Southee Road northwards is 60 km/h. Details of each segment along Londonderry Road as referenced in Figure 2-1 are summarised in Table 2-2.

Table 2-2 Key segments along Londonderry Road

Segment ID	Posted Speed (km/h)	Number of Lanes (per direction)
SG-5	80	1
SG-6	60	1
SG-7	40	1
SG-8	60	1
SG-9	80	1
SG-10	60	1

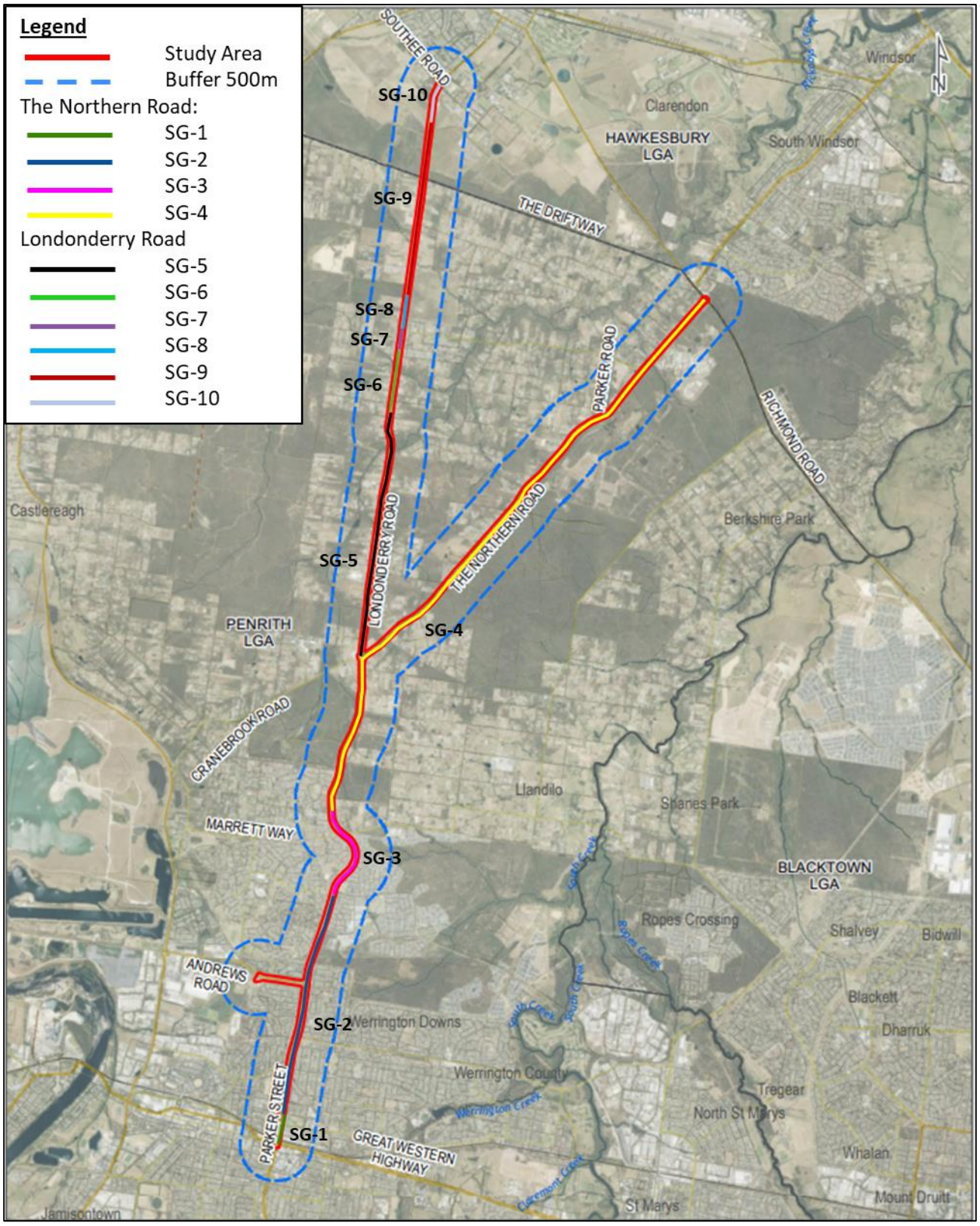


Figure 2-1 Key road corridors within the study area

2.2 Public transport

2.2.1 Introduction

The study area and its immediate vicinity is serviced by both train and bus services as described in Section 2.2.2 and 2.2.3 respectively.

2.2.2 Trains

On the T1 North Shore and Western line, Kingswood Railway Station is situated approximately 700m to the east of the Great Western Highway / Parker Street intersection, while Penrith Railway Station is about 1.6 kilometres to the west.

Richmond Railway Station is located approximately 1.7 kilometres to the north-east of the Londonderry Road / Southee Road intersection and is serviced by both the T1 Western line and T5 Cumberland line services.

2.2.3 Bus services

The following bus services travel along The Northern Road within the study area:

- Route 673 – Windsor to Penrith via Cranebrook
- Route 674 – Windsor to Mount Druitt via South Windsor and Shanes Park
- Route 678 – Richmond to Penrith via Cranebrook
- Route 782 – St Marys to Penrith via Werrington
- Route 780 – Mount Druitt to Penrith via Ropes Crossing
- Route 783 – Werrington to Penrith via Jordan Springs
- Route 786 – Penrith to Cranebrook via North Penrith (Loop Service)

In addition, the following bus service travels along Londonderry Road and The Northern Road within the study area:

- Route 677 – Richmond to Penrith via Londonderry.

Maps of relevant bus routes are provided in Figure 2-2 and Figure 2-3.

The above noted bus routes are the key public bus routes that run through the study area, however there are other public bus routes and school bus routes that run within or pass through the study area that may be impacted by changes in traffic conditions during construction of the proposal. A comprehensive list of impacted bus routes, bus stop locations and operating times is provided in Appendix A of this report. A plan showing impacted bus stops is provided in Appendix B of this report.

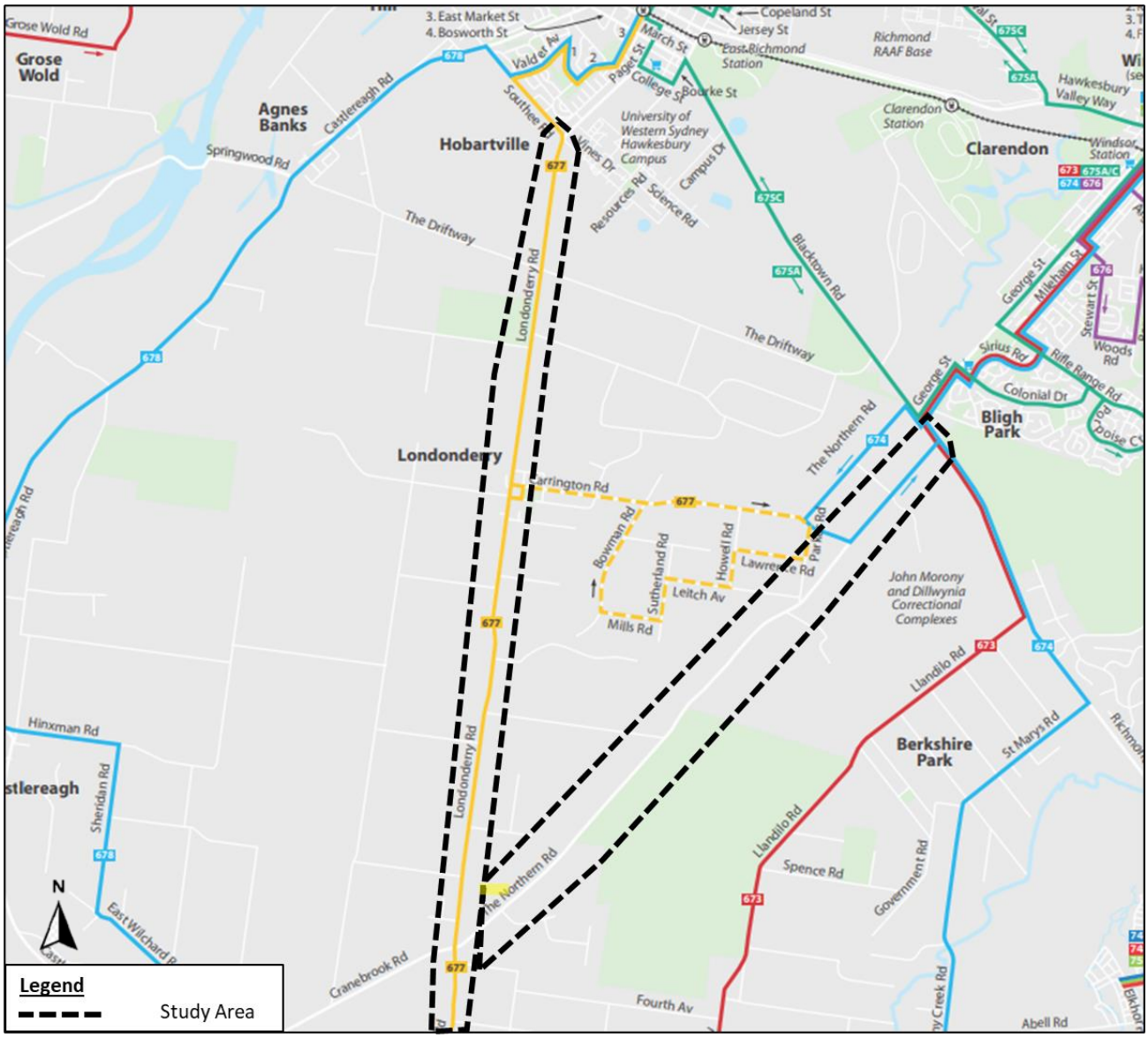


Figure 2-2 Bus routes along The Northern Road and Londonderry Road (1 of 2) (Transport 2023a)

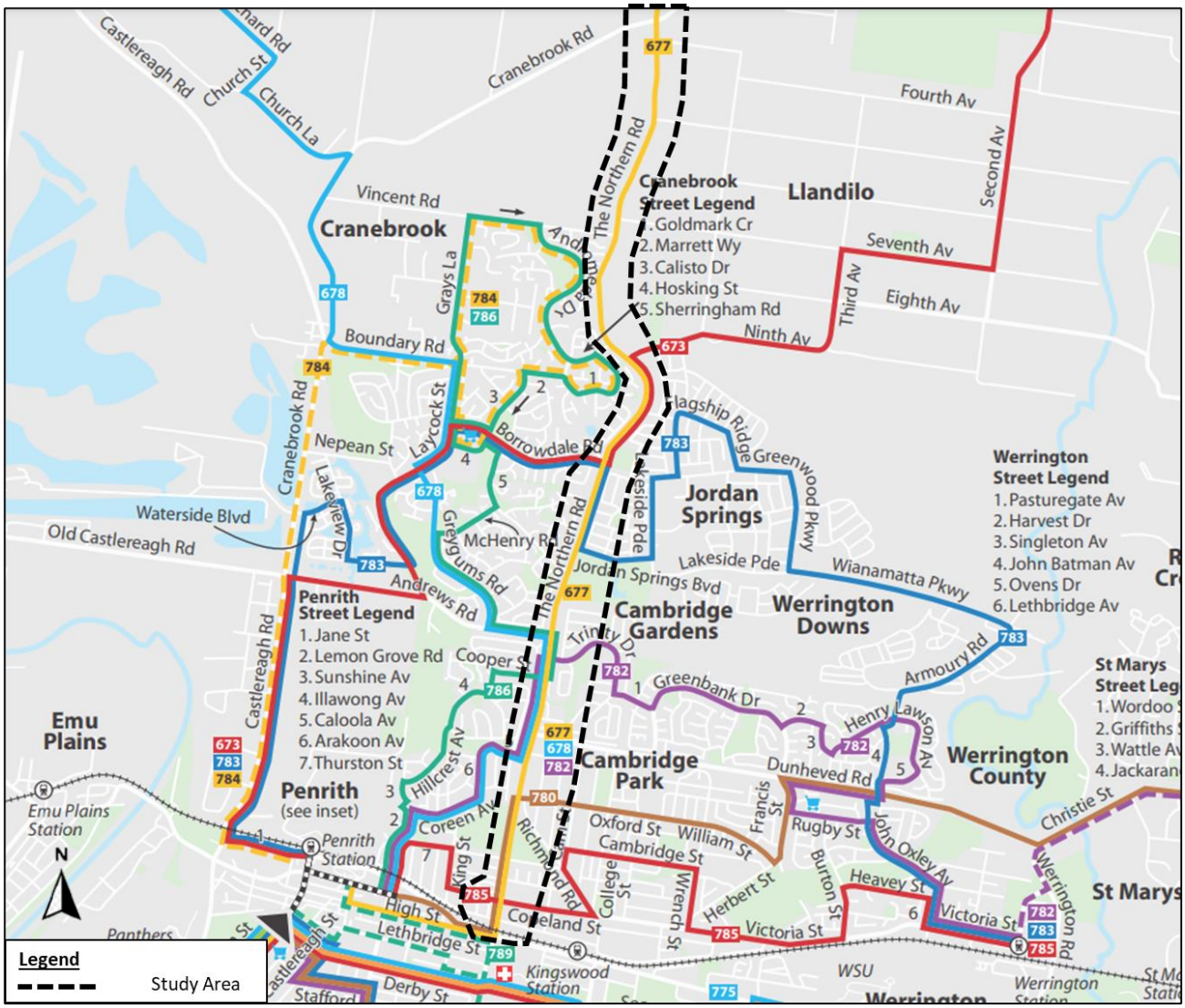


Figure 2-3 Bus Routes along The Northern Road (2 of 2) (Transport 2023a)

Table 2-3 summarises bus services that operate in the vicinity of the study area, including the route numbers, route description, as well as average weekday service frequencies during the AM, PM, and off-peak periods.

Table 2-3 Bus service frequency

Route No.	Description	Number of AM Peak services (6am-9am)	Number of PM Peak services (3pm-6pm)	Number of Off-Peak services (9am-3pm)	Total
673	Windsor to Penrith via Cranebrook	3	2	2	7
674	Windsor to Mount Druitt via South Windsor and Shanes Park	1	2	2	5
677	Richmond to Penrith via Londonderry	3	3	3	9
678	Richmond to Penrith via Cranebrook	3	2	1	6
780	Mount Druitt to Penrith via Ropes Crossing	9	10	13	32

Route No.	Description	Number of AM Peak services (6am-9am)	Number of PM Peak services (3pm-6pm)	Number of Off-Peak services (9am-3pm)	Total
783	Werrington to Penrith via Jordan Springs	6	5	7	18
786	Penrith to Cranebrook via North Penrith (Loop Service)	6	6	12	24

Note: The above bus frequencies are for one direction only.

2.3 Active transport

Pedestrian facilities within the study area include footpaths and shared paths along The Northern Road between Borrowdale Way and the Great Western Highway, noting that the path is not continuous along the southbound carriageway between Jordan Springs Boulevard and Andrews Road. A footpath also exists along The Northern Road northbound from Ninth Avenue to Andromeda Drive. Pedestrian crossings are provided at the signalised intersections along The Northern Road.

A pedestrian path exists along the western side of Londonderry Road from approximately 100m north of Namatjira Avenue to Warrina Place, and along the eastern side of Londonderry Road from approximately 50m north of Carrington Road to approximately 240m south of Kenmare Road where it terminates at the southern end of the existing safety barrier at the LNR11 culvert crossing.

Figure 2-4 and Figure 2-5 present the existing bicycle network within the study area. The Transport Cycleway Finder online tool indicates that there are cycle routes along The Northern Road between Blacktown Road/Richmond Road in the north and Andrews Road in the south. These routes are identified as 'road shoulders' that cyclists may utilise. Shared paths also exist along The Northern Road between Borrowdale Way and Andrews Road, and along Andrews Road within the study area, providing connectivity to suburbs such as Cranebrook and Jordan Springs.

Dedicated bicycle lanes exist between the general traffic left turn and through lanes at the intersections on The Northern Road at Andromeda Drive and Ninth Avenue in the northbound and southbound directions respectively. No other dedicated bicycle lanes exist within the study area.

Londonderry Road is not designated as a cycle route within the study area; however, the Transport Cycleway Finder online tool identifies some sections of Londonderry Road as General Roads with bicycles sharing the road space with other vehicles.

The Proposal intends to retain existing pedestrian and cycling facilities.

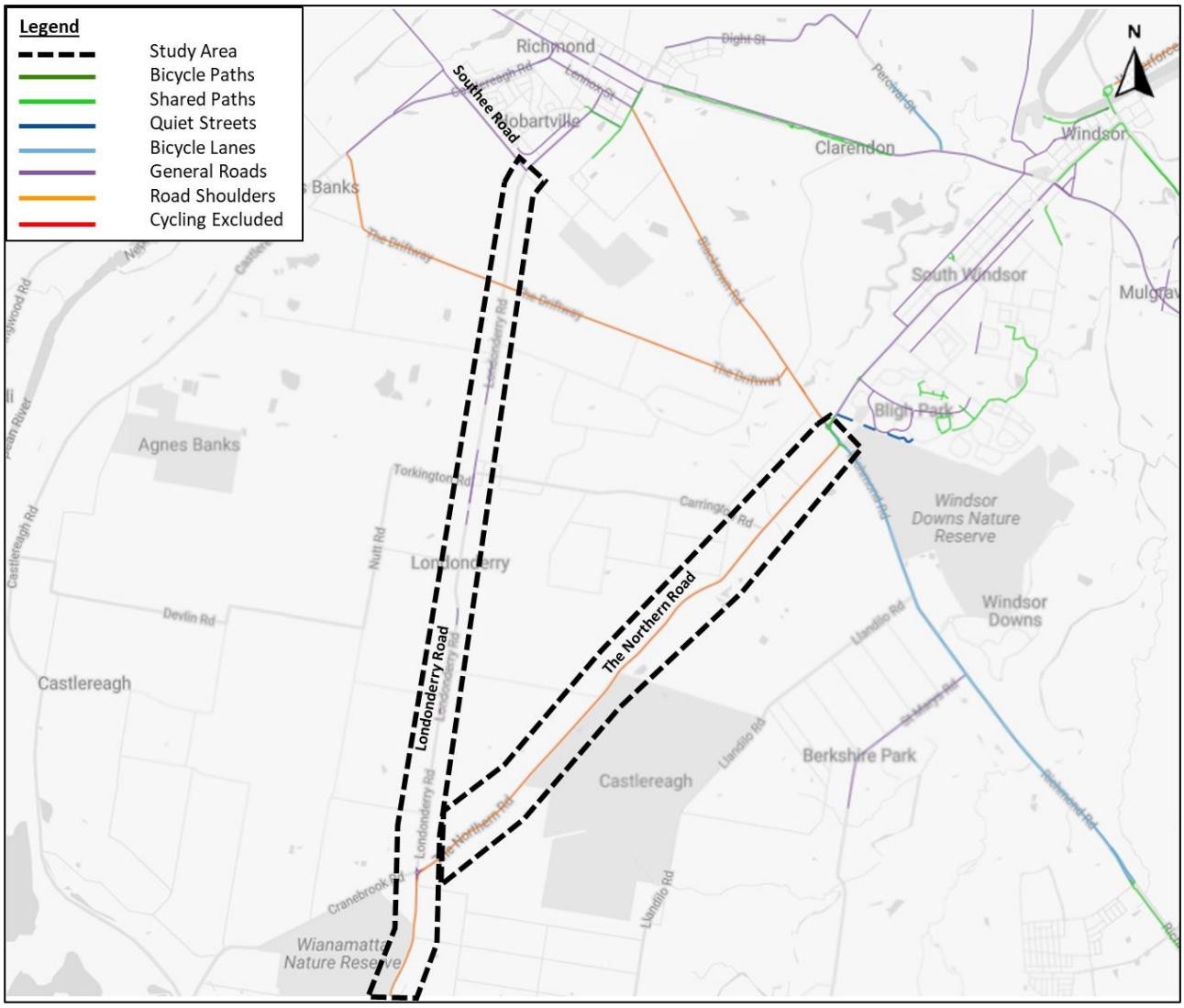


Figure 2-4 Existing bicycle network along The Northern Road and Londonderry Road (1 of 2) (Transport 2023b)

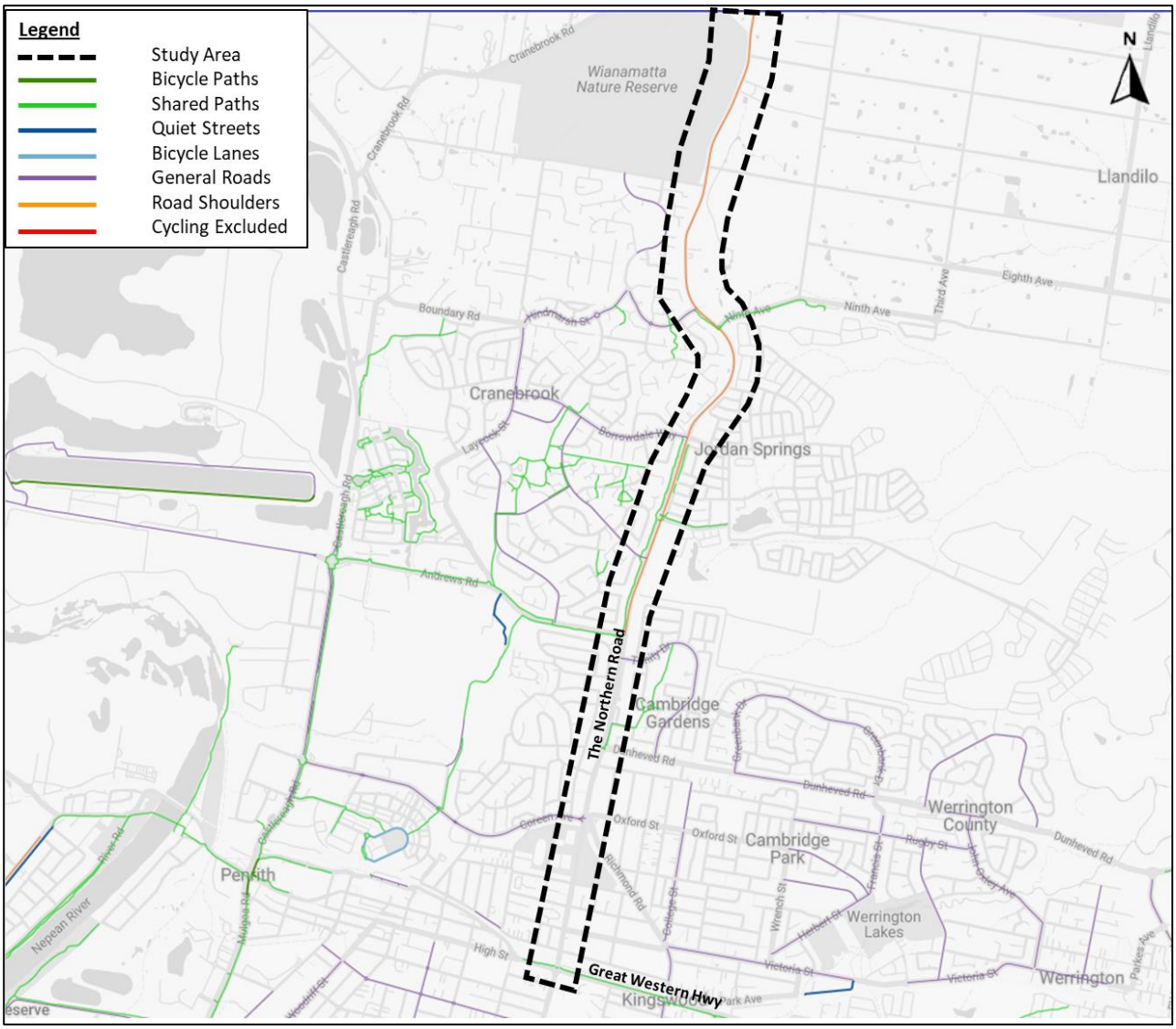


Figure 2-5 Existing bicycle network along The Northern Road – (2 of 2) (Transport 2023b)

2.4 Crash data analysis

This assessment is based on crash data supplied by Transport for the latest five-year period (being 2018 to 2022 inclusive). The data covers crashes reported to the NSW Police and includes fatal, injury and/or non-casualty crashes.

2.4.1 The Northern Road crashes

A total of 148 casualties resulted from 151 crashes during the considered five-year period. Of the 151 crashes, 102 crashes resulted in injuries (serious, moderate, minor/other injury). Additionally, there have been 3 fatal crashes, and the remaining are classified as non-casualty crashes. A summary of crashes on The Northern Road is illustrated in Figure 2-6, as well as in Table 2-4 and Table 2-5.

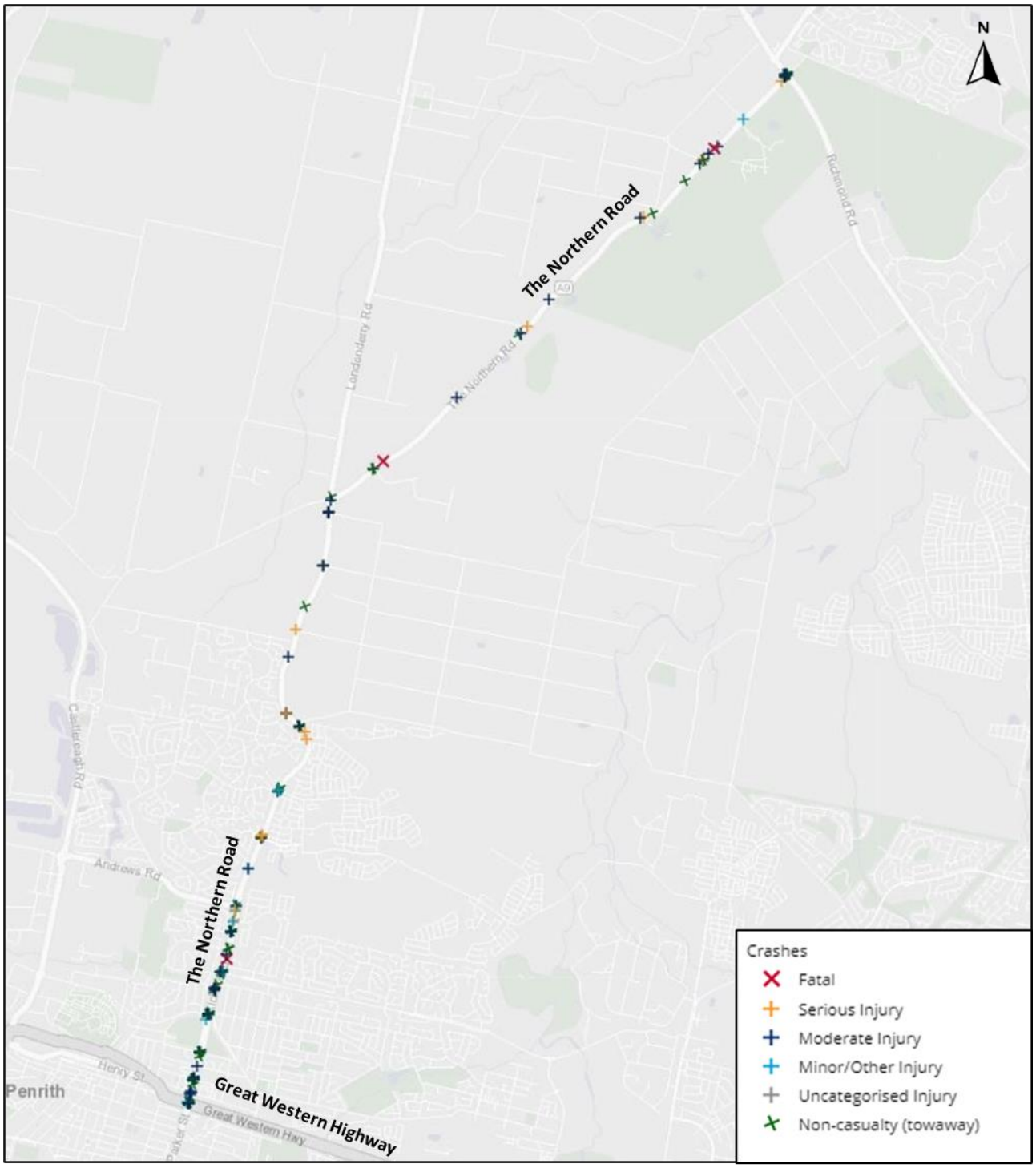


Figure 2-6 Crash severity and locations along The Northern Road during 2018-2022 (Transport)

Table 2-4 Types of crashes per year and number of casualties on The Northern Road

Year	Crashes	Casualties
2018	26	19
2019	27	20
2020	27	37
2021	30	29
2022	41	43
Total	**151**	**148**

Table 2-5 Severity of crashes on The Northern Road

Crash severity	Crashes	Proportion
Non-casualty (towaway)	46	30%
Minor/other injury	21	14%
Moderate injury	62	41%
Serious injury	19	13%
Fatal	3	2%
Total	**151**	**100%**

A breakdown of recorded crashes by road user type is provided in Table 2-6. There were a total of 8 pedestrian casualties recorded along The Northern Road between 2018 and 2022.

