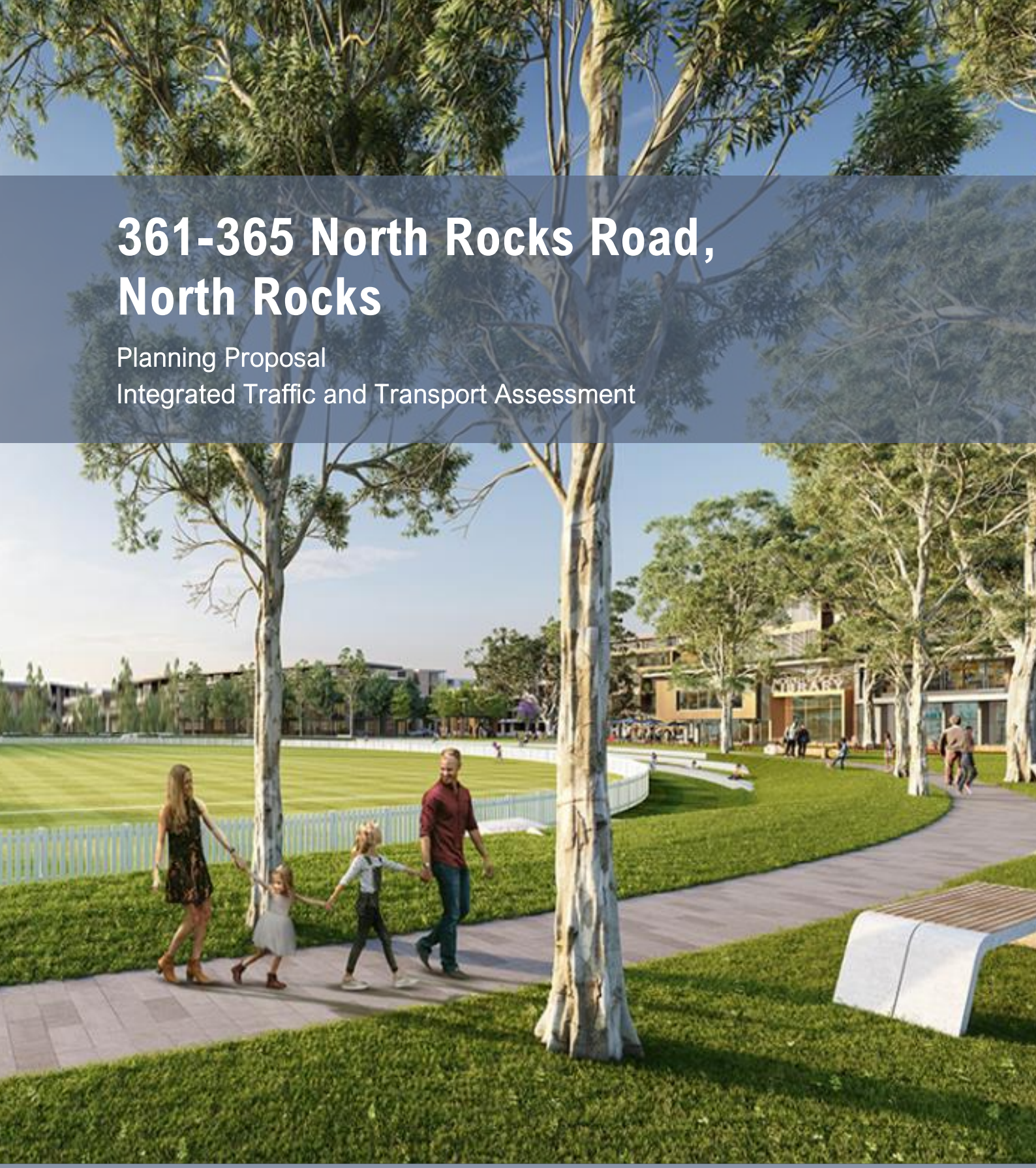
361-365 North Rocks Road, North Rocks

Planning Proposal
Integrated Traffic and Transport Assessment



Prepared by: GTA Consultants (Group) Pty Ltd for EG Funds Management
on 3/05/2021
Reference: N174100
Issue #: D

GTAconsultants now Stantec

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Quality Record

Issue	Date	Description	Prepared By	Checked By	Approved By	Signed
A	18/12/2020	Issued for review and coordination	Zara Abbasi Mansee Sachdeva Ashish Modessa	Brett Maynard Chris Wilson Nick Buchanan	Brett Maynard	Brett Maynard
B	22/02/2021	Updated to address peer review and TfNSW comments	Zara Abbasi Mansee Sachdeva Ashish Modessa	Brett Maynard	Brett Maynard	Brett Maynard
C	13/04/2021	Final to address client comments	Zara Abbasi Mansee Sachdeva Ashish Modessa	Brett Maynard	Brett Maynard	Brett Maynard
D	03/05/2021	Final for submission	Mansee Sachdeva Ashish Modessa	Brett Maynard	Brett Maynard	Brett Maynard

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EXECUTIVE SUMMARY

Introduction and Proposal

This integrated traffic and transport assessment has been prepared by GTA, now Stantec in response to the future renewal of land at 361-365 North Rocks Road, North Rocks (the site).

The site is currently occupied by the Royal Institute for Deaf and Blind Children (RIDBC). The site has been secured by EG and current RIDBC operations are planned to relocate to the Macquarie University precinct in North Ryde, in several years' time (onwards from 2022).

The planning proposal seeks to rezone the subject site from low density residential (R2) to part medium density residential (R3) and high density residential (R4), with a maximum floor space ratio of 1:35:1.

The planning proposal seeks to create North Rocks Village (see Figure E1), a Housing Diversity Precinct (HDP) as expressed in Council's Local Strategic Planning Statement (LSPS). It will deliver a genuine mix of housing opportunities within a garden village setting that complements existing neighbourhood character.

Key elements of the village will comprise:

- executive/ family housing including small lot housing, townhouses, terraces, large private garden and terrace style apartments, low-rise apartments as well as seniors living and affordable housing
- publicly accessible open spaces including a full-sized oval able to accommodate sporting fixtures, in addition to community gardens, walking trails, green and blue connections and public access throughout the site
- the creation of a village square with direct pedestrian connection to North Rocks Shopping Centre
- multiple community spaces to provide for the development of cultural, community and arts programs, including co-working areas, multi-purpose facilities and a Hear the Children (RIDBC) early intervention service
- improved transport connection and infrastructure including to the M2 express bus interchange along Barclay Road
- local road upgrades including signalisation of the site access with the adjacent shopping centre.

The potential dwelling yield of the conceptual master plan is approximately 935 residential dwellings comprising 690 apartments and 245 townhouses, studio terraces and detached housing. Senior housing is to comprise 25% of the overall concept including approximately 145 seniors independent living units (seniors living), and a small aged-care facility. In addition, it proposes approximately 3,400 square metres of commercial and community floorspace within a proposed community 'hub' near the oval and village square, close to North Rocks Road.

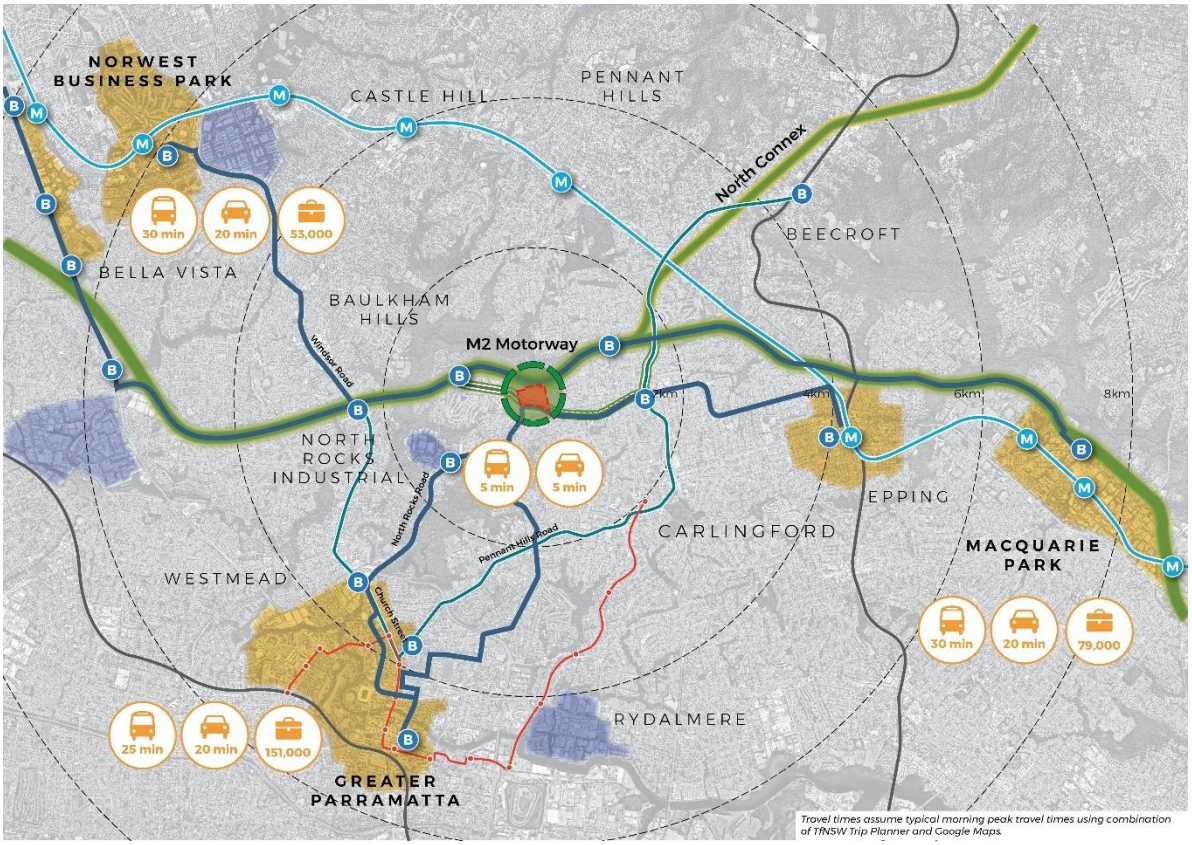
The site is located eight kilometres north of Greater Parramatta, Sydney's 'Central' or 'River' City, and 30 kilometres northwest of the Sydney CBD. It is centrally positioned between a number of strategic employment centres including Norwest/ Bella Vista and Castle Hill, Macquarie Park in addition to the Parramatta CBD and Westmead health precinct (see Figure E2).

Transport for NSW (TfNSW) was consulted during the preparation of the planning proposal and no in-principle objections were raised in regard to the site's strategic or site-specific merit. Whilst there are a number of detailed traffic and intersection design matters to be finalised, these are best addressed following a gateway determination from the Department of Planning Industry and Environment (DPIE), prior to public exhibition. This will allow EG to work closely with TfNSW to resolve these matters, along with any other issues raised through the gateway process. This approach is consistent with DPIE Guidelines for the preparation of planning proposals and with previous correspondence issued by the former Roads and Maritime Services (RMS) on 19 October 2018, which also raised no objection in-principle to a proposal proceeding, which was of a higher density and dwelling yield at the time.

Figure E1: Indicative site layout

Base source: Fender Katsalidis

Figure E2: Site location and regional transport context



Source: Mecone

Proposal Vision, Objectives and Principles

Vision

The vision for the future renewal of the site is to:

*"Create a **sustainable** urban village comprising a diversity of housing types and a range of public open spaces including a full-size oval. A focus for **social interaction** will be a new community 'hub', village green and plaza space. The concept represents a **unique place making** opportunity to create a genuine **sense of community** through inspired urban spaces and local resident amenity."*

Objectives

In order to support this vision and respond to existing local issues, four key transport objectives for the precinct have been developed:

1. Create a local street network that is designed for people first and vehicles second.
2. Prioritise active and public transport, as well as demand management measures to support sustainable travel behaviour and encourage reduced car use.
3. Discourage unnecessary car trips by providing on-site amenity (community, commercial and open space), in addition to direct walkable access to the adjacent shopping centre.
4. Establish the site as part of Sydney's connected network taking advantage of its location to Greater Parramatta/ Central River City.

Principles

Based on the vision and objectives identified, transport principles will be used to inform the development and ultimately the transport outcomes for North Rocks. These principles and how they relate to the objectives are set out in Table E1.

Existing Transport Task and Future Development Objectives

The 2016 Census Journey to Work (JTW) data generally provides the most robust picture of existing travel patterns at the local level. Analysis of 2016 JTW data shows an existing mode split of 64 per cent car driver and three per cent car passenger. The JTW also indicates low level of cyclist and pedestrian travel, likely due to manmade and natural barriers such as the M2 Motorway and steep topography of the area and long commuting distances.

Despite being located in close proximity to several trip attractors, including the North Rocks Shopping Centre, there is limited immediate accessibility to mass transit public transport options (such as heavy rail, metro and light rail) and rapid bus services, which results in longer travel times when compared to private cars. Notwithstanding, M2 express bus services are 1-1.5 kilometres west of the site, which provide high frequency bus transit services between the Hills District and Sydney CBD. There are also regular services to Parramatta CBD with stops adjacent to the site.

There is a high existing rate of car ownership in the area given the current low-density suburban nature, which results in a high reliance on private car travel to and from North Rocks. However, it is anticipated that future residents and employees of the development will be less reliant on private vehicles through higher densities and strategies proposed to be implemented to encourage the use of sustainable travel modes.

A higher proportion of new trips to/ from the development should be catered for by public transport, walking and cycling.

For general site access and future planning for a greater mode split to public transport and active travel, the private vehicle mode share is targeted to reduce from 64 per cent to 49 per cent car driver, with a slight increase to five per cent car passenger, compared to the existing JTW characteristics of North Rocks. This includes a 10 per cent shift towards bus travel, which is expected to occur considering:

- Expected residential demographics associated with the proposal compared to the lower density surrounds
- Future improvements in several public transport services/ frequencies in the region.
- Change in travel behaviour linked to the transformation of Parramatta into the Central City, with associated improvements in transport access and disincentives for car users, i.e. limited supply of all-day commuter parking in the CBD.
- The site is within a 30-minute commute to other surrounding major employment centres.
- Opportunities linked to existing and future mix of uses in the surrounding area (employment, shopping, recreation, education).
- Proposed lower car parking provisions through using the Parramatta DCP rate (1,783 spaces) as a maximum, instead of applying the Hills DCP (2,628 spaces).
- Implementation of Green Travel Plan initiatives for all future residents and employees.

Overall, with the desired transformation of Parramatta CBD into the Central City as per the District Plan outcomes, assuming the adequate provision of public transport and other sustainable transport infrastructure, travel behaviour in North Rocks is expected to evolve to reflect the current travel patterns in suburbs that are located at a similar distance from the Sydney CBD. Its commuting distance to other major employment centres (Norwest/ Bella Vista and Macquarie Park) via the M2 express bus services is another strategic advantage.

Integrated Transport Solution

Overall, there is adequate capacity within the existing bus network to cater for the expected increase in demand generated by the proposal. Several improvements/ initiatives are also proposed to improve active and public transport usage, as detailed in Table E1.

A range of opportunities are available to reduce private car usage (during road network peak periods in particular). Figure E3 summarises the integrated transport strategy intended to support the proposed North Rocks Village, having regard to the objectives and principles outlined above. It is proposed that key components of the strategy are in place from day one to ensure resident uptake of sustainable travel modes occurs immediately. Further consultation with Transport for NSW will occur as part of future development applications to understand any bus network changes proposed in the area as part of the Sydney Metro West project that may further benefit North Rocks and complement the services proposed as part of this strategy.

In addition to the lower car reliance of the residential typologies proposed, a key aspect of the strategy is the development of a Green Travel Plan, which is proven to be a successful way of changing travel behaviour throughout Australia and overseas. A Green Travel Plan is a strategy with a package of practical measures for a development or organisation to implement in order to influence and encourage sustainable travel behaviour from the residents, staff and visitors. Essentially, the plan encourages greater use of active and public transport trips and reduce the reliance on private vehicle trips. The plan would be enacted by the developer and would be maintained by the property manager(s). Bicycle parking, end-of-trip facilities, shared path infrastructure, Opal card subsidies (e.g. initial credit provided to residents upon moving into the development), car share vehicles and a shuttle bus service represent developer-led initiatives that will have a tangible benefit for future residents and staff, as well as a broader community benefit.

These improvements in public transport and active transport will allow the target mode share for the site to be achieved, appropriately reflecting and responding to the future conditions of the area with the development of Parramatta as Sydney´s Central City.

Traffic Impact

To facilitate vehicle access to/ from the site, a new signalised intersection is proposed adjacent to the eastern shopping centre access on North Rocks Road, which will significantly improve safety for traffic entering/ exiting the two sites, as well as safe pedestrian movement between the two sites while also linking bus stops on either side of North Rocks Road. The concept design for the new signalised intersection is shown in Figure E7. In conjunction with secondary entry from Baden Powell Place and exit to North Rocks Road (further east), suitable site access and circulation is available to cater for the proposed site renewal.

The traffic assessment considered 10 intersections near the site and at key arterial road interfaces, to understand the impact of the proposal. Several sources of traffic data were used to create the base scenarios, whilst future traffic growth was derived from TfNSW strategic modelling. A person-trips assessment was also completed to understand trips generated by the proposal for all modes of transport. Based on this assessment, it was determined that the site would generate 365 to 385 vehicle trips during any weekday peak hour, which represents a net increase of 235 to 305 vehicles in any peak hour when considering the traffic generated by the existing site operations.

The current proposal (subject of this assessment) is significantly less dense in terms of dwelling yield than earlier proposals discussed with the Roads and Maritime Services and Transport for NSW, prior to 2018.

In terms of traffic impacts arising from the development proposal:

- North Rocks Road generally operates satisfactorily, with some existing delays at key intersections during road network peak periods.
- Forecast background traffic growth (not associated with this proposal) may further reduce available capacity at a number of key intersections with North Rocks Road (Windsor Road/Church Street, Jenkins Road/Oakes Road and Pennant Hills Road) during road network peak periods.
- The proposed signalised intersection along North Rocks Road (opposite the shopping centre and shown in Figure E7) is expected to operate at a satisfactory level of service.
- The traffic generated by the proposal is insignificant when compared to the forecast unconstrained background traffic growth occurring at a District and Metropolitan scale.
- Development traffic disperses quickly beyond the immediate intersections, with minor additional traffic volumes on any turning movement at the arterial road intersections.
- Overall, the traffic generated by the proposal alone will not have adverse impacts on the local road network near the site, nor on the broader arterial road network.
- Key road corridor upgrade works will ultimately be required whether or not the site is redeveloped (i.e. not triggered by the redevelopment), noting there are several road and intersection improvements already in planning or delivery that this proposal (and the broader areas) will benefit from.

Notwithstanding the above, potential broader upgrade works and practical local measures are identified in this assessment to further improve the capacity and movement of traffic in the area.

While consultation has already occurred with the relevant authorities (RMS and TfNSW), further, more detailed discussions will be required to confirm and agree on site access arrangements and any other localised improvements.

The proponent would work with the authorities to identify any relevant works contributions that will benefit not only the future development of the site, but also accessibility to/ from North Rocks (whether by car or other modes). Given the low additional traffic generated by the proposal compared to existing and background traffic at key intersections such negotiations with relevant authorities would give preference to improving existing transport conditions closer to the site.

Summary

Overall, the site is in a good strategic location from a transport perspective, being adjacent to North Rocks Shopping Centre and within 30-minute commuting catchment of key employment areas such as Parramatta-Westmead, Norwest/ Bella Vista and Macquarie Park. It leverages existing schools and open space assets, provides community benefits such as a new sports oval and community facilities, as well as proposes a suite of improvements to existing transport infrastructure and services near the site to increase active and public transport trips and reduce the reliance on private vehicle trips. Finally, it provides a range of residential typologies that will bring a more diverse demographics to North Rocks. These demographics have been shown elsewhere to have lower reliance on private vehicle travel than the existing predominant low density residential dwellings.

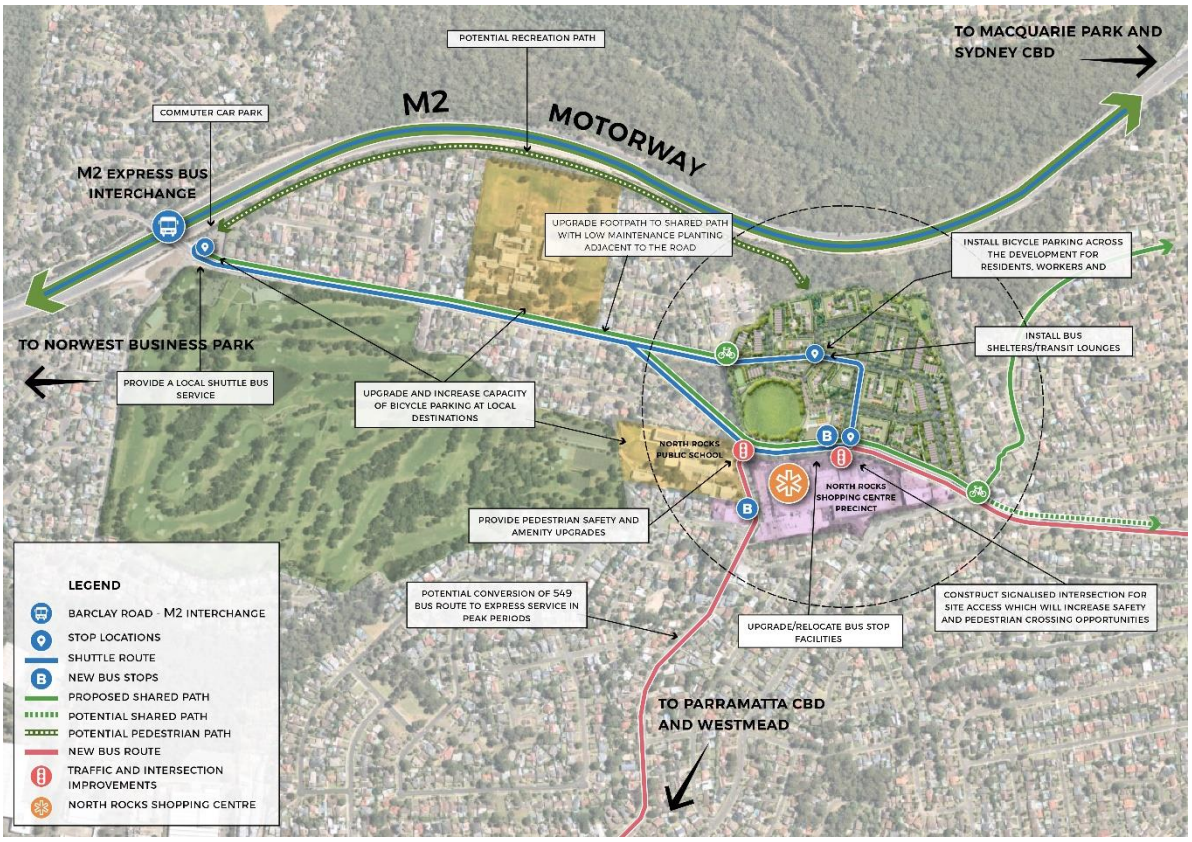
On the basis of the above, the proposal has appropriate strategic and site-specific merit from a traffic and transport perspective and can be supported.

Table E1: Integrated Transport Actions

Objectives	Principles	Issues	Proposed Integrated Transport Strategy Actions
1. Create a local street network that is designed for people first and vehicles second.	• Integrate transport and land use within the site to influence the location, timing, scale and density of development. • Implement a road planning framework within the site that recognises the movement and access requirements. • Provide improved permeability of connections by removing barriers to local movement by sustainable modes. • Facilitate appropriate provision for local delivery access within the site.	<u>Local Connectivity</u> • Lack of well-planned walking and cycling network discourages active travel • Current mid-block signalised pedestrian crossing on North Rocks Road favours through traffic over pedestrians resulting in people jaywalking.	<u>Local Connectivity</u> • Provide walking and cycling networks throughout the site. The walking and cycling networks will connect the site with the bus corridor along both North Rocks Road and potentially M2 Hills Motorway, as well as to key local destinations such as schools and North Rocks Shopping Centre through the construction of additional shared paths and missing links. • Signalise the vehicle access to the site and the eastern shopping centre car park access. This will provide additional pedestrian crossings of North Rocks Road, encouraging walking to the shopping centre whilst improving safety outcomes. Internal pedestrian footpaths will connect to the broader pedestrian network.
2. Prioritise active and public transport, as well as demand management measures to support sustainable travel behaviour and encourage reduced car use.	• Support public transport and walking and cycling to grow the proportion of travel by these modes. • Provide safe and direct access to support key desire lines and to major trip generators outside the precinct. • Leverage new and committed infrastructure to provide new services and associated transport infrastructure to maximise benefits. • Implement a policy framework that supports sustainable travel behaviour (such as parking rates, behavioural programs, travel plans). • Improve efficiency by sharing road space more effectively among all modes of road-based transport.	<u>Public Transport Facilities and Incentives</u> • Existing bus shelters and pedestrian queuing areas will not be suitable for additional bus patronage anticipated to be generated by the development. • Distance between the site and key destinations and public transport interchange may discourage residents, staff and visitors from using active and public transport. • On-demand/ loop shuttle service will require patrons to wait on-site or at the commuter car park in all weather conditions, and therefore might be discouraged to use buses if raining. <u>Walking and Cycling</u> • Current pedestrian paths near the site are not suitable for high pedestrian volumes or cyclists. • Current traffic signal phasing favours vehicles over pedestrians resulting in jaywalking.	<u>Public Transport Facilities and Incentives</u> • Improve bus stop facilities adjacent to the site (as well as nearby) and increase pedestrian queuing capacity, where practical, in consultation with TfNSW and bus operators. • Introduce shuttle bus services (see Figure E4 example) linking the North Rocks area with the M2 Busway Barclay Road interchange, in consultation with TfNSW and bus operators. • Construct new shelters/ transit lounges with help points (see Figure E5 example), live transport information and on-demand call facilities at the Barclay Street commuter car park and at two locations within the development site. • Subsidise public transport for new residents and staff through providing credit (to a specified meaningful value) on either new or existing Opal cards. This would incentivise residents and staff to try the public transport network soon after they move into the development, which would influence their mode choice in future. <u>Walking and Cycling</u> • Complete the shared path between Jennie Place (east of the site) and the Barclay Street commuter car park along the north side of Barclay Road, with a further recreational path opportunity within open space south of the M2 Motorway and provide clear pedestrian and cyclist wayfinding. • Build on existing local initiatives and provide low maintenance planting or fencing in the verge between key pedestrian footpaths and adjacent roads to eliminate the maintenance of grass strips and improve safety. Fencing, landscaping and improvements to existing median islands and kerb ramps would be considered around the North Rocks Road/ Barclay Road intersection to

Objectives	Principles	Issues	Proposed Integrated Transport Strategy Actions
			improve pedestrian safety by eliminating crossing at locations other than designated crossing facilities. • Construct additional shared path connections to local destinations in consultation with Council (including to Don Moore Reserve). • Provide clear pedestrian and cyclist wayfinding along Barclay Road and North Rocks Road. • Create a bicycle user group (targeting those living or working within five kilometres of the site) • Establish community events such as annual 'ride to work' or 'ride to school' day <u>Travel Demand Management</u> • Prepare a Green Travel Plan(s) that details specific actions upon residents, staff and visitors to achieve the targeted travel behaviour shift. Include information detailing opportunities and facilities available to all residents, such as maps of the available cycling routes to and within the site.
3. Provide a diversity of land uses to provide residents with walkable access to a variety of services and facilities and discourage unnecessary car trips.	• Integrate transport and land use within the site to influence the location, timing, scale and density of development.	<u>Bicycle Facilities</u> • Various local destinations in close proximity not easily accessible by walking and cycling. <u>Travel Demand Management</u> • Potential car ownership within the development, coupled with high car dependence in the surrounding area and traffic volumes on the road network, will lead to increased traffic congestion.	<u>Bicycle Facilities</u> • Provide high quality bicycle parking in accessible areas to cyclists that would be secure from theft. In addition, high quality change and shower facilities could be provided for retail/ commercial tenant and public use. • Upgrade and increase capacity of bicycle parking and lockers at local destinations, such as the Barclay Road commuter car park and local schools to encourage cycling for these short distance trips. <u>Travel Demand Management</u> • Provide car share services within the development to reduce reliance on use and ownership of private vehicles, particularly more than one vehicle.
4. Establish the site as part of Sydney's connected network taking advantage of its location to the Parramatta CBD/ Central River City.	• Improve the efficiency of the transport network through increasing public transport efficiency and making existing infrastructure more efficient. • Consider access to the broader region as part of the Parramatta CBD/ Central River City when proposing public transport improvements.	<u>Bus Services</u> • Limited bus services through North Rocks and long travel times given services are 'all stops' discourages existing residents of North Rocks from using buses over private vehicle.	<u>Bus Services</u> • Increase bus service frequency towards Carlingford Station (Route 630), Epping Station and Parramatta (Route 549), in consultation with TfNSW and bus operators. • Modify bus route 549 into a limited stops or express service in peak periods (i.e. 549X), with only eight stops along the entire route (see Figure E6), as well as operating at an increased frequency. This could include investigating sections of bus priority where feasible and would provide faster and more reliable travel times to both Parramatta and Epping for North Rocks residents. They would then also be able to interchange with light rail, heavy rail and Metro services. • Modify bus route 546 into a limited stops or express service in peak periods (i.e. 546X), via Statham Avenue and Bettington Road with fewer stops and more direct route between Epping and North Rocks.

Figure E3: Proposed Intergrated Transport Actions



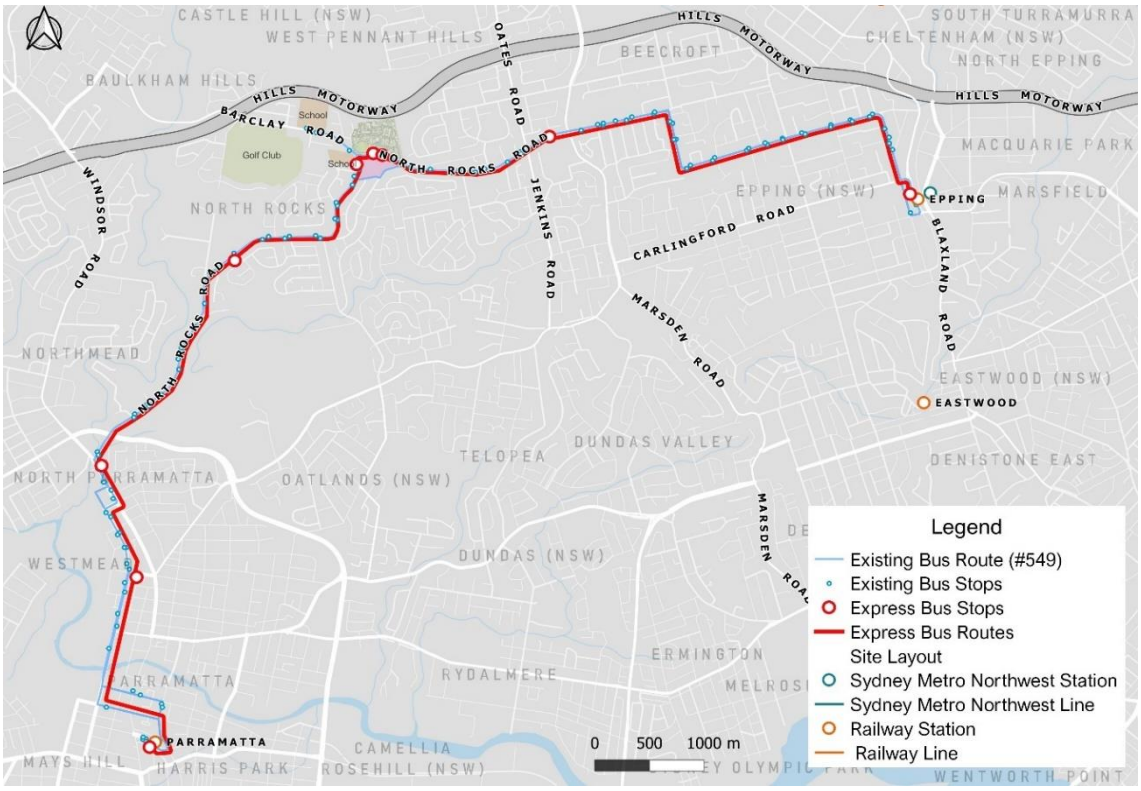
Source: Mecone

Figure E4: Shuttle Bus

Source: PAYCE Consolidated

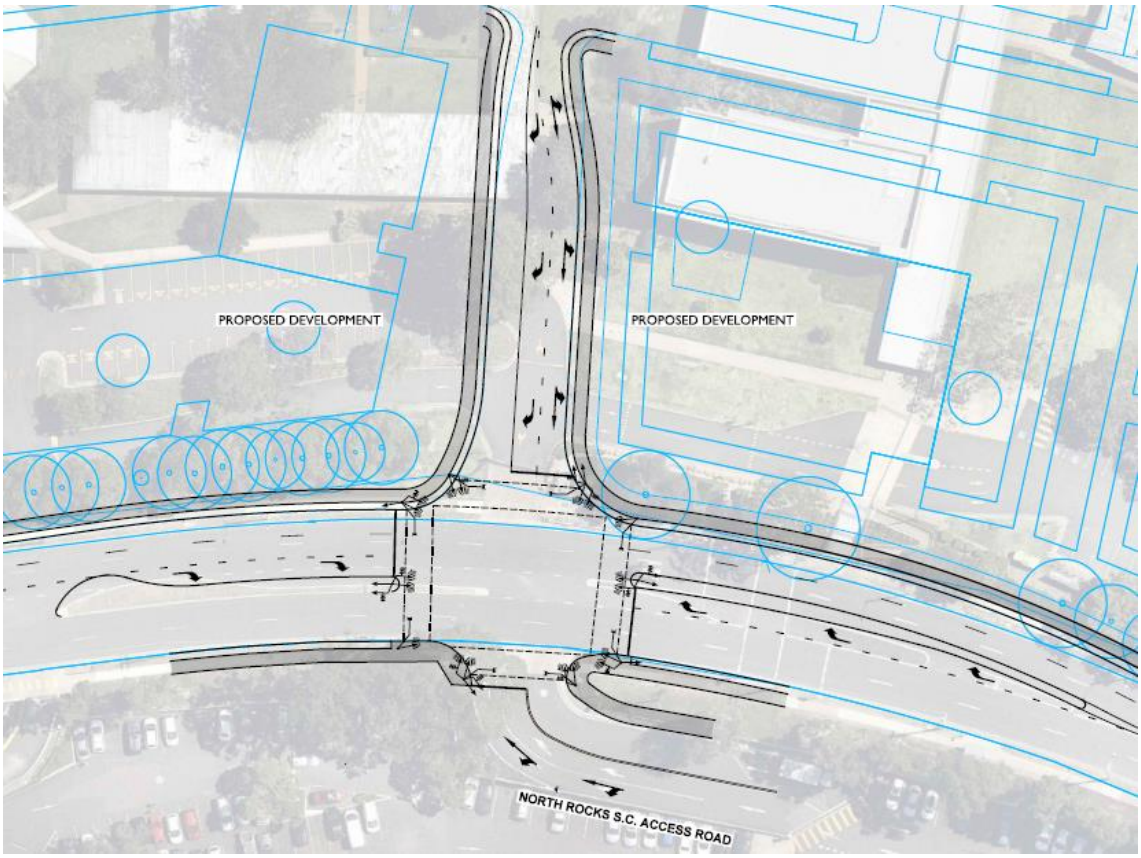
Figure E5: Transit Lounge

Figure E6: Proposed Bus Route 549 limited stops service



Base source:

Figure E7: North Rocks Road signalised access point



Base source: Nearmap (aerial photo) and Fender Katsalidis (indicative development footprint)

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1. INTRODUCTION

01

1.1. Background

EG Funds Management (EG) has prepared a planning proposal for land at 361-365 North Rocks Road, North Rocks (the site).

The site is currently occupied by the Royal Institute for Deaf and Blind Children (RIDBC). The site has been secured by EG and current RIDBC operations are planned to relocate to Macquarie University precinct in North Ryde, in several years' time (onwards from 2022).

A planning proposal has been prepared, which seeks to rezone the subject site from low density residential (R2) to part medium density residential (R3) and high density residential (R4), with a maximum floor space ratio of 1:35:1.

The planning proposal seeks to create North Rocks Village, a Housing Diversity Precinct (HDP) as expressed in Council's Local Strategic Planning Statement (LSPS). It will deliver a genuine mix of housing opportunities within a garden village setting that complements existing neighbourhood character.

A preliminary traffic and transport assessment, prepared by Jacobs, was issued to Roads and Maritime Services (now Transport for NSW – Planning and Programs) in September 2018 to inform pre-lodgement discussions for a proposal with higher density and dwelling yield. In-principle support was provided by Roads and Maritime and TfNSW on 19 October 2018, subject to further detail relating to the following:

- Completion of a comprehensive assessment of the planning proposal impacts
- Justification of trip generation and distribution on the road network
- Assessment of ultimate development plus ten years background growth
- Identification of transport infrastructure upgrades required to mitigate the planning proposal impacts.

EG engaged GTA Consultants (GTA) to prepare a detailed transport assessment addressing the feedback received, in conjunction with the Jacobs strategic transport analysis. During the development of the planning proposal, the project team met with City of Parramatta Council and Transport for NSW (TfNSW) on several occasions to present general findings and recommendations; with feedback provided used to further inform the finalisation of this detailed transport assessment.

Transport for NSW (TfNSW) was consulted during the preparation of the planning proposal and no in-principle objections were raised in regard to the site's strategic or site-specific merit. Whilst there are a number of detailed traffic and intersection design matters to be finalised, these are best addressed following a gateway determination from the Department of Planning Industry and Environment (DPIE), prior to public exhibition. This will allow EG to work closely with TfNSW to resolve these matters, along with any other issues raised through the gateway process. This approach is consistent with DPIE Guidelines for the preparation of planning proposals and with previous correspondence issued by the former Roads and Maritime Services (RMS) in 2018.

1.2. Purpose of this Report

This report sets out an assessment of the anticipated transport implications of the planning proposal, including consideration of the following:

- Strategic planning context
- Existing transport and traffic conditions surrounding the site
- Pedestrian and bicycle considerations and requirements
- Public transport considerations and requirements

- Proposed integrated transport strategy
- Suitability of the proposed access arrangements for the site
- Future transport conditions without the proposal
- Additional trips generated by the proposal
- Traffic impact of the planning proposal on the adjacent and wider road network
- Parking requirements.

1.3. References

In preparing this report, reference has been made to the following:

- inspections of the site and its surrounds
- *A Metropolis of Three Cities -The Greater Sydney Region Plan,* Greater Sydney Commission 2018
- The *Central City District Plan*, Greater Sydney Commotion 2018
- *Future Transport Strategy 2056*, Transport for NSW, 2018
- The Hills Development Control Plan (DCP) 2012
- The Hills Local Environment Plan (LEP) 2012
- Parramatta DCP 2011
- *Planning Guidelines for Walking and Cycling*, NSW Government, November 2014
- *Guide to Traffic Generating Developments*, Transport for NSW, 2002
- *Guide to Traffic Generating Developments – Updated Traffic Surveys*, TDT 2013/04, Transport for NSW, May 2013Other documents and data as referenced in this report
- traffic surveys undertaken by Matrix on 1 December 2016 and 21 May 2019
- SCATs data obtained from Transport for NSW.

2. PLANNING CONTEXT

02

2.1. Key Strategic Documents

This section provides an overview of the strategic context of the site and wider area by reviewing key strategic documents that will influence residential and employment growth and infrastructure spending in North Rocks and the broader Sydney metropolitan area.

2.1.1. A Metropolis of Three Cities -The Greater Sydney Region Plan

A Metropolis of Three Cities -The Greater Sydney Region Plan is a NSW Government report that establishes a 40-year strategic land use plan for Sydney. The plan was developed concurrently with *Future Transport Strategy 2056*, which aims to deliver better connectivity and accessibility for the residents of Greater Sydney. The land use vision for Greater Sydney is a metropolis of three cities:

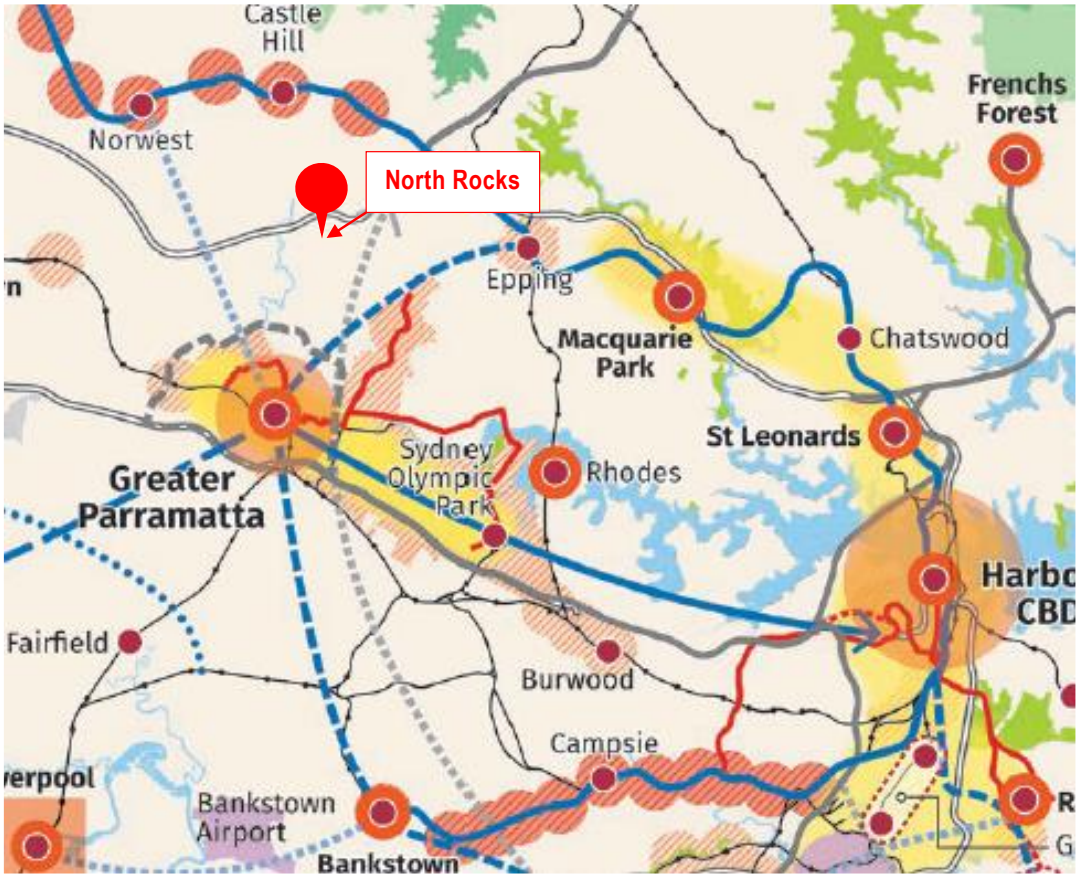
- the Eastern Harbour City (Sydney CBD)
- the Central River City (Greater Parramatta)
- the Western Parkland City (around the new Western Sydney Airport).

Consistent with Future Transport, one of the key elements of the plan is the vision of a 30-minute city which aims to provide transport infrastructure and services that enable people to reach their nearest metropolitan or Strategic Centre within 30 minutes, seven days a week.

The site is within the Central City District and the Central River City (Greater Parramatta). The *Metropolis of Three Cities* introduces housing targets of 207,500 for the Central City District (which includes the site) between 2016 to 2036.

As shown in Figure 2.1, the site is centrally positioned between several locations within Sydney that have been identified as 'Strategic Centres', which are classified as future hubs for employment. These include Norwest/ Bella Vista Macquarie Park, Parramatta CBD in addition to Castle Hill and Epping. In the future, North Rocks will have the potential to act as a connective hub between Strategic Centres.

Figure 2.1: Three Cities Context



Basemap source: A Metropolis of Three Cities (Greater Sydney Commission (2018).

2.1.2. Central City District Plan

The *Central City District Plan* is a 20-year plan to manage growth in the context of economic, social and environmental matters to achieve the 40-year vision of Greater Sydney. It is a guide for implementing the Greater Sydney Region Plan, *A Metropolis of Three Cities*, at a district level and is a bridge between regional and local planning.

This will be achieved by:

- Developing the economy with jobs and skills growth from unprecedented city-scale infrastructure investments.
- Supporting cohesive and socially dynamic communities with new social infrastructure like schools and community services, new cultural and sporting facilities.
- Establishing transport connections north, south, east and west from Parramatta to optimise Greater Parramatta's location in the centre of Greater Sydney.
- Transforming the Westmead health and education precinct to an innovation district with greater diversity of knowledge-intensive jobs.
- Retaining industrial and urban services land and creating new skills with a 21st Century clean-tech and advanced manufacturing cluster around precincts such as Camellia, Rydalmere, Silverwater and Auburn.
- Linking parks, bushland, playgrounds and waterways through the Greater Sydney Green Grid with enhanced opportunities for safe walking and cycling paths.

North Rocks is identified as a 'Local Centre' in the District Plan. Local centres are identified as future renewal opportunities with improved transport connections. This subject site occupies a significant part of what could be described as the core of the local centre.

2.1.3. Future Transport 2056 Strategy

The *Future Transport Strategy 2056* (Future Transport) is a 40-year strategy for Sydney and regional NSW prepared by TfNSW. The plan includes several initiatives relevant to the site including:

- 0-10 year committed projects:
  - WestConnex
  - NorthConnex
  - priority cycleway links in the Central River City
  - Sydney Metro West
  - Parramatta Light Rail stage 1 and 2.
- 0-10 year investigation:
  - improved bus services between Parramatta and centres to the north and south of Parramatta
  - Parramatta inner ring road (improvements to existing surface roads)
  - T-Way to T-Way link
  - safe cycleway network within 10 kilometres of Parramatta
  - Parramatta to Epping mass transit/ train link.
- 20+ years visionary:
  - Central City strategic road corridor (NorthConnex to Southern Sydney).

2.1.4. State Infrastructure Strategy 2018

The *State Infrastructure Strategy* by Infrastructure NSW sets out the NSW Government's priorities for the next 20 years. Combined with the *Future Transport* and the *Metropolis of Three Cities*, it brings together infrastructure investment and land-use planning for the cities and regions. The most relevant element of the strategy is to:

- Link integrated strategic land use and infrastructure planning:
  - Prepare a place-based strategic business case for the pilot growth infrastructure compact in the Greater Parramatta to the Olympic Peninsula area by mid-2018.
  - Subject to the outcomes of the pilot growth infrastructure compact, prepare place-based strategic business cases for future updates to District Plans and Regional Plans.
  - NSW Government agencies to integrate Growth Areas, Planned Precincts and growth infrastructure compacts (subject to the outcomes of the pilot growth infrastructure compact) into asset management plans and capital infrastructure plans from 2019-20.

2.2. Proposal Vision, Objectives and Principles

This section defines the vision, objectives and principles for the redevelopment of the site and the links to the planning framework of the key strategic documents reviewed in the preceding sections to demonstrate consistency with the overarching state and local government strategic planning documents.

2.2.1. Vision for the site

The vision for the future renewal of the site is to:

*"Create a **sustainable** urban village comprising a diversity of housing types and a range of public open spaces including a full-size oval. A focus for **social interaction** will be a new community 'hub'; village green and plaza space. The concept represents a **unique place making** opportunity to create a genuine **sense of community** through inspired urban spaces and local resident amenity."*

2.2.2. Objectives

In order to support this vision and respond to the issues outlined in Chapter 3, four key transport objectives for the precinct have been developed:

1. Create a local street network that is designed for people first and vehicles second.
2. Prioritise active and public transport, as well as demand management measures to support sustainable travel behaviour and encourage reduced car use.
3. Discourage unnecessary car trips by providing on-site amenity (community, commercial and open space) in addition to direct walkable access to the adjacent shopping centre.
4. Establish the site as part of Sydney's connected network taking advantage of its location to the Parramatta CBD/ Central River City.

2.2.3. Principles

Based on the vision and objectives identified, the following transport principles will be used to inform option development and ultimately the transport outcomes for North Rocks. These principles and how they relate to the objectives are set out in Table 2.1.

Table 2.1: Transport planning objectives and principles

Objectives	Principles
1. Create a local street network that is designed for people first and vehicles second.	• Integrate transport and land use within the site to influence the location, timing, scale and density of development. • Implement a road planning framework within the site that recognises the movement and access requirements. • Provide improved permeability of connections by removing barriers to local movement by sustainable modes. • Facilitate appropriate provision for local delivery access within the site.
2. Prioritise active and public transport, as well as demand management measures to support sustainable travel behaviour and encourage reduced car use.	• Support public transport and walking and cycling to grow the proportion of travel by these modes. • Provide safe and direct access to support key desire lines and to major trip generators outside the precinct. • Leverage off new and committed infrastructure to provide new services and infrastructure to maximise benefits. • Implement a policy framework that supports sustainable travel behaviour (such as parking rates, behavioural programs, travel plans). • Improve efficiency by sharing road space more effectively among all modes of road-based transport.

Objectives	Principles
3. Provide a diversity of land uses to provide residents with walkable access to a variety of services and facilities and discourage unnecessary car trips.	• Integrate transport and land use within the site to influence the location, timing, scale and density of development.
4. Establish the site as part of Sydney's connected network taking advantage of its location to the Parramatta CBD/ Central River City.	• Improve the efficiency of the transport network through increasing public transport efficiency and making existing infrastructure more efficient. • Consider access to the broader region as part of the Parramatta CBD/ Central River City when proposing public transport improvements.

Overall, the proposed renewal of the site is consistent with the applicable strategic policy framework, including providing a diversity of housing types within 30 minutes to the Central River City (i.e. Parramatta and Westmead) and a number of other nearby major employment centres such as Norwest/ Bella Vista, Macquarie Park, and Epping in addition to the North Rocks Industrial Precinct. The site is also within 1-1.5 kilometres of express bus routes along M2 Motorway. Therefore, it aligns with the goals of Future Transport 2050 and A Metropolis of Three Cities.

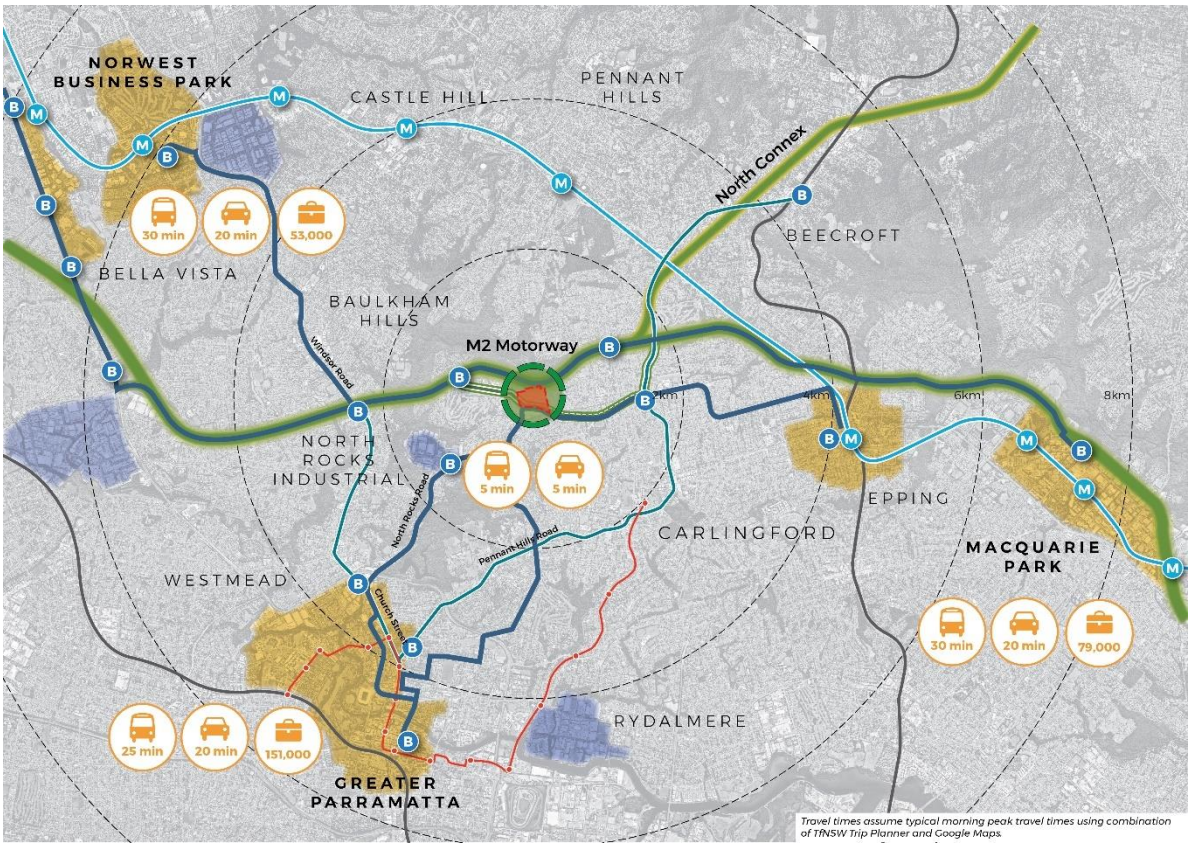
3. EXISTING TRANSPORT CONTEXT

03

3.1. Site Context

The site was historically located within The Hills Shire local government area, however, became part of the City of Parramatta local government area as a result of the 2016 boundary changes. The site is located eight kilometres north of the Parramatta CBD, Sydney's 'Central' or 'River' City, and 30 kilometres northwest of the Sydney CBD. It is also centrally positioned between several locations within Sydney that have been identified as 'Strategic centres' and that will provide future hubs for employment. These include Norwest/ Bella Vista, Macquarie Park, Castle Hill and Epping. The site location in a regional context is shown in Figure 3.1 and indicates that public transport services to site are limited to bus services, including the express bus routes along M2 Motorway. The site and its surrounding local context are shown in Figure 3.2.

Figure 3.1: Site location and regional transport context



Source: Mecone

The site is located at 361-365 North Rocks Road, North Rocks, north of North Rocks Road and south of the M2 Motorway. It is legally known as Lot 3001 DP 1115866 and is approximately 12.6 hectares in area, with a frontage of approximately 460 metres to North Rocks Road. The existing site was purpose-built for the RIDBC and contains a series of roads, parking, buildings and structures of various ages, with more than 400 staff and almost 2,000 volunteers.

The site contains existing playing spaces, a small oval and tennis courts, which are not available to the general public. Vegetation and perimeter trees are located along the western and northern boundaries.

A mix of low density residential, educational and public recreation land uses dominate the local area and as such, North Rocks is strategically positioned to act as a residential hub servicing the key employment and education precincts within the Central City District. North Rocks Public School is located opposite the site; whilst Muirfield High School is located 500 metres west of the site and Murray Farm Public School is 800

metres east of the site. In addition, North Rocks Shopping Centre is located immediately to the south of the site, with access via North Rocks Road.

The surrounding land use is further illustrated in Figure 3.2.