Table 2-6 Casualties by road user type on The Northern Road)

Road user type	Casualties
Motor vehicle driver	101
Motor vehicle passenger	25
Motorcycle rider	13
Pedestrian	8
Pedal cycle rider	1
Total	**148**

2.4.2 Londonderry Road crashes

A total of 37 casualties resulted from 30 crashes along Londonderry Road within the study area. Of the 30 crashes, 23 crashes resulted in injuries (serious, moderate and minor/other injury). There has been one recorded fatal crash, and the remaining are classified as non-casualty crashes. A summary of crashes on Londonderry Road is shown in Figure 2-7, as well as in Table 2-7 and Table 2-8.

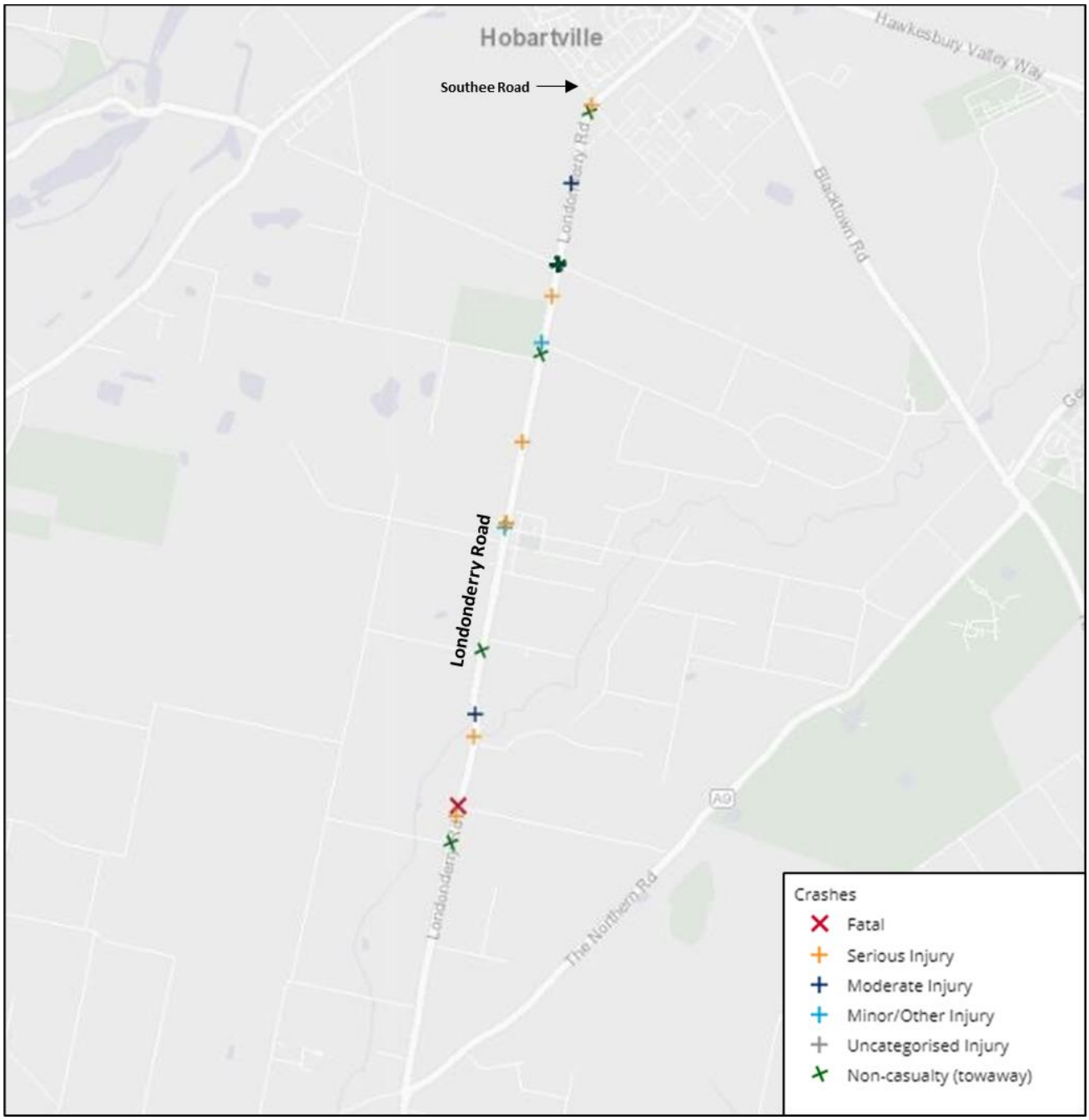


Figure 2-7 Crash locations and severity of crashes along Londonderry Road during 2018-2022 (Transport)

Table 2-7 Number of crashes per year and casualties on Londonderry Road

Year	Crashes	Casualties
2018	5	6
2019	6	5
2020	5	5
2021	3	5
2022	11	16
Total	**30**	**37**

Table 2-8 Severity of crashes on Londonderry Road

Crash severity	Crashes	Proportion
Non-casualty (towaway)	7	23%
Minor/other injury	4	14%
Moderate injury	8	27%
Serious injury	10	33%
Fatal	1	3%
Total	**30**	**100%**

A breakdown of recorded crashes by road user type is provided in Table 2-9. This shows that most of the casualties involved motor vehicles (as a driver and/or passenger). Similar to The Northern Road, most of the casualties involved motor vehicles (as a driver and/or passenger).

Table 2-9 Casualties by road user type on Londonderry Road

Road user type	Casualties
Motor vehicle driver	26
Motor vehicle passenger	8
Motorcycle rider	2
Pedal cycle rider	1
Total	**37**

2.5 Traffic volumes

Traffic data was sourced to gain a good understanding of existing conditions, and to compare the baseline against the construction and operational scenarios as part of the Working Paper assessment. A summary of the traffic data is provided in Table 2-10.

Table 2-10 Summary of traffic data used for the Working Paper

Data type	Source	Survey dates	Survey times
Mid-block surveys – Automatic Tube Counts (ATC)	Matrix	18 July 2023 to 25 July 2023	24 hours
SCATS signal data	Transport	22 June 2023	24 hours
Classified intersection counts	Matrix	18 July 2023 to 24 July 2023	6:00am to 10:00am 2:00pm to 6:00pm

2.5.1 Mid-block

2.5.1.1 Mid-block volumes from traffic surveys

Automatic Traffic Counts (ATC) were carried out from 18 July 2023 to 25 July 2023 to determine mid-block traffic volumes within the study area, the locations of which are presented in Figure 2-8.

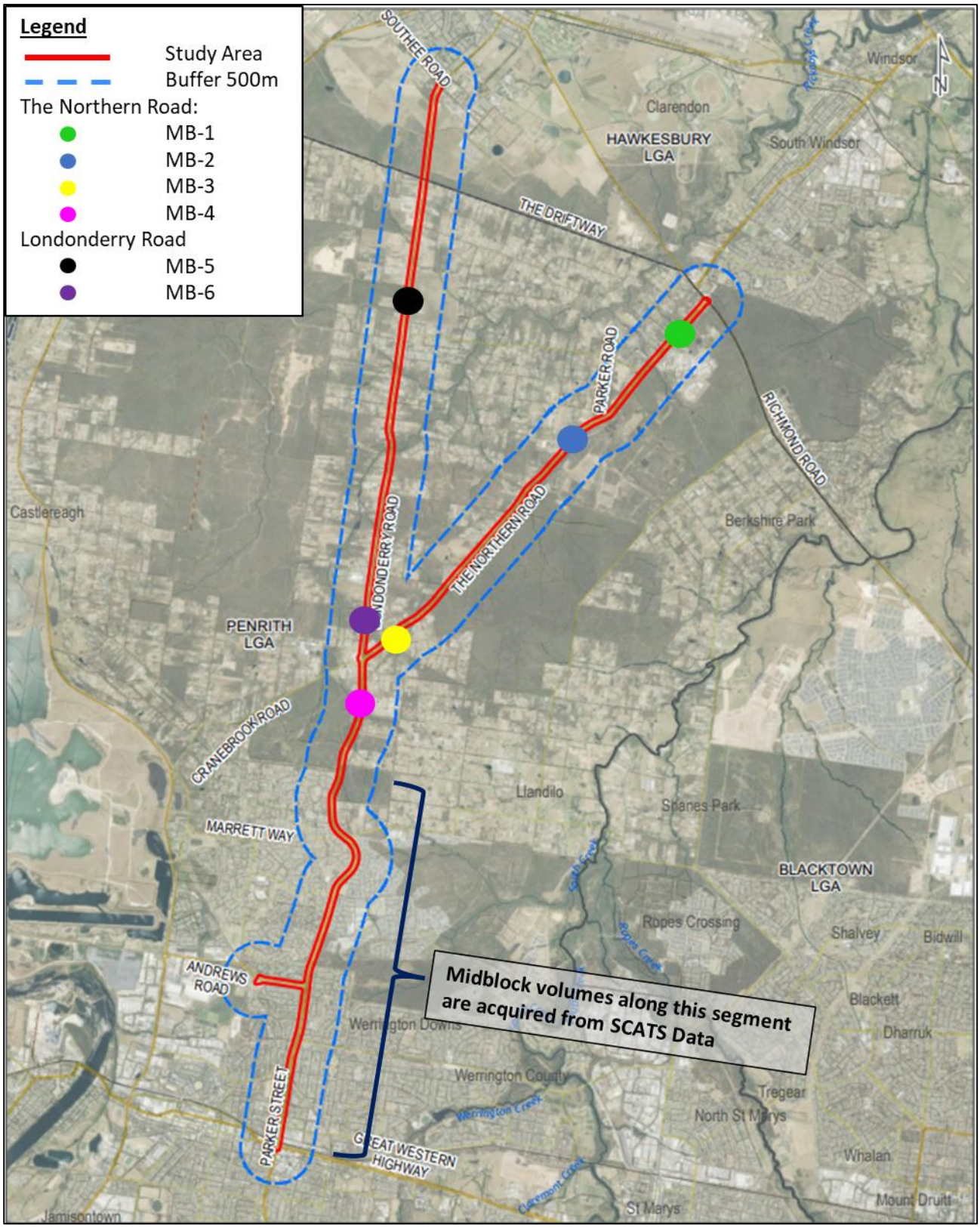


Figure 2-8 ATC locations for mid-block traffic volumes

Mid-block traffic volumes for the AM and PM peak hours are summarised in Table 2-11.

Table 2-11 Mid-block peak hour traffic volumes (weekday) of MB-1 to MB-6

ID	Name	Source	AM peak (1 hour)			PM peak (1 hour)		
			NB	SB	Two-way	NB	SB	Two-way
MB-1	The Northern Road (between Richmond Road and north of Carrington Road)	ATC	666	723	1,389	807	629	1,436
MB-2	The Northern Road (between south of Carrington Road and north of Whitegates Road)	ATC	785	645	1,430	712	648	1,360
MB-3	The Northern Road (between south of Whitegates Road and Londonderry Road)	ATC	757	574	1,331	708	656	1,364
MB-4	The Northern Road (between Londonderry Road and north of Vincent Road)	ATC	792	647	1,439	735	817	1,553
MB-5	Londonderry Road (between Southee Road and north of Namatjira Avenue)	ATC	413	319	732	438	470	908
MB-6	Londonderry Road (between south of Namatjira Avenue and The Northern Road)	ATC	397	348	745	460	465	925

NB: Northbound
SB: Southbound

The data in Table 2-11 shows that on:

- The Northern Road (between Richmond Road and Londonderry Road) – MB-1 to MB-3:
  - Traffic volumes on this section of The Northern Road vary between 574 and 807 vehicles per direction during peak hours depending on the location.
  - During both the AM and PM peak, the volume of traffic travelling northbound on this section of The Northern Road is generally slightly higher compared to traffic observed in the southbound direction. Suburbs to the north are more urbanised, which could contribute to more northbound traffic movements in both AM and PM peaks. Motorists may also be generally taking this route to get to Richmond Road, which forms connections to suburbs east and west of the study area.

- Londonderry Road (between Southee Road and The Northern Road / Cranebrook Road) – MB-5 to MB-6:
  - Traffic volumes on this section of Londonderry Road vary between 319 and 470 vehicles per direction during peak hours depending on the location.
  - In the AM peak, the volume of traffic travelling northbound on Londonderry Road is higher, whilst in the PM peak traffic travelling southbound on Londonderry Road is higher, which could be attributed to motorists generally taking this route to get to/from the Richmond town centre.
- The Northern Road (between Londonderry Road and north of Vincent Road) – MB-4:
  - Traffic volumes on this section of The Northern Road vary between 647 and 817 vehicles per direction during peak hours depending on location.
  - In the AM peak, the volume of traffic travelling northbound on this section of The Northern Road is higher, whilst the opposite is observed in the PM peak when traffic travelling southbound is higher. The traffic volume at this mid-block location contributes to the flow that travels on Londonderry Road and The Northern Road (towards Richmond Road).

2.5.1.2 SCATS signal data

Sydney Coordinated Adaptive Traffic System (SCATS) data provided by Transport for The Northern Road between Andromeda Drive and Great Western Highway was reviewed in addition to the mid-block traffic surveys. Figure 2-9 shows the mid-block locations for which SCATS data was used to derive the AM and PM peak hour traffic volumes shown in Table 2-12.

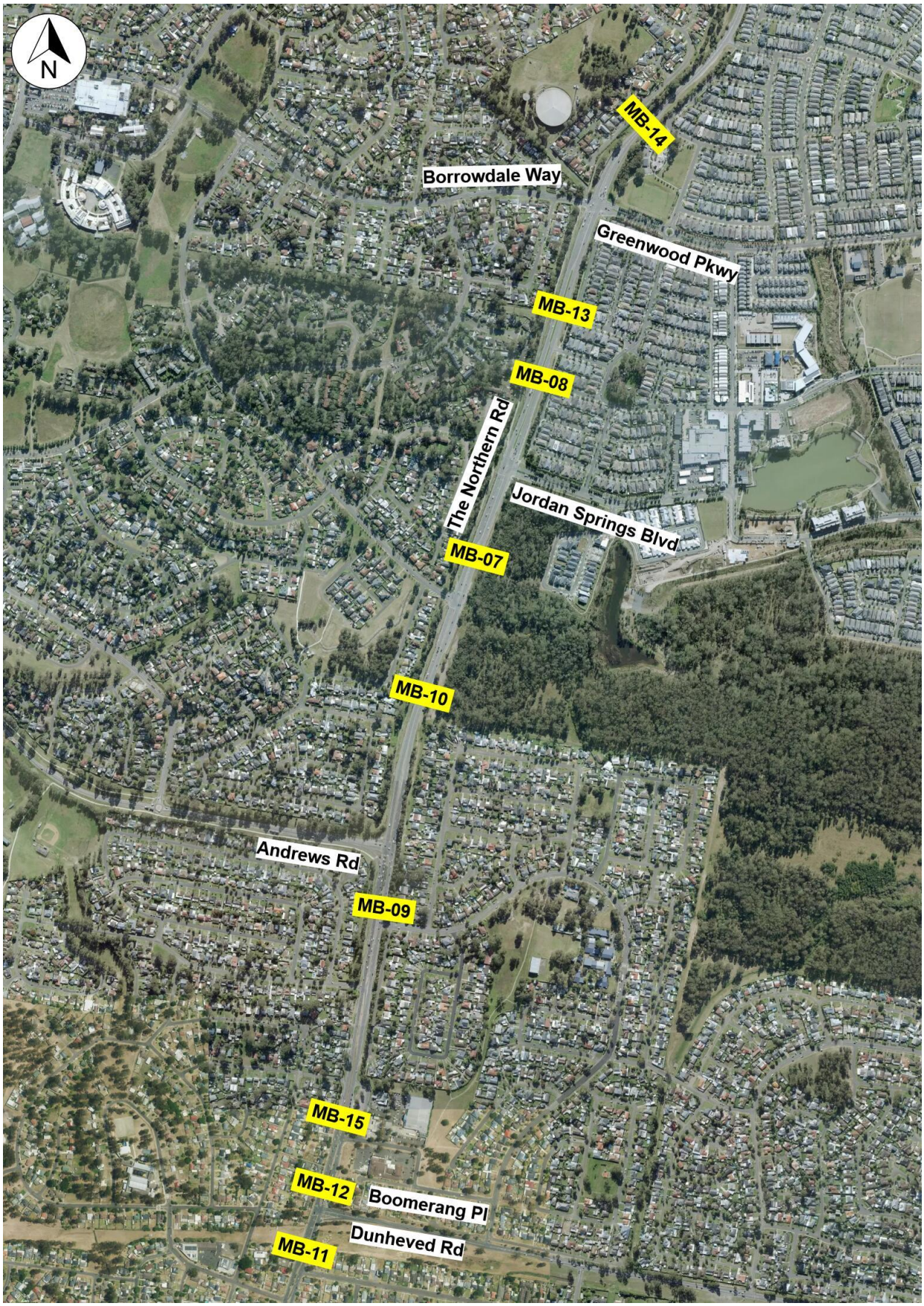


Figure 2-9 Mid-block locations for which SCATS data was used to derive traffic volumes

Table 2-12 Mid-block peak hour traffic volumes (weekday) of MB-7 to MB-15

ID	Name	Source	AM peak (1 hour)			PM peak (1 hour)		
			NB	SB	Two-way	NB	SB	Two-way
MB-07	The Northern Road - south of Jordan Springs Boulevard	SCATS	1,031	1,760	2,791	1,691	1,355	3,046
MB-08	The Northern Road – north of Jordan Springs Boulevard	SCATS	832	1,252	2,084	1,073	1,029	2,102
MB-09	The Northern Road - south of Andrews Road	SCATS	1,404	2,109	3,513	2,039	1,852	3,891
MB-10	The Northern Road - north of Andrews Road	SCATS	1,133	1,909	3,042	1,795	1,602	3,397
MB-11	The Northern Road - south of Dunheved Road	SCATS	1,106	1,971	3,077	1,875	1,760	3,635
MB-12	The Northern Road - north of Dunheved Road	SCATS	1,268	1,953	3,221	2,008	1,634	3,642
MB-13	The Northern Road - south of Borrowdale Way	SCATS	816	1,196	2,012	829	1,207	2,036
MB-14	The Northern Road - north of Borrowdale Way	SCATS	1,018	999	2,017	987	1,101	2,088
MB-15	The Northern Road - north of Boomerang Place	SCATS	1,335	1,896	3,231	2,063	1,637	3,700

NB: Northbound
SB: Southbound

The data presented in Table 2-12 shows that:

- The volumes include mid-block locations along The Northern Road from north of Greenwood Parkway (MB-14) to south of Dunheved Road (MB-11).
- Traffic volumes along this section vary between 816 and 2,109 vehicles per direction during peak hours depending on the location.
- In the AM peak, the volume of traffic travelling southbound on this segment of The Northern Road is generally higher as this is the route motorists generally take to get to the Great Western Highway and the M4 Motorway.
- The opposite is observed in the PM peak when traffic travelling northbound is generally higher.

2.5.2 Classified intersection counts

The roundabout at The Northern Road and Londonderry Road is a key convergence point for the two road corridors. Classified traffic counts were conducted from Tuesday 18 July 2023 to Monday 24 July 2023 to capture all traffic movements at the roundabout during both the morning and afternoon peak periods. These traffic counts were used to identify the directional split of traffic volumes for both peak periods, as shown in Table 2-13. This information was used in conjunction with the mid-block traffic volumes to inform the traffic impact assessment.

Table 2-13 Traffic split at The Northern Road/Londonderry Road/Cranebrook Road roundabout

Road	AM Peak		PM Peak	
	Northbound	Southbound	Northbound	Southbound
The Northern Road	40%	39%	42%	48%
Londonderry Road	40%	40%	44%	40%
Cranebrook Road	20%	21%	14%	12%

2.6 Parking

No formal parking is available along The Northern Road and Londonderry Road within the study area, and paved road shoulders are generally too narrow to accommodate parked vehicles, with the following notable exceptions:

- Along Londonderry Road through the Londonderry village, between Namatjira Avenue and Kenmare Road, where the existing shoulders are generally wide enough to accommodate parked vehicles. The only parking prohibition identified along this length of road is at the existing pedestrian crossing at the Londonderry Public School, as indicated by No Stopping signs approximately 20m north and 10m south of the crossing.
- Along The Northern Road from approximately 230m north of Andromeda Drive to the intersection with Greenwood Parkway/Borrowdale Way, where the combination of the existing shoulders and traversable verge may be regarded as adequate parking space. However, parking prohibition is indicated by existing No Stopping signs at regular intervals along the northbound lane within this length of road. No Stopping signs also exist along the southbound lane on either side of Andromeda Drive from approximately 230m north to approximately 90m of the intersection, and for approximately 60m south from Ninth Avenue.

No other prominent parking prohibitions or restrictions have been observed within the proposal boundary along these routes, except for general prohibition along the dual carriageway section of The Northern Road south from the intersection with Greenwood Parkway/Borrowdale Way.

3. Existing capacity and level of service

This section provides a qualitative assessment of the existing mid-block capacity. This assessment is used to inform the effectiveness of the two key corridors within the study area from a traffic capacity perspective. Mid-block level of service (LoS) is also used to define operating conditions or service quality. The mid-block capacity and associated LoS is used to determine the base case (existing conditions) and inform the assessment of the impacts of the construction phase of the Proposal, noting that the Proposal does not substantially change normal traffic operations. The methods used to analyse traffic depend on the facility type, which may be classified into two categories:

- Interrupted flow facilities: traffic flow is regulated by fixed external elements, such as traffic signals, stop signs, give-way signs, roundabouts or other controls, which cause traffic to stop periodically, irrespective of the total amount of traffic. These have been assessed using the method outlined in Section 6.2 of Austroads *Guide to Traffic Management Part 3*.
- Uninterrupted flow facilities: traffic flow is regulated by vehicle-vehicle interactions and interactions between vehicles and the roadway; there are no fixed elements external to the traffic stream, such as traffic control signals that cause interruption to traffic flow. These have been assessed using the method outlined in Section 5.2.1 of the Austroads *Guide to Traffic Management Part 3*.

For the purposes of this assessment, the sections of The Northern Road at MB-01 to MB-04 are considered to operate under uninterrupted flow conditions, except the section between Whitegates Road and Londonderry Road (MB-03), which operates as an interrupted flow facility due to the proximity of the mid-block survey location to the roundabout at Londonderry Road, noting that traffic flow along this section may therefore be influenced by the roundabout. The remaining sections of The Northern Road are considered to operate as interrupted flow facilities.

Londonderry Road between Smeeton Road and The Driftway (MB-05) is considered to operate under uninterrupted flow conditions, while the section south of Smeeton Road (MB-06) is considered to operate under interrupted flow conditions due to the proximity of the mid-block survey location to the roundabout at The Northern Road.

3.1 Interrupted flows

3.1.1 Typical mid-block capacity

Typical mid-block capacity expressed as a number of Passenger Car Units (PCU) per hour is shown in Table 3-1, which sets out typical mid-block capacities for various types of urban roads with interrupted flow.

Table 3-1 Typical mid-block capacities for urban roads with interrupted flow

Type of lane	One-way mid-block capacity (PCU/hr)
Median or inner lane	
Divided road	1,000
Undivided road	900
Middle lane (of a 3-lane carriageway)	
Divided road	900
Undivided road	1,000
Kerb lane	
Adjacent to parking lane	900
Occasional parked vehicles	600
Clearway conditions	900

Source: Based on Austroads Guide to Traffic Management – Part 3: Traffic Studies and Analysis

3.1.2 Level of service criteria

The capacity of urban roads is generally determined by the capacity of intersections or mid-block capacity (the section of road between intersections). The mid-block capacity of roads can be compared to existing traffic volumes and a volume to capacity ratio (V/C) calculated.

The V/C is a measure of the amount of traffic carried by a section of road compared to its nominal capacity. As the V/C nears one, the speed on the link decreases and both the likelihood and the duration of flow breakdown increases.

The *Austroads Guide to Traffic Management Part 3* outlines LoS criteria for mid-block sections of road based on the V/C. A summary of the LoS criteria is presented in Table 3-2.

Table 3-2 Mid-block level of service criteria

Level of Service	Interrupted flow facilities (Arterial and collector roads)	Volume to Capacity Ratio
A	Primarily free flow operations at average travel speeds, usually about 90% of the free flow speed (FFS) for the given straight class. Vehicles are completely unimpeded in their ability to manoeuvre within the traffic stream. Control delay at signalised intersections is minimal.	≤ 0.34
B	Reasonably unimpeded operations at average travel speeds, usually about 70% of the FFS for the street class. The ability to manoeuvre within the traffic stream is only slightly restricted and control delays at signalised intersections are not significant.	0.35 to 0.50
C	Stable operations: however, ability to manoeuvre and change lanes in mid-block locations may be more restricted than at Los B, and longer ques, adverse signal coordination or both may contribute to lower average travel speeds of about 50% of the FFS for the street class.	0.51 to 0.74
D	A range in which small increases in flow may cause substantial increases in delay and decreases in travel speed. LoS D may be due to adverse signal progression, inappropriate signal timing, high volumes or a combination of these factors. Average travel speeds are about 40% of FFS.	0.75 to 0.89
E	Characterised by significant delays and average travel speeds of 33% of the FFS or less. Such operations are caused by a combination of adverse progression, high signal density, high volumes, extensive delays at critical intersections and inappropriate signal timing.	0.90 to 0.99
F	Characterised by urban street flow extremely low speeds, typically 25% to 33% of the Flow Speed (FS). Intersection congestion is likely at critical signalised locations, with high delays, high volumes in extensive queuing.	≥ 1

3.1.3 Level of service assessment

Mid-block LoS assessment was carried out at the locations shown in Figure 2-8 and Figure 2-9 above. Mid-block traffic volumes during the AM and PM peaks for the locations shown in Figure 2-9 (MB-07 to MB-15) were calculated using the SCATS data provided by Transport for the signalised intersections along The Northern Road between Eton Road and Jardine Way.

The nominal capacity was analysed at the mid-block locations and the existing typical mid-block capacity compared with the assumed traffic volumes prior to construction (Base Case). This was used to determine the LoS, as follows:

- The northbound carriageway of The Northern Road operates with LoS E or better during the AM peak, except north of Borrowdale Way (MB-14), which operates with LoS F. The PM peak operates with LoS F, except the sections between Jordan Springs Boulevard and Borrowdale Way (MB-08 and MB-13), as well as east of Londonderry Road (MB-03), which operate with LoS C and LoS E respectively.
- The southbound carriageway of The Northern Road operates with LoS F during the AM peak, except north of Jordan Springs Boulevard (MB-08), south of Borrowdale Way (MB-13), north of Boomerang Place (MB-15) and east of Londonderry Road (MB-03), which operate with LoS E or better. During the PM peak, the southbound carriageway operates with LoS F south of Andrews Road (MB-09), south of Dunheved Road (MB-11) and north of Borrowdale Way (MB-14). The LoS is E or better at all other locations.
- Londonderry Road south of Smeeton Road (MB-06) operates with LoS B and C during the AM and PM peaks, respectively.

The mid-block performance results during the AM and PM peak periods are summarised in Table 3-3.

Table 3-3 Mid-block assessment for interrupted flow segments – Base Case Weekday

ID	Location/ Direction	Capacity (PCU)	AM Peak			PM Peak		
			Volume (PCU)	V/C	LoS	Volume (PCU)	V/C	LoS
MB-03	**The Northern Road - east of Londonderry Road**							
	Northbound	900	863	0.96	E	829	0.92	E
	Southbound	900	667	0.74	D	758	0.84	D
MB-06	**Londonderry Road - south of Smeeton Road**							
	Northbound	900	427	0.47	B	499	0.55	C
	Southbound	900	414	0.46	B	541	0.60	C
MB-07	**The Northern Road - south of Jordan Springs Boulevard**							
	Northbound	1900	1201	0.63	C	1970	>1	F
	Southbound	1900	1970	>1	F	1565	0.82	D
MB-08	**The Northern Road - north of Jordan Springs Boulevard**							
	Northbound	1900	969	0.51	C	1250	0.66	C
	Southbound	1900	1462	0.77	D	1239	0.65	C
MB-09	**The Northern Road - south of Andrews Road**							
	Northbound	1900	1639	0.86	D	2380	>1	F
	Southbound	1900	2253	>1	F	1981	>1	F
MB-10	**The Northern Road - north of Andrews Road**							
	Northbound	1900	1322	0.70	C	2095	>1	F
	Southbound	1900	2137	>1	F	1794	0.94	E
MB-11	**The Northern Road - south of Dunheved Road**							
	Northbound	1900	1289	0.68	C	2185	>1	F
	Southbound	1900	2207	>1	F	1970	>1	F
MB-12	**The Northern Road - between Dunheved Road and Boomerang Place**							
	Northbound	1900	1478	0.78	D	2340	>1	F
	Southbound	1900	2186	>1	F	1830	0.96	E
MB-13	**The Northern Road - south of Borrowdale Way**							
	Northbound	1900	951	0.50	C	966	0.51	C
	Southbound	1900	1339	0.70	C	1351	0.71	C
MB-14	**The Northern Road - north of Borrowdale Way**							
	Eastbound	900	1186	>1	F	1150	>1	F
	Westbound	900	1118	>1	F	1233	>1	F
MB-15	**The Northern Road - north of Boomerang Place**							
	Northbound	1900	1556	0.82	D	2404	>1	F
	Southbound	1900	1704	0.90	E	1471	0.77	D

3.2 Uninterrupted flows

3.2.1 Level of service criteria

Section 5.2.1 of the *Austroads Guide to Traffic Management Part 3* provides a method to assess the performance of a two-way segment of road as directional segments with each direction of travel considered separately. The assessment is based on determining the LoS and comparing it against the LoS criteria. This method distinguishes between three categories of two-lane roads, where The Northern Road and Londonderry Road have been considered as Class I roads. The LoS criteria for Class I roads are shown in Figure 3-1 below.

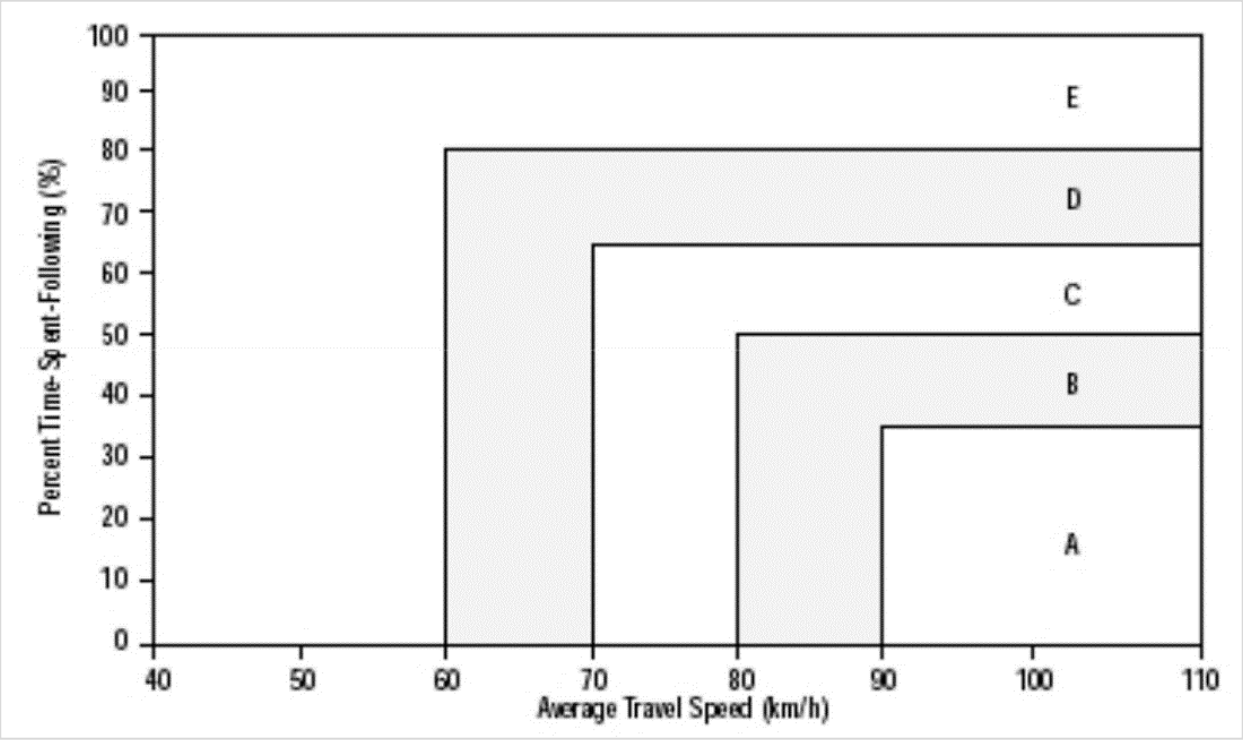


Figure 3-1 LoS criteria for two-lane highways in Class I

Two service measures are used to describe vehicle LoS on Class I roads namely Average Travel Speed (ATS) and Percent Time Spent Following (PTSF). Figure 3-2 and Figure 3-3 show the expected average travel speed and the proportional time-spent-following for ideal or base conditions, respectively.

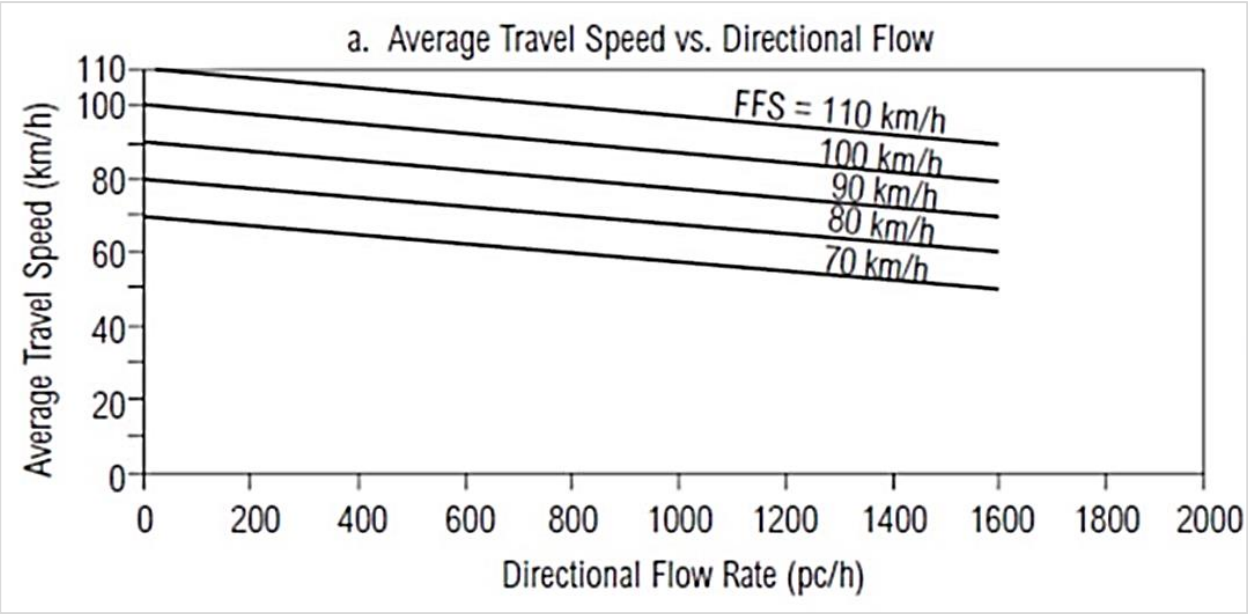


Figure 3-2 Average Travel Speed (ATS) relationship for directional segments

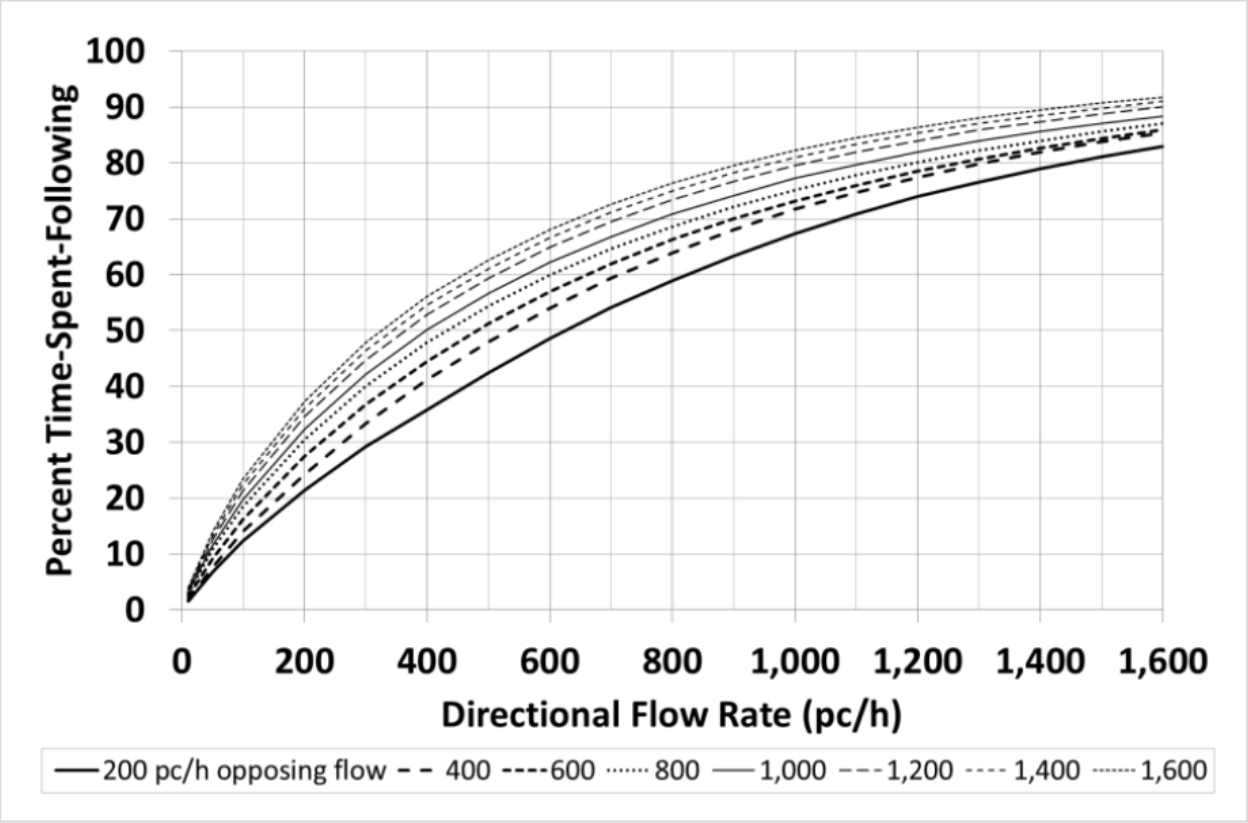


Figure 3-3 Percent time spent following (PTSF) relationship for directional segments

3.2.2 Level of service assessment

LoS was assessed for each direction of travel separately at three locations along The Northern Road and one location along Londonderry Road. The traffic volumes during the AM and PM peaks and the average travel speed from the mid-block surveys described in Section 2.5.1 were used to estimate the Average Travel Speed (ATS) and Percent Time Spent Following (PTSF) using Figure 3-2 and Figure 3-3. The ATS and PTSF values were then used to determine the LoS from Figure 3-1.

The analysis indicates that both roads operate with LoS E or better during both peaks. A summary of the determined LoS during the AM and PM peak periods for the Base Case on a weekday is provided in Table 3-4.

Table 3-4 Mid-block level of service for uninterrupted flow segments – Base Case Weekday

ID	Location/ Direction	AM Peak				PM Peak			
		Volume (PCU)	ATS (km/h)	PTSF	LoS	Volume (PCU)	ATS (km/h)	PTSF	LoS
	The Northern Road between Richmond Road and north of Carrington Road								
MB-01	Northbound	830	60	73%	E	921	57	75%	E
	Southbound	842	58	73%	E	758	61	70%	D
	The Northern Road between south of Carrington Road and north of Whitegates Road								
MB-02	Northbound	885	64	72%	D	835	66	70%	D
	Southbound	722	70	63%	D	761	69	70%	D
	The Northern Road between Londonderry Road and north of Vincent Road								
MB-04	Northbound	882	60	73%	E	863	60	74%	E
	Southbound	698	65	67%	D	921	60	75%	E
	Londonderry Road between Southee Road and north of Namatjira Avenue								
MB-05	Northbound	450	60	44%	E	491	60	51%	E
	Southbound	362	60	41%	E	518	59	52%	E

The mid-block analysis was carried out for a single peak on a Saturday. Both directions of The Northern Road operate with LoS D, while Londonderry Road operates with LoS D and LoS E in the northbound and southbound directions respectively. Table 3-5 provides a summary of the LoS for the Base Case on a Saturday.

Table 3-5: Mid-block level of service for uninterrupted flow segments – Base Case Saturday

ID	Location/ Direction	Base Case (without construction traffic)			
		Volume (PCU)	ATS (km/h)	PTSF	LoS
	The Northern Road between Richmond Road and north of Carrington Road				
MB-01	Northbound	702	61	64%	D
	Southbound	695	61	64%	D
	The Northern Road between south of Carrington Road and north of Whitegates Road				
MB-02	Northbound	1002	63	80%	D
	Southbound	1009	63	80%	D
	The Northern Road between Londonderry Road and north of Vincent Road				
MB-04	Northbound	636	68	61%	D
	Southbound	664	63	62%	D
	Londonderry Road between Southee Road and north of Namatjira Avenue				
MB-05	Northbound	339	61	39%	D
	Southbound	422	60	41%	E

4. Assessment scenarios

4.1 Construction phase scenario

The construction activities in relation to the Proposal that may impact road users include:

- Site establishment including barrier installation
- Tree clearing
- Construction and upgrades of transverse and longitudinal drainage
- Installation and adjustment of utility crossings and overhead utilities
- Pavement demolition
- Pavement construction

These construction activities primarily create short-term increases in vehicle numbers, delays or increased travel times for motorists.

There are four main construction staging strategies that will be used to undertake the works:

- Offline works
- 56-hour weekend closures
- Short-term lane closures
- Long-term lateral shifts

The above construction staging strategies were developed into specific scenarios as described below, which will be selected depending on the specific work types, constraints, and estimated impact to traffic flow and safety. The impacts relating to the proposed construction staging strategies are discussed in Section 5.

4.1.1 Construction Scenario 1 - Offline works

This scenario involves maintaining two lanes of traffic (one lane per direction), separated by temporary safety barriers from the works zone. This can be carried out in areas where there is enough existing road width to safely maintain two lanes of traffic with temporary barriers separating traffic from a work area to undertake the work safely and efficiently.

4.1.2 Construction Scenario 2 - 56-hour weekend closures

This scenario involves full closure of a section of The Northern Road or Londonderry Road within the study area for a period of 56 hours at the weekend to construct shoulder widening, pavements or culvert upgrades. This type of closure would be for the period between Friday 10:00pm and Monday 6:00am.

Potential detour routes during the full closures are presented in Figure 4-1 to Figure 4-7 and will be subject to Transport Customer Journey Planning (CJP) acceptance through the Contractor's Construction Traffic Management Plan. The assessment of the impact of the 56-hour weekend closures assumes that no construction activities on any adjacent projects are taking place concurrently with these closures. Coordination with adjacent projects would therefore be required during construction.

The potential detour routes for a full closure on The Northern Road between Richmond Road/Blacktown Road in the north and Cranebrook Road in the south is shown on Figure 4-1.

The potential detour routes for a full closure on Londonderry Road between The Driftway in the north and Cranebrook Road in the south is shown on Figure 4-2.

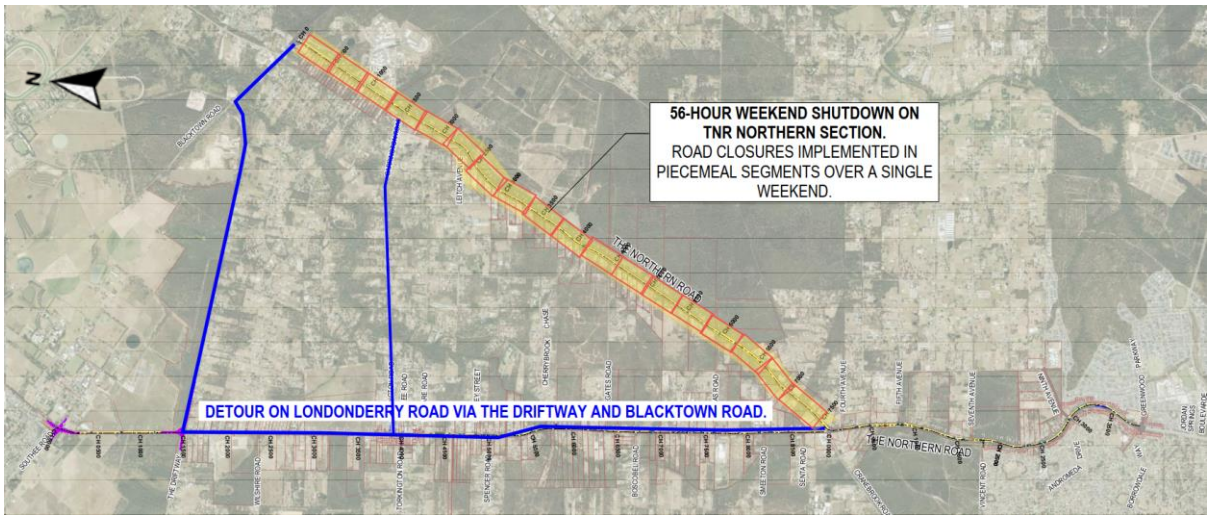


Figure 4-1 Detour routes during 56-hour weekend closure on The Northern Road [Northern Section]

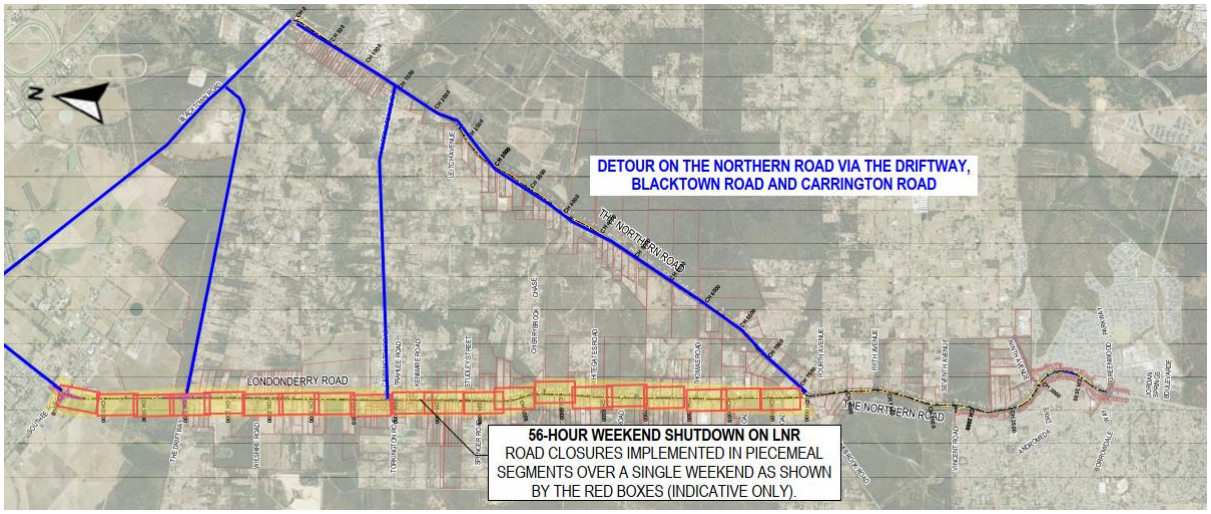


Figure 4-2 Detour routes during 56-hour weekend closure on Londonderry Road

Weekend closure of The Northern Road between Cranebrook Road and Greenwood Parkway/Borrowdale Road for a period of 56 hours may also be required. Traffic would potentially be diverted via two detour routes, which include local and State Roads to the immediate east and west of The Northern Road corridor, as shown in Figure 4-3.

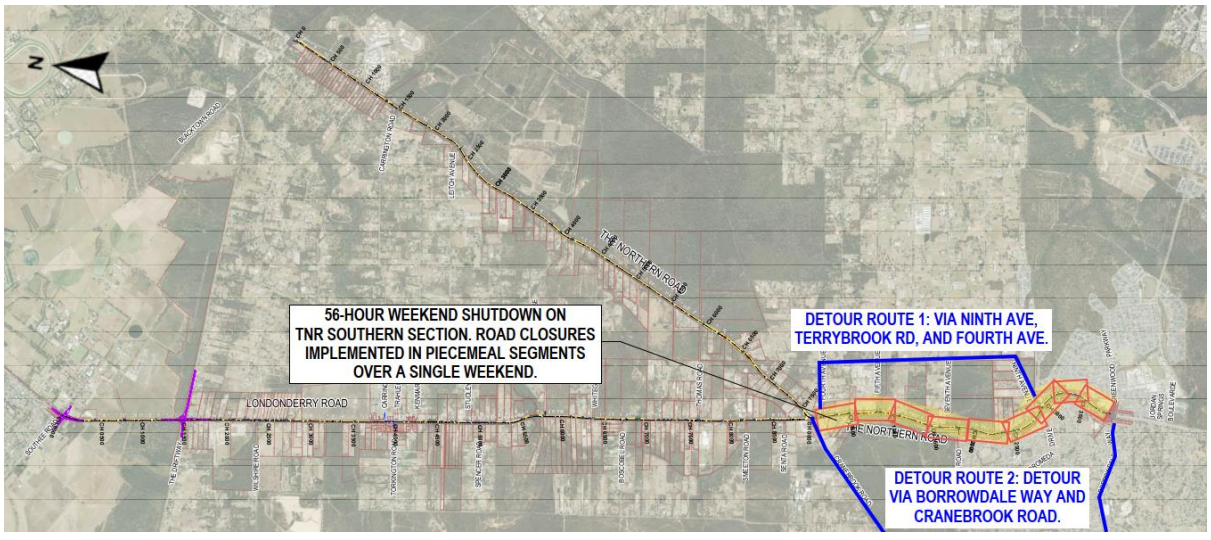


Figure 4-3 Detour routes during 56-hour weekend closure on The Northern Road [Southern Section]

It is anticipated that 56-hour full road closures would also be required to construct culverts across Vincent Road and Fifth Avenue at the intersections with The Northern Road, with traffic diverted via the potential detour routes shown in Figure 4-4 and Figure 4-5 respectively. These works could potentially also be managed under partial closures that may include short-term contraflow under stop/slow traffic control as discussed in Section 4.1.3. The detour routes shown below would also be applicable to partial closures.

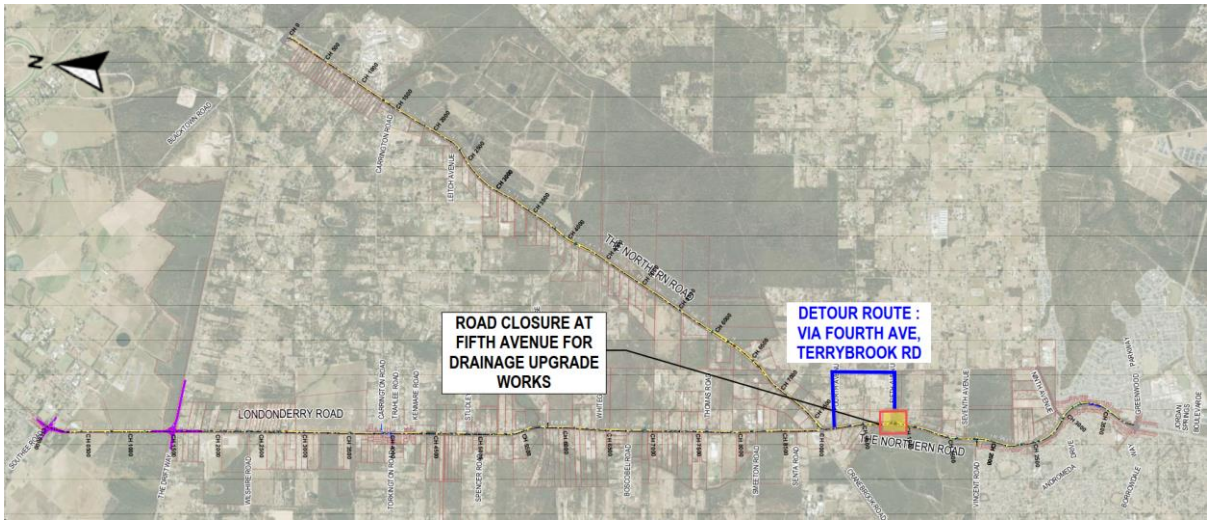


Figure 4-4 Detour routes during 56-hour weekend road closure on Fifth Avenue

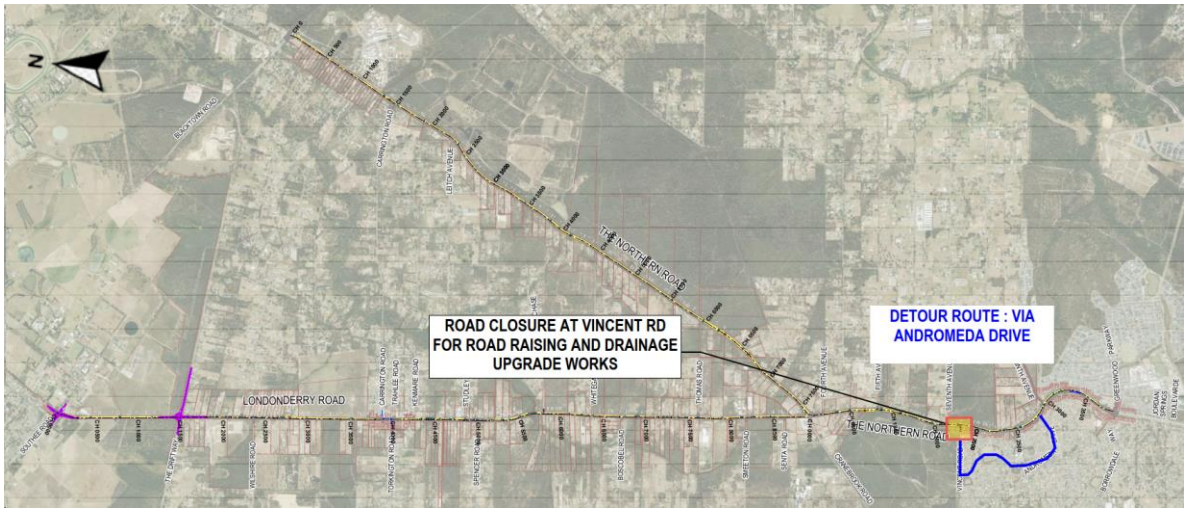


Figure 4-5 Detour routes during 56-hour weekend road closure at Vincent Road

The construction works on Carrington Road includes an upgrade of the existing culvert underneath Carrington Road at the intersection with The Northern Road, which is expected to be completed in two stages, requiring partial closure of Carrington Road at the intersection with The Northern Road. The partial closure of Carrington Road would involve closing one direction of traffic at a time. Potential detour routes to be provided during these partial road closures are shown in Figure 4-6 and Figure 4-7.