Figure 3.2: Site location and surrounding land use

Basemap source: Nearmap

3.2. Road Network

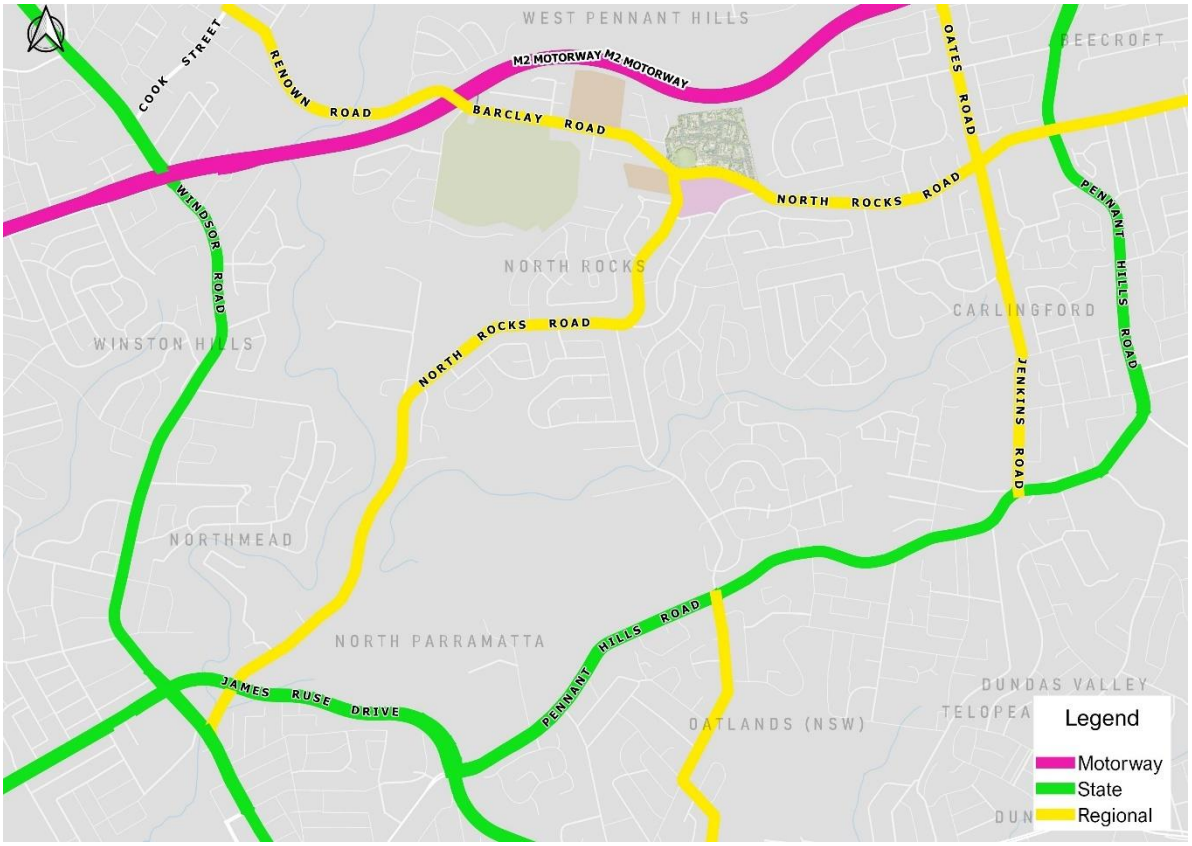
3.2.1. Adjoining Roads

State and regional roads border North Rocks, each carrying significant traffic volumes, particularly during the peak periods. These roads include the M2 Hills Motorway, Pennant Hills Road and Church Street/ Windsor Road. Together they provide access to key Sydney locations including Parramatta to the south, Norwest/ Bella Vista to the north and Macquarie Park and Sydney CBD to the east.

The site is accessible by several key arterial roads that provide road connectivity in all directions. As is a general issue across the Sydney metropolitan road network, the surrounding arterial road network experiences some delays and queuing at certain times of the day that should not impact the ability for growth of a local centre.

The key adjoining roads are shown in Figure 3.3 and described in the following subsections.

Figure 3.3: Surrounding Road Network



M2 Hills Motorway

The M2 Hills Motorway is a privately-operated toll road connecting the Lane Cove Tunnel with the Westlink M7 Motorway. It is a key link in the Sydney Orbital Network and provides users with direct access to the Sydney CBD and north-western suburbs. The recently completed NorthConnex link also allows convenient access between the M1 and M2 Motorways, bypassing 21 sets of traffic signals along Pennant Hills Road.

The motorway generally runs in an east-west direction and varies between two and three through lanes. A dedicated bus lane exists between the Beecroft road overpass and the M2 Busway Barclay Road interchange, carrying frequent express bus services to and from the Sydney CBD.

Pennant Hills Road (Cumberland Highway)

Pennant Hills Road is classified as a State Road and near the North Rocks area, it is aligned in a north-south direction and has two lanes in each direction. Pennant Hills Road connects Parramatta with Wahroonga and continues to form the M1 Motorway leading north towards the Central Coast and Newcastle. The NorthConnex link has also improved traffic conditions along Pennant Hills Road between the M1 and M2 Motorways, and is subsequently discussed further in this chapter.

Church Street/ Windsor Road

The Church Street/ Windsor Road corridor is classified as a State Road and is aligned in a north-south direction with at least two lanes in each direction. The corridor is Windsor Road north of North Rocks Road and links the Northwest Growth Centre. South of North Rocks Road, the corridor becomes Church Street and links to Parramatta CBD.

North Rocks Road

North Rocks Road is classified as a Regional Road. It is a two-way road with a speed limit of 60 kilometres per hour. Between Pennant Hills Road and Barclay Road, it is aligned in an east-west direction and configured with two travel lanes, with no kerbside parking permitted. Towards Church Street it is generally aligned in the north-south direction and configured with one travel lane and one kerbside parking lane in each direction.

Barclay Road

Barclay Road is classified as a Regional Road and is aligned in an east-west direction connecting the site with the M2 Hills Motorway overpass and M2 Busway Barclay Road interchange. It is a two-way road configured with two travel lanes in each direction and has a speed limit of 60 kilometres per hour. Kerbside parking is not permitted along Barclay Road.

New North Rocks Road

New North Rocks Road is a collector road running in a north-south direction, parallel to North Rocks Road. On either end it connects with North Rocks Road and provides access to North Rocks Shopping Centre. New North Rocks Road has a speed limit of 50 kilometres per hour, with one travel lane and one kerbside parking lane in each direction.

Oakes Road/ Jenkins Road

Oakes Road and Jenkins Road are classified as Regional Roads. Oakes Road begins in West Pennant Hills and runs through to North Rocks Road where it turns into Jenkins Road, linking with Pennant Hills Road in Carlingford. Both roads are two-way with a speed limit of 50 kilometres per hour. Both roads are configured with two travel lanes approaching to North Rocks Road and one travel lane with one kerbside parking lane in the remaining sections. It is noted that these roads act as a 'rat-run' for traffic avoiding congestion on Pennant Hills Road during the peak periods between the suburbs of West Pennant Hills and Telopea.

Summary

Overall, the site has a reasonable level of connectivity to nearby Strategic Centres. The site has access to the M2 Motorway which facilitates direct journeys to Macquarie Park and on to the Sydney CBD, as well as Norwest/ Bella Vista, Castle Hill and Rouse Hill to the northwest. Pennant Hills Road/ Cumberland Highway also carries vehicle traffic to either Parramatta or to the Northern Suburbs, the latter benefited by the recently completed NorthConnex.

3.2.2. Surrounding Intersections

The following intersections are located in the immediate vicinity of the site:

- North Rocks Road/ Barclay Road (signalised)
- North Rocks Road/ New North Rocks Road (signalised)
- Barclay Road/ Baden Powell Place (priority-controlled)
- Barclay Road/ Tiernan Ave (priority-controlled).

The following intersections in the broader road network provide access to North Rocks from the surrounding arterial road network (i.e. Pennant Hills Road and Church Street):

- North Rocks Road/ Oakes Road/ Jenkins Road (signalised)
- North Rocks Road/ Pennant Hills Road (signalised)
- North Rocks Road/ Church Street/ Windsor Road (signalised).

3.2.3. Site observations

Several site visits have been completed since 2016. Key site observations are summarised below and are typically in-line with the pre-COVID traffic conditions in the area:

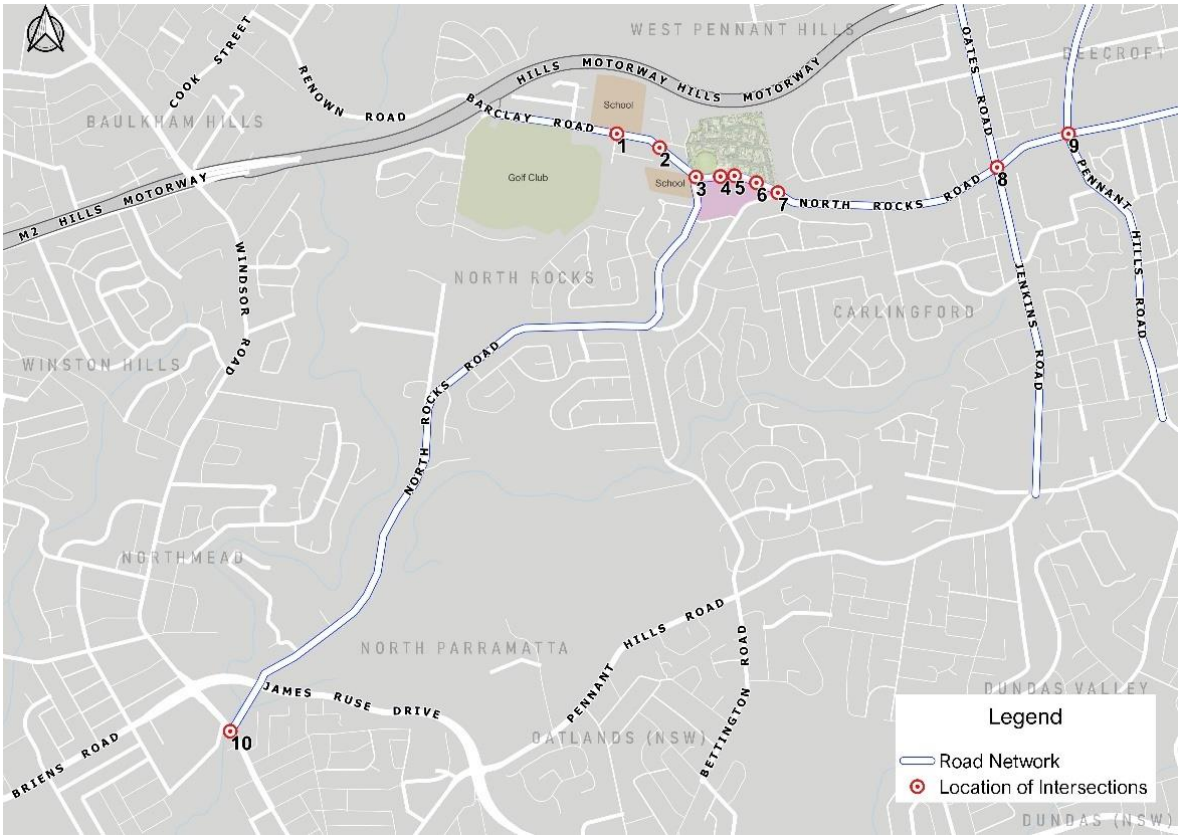
- The posted speed limit on the surrounding roads varies between 50 kilometres per hour and 60 kilometres per hour.
- There are two existing site access locations along its frontage to North Rocks Road and one site access via Duncan Place.
- On-street parking is not permitted on North Rocks Road or Barclay Road near the site.
- Unrestricted on-street parking is permitted in surrounding local roads that are generally occupied by low density residential development.
- Site observations in the area confirm the following key intersections experience delays during the weekday AM and PM peak periods:
    - North Rocks Road/ Barclay Road
    - North Rocks Road/ Oakes Road/ Jenkins Road
    - North Rocks Road/ Pennant Hills Road
    - North Rocks Road/ Church Street (and Windsor Road/ Church Street corridor generally).
- The Barclay Street commuter car park, located near the M2 Busway Barclay Road interchange, is generally at capacity at 7am and at 80 per cent capacity at 6:00pm.

3.3. Traffic Volumes

For the purposes of quantifying capacity, GTA commissioned vehicle turning movement counts on Tuesday 1 December 2016 at the following intersections as represented in Figure 3.4:

1. Barclay Road/ Tiernan Avenue
2. Barclay Road/ Baden Powell Place
3. North Rocks Road/ Barclay Road
4. North Rocks Road/ North Rocks Shopping Centre access 1
5. North Rocks Road/ site access 1/ North Rocks Shopping Centre access 2
6. North Rocks Road/ site access 2/ North Rocks Shopping Centre access 3
7. North Rocks Road/ New North Rocks Road
8. North Rocks Road/ Oakes Road/ Jenkins Road.

Figure 3.4: Locations of intersection surveys



These surveys were conducted during typical weekday AM and PM road network peak periods. Peak hours were identified as the following:

- AM peak: 7:45 to 8:45 am
- PM peak: 4:15 to 5:15 pm.

The average peak hour traffic volume on North Rocks Road along the site frontage was surveyed to be approximately 1,700 vehicles for both directions combined. Peak hour flows are such that the morning peak has higher traffic volumes and flows in the eastbound direction whereas the westbound traffic flow is greater in the evening peak. Additionally, Barclay Road carries higher traffic volumes than North Rocks Road, south of the Barclay Road/ North Rocks Road intersection. However, all three legs of the intersection carry high traffic volumes, with key turning movements to and from the south.

The existing (2016) surveyed traffic entering and exiting the site is as follows:

- AM peak hour: 146 vehicles (119 in and 27 out)
- PM peak hour: 60 vehicles (10 in and 50 out).

In terms of North Rocks shopping centre traffic activity, the 2016 survey data indicates that:

- The shopping centre generates more traffic in the PM peak as compared to the AM peak.
- Approximately 70 per cent of the traffic exiting the shopping centre turns left from the access points at North Rocks Road.
- Shopping centre traffic wanting to travel eastbound generally uses the access via New North Rocks Road, turning right at the North Rocks Road/ New North Rocks Road intersection.

In response to TfNSW Planning and Program feedback[1] on the preliminary traffic and transport assessment, additional vehicle turning movement counts were commissioned on Tuesday 21 May 2019 for the intersection of Pennant Hills Road/ North Rocks Road, whilst traffic volumes for the Church Street/ North Rocks Road intersection were obtained from Jacobs' modelling of the intersection for the preliminary traffic and transport assessment. GTA also obtained both December 2016 and December 2018 data from TfNSW and conducted high level comparisons to ensure the original data is still relevant for the study area. The data was deemed to be within the five per cent margin of natural fluctuation and error. Detailed comparison and assessment of the data is summarised in Section 7.2.2.

TfNSW Planning and Program also requested that existing conditions traffic analysis be completed for the Thursday and Saturday retail peak periods to consider North Rocks Shopping Centre. With the recent upgrades completed (2019) at North Rocks Shopping Centre, project team discussions with the centre owner (Challenger Group) suggests there are no short to medium term plans to redevelop the site. As such, given the predominantly residential nature of the planning proposal and the shopping centre expected to operate in a business-as-usual manner, additional traffic data was not collected for Thursday and Saturday retail peaks; with this assessment focusing on the development impacts during the typical weekday commuter peak periods.

3.4. Public Transport

3.4.1. Bus Network

Local Services

Buses are the predominant form of public transport in and around North Rocks. Several bus services operate along North Rocks Road, linking the area to Epping, Macquarie Park, Parramatta and Blacktown, as summarised in Table 3.1 and shown in Figure 3.5 and Figure 3.6.

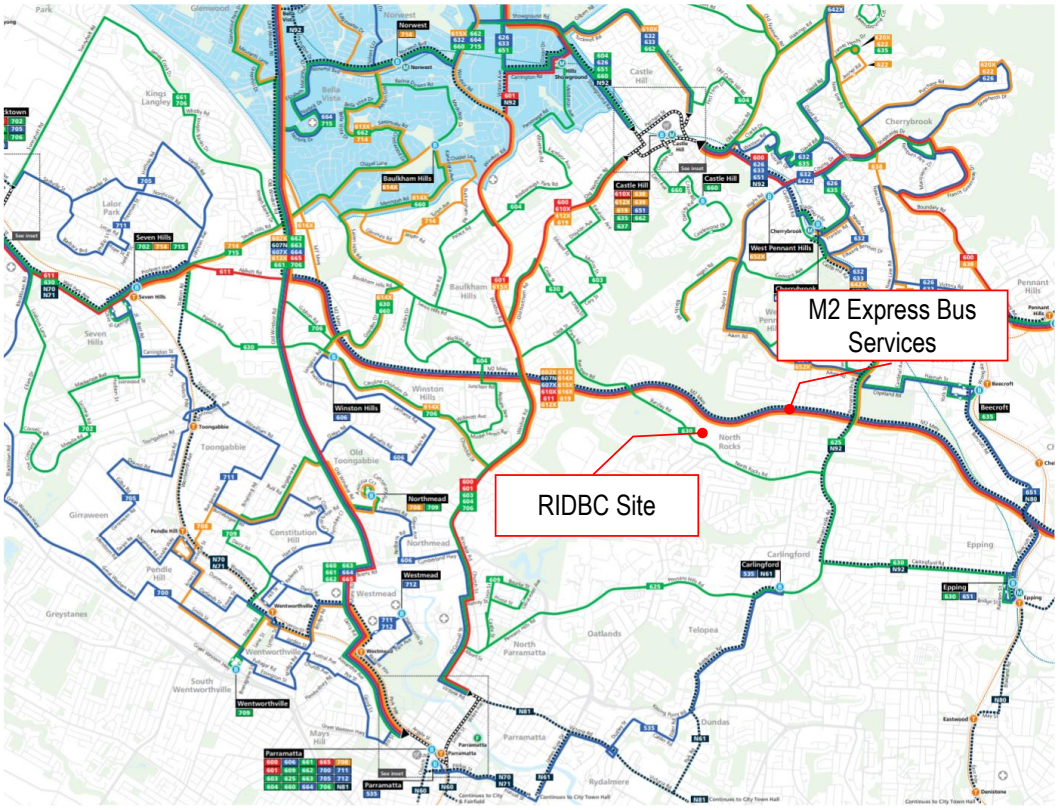
Table 3.1: Bus Routes at North Rocks

Route numbers	Route description	Distance to nearest Stop (m)	Frequency peak/ off peak
546	Parramatta to North Rocks/ Epping Station	Immediate site frontage	30 minutes/ 60 minutes
549	Parramatta to Epping via North Rocks		30 minutes/ 60 minutes
553	North Rocks to Beecroft		PM only 2 services North Rocks to Beecroft AM only 1 service Beecroft to North Rocks
625	Parramatta to Pennant Hills		AM only 1 service Pennant Hills to Parramatta PM only 1 service Parramatta to Pennant Hills
630	Blacktown to Macquarie via Baulkham Hills and Carlingford		60 minutes

Overall, there is opportunity to improve the bus network through North Rocks itself, in order to provide fast, frequent and reliable trips to the Parramatta CBD.

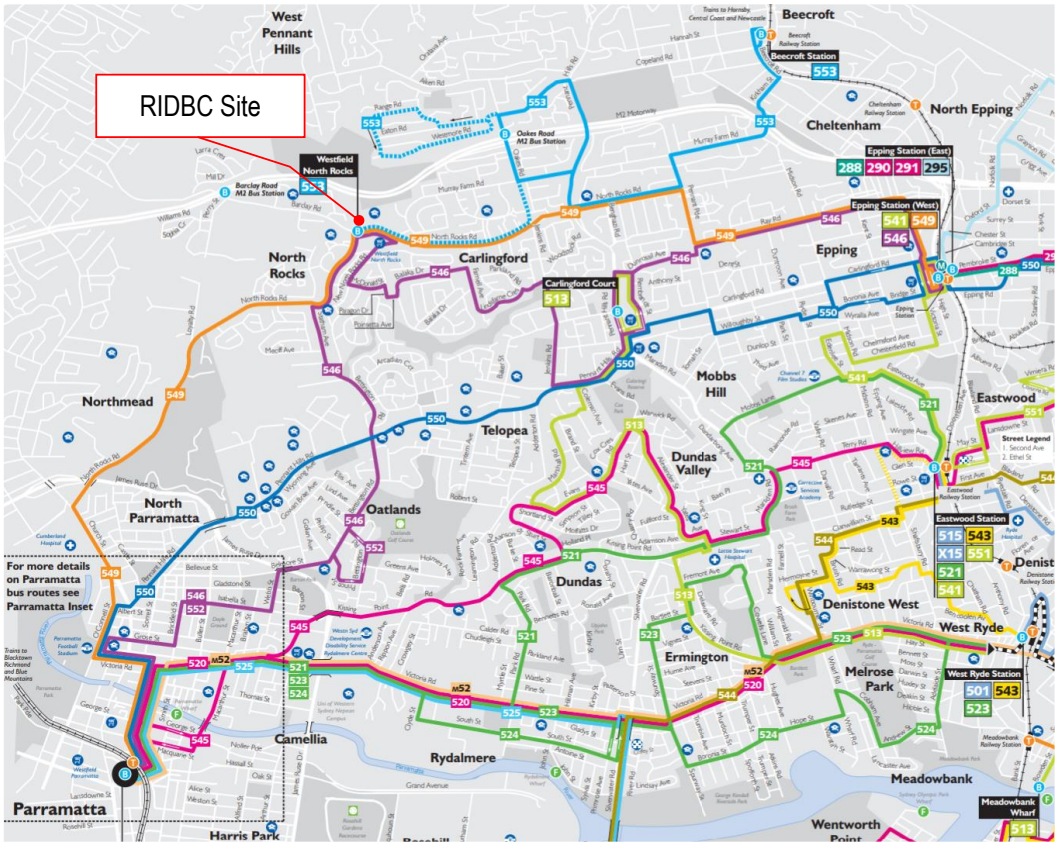
[1] TfNSW Planning and Program, 'Preliminary Planning Proposal: 361-365 North Rocks Road, North Rocks' dated 19 October 2018 (ref. SYD16/01163/03)

Figure 3.5: HillsBus network map near North Rocks



Source: https://www.cdcbus.com.au/images/files/maps/hillsbus/Region_4_Network_Map.pdf accessed December 2020

Figure 3.6: State Transit bus network map near North Rocks



Source: https://transportnsw.info/document/4247/state_transit_north_shore_and_west_network_map.pdf accessed December 2020

M2 Express Bus Services

The Barclay Road M2 Bus station is located between 1 and 1.5 kilometres west of the site and is serviced by Hillsbus express services. While this bus station is a 10-20 minute walking distance (depending on walking pace), it can also be accessed by bicycle (5-6 minutes), car (two minutes) or the Route 630 bus service (three minutes). A commuter car park is provided on Barclay Road with capacity for approximately 100 cars. TfNSW is currently in the planning process to construct a new commuter park by mid-2022 for approximately 135 vehicles on a currently vacant site on the corner of Barclay Road and Perry Street[2] (immediately south of the existing commuter car park).

Key M2 bus routes include up to nine express bus services from North Rocks through North Sydney into the Sydney CBD. In addition, westbound bus routes provide interchange opportunities at surrounding stops (Windsor Road) to connect with other strategic centres such as Parramatta, Westmead, Norwest/ Bella Vista, Castle Hill and Rouse Hill.

To facilitate the movement of buses during peak hour on the M2 Hills Motorway, a dedicated bus lane exists between the Beecroft Road overpass and the M2 Busway Barclay Road interchange. Facilities include a pedestrian ramp to provide accessibility for all users, a large waiting bay protected from general traffic, and multiple bus shelters.

[2] https://www.transport.nsw.gov.au/projects/current-projects/north-rocks-commuter-car-park accessed December 2020

3.4.2. Train Network

Carlingford Station is located 3.5 kilometres southeast of the site and was the start of the T6 train line that terminates at Clyde. It has now been decommissioned to make way for construction of the Parramatta Light Rail that replaces the T6 train line north of Camellia. Bus Route 535 has been introduced to temporarily replace the previous heavy rail service and provide services between Carlingford and Parramatta. Details of the light rail are discussed in Section 4.2.

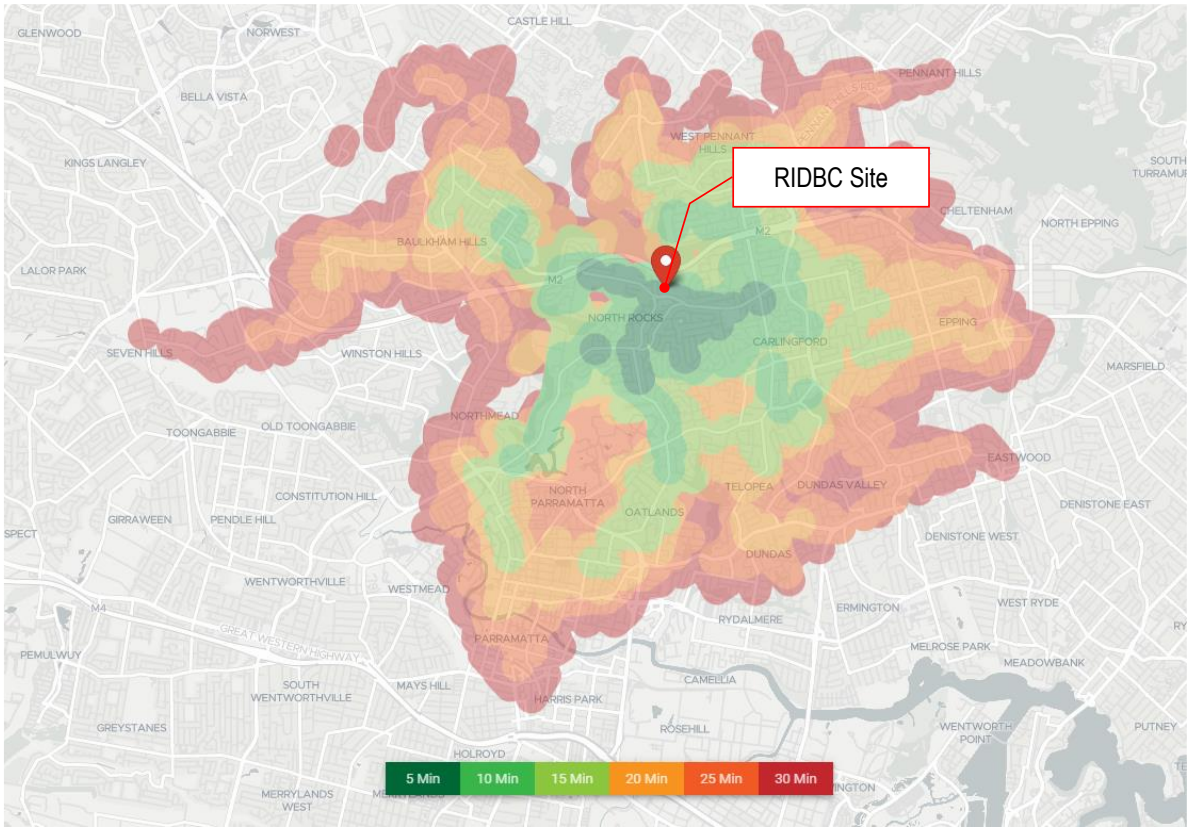
3.4.3. Public Transport Travel Time

The location of the site, in the context of the 30-minute city concept using public transport (door-to-door), is shown in Figure 3.7 and Figure 3.8.

Figure 3.7 shows that Epping and Parramatta are accessible by public transport within 30 minutes. Notwithstanding, a review of TfNSW Trip Planner suggests that Norwest/ Bella Vista and Macquarie Park are also within 30 minutes of the site (based on departure around 7:30am-8:00am), noting that the software used to generate public transport travel time plots applies additional travel time for interchange between modes and the like, which can be avoided if commuters make use of trip planning tools. Any improvements between the site and the M2 interchange (i.e. increased bus frequencies, shuttle services and additional commuter car/ bicycle parking) will further assist the door-to-door travel time and reinforce the accessibility of these centres.