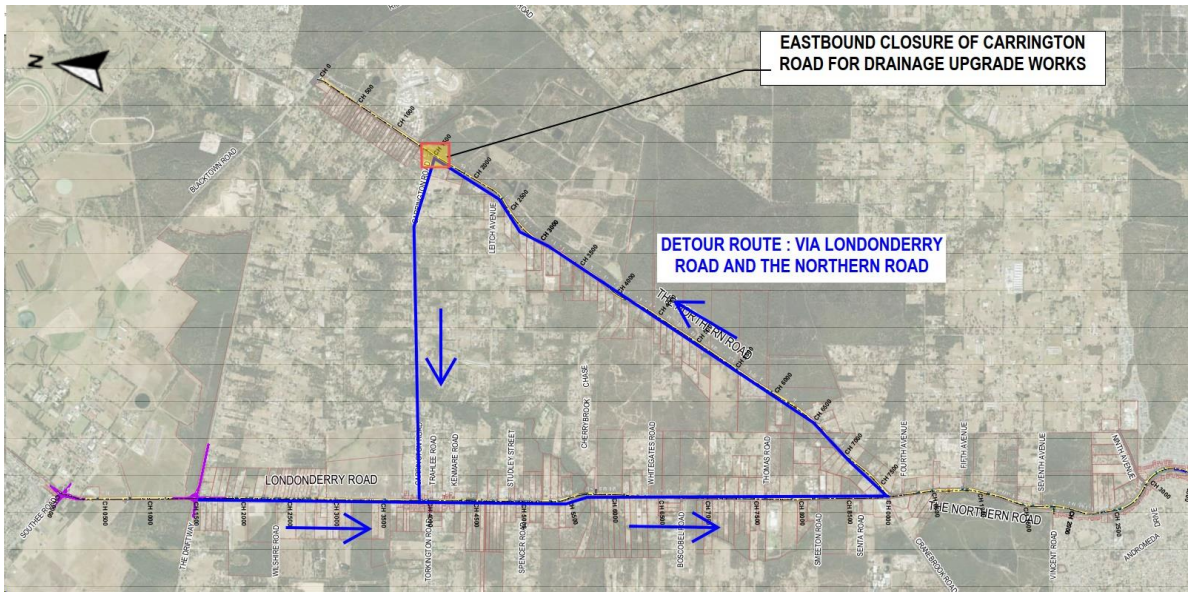


Figure 4-6 Detour routes during 56-hour weekend eastbound closure of Carrington Road

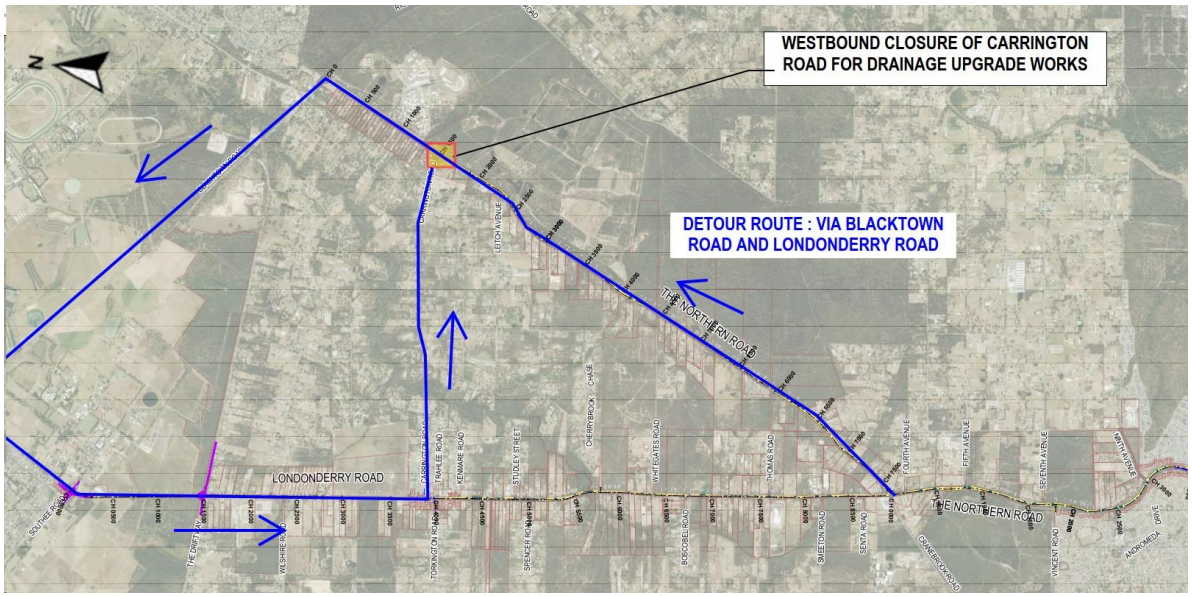


Figure 4-7 Detour routes during 56-hour weekend westbound closure of Carrington Road

The realignment of The Northern Road at Vincent Road and Seventh Avenue is envisaged to be constructed in multiple stages with long-term lateral shifts as described in Section 4.1.4. An additional aspect at these works is that Seventh Avenue would be closed for a weekend to do the work on Seventh Avenue itself. Local traffic would be able to use the alternative routes via Fifth Avenue and Ninth Avenue to access properties along Seventh Avenue during that weekend closure.

4.1.3 Construction Scenario 3 - Short-term contraflow

This scenario involves alternating traffic flows under stop/slow traffic control outside of peak hours along sections of The Northern Road and Londonderry Road within the study area. This arrangement would only be used during the off-peak dayshift (9am to 4pm) or nightshift (9pm to 5am).

The drainage improvements in the vicinity of the intersection of The Northern Road and Andrews Road will require short-term contraflow on Andrews Road during a 56-hour weekend period for the installation of culverts crossing underneath Andrews Road. Refer to Section 4.1.5 for further details.

Partial closure of Vincent Road with a short-term contraflow is also required to complete the works on Vincent Road.

4.1.4 Construction Scenario 4 - Long-term lateral shifts

This includes maintaining two lanes of traffic, switching the traffic to run on either side of the construction zone, which would generally require either temporary or permanent (extra-over) road widening on one side of the road. This scenario is required to enable construction of the road raising areas and to install new box culverts across the full width of the single carriageway roads.

4.1.5 Construction Scenario 5 - 56-hour closure of one carriageway of The Northern Road

Closure of one carriageway at a time on The Northern Road between Sherringham Road and Cooper Street will be required to construct culverts across The Northern Road in the vicinity of Andrews Road. Traffic will be shifted to the other carriageway to maintain two-way traffic. This closure is proposed for the period between Friday 10:00pm and Monday 6:00am.

To facilitate drainage works along the eastern side of The Northern Road between Trinity Drive and Boomerang Place, closure of one lane on The Northern Road (southbound) will also be required, as well as the adjacent footpath. In addition, Star Court or Boomerang Place will also require short-term partial closures for the installation of drainage culverts across those roads at their respective intersections with The Northern Road. These closures would be confined to periods outside of core business hours, with consideration of the potential impact to local businesses.

4.2 Normal operational scenario (post-improvement)

As mentioned in Section 1.2 of this report, the Proposal is not intended to provide any upgrade to the capacity of the existing roads under normal traffic conditions.

Under the normal operational scenario, the widened shoulder will fulfill typical shoulder functions consistent with Austroads Guide to Road Design. It is envisaged that there will be no changes to existing traffic operations and that vehicles will use the existing trafficable lanes available on both corridors.

The Proposal includes a section of realignment of The Northern Road at Seventh Avenue and Vincent Road. Although this realignment and associated road layout introduces road safety improvements, it is considered that the revised road alignment and layout do not materially increase capacity and would not result in significant changes in traffic patterns.

4.3 Flood evacuation scenario (post-improvement)

During the flood evacuation scenario, it is expected that the widened shoulder on both The Northern Road and Londonderry Road would be utilised as a second trafficable lane (southbound). Refer to Section 4.3.1 for details of additional changes to road furniture along these routes to accommodate two lanes of southbound traffic during an evacuation.

A qualitative assessment of traffic operations under the flood evacuation scenario has been carried out, with commentary on the safety and operation of traffic management during flood events discussed in Section 5.3. The assessment specifically considers the following five convergence points as shown on Figure 4-8:

- The Northern Road/Richmond Road/Blacktown Road (The Northern Road Evacuation Route entry)
- The Northern Road/Londonderry Road (Londonderry Road Evacuation Route convergence point)
- The Northern Road/Vincent Road (Castlereagh Evacuation Route convergence point)
- The Northern Road/Ninth Avenue (Llandilo Road Evacuation Route convergence point)
- Parker Street/Great Western Highway (The Northern Road Evacuation Route exit to Great Western Highway)

The Castlereagh Evacuation Route is subject to potential revision as shown on Figure 4-8. Table 4-1 provides details of how the flood evacuation scenarios would be managed during a flood event, as illustrated in Figure 4-9 to Figure 4-13.

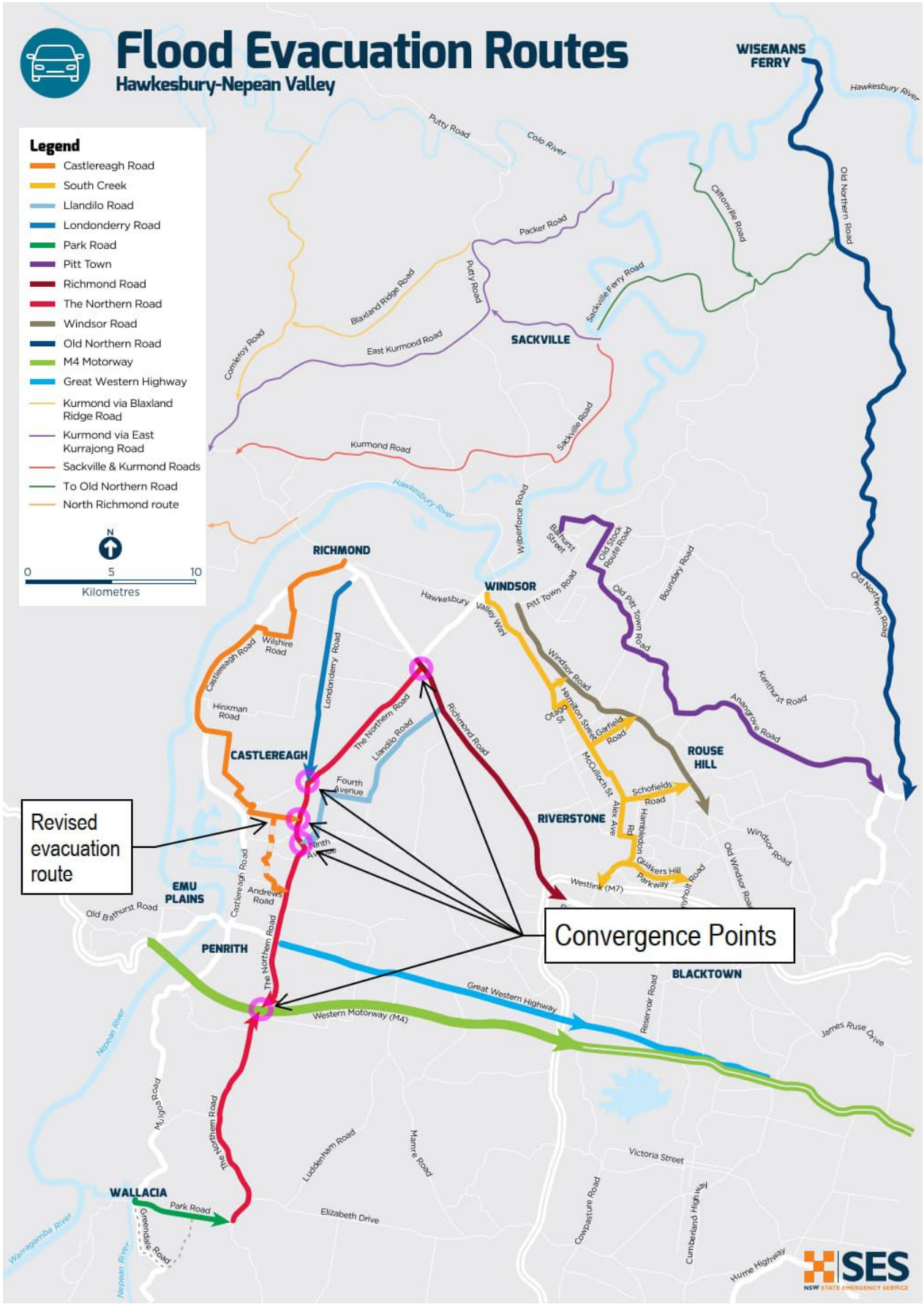


Figure 4-8 Flood evacuation route map (SES) with convergence points added

Table 4-1 Potential evacuation scenarios

Intersection	Potential Flood Evacuation Scenarios		Remarks
Richmond Road / Blacktown Road / The Northern Road / Local Flood Evacuation Route	1	Blacktown Road Dual right turn entry into The Northern Road with other 2 entries closed	Local Traffic Control
	2	Local Flood Route (northern leg) entry to The Northern Road with other 2 entries closed	Local Traffic Control
	3	Richmond Road dual left turn entry to The Northern Road with other two entries closed	Local Traffic Control
	4	Roundabout operation as normal (single lane entry to The Northern Road with The Northern Road shoulder in operation)	No traffic control
The Northern Road / Londonderry Road / Cranebrook Road	1	One evacuation lane entry each from The Northern Road & Londonderry Road with Cranebrook Road entry closed. Traffic on Londonderry Road shoulder need to merge to through traffic lane and traffic on The Northern Road traffic lane need to merge to shoulder evacuation lane before the roundabout	Local Traffic Control
	2	Londonderry Road two evacuation lanes entry with The Northern Road & Cranebrook Road closed	Local Traffic Control (Physical barrier at the traffic island to be removed manually to facilitate flood evacuation operation)
	3	The Northern Road two evacuation lanes entry with Londonderry Road & Cranebrook Road closed	Local Traffic Control
	4	Roundabout operation as normal (Traffic on Londonderry Road shoulder need to merge to normal traffic lane and traffic on The Northern Road normal traffic lane need to merge to shoulder before the roundabout)	No traffic control
The Northern Road / Vincent Road	1	The Northern Road dual lane through the intersection with Vincent Road entry closed	Local Traffic Control
	2	Dual right turn entry from Vincent Road to The Northern Road S/B (lane and shoulder) with The Northern Road through lane(s) closed	Local Traffic Control (Physical barrier in the median of The Northern Road to be removed manually to facilitate flood evacuation operation)
The Northern Road / Ninth Avenue (signal phasing to prioritise the movement)	1	Ninth Avenue Dual left turn lane entry to The Northern Road S/B	Police Point Duty
	2	The Northern Road dual lane passthrough the intersection (No right turn into Ninth Avenue)	Police Point Duty
Great Western Highway / Parker Street	1	Two lane left turn from southbound Parker Street into eastbound Great Western Highway: one left turn lane using existing left turn slip lane, and the second left turn is via the left-most straight arrow traffic lane around the existing traffic island and onto eastbound Great Western Highway. Assume all legs are (generally) operating normally for this scenario, with the second left turn (going around the island) operating as both a straight through and left turn (vehicles can do either from that lane).	Police Point Duty

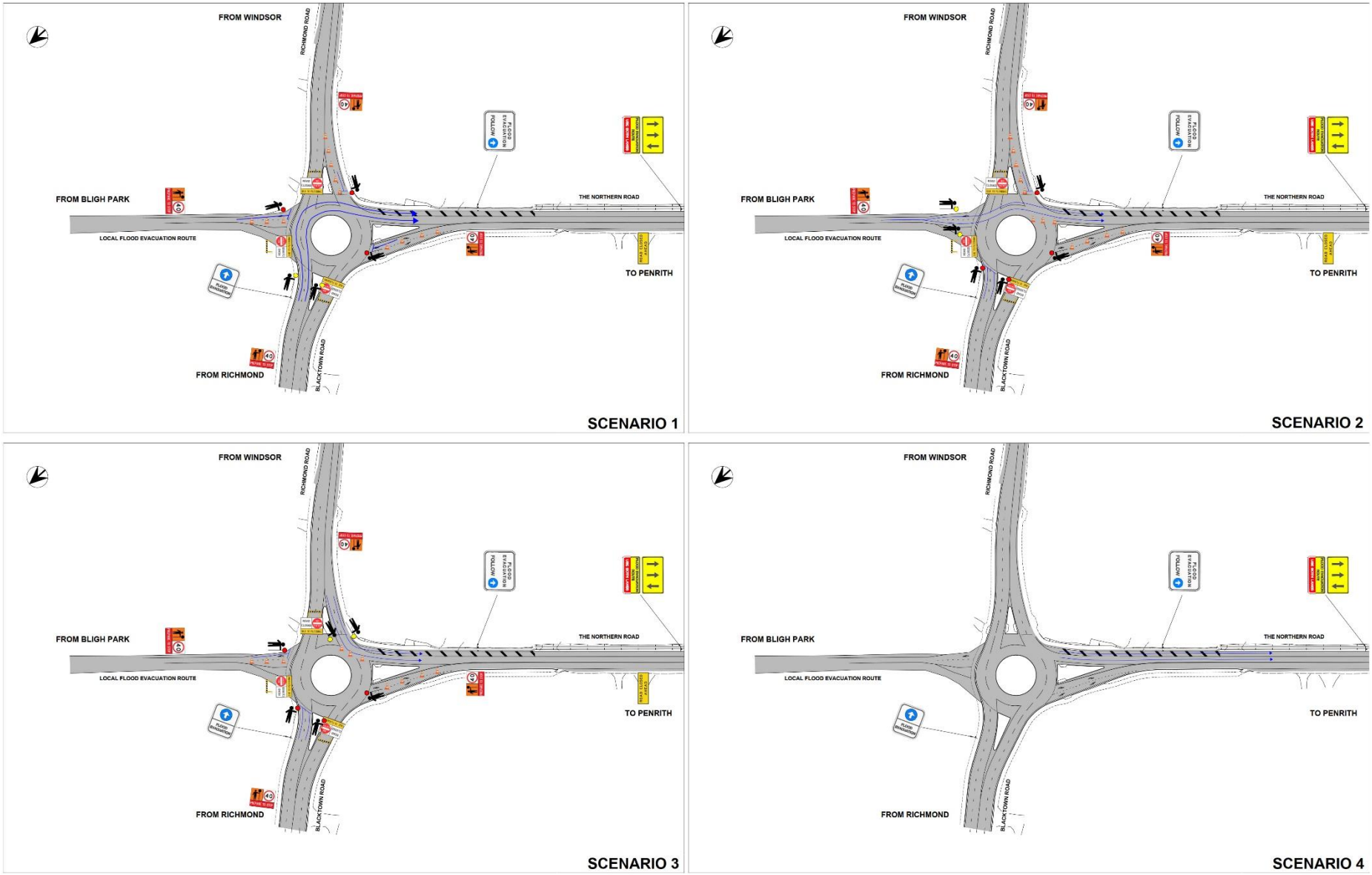


Figure 4-9 Evacuation scenarios at the start of The Northern Road evacuation route

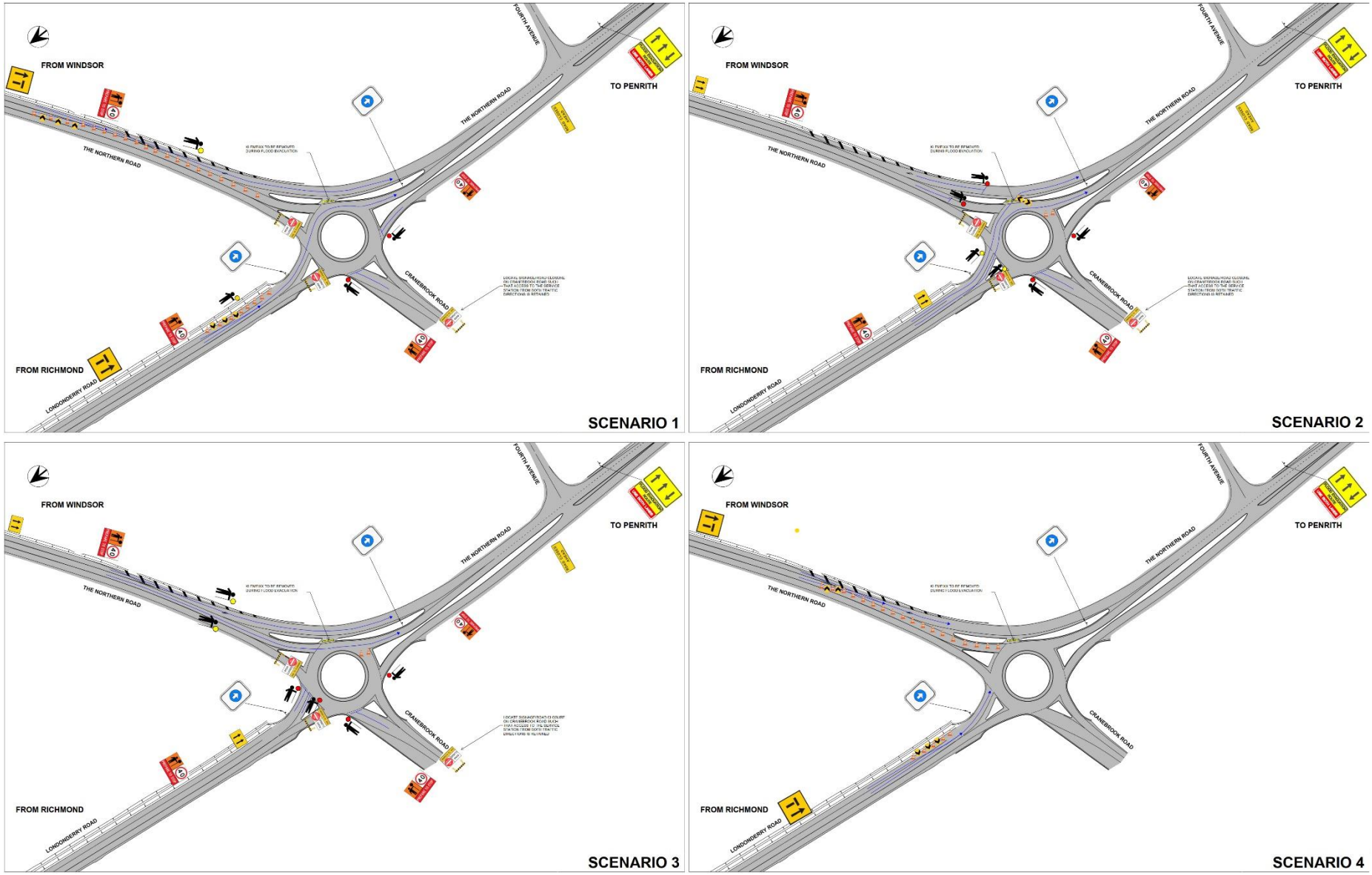
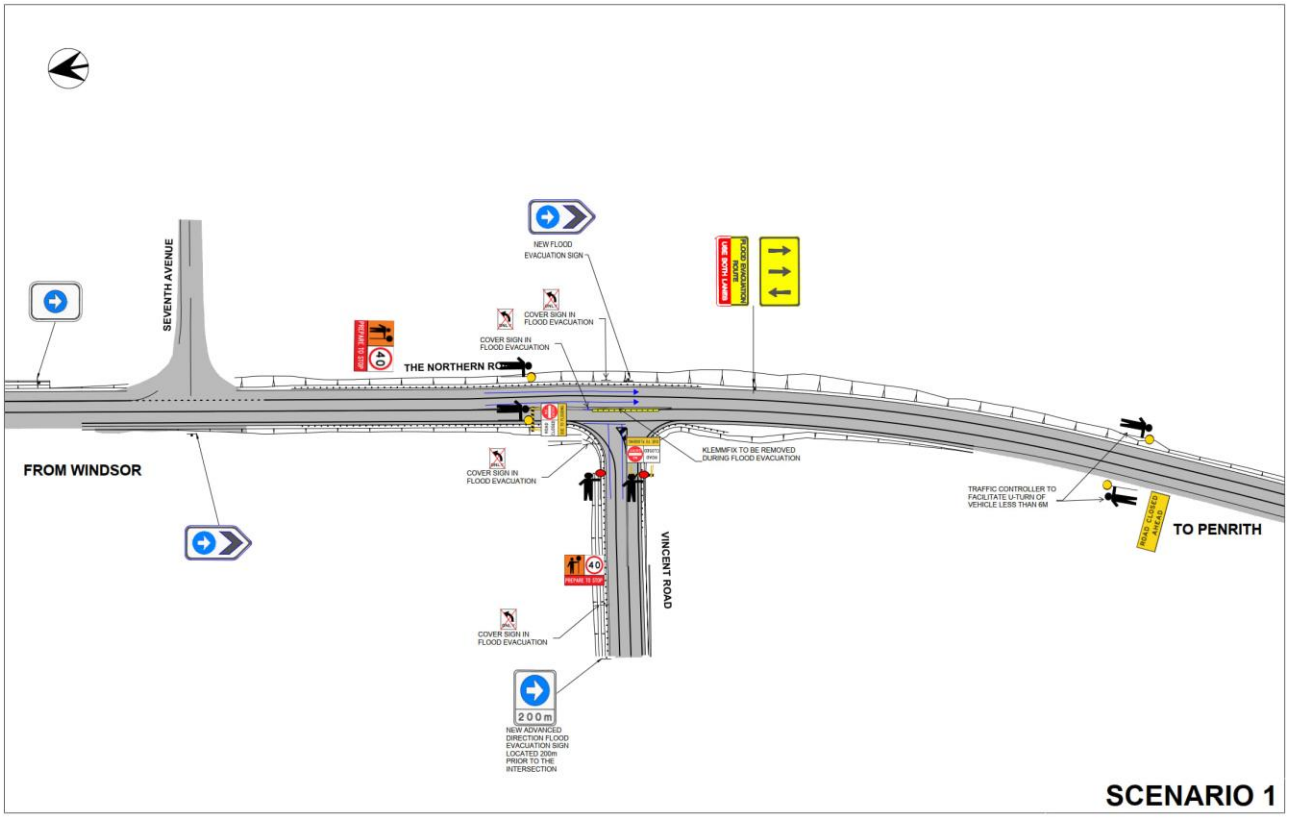


Figure 4-10 Convergence of the Londonderry Road and The Northern Road evacuation routes