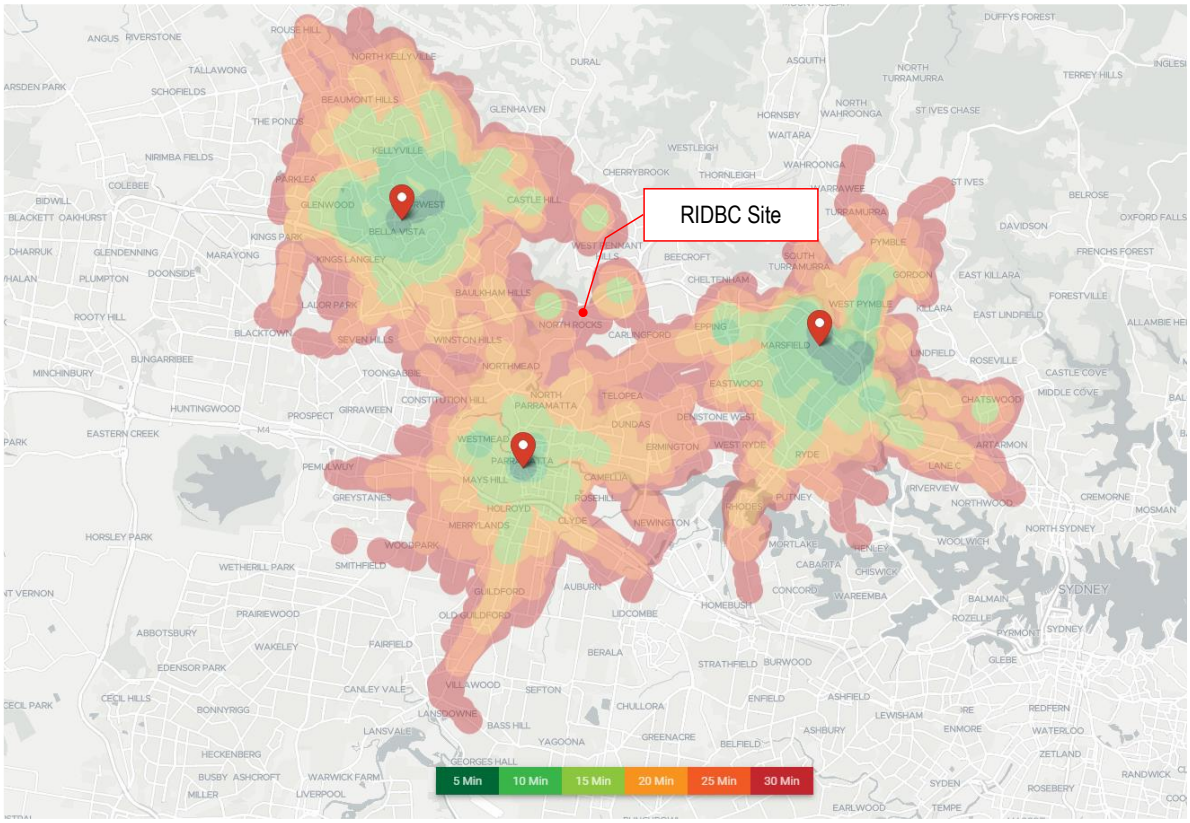
Conversely, Figure 3.8 shows 30-minute access (door-to-door) from the key centres of Parramatta (Central River City), Norwest/ Bella Vista and Macquarie Park. This shows the North Rocks site, within the broader regional context, is accessible from the major centres by public transport in close to 30 minutes, which is aligned with the vision for Greater Sydney of providing transport infrastructure and services that enable people to reach their nearest metropolitan or Strategic Centre within 30 minutes. This makes the site a prime location to provide additional housing, along with a variety of housing typologies to suit a range of demographics, in relatively close proximity to employment areas and other trip attractors. In addition, improved public transport services and infrastructure initiatives around the site are also proposed to ensure people can move efficiently to and from both the Central River City and more broadly across Sydney, which is detailed further in this report.

Figure 3.7: Travel time by public transport from the site (door-to-door)



Source: https://app.targomo.com, Interpeak, accessed March 2021

Figure 3.8: 30 Minute access from Key Centres by public transport (door-to-door)

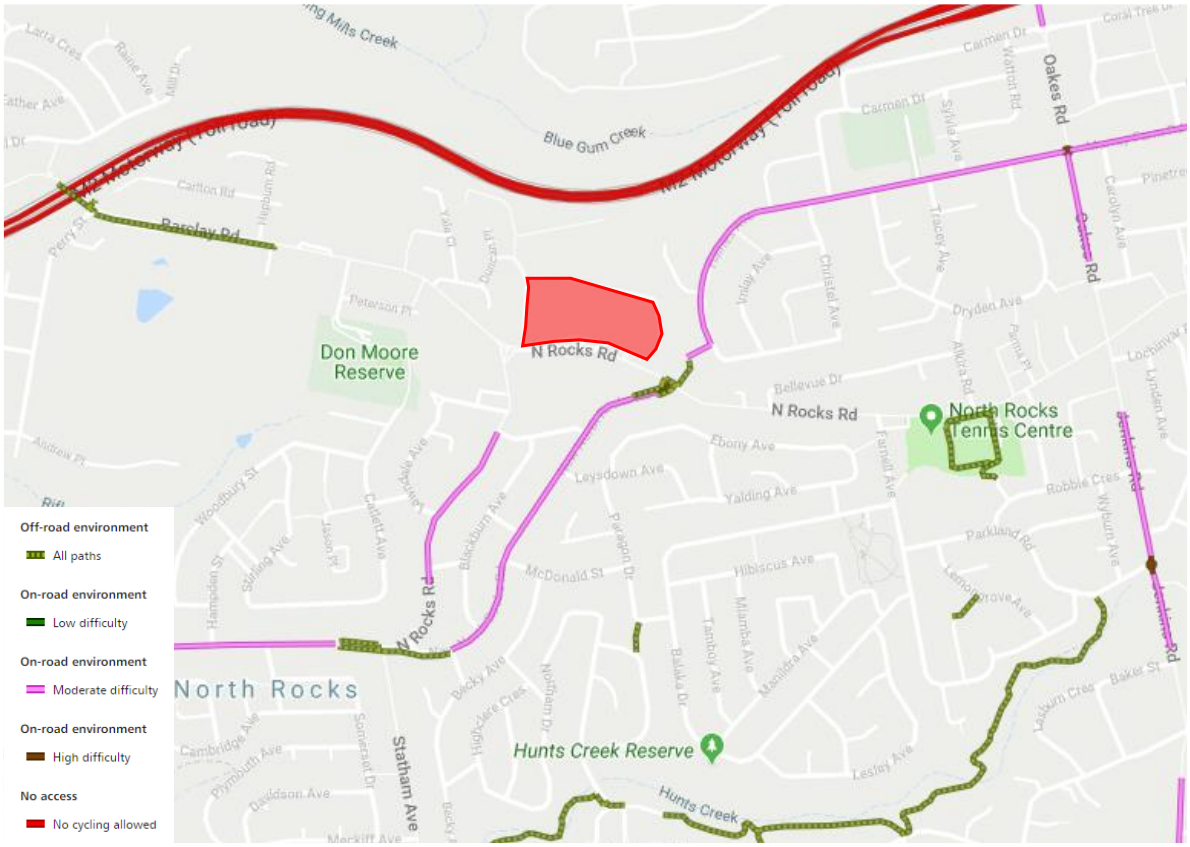


Source: https://app.targomo.com, Interpeak, accessed March 2021

3.5. Walking and Cycling

Figure 3.9 illustrates the existing cycling network within the area and relative to the site. There are some on-road and off-road (shared paths) bicycle route facilities including along Barclay Road, North Rocks Road and New North Rocks Road that link the area to Parramatta, Epping and Carlingford. Cycle routes along the shoulder of the Hills M2 Motorway are temporarily closed between Pennant Hills Road and Windsor Road. A detour route is provided through North Rocks, using various streets including Murray Farm Road, Haines Avenue, New North Rocks Road, North Roads. Along North Rocks Road and Barclay Road there are sections of shared path provided, with opportunities to expand the cycle network near the site.

Figure 3.9: Cycling network in North Rocks

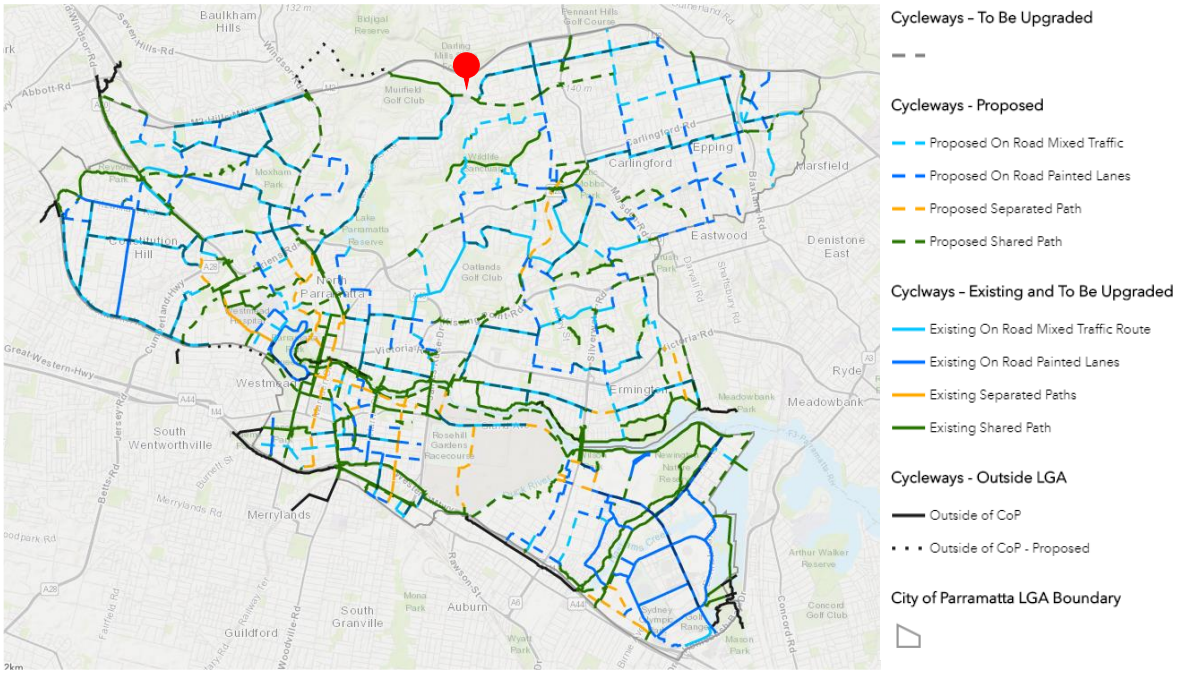


Source: Cycleways finders accessed December 2020

City of Parramatta's Draft Bike Plan 2017-2037[3] identifies two proposed routes relevant to North Rocks, including an approximately seven-kilometre route to Parramatta CBD as well as an approximately 13-kilometre Hills M2 Motorway alternative route using routes currently part of the temporary motorway cycle route closure detour. These routes and others are illustrated in Figure 3.10.

[3] *Draft Bike Plan 2017-2037*, City of Parramatta Council dated April 2017

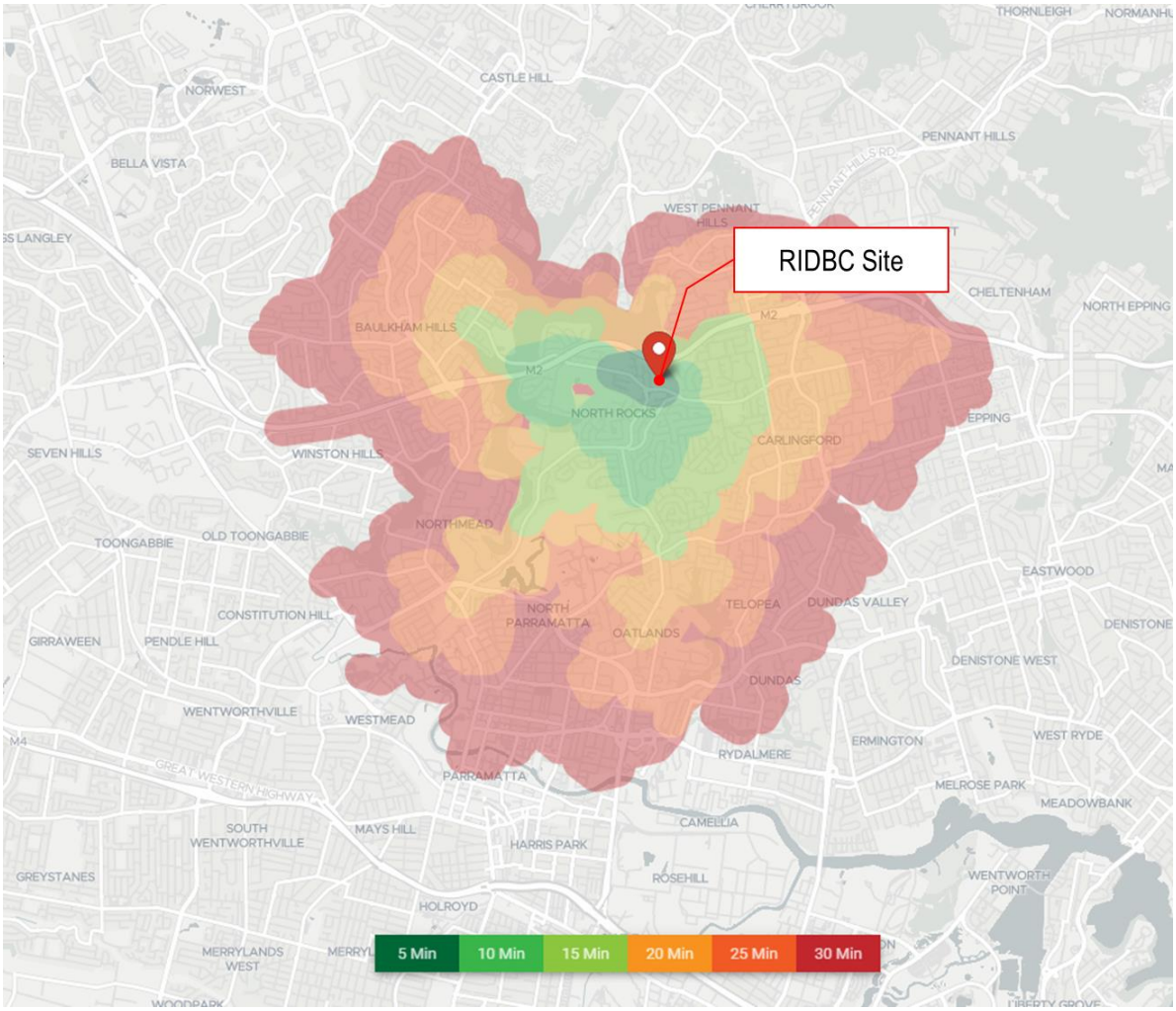
Figure 3.10:City of Parramatta Bike Plan 2017



Base source: http://parracity.maps.arcgis.com/apps/webappviewer/index.html?id=32acd43d7e9f424893d1ae408fbbc97e, accessed May 2019

Figure 3.11 shows a 30-minute cycling catchment from the site. It can be seen there is more accessibility to the south of the site and that the northern side of the Parramatta CBD is accessible within 30 minutes cycling time. Carlingford Station is also located within a 15-minute cycle from the site, which could encourage people to cycle to the Parramatta Light Rail to access areas such as Rydalmere industrial precinct and the nearby Western Sydney University campus.

Figure 3.11:Cycling catchment



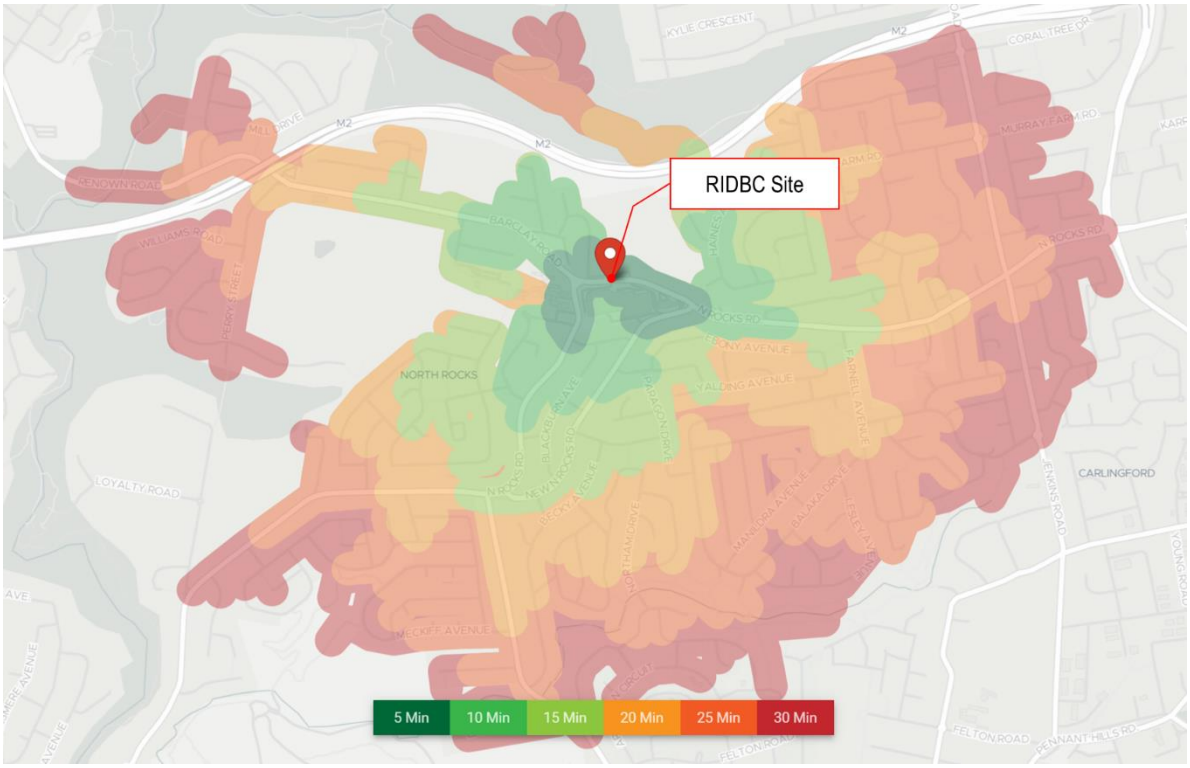
Source: https://app.targomo.com accessed March 2021

The area generally provides well-established pedestrian facilities, with footpaths along all streets. In particular, footpaths are provided on both sides of North Rocks Road and Barclay Road leading west towards the M2 Busway Barclay Road interchange, which provides frequent bus services to Sydney CBD, the north-western and western suburbs.

Pedestrian crossings are provided on two of three legs of the signalised North Rocks Road/ Barclay Road intersection, facilitating the movement of pedestrians between the site and the surrounding mixed land uses. There is also a mid-block signalised pedestrian crossing on North Rocks Road located between the two existing site access points.

Figure 3.12 illustrates a 30-minute walking catchment from the site. The map shows the M2 Motorway as a barrier for pedestrian connectivity to the north and that the M2 Busway Barclay Road interchange is approximately 20 minutes' walk from the site.

Figure 3.12:Walking catchment



Source: https://app.targomo.com accessed March 2021

3.6. Local Car Sharing Initiatives

Car share schemes have become increasingly common throughout Sydney and are now recognised as a viable transport option for drivers. They offer an alternative to private car ownership and are likely to be of benefit to future tenants and residents of the development. Car share will form an integral part of the ongoing transformation of North Rocks to reduce vehicle ownership by existing and future residents, especially a second vehicle. This is crucial for areas with more apartment living, where on-site car parking typically does not support ownership of more than one vehicle.

There are no existing car share pods close to the site, with pods operated by GoGet removed from Carlingford to the southeast of the site. With further transformation of the local area being led by this planning proposal, there will be opportunities to negotiate with car share providers to install pods within the site or nearby, as viability increases with more residents and workers. Car sharing pods in around the site will increase accessibility for the site and decrease car ownership dependency, particularly more than one vehicle.

3.7. Travel Patterns

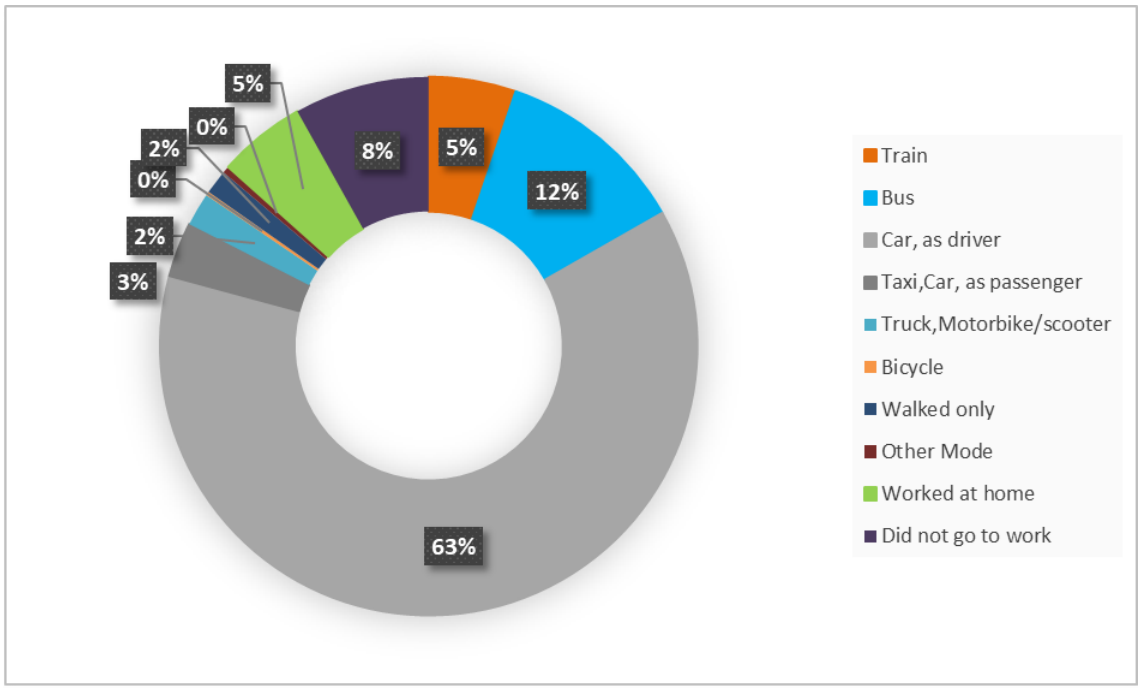
Journey to Work (JTW) 2016 data was gathered from the Australian Bureau of Statistics (ABS) for North Rocks (Statistical Area Level 2). The JTW data indicates that there is an approximately even proportion of those employed and residing in North Rocks.

Figure 3.13 and Figure 3.14 show resident and employee travel mode share respectively. Approximately 66 per cent of trips made by residents of North Rocks were by car (as driver or passenger) and 17 per cent via public transport. About 77 per cent of trips made by those working in North Rocks were by car (as driver or passenger) and seven per cent via public transport. Thus, the JTW data for residents and employees in the

North Rocks area shows a heavy reliance on private vehicle usage, creating significant road network management issues during peak periods. Conversely only two per cent of residents walk to work. Use of bicycles is almost zero, which illustrates not only a lack of active transport facilities, but also a lack of connectivity to local and regional cycling routes. The high reliance on private vehicles can also be attributed to the existing low density suburban nature of North Rocks, with housing stock generally comprising standalone dwellings, townhouses and/ or duplex products. In such suburban locations, car ownership is high as space and parking is less of premium, compared to medium and high density living where on average one car space (or less) is allocated per apartment.

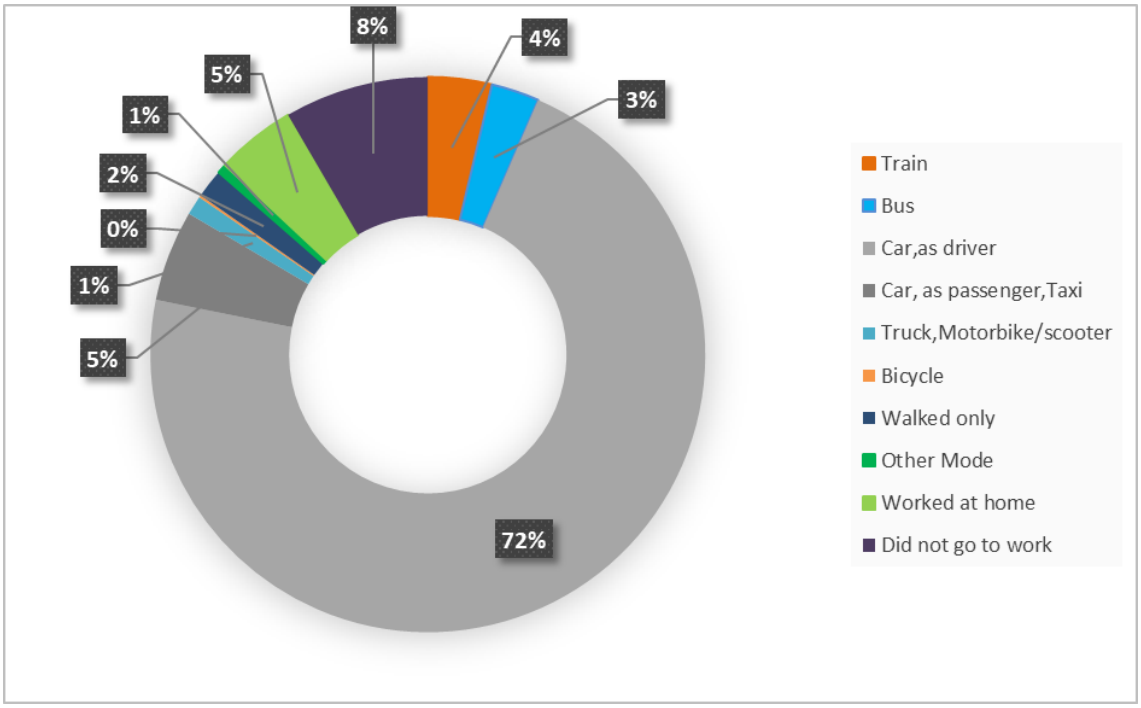
Key destinations for residents include Parramatta, Sydney CBD, Ryde-Hunters Hill, Cumberland and Blacktown, with about 27 per cent of North Rocks residents being employed in Parramatta.

Figure 3.13:Resident travel mode share



Source: ABS, 2016 using https://auth.censusdata.abs.gov.au/webapi/jsf/dataCatalogueExplorer.xhtml accessed May 2019

Figure 3.14:Employee travel mode share



Source: ABS, 2016 using https://auth.censusdata.abs.gov.au/webapi/jsf/dataCatalogueExplorer.xhtml accessed May 2019

4. PLANNED AND COMMITTED TRANSPORT PROJECTS

04

4.1. Overview

This section briefly outlines planned, committed and recently completed transport projects that will influence travel behaviours and traffic conditions on the arterial road network near North Rocks.

4.2. Local Transport Infrastructure

TfNSW has commenced planning for the expansion of commuter car parking for the M2 Busway Barclay Road interchange, which will increase capacity by approximately 135 spaces, hence reduce demand for on-street car parking on the surrounding residential streets.

As of February 2021, TfNSW is continuing investigations (following community consultation) for improvements to the Pennant Hills Road/ North Rocks Road intersection in Carlingford, which are anticipated to be completed by early 2024. The improvements are illustrated in Figure 4.1 and include additional intersection capacity along Pennant Hills Road and North Rocks Road (East) and a new eastbound left turn slip lane. These improvements have been considered for future year traffic modelling.

Figure 4.1: Pennant Hills Road/ North Rocks Road Improvements

Source: https://www.rms.nsw.gov.au/projects/pennant-hills-road-north-rocks-road-carlingford/index.html accessed January 2021

4.3. Parramatta Light Rail

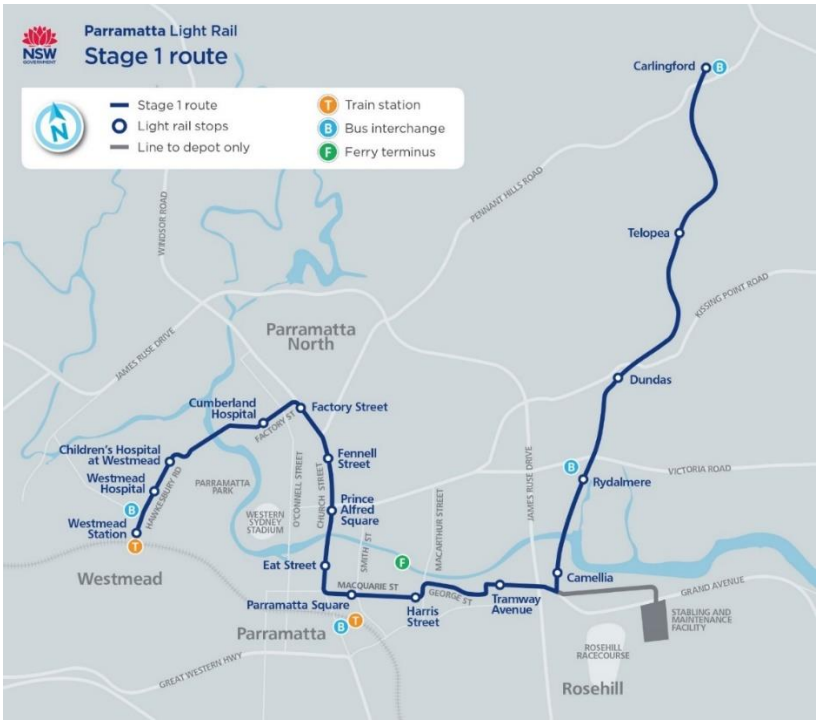
Parramatta Light Rail Stage 1, shown in Figure 4.2, is a 12-kilometre line between Westmead, Parramatta CBD and Carlingford.

Parramatta Light Rail is a NSW Government commitment to support sustainable urban growth in the Greater Parramatta to Olympic Peninsula (GPOP) priority growth area and to make the City of Parramatta the focal point for Western Sydney.

Parramatta Light Rail will support urban growth by delivering a high-frequency, turn-up and-go light rail service that will attract people and jobs to the GPOP priority growth area. Stage 1 of the Parramatta Light Rail project is the first of the roll out across the GPOP priority growth area, with future stages to be subject to future design development, assessments and approvals.

Stage 1 of Parramatta Light Rail from Westmead to Carlingford will improve local accessibility along the proposed 10.6 kilometres of the light rail alignment. It will provide integration with land use and other transport modes around the 16 light-rail stops and be a catalyst for urban renewal, focused on the Parramatta North Urban Transformation area, Parramatta CBD, Camellia, Rydalmere and Telopea.

Figure 4.2: Parramatta Light Rail Stage 1



Source: http://www.parramattalightrail.nsw.gov.au

Stage 2 of Parramatta Light Rail is currently in the design phase and if it proceeds (which is currently in doubt), will link Stage 1 at Rydalmere to Sydney Olympic Park via a nine-kilometre line with 10-12 stops through Ermington, Melrose Park and Wentworth Point.

The implementation of the Paramatta Light Rail will present opportunities for improved bus and cycling accessibility between North Rocks and Carlingford, while reducing general road capacity into the Parramatta CBD as a result of the light rail alignment. Consultation with TfNSW is necessary to understand any improvements to bus services and cycling infrastructure that may benefit North Rocks.

4.4. Other projects

The following projects will influence future travel patterns in the Northern, North-Western and Western Sydney regions, however, will have less of an effect on travel behaviours to/ from North Rocks.

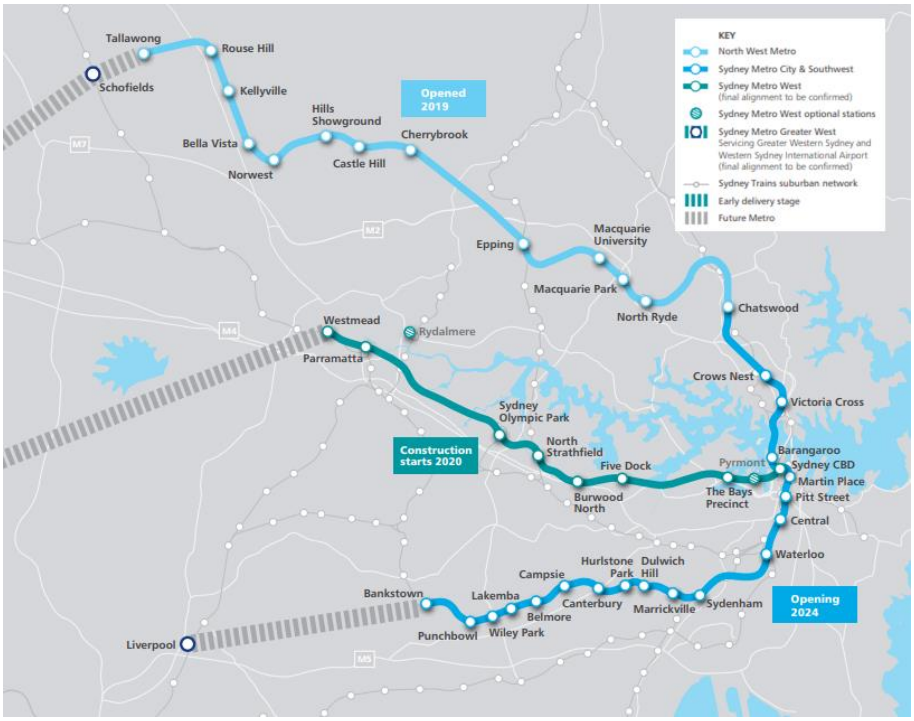
4.4.1. Sydney Metro Expansion

By 2024, the proposed Sydney Metro will convert the Bankstown railway line to achieve a 66-kilometre Sydney Metro network between Rouse Hill in Sydney's northwest and Bankstown in the southwest, via the Sydney CBD. The Metro trains will increase frequency to the Sydney CBD during peak periods, with a train every four minutes.

Sydney Metro Northwest operates from Tallawong (Schofields) to Chatswood and started in May 2019. Stage 2 of Sydney Metro will extend south from Chatswood, under Sydney Harbour, via new underground stations within the CBD and continue along the existing rail corridor to Bankstown.

An overview of the future Sydney Metro network is shown in Figure 4.3, which also includes Sydney Metro West that will be operational by 2030 and service the key precincts of Greater Parramatta, Sydney Olympic Park, The Bays Precinct and the Sydney CBD. The new line is likely to result in replanning of bus services to/ from the precincts to support the additional capacity on the railway. This could include services from North Rocks and surrounds, with further TfNSW consultation required as part of future development phases to understand any benefits for North Rocks.

Figure 4.3: Sydney Metro route alignment

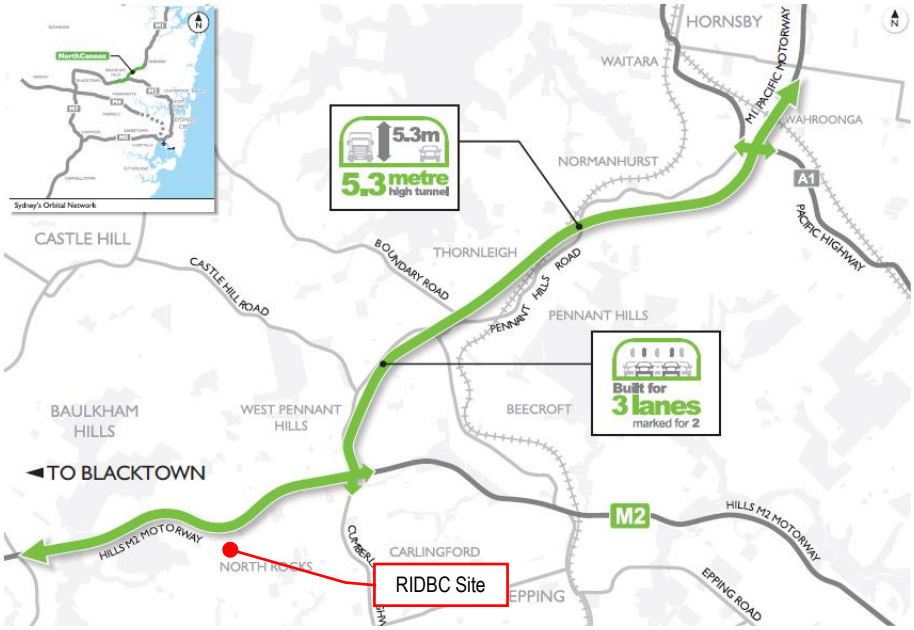


Source: Sydney Metro West Project Overview 2019

4.4.2. NorthConnex

The NorthConnex motorway is a recently completed nine-kilometre tunnel and motorway, as shown in Figure 4.4. NorthConnex creates a link between the M1 Pacific Motorway at Wahroonga to the M2 Hills Motorway at West Pennant Hills. A key objective of the NorthConnex is the removal of approximately 5,000 heavy vehicles from Pennant Hills Road per day, thereby significantly improving capacity along Pennant Hills Road and the surrounding road network. The alignment of NorthConnex involves connecting with the M2 Hills Motorway west of Oakes Road, which will result in better accessibility for vehicles to Sydney's North, namely the Hornsby area.

Figure 4.4: NorthConnex overview map



Base source: NorthConnex accessed June 2019

5. PLANNING PROPOSAL

05

5.1. Overview

As previously outlined, the planning proposal and associated masterplan have the potential to deliver approximately 935 residential dwellings (apartments, townhouses, terraces and free-standing houses). 25 per cent of the concept will also comprise of seniors housing including 145 seniors ILUs and a 60-80-bed residential aged care facility. It also includes a new full-size oval for use by the broader local community along with a community 'hub' comprising a multi-purpose community space and neighbourhood library (2,700 square metres). The proposed 700 square metres of retail/ commercial space will be a limited ancillary offering to support new residents' needs and complement the neighbouring North Rocks Shopping Centre.

Table 5.1: Indicative development yields

Use	Area
Residential	935 dwellings (690 apartments and 245 townhouses, terraces and free-standing houses)
Seniors Living	145 units
Aged Care Facility	60-80 beds
Community space and library	2,700 m^2
Retail/ commercial	700 m^2
Publicly accessible open space	Approx. 30 per cent of site

The indicative site layout is shown in Figure 5.1.

Figure 5.1: Indicative site layout

Base source: Fender Katsalidis

5.2. Access Arrangement

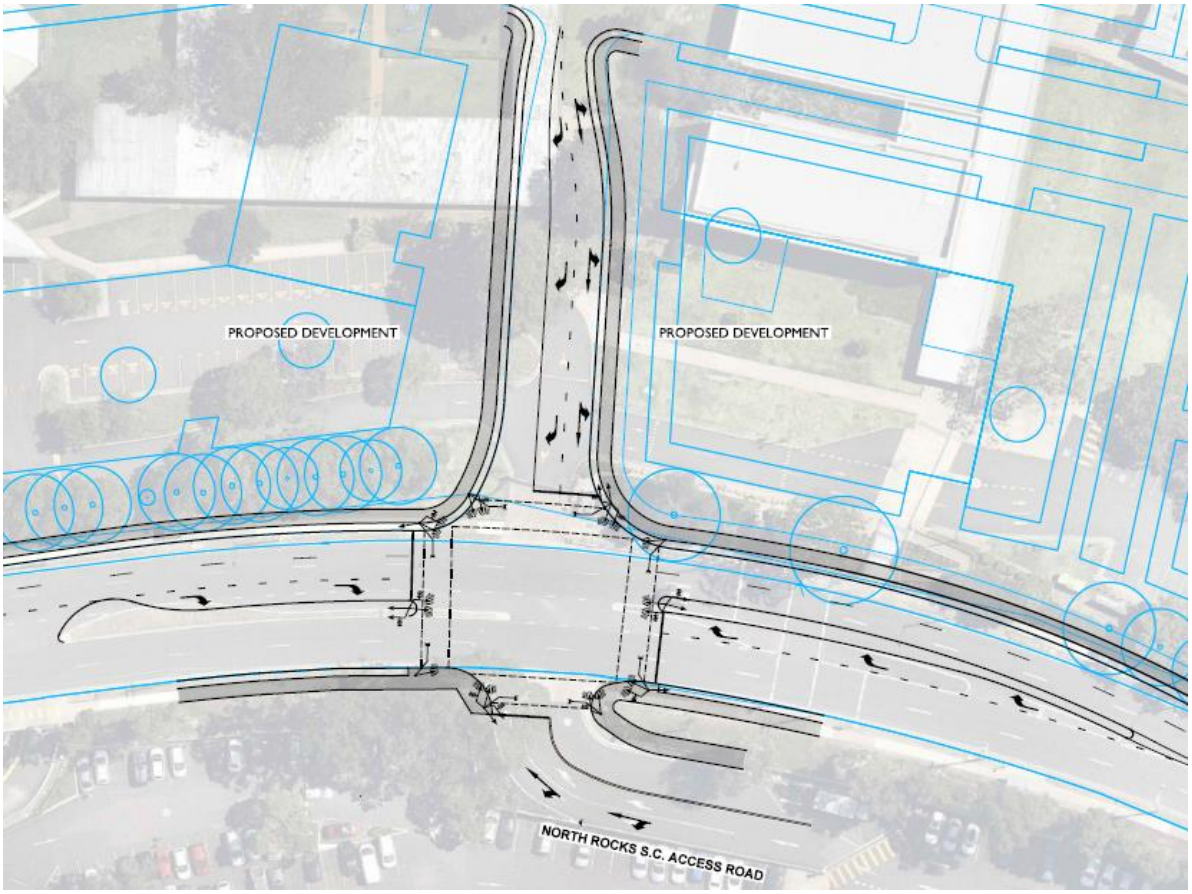
The proposal includes three vehicular accesses. The main access is from North Rocks Road (all movements), with secondary accesses from North Rocks Road (to the east) and Baden Powell Place (from Barclay Road). On North Rocks Road, changes to existing intersection arrangements are required to accommodate background traffic growth and site-generated traffic. These have been developed in consultation with the owner of North Rocks Shopping Centre, who has offered in-principle support for the proposed concept on the basis that all existing access opportunities to the shopping centre car parking are not adversely impacted.

The proposed access arrangement for the site is detailed below and shown in Figure 5.1:

- North Rocks Road/ North Rocks Shopping Centre eastern access/ main site access – realignment of current site access with the eastern shopping centre access to form an all turning movements signalised intersection. The signalised intersection would include right turn bays along North Rocks Road for the shopping centre and the site.
- North Rocks Road/ secondary site egress – a left-out only from the site to North Rocks Road.
- Baden Powell Place/ secondary site entry – an entry-only to the site via Baden Powell Place as an extension of the existing road.

A concept layout of the proposed signalised access is shown in Figure 5.2, with a more detailed plan included in Appendix A.

Figure 5.2: North Rocks Road signalised access point



Base source: Nearmap (aerial photo) and Fender Katsalidis (indicative development footprint)

In terms of addressing key assessment criteria used by TfNSW, the proposed signalised access on North Rocks Road:

- provides traffic control at a site with an existing traffic capacity or road safety problem, with turning movement delays increasing along North Rocks Road and near misses reported at this location
- controls conflicting movements with high traffic flows, noting the adjacent high traffic generator (shopping centre) and being accessed by local residents through this intersection
- facilitates access to/ from local areas in a major road system (per above), including pedestrian movements (enhanced desire line between the development and shopping centre/ bus stops, and safer crossing location for Muirfield High School students to access the shopping centre)
- forms part of an area wide system of traffic management; operating in coordination with adjacent signals at Barclay Road and New North Rocks Road.

The proposed signalised intersection arrangement effectively replaces the existing mid-block pedestrian signals. It is located 185 metres and 230 metres from the nearby signalised North Rocks Road intersections at Barclay Road and New North Rocks Road. This presents opportunities for signal coordination between the three intersections along North Rocks Road to efficiently manage traffic flows.

Furthermore, the four-way intersection arrangement with the shopping centre significantly improves the capacity for safe pedestrian movement between the two sites, which is currently limited due to the mid-block pedestrian signals favouring through traffic. The intersection improves safety for traffic entering/ exiting the two sites with controlled turning movements, while also linking the bus stops on either side of North Rocks Road. This intersection location also facilitates the best internal site layout outcomes for the development and includes modifications to the existing road arrangement to cater for all relevant design vehicles to/ from both the site and the adjacent shopping centre. Swept path analysis is included with the traffic signal concept in Appendix A.

It should be noted that several other site access options were investigated during the development of the proposed site master plan, including a fourth leg to the existing signalised intersection of North Rocks Road and Barclay Road, primary access via Baden Powell Place and new traffic signals towards the eastern boundary of the site. These options result in a compromised vehicle access and circulation outcomes, and traffic movement/ capacity issues, whilst creating challenges from a site layout, urban design and community impact perspective.

The proposal to have the main site access intersection aligned with the North Rocks Shopping Centre access (replacing the existing mid-block signalised pedestrian crossing) helps better distribute the site generated traffic across the local road network, as opposed to concentrating all movements at one existing intersection.

Furthermore, the proposed site layout allows for the provision of a new oval and village green to form a contiguous recreation and open space precinct with the existing Council reserve along Barclay Road. The oval will be clearly visible for motorists approaching via the North Rocks Road/ Barclay Road intersection. A visually prominent, easily accessible location for the oval along North Rocks Road was favoured over a more isolated location away from the road frontage. The proposed signalised intersection arrangement would significantly improve pedestrian crossing opportunities between the site and North Rocks Shopping Centre (as well as the westbound bus stop), which is crucial for reducing short vehicle trips between the sites and providing convenient bus stop access. The traffic signals would also improve safety for right turn vehicle movements to/ from North Rocks Shopping Centre, with the current priority-controlled arrangements becoming problematic as a result of background traffic growth, as illustrated later in the report.

The existing geometry of the shopping centre access, while not desirable for traffic signals, is not unique. A similar design was used for the Barangaroo South basement egress to Sussex Street/ Hickson Road (shown

in Figure 5.3 and Figure 5.4). This basement egress was constructed in the last five years and forms a fourth leg to the Sussex Street, Hickson Road and Napoleon Street intersection, which was signalised at the same time. As illustrated in the photos below, the basement egress is enclosed thus limiting sight lines to the signal lanterns, with only a 'traffic lights' sign and pavement markings warning motorists of the traffic signals ahead.

Figure 5.3: Barangaroo South Basement Egress

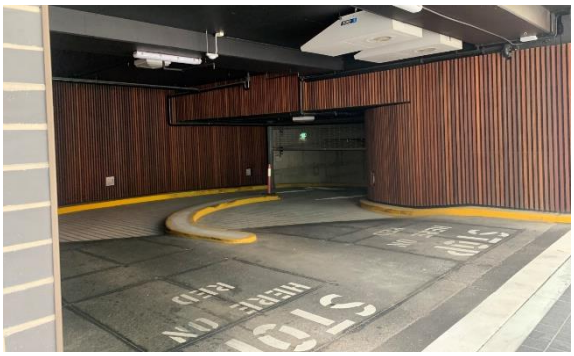


Figure 5.4: Barangaroo South Basement Egress

In comparison, the shopping centre access does not have such sight line constraints approaching the traffic signals, with the proposal to install a 'Prepare to Stop – Traffic Signals' sign with flashing lights to mitigate the existing geometrical constraints.

The project team remains committed to working with TfNSW to optimise the traffic signal design and operation during delivery of the redevelopment project.

6. INTEGRATED TRANSPORT STRATEGY

06

6.1. Proposed Actions

This chapter details the integrated transport strategy to support the proposed North Rocks urban village, having regard to the objectives and principles outlined in Section 2.2. Based on the analysis completed in this report, a range of opportunities are proposed to reduce car dependency (particularly trips during the road network peak periods) and promote more trips by walking, cycling and public transport.

A key aspect of the strategy is the development of a Green Travel Plan, which is proven to be a successful way of changing travel behaviour throughout Australia and overseas. A Green Travel Plan is a strategy with a package of practical measures for a development or organisation to implement in order to influence and encourage sustainable travel behaviour from the residents, staff and visitors. Essentially, the plan encourages greater use of active and public transport trips and reduces the reliance on private vehicle trips. The plan would be enacted by the developer and would be maintained by the property manager(s). Bicycle parking, end-of-trip facilities, shared path infrastructure, Opal card subsidies (e.g. initial credit provided to residents upon moving into the development), car share vehicles and a shuttle bus service represent developer-led initiatives that can be expected to have a tangible benefit for future residents and staff, as well as a broader community benefit.

As detailed in Section 6.2.1, the capacity in the existing bus network is sufficient to accommodate demand generated by the proposal. However, additional transport initiatives are proposed to increase the mode share for public transport for the development (i.e. to achieve the proposed mode share target).

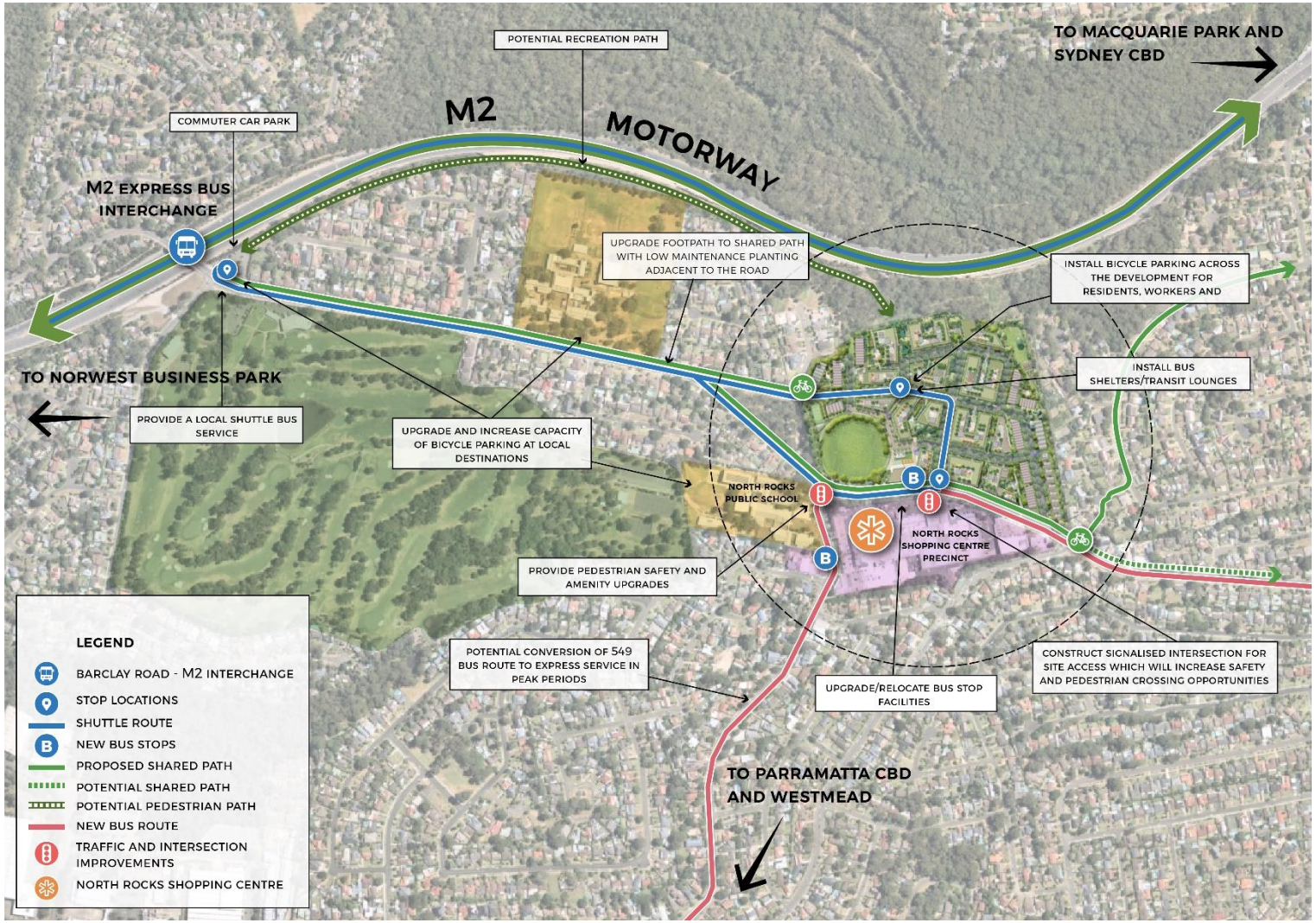
A summary of objectives, principles and proposed integrated transport actions is provided in Table 6.1 and Figure 6.1, with further details in the subsequent sections of this chapter.

Table 6.1: Integrated Transport Actions

Objectives	Principles	Issues	Proposed Integrated Transport Strategy Actions
1. Create a local street network that is designed for people first and vehicles second.	• Integrate transport and land use within the site to influence the location, timing, scale and density of development. • Implement a road planning framework within the site that recognises the movement and access requirements. • Provide improved permeability of connections by removing barriers to local movement by sustainable modes. • Facilitate appropriate provision for local delivery access within the site.	Local Connectivity • Lack of well-planned walking and cycling network discourages active travel • Current mid-block signalised pedestrian crossing on North Rocks Road favours through traffic over pedestrians resulting in people jaywalking.	Local Connectivity • Provide walking and cycling networks throughout the site. The walking and cycling networks will connect the site with the bus corridor along both North Rocks Road and potentially M2 Hills Motorway, as well as to key local destinations such as schools and North Rocks Shopping Centre through the construction of additional shared paths and missing links. • Signalise the vehicle access to the site and the eastern shopping centre car park access. This will provide additional pedestrian crossings of North Rocks Road, encouraging walking to the shopping centre whilst improving safety outcomes. Internal pedestrian footpaths will connect to the broader pedestrian network.
2. Prioritise active and public transport, as well as demand management measures to support sustainable travel behaviour and encourage reduced car use.	• Support public transport and walking and cycling to grow the proportion of travel by these modes. • Provide safe and direct access to support key desire lines and to major trip generators outside the precinct. • Leverage new and committed infrastructure to provide new services and associated transport infrastructure to maximise benefits. • Implement a policy framework that supports sustainable travel behaviour (such as parking rates, behavioural programs, travel plans). • Improve efficiency by sharing road space more effectively among all modes of road-based transport.	Public Transport Facilities and Incentives • Existing bus shelters and pedestrian queuing areas will not be suitable for additional bus patronage anticipated to be generated by the development. • Distance between the site and key destinations and public transport interchange may discourage residents, staff and visitors from using active and public transport. • On-demand/ loop shuttle service will require patrons to wait on-site or at the commuter car park in all weather conditions, and therefore might be discouraged to use buses if raining. Walking and Cycling • Current pedestrian paths near the site are not suitable for high pedestrian volumes or cyclists.	Public Transport Facilities and Incentives • Improve bus stop facilities adjacent to the site (as well as nearby) and increase pedestrian queuing capacity, where practical, in consultation with TfNSW and bus operators. • Introduce shuttle bus services linking the North Rocks area with the M2 Busway Barclay Road interchange, in consultation with TfNSW and bus operators. • Construct new shelters/ transit lounges with help points, live transport information and on-demand call facilities at the Barclay Street commuter car park and at two locations within the development site. • Subsidise public transport for new residents and staff through providing credit (to a specified meaningful value) on either new or existing Opal cards. This would incentivise residents and staff to try the public transport network soon after they move into the development, which would influence their mode choice in future. Walking and Cycling • Complete the shared path between Jennie Place (east of the site) and the Barclay Street commuter car park along the north side of Barclay Road, with a further recreational path opportunity within open space south of the M2 Motorway, and provide clear pedestrian and cyclist wayfinding. • Build on existing local initiatives and provide low maintenance planting or fencing in the verge between key pedestrian footpaths and adjacent roads to eliminate the maintenance of grass strips and improve safety. Fencing, landscaping and improvements to existing median islands and kerb ramps would be considered around

Objectives	Principles	Issues	Proposed Integrated Transport Strategy Actions
		Current traffic signal phasing favours vehicles over pedestrians resulting in jaywalking.	the North Rocks Road/ Barclay Road intersection to improve pedestrian safety by eliminating crossing at locations other than designated crossing facilities. • Construct additional shared path connections to local destinations in consultation with Council (including to Don Moore Reserve). • Provide clear pedestrian and cyclist wayfinding along Barclay Road and North Rocks Road. • Create a bicycle user group (targeting those living or working within five kilometres of the site) • Establish community events such as annual 'ride to work' or 'ride to school' day <u>Travel Demand Management</u> • Prepare a Green Travel Plan(s) that details specific actions upon residents, staff and visitors to achieve the targeted travel behaviour shift. Include information detailing opportunities and facilities available to all residents, such as maps of the available cycling routes to and within the site.
3. Provide a diversity of land uses to provide residents with walkable access to a variety of services and facilities and discourage unnecessary car trips.	• Integrate transport and land use within the site to influence the location, timing, scale and density of development.	<u>Bicycle Facilities</u> • Various local destinations in close proximity not easily accessible by walking and cycling. <u>Travel Demand Management</u> • Potential car ownership within the development, coupled with high car dependence in the surrounding area and traffic volumes on the road network, will lead to increased traffic congestion.	<u>Bicycle Facilities</u> • Provide high quality bicycle parking in accessible areas to cyclists that would be secure from theft. In addition, high quality change and shower facilities could be provided for retail/ commercial tenant and public use. • Upgrade and increase capacity of bicycle parking and lockers at local destinations, such as the Barclay Road commuter car park and local schools to encourage cycling for these short distance trips. <u>Travel Demand Management</u> • Provide car share services within the development to reduce reliance on use and ownership of private vehicles, particularly more than one vehicle.
4. Establish the site as part of Sydney's connected network taking advantage of its location to the Parramatta CBD/ Central River City.	• Improve the efficiency of the transport network through increasing public transport efficiency and making existing infrastructure more efficient. • Consider access to the broader region as part of the Parramatta CBD/ Central River City when proposing public transport improvements.	<u>Bus Services</u> • Limited bus services through North Rocks and long travel times given services are 'all stops' discourages existing residents of North Rocks from using buses over private vehicle.	<u>Bus Services</u> • Increase bus service frequency towards Carlingford Station (Route 630), Epping Station and Parramatta (Route 549), in consultation with TfNSW and bus operators. • Modify bus route 549 into a limited stops or express service in peak periods, with only eight stops along the entire route, as well as operating at an increased frequency. This could include investigating sections of bus priority where feasible and would provide faster and more reliable travel times to both Parramatta and Epping for North Rocks residents. They would then also be able to interchange with light rail, heavy rail and Metro services. • Modify bus route 546 into a limited stops or express service in peak periods, via Statham Avenue and Bettington Road with fewer stops and more direct route between Epping and North Rocks.