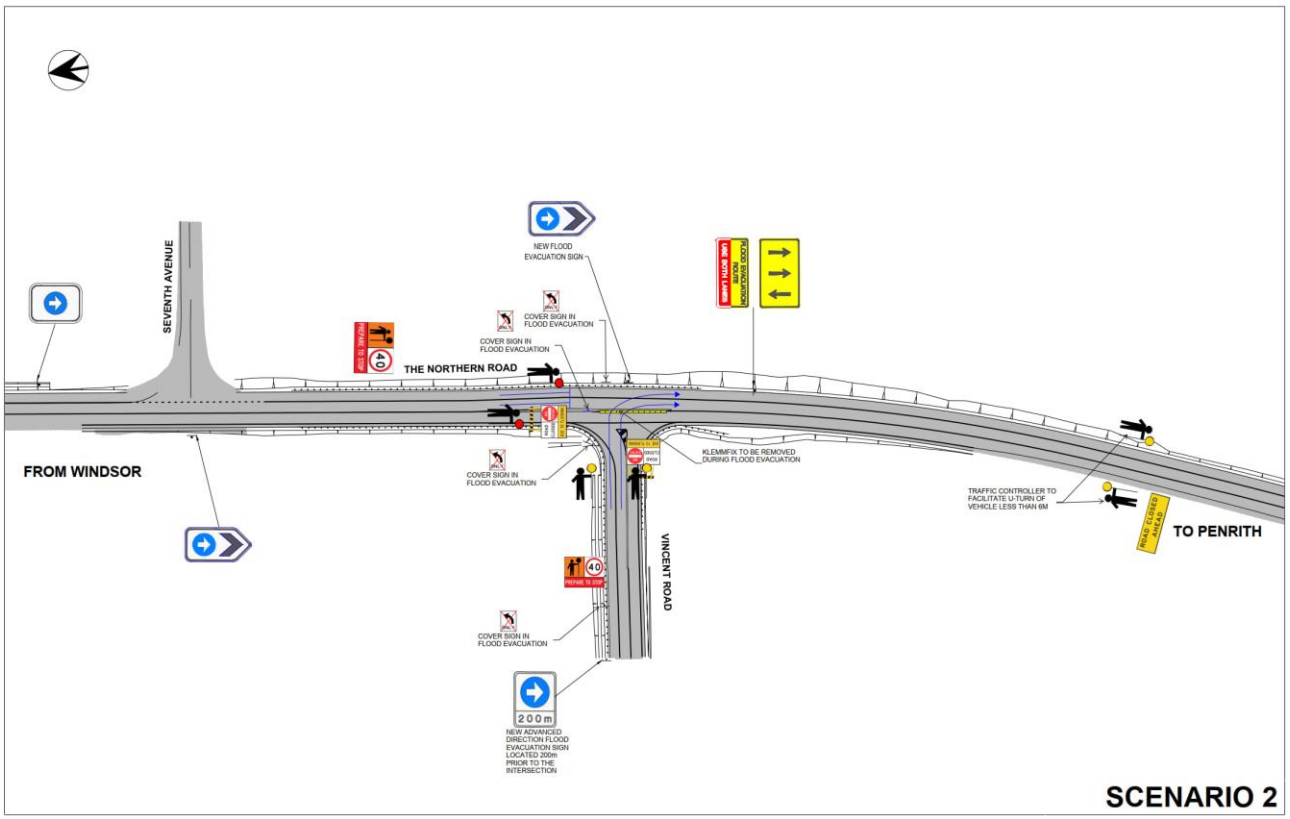


Figure 4-11 Convergence of the Castlereagh and The Northern Road evacuation routes at Vincent Road

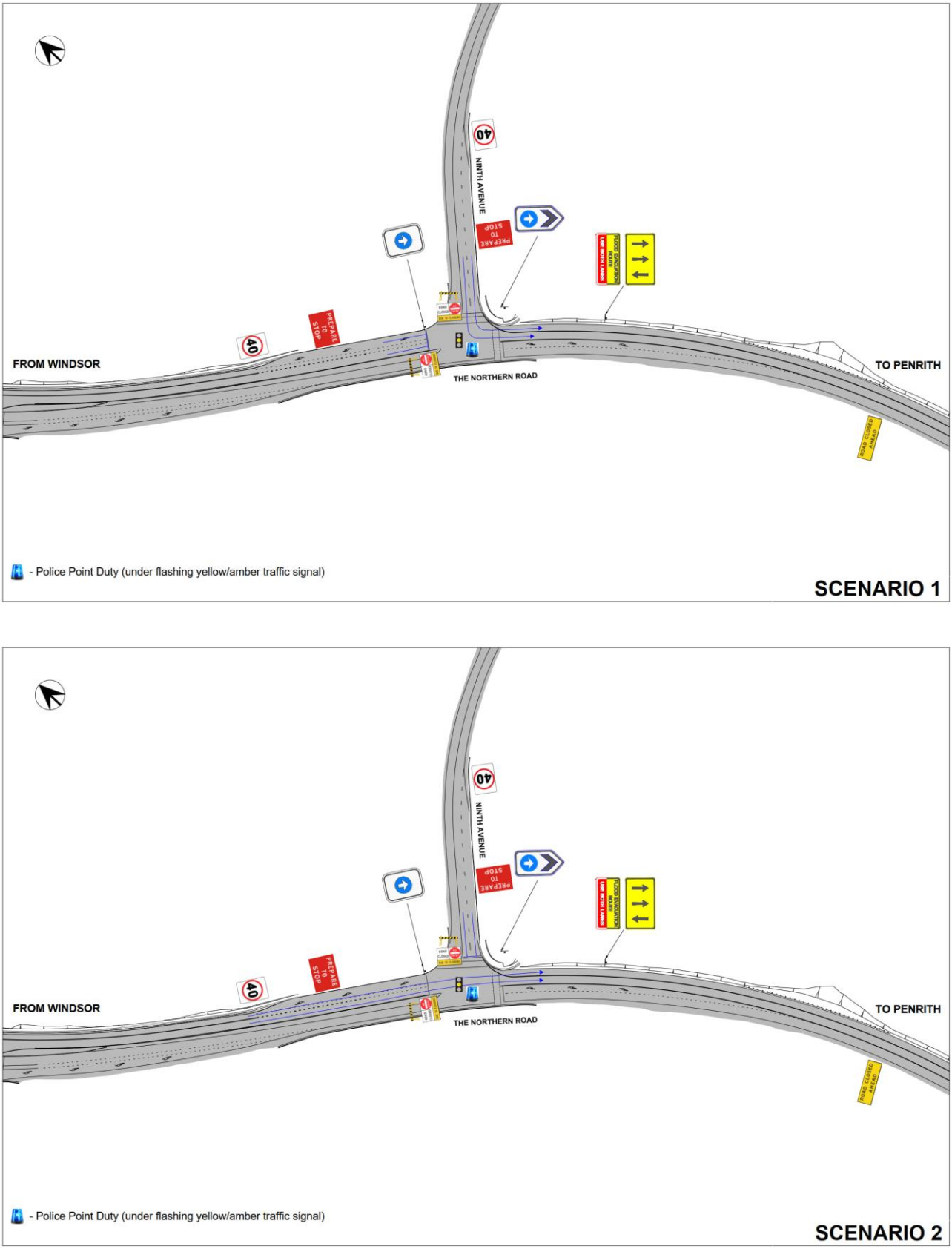


Figure 4-12 Convergence of the Llandilo and The Northern Road evacuation routes at Ninth Avenue

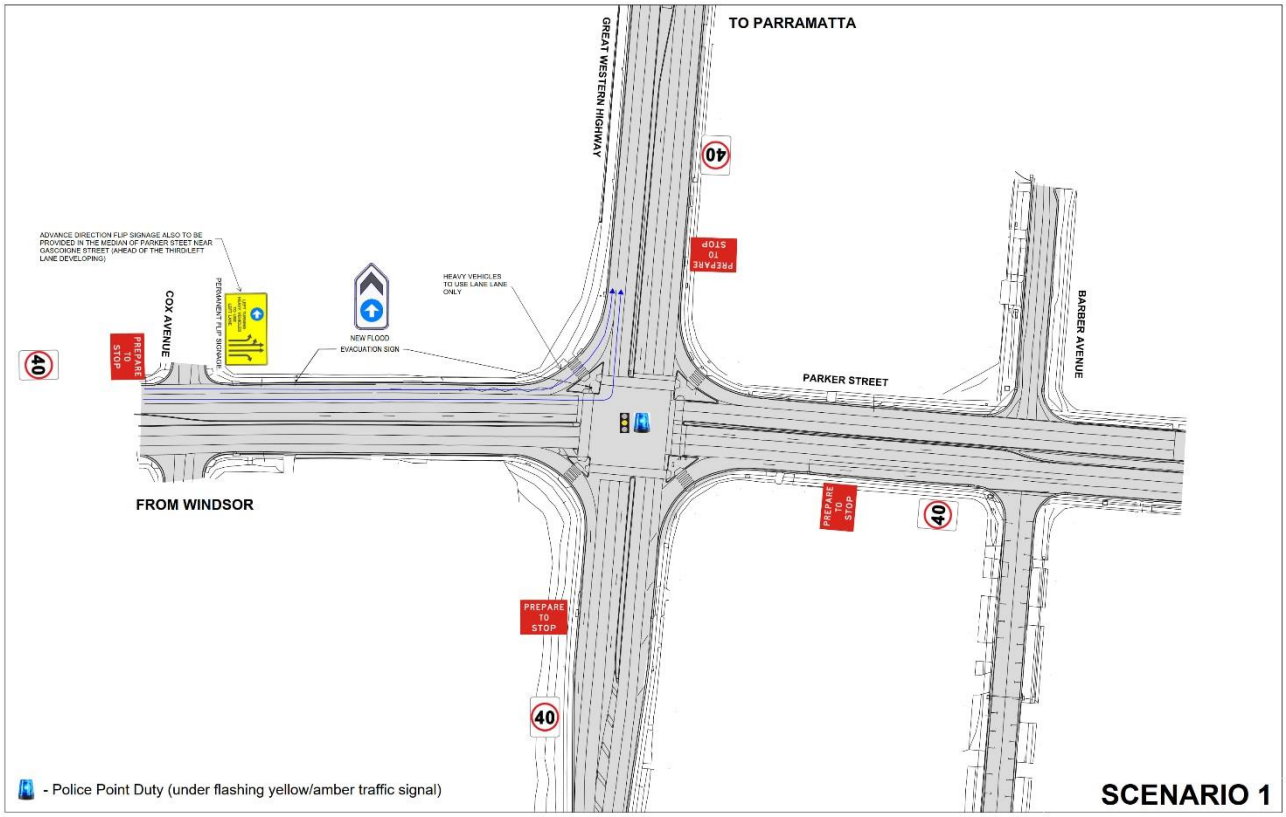


Figure 4-13 Exit of The Northern Road evacuation route at the Parker Street and Great Western Highway intersection

The Parker Street and Great Western Highway intersection shown in Figure 4-13 does not require any physical modification at the intersection to accommodate outbound flood evacuation traffic, noting that the evacuation would be managed by the NSW Police as described in Table 4-1.

4.3.1 Road furniture adjustments to accommodate flood evacuations

The Proposal includes adjustments to existing road furniture, including kerbs, islands and medians, to accommodate two lanes of southbound traffic during flood evacuations, as described below.

4.3.1.1 The Northern Road / Londonderry Road roundabout

The Proposal introduces an opening in the existing kerbed median and the installation of removable kerbs at the roundabout at the convergence of the Londonderry Road and The Northern Road evacuation routes, as shown in Figure 4-14, which shows day-to-day traffic movements for southbound traffic along these routes similar to current operations. The removable kerb will be removed during a flood evacuation that requires two lanes of southbound traffic from Londonderry Road to continue south through the roundabout, as shown on Figure 4-15. Traffic in the normal traffic lane would travel through the roundabout as normal, with traffic in the widened shoulder directed through the opening in the median, and onto the slip lane. Traffic island kerb adjustments are also required to accommodate the two lanes of southbound traffic from Londonderry Road.

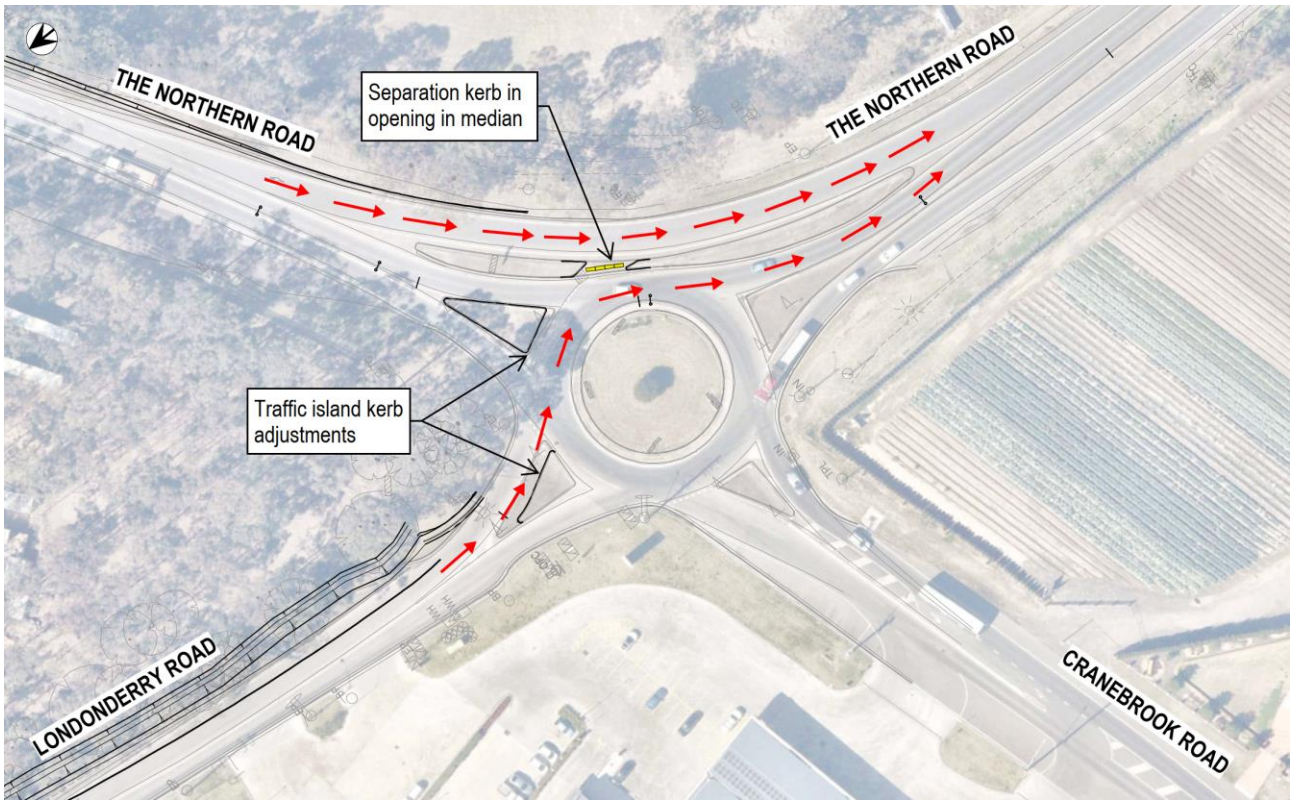


Figure 4-14 Opening in median with removable kerb at The Northern Road / Londonderry Road roundabout – Normal operation

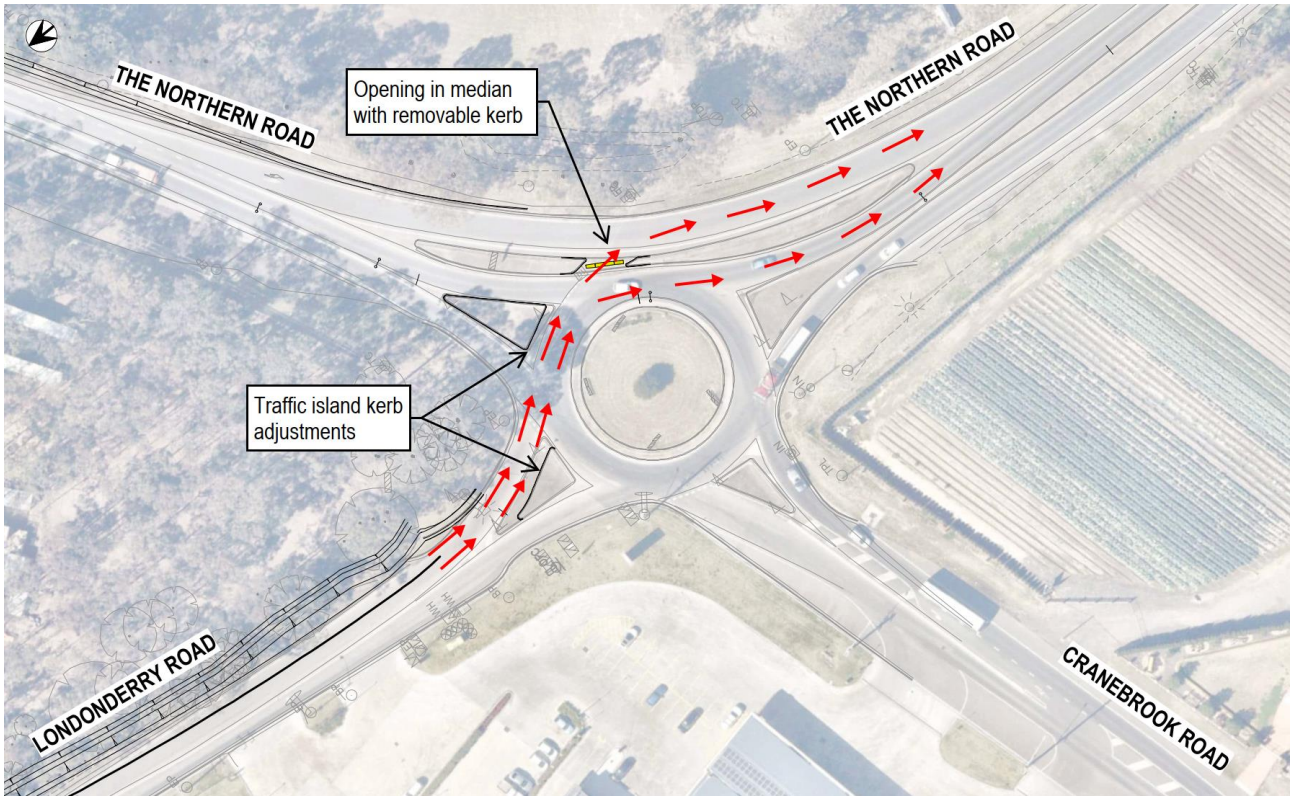


Figure 4-15 Opening in median with removable kerb at The Northern Road / Londonderry Road roundabout – Flood evacuation scenario

4.3.1.2 The Northern Road / Vincent Road intersection

The existing intersection on The Northern Road at Vincent Road includes a kerbed median on The Northern Road to prevent right turn movements. The Proposal includes the realignment of The Northern Road, with extended kerbed medians to increase the effectiveness in preventing right turn movements. An opening in the median is provided to enable two lanes of eastbound traffic on Vincent Road to turn right into The Northern Road, continuing southbound during an evacuation. Removable kerbs are provided in the opening to prevent right turn movements during normal operation, as shown on Figure 4-16, with those kerbs removed during a flood evacuation to enable right turn movements from Vincent Road onto The Northern Road southbound, as shown on Figure 4-17. The existing kerbed traffic island on Vincent Road at the intersection will also be removed permanently to enable the right turn movements during an evacuation.

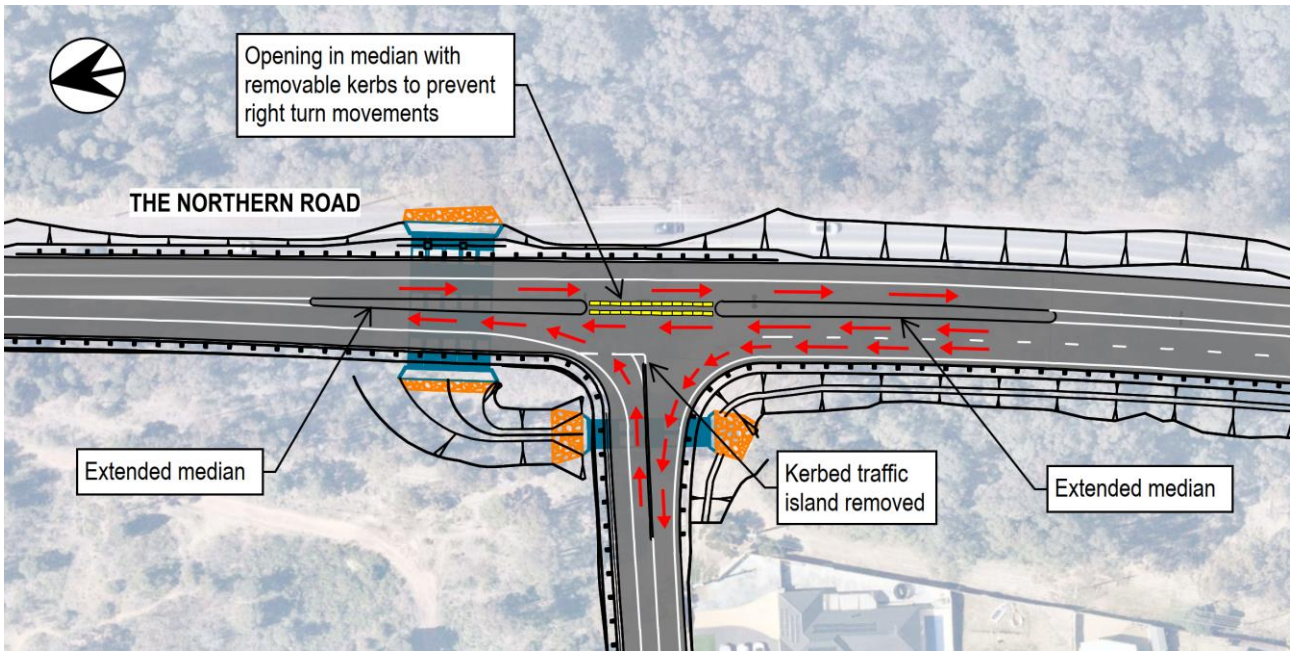


Figure 4-16 Opening in median with removable kerbs at The Northern Road / Vincent Road intersection – Normal operation

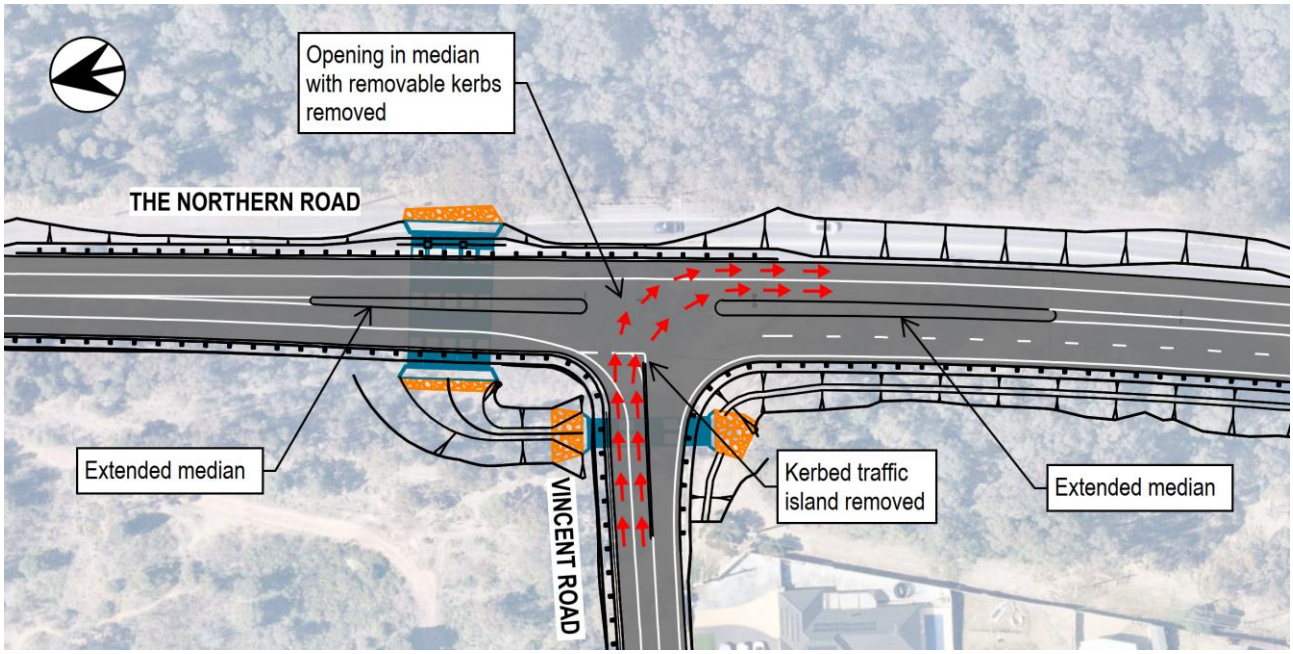


Figure 4-17 Opening in median with removable kerbs at The Northern Road / Vincent Road intersection – Flood evacuation scenario

4.3.1.3 Londonderry Road at the Londonderry Public School

Kerbed traffic islands at the pedestrian crossing on Londonderry Road at the Londonderry Public School are located within the southbound shoulder. The Proposal includes the replacement of these traffic islands with removable kerbed islands to enable the shoulder to be used as a second evacuation lane during flood evacuations following removal of the traffic islands. The removable traffic islands would be reinstated after a flood evacuation event. Refer to Figure 4-18 for details of the replacement of the existing kerbed islands on Londonderry Road.

Figure 4-18 Traffic islands in the southbound shoulder at the pedestrian crossing on Londonderry Road

5. Impact assessment

5.1 Construction phase

5.1.1 Impacts to surrounding road network

The proposed construction works would generate 10 to 30 light vehicle movements per direction per day. These light vehicles would typically travel to and from sites outside the network peak hours of 7am to 9am (AM) and 3pm to 5pm (PM). The road network surrounding the proposal site is anticipated to have sufficient capacity to accommodate the additional light vehicle traffic for the duration of the works, accordingly the light vehicle component of the construction traffic for the Proposal would have negligible impacts on the operation of these roads.

In addition, an estimated maximum of 30 heavy vehicle movements per direction per hour will be generated during construction. A mid-block assessment was carried out to estimate the capacity and LoS of the road network during the proposed construction works. To assess the worst-case scenario, the assessment was undertaken at all mid-block locations (MB-01 to MB-15) during the weekday AM and PM peaks. As noted above, the construction-related light traffic vehicle movements would typically occur outside of these peak hours and have therefore been excluded from the peak hour assessment.

The assessment indicates that six of the interrupted segments would continue to operate with the same LoS as the base case indicating that the additional traffic associated with construction would have negligible impact on the operation of these segments. However, minor impacts are expected on the following sections due to the additional heavy vehicle traffic generated by the construction works, as these sections would operate with a lower LoS than the base case:

- MB-03: the northbound carriageway of The Northern Road operates with LoS E without the construction traffic and would operate with LoS F during construction in the AM peak. The southbound carriageway would operate with the same LoS with construction traffic. In the PM peak, this segment operates with LoS E and D in the base case for the northbound and southbound carriageways respectively, however, with construction traffic the segment would operate with LoS F and E for the northbound and southbound carriageways respectively.
- MB-06: Londonderry Road operates with LoS B in both directions for the base case scenario and would operate with LoS C during construction in the AM peak. No change to the LoS is anticipated in the PM peak.
- MB-09: the additional construction traffic would impact the LoS of the northbound carriageway of The Northern Road during the AM peak, noting that this segment operates with LoS D in the base case compared to LoS E for the construction scenario.
- MB-12: the southbound carriageway of The Northern Road operates with LoS E without construction traffic during the PM peak and would operate with LoS F during construction.
- MB-13: the southbound carriageway of The Northern Road operates with LoS C in the base case compared to LoS D with construction traffic during the PM peak.

Impacts of construction traffic on the LoS of all interrupted segments are presented in Table 5-1 and Table 5-2 for the AM and PM peaks respectively.