Figure 6.1: Summary of Actions



Source: Mecone

6.2. Action Details

6.2.1. Public Transport

Trip generation estimates completed for the proposal in Section 7.1.4 suggest that some 155 to 165 people would catch buses in the peak hour from the development to areas such as Parramatta, Westmead, Sydney CBD, Norwest/ Bella Vista and Macquarie Park (i.e. less than half to/ from the M2 Busway Barclay Road interchange, with the remainder travelling towards Parramatta). A further 40 people would require access to nearby train stations, such as Epping and Eastwood, with the ideal transport mode being bus as opposed to 'park and ride' given limited commuter car parking opportunities at these stations.

The study has investigated the potential provision of new and additional bus services, which would improve bus usage in the area. These include:

- Provide a shuttle/ loop service (12-21 seat minibus) between the site and the M2 Busway Barclay Road interchange during peak periods and potentially at other times integrate into a broader on demand service for anyone to use.
- Increase route 549 services between Epping and Parramatta via North Rocks across the day (at least four services hourly each way during peak periods and two services hourly each way interpeak).
- Introduce a new limited stops service (full size bus) to Parramatta supplementing current routes via Church Street (three to four services in the peak hour per peak direction).

In addition, it is proposed to work with TfNSW and bus operators to improve bus stop facilities adjacent to the site and nearby to increase patron queuing capacity, where practical.

Regular Route Services

In response to TfNSW comments, sample M2 express bus occupancy surveys were completed between 7:30am and 8:30am on a weekday in May 2019 to understand the available capacity on services towards the east, that is including Macquarie Park, North Sydney and Sydney CBD. The survey results suggest there were approximately 1,600 empty seats on eastbound services across some 100 services with an available standing capacity for a further 2,400 passengers on the services.

The proposal is expected to generate 155 to 165 bus passengers across the bus network of which less than half are expected to be to/ from the M2 Busway Barclay Road interchange. Therefore, there is expected to be adequate capacity on existing bus services to accommodate the additional trips, including in the event that there is a 10 to 20 per cent reduction in services along the M2 resulting from the Sydney Metro and its future extension into the Sydney CBD.

It is expected that the provision of a shuttle service and other initiatives implemented will improve bus usage.

Proposed Peak Express Services

The additional population generated by the proposal presents an opportunity for the region bus operator to increase buses services to North Rocks as part of their contract, with the obvious measure being increased frequency of route 549 and potentially route 546 for the broader community if the demand is there. Discussions with TfNSW indicated that they would be supportive of increasing the status of the route 549 service from a local to a suburban service route. Engaging with TfNSW and the region bus operator as part of future bus contract renewals would ensure that the additional demand generated by the development is catered for in bus planning for the area.

Route 549 currently operates at 30-minute intervals during peak periods and hourly interpeak. Community engagement by the proponent suggests that public transport improvements are desired by the community.

In addition to this, a limited stops service is proposed for detailed discussion with TfNSW/ region bus operator between North Rocks and Parramatta via Church Street to improve bus usage. Such route could also commence at Epping and provide three to four services in the peak direction and adjusted based on demand off-peak. A route via Church Street (shown in Figure 6.2) provides the better stop and interchange opportunities, as follows:

- Epping Station
- Roselea Public School, St Gerard's Catholic Primary School, Pennant Hills Road/ North Rocks Road intersection – interchange with buses heading north and west towards Pennant Hills and Blacktown
- Site and North Rocks Shopping Centre
- Lawndale Avenue neighbourhood shops
- North Rocks Industrial Precinct
- North Rocks Road/ Church St intersection – interchange with buses heading north towards Rouse Hill and Dural
- Factory Street light rail stop near O'Connell Street
- Parramatta CBD.

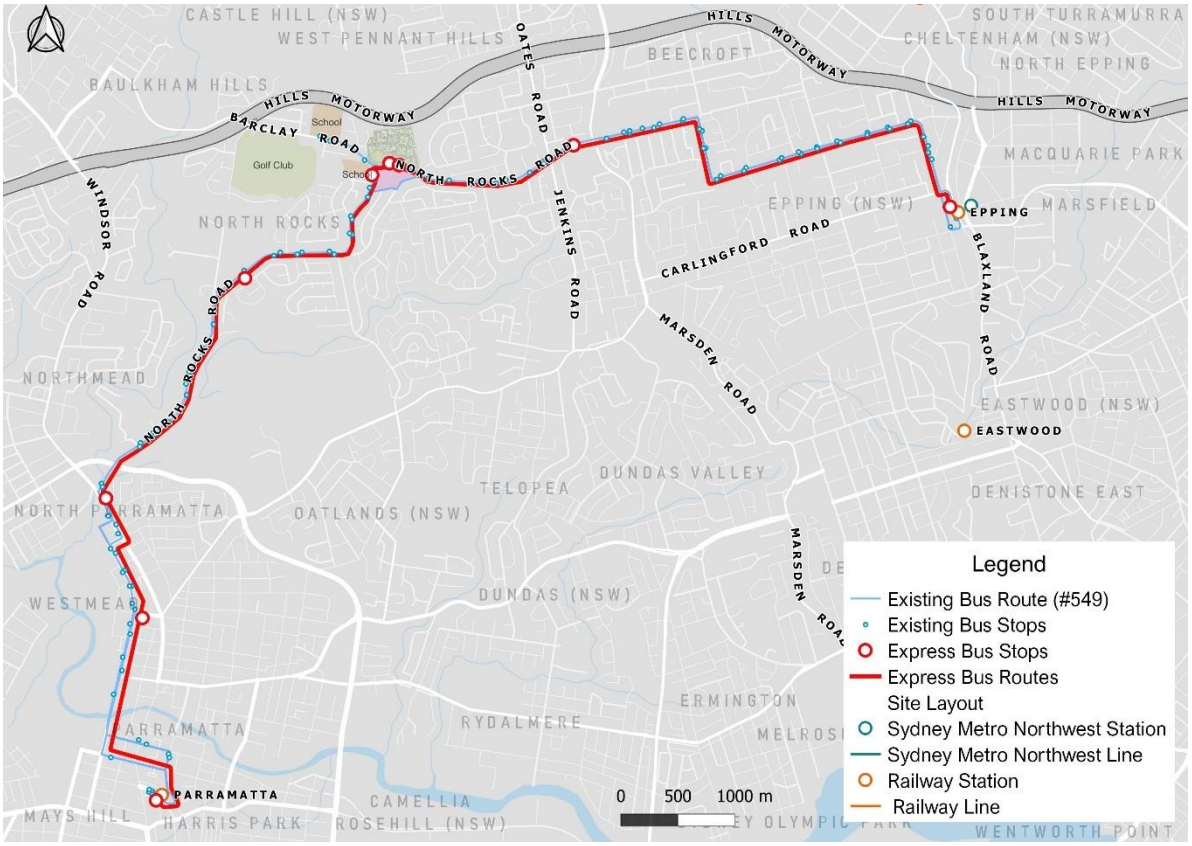
This route is desirable as it makes use of existing bus lanes along Church Street, with options investigated by GTA to increase the left turn opportunities from North Rocks Road into Church Street to improve the travel time noting the movement is currently affected by right turn queues during the peak periods. These investigations are subject to further discussions with TfNSW to explore viability.

The limited stops service would also provide return services to avoid empty buses travelling towards the start. This would cater for employment generators such as North Rocks Industrial Precinct and North Rocks Shopping Centre, where workers travel in the opposing direction to residents of North Rocks. This has the potential to further influence existing travel behaviours for workers in North Rocks, therefore contributing towards improving traffic conditions in the area.

The existing 549 bus service takes approximately 47 minutes to complete the Epping to Parramatta route at around 7:30am (29 minutes from the site to Parramatta CBD), with a total of 54 bus stops located along the route. The typical travel time by car at this time is 22-45 minutes (14-24 mins from the site) to Parramatta. A reduced total of six intermediate stops along this limited stop route (four from the site) could result in a significant time saving of 5-10 minutes, with bus travel times comparable with private car travel (when considering the available bus lane along a significant proportion of the Church Street corridor). Such improved bus travel times and associated reliability and passenger comfort will be more attractive to future commuters and will assist in meeting or exceeding mode share targets.

The proponent is also committed to contributing towards such a limited stops service in the peak periods for a minimum period (e.g. 2-3 years), with the understanding that the NSW Government or region bus operator would fully fund and operate the service thereafter. It is also proposed that the service is operated within the region bus contract, with fares integrated into the Opal card system. This limited stops service is in-line with the Future Transport 2056 Strategy (see Section 2.1.3), which includes a 0-10 year investigation for infrastructure investment to improve bus services between Parramatta and centres to the north and south of Parramatta.

Figure 6.2: Potential Bus Route 549 Express



Proposed Shuttle Bus/ On-Demand Service

The proposed shuttle service (small electric bus similar to Figure 6.4) would operate between the site and the M2 Busway Barclay Road interchange as shown in Figure 6.3 and would be available to the broader community. This would cover approximately 1.4 kilometres (one-way) and would operate on a continuous loop during commuter peak periods, with the potential for further off-peak services. This would be in addition to regular bus services along Barclay Road (route 630) that operate every 30 minutes in the peak periods.

The shuttle services would set-down/ pick-up and loop through the existing commuter car park. Safe, weather protected, and well-located bus stop/ transit lounges similar to that shown in Figure 6.5 are envisaged for passengers within the site and at the Barclay Street commuter car park that includes a new shelter/ transit lounge with help point, transport information and on-demand call facility.

The bus stop/ transit lounge would be located on the southwest corner near the entrance of the commuter car park. Existing accessible car parking spaces would be relocated adjacent to the facility, with a minor reduction in general commuter spaces (i.e. 2-3 spaces). The minor loss of commuter spaces will be offset by the new approximately 135 space commuter car park proposed to be constructed by TfNSW on land between the motorway and Perry Street that has been vacated by NorthConnex.

The proponent is committed to fully funding a shuttle/ on-demand service and associated stop facilities that could be operated by the region bus operator for an extended period (minimum 10 years) where the service is free to users, until such time as there is a sustainable demand for a local feeder service or area-wide on-demand service provided by the NSW Government or region bus operator.

Figure 6.3: Proposed Bus Improvements

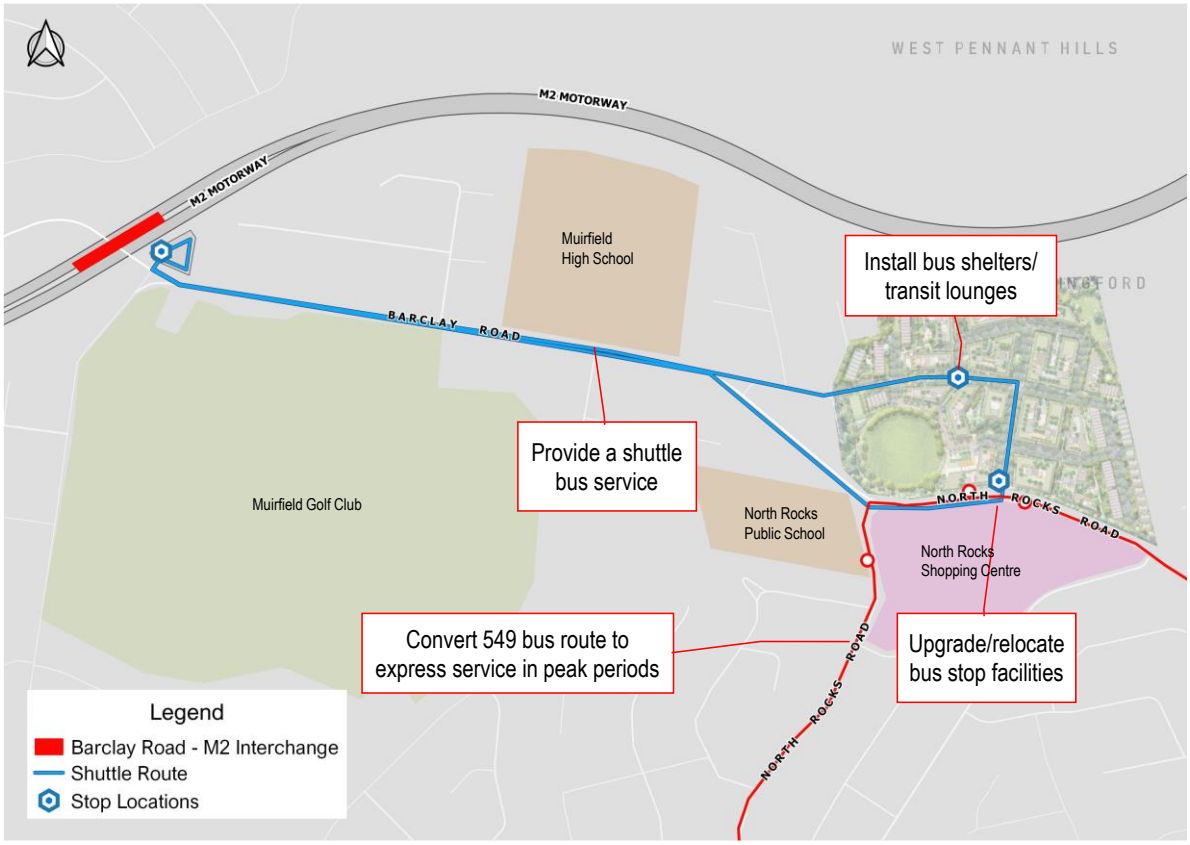


Figure 6.4: Example Shuttle Bus

Source: PAYCE Consolidated

Figure 6.5: Example Transit Lounge

Source: https://challenges.cityoftomorrow.com/

6.2.2. Active Transport

The proposal aims to encourage cycling as a viable alternative to the private car use for journeys under five kilometres. Linkage to key local destinations and existing networks will be provided by the proposal, as well as bicycle parking and end-of-trip facilities.

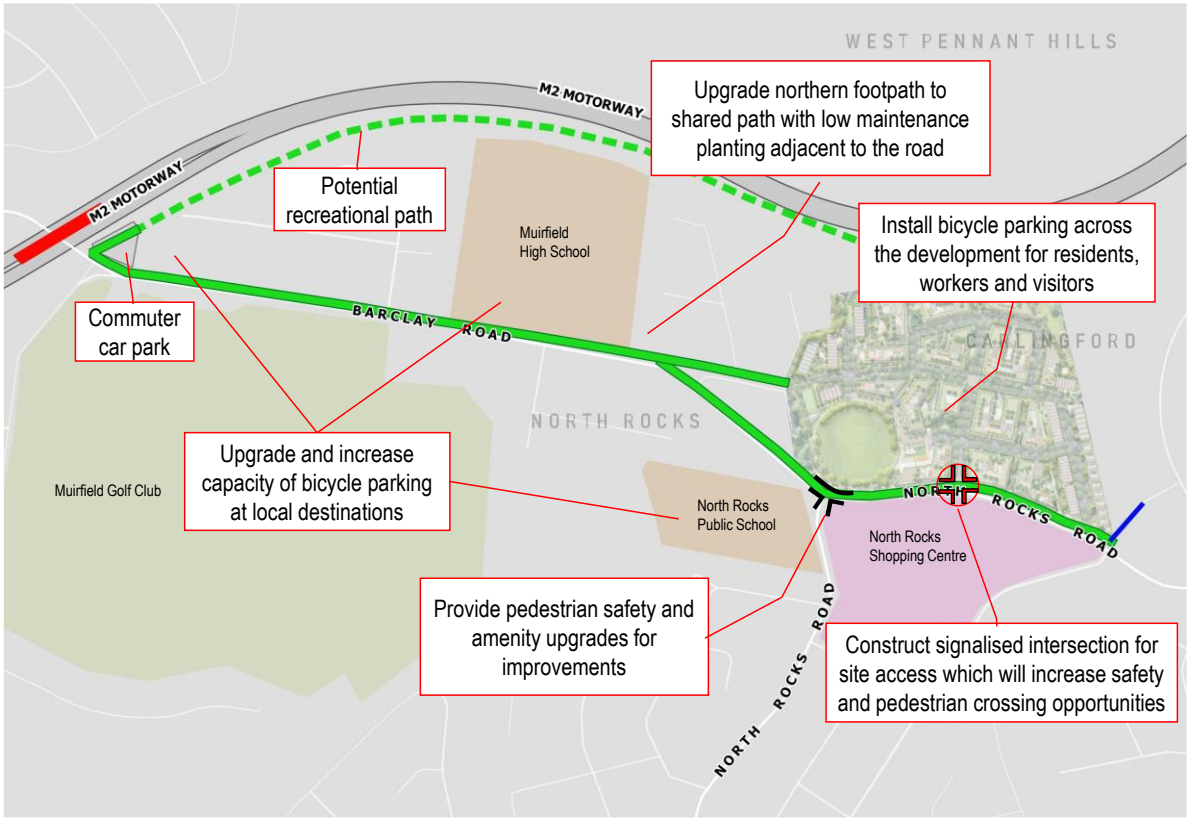
When planning, careful consideration needs to be given to factors that may affect the level of use. For example, the implicit provision for walkers and cyclists include:

- Security and safety
- Visibility
- Shelter

- Convenience
- Signage.

A summary of the proposed active travel actions detailed in Table 6.1 are illustrated in Figure 6.6.

Figure 6.6: Potential shared paths to/ from Barclay Street commuter car park



Bicycle Parking and End-of-Trip Facilities

The bicycle parking requirements for different land use types set out in both the Hills DCP 2012 and Parramatta DCP 2011 were analysed. The Hills DCP 2012 does not specify bicycle parking provisions applicable to the proposal, given there is no rate for residential developments and the rates for retail and commercial premises are only for developments of more than 5,000 square metres gross leasable floor area (GLFA) (proposed retail/ commercial space is approximately 700 square metres floor area only). Therefore, a summary of Parramatta DCP 2011 bicycle parking requirements is provided in Table 6.2.

Table 6.2: Bicycle parking requirements for Parramatta DCP 2011

Land use	Bicycle parking rate	Required bicycle parking
Residential Flat Buildings [1]	1 bicycle space per 2 dwellings	544 spaces
Business/ Office/ Retail	1 bicycle space per 200 m^2 of floor space	4 spaces

[1] Includes seniors living units and excludes townhouses which are expected to have room for bicycle storage

Where a bicycle parking rate is not specified for a particular use, the rates nominated by the NSW Planning Guidelines for Walking and Cycling should be adopted. These rates are identified in Table 6.3.

Table 6.3: NSW Planning Guidelines for Walking and Cycling

Land Use	Bicycle parking rate		Required bicycle parking	
	Resident/ staff (long-term use)	Customer/ visitor (short-term use)	Resident/ staff (long-term use)	Customer/ visitor (short-term use)
Residential Flat Buildings [1]	20-30% of units	5-10% of units	198-297	50-100
Aged or disabled self-contained housing	3-5% of rooms	3-5% of rooms	3-4	3-4
Commercial/ Retail	3-5% of staff	5-10% of staff	1-2[2]	2-3[2]
Community space	3-5% of staff	5-10% of staff	1[3]	1[3]

[1] excluding townhouses, terraces and small lots which are expected to have room for bicycle storage
[2] assuming 1 staff per 25 square metres GLFA (conservative, allowing for flexible uses)
[3] assuming 1 staff per 400 square metres GFA.

The rates from Parramatta DCP 2011 are higher than the rates in the NSW Planning Guidelines for Walking and Cycling. It is recommended that bicycle parking (and associated end-of-trip facilities where relevant) is provided in excess of the above rates, given the development aims to encourage cycling.

End-of-trip facilities should include change rooms and shower facilities for employees and visitors, as well as bicycle lockers (for residents and retail/ commercial employees). Bicycle parking should be strategically provided across the public domain area for visitor use.

6.2.3. Travel Demand Initiatives

Green Travel Plans

Green Travel Plans have proven to be a successful way of changing travel behaviour throughout Australia and overseas. A Green Travel Plan is a way in which a development manages the transport needs of residents, staff or visitors.

The aim of the plan is to reduce the environmental impact of travel to and from a given site and in association with its operation. Essentially, the plan encourages more efficient use of motor vehicles as well as alternatives to the private car.

Green Travel Plans are informed by the existing (or planned) transport network and operations and supported by policy and program initiatives to encourage the use of these networks. A Green Travel Plan is a strategy with a package of practical measures for an organisation to implement for a given site in order to influence and encourage sustainable travel behaviour.

It is recommended that a Travel Plan be prepared for the site as part of future stages of the proposal and associated development applications. The Travel Plan would detail specific actions upon residents, visitors and staff to achieve the targeted travel behaviour shift. The preparation of a Travel Plan is a requirement under the City of Parramatta DCP for this type of development (development of more than 5,000 square metres of GFA and with good public transport accessibility[4]).

Car Share

Car share services, such as GoGet, aim to reduce the reliance on use and ownership of private vehicles, with memberships available for both personal and business use.

[4] within a 800m radial catchment of a railway station or within 400m radial catchment of a bus stop with a service frequency of an average of 15 minutes or less during the morning peak hour in either direction)

The Parramatta DCP 2011 has a requirement for one car share parking space to be provided for residential developments with more than 50 residential units and in close proximity to railway stations and/ or high frequency bus routes. The Parramatta DCP states that one car share can be provided in lieu of three car parking spaces. It is noted that other councils (i.e. City of Canada Bay Council) have reported that "*each share car replaces between eight and 23 private car parking spaces, depending on the location of development*".

As such, provision of car share within the development could reduce the parking demand via lowering car ownership and thus traffic generated by the proposal as residents are less likely to default to vehicle trips for short distant travel (i.e. to shopping centre or M2 Busway Barclay Road interchange). It is recommended that this be investigated further with service providers with spaces provided in publicly accessible areas such as on-street or public/ visitor car parking. If required, it is further recommended that the initial provision of car share vehicle(s) is subsidised such that these facilities are available from day one.

7. TRAFFIC AND PARKING ASSESSMENT

7

7.1. Trip Generation Assessment

7.1.1. Overview

This section includes a detailed assessment of the anticipated trips that will be generated by the development and considers walking, cycling, public transport and vehicle trips, with reference to travel mode share targets identified for the development.

7.1.2. Traffic generation reference data

Residential

For the residential component, which is the main traffic-generating use proposed for the site, an analysis of high density residential sites included in the TfNSW *Guide to Traffic Generating Developments – Updated Traffic Surveys* (TDT 2013/04a) showed that all of the surveyed sites were located near train stations. The proximity of these sites to a train station would equate to a lower car driver mode share in comparison to current travel behaviour in North Rocks, especially in peak periods when commuters are more likely to use the train than drive. As a result, the use of person-trip rates (instead of vehicle-trip rates), along with the determination of specific mode shares for the site was considered more appropriate for this assessment to better reflect the anticipated travel patterns for the development, which will be unique (and differ from) the broader existing North Rocks area and the high-density residential sites surveyed by TfNSW.

Seniors Living

For the seniors living component, which comprises approximately 25 per cent of the overall residential GFA, TfNSW TDT 2013/04a provides traffic generation survey data on several independent living facilities around Sydney metropolitan and regional areas (based on a trip generation study prepared by Hyder for TfNSW in 2009), with a summary presented in Table 7.1.

Table 7.1: Vehicle trip rate summary (Hyder, 2009)

Peak hour	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Average
Weekday site peak	0.42	0.26	0.23	0.32	0.25	0.44	0.39	0.39	0.55	0.46	0.4
Network PM peak	0.36	0.06	0.05	0.24	0.17	0.23	0.31	0.23	0.03	0.33	0.2
Daily total vehicle trips	2.89	1.35	1.44	1.79	1.55	3.1	2.14	2.17	1.97	2.58	2.1

The Hyder survey results indicate an average site traffic generation of 0.2 trips per dwelling in the PM peak hour. The surveys also revealed that the AM peak trip generation rate is around 33 to 43 per cent of the site peak hour rate (i.e. 0.13-0.17 trips per dwelling).

Residential Aged Care

Aged care traffic generation rates are provided in the TfNSW *Guide to Traffic Generating Developments* 2002, which recommends a rate of between 0.1 and 0.2 trips per dwelling for housing for aged and disabled persons.

Retail/ Commercial

The retail/ commercial component is expected to be local specialty facilities aimed at the residents and workers from within the development and as such, unlikely to generate high traffic demand to and from the site. It may comprise a café, small general store, medical services and childcare that will operate ancillary to other land uses that form the proposal. Trip generation rates for small specialty stores have been adopted

from the TfNSW *Guide to Traffic Generating Developments* 2002, which provides rates for vehicle trips, as a conversative approach.

Summary

The person-trip rates and rates for other modes for the seniors living, aged care and retail components were deduced from the adopted vehicle-trip generation rates after applying the expected mode shares.

In summary, the projected generation of trips are based on the following:

- Residential component:
  - Person-trip generation rates for high density residential sourced from the TfNSW TDT 2013/04a, having consideration of the scale of development sites and its location.
  - Specific future mode share assumptions to determine vehicle-trip generation rates.
- Seniors living, aged care and retail/ commercial components:
  - Vehicle-trip generation rates sourced from TfNSW *Guide to Traffic Generating Developments* 2002 or TDT 2013/04a.
  - Specific future mode share assumptions to determine person-trip generation rates.

It is acknowledged that the peaks for the different uses do not always coincide with each other or with the road network peaks. Some consideration has been given to this, through discount factors. In addition, it has been assumed that the proposed full-size sports oval will generate trips outside of the road network peaks, and therefore not included in this assessment. This is on the basis that junior grade sports training typically occurs after school, whereas adult grade training occurs after 7pm (based on GTA analysis of similar facilities), with opportunity to limit bookings that commence or conclude in the peak hour. Likewise, it has been assumed that the community hub and library will not typically generate external trips during the road network peaks and is therefore also not included in this assessment.