Table 5-1 Mid-block assessment for interrupted flow segments – Base Case and Base Case with Construction Traffic – weekday AM peak

ID	Location/ direction	Capacity (PCU)	Base Case (without construction traffic)			Base Case (with construction traffic)		
			Volume (PCU)	V/C	LoS	Volume (PCU)	V/C	LoS
MB-03	**The Northern Road - east of Londonderry Road**							
	Northbound	900	863	0.96	E	928	>1	F
	Southbound	900	667	0.74	D	732	0.81	D
MB-06	**Londonderry Road - south of Smeeton Road**							
	Northbound	900	427	0.47	B	492	0.55	C
	Southbound	900	414	0.46	B	479	0.53	C
MB-07	**The Northern Road - south of Jordan Springs Boulevard**							
	Northbound	1,900	1,201	0.63	C	1,266	0.67	C
	Southbound	1,900	1,970	>1	F	2,035	>1	F
MB-08	**The Northern Road - north of Jordan Springs Boulevard**							
	Northbound	1,900	969	0.51	C	1,034	0.54	C
	Southbound	1,900	1,462	0.77	D	1,527	0.80	D
MB-09	**The Northern Road - south of Andrews Road**							
	Northbound	1,900	1,639	0.86	D	1,704	0.90	E
	Southbound	1,900	2,253	>1	F	2,318	>1	F
MB-10	**The Northern Road - north of Andrews Road**							
	Northbound	1,900	1,322	0.70	C	1,387	0.73	C
	Southbound	1,900	2,137	>1	F	2,202	>1	F
MB-11	**The Northern Road - south of Dunheved Road**							
	Northbound	1,900	1,289	0.68	C	1,354	0.71	C
	Southbound	1,900	2,207	>1	F	2,272	>1	F
MB-12	**The Northern Road - between Dunheved Road and Boomerang Place**							
	Northbound	1,900	1,478	0.78	D	1,543	0.81	D
	Southbound	1,900	2,186	>1	F	2,251	>1	F
MB-13	**The Northern Road - south of Borrowdale Way**							
	Northbound	1,900	951	0.50	C	1,016	0.53	C
	Southbound	1,900	1,339	0.70	C	1,404	0.74	C
MB-14	**The Northern Road - north of Borrowdale Way**							
	Northbound	900	1,186	>1	F	1,251	>1	F
	Southbound	900	1,118	>1	F	1,183	>1	F
MB-15	**The Northern Road - north of Boomerang Place**							
	Northbound	1,900	1,556	0.82	D	1,621	0.85	D
	Southbound	1,900	1,704	0.90	E	1,769	0.93	E

Table 5-2 Mid-block assessment for interrupted flow segments – Base Case and Base Case with Construction Traffic (weekday PM peak)

ID	Location/ direction	Capacity (PCU)	Base Case (without construction traffic)			Base Case (with construction traffic)		
			Volume (PCU)	V/C	LoS	Volume (PCU)	V/C	LoS
MB-03	**The Northern Road - east of Londonderry Road**							
	Northbound	900	829	0.92	E	894	0.99	F
	Southbound	900	758	0.84	D	823	0.91	E
MB-06	**Londonderry Road - south of Smeeton Road**							
	Northbound	900	499	0.55	C	564	0.63	C
	Southbound	900	541	0.60	C	606	0.67	C
MB-07	**The Northern Road - south of Jordan Springs Boulevard**							
	Northbound	1,900	1,970	>1	F	2,035	>1	F
	Southbound	1,900	1,565	0.82	D	1,630	0.86	D
MB-08	**The Northern Road - north of Jordan Springs Boulevard**							
	Northbound	1,900	1,250	0.66	C	1,315	0.69	C
	Southbound	1,900	1,239	0.65	C	1,304	0.69	C
MB-09	**The Northern Road - south of Andrews Road**							
	Northbound	1,900	2,380	>1	F	2,445	>1	F
	Southbound	1,900	1,981	>1	F	2,046	>1	F
MB-10	**The Northern Road - north of Andrews Road**							
	Northbound	1,900	2,095	>1	F	2,160	>1	F
	Southbound	1,900	1,794	0.94	E	1,859	0.98	E
MB-11	**The Northern Road - south of Dunheved Road**							
	Northbound	1,900	2,185	>1	F	2,250	>1	F
	Southbound	1,900	1,970	>1	F	2,035	>1	F
MB-12	**The Northern Road - north of Dunheved Road**							
	Northbound	1,900	2,340	>1	F	2,405	>1	F
	Southbound	1,900	1,830	0.96	E	1,895	1.00	F
MB-13	**The Northern Road - south of Borrowdale Way**							
	Northbound	1,900	966	0.51	C	1,031	0.54	C
	Southbound	1,900	1,351	0.71	C	1,416	0.75	D
MB-14	**The Northern Road - north of Borrowdale Way**							
	Northbound	900	1,150	>1	F	1,215	>1	F
	Southbound	900	1,233	>1	F	1,298	>1	F
MB-15	**The Northern Road – north of Boomerang Place**							
	Northbound	1,900	2,404	>1	F	2,469	>1	F
	Southbound	1,900	1,471	0.77	D	1,536	0.81	D

The mid-block analysis shows that the construction traffic would have no impacts on the operation of the uninterrupted flow segments, as LoS would remain unchanged.

Table 5-3 and Table 5-4 provide a summary of the impacts on the uninterrupted flow segments for the weekday AM and PM peaks respectively.

Table 5-3 Mid-block level of service for uninterrupted flow segments – Base Case and Base Case with Construction Traffic – weekday AM peak

ID	Location/ direction	Base Case (without construction traffic)				Base Case (with construction traffic)			
		Volume (PCU)	ATS (km/h)	PTSF	LoS	Volume (PCU)	ATS (km/h)	PTSF	LoS
MB-01	The Northern Road between Richmond Road and north of Carrington Road								
	Northbound	830	60	73%	E	862	60	74%	E
	Southbound	842	58	73%	E	875	57	74%	E
MB-02	The Northern Road between south of Carrington Road and north of Whitegates Road								
	Northbound	885	64	72%	D	918	64	74%	D
	Southbound	722	70	63%	D	754	68	70%	D
MB-04	The Northern Road between Londonderry Road and north of Vincent Road								
	Northbound	882	60	73%	E	914	60	73%	E
	Southbound	698	65	67%	D	730	63	69%	D
MB-05	Londonderry Road between Southee Road and north of Namatjira Avenue								
	Northbound	450	60	44%	E	482	60	48%	E
	Southbound	362	60	41%	E	395	60	52%	E

Table 5-4 Mid-block level of service for uninterrupted flow segments – Base Case and Base Case with Construction Traffic – weekday PM peak

ID	Location/ direction	Base Case (without construction traffic)				Base Case (with construction traffic)			
		Volume (PCU)	ATS (km/h)	PTSF	LoS	Volume (PCU)	ATS (km/h)	PTSF	LoS
MB-01	The Northern Road between Richmond Road and north of Carrington Road								
	Northbound	921	57	75%	E	954	55	75%	E
	Southbound	758	61	70%	D	790	60	72%	E
MB-02	The Northern Road between south of Carrington Road and north of Whitegates Road								
	Northbound	835	66	70%	D	868	65	73%	D
	Southbound	761	69	70%	D	793	67	71%	D
MB-04	The Northern Road between Londonderry Road and north of Vincent Road								
	Northbound	863	60	74%	E	896	60	75%	E
	Southbound	921	60	75%	E	953	60	77%	E
MB-05	Londonderry Road between Southee Road and north of Namatjira Avenue								
	Northbound	491	60	51%	E	524	60	53%	E
	Southbound	518	59	52%	E	551	59	53%	E

Impacts of heavy vehicles entering and exiting the ancillary sites will be assessed by the appointed Construction Contractor once the driveway designs are completed during detailed design, as part of the Traffic Management Plan for the proposal.

5.1.1.1 Construction Scenario 1 - Offline works

Proposal works will be carried out behind safety barriers and two-way traffic would be maintained throughout construction. Vehicular access to the construction sites would be provided at the start of the safety barrier system and vehicles would exit in a forward direction at the end of the barrier system. Accordingly, as construction works and vehicle movements would largely occur offline, this scenario is anticipated to impose no impact on the operation of the surrounding road network.

5.1.1.2 Construction Scenario 2 - 56-hour weekend closures

For the purposes of this Working Paper, a mid-block assessment was undertaken at three locations on The Northern Road considering the closure of Londonderry Road, and at two locations on Londonderry Road considering the closure of The Northern Road. This scenario would occur during weekends (Friday 10:00pm to Monday 6:00am), accordingly the mid-block capacity assessment considers a single peak on Saturday which provides a worst-case assessment.

The proposed detour routes for the closure of Londonderry Road or The Northern Road north of the roundabout at Cranebrook Road would result in an increase in travel distances by a maximum of 14.4km (equivalent to a 13-minute drive) and 12.4km (equivalent to a 11-minute drive), respectively. The mid-block analysis indicates that roads forming part of these detour routes would operate with significant delays and queuing. As mentioned above these closures are proposed during the weekend and would accordingly be in operation for a relatively short period of time in a specific configuration.

The impacts of Construction Scenario 2 on the LoS of the interrupted segments north of the roundabout at the intersection of Londonderry Road / The Northern Road / Cranebrook Road for a Saturday peak are shown in Table 5-5.

Table 5-5 Mid-block level of service for interrupted flow segments – Construction Scenario 2 – Saturday peak

ID	Location/ direction	Capacity (PCU)	Base Case			Construction Scenario 2 (closure of Londonderry Road)			Construction Scenario 2 (closure of The Northern Road)		
			Volume (PCU)	V/C	LoS	Volume (PCU)	V/C	LoS	Volume (PCU)	V/C	LoS
	The Northern Road - east of Londonderry Road										
MB-03	Northbound	900	653	0.73	C	1,003	>1	F	N/A	N/A	N/A
	Southbound	900	607	0.67	C	958	>1	F	N/A	N/A	N/A
	Londonderry Road - south of Smeeton Road										
MB-06	Northbound	900	343	0.38	B	N/A	N/A	N/A	930	>1	F
	Southbound	900	468	0.52	C	N/A	N/A	N/A	1,142	>1	F

The proposed road closures are anticipated to impact the operation of several uninterrupted sections along the proposed detour routes resulting in lower LoS.

Although LoS would remain unchanged along most segments, the Percentage Time Spent Following (PTSF) would be equal to or greater than 78% indicating that vehicles would be travelling in platoons behind slower vehicles, as passing opportunities would be scarce. In addition, diversion of traffic to alternative routes is anticipated to increase delays and congestion at the intersections along these routes, particularly if the intersections are currently operating with capacity issues.

Table 5-6 provides a summary of the impact of the construction works on the uninterrupted segments for Construction Scenario 2, north of the roundabout at the intersection of Londonderry Road / The Northern Road / Cranebrook Road.

Table 5-6 Mid-block level of service for uninterrupted flow segments – Construction Scenario 2 – Saturday peak

ID	Location/ direction	Base Case (without construction traffic)				Construction Scenario 2 (closure of Londonderry Road)				Construction Scenario 2 (closure of The Northern Road)			
		Volume (PCU)	ATS (km/h)	PTSF	LoS	Volume (PCU)	ATS (km/h)	PTSF	LoS	Volume (PCU)	ATS (km/h)	PTSF	LoS
	The Northern Road between Richmond Road and north of Carrington Road												
MB-01	Northbound	702	61	64%	D	1,052	53	81%	E	N/A	N/A	N/A	N/A
	Southbound	695	61	64%	D	1,045	53	81%	E	N/A	N/A	N/A	N/A
	The Northern Road between south of Carrington Road and north of Whitegates Road												
MB-02	Northbound	1,002	63	80%	D	995	63	80%	D	N/A	N/A	N/A	N/A
	Southbound	1,009	63	80%	D	1,126	63	80%	D	N/A	N/A	N/A	N/A
	Londonderry Road between Southee Road and north of Namatjira Avenue												
MB-05	Northbound	339	61	39%	D	N/A	N/A	N/A	N/A	926	54	78%	E
	Southbound	422	60	41%	E	N/A	N/A	N/A	N/A	1096	53	81%	E

The closure of The Northern Road between Cranebrook Road and Greenwood Parkway / Borrowdale Way would result in the diversion of up to 664 Passenger Car Units (PCU) in one direction based on the highest number of vehicles recorded at MB-04 during a Saturday peak. This diversion would likely increase the pressure on the roads which form part of the proposed detour routes. Further investigation would be required during preparation of the Construction Traffic Management Plan to quantify the impact of this closure if this scenario was identified as the preferred arrangement. Alternative arrangements such as Construction Scenario 3 may be used to complete the construction works along this segment of The Northern Road.

Temporary short-term closure of Vincent Road, Fifth Avenue and Seventh Avenue (refer to Section 4.1.2) would result in increasing the travel distance by a maximum of 2.8km (equivalent to a 4-minute drive) and would potentially impact the operation of the roads that form part of the detour routes due to the diverted traffic. However, the road closures are proposed during the weekend when traffic volumes are expected to be low. Accordingly the impacts are anticipated to be minor.

The 56-hour weekend partial closure of Carrington Road (refer to Section 4.1.2) would increase the travel distance by a maximum of 12.1km (equivalent to a 12-minute drive). The roads included in the proposed detour routes are anticipated to have sufficient capacity to accommodate the additional traffic. Accordingly, this closure would have minor impacts on the operation of these roads.

5.1.1.3 Construction Scenario 3 - Short-term contraflow

The Northern Road (between Cranebrook Road and Richmond Road) / Londonderry Road (between Cranebrook Road and Southee Road)

To assess the impacts of short-term contraflow with stop/slow traffic control at any point of the corridor, a high-level expected queue length has been estimated for a representative location on both The Northern Road and Londonderry Road, during the dayshift. It is assumed that vehicles would be stopped for two minutes (which emulates a standard cycle time at a signalised intersection) at a time at the stop/slow traffic control point.

The longest queues would generally occur during the off-peak dayshift on weekdays (refer to Section 4.1.3), when the queue is anticipated to reach approximately 185m on The Northern Road southbound, and 165m in the northbound direction. On Londonderry Road the queue is expected to be 100m in the southbound and northbound direction.

It should be noted that queues during the nightshift are anticipated to be less than dayshift queues, given that background traffic is generally less during the night.

The Northern Road (between Cranebrook Road and Greenwood Parkway)

Assuming a likely vehicle stoppage of two minutes in each direction, the longest queue expected during the off-peak dayshift is anticipated to be 260m on The Northern Road in the southbound direction and 245m in the northbound direction.

Andrews Road

Given that Andrews Road is a local road, and a lower order road compared to The Northern Road, it is assumed that vehicles would be stopped for one minute each time at the stop/slow control point (compared to two minutes on The Northern Road) to allow for the queues that form to dissipate quicker.

The weekday SCATS traffic volumes for The Northern Road and Andrews Road intersection were used to estimate the expected queue on Andrews Road during the nominated 56-hour weekend construction period. It was assumed that the weekday volume could serve as the worst-case scenario, as the observed weekday traffic within the study area is generally greater than weekend traffic.

Having regard to the above assumptions, the longest queue on Andrews Road is anticipated to be approximately 150m in the westbound direction and 140m in the eastbound direction, noting that the contraflow arrangement on Andrews Road is nominated during a 56-hour weekend (refer to Section 4.1.3).

5.1.1.4 Construction Scenario 4 - Long-term lateral shifts

Temporary road widening will be constructed to maintain two-way traffic, accordingly this scenario is expected to have little or no impact on the surrounding road network.

5.1.1.5 Construction Scenario 5 - 56-hour closure of one-carriageway of The Northern Road

To provide a worst-case analysis, the mid-block capacity assessment of Construction Scenario 5 was carried out for a single peak on Saturday, as this scenario is proposed to occur during weekends (Friday 10pm to Monday 6am).

The analysis indicates that The Northern Road operates with LoS D or better for the base case scenario, and providing one lane in each direction on The Northern Road would result in LoS F, except on the northbound carriageway at MB-07 (refer to Figure 2-9), which would operate with LoS E.

Table 5-7 provides a summary of the impacts of Construction Scenario 5 on the LoS of the impacted segments on The Northern Road.

Table 5-7 Mid-block level of service for interrupted flow segments – Construction Scenarios 5 – Saturday peak

ID	Location/ direction	Base Case (without construction works)				Construction Scenario 5 (closure of one carriageway on The Northern Road)			
		Capacity (PCU)	Volume (PCU)	V/C	LoS	Capacity (PCU)	Volume (PCU)	V/C	LoS
MB-07	**The Northern Road - south of Jordan Springs Boulevard**								
	Northbound	1900	850	0.45	B	900	850	0.94	E
	Southbound	1900	1393	0.73	C	900	1393	>1	F
MB-09	**The Northern Road - south of Andrews Road**								
	Northbound	1900	1159	0.61	C	900	1159	>1	F
	Southbound	1900	1593	0.84	D	900	1593	>1	F
MB-10	**The Northern Road - north of Andrews Road**								
	Northbound	1900	935	0.49	B	900	935	>1	F
	Southbound	1900	1511	0.80	D	900	1511	>1	F

Construction Scenario 5 includes closure of one lane along the southbound carriageway of The Northern Road between Trinity Drive and Boomerang Place during weekends (Friday 10pm to Monday 6am) for the proposed drainage works. No weekend traffic data was provided for the assessment along this section of the road. As such, the maximum traffic volume on a weekday at MB-15 was used to assess the impact of these works, which provides a worst-case scenario. This assessment indicates that this section of The Northern Road would operate with LoS F indicating extensive delays and queuing, noting that the impact is anticipated to be less as traffic volumes are generally lower during weekends and at night. Table 5-8 provides a summary of the impacts of closing one lane along the southbound carriageway of The Northern Road on the LoS of the impacted segment.

Table 5-8 Mid-block level of service for MB-15 – Construction Scenarios 5 – Weekday

ID	Location/ direction	Capacity (PCU)	Construction Scenario 5 (closure of one lane on The Northern Road between Trinity Drive and Boomerang Place)		
			Volume (PCU)	V/C	LoS
MB-15	**The Northern Road - north of Boomerang Place**				
	Southbound	900	1,704	>1	F

5.1.2 Impacts to active transport

The Northern Road, Londonderry Road, Vincent Road, Fifth Avenue, Seventh Avenue and Carrington Road have limited pedestrian facilities within the areas where shoulder widening is proposed (refer to Section 2.3). The pedestrian path along Londonderry Road southbound, south of Kenmare Road, will be relocated as part of the construction of the shoulder widening.

It is intended that the same level of functionality will be maintained throughout construction. The Construction Environmental Management Plan (CEMP) to be developed prior to construction would address the management of pedestrian movements during construction, including at the path along Londonderry Road south of Kenmare Road and across the culvert extensions at LNR10 and LNR11.

The shared path along Andrews Road will require adjustments during the construction of the drainage crossings. These adjustments are expected to include partial closure or diversion and will be short-term noting that the work directly impacting the path is intended to be completed during a 56-hour weekend or at night.

The footpath along the eastern side of The Northern Road between Trinity Drive and Boomerang Place will be closed due to the drainage works along this section, noting that the work is intended to be completed during a 56-hour weekend or at night. An alternative detour route is available via the footpath along the western side of The Northern Road. Impacts are therefore considered to be negligible.

The Transport Cycleway Finder (refer to Figure 2-4 and Figure 2-5) shows a designated cycle route along the shoulder of The Northern Road. The maximum daily number of cyclists recorded during the mid-block surveys on The Northern Road and Londonderry Road is 12 and 5 cyclists respectively, indicating that a very low volume of cyclists use these roads per day. Cyclists would need to be detoured via Londonderry Road during implementation of the contraflow arrangement and closure of The Northern Road, and vice versa. The alternative route via Londonderry Road is longer by approximately 2.7 km (equivalent to 10 minutes cycling). Only minor impacts are anticipated on cyclists due to the proposed detours.

The CEMP would also consider the management of cyclists during construction noting that the Construction Scenarios 1 to 5 (refer to Section 4.1) will impose some limitations on cycling, including reduced shoulder widths, stop/slow arrangements and detours. However, as noted above, the volume of cyclists appears to be low, and the impacts are therefore expected to be limited.

5.1.3 Impacts to public transport

Bus routes 674 and 677 would be affected by the closure of The Northern Road and Londonderry Road respectively. Bus route 674 travels along The Northern Road between Richmond Road/Blacktown Road and Carrington Road and uses the bus stop (ID 2753658) located on The Northern Road south of Toorah Road. Bus route 677 travels along Londonderry Road between The Driftway and The Northern Road and has several stops along the road.

Access to the bus stop on The Northern Road (route 674, bus stop ID 2753658) would be unavailable during the proposed temporary closure of The Northern Road in Construction Scenario 2 and closure of the eastbound carriageway on Carrington Road. Bus routes would need to be altered, as there would be no need for the loop via Bennett Street resulting in a shorter travel time. Patrons would however have to walk an additional distance of approximately 1.6 km (equivalent to a 22-minute walk) to use the bus stops along Blacktown Road between The Northern Road and George Street. Consideration should accordingly be given during detailed design stage to investigate the feasibility of temporarily relocating the bus stop north of Toorah Road and use of this road as an alternative to Carrington Road.

Closure of Londonderry Road would impact 19 bus stops and would increase the bus travel distance by 5.3 km (equivalent to a six-minute drive). Alternative bus routes and temporary relocation of affected bus stops would be investigated during detailed design to minimise impacts on bus service operations. Any relocation of bus facilities should be undertaken in a manner that reduces potential disruption to access and walking distances.

The contraflow arrangement would enable buses to continue using the same travel routes with a potential increase in travel time. Bus stops would need to be temporarily relocated outside work zones during implementation of these contraflow arrangements. Accordingly, the proposed works are expected to have minor impacts on bus service operations.

No bus routes currently travel along Fifth Avenue and the section of Vincent Road between Andromeda Drive and The Northern Road, accordingly the proposed short-term closures of these roads are not expected to have impacts on the operation of bus services.

The works along The Northern Road at Ninth Avenue are proposed to be carried out during weekends, accordingly no impacts are anticipated on the school buses that currently travel along Ninth Avenue on weekdays.

Construction Scenario 3 and 5 may result in minor delays to travel time. Bus stops within work zones may need to be temporarily relocated outside of work zones. The temporary relocation of the bus stops within the work zone during

Construction Scenario 3 and 5 would also result in a change in walking distance. Further details regarding the bus service operations during the proposed works will be provided in the Construction Traffic Management Plan to be prepared during detailed design.

5.1.4 Impacts to parking

As noted in Section 2.6, parking within the study area primarily occurs in the shoulder along Londonderry Road through the Londonderry village. The proposed construction activities that will impact this parking is limited to the milling and resheeting of the existing southbound shoulder, which will be completed in sections. Side streets within the Londonderry village have sufficient width to provide alternatives for parking.

While there are generally no parking restrictions along Fifth Avenue, Vincent Road and Carrington Road, parking is prohibited in the vicinity of the intersections with The Northern Road. Accordingly, parking will not be impacted by the construction activities on these side roads as the construction will be limited to the vicinity of the intersections where parking is prohibited.

5.1.5 Impacts due to unplanned events

Construction activities would cease during unplanned events, such as flooding or bushfire, where continued works would have significant impacts on traffic flow and would impede evacuation, or if there is a risk to construction personnel. Depending on the progress of construction at the time of the unplanned event, certain sections of road may continue to be closed or partially closed due to the works, resulting in increased travel times and delays.

Arrangements would be made to allow for evacuation to proceed in the event of a flood during construction.

5.2 Operation phase (normal mode)

5.2.1 Impacts to motorists

As discussed in Section 1.2, the Proposal is not intended to provide additional capacity under normal traffic operating conditions, but rather improve the resilience of the flood evacuation network during flood events. The Proposal would not adversely impact motorists' journey time, or the reliability and capacity of the roads.

The Proposal includes a section of realignment of The Northern Road at Seventh Avenue and Vincent Road to reduce project impacts on adjacent sensitive receivers and improve road safety. Although this realignment and associated road layout introduces road safety improvements, it is considered that the revised road alignment and layout do not materially increase capacity and would not result in significant changes in traffic patterns.

5.2.2 Impacts to active transport

The intention of the Proposal is to retain existing pedestrian and cyclist infrastructure or replace like for like where the existing infrastructure is impacted by the proposed works.

Pedestrian handrails and 1.5m wide footways have been provided across the bridge sized structural culverts, which is defined as a culvert with a combined opening width of 6m or more. These footways consider the flood evacuation scenario with live traffic in the southbound shoulder. The footway width and barrier system will be reviewed during detailed design.

A pipe handrail is proposed on The Northern Road from MC10 Ch 33 to Ch 66 (southeast corner of The Northern Road and Richmond Road roundabout) to protect cyclists and pedestrians from falling into the open drainage channel next to the relocated shared path.

The Proposal would have negligible impacts on existing active transport operations under normal operating conditions as pedestrian and cyclist desire lines are not expected to change during normal operation. The proposed handrails are expected to improve the overall safety of pedestrians and cyclists.

5.2.3 Impacts to public transport

Most existing bus stops within the proposal area will be retained under the Proposal. However two bus stops would need to be relocated due to changes in the road design. Bus stop ID 2747276 currently located on the northbound lane, about 30m south of Vincent Road on The Northern Road in Llandilo, would be relocated about 130m to the south of its present location. Bus stop ID 274991 currently located on the southbound lane, about 210m south of Ninth Avenue on The Northern Road in Jordan Springs, would be relocated about 20m north. These bus stop relocations will result in minor changes in walking distances, with the greatest impact being the additional 130m at the Vincent Road bus stop.

Rail services are not impacted by the Proposal.

Accordingly, the Proposal would have minimal impacts to public transport operation in terms of accessibility, journey time, reliability and functionality, and would operate as existing under normal traffic operations.

Bus services would also benefit from the improved road safety benefits of the realignment of The Northern Road at the Seventh Avenue and Vincent Road intersection as discussed in Section 5.2.1.

5.2.4 Impacts to parking

The existing parking conditions described in Section 2.6 will be retained for normal traffic conditions. As such, impacts to parking is negligible.

5.3 Operation phase (flood evacuation)

5.3.1 Impacts to motorists

With the proposed improvements, the evacuation routes would operate as two lanes southbound utilising the widened shoulder as the second evacuation lane during a flood event. The additional lane effectively doubles the capacity for southbound traffic during an evacuation. It is anticipated that both The Northern Road and Londonderry Road would operate at capacity for some period during a flood evacuation event, with some level of congestion, particularly in the vicinity of intersections. Despite the anticipated level of congestion during flood events, increasing the capacity southbound would allow larger traffic volumes to move during the flood event compared to existing flood evacuation events.

5.3.2 Impacts to active transport

The dedicated bicycle lane on The Northern Road southbound on the approach to the Ninth Avenue intersection will be impacted during a flood evacuation with two lanes of general traffic travelling southbound, including using the left turn lane under traffic control to continue southbound along the widened shoulder of The Northern Road. It is assumed that cyclists would not be using the road during a flood evacuation. The intersection will also be controlled by NSW Police during an evacuation. The Proposal does not introduce any other changes to pedestrian and cyclist movements or access during a flood evacuation event.

5.3.3 Impacts to public transport

The Proposal will have no impact on public transport facilities during flood events. It is expected that any changes to public transport services during a flood evacuation event would be informed by the SES emergency plan.

5.3.4 Impacts to parking

Refer to Section 2.6 for a description of the existing parking conditions, provisions and prohibitions. The Proposal introduces the use of the southbound shoulder as an additional flood evacuation lane. The shoulder therefore needs to be clear of parked vehicles before a flood evacuation can occur. Special event clearway sign with custom messaging stating ‘FLOOD EVACUATION’ will be used at key locations to prohibit parking in the shoulder during these events.

6. Mitigation measures

This section identifies mitigation measures and safeguards to reduce the construction and operation impacts of the Proposal.

6.1 Construction Traffic Management Plan

A Traffic Management Plan (TMP) would be prepared and implemented as part of the CEMP. The TMP would be prepared in accordance with the Transport *Traffic Control at Work Sites Manual* (RTA, 2010) and *QA Specification G10 Control of Traffic* (Transport, 2008). The TMP would include:

- Confirmation of haulage routes for the delivery of materials to site
- Measures to maintain access to local roads and properties
- Site-specific traffic control measures (including signage) to manage and regulate traffic movements
- Measures to maintain pedestrian and cyclist access
- Measures to maintain public transport routes and facilities
- Requirements and methods to consult and inform the local community of impacts on the local road network
- Access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads
- A response plan for any construction traffic incident
- A response plan for unplanned events such as evacuations due to flooding or bushfires. Arrangements would be made to allow for evacuations for flood events during construction.
- Consideration of other developments that may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic, and
- Monitoring, review and amendment mechanisms.

6.2 Communications strategy

Road users are to be informed of journey changes through a comprehensive communications strategy, which includes:

- Community information brochures
- Advertising in all forms of the media
- Variable Message Signs (VMS) on the roadside to be used as advance warning medium to advise motorists about the changes in traffic conditions ahead
- Traffic management controls, including advisory, directional, warning, and regulatory signage.

These measures would be outlined in the Community and Stakeholder Engagement Strategy prepared for the Proposal prior to commencement of construction.

6.3 Road network

Further traffic modelling would be carried out during detailed design to inform detailed construction methods and traffic staging. Traffic modelling would assess the potential traffic impacts from detailed design and identify whether any additional mitigation measures or traffic control measures would be required.

Contraflow arrangements, full or partial road closures and stop/slow control would be used outside the road network peak periods, at night, or during weekends, as traffic volumes during these times are lower.

Any temporary traffic diversions, clearways and lane closures for work carried out would be implemented in accordance with Transport Management Centre (TMC) and Council requirements.