7.1.3. Future mode share

The 2016 Census JTW data generally provides a broad picture of existing travel patterns at the local level. Analysis of existing JTW data showed an existing mode split of 64 per cent car driver and three per cent car passenger. Based on previous discussions for general site access and future planning to include a larger mode split to public transport and active travel, the private vehicle mode share is targeted to reduce to 49 per cent car driver (15 per cent reduction) and five per cent car passenger (two per cent increase), compared to the existing JTW characteristics of North Rocks. This includes a 10 per cent shift towards bus travel, which is expected to be delivered through:

- Expected residential demographics associated with the proposal compared to the lower density surrounds
- Future improvement in several public transport services/ frequencies in the region as outlined in Section 6.2.1.
- Change in travel behaviour linked to the transformation of Parramatta into a Central City, with associated improvements in transport access and disincentives for car users, i.e. limited supply of all-day commuter parking in the CBD.
- Opportunities linked to existing and future mix of uses in the surrounding area (employment, shopping, recreation, education)
- Proximity of the site to Parramatta CBD and other nearby strategic employment centres within 30 minutes travel by public transport.
- Proposed lower car parking provisions through using the Parramatta DCP rates as a maximum, instead of applying the Hills DCP (discussed in Section 7.3).

- Implementation of Green Travel Plan initiatives for all future residents and employees.

Overall, with the desired transformation of Parramatta CBD into the Central City as per the District Plan outcomes, assuming the adequate provision of public transport and alternative sustainable modes of transport, travel behaviour in North Rocks is expected to evolve to reflect current travel patterns in suburbs located at a similar distance from the Sydney CBD. Its commuting distance to other major employment centres via the M2 express bus services is another strategic advantage. A comparison of suburbs and targets for North Rocks is presented in Table 7.2.

Table 7.2: Mode share benchmark

Mode Share	North Rocks		Comparable Suburbs (2016)				
Benchmark	2016	Target 2026	Rosebery	Leichhardt	Balmain	Randwick	Kensington
Residents Mode Share (JTW)							
Vehicle Driver	64%	49%	46%	42%	38%	38%	35%
Vehicle Passenger	3%	5%	5%	4%	4%	3%	4%
Train	5%	5%	13%	10%	5%	7%	6%
Bus	12%	22%	18%	18%	23%	25%	28%
Ferry/Tram	0%	0%	0%	4%	6%	0%	0%
Walk only	1%	2%	5%	5%	6%	10%	10%
Bicycle/Other	1%	2%	2%	3%	3%	4%	3%
Worked at home/ did not work	13%	15%	10%	14%	15%	12%	15%
Employees Mode Share							
Vehicle Driver	73%	63%	51%	40%	53%	58%	60%
Vehicle Passenger	5%	5%	4%	4%	3%	3%	4%
Train	4%	4%	9%	14%	7%	8%	16%
Bus	3%	12%	10%	13%	7%	6%	6%
Ferry/Tram	0%	0%	0%	0%	1%	1%	0%
Walk only	2%	4%	10%	13%	7%	6%	4%
Bicycle/Other	1%	2%	2%	4%	2%	2%	2%
Worked at home/ did not work	13%	10%	15%	11%	21%	16%	9%
Bus services							
Distance to CBD	7.5 km	7.5 km	6.7 km	7.1 km	5.5 km	8.4 km	6.1 km
Bus time to CBD	23 min	23 min	30 min	25 min	20 min	25 min	21 min

Note: the distance and bus time for North Rocks is to Parramatta CBD, whereas for the benchmark sites it is to Sydney CBD.

It is noted that Harold Park, Forest Lodge, is a similar example of a residential/ mixed-use development near a CBD that relies on buses (and light rail). More ambitious mode share targets of 25 per cent car driver and 39 per cent public transport travel were adopted for Harold Park; with surveys completed in 2015 by GTA (three months after occupation of the first precincts of the development) suggesting 34 per cent car driver and 39 per cent public transport travel. The green travel plan for the Harold Park development was prepared by GTA and relied on similar integrated transport actions to those proposed for this development, such as lower parking provisions, car share memberships and public transport use incentives to work towards the target, with the public transport uptake being achieved in 2015. Therefore, the proposed mode share targets for this development are considered appropriate and achievable with the implementation of the integrated transport actions proposed as part of the study from day one.

For this assessment, it is assumed that:

- Trips generated in the peak hour by the residential and seniors living components would have the same mode share as the target residents' mode share for 2026.
- Trips generated in the peak hour by the retail and aged care (typically staff) components would have the same mode share as the target employees' mode share for 2026.

JTW has been used since it remains the most reliable data available at the travel zone level. However, analysis of travel patterns from the Household Travel Survey, available only at a higher scale for Greater Sydney, shows that car driver mode share in the peak hour considering all trips' purposes could be lower than that of the JTW. This transport assessment is conservative in using JTW mode shares.

7.1.4. Trip Generation by Mode

The quantity of dwellings and RACF beds in this section reflect the detailed land use and area schedule resulting from the master plan layout. These differ slightly to the indicative (rounded) yields reported elsewhere in the report, however, does not materially change the findings and recommendations of this study.

Residential Use

The selected person-trip rate for the analysis was the average peak network hour person-trips per bedroom, for developments of more than 50 apartments surveyed for the TfNSW traffic generation rates update (TDT 2013/04a). The proposed development is expected to yield roughly 2.14 bedrooms per dwelling. The TfNSW surveyed site yielded roughly 2.01 bedrooms per dwelling, with person-trip rates of 0.71 trips per dwelling in the AM peak and 0.65 trips per dwelling in the PM peak. Applying this data to the proposed development yields equates to a person-trip rate of 0.76 trips per dwelling in the AM peak and 0.69 trips per dwelling in the PM peak.

The future private vehicle mode share is expected to be 49 per cent for car driver as described in Section 6.3.2. Based on the above, the trips generated per mode and per dwelling for the residential component was calculated and is summarised in Table 7.3 and Table 7.4.

Table 7.3: Future residential trip generation rate per mode

Travel mode	Resident Mode Share	AM peak	PM Peak
Person-trips per dwelling	100%	0.76	0.69
Vehicle-trips per dwelling	49%	0.37	0.34
Bus-trips per dwelling	22%	0.16	0.15
Train-trips per dwelling	5%	0.04	0.04

Table 7.4: Future residential trip generation

Land use	Dwellings	Generated trips	
		AM peak trips	PM peak trips
Person-trips	935	706	647
Vehicle-trips		346	318
Bus-trips		150	140
Train-trips		37	37

The private vehicle trips per dwelling for the proposal was calculated to be 0.37 trips per dwelling for the AM peak and 0.34 trips per dwelling for the PM peak. Compared with TDT 2013/04a, the adopted rates are higher than the average vehicle trip rate in Sydney for high-density residential uses (0.15-0.19 trips per dwelling), however are considered a more realistic given the distance to the closest station (circa 3.5 kilometres to the future Carlingford Light Rail stop) and bus rapid transit station (circa one to 1.5 kilometres for the M2 Busway).

Seniors Living

Traffic generation rates of 0.14 trips per dwelling for the AM peak and 0.18 trips per dwelling for the PM peak have been adopted for this assessment that consider the average site traffic generation rate from the data presented in Section 7.1.2.

Based on the above, the trips generated per mode and per dwelling for the seniors living component was calculated and is summarised in Table 7.5 and Table 7.6.

Table 7.5: Future seniors living trip generation rate per mode

Travel mode	Resident Mode Share	AM peak	PM Peak
Person-trips per dwelling	100%	0.28	0.37
Vehicle-trips per dwelling	49%	0.14	0.18
Bus-trips per dwelling	22%	0.06	0.08
Train-trips per dwelling	5%	0.01	0.01

Table 7.6: Future seniors living trip generation

Land use	Dwellings	Generated trips	
		AM peak trips	PM peak trips
Person-trips	145	40	53
Vehicle-trips		20	26
Bus-trips		9	11
Train-trips		1	1

Aged Care

Noting that the TfNSW *Guide to Traffic Generating Developments* 2002 recommends rates of between 0.1 and 0.2 trips per dwelling for housing for aged and disabled persons, the traffic generation rates adopted for the seniors living component have also been adopted for the aged care component.

Based on the above, the trips generated per mode and per bed for the aged care component was calculated and is summarised in Table 7.7 and Table 7.8.

Table 7.7: Future aged care trip generation rate per mode

Travel mode	Employees Mode Share	AM peak	PM Peak
Person-trips per dwelling	100%	0.22	0.29
Vehicle-trips per dwelling	63%	0.14	0.18
Bus-trips per dwelling	12%	0.03	0.03
Train-trips per dwelling	4%	0.01	0.01

Table 7.8: Future aged care trip generation

Land use	Dwellings/ Rooms	Generated trips	
		AM peak trips	PM peak trips
Person-trips	80	17	23
Vehicle-trips		11	14
Bus-trips		2	3
Train-trips		0	1

Retail/ Commercial Use

The retail/ commercial component of the proposal is expected to be limited to a café, general store, medical services and childcare, primarily for the use of residents and workers from within the development. Such retail/ commercial uses are not proposed to compete with or detract customers from North Rocks Shopping Centre; or be considered a destination for customers travelling from outside the local area during the road network peaks.

The rate for the retail use component for the proposal is deemed to be similar to specialty stores, which produces 4.6 vehicle-trips per 100 square metres of gross leasable floor area (GLFA) for the PM peak, as per the TfNSW *Guide to Traffic Generating Developments* (2002). Additionally, based on the local nature of the retail uses proposed, it is assumed that approximately 80 per cent of trips in the morning and evening peak periods would be generated internally from the site and thus, would produce negligible new vehicle trips on the external road network. For the AM peak, the rate was set as 50 per cent of the rate for the PM peak.

The retail use is expected to generate four and eight person-trips in the weekday AM and PM peaks respectively, with half of these being vehicle trips.

Trip Generation Summary

The trip generation for the proposal is summarised in Table 7.9. The net additional vehicle trips were determined by deducting the existing surveyed traffic movements from the site (146 and 60 vehicle trips in the AM and PM peaks respectively).

Table 7.9: Future trip generation summary

Mode	Number of dwellings/ floor area	Generated trips		Net additional trips	
		AM peak	PM peak	AM peak	PM peak
Person-trips	935 dwellings 145 ILU 80 RAC 700 m^2 GFA retail	768	730	-	-
Vehicle-trips		379	363	233	303
Bus-trips		161	155	-	-
Train-trips		39	40	-	-

Based on the above, the proposal could potentially generate 365 to 380 vehicle trips during any weekday peak hour. This represents a net increase of 235 to 305 vehicles in any peak hour in addition to the traffic generated by the existing development.

7.1.5. Traffic Distribution and Assignment

The following in/ out splits were assumed based on proposed land uses:

- 80 per cent outbound and 20 per cent inbound for residential AM peak trips
- 20 per cent outbound and 80 percent inbound for residential PM peak trips
- 50 per cent outbound and 50 percent inbound for seniors living and aged care AM and PM peak trips

Based on the in/ out split assumptions, the traffic generation was further divided to understand directional trips as summarised in Table 7.10.

Table 7.10: Trip directional split

AM peak		PM peak	
Inbound trips	Outbound trips	Inbound trips	Outbound trips
87	294	278	87

The existing site traffic as part of the RIDBC uses (which has been surveyed as generating 146 trips (119 in and 27 out) in the AM peak and 60 trips (10 in and 50 out) in the PM peak) was then considered, with the net additional traffic by direction summarised in Table 7.11.

Table 7.11: Net increase in trips with the proposal by direction

AM peak		PM peak	
Inbound trips	Outbound trips	Inbound trips	Outbound trips
-32 [1]	267	268	37

[1] The proposed development is expected to generate less inbound trips in the AM peak compared to the existing use, however modelling has been completed assuming no change as a conservative approach)

The road network assignment of the traffic from the proposal was based on analysis of TfNSW strategic modelling outputs[5] for 2026 and 2036. Link volumes were analysed to understand the travel patterns of the North Rocks TZ, which were then used to determine traffic assignment along certain roads and routes for the site. Outputs from the strategic modelling for future years were used rather than current JTW data as future traffic conditions are likely to change given the current planning for more centres, priority precincts and other future growth. The traffic assignment is shown in Table 7.12.

Table 7.12: Assumed trip distribution

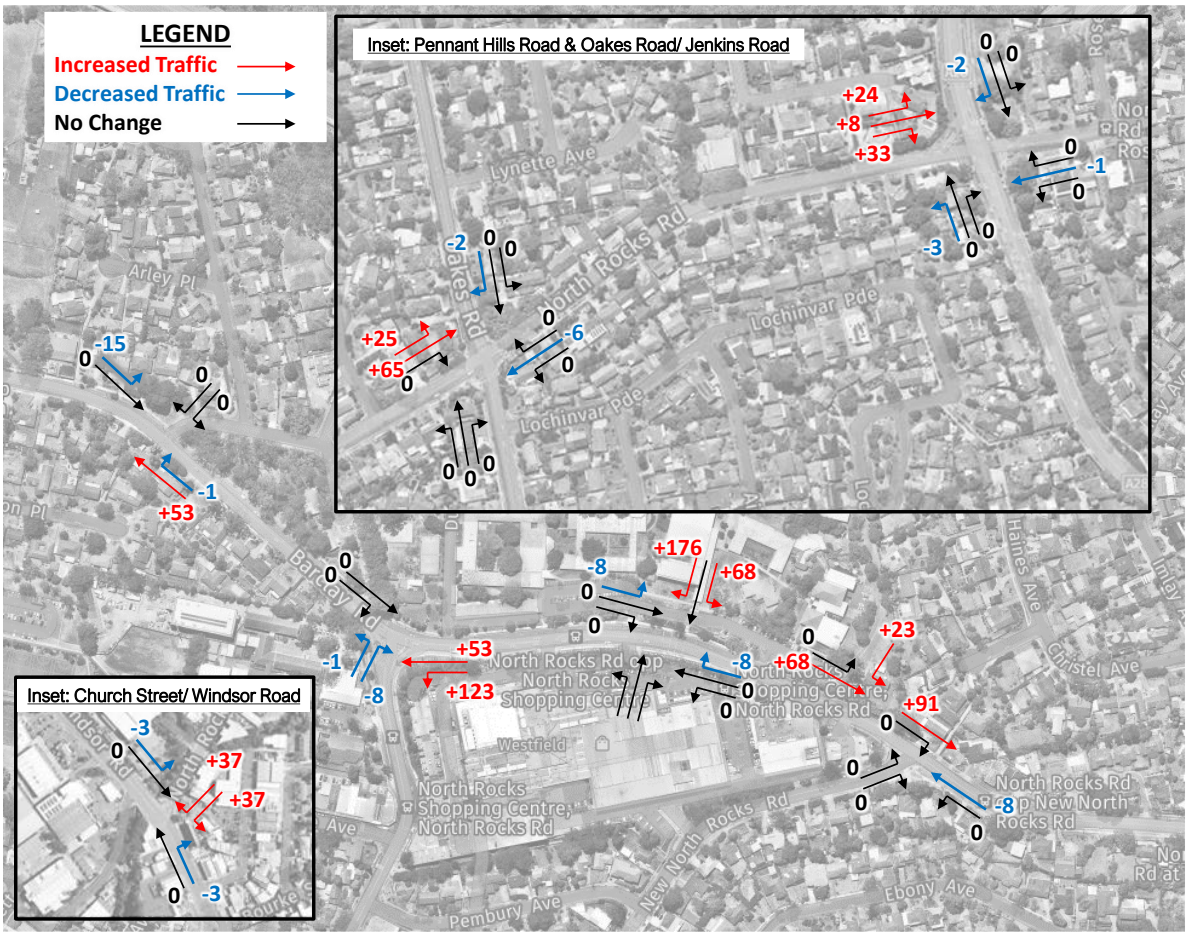
Road	AM peak		PM peak	
	Inbound	Outbound	Inbound	Outbound
Barclay Road	47%	20%	23%	36%
North Rocks Road (East)	25%	34%	34%	31%
North Rocks Road (South)	28%	46%	43%	33%

It has been assumed that the distribution of traffic to/ from North Rocks Road (South) onto Statham Avenue/ Bettington Road, Church Street and Windsor Road would be split 40:30:30 for both peak periods.

The anticipated change in traffic volumes at the modelled intersections as a result of the development is illustrated in Figure 7.1 and Figure 7.2. The figures illustrate the marginal additional traffic at key intersections further from the site, indicating that development traffic disperses quickly beyond the immediate intersections, with the additional traffic less than 40 vehicles per hour on any turning movement at the arterial road intersections. At all locations, the development traffic represents a small portion of the overall background traffic (existing and future).

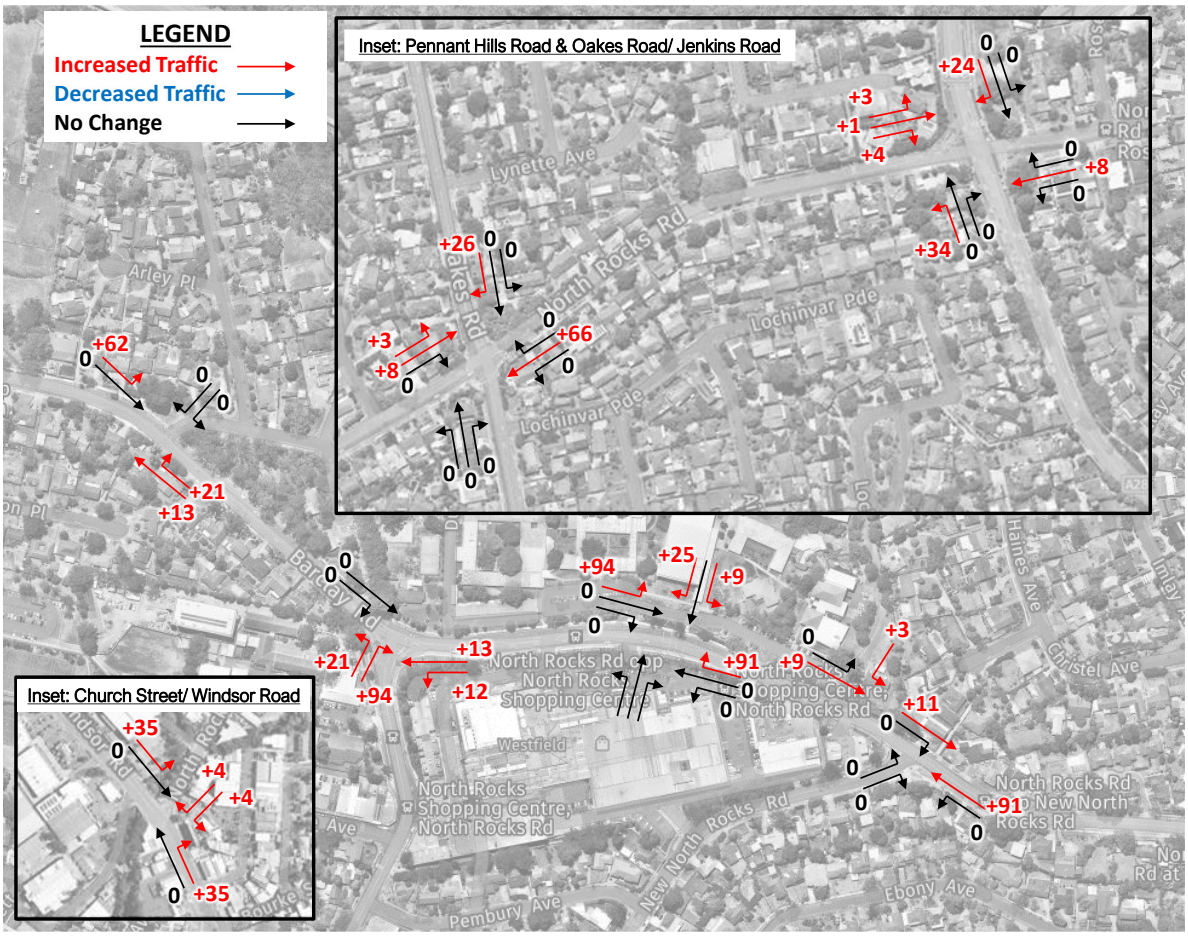
[5] RMS STFM volume plots for Land Use 2016 (Version 1.3)

Figure 7.1: Development Traffic – Weekday AM peak



Base source: Google Maps

Figure 7.2: Development Traffic – Weekday PM peak



Base source: Google Maps

7.2. Traffic Assessment

7.2.1. Methodology

The operation of the key study intersections have been assessed using SIDRA INTERSECTION[6] (SIDRA), a computer-based modelling package which calculates intersection performance.

SIDRA determines the average delay that vehicles encounter and provides a measure of the level of service. Table 7.13 shows the criteria that SIDRA adopts in assessing the level of service. Intersections operating at level of service D or better are generally considered to have acceptable delays.

Table 7.13: SIDRA level of service criteria

Level of Service	Average delay per vehicle (secs/ veh)	Traffic signals, roundabouts	Give way and stop signs
A	Less than 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required

[6] Program used under license from Akcelik & Associates Pty Ltd.

Level of Service	Average delay per vehicle (secs/ veh)	Traffic signals, roundabouts	Give way and stop signs
D	43 to 56	Near capacity	Near capacity, accident study required
E	57 to 70	At capacity, at signals incidents will cause excessive delays	At capacity, requires other control mode
F	Greater than 70	Extra capacity required	Extreme delay, major treatment required

This traffic assessment considers the 10 intersections identified in Section 3.3. A subset of the ten intersections has been modelled as a network due to close proximity, namely:

- North Rocks Road/ Barclay Road
- North Rocks Road/ Shopping Centre Access 1
- North Rocks Road/ Shopping Centre Access 2/ Site Access 1
- North Rocks Road/ Pedestrian Crossing
- North Rocks Road/ New North Rocks Road.

This section sets out an assessment of the existing as well as future anticipated operation of the study intersections for the projected 2026 and 2036 future year scenarios, in both the AM and PM peak periods. This assessment includes consideration of the following factors:

- SCATS data for sites 1443 (North Rocks Road/ Barclay Road) and 2985 (North Rocks Road/ New North Rocks Road) to develop average cycle times to adopt for SIDRA modelling
- Anticipated network growth based on TfNSW Strategic Transport Model output summaries
- The expected traffic generation by the proposal
- Recommended intersection treatments based on SIDRA modelling outcomes.

The assessment conservatively assumes 100 per cent of the development will be completed by 2026 in order to assess the full impact of the proposal on the road network in both the 2026 and 2036 scenarios. This is considered appropriate given the purpose of a planning proposal is to assess the strategic merit and site-specific merits of rezoning a site and construction staging details are yet to be determined (likely 15-20 years and typically addressed at the development application stage). Therefore, any assessment of the incremental/ staged impacts of the proposal will be covered as part of future development applications. Furthermore, if a lower development completion (i.e. 10-20 per cent) was assessed for 2026, any interim mode shares used for this scenario (i.e. somewhere between existing and targeted) would not result in more traffic generated than has been conservatively assessed in this report.

Calibration details for the SIDRA modelling are included in Appendix B to clarify or justify any departures from default parameters.

The results generated from the intersection analysis are the typical TfNSW requirements: Degree of Saturation (DOS), Level of Service (LOS), Average Delays and Queue Lengths. A summary is provided in Section 7.2.7 with the overall intersection performance reported for signalised intersections; and the worst movement reported for priority-controlled intersection.

7.2.2. Reference Demands

All input data has been sourced from either the 1 December 2016 traffic counts or Jacobs' modelling. The intersection of Pennant Hills Road/ North Rocks Road has been developed by GTA using 21 May 2019 data sourced from both traffic surveys and TfNSW signal timing data.

GTA has obtained both December 2016 and December 2018 data from TfNSW and conducted high level comparisons to ensure the original data is still relevant for the study area. The data was deemed to be within the five per cent margin of natural fluctuation and error.

Following advice received from TfNSW regarding the North Rocks Road/ Church Street intersection, GTA obtained SCATS traffic volume and timing data from TfNSW to update the model to reflect current operations. The SCATS traffic volumes were approximately 10 per cent lower than the data used by Jacobs and therefore the Jacobs data was deemed appropriate. Google traffic revealed that the intersection is beyond capacity in both peaks (due to downstream effects) and therefore the saturation flows have been adjusted to match approximately 100 per cent capacity, in-line with the SIDRA recommended calibration process. The extent of queuing appeared to interact with other intersections and therefore not calibrated. Instead, queue lengths are used for comparative assessment purposes only.

7.2.3. Future Demands

Future traffic growth for the surrounding roads for the years 2026 and 2036 were derived from the TfNSW strategic modelling. Growth on Barclay Road and North Rocks Road was compared to traffic volumes as surveyed in 2016. It was found that from 2016 to 2026, an overall traffic volume growth of 11 per cent is expected, increasing to 24 per cent overall growth from 2016 to 2036.

All future intersection traffic volumes have been developed based on the 2016 data scaled to 2026/ 2036, apart from the Pennant Hills Road/ North Rocks Road intersection which is based on 2019 data and scaled accordingly.

7.2.4. Local Intersection Upgrades

As part of the proposal, the existing mid-block pedestrian crossing between the site and shopping centre will be decommissioned and replaced by full signalisation of the intersection 30 metres to the west. The existing 'filtering' movements on North Rocks Road will remain. The signalised intersection would provide:

- safer vehicle access to and from the new development site and the shopping centre
- control over conflicting movements to and from the new development site, the shopping centre and the heavy traffic movements on North Rocks Road
- safe access for pedestrians to and from the new development site, the shopping centre and bus stops.

This new signalised intersection is being proposed as main site access on North Rocks Road and is approximately 200 metres east of the current North Rocks Road/ Barclay Road intersection and approximately 250 metres west of the North Rocks Road/ New North Rocks Road intersection. While it may cause platooning of traffic along the North Rocks Road Corridor, effective management of signal phasing can be utilised to minimise any adverse impacts on corridor performance caused by the platooning of vehicles. Platooning is currently being managed along the North Rocks Road corridor, with coordinated operation between the two existing adjacent intersections. This coordination also generates opportunities for filtered right turns at the proposed new access, allowing drivers to find appropriate gaps between the cycles and platoon arrivals. Therefore, filtered right turns were assessed at this proposed new site access.

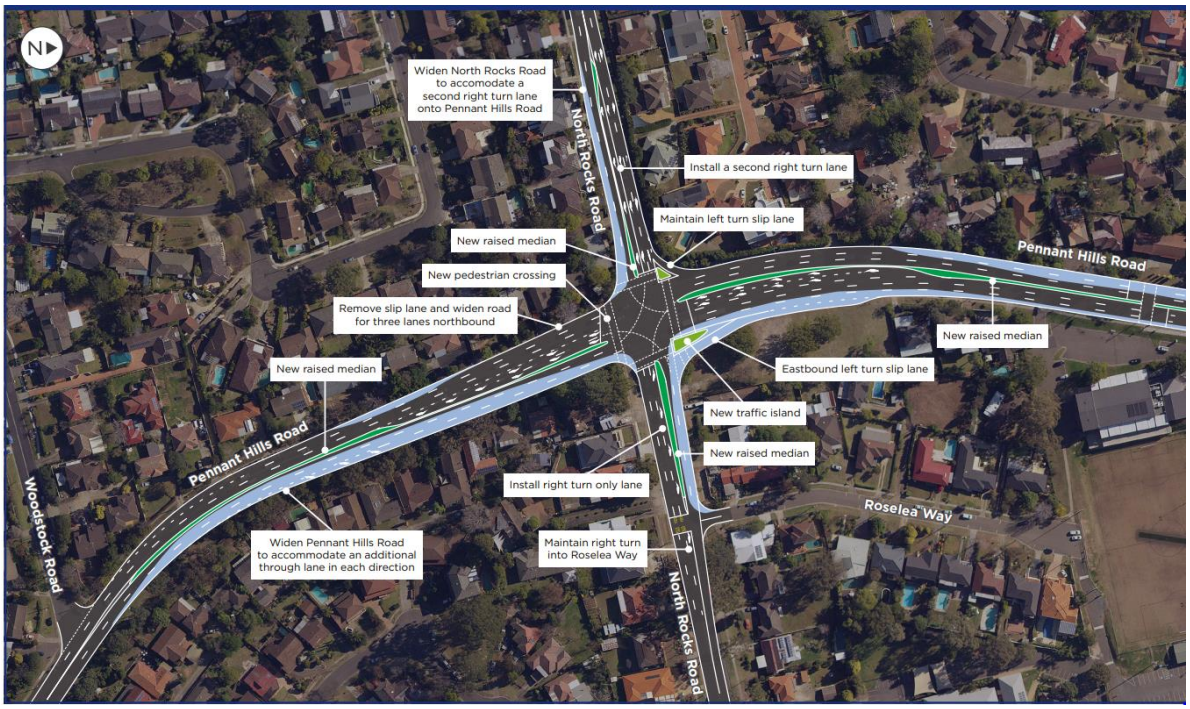
It is acknowledged that the detailed signal arrangements will require further discussion with the Network Operations Team at TfNSW during future development phases, with the assumptions and level of assessment prepared considered appropriate for this stage of the development proposal.

7.2.5. Regional Intersection Upgrades

It is understood that the NSW government is funding the upgrade of the North Rocks Road/ Pennant Hills Road intersection as part of the Urban Road Congestion Program. As of February 2021, TfNSW is continuing investigations following the community consultation stage, with improvements to intersection expected to

begin in late 2021 or early 2022. It is therefore anticipated that the upgrade works will have been completed by the 2026 model year and hence the upgraded layout of this intersection has been assessed for all future scenarios. The proposed upgraded layout is presented in Figure 7.3.

Figure 7.3: Proposed upgraded intersection of North Rocks Road/ Pennant Hills Road



Source: https://www.rms.nsw.gov.au/projects/01documents/pennant-hills-road-north-rocks-road-carlingford/pennant-hills-road-north-rocks-road-carlingford-have-your-say-notification-nov-2020.pdf

7.2.6. Disclaimers

This report does not consider external factors resulting from any other elements not specifically mentioned within this report.

The traffic volumes for the GTA developed models are based on survey data at the stop line. Calibration has been based on previously observed traffic conditions (2016 and 2019) and Google traffic. Model calibration does not include queues and delays beyond capacity.

7.2.7. SIDRA Modelling

Existing Base

The results for the existing conditions analysis are summarised in Table 7.14.

Table 7.14: Existing traffic conditions summary

Scenario	Intersection	DOS	Average Delay (sec)	95th Percentile Queue (m)	LOS
AM	1 Barclay Road/ Tiernan Avenue	0.51	10	104	A
	2 Barclay Road/ Baden Powell Place	0.34	21	19	B
	3 North Rocks Road/ Barclay Road	0.69	21	123	B
	4 North Rocks Road/ Shopping Centre Access	0.30	65	7	E

Scenario	Intersection	DOS	Average Delay (sec)	95th Percentile Queue (m)	LOS
	5 North Rocks Road/ Site Access/ Shopping Centre Access	0.23	57	13	E
	6 North Rocks Road/ Pedestrian Crossing	0.32	4	39	A
	7 North Rocks Road/ New North Rocks Road	0.93	16	94	B
	8 North Rocks Road/ Oakes Road/ Jenkins Road	1.03	72	359	F
	9 Church Street/ North Rocks Road	1.00	71	339	F
	10 North Rocks Road/ Pennant Hills Road	1.00	84	>500	F
PM	1 Barclay Road/ Tiernan Avenue	0.46	4	76	A
	2 Barclay Road/ Baden Powell Place	0.40	11	5	A
	3 North Rocks Road/ Barclay Road	0.90	28	216	B
	4 North Rocks Road/ Shopping Centre Access	0.59	88	15	F
	5 North Rocks Road/ Site Access/ Shopping Centre Access	0.53	97	6	F
	6 North Rocks Road/ Pedestrian Crossing	0.42	3	44	A
	7 North Rocks Road/ New North Rocks Road	0.91	22	149	B
	8 North Rocks Road/ Oakes Road/ Jenkins Road	0.99	82	477	F
	9 Church Street/ North Rocks Road	1.01	58	280	E
	10 North Rocks Road/ Pennant Hills Road	1.07	99	>500	F

North Rocks Road immediately surrounding the site is operating satisfactorily during road network peak hours. These modelling results generally reflect previously observed traffic conditions during the peak periods. Delays and queues are not excessive for the peak hour and are acceptable for the road environment.

The right turn movement out of the shopping centre access (Site 5) operates at poor level of service. However, it is noted that this delay is experienced by a limited amount of traffic and the 95 percentile queues are less than one vehicle (or six metres) at this right turn movement.

Based on knowledge of the area and Google traffic, the three North Rocks Road intersections with Church Street, Oakes Road/ Jenkins Road and Pennant Hills Road operate at capacity only during the peak periods which is reflected in the in the results presented. Since these intersections already experience capacity issues, any background growth for the years 2026 and 2036 will result in additional delays at these intersections. The future scenario assessments have been conducted to understand the additional impacts resulting from the development traffic and the potential mitigation that could offset the resultant impacts.

2026 Conditions

The future scenarios have been developed based on cycle lengths rounded to the nearest 10 and operates SIDRA optimised timing. The future demands have been compared across three separate scenarios listed in Table 7.15.

Table 7.15: Scenario details of future year assessments

Scenario	Details
Future Base	Average growth interpolated from year 2016 (or 2019) to 2026 and 2036 + upgraded layout at North Rocks Road/ Pennant Hills Road
Future plus development	Future base + development traffic + signalised main site access + decommissioning of pedestrian only crossing + inclusion of secondary egress
Future plus development and mitigation measures	Above with inclusion of potential measures to improve road capacity

As discussed in Section 7.2.3, the future growth demands have been extracted from high level strategic model supplied by TfNSW without specific details on movement growth. As such, the average growth of all movements has been utilised across the entire network.

Table 7.16 reproduces the study intersections and ID numbers to simplify the comparison summary tables.

Table 7.16: List of intersection ID numbers with reference locations

ID	Intersection
1	Barclay Road/ Tiernan Avenue
2	Barclay Road/ Baden Powell Place
3	North Rocks Road/ Barclay Road
4	North Rocks Road/ Shopping Centre Access
5	North Rocks Road/ RIDBC/ Shopping Centre Access (signalised access in development scenario)
6	North Rocks Road Pedestrian Crossing (decommissioned in development scenario and existing site ingress converted to egress)
7	North Rocks Road/ New North Rocks Road
8	North Rocks Road/ Oakes Road/ Jenkins Road
9	Church Street/ North Rocks Road
10	North Rocks Road/ Pennant Hills Road

The results for the 2026 conditions analysis are summarised in Table 7.17.

Table 7.17: 2026 traffic conditions comparison

		2026 Base				2026 plus development				2026 plus development and mitigation measures			
Scenario	ID	DOS	Average Delay (sec)	95th %ile Queue (m)	LOS	DOS	Average Delay (sec)	95th %ile Queue (m)	LOS	DOS	Average Delay (sec)	95th %ile Queue (m)	LOS
AM	1	0.58	10	126	A	0.59	10	131	A	-	-	-	-
	2	0.39	27	57	B	0.41	28	61	B	-	-	-	-
	3	0.87	25	169	B	0.94	30	209	C	-	-	-	-
	4	0.47	105	11	F	1.10	>200	30	F	-	-	-	-
	5	0.26	87	3	F	0.55	21	110	B	-	-	-	-
	6	0.36	4	43	A	0.03	9	1	A	-	-	-	-
	7	0.89	16	110	B	0.89	15	110	B	-	-	-	-
	8	1.01	101	>500	F	1.03	110	>500	F	-	-	-	-
	9	1.12	114	479	F	1.14	124	497	F	1.11	109	462	F
	10	0.96	64	470	E	0.99	74	>500	F	-	-	-	-
PM	1	0.55	6	110	A	0.56	6	113	A	-	-	-	-
	2	0.45	13	6	A	0.48	15	15	A	-	-	-	-
	3	0.90	32	238	C	0.91	38	243	C	-	-	-	-
	4	0.95	>200	33	F	1.25	>200	70	F	-	-	-	
	5	0.91	>200	13	F	0.84	17	180	B	-	-	-	-
	6	0.47	3	47	A	0.004	9	0	A	-	-	-	-
	7	0.92	23	191	B	0.89	22	221	B	-	-	-	-
	8	1.07	116	430	F	1.08	123	>500	F	-	-	-	-
	9	1.05	49	285	D	1.09	59	328	E	0.97	44	233	D
	10	0.95	58	475	E	0.95	59	475	E	-	-	-	-

The proposed site access traffic signals (Site 5) are expected to operate at a satisfactory level of service with the development traffic. With the additional development traffic, average delay at all sites is expected to remain comparable to 'without development' traffic conditions (an increase of less than 10 seconds in average delay) except for the western shopping centre access (Site 4) and Church Street/ North Rocks Road intersection (Site 9) in the PM peak hour. It is noted that Site 4 and Site 9 are operating at capacity without the proposed development traffic and additional traffic further exacerbates the delays experienced at this intersection.

It is expected that some vehicles previously utilising the western access (Site 4) may use the signals to turn right in and out of North Rocks Road. However, the more significant factor in the selection of access point by patrons will be the internal car park layout and connectivity. Therefore, only a minor shift in traffic is expected that better balances the delays across the shopping centre access points and hence, this increase in right turn traffic is not expected to significantly impact the operation of the proposed signal. Nonetheless, a sensitivity test has been carried out to assess the impacts of this increase in right turning traffic for the critical 2036 PM peak hour traffic conditions and is discussed in detail in the 2036 results section below.

Key findings for other intersections are detailed below:

- North Rocks Road/ Shopping Centre (western) access (Site 4):
    - currently operates at level of service E in the AM peak and level of service F in the PM peak; therefore the estimated background growth in traffic along North Rocks Road will likely result in the right turn movement out of the shopping centre experiencing further delays.
    - there is a potential to consider this access point as a left-in/ left-out only due to the provision of signals at the other access (Site 5). The following commentary is provided in this regard:
        - the internal circulation within the shopping centre does not permit vehicles to access car parking on the west side of the site via the new traffic signals due to the internal one-way eastbound traffic flows between these areas, which could result in underutilisation of this car parking area.
        - vehicles approaching from the west (i.e. Barclay Road) would no longer be able to directly access this section of the car park and would be required to complete a circa 550-metre detour via North Rocks Road (south of Barclay Road), Pembury Avenue and New North Rocks Road to access the undercover parking; or a 1.1-kilometre detour to access the rooftop parking on the west side of the site. This is unnecessary traffic circulation on the adjacent road network.
        - departing vehicles from this section of the car park will be able to use the new traffic signals to travel eastbound (i.e. turn right).
        - the primary advantage of converting this access to left turns only would be that it allows the right turn bay into the shopping centre at the proposed signalised intersection to be extended.
        - likewise, it may also improve safety for road users as there are fewer conflicting movements, however the nearby signals will assist right turns by creating gaps in traffic flow as is currently provided by existing signals nearby.
    - Whilst there are advantages in converting this access to left-in/ left-out, such consideration would need to be conscious of the accessibility impacts that it will have on the shopping centre operation, as well as the adjacent road network, due to shopping centre traffic redistributing to alternative access points and travelling through additional intersections. Such redistribution will increase the number of right turns at the North Rocks Road/ Barclay Road traffic signals, as well as at the new traffic signals. The current arrangement offers shopping centre patrons the most direct routes, allowing traffic to be dispersed across the road network via different access points. Considering this, any restriction to the access point cannot feasibly be recommended.
    - A sensitivity test was carried out at the new traffic signals using SIDRA. The proposed 40-metre right turn bay for the shopping centre is expected to accommodate the existing right turn volumes (58 vehicles per hour) in 2036 (95th percentile queue of 26 metres). An additional 50 per cent traffic turning right can be accommodated within the available right turn bay length, with an additional two seconds of green time. This does not compromise overall intersection operation and therefore there is sufficient flexibility in the proposed design.
- North Rocks Road/ Barclay Road intersection (Site 3):
    - is expected to reduce level of service from B to C with the development traffic (additional five seconds average delay) for the AM peak hour

- the intersection will continue to operate satisfactorily at level of service C for both peak periods, therefore the minor impact is not considered to warrant mitigation.

- North Rocks Road/ Oakes Road/ Jenkins Road intersection (Site 8):
  - is expected to continue to operate at capacity during road network peak periods with the development traffic
  - the additional development traffic increases the average delay at the intersection by 9 seconds in the AM peak, while in the PM peak the average delay increases by 7 seconds
  - the main issue in the AM peak is downstream blockage from Pennant Hills Road and the right turn volume from the west approach reducing through capacity given there is no dedicated turning lane. Any potential mitigation would involve either separating or removing (peaks only) the west approach right turn movement
  - noting the recent opening of NorthConnex and the planned upgrade at the Pennant Hills Road/ North Rocks Road intersection, the operating performance of this intersection may potentially improve as some through traffic from the North-western and Northern Suburbs redistributes from Oakes Road/ Jenkins Road back to Pennant Hills Road.
- Church Street/ North Rocks Road intersection (Site 9):
  - is expected to continue to operate at capacity in the AM peak with the additional development traffic
  - the additional development traffic increases the average delay at the intersection by 10 seconds in the AM and the PM peak.
  - the main issue in the AM peak is downstream blockage from beyond the James Ruse Drive and Windsor Road interchange
  - any potential mitigation to provide additional right turn capacity for the North Rocks Road approach would require partial land acquisition or resumed land on the northeast section. However, this does not have any significant benefits to improving the overall operation given the already congested traffic conditions during the peak periods. A better use of widened road would be to extend the left turn lane on North Rocks Road to provide a competitive advantage for bus services to Parramatta and improve reliability
  - the extension of the left turn bay is not expected to improve the overall operating conditions (in terms of levels of service) of the intersection but is expected to provide better storage capacity and reduce left turn delays. As both approach lanes currently turn right at the intersection, widening options are expected to slightly reduce right turn storage capacity, however this would not affect intersection operation
  - during the PM peak, there is spare capacity in the southbound direction for which SIDRA recommends southbound green time be redistributed to the northbound right turn movement. This change will facilitate the additional development generated traffic and can improve operations immediately by reducing queuing in the peak periods.
- North Rocks Road/ Pennant Hills Road intersection (Site 10):
  - is expected to continue to operate at capacity during road network peak periods with the additional development traffic
  - the additional development traffic increases the average delay at the intersection by 10 seconds in the AM peak, while in the PM peak the average delay increases by only one second.

- the main issue in the AM peak is downstream blockage from the Carlingford Shops and schools; whilst downstream blockage from the M2/ Cumberland Highway interchange is the main issue in the PM peak. Notwithstanding, both peak period operations can be improved by converting the south approach dedicated left turn lane into a shared through and left turn lane, which is in-line with the TfNSW Pinch Point Program proposal.

2036 Conditions

The same methodology for the 2026 has been completed for the 2036 future scenario.

SIDRA Network produced unstable results for 2036 Base traffic conditions due to the high volume of background traffic based on the adopted growth rates. These results were discussed with the software developer and it was suggested that Site 3 (North Rocks Road and Barclay Road intersection) be modelled as an independent site to address this the stability issue. This was adopted, with the other intersections still assessed as a SIDRA network.

The results for the 2036 conditions analysis are summarised in Table 7.18.

Table 7.18: 2036 traffic conditions comparison

		2036 Base				2036 plus development				2036 plus development and mitigation			
Scenario	ID	DOS	Average Delay (sec)	95th %ile Queue (m)	LOS	DOS	Average Delay (sec)	95th %ile Queue (m)	LOS	DOS	Average Delay (sec)	95th %ile Queue (m)	LOS
AM	1	0.68	12	172	A	0.68	11	171	A	-	-	-	-
	2	0.48	37	72	C	0.49	38	79	C	-	-	-	-
	3	1.01	42	282	C	1.11	47	383	D	-	-	-	-
	4	0.80	234	20	F	>1.5	>500	93	F	-	-	-	-
	5	0.41	151	4	F	0.63	21	124	B	-	-	-	-
	6	0.40	4	49	A	0.33	10	1	A	-	-	-	-
	7	0.88	17	142	B	0.88	15	144	B	-	-	-	-
	8	1.13	165	>500	F	1.16	188	>500	F	-	-	-	-
	9	1.23	172	>500	F	1.27	188	>500	F	1.25	177	>500	F
	10	1.08	102	>500	F	1.10	114	>500	F				
PM	1	0.60	6	140	A	0.60	6	144	A	-	-	-	-
	2	0.50	16	9	B	0.53	17	20	B	-	-	-	-
	3	0.94	49	411	D	0.99	61	430	E	-	-	-	-
	4	1.66	>500	123	F	>1.5	200	210	F	-	-	-	-
	5	1.50	>500	46	F	0.72	19	180	B	-	-	-	-
	6	0.52	2	48	A	0.47	9	0	A	-	-	-	-
	7	0.90	25	266	B	0.88	28	345	B	-	-	-	-
	8	1.20	186	>500	F	1.20	203	>500	F	-	-	-	-
	9	1.21	150	441	F	1.24	175	>500	F	1.09	65	346	E
	10	1.07	101	>500	F	1.07	101	>500	F				

The findings discussed for the 2026 scenarios are all relevant to the 2036 results, with the following additional comments resulting from the 2036 analysis:

- By 2036, the background traffic on North Rocks Road will increase to a level requiring signalisation at the main site access on North Rocks Road.
- The proposal, inclusive of signalisation of the site and shopping centre access, will improve capacity and safety by 2036.

As expected, since the development traffic was assumed to be 100 per cent by 2026, the relative difference in year 2036 results are generally identical. Therefore, the potential mitigation measures from a level of service perspective remain unchanged.

The average increase in delay with the development traffic is marginally higher than the 2026 results. With the additional development traffic, the average delay for all sites increases by 23 seconds or less except for the western shopping centre access (Site 4). As per the 2026 results, Site 4 will be operating at capacity for 2036 traffic conditions without the proposed development traffic and any additional traffic further exacerbates the delays experienced at this intersection.

Sensitivity Testing

It is acknowledged that providing signals at the site access (Site 5) may attract additional right turning traffic from the southern approach (traffic exiting the shopping centre). Presently (2016 volumes) there are 53 vehicles (combination of both west and east access points) turning right from the shopping centre access into North Rocks Road. It is noted that the current car park arrangement for the shopping centre does not allow vehicles parked in the western area to use the proposed traffic signals. Nonetheless, a sensitivity analysis has been completed based on a conservative 50 additional vehicles in the 2036 PM peak turning right from the shopping centre into North Rocks Road (should any future reconfiguration of the shopping centre car park permit this). The results are presented in Table 7.19.

Table 7.19: 2036 PM peak sensitivity test results comparison

		2036 Base (no signals)				2036 plus development				2036 plus development - sensitivity test			
Scenario	ID	DOS	Average Delay (sec)	95th %ile Queue (m)	LOS	DOS	Average Delay (sec)	95th %ile Queue (m)	LOS	DOS	Average Delay (sec)	95th %ile Queue (m)	LOS
PM	Site 5	1.50	>500	46	F	0.72	19	180	B	0.72	21	180	B
	Site 6	0.52	3	48	A	0.47	9	3	A	0.05	9	1	A
	Site 7	0.90	25	266	B	0.88	28	345	B	0.88	28	345	B

The results indicate the site access (Site 5) is expected to operate satisfactorily at level of service B with a marginal increase in delay (two to three second) due to the additional right turning traffic from south approach.

7.2.8. Traffic Impact Summary

The proposed signalised access point on North Rocks Road is expected to operate satisfactorily from a level of service perspective. Whilst the development traffic does not have adverse impacts on the local road network near the site, nor on the regional network (Sites 9 and 10), it adds traffic to North Rocks Road intersections that are already operating at capacity in the peak periods (Jenkins Road/ Oakes Road, Windsor Road, Pennant Hills Road) and are expected to worsen with any background traffic growth.

The traffic generated by the proposal is insignificant when compared to the forecast unconstrained background traffic growth occurring at a District and Metropolitan scale. As such, key road corridor upgrade

works are required whether or not the development occurs and are not triggered by the future renewal of the site, noting there are several road and intersection improvements already in planning or delivery that this proposal (and the broader area) will benefit from.

Only minor incremental increases in delays are expected for majority of the intersections along the North Rocks Road corridor (except for Site 4). Site 4 is one of several uncontrolled access points to North Rocks Shopping Centre and could be suitably managed by localised access controls. Potential measures to improve capacity at key intersections require either land acquisition or significant redistribution of traffic that may have marginal long-term benefits to the broader road network. Accordingly, they have not been modelled as part of the traffic assessment. A summary of the potential mitigation measures identified is provided below and requires consultation with relevant authorities as to whether further exploration is warranted given these intersection capacity constraints are a current/ existing issue:

North Rocks Road/ Oakes Road/ Jenkins Road intersection west approach:

- Remove west approach right turn movement during AM peak and investigate alternate route for the banned movement (i.e. restrict to right turn at Pennant Hills Road). This mitigation has the potential to greatly improve queues and delays in both peak periods although will potentially have knock-on effects at Pennant Hills Road.

Church Street/ North Rocks Road intersection northeast approach:

- Extend the left turn lane carriageway widening (by land acquisition and/or widening bridge structure) to provide to improve bus travel time and reliability at the expense of right turn capacity. This would involve significant works and addresses an existing queuing issue.

The proponent would work with relevant authorities to identify any relevant works contributions that will benefit not only the development, but also accessibility to/ from North Rocks (whether by car or other modes). Given the low additional traffic generated by the proposal compared to existing and background traffic growth at these identified intersections, such negotiations with relevant authorities would give preference to improving existing transport conditions closer to the site.

7.3. Car Parking Assessment

Table 7.20 provides an overview of parking rates required in The Hills DCP, Parramatta DCP and the *Guide to Traffic Generating Developments* (TfNSW, 2002). The Hills DCP 2012 applies to the site, however, given the change in local government areas, parking requirements from Parramatta DCP 2011 have also been assessed. The State Environmental Planning Policy – Housing for Seniors or People with a Disability, 2004 (SEPP Seniors) has been referenced for parking rates for the residential aged care facility.

Table 7.20: Comparison of parking requirements

Description	Use	The Hills Shire DCP	Parramatta DCP (outside 400 m of transit)	TfNSW[1] (medium density)
Residential Apartment Building/ Townhouse/ Terraces and Small Lots (parking spaces per dwelling)	1 bedroom	1.0	1.0	1
	2 bedroom[2]	2.0	1.25	1.2
	3 bedroom	2.0	1.5	1.5
	Visitors	0.4	0.25	0.2
Aged Care		Visitors – 1.0 per bed, Staff – 0.5 per staff, Ambulance – 1 space		
Community uses [3]		Empirical Assessment (1.0 per 100 m^2)		
Retail/ commercial (parking space per 100 m^2)		5.4	3.3	4.5
Oval [4]		Council Advice (50 to 80 spaces)		
Required parking		**2,594**	**1,757**	**1,674**

[1] *Guide to Traffic Generating Developments* (TfNSW, 2002).
[2] including independent living units assumed to have 2 bedrooms.
[3] based on the community facility being ancillary to the broader development.
[4] based on feedback received from City of Parramatta to Elton Consulting dated 27 May 2018.

Table 7.20 indicates that the proposal is required to provide 2,594 spaces based on Hills Shire Council parking requirements and 1,757 spaces based on City of Parramatta Council parking requirements. The City of Parramatta parking requirements are generally aligned with the parking requirements when adopting the TfNSW Guide 2002 rates (1,674 spaces).

Car parking for the oval will be provided along the periphery of the playing field as well as within a basement car park shared with the community and commercial/ retail uses.

In the current situation, the Hills DCP rates apply to the site. However, considering the location of the site near schools and shops, its medium/ high density character and proposed improved availability of public transport services, the Parramatta DCP rates would be more appropriate and is recommended as maximum provisions. Reduced rates would also better respond to the mode share objectives for the site and the strategy of encouraging sustainable modes of transport, further emphasising why the Hills DCP rates are not appropriate for the development.

Provisions for motorcycle parking, electric vehicle facilities, car share pods, loading and service vehicle areas, waste collection and emergency vehicle parking will all be considered as part of any future development application(s) for specific uses/ buildings across the site.

8. CONCLUSION

CONCLUSION

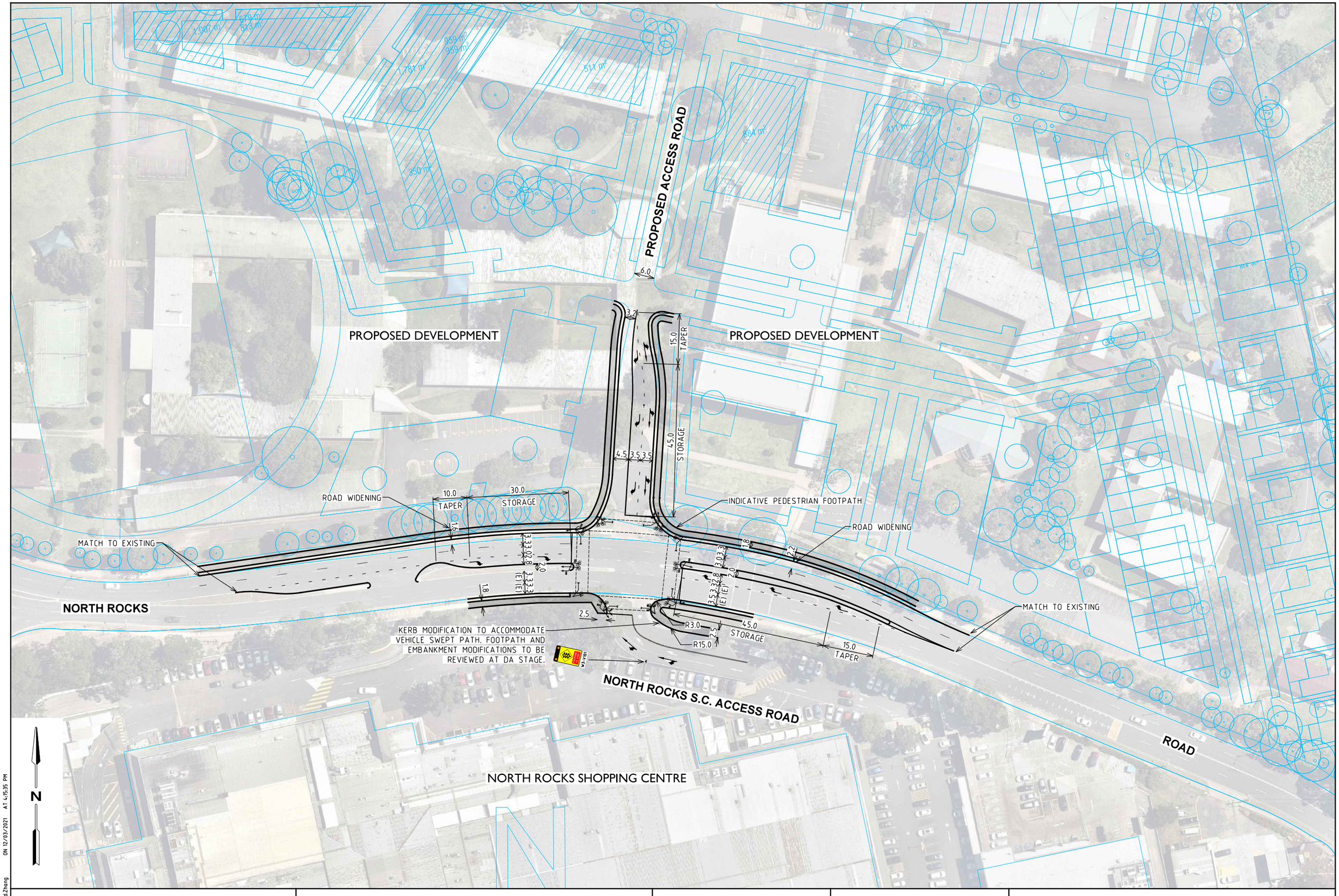
Based on the analysis and discussions presented in this report, the following conclusions are made:

- The Planning Proposal would facilitate a mixed-use development at 361-365 North Rocks Road, North Rocks, indicatively comprising 935 residential dwellings (690 apartments and 245 townhouses and free-standing houses), 145 seniors independent