6.4 Site access

Site access is to be provided to construction zones/sites in a way to minimise any impacts to traffic. The location of site accesses would consider sight distances and, where required, be managed by traffic controllers to ensure safe access and egress to site.

Heavy vehicle movements to be minimised during peak traffic periods (i.e. not between 7:15am and 8.15am or 4:45pm and 5:45pm), where practicable.

Ancillary facility sites and accesses to these sites and other work zones will be assessed and confirmed during detailed design. The design of any construction accesses would consider the number of vehicle movements and the size of vehicles, including their swept paths and the speed of traffic.

6.5 Local road access

Local road access will be maintained in all construction scenarios discussed in this report. The construction of the improvements will be managed through traffic control so that access is always maintained, where possible. In the event that access cannot be maintained, prior consultation will be undertaken.

Any damage to the local road network identified to be caused by construction vehicles for the Proposal would be rectified by the contractor to a standard similar to the existing road condition.

6.6 Property access

Property accesses are to be managed by the Contractor. The Construction Staging Scenarios have sought to ensure that consideration is given to allow continued property access. This will involve the use of sub-staging and the potential use of temporary surfaces or realignment of property accesses, where feasible. However, in areas with more constraints, use of expedited pavement profiles in front of property accesses is to be considered.

Driveway access to residential properties would be designed in greater detail in detailed design. Sight distances, setbacks and gradients would be designed in accordance with the Australian Standards, Austroads Road Design Guides, RMS (Transport) Supplements and Council Standards.

Where possible, the Contractor would seek to carry out the proposed works in the vicinity of Londonderry Public School outside of school term.

6.7 Pedestrian and cyclist access

It is anticipated that the same level of functionality would be maintained as exist for pedestrian and cyclist movements, within the Proposal extents, for the duration of the construction period. Consideration would be given to undertaking the construction works requiring closure of active transport facilities at night to offset any impacts associated with the closure, and appropriate pedestrian signage would be used for advanced warning.

6.8 Public transport

Consideration would be given during detailed design to investigate the feasibility of temporarily relocating bus stops to reduce impacts on bus service operations, and/or the use of local roads to access the impacted bus stops. Consultation with Transport and bus companies will be required to inform staging design and impacts to bus routes.

6.9 Unplanned events

The appointed Contractor will be required to develop an emergency response plan which will identify the emergency response and management measures that will be applied to emergencies that may arise from the construction staging scenarios, and for emergencies that may originate externally to the site such as floods or bushfires.

The objective of this plan would be to ensure incident planning and response procedures are managed effectively during construction and outlines the general procedures for initiating an emergency response that could occur as a result of the construction works, natural causes or a vehicle collision.

Arrangements would be made to allow evacuations to proceed for flood events during construction.

6.10 Adjacent projects and cumulative impacts

The Contractor will plan the works to reduce the potential for cumulative traffic impacts on the road network. The Contractor will liaise with any potential construction sites in the vicinity of the proposed works to reduce cumulative impacts wherever possible and to ensure synergy in communications. Further details will be provided in the Construction Traffic Management Plan (CTMP), which will be prepared prior to commencement of construction.

7. Conclusion

The Hawkesbury-Nepean Flood Evacuation Road Resilience Program aims to improve the resilience of the flood evacuation network along Londonderry Road and The Northern Road. The proposed works are not intended to change traffic conditions in normal operations. At a high-level, the improvements associated with the Proposal will provide:

- Evacuation capacity improvements (e.g. shoulder widening to provide sufficient width for use as an additional southbound lane during flood evacuation only). This includes minor modifications to the flood evacuation routes particularly at convergence intersections with The Northern Road to facilitate dual southbound lanes during a flood evacuation event.
- Drainage-related improvements (e.g. upsized transverse drainage structures, road raising, channel works, pit and pipe works).

This Traffic and Transport Working Paper provides a qualitative assessment of traffic operations for the Proposal during construction, and operation during both normal traffic and flood evacuation scenarios.

The introduction of up to 30 heavy vehicle movements per direction per hour and 10 to 30 light vehicle movements per direction per day outside the AM and PM peaks for the duration of the proposed works is anticipated to have minor impacts on the operation of the surrounding road network.

Implementation of the stop/slow traffic controls and contraflow arrangements would increase travel times. To mitigate this impact, these traffic controls would be implemented outside of peak periods, or at night, as traffic volumes during these times are lower.

Traffic would be detoured via Londonderry Road during the temporary closure of The Northern Road (north of the Londonderry Road / The Northern Road / Cranebrook Road roundabout) and vice versa. Diversion of traffic to alternative routes is anticipated to result in reduced level of service at some locations and is likely to increase delays and congestion at intersections along these routes, particularly where the intersections are currently operating with capacity issues. However, these closures are proposed to be implemented during weekends only.

The level of functionality for existing active transport facilities will be maintained throughout construction. All construction staging scenarios are expected to have minimal impacts to pedestrians. Only minor impacts are anticipated on cyclists as a safe alternative route would be nominated.

The proposed construction works would affect bus service operations. Alternative routes and temporary relocation of affected bus stops would be further investigated during detailed design to minimise impacts on bus operations. The need for permanent bus stop relocations have been identified for two stops on The Northern Road.

The temporary loss of kerbside parking along Londonderry Road due to construction works would have minor impacts on parking capacity as there are alternative kerbside parking opportunities nearby.

A Construction Traffic Management Plan is proposed to identify safeguards and mitigation measures to reduce traffic and transport impacts during construction. A Community and Stakeholder Engagement Plan would also be prepared to ensure the local community and businesses are kept informed of construction activity timing, and alternative traffic and transport arrangements through the construction phase.

During construction, arrangements would be made to allow evacuations to proceed in the event of a flood.

Following construction, during normal traffic operations, no change to general traffic and other road users are envisaged, as traffic is expected to operate similarly to existing conditions.

With the proposed improvements, during flood evacuations, the routes would operate as two lanes southbound utilising the widened shoulder as the second evacuation lane. It is anticipated that both roads (The Northern Road and Londonderry Road) would operate at capacity for some period during an evacuation event, with some level of congestion particularly in the vicinity of key convergence points. General traffic evacuating southbound would be controlled, particularly at the five key convergence points, with the use of relevant traffic management devices (including advance warning signs and stop/slow traffic controllers) to minimise congestion, and to maintain overall road user safety. Increasing the capacity southbound would improve traffic flow during a flood evacuation event compared to existing road capacity levels. The minor modifications at the key convergence points to facilitate two outbound lanes during an evacuation event would improve the evacuation traffic flow through these intersections.

8. References

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TfNSW, 2023b, *TfNSW Cycleway Finder online tool*, Accessed: 6 November 2023. Available: https://www.service.nsw.gov.au/transaction/use-the-cycleway-finder-map

Appendix A

List of impacted bus routes

Bus Route	Bus Stop ID	Bus Stop Name	Latitude	Longitude
4000	School Bus (Weekday: 06:39 - 07:23 & 15:52- 16:40)			
	2747273	Cherrywood Village, The Northern Rd	-33.698992	150.726920
4009	School Bus (Weekday: 08:17- 08:49)			
	2747276	Vincent Rd at The Northern Rd	-33.705880	150.723768
	2747266	Ninth Ave before The Northern Rd	-33.714158	150.726602
4014	School Bus (Weekday: 07:35- 08:13)			
	2747266	Ninth Ave before The Northern Rd	-33.714158	150.726602
	274991	The Northern Rd before Jardine Way	-33.716553	150.726230
	2747278	The Northern Rd after Jordan Springs Bvd	-33.727905	150.720368
	274998	The Northern Rd after Sheringham Rd	-33.730575	150.719179
	2750251	Richmond Rd before Trinity Dr	-33.735879	150.717574
	2750252	Richmond St opposite Cooper St	-33.738365	150.717060
	2750253	Richmond St before Boomerang Pl	-33.740173	150.716677
	2750254	Richmond St at Eton Rd	-33.743810	150.715338
	2747272	Parker St after Oxford St	-33.747363	150.714419
	2747279	Parker St after Glebe Pl	-33.751797	150.713415
	2747280	St Dominic's College, Parker St	-33.753647	150.712983
4033	School Bus (Weekday: 08:30- 09:00)			
	2749276	The Northern Rd after Ninth Ave	-33.716503	150.726042
	274997	The Northern Rd opposite Jordan Springs Bvd	-33.726962	150.720351
	274927	Andrews Rd after The Northern Rd	-33.734910	150.715644
	2750250	Richmond St after Cooper St	-33.737273	150.716934
	275067	Cooper St before Richmond Rd	-33.737756	150.716469
	275066	Cooper St before Pelsart Ave	-33.737605	150.714557
	275065	Cooper St opposite Moonbi Rd	-33.737408	150.713139
	274928	Greygums Rd opposite Bottlebrush Dr	-33.733552	150.711970
4062	School Bus (Weekday: 07:08- 08:25)			
	274991	The Northern Rd before Jardine Way	-33.716553	150.726230
	2747278	The Northern Rd after Jordan Springs Bvd	-33.727905	150.720368
	274998	The Northern Rd after Sheringham Rd	-33.730575	150.719179
	2750251	Richmond Rd before Trinity Dr	-33.735879	150.717574
	274778	Trinity Dr opposite Grange Cres	-33.736652	150.719049
	2750254	Richmond St at Eton Rd	-33.743810	150.715338
	2747272	Parker St after Oxford St	-33.747363	150.714419
	2747279	Parker St after Glebe Pl	-33.751797	150.713415
	2747280	St Dominic's College, Parker St	-33.753647	150.712983
	274928	Greygums Rd opposite Bottlebrush Dr	-33.733552	150.711970
4064	School Bus (Weekday: 07:27- 08:10)			
	274911	Borrowdale Way at Seaton Cres	-33.722086	150.721810
	274997	The Northern Rd opposite Jordan Springs Bvd	-33.726962	150.720351
	274996	The Northern Rd before Sherringham Rd	-33.730557	150.718986
	274995	The Northern Rd after Andrews Rd	-33.733443	150.717710
	2750247	Richmond Rd after Coreen Ave	-33.745706	150.714480
4072	School Bus (Weekday: 07:28- 08:08)			
	2747267	Ninth Ave after The Northern Rd	-33.714112	150.725894
	2749276	The Northern Rd after Ninth Ave	-33.716503	150.726042
	274997	The Northern Rd opposite Jordan Springs Bvd	-33.726962	150.720351
	274996	The Northern Rd before Sherringham Rd	-33.730557	150.718986
	274995	The Northern Rd after Andrews Rd	-33.733443	150.717710
	2750250	Richmond St after Cooper St	-33.737273	150.716934
	2750249	Richmond St at Brewongle Ave	-33.740002	150.716433
	2747293	St Dominic's College, Copeland St	-33.754478	150.714556

Bus Route	Bus Stop ID	Bus Stop Name	Latitude	Longitude
4073	School Bus (Weekday: 08:00- 08:24)			
	2747276	Vincent Rd at The Northern Rd	-33.705880	150.723768
	2747267	Ninth Ave after The Northern Rd	-33.714112	150.725894
	2749276	The Northern Rd after Ninth Ave	-33.716503	150.726042
	274997	The Northern Rd opposite Jordan Springs Bvd	-33.726962	150.720351
	274996	The Northern Rd before Sherringham Rd	-33.730557	150.718986
	274995	The Northern Rd after Andrews Rd	-33.733443	150.717710
	2747254	Trinity Dr at Grange Cres	-33.736823	150.718760
	2750252	Richmond St opposite Cooper St	-33.738365	150.717060
	2750253	Richmond St before Boomerang Pl	-33.740173	150.716677
4077	School Bus (Weekday: 07:32- 08:40)			
	2747276	Vincent Rd at The Northern Rd	-33.705880	150.723768
4079	School Bus (Weekday: 08:07- 08:42)			
	274974	Borrowdale Way opposite Seaton Cres	-33.721946	150.721571
	2747278	The Northern Rd after Jordan Springs Bvd	-33.727905	150.720368
	274998	The Northern Rd after Sheringham Rd	-33.730575	150.719179
	274927	Andrews Rd after The Northern Rd	-33.734910	150.715644
	2750251	Richmond Rd before Trinity Dr	-33.735879	150.717574
	2750250	Richmond St after Cooper St	-33.737273	150.716934
	2750252	Richmond St opposite Cooper St	-33.738365	150.717060
	275067	Cooper St before Richmond Rd	-33.737756	150.716469
	275066	Cooper St before Pelsart Ave	-33.737605	150.714557
	275065	Cooper St opposite Moonbi Rd	-33.737408	150.713139
	2750253	Richmond St before Boomerang Pl	-33.740173	150.716677
	2750254	Richmond St at Eton Rd	-33.743810	150.715338
	2750133	Caloola Ave before Kareela Ave	-33.743985	150.714344
	2750134	Caloola Ave before Orana Ave	-33.743640	150.713291
	2747272	Parker St after Oxford St	-33.747363	150.714419
	2747279	Parker St after Glebe Pl	-33.751797	150.713415
	2747280	St Dominic's College, Parker St	-33.753647	150.712983
	274928	Greygums Rd opposite Bottlebrush Dr	-33.733552	150.711970
	2747294	Copeland St opposite St Dominic's College	-33.754471	150.714117
	2747293	St Dominic's College, Copeland St	-33.754478	150.714556
4123	School Bus (Weekday: 07:45- 08:00)			
	274996	The Northern Rd before Sherringham Rd	-33.730557	150.718986
	274995	The Northern Rd after Andrews Rd	-33.733443	150.717710
	2747254	Trinity Dr at Grange Cres	-33.736823	150.718760
	2747267	Ninth Ave after The Northern Rd	-33.714112	150.725894
	2749276	The Northern Rd after Ninth Ave	-33.716503	150.726042
	274997	The Northern Rd opposite Jordan Springs Bvd	-33.726962	150.720351
	274996	The Northern Rd before Sherringham Rd	-33.730557	150.718986
	274995	The Northern Rd after Andrews Rd	-33.733443	150.717710
	2750250	Richmond St after Cooper St	-33.737273	150.716934
	2750249	Richmond St at Brewongle Ave	-33.740002	150.716433

Bus Route	Bus Stop ID	Bus Stop Name	Latitude	Longitude
4138	School Bus (Weekday: 08:04- 08:30)			
	2747276	Vincent Rd at The Northern Rd	-33.705880	150.723768
	2747267	Ninth Ave after The Northern Rd	-33.714112	150.725894
	2747266	Ninth Ave before The Northern Rd	-33.714158	150.726602
	2749276	The Northern Rd after Ninth Ave	-33.716503	150.726042
	274997	The Northern Rd opposite Jordan Springs Bvd	-33.726962	150.720351
	274996	The Northern Rd before Sherringham Rd	-33.730557	150.718986
	274995	The Northern Rd after Andrews Rd	-33.733443	150.717710
	2750250	Richmond St after Cooper St	-33.737273	150.716934
	2750249	Richmond St at Brewongle Ave	-33.740002	150.716433
	274789	Cambridge Park Anglican Church, Oxford St	-33.746854	150.716461
	274790	Oxford St at Pembroke St	-33.747097	150.718068
	2750246	Parker St Reserve, Parker St	-33.750499	150.713426
	2747277	Parker St opposite St Dominic's College	-33.753723	150.712687
4541	School Bus (Weekday: 15:00- 16:10)			
	274992	The Northern Rd opposite Cherrywood Village	-33.698844	150.726842
	2747276	Vincent Rd at The Northern Rd	-33.705880	150.723768
	274927	Andrews Rd after The Northern Rd	-33.734910	150.715644
	2750250	Richmond St after Cooper St	-33.737273	150.716934
	275067	Cooper St before Richmond Rd	-33.737756	150.716469
	275066	Cooper St before Pelsart Ave	-33.737605	150.714557
	275065	Cooper St opposite Moonbi Rd	-33.737408	150.713139
	2750246	Parker St Reserve, Parker St	-33.750499	150.713426
	2747277	Parker St opposite St Dominic's College	-33.753723	150.712687
	274928	Greygums Rd opposite Bottlebrush Dr	-33.733552	150.711970
4548	School Bus (Weekday: 15:35- 16:26)			
	2747276	Vincent Rd at The Northern Rd	-33.705880	150.723768
4568	School Bus (Weekday: 14:45- 15:07)			
	2747266	Ninth Ave before The Northern Rd	-33.714158	150.726602
	274960	Andrews Rd before The Northern Rd	-33.734724	150.715976
	2750251	Richmond Rd before Trinity Dr	-33.735879	150.717574
	274778	Trinity Dr opposite Grange Cres	-33.736652	150.719049
	274959	Greygums Rd before Andrews Rd	-33.733787	150.712147
4581	School Bus (Weekday: 14:47- 15:07)			
	2747266	Ninth Ave before The Northern Rd	-33.714158	150.726602
	274991	The Northern Rd before Jardine Way	-33.716553	150.726230
	2747278	The Northern Rd after Jordan Springs Bvd	-33.727905	150.720368
	274998	The Northern Rd after Sheringham Rd	-33.730575	150.719179
	2750251	Richmond Rd before Trinity Dr	-33.735879	150.717574
	274778	Trinity Dr opposite Grange Cres	-33.736652	150.719049
4595	School Bus (Weekday: 14:49- 16:20)			
	2747267	Ninth Ave after The Northern Rd	-33.714112	150.725894
	274927	Andrews Rd after The Northern Rd	-33.734910	150.715644
	2750250	Richmond St after Cooper St	-33.737273	150.716934
	2750249	Richmond St at Brewongle Ave	-33.740002	150.716433
	2750247	Richmond Rd after Coreen Ave	-33.745706	150.714480
	2750246	Parker St Reserve, Parker St	-33.750499	150.713426
	2747277	Parker St opposite St Dominic's College	-33.753723	150.712687
	274928	Greygums Rd opposite Bottlebrush Dr	-33.733552	150.711970
	2747294	Copeland St opposite St Dominic's College	-33.754471	150.714117
	2747293	St Dominic's College, Copeland St	-33.754478	150.714556

Bus Route	Bus Stop ID	Bus Stop Name	Latitude	Longitude
4617	School Bus (Weekday: 15:12- 16:00)			
	274960	Andrews Rd before The Northern Rd	-33.734724	150.715976
	2750251	Richmond Rd before Trinity Dr	-33.735879	150.717574
	274778	Trinity Dr opposite Grange Cres	-33.736652	150.719049
	2750171	Cooper St after Richmond Rd	-33.737847	150.716183
	2750140	Cooper St opposite Pelsart Ave	-33.737719	150.714612
	2750141	Cooper St at Moonbi Rd	-33.737345	150.712605
	2750249	Richmond St at Brewongle Ave	-33.740002	150.716433
	274959	Greygums Rd before Andrews Rd	-33.733787	150.712147
4636	School Bus (Weekday: 15:04- 16:02)			
	2747267	Ninth Ave after The Northern Rd	-33.714112	150.725894
	2749276	The Northern Rd after Ninth Ave	-33.716503	150.726042
	274974	Borrowdale Way opposite Seaton Cres	-33.721946	150.721571
4651	School Bus (Weekday: 14:45- 15:05)			
	2747276	Vincent Rd at The Northern Rd	-33.705880	150.723768
	2747266	Ninth Ave before The Northern Rd	-33.714158	150.726602
	274991	The Northern Rd before Jardine Way	-33.716553	150.726230
	2747278	The Northern Rd after Jordan Springs Bvd	-33.727905	150.720368
	274998	The Northern Rd after Sheringham Rd	-33.730575	150.719179
	2750251	Richmond Rd before Trinity Dr	-33.735879	150.717574
	274778	Trinity Dr opposite Grange Cres	-33.736652	150.719049
5012	School Bus (Weekday: 08:32- 08:55)			
	2753120	Londonderry Rd after Spencer St	-33.654700	150.733780
	2753119	Londonderry Rd opposite White Gates Rd	-33.666940	150.732238
5021	School Bus (Weekday: 08:24- 08:54)			
	276584	The Northern Rd opposite Whitegates Rd	-33.670599	150.752550
	2747292	Fourth Ave after The Northern Rd	-33.691533	150.728421
	2747273	Cherrywood Village, The Northern Rd	-33.698992	150.726920
	274992	The Northern Rd opposite Cherrywood Village	-33.698844	150.726842
	2747274	Vincent Rd opposite The Northern Rd	-33.705891	150.723918
	274991	The Northern Rd before Jardine Way	-33.716553	150.726230
	274911	Borrowdale Way at Seaton Cres	-33.722086	150.721810
5024	School Bus (Weekday: 06:55- 08:47)			
	2753112	Londonderry Public School, Trahlee Rd	-33.646430	150.735849
	2753111	Muscharry Rd at Trahlee Rd	-33.646226	150.736854
	2753113	Londonderry Rd after Studley St	-33.654160	150.734050
	2747273	Cherrywood Village, The Northern Rd	-33.698992	150.726920
	2747274	Vincent Rd opposite The Northern Rd	-33.705891	150.723918
	274991	The Northern Rd before Jardine Way	-33.716553	150.726230
	2747278	The Northern Rd after Jordan Springs Bvd	-33.727905	150.720368
	274998	The Northern Rd after Sheringham Rd	-33.730575	150.719179
	2750251	Richmond Rd before Trinity Dr	-33.735879	150.717574
	2750252	Richmond St opposite Cooper St	-33.738365	150.717060
	2750253	Richmond St before Boomerang Pl	-33.740173	150.716677
	2750254	Richmond St at Eton Rd	-33.743810	150.715338
	2747272	Parker St after Oxford St	-33.747363	150.714419
	2747279	Parker St after Glebe Pl	-33.751797	150.713415
	2747280	St Dominic's College, Parker St	-33.753647	150.712983
	275613	Richmond Rd after George St	-33.640217	150.784682
	275349	Carrington Rd after Bowmans Rd	-33.647040	150.750711

Bus Route	Bus Stop ID	Bus Stop Name	Latitude	Longitude
5028	School Bus (Weekday: 07:55- 08:55)			
	2753110	RAAF Base Londonderry Rd	-33.640469	150.736721
	2753112	Londonderry Public School, Trahlee Rd	-33.646430	150.735849
	2753111	Muscharry Rd at Trahlee Rd	-33.646226	150.736854
	2753113	Londonderry Rd after Studley St	-33.654160	150.734050
	2753120	Londonderry Rd after Spencer St	-33.654700	150.733780
	2753119	Londonderry Rd opposite White Gates Rd	-33.666940	150.732238
	2753117	Londonderry Rd after Smeeton Rd	-33.682441	150.729009
	2753658	The Northern Rd opposite John Morony Correction Centre	-33.646742	150.780046
	275316	Blacktown Rd George St	-33.640316	150.784521
	275350	Carrington Rd opposite Bowmans Rd	-33.647050	150.751756
5030	School Bus (Weekday: 07:32- 08:22)			
	2753112	Londonderry Public School, Trahlee Rd	-33.646430	150.735849
	2753111	Muscharry Rd at Trahlee Rd	-33.646226	150.736854
	2753116	Londonderry Rd before The Northern Rd	-33.689250	150.728029
	2753658	The Northern Rd opposite John Morony Correction Centre	-33.646742	150.780046
	275316	Blacktown Rd George St	-33.640316	150.784521
	275350	Carrington Rd opposite Bowmans Rd	-33.647050	150.751756
	275349	Carrington Rd after Bowmans Rd	-33.647040	150.750711
5039	School Bus (Weekday: 07:28- 07:50)			
	275316	Blacktown Rd George St	-33.640316	150.784521
	2753658	The Northern Rd opposite John Morony Correction Centre	-33.646742	150.780046
	274993	The Northern Rd before Cranebrook Rd	-33.690490	150.727800
	2747414	Seventh Ave at The Northern Rd	-33.704511	150.724460
5042	School Bus (Weekday: 07:32- 07:38)			
	2753120	Londonderry Rd after Spencer St	-33.654700	150.733780
	2753119	Londonderry Rd opposite White Gates Rd	-33.666940	150.732238
	2753117	Londonderry Rd after Smeeton Rd	-33.682441	150.729009
	2753125	Londonderry Rd after Cranebrook Rd	-33.688627	150.727972
5043	School Bus (Weekday: 07:39- 08:03)			
	275354	Londonderry Rd opposite Vines Dr	-33.611180	150.742650
	275353	Londonderry Rd at The Driftway	-33.624240	150.739700
	275351	Londonderry Rd opposite Garrington Rd	-33.644560	150.735753
	2753112	Londonderry Public School, Trahlee Rd	-33.646430	150.735849
	2753111	Muscharry Rd at Trahlee Rd	-33.646226	150.736854
	275350	Carrington Rd opposite Bowmans Rd	-33.647050	150.751756
	275349	Carrington Rd after Bowmans Rd	-33.647040	150.750711
5045	School Bus (Weekday: 07:17- 08:00)			
	275353	Londonderry Rd at The Driftway	-33.624240	150.739700
	275351	Londonderry Rd opposite Garrington Rd	-33.644560	150.735753
	2753112	Londonderry Public School, Trahlee Rd	-33.646430	150.735849
	2753111	Muscharry Rd at Trahlee Rd	-33.646226	150.736854
5081	School Bus (Weekday: 08:24- 08:49)			
	274911	Borrowdale Way at Seaton Cres	-33.722086	150.721810
	2747378	Jordan Springs Bvd at McGarritys Pde	-33.727738	150.721881

Bus Route	Bus Stop ID	Bus Stop Name	Latitude	Longitude
5088	School Bus (Weekday: 07:28- 08:18)			
	2753112	Londonderry Public School, Trahlee Rd	-33.646430	150.735849
	2753111	Muscharry Rd at Trahlee Rd	-33.646226	150.736854
	2753116	Londonderry Rd before The Northern Rd	-33.689250	150.728029
	2753658	The Northern Rd opposite John Morony Correction Centre	-33.646742	150.780046
	275315	The Northern Rd at Carrington Rd	-33.651530	150.775030
	275316	Blacktown Rd George St	-33.640316	150.784521
	275350	Carrington Rd opposite Bowmans Rd	-33.647050	150.751756
	275349	Carrington Rd after Bowmans Rd	-33.647040	150.750711
5502	School Bus (Weekday: 15:06- 15:47)			
	274974	Borrowdale Way opposite Seaton Cres	-33.721946	150.721571
	2747278	The Northern Rd after Jordan Springs Bvd	-33.727905	150.720368
	274998	The Northern Rd after Sheringham Rd	-33.730575	150.719179
	274927	Andrews Rd after The Northern Rd	-33.734910	150.715644
	2750251	Richmond Rd before Trinity Dr	-33.735879	150.717574
	2750250	Richmond St after Cooper St	-33.737273	150.716934
	2750252	Richmond St opposite Cooper St	-33.738365	150.717060
	2750249	Richmond St at Brewongle Ave	-33.740002	150.716433
	2750253	Richmond St before Boomerang Pl	-33.740173	150.716677
	2750254	Richmond St at Eton Rd	-33.743810	150.715338
	2750247	Richmond Rd after Coreen Ave	-33.745706	150.714480
	2747272	Parker St after Oxford St	-33.747363	150.714419
	2747105	Oxford St after Barker St	-33.746754	150.715346
	2747279	Parker St after Glebe Pl	-33.751797	150.713415
	2747280	St Dominic's College, Parker St	-33.753647	150.712983
	274928	Greygums Rd opposite Bottlebrush Dr	-33.733552	150.711970
	2747293	St Dominic's College, Copeland St	-33.754478	150.714556
5522	School Bus (Weekday: 14:52- 16:06)			
	275351	Londonderry Rd opposite Garrington Rd	-33.644560	150.735753
	2753112	Londonderry Public School, Trahlee Rd	-33.646430	150.735849
	2753111	Muscharry Rd at Trahlee Rd	-33.646226	150.736854
	2753117	Londonderry Rd after Smeeton Rd	-33.682441	150.729009
	275613	Richmond Rd after George St	-33.640217	150.784682
	275349	Carrington Rd after Bowmans Rd	-33.647040	150.750711
5524	School Bus (Weekday: 14:58- 15:23)			
	2747267	Ninth Ave after The Northern Rd	-33.714112	150.725894
5525	School Bus (Weekday: 15:25- 16:10)			
	275313	The Northern Rd before Whitegates Rd	-33.670801	150.752248
5527	School Bus (Weekday: 15:26- 15:58)			
	275613	Richmond Rd after George St	-33.640217	150.784682
5537	School Bus (Weekday: 15:00- 15:26)			
	2753112	Londonderry Public School, Trahlee Rd	-33.646430	150.735849
	2753111	Muscharry Rd at Trahlee Rd	-33.646226	150.736854
	2753113	Londonderry Rd after Studley St	-33.654160	150.734050
	2753115	Londonderry Rd after Thomas Rd	-33.678620	150.729830
5538	School Bus (Weekday: 15:30- 15:50)			
	2753112	Londonderry Public School, Trahlee Rd	-33.646430	150.735849
	275350	Carrington Rd opposite Bowmans Rd	-33.647050	150.751756

Bus Route	Bus Stop ID	Bus Stop Name	Latitude	Longitude
5545	School Bus (Weekday: 14:45- 15:25)			
	2747266	Ninth Ave before The Northern Rd	-33.714158	150.726602
	274991	The Northern Rd before Jardine Way	-33.716553	150.726230
	2747278	The Northern Rd after Jordan Springs Bvd	-33.727905	150.720368
	274998	The Northern Rd after Sheringham Rd	-33.730575	150.719179
	2750251	Richmond Rd before Trinity Dr	-33.735879	150.717574
	274778	Trinity Dr opposite Grange Cres	-33.736652	150.719049
	2747285	St Dominic's College, Gascoigne St	N/A	N/A
	2747280	St Dominic's College, Parker St	-33.753647	150.712983
5546	School Bus (Weekday: 15:21- 16:15)			
	2753110	RAAF Base Londonderry Rd	-33.640469	150.736721
	2753112	Londonderry Public School, Trahlee Rd	-33.646430	150.735849
	2753111	Muscharry Rd at Trahlee Rd	-33.646226	150.736854
	274974	Borrowdale Way opposite Seaton Cres	-33.721946	150.721571
	2747278	The Northern Rd after Jordan Springs Bvd	-33.727905	150.720368
	274998	The Northern Rd after Sheringham Rd	-33.730575	150.719179
	2750251	Richmond Rd before Trinity Dr	-33.735879	150.717574
	274778	Trinity Dr opposite Grange Cres	-33.736652	150.719049
5563	School Bus (Weekday: 14:55- 15:37)			
	2747266	Ninth Ave before The Northern Rd	-33.714158	150.726602
	274991	The Northern Rd before Jardine Way	-33.716553	150.726230
	274911	Borrowdale Way at Seaton Cres	-33.722086	150.721810
5564	School Bus (Weekday: 15:47- 16:11)			
	275316	Blacktown Rd George St	-33.640316	150.784521
	2753658	The Northern Rd opposite John Morony Correction Centre	-33.646742	150.780046
5569	School Bus (Weekday: 15:00- 15:44)			
	2747266	Ninth Ave before The Northern Rd	-33.714158	150.726602
	2747378	Jordan Springs Bvd at McGarritys Pde	-33.727738	150.721881
	2749101	Sherringham Rd opposite Ironbark Dr	-33.729661	150.718183
5570	School Bus (Weekday: 15:40- 16:25)			
	275316	Blacktown Rd George St	-33.640316	150.784521
	2753658	The Northern Rd opposite John Morony Correction Centre	-33.646742	150.780046
	274993	The Northern Rd before Cranebrook Rd	-33.690493	150.727824
	274992	The Northern Rd opposite Cherrywood Village	-33.698844	150.726842
	2749276	The Northern Rd after Ninth Ave	-33.716503	150.726042
	274974	Borrowdale Way opposite Seaton Cres	-33.721946	150.721571
	274927	Andrews Rd after The Northern Rd	-33.734910	150.715644
	2750250	Richmond St after Cooper St	-33.737273	150.716934
	2750249	Richmond St at Brewongle Ave	-33.740002	150.716433
	275039	Caloola Ave after Kareela Ave	-33.743871	150.714369
	275038	Caloola Ave opposite Orana Ave	-33.743497	150.713130
	2747105	Oxford St after Barker St	-33.746754	150.715346
	2747103	Oxford St at Cam St	-33.747336	150.718786
	274928	Greygums Rd opposite Bottlebrush Dr	-33.733552	150.711970
	2747293	St Dominic's College, Copeland St	-33.754478	150.714556
5578	School Bus (Weekday: 15:52- 16:55)			
	275354	Londonderry Rd opposite Vines Dr	-33.611180	150.742650
	275353	Londonderry Rd at The Driftway	-33.624240	150.739700
	275351	Londonderry Rd opposite Garrington Rd	-33.644560	150.735753
	2753120	Londonderry Rd after Spencer St	-33.654700	150.733780
	2753119	Londonderry Rd opposite White Gates Rd	-33.666940	150.732238
	2753117	Londonderry Rd after Smeeton Rd	-33.682441	150.729009

Bus Route	Bus Stop ID	Bus Stop Name	Latitude	Longitude
5040	School Bus (Weekday: 07:56- 08:23)			
	275354	Londonderry Rd opposite Vines Dr	-33.611180	150.742650
5594	School Bus (Weekday: 14:54- 15:23)			
	275354	Londonderry Rd opposite Vines Dr	-33.611180	150.742650
	275353	Londonderry Rd at The Driftway	-33.624240	150.739700
	275351	Londonderry Rd opposite Garrington Rd	-33.644560	150.735753
	2753112	Londonderry Public School, Trahlee Rd	-33.646430	150.735849
	2753111	Muscharry Rd at Trahlee Rd	-33.646226	150.736854
	2753120	Londonderry Rd after Spencer St	-33.654700	150.733780
	2753119	Londonderry Rd opposite White Gates Rd	-33.666940	150.732238
	2753117	Londonderry Rd after Smeeton Rd	-33.682441	150.729009
	274993	The Northern Rd before Cranebrook Rd	-33.690493	150.727824
	274992	The Northern Rd opposite Cherrywood Village	-33.698844	150.726842
	2747266	Ninth Ave before The Northern Rd	-33.714158	150.726602
5595	School Bus (Weekday: 14:54- 16:19)			
	2747266	Ninth Ave before The Northern Rd	-33.714158	150.726602
	274991	The Northern Rd before Jardine Way	-33.716553	150.726230
	2747278	The Northern Rd after Jordan Springs Bvd	-33.727905	150.720368
	274998	The Northern Rd after Sheringham Rd	-33.730575	150.719179
	274927	Andrews Rd after The Northern Rd	-33.734910	150.715644
	2750251	Richmond Rd before Trinity Dr	-33.735879	150.717574
	2750250	Richmond St after Cooper St	-33.737273	150.716934
	2750252	Richmond St opposite Cooper St	-33.738365	150.717060
	2750249	Richmond St at Brewongle Ave	-33.740002	150.716433
	2750253	Richmond St before Boomerang Pl	-33.740173	150.716677
	2750247	Richmond Rd after Coreen Ave	-33.745706	150.714480
	2750246	Parker St Reserve, Parker St	-33.750499	150.713426
	2747285	St Dominic's College, Gascoigne St	N/A	N/A
	2747280	St Dominic's College, Parker St	-33.753647	150.712983
	2747277	Parker St opposite St Dominic's College	-33.753723	150.712687
5044	School Bus (Weekday: 08:15- 08:47)			
	275354	Londonderry Rd opposite Vines Dr	-33.611180	150.742650
	275353	Londonderry Rd at The Driftway	-33.624240	150.739700
	275351	Londonderry Rd opposite Garrington Rd	-33.644560	150.735753
	2753112	Londonderry Public School, Trahlee Rd	-33.646430	150.735849
	2753111	Muscharry Rd at Trahlee Rd	-33.646226	150.736854
	275350	Carrington Rd opposite Bowmans Rd	-33.647050	150.751756
	275349	Carrington Rd after Bowmans Rd	-33.647040	150.750711
5600	School Bus (Weekday: 15:22- 16:33)			
	275316	Blacktown Rd George St	-33.640316	150.784521
	2753658	The Northern Rd opposite John Morony Correction Centre	-33.646742	150.780046
673	(Weekday: 06:58- 18:34; Sat: 09:41- 16:44)			
	275613	Richmond Rd after George St	-33.640217	150.784682
	275316	Blacktown Rd George St	-33.640316	150.784521
	2747292	Fourth Ave after The Northern Rd	-33.691529	150.728453
	274992	The Northern Rd opposite Cherrywood Village	-33.698844	150.726842
	2747276	Vincent Rd at The Northern Rd	-33.705880	150.723768
	2747267	Ninth Ave after The Northern Rd	-33.714112	150.725894
	2747266	Ninth Ave before The Northern Rd	-33.714158	150.726602
	2749276	The Northern Rd after Ninth Ave	-33.716503	150.726042
	274991	The Northern Rd before Jardine Way	-33.716553	150.726230
	274911	Borrowdale Way at Seaton Cres	-33.722086	150.721810
	274974	Borrowdale Way opposite Seaton Cres	-33.721946	150.721571

Bus Route	Bus Stop ID	Bus Stop Name	Latitude	Longitude
674	(Weekday: 06:16- 19:07; Weekend: 08:20- 18:13)			
	275613	Richmond Rd after George St	-33.640217	150.784682
	275316	Blacktown Rd George St	-33.640316	150.784521
	2753658	The Northern Rd opposite John Morony Correction Centre	-33.646742	150.780046
677	Londonderry Road (Weekday: 06:17 - 19:00; Weekend: 07:40 - 19:19)			
	275341, 275354	Londonderry Rd at and opposite Vines Dr	-33.611452	150.742680
	2753109	Londonderry Rd at and after The Driftway	-33.624315	150.739889
	2753110, 275352	RAAF Base Londonderry Rd	-33.640490	150.736710
	275351	Londonderry Rd opposite Garrington Rd	-33.644555	150.735741
	2753112	Londonderry Public School, Trahlee Rd	-33.646430	150.735849
	2753111	Muscharry Rd at Trahlee Rd	-33.646226	150.736854
	2753113	Londonderry Rd after Studley St	-33.654160	150.734050
	2753120	Londonderry Rd after Spencer St	-33.654700	150.733780
	2753119, 2753114	Londonderry Rd at and opposite White Gates Rd	-33.666940	150.732238
	2753115, 2753118	Londonderry Rd opposite and after Thomas Rd	-33.678620	150.729830
	2753117	Londonderry Rd after Smeeton Rd	-33.682441	150.729009
	2753116	Londonderry Rd before The Northern Rd	-33.689250	150.728029
	275350	Carrington Rd opposite Bowmans Rd	-33.647050	150.751756
677	The Northern Road (Weekday: 06:17 - 19:00; Weekend: 07:40 - 19:19)			
	274993	The Northern Rd before Cranebrook Rd	-33.690493	150.727824
	2747273	Cherrywood Village, The Northern Rd	-33.698992	150.726920
	274992	The Northern Rd opposite Cherrywood Village	-33.698844	150.726842
	2747274	Vincent Rd opposite The Northern Rd	-33.705891	150.723918
	2747276	Vincent Rd at The Northern Rd	-33.705880	150.723768
	2749276	The Northern Rd after Ninth Ave	-33.716503	150.726042
	274991	The Northern Rd before Jardine Way	-33.716553	150.726230
	274997	The Northern Rd opposite Jordan Springs Bvd	-33.726962	150.720351
	2747278	The Northern Rd after Jordan Springs Bvd	-33.727905	150.720368
	274996	The Northern Rd before Sherringham Rd	-33.730557	150.718986
	274998	The Northern Rd after Sheringham Rd	-33.730575	150.719179
	274995	The Northern Rd after Andrews Rd	-33.733443	150.717710
	2750251	Richmond Rd before Trinity Dr	-33.735879	150.717574
	2750250	Richmond St after Cooper St	-33.737273	150.716934
	2750252	Richmond St opposite Cooper St	-33.738365	150.717060
	2750249	Richmond St at Brewongle Ave	-33.740002	150.716433
	2750253	Richmond St before Boomerang Pl	-33.740173	150.716677
	2750254	Richmond St at Eton Rd	-33.743810	150.715338
	2750247	Richmond Rd after Coreen Ave	-33.745706	150.714480
	2747272	Parker St after Oxford St	-33.747363	150.714419
	2750246	Parker St Reserve, Parker St	-33.750499	150.713426
	2747279	Parker St after Glebe Pl	-33.751797	150.713415
	2747280	St Dominic's College, Parker St	-33.753647	150.712983
	2747277	Parker St opposite St Dominic's College	-33.753723	150.712687

Bus Route	Bus Stop ID	Bus Stop Name	Latitude	Longitude
678	(Weekday: 06:24- 20:33; Sat: 07:48- 17:22)			
	274960	Andrews Rd before The Northern Rd	-33.734724	150.715976
	274927	Andrews Rd after The Northern Rd	-33.734910	150.715644
	2750251	Richmond Rd before Trinity Dr	-33.735879	150.717574
	2750250	Richmond St after Cooper St	-33.737273	150.716934
	2750252	Richmond St opposite Cooper St	-33.738365	150.717060
	2750249	Richmond St at Brewongle Ave	-33.740002	150.716433
	2750253	Richmond St before Boomerang Pl	-33.740173	150.716677
	275039	Caloola Ave after Kareela Ave	-33.743871	150.714369
	2750133	Caloola Ave before Kareela Ave	-33.743985	150.714344
	2750134	Caloola Ave before Orana Ave	-33.743640	150.713291
	275038	Caloola Ave opposite Orana Ave	-33.743497	150.713130
	274959	Greygums Rd before Andrews Rd	-33.733787	150.712147
	274928	Greygums Rd opposite Bottlebrush Dr	-33.733552	150.711970
783	(Weekday: 04:58- 21:43; Sat: 07:06- 21:26)			
	274911	Borrowdale Way at Seaton Cres	-33.722086	150.721810
	274974	Borrowdale Way opposite Seaton Cres	-33.721946	150.721571
	274997	The Northern Rd opposite Jordan Springs Bvd	-33.726962	150.720351
	2747378	Jordan Springs Bvd at McGarritys Pde	-33.727738	150.721881
	2747386	Jordan Springs Bvd opposite McGarritys Pde	-33.727920	150.721805
784	(Weekday: 06:29- 17:51)			
	274946	Andromeda Dr after Geneva Rd	-33.707125	150.720658
	2749284	Andromeda Dr opposite Goldmark Cres	-33.714746	150.721300
	2749285	Goldmark Cres opposite Britten Cl	-33.715283	150.722753
786	(Weekday: 04:51- 23:15; Weekend: 07:14- 23:20)			
	274946	Andromeda Dr after Geneva Rd	-33.707125	150.720658
	2749284	Andromeda Dr opposite Goldmark Cres	-33.714746	150.721300
	2749285	Goldmark Cres opposite Britten Cl	-33.715283	150.722753
	274911	Borrowdale Way at Seaton Cres	-33.722086	150.721810
	274974	Borrowdale Way opposite Seaton Cres	-33.721946	150.721571
	274997	The Northern Rd opposite Jordan Springs Bvd	-33.726962	150.720351
	2747278	The Northern Rd after Jordan Springs Bvd	-33.727905	150.720368
	274960	Andrews Rd before The Northern Rd	-33.734724	150.715976
	274927	Andrews Rd after The Northern Rd	-33.734910	150.715644
	2750251	Richmond Rd before Trinity Dr	-33.735879	150.717574
	2750250	Richmond St after Cooper St	-33.737273	150.716934
	275067	Cooper St before Richmond Rd	-33.737756	150.716469
	2750171	Cooper St after Richmond Rd	-33.737847	150.716183
	275066	Cooper St before Pelsart Ave	-33.737605	150.714557
	2750140	Cooper St opposite Pelsart Ave	-33.737719	150.714612
	275065	Cooper St opposite Moonbi Rd	-33.737408	150.713139
	2750141	Cooper St at Moonbi Rd	-33.737345	150.712605
	274959	Greygums Rd before Andrews Rd	-33.733787	150.712147
	274928	Greygums Rd opposite Bottlebrush Dr	-33.733552	150.711970
5520	School Bus (Weekday: 15:30- 16:06)			
	275613	Richmond Rd after George St	-33.640217	150.784682
	2747274	Vincent Rd opposite The Northern Rd	-33.705891	150.723918

Bus Route	Bus Stop ID	Bus Stop Name	Latitude	Longitude
5507	School Bus (Weekday: 14:54- 15:14)			
	274960	Andrews Rd before The Northern Rd	-33.734724	150.715976
	2750251	Richmond Rd before Trinity Dr	-33.735879	150.717574
	274778	Trinity Dr opposite Grange Cres	-33.736652	150.719049
	2750254	Richmond St at Eton Rd	-33.743810	150.715338
	2750133	Caloola Ave before Kareela Ave	-33.743985	150.714344
	2750134	Caloola Ave before Orana Ave	-33.743640	150.713291
	2747272	Parker St after Oxford St	-33.747363	150.714419
	2747279	Parker St after Glebe Pl	-33.751797	150.713415
	2747280	St Dominic's College, Parker St	-33.753647	150.712983
	274959	Greygums Rd before Andrews Rd	-33.733787	150.712147
5547	School Bus (Weekday: 15:38- 16:01)			
	275354	Londonderry Rd opposite Vines Dr	-33.611180	150.742650
	275353	Londonderry Rd at The Driftway	-33.624240	150.739700
	275349	Carrington Rd after Bowmans Rd	-33.647040	150.750711
5587	School Bus (Weekday: 15:22- 16:21)			
	275613	Richmond Rd after George St	-33.640217	150.784682
8122	School Bus (Weekday: 07:00- 07:50)			
	275341	Londonderry Rd at Vines Dr	-33.611180	150.742650
	2753629	Londonderry Rd before Reynolds Rd	-33.629826	150.738860
	2753110	RAAF Base Londonderry Rd	-33.640469	150.736721
	2753113	Londonderry Rd after Studley St	-33.654160	150.734050
	2753114	Londonderry Rd at White Gates Rd	-33.666940	150.732238
	2753115	Londonderry Rd after Thomas Rd	-33.678620	150.729830
8534	School Bus (Weekday: 14:55- 15:55)			
	275353	Londonderry Rd at The Driftway	-33.624240	150.739700
	275352	RAAF Base, Londonderry Rd	-33.640533	150.736566
	275351	Londonderry Rd opposite Garrington Rd	-33.644560	150.735753
	2753120	Londonderry Rd after Spencer St	-33.654700	150.733780
	2753119	Londonderry Rd opposite White Gates Rd	-33.666940	150.732238
	2753118	Londonderry Rd opposite Thomas Rd	-33.678278	150.729740
	2753117	Londonderry Rd after Smeeton Rd	-33.682441	150.729009
4532	School Bus (Weekday: 15:35- 16:03)			
	274960	Andrews Rd before The Northern Rd	-33.734724	150.715976
	2750251	Richmond Rd before Trinity Dr	-33.735879	150.717574
	2750252	Richmond St opposite Cooper St	-33.738365	150.717060
	2750253	Richmond St before Boomerang Pl	-33.740173	150.716677
	2750254	Richmond St at Eton Rd	-33.743810	150.715338
	274959	Greygums Rd before Andrews Rd	-33.733787	150.712147
4623	School Bus (Weekday: 14:53- 15:05)			
	2750251	Richmond Rd before Trinity Dr	-33.735879	150.717574
	274778	Trinity Dr opposite Grange Cres	-33.736652	150.719049
4653	School Bus (Weekday: 15:05- 15:25)			
	2747293	St Dominic's College, Copeland St	-33.754478	150.714556

Bus Route	Bus Stop ID	Bus Stop Name	Latitude	Longitude
4599	School Bus (Weekday: 15:05- 16:05)			
	2747306	Trinity Dr at Cleeve Pl	-33.736684	150.717874
	2747254	Trinity Dr at Grange Cres	-33.736823	150.718760
	2750252	Richmond St opposite Cooper St	-33.738365	150.717060
	2750253	Richmond St before Boomerang Pl	-33.740173	150.716677
	2750253	Richmond St before Boomerang Pl	-33.740173	150.716677
	2750254	Richmond St at Eton Rd	-33.743810	150.715338
	2747272	Parker St after Oxford St	-33.747363	150.714419
	2747285	St Dominic's College, Gascoigne St	N/A	N/A
	2747280	St Dominic's College, Parker St	-33.753647	150.712983
	2747293	St Dominic's College, Copeland St	-33.754478	150.714556
782	(Weekday: 05:12- 21:32; Weekend: 07:07- 22:37)			
	2747254	Trinity Dr at Grange Cres	-33.736823	150.718760
	274778	Trinity Dr opposite Grange Cres	-33.736652	150.719049
	2750252	Richmond St opposite Cooper St	-33.738365	150.717060
	2750249	Richmond St at Brewongle Ave	-33.740002	150.716433
	2750253	Richmond St before Boomerang Pl	-33.740173	150.716677
	275039	Caloola Ave after Kareela Ave	-33.743871	150.714369
	2750133	Caloola Ave before Kareela Ave	-33.743985	150.714344
	2750134	Caloola Ave before Orana Ave	-33.743640	150.713291
	275038	Caloola Ave opposite Orana Ave	-33.743497	150.713130
	2747254	Trinity Dr at Grange Cres	-33.736823	150.718760
4647	School Bus (Weekday: 15:19- 16:07)			
	2747254	Trinity Dr at Grange Cres	-33.736823	150.718760
	2750252	Richmond St opposite Cooper St	-33.738365	150.717060
4044	School Bus (Weekday: 07:12- 08:20)			
	2747254	Trinity Dr at Grange Cres	-33.736823	150.718760
	2750252	Richmond St opposite Cooper St	-33.738365	150.717060
	2750253	Richmond St before Boomerang Pl	-33.740173	150.716677
	2750254	Richmond St at Eton Rd	-33.743810	150.715338
	2747272	Parker St after Oxford St	-33.747363	150.714419
	2747279	Parker St after Glebe Pl	-33.751797	150.713415
	2747280	St Dominic's College, Parker St	-33.753647	150.712983
4058	School Bus (Weekday: 06:59- 08:54)			
	2747254	Trinity Dr at Grange Cres	-33.736823	150.718760
	2750171	Cooper St after Richmond Rd	-33.737847	150.716183
	2750140	Cooper St opposite Pelsart Ave	-33.737719	150.714612
	2750141	Cooper St at Moonbi Rd	-33.737345	150.712605
	2747293	St Dominic's College, Copeland St	-33.754478	150.714556
4036	School Bus (Weekday: 07:00- 08:12)			
	274778	Trinity Dr opposite Grange Cres	-33.736652	150.719049
	2750250	Richmond St after Cooper St	-33.737273	150.716934
	2750249	Richmond St at Brewongle Ave	-33.740002	150.716433
4639	School Bus (Weekday: 15:26- 15:56)			
	2750250	Richmond St after Cooper St	-33.737273	150.716934
4047	School Bus (Weekday: 06:58-08:20)			
	2750171	Cooper St after Richmond Rd	-33.737847	150.716183
	2750140	Cooper St opposite Pelsart Ave	-33.737719	150.714612
	274789	Cambridge Park Anglican Church, Oxford St	-33.746854	150.716461
	274790	Oxford St at Pembroke St	-33.747097	150.718068
	2747294	Copeland St opposite St Dominic's College	-33.754471	150.714117

Bus Route	Bus Stop ID	Bus Stop Name	Latitude	Longitude
780	(Weekday: 05:18- 23:20; Weekend: 06:30- 22:50)			
	2747272	Parker St after Oxford St	-33.747363	150.714419
	2747105	Oxford St after Barker St	-33.746754	150.715346
	274789	Cambridge Park Anglican Church, Oxford St	-33.746854	150.716461
	274790	Oxford St at Pembroke St	-33.747097	150.718068
	2747103	Oxford St at Cam St	-33.747336	150.718786
	2750246	Parker St Reserve, Parker St	-33.750499	150.713426
	2747279	Parker St after Glebe Pl	-33.751797	150.713415
	2747280	St Dominic's College, Parker St	-33.753647	150.712983
	2747277	Parker St opposite St Dominic's College	-33.753723	150.712687
	2747105	Oxford St after Barker St	-33.746754	150.715346
	2747103	Oxford St at Cam St	-33.747336	150.718786
	2747293	St Dominic's College, Copeland St	-33.754478	150.714556
8520	School Bus (Weekday: 15:05- 15:58)			
	2747285	St Dominic's College, Gascoigne St	N/A	N/A
4523	School Bus (Weekday: 15:05- 15:59)			
	2747285	St Dominic's College, Gascoigne St	N/A	N/A
	2747280	St Dominic's College, Parker St	-33.753647	150.712983
4641	School Bus (Weekday: 15:11- 16:04)			
	2747285	St Dominic's College, Gascoigne St	N/A	N/A
	2747280	St Dominic's College, Parker St	-33.753647	150.712983
4600	School Bus (Weekday: 15:16- 15:51)			
	2747285	St Dominic's College, Gascoigne St	N/A	N/A
	2747280	St Dominic's College, Parker St	-33.753647	150.712983
4559	School Bus (Weekday: 15:19- 15:49)			
	2747285	St Dominic's College, Gascoigne St	N/A	N/A
	2747280	St Dominic's College, Parker St	-33.753647	150.712983
5596	School Bus (Weekday: 15:20- 15:29)			
	2747285	St Dominic's College, Gascoigne St	N/A	N/A
4513	School Bus (Weekday: 15:24- 15:35)			
	2747285	St Dominic's College, Gascoigne St	N/A	N/A
	2747280	St Dominic's College, Parker St	-33.753647	150.712983
4527	School Bus (Weekday: 14:50- 16:05)			
	2747285	St Dominic's College, Gascoigne St	N/A	N/A
	2747280	St Dominic's College, Parker St	-33.753647	150.712983
	2747293	St Dominic's College, Copeland St	-33.754478	150.714556
5597	School Bus (Weekday: 15:30- 15:45)			
	2747285	St Dominic's College, Gascoigne St	N/A	N/A
4501	School Bus (Weekday: 14:52- 15:22)			
	274928	Greygums Rd opposite Bottlebrush Dr	-33.733552	150.711970
785	(Weekday: 05:08- 21:06; Weekend: 07:13- 19:06)			
	2747294	Copeland St opposite St Dominic's College	-33.754471	150.714117
	2747293	St Dominic's College, Copeland St	-33.754478	150.714556
	2750463, 2750464	Copeland St opposite and after Jenkins Ave	-33.753746	150.711047
4146	School Bus (Weekday: 07:43- 08:21)			
	2747293	St Dominic's College, Copeland St	-33.754478	150.714556

Bus Route	Bus Stop ID	Bus Stop Name	Latitude	Longitude
4624	School Bus (Weekday: 15:10- 15:34)			
	2747293	St Dominic's College, Copeland St	-33.754478	150.714556
5054	School Bus (Weekday: 07:10- 08:12)			
	275613	Richmond Rd after George St	-33.640217	150.784682
	275316	Blacktown Rd George St	-33.640316	150.784521
5100	School Bus (Weekday: 07:12- 08:34)			
	275613	Richmond Rd after George St	-33.640217	150.784682
5047	School Bus (Weekday: 07:09- 08:32)			
	275316	Blacktown Rd George St	-33.640316	150.784521

Appendix B

Impacted bus stop locations

NOT FOR CONSTRUCTION

1:10000 @ A1 0 100 200 300 400 500 m

DRAWING FILE LOCATION / NAME
V:_Vault\Projects\3801\3801943\11B_CADD\CAD\Info_Docs\20231011_SITE COMPOUND_STOCKPILE LOCATIONS\HNVSRD-SMEC-0154-CS-SKE-001102.dwg

HAWKESBURY NEPEAN VALLEY FLOOD EVACUATION ROAD
RESILIENCE IMPROVEMENTS - STATE ROADS
BUS STOP LOCATIONS

INFORMATION DOCUMENT
HNVSRD-SMEC-0154-CS-SKE-001102

SMEC
Member of the Surbana Jurong Group
ABN 47 065 475 149
LEVEL 9 20 BERRY STREET
NORTH SYDNEY NSW 2060

SMEC

PO Box 1052, North Sydney NSW 2059

Phone: +61 2 9925 5555

Email: sydney@smec.com

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www.smec.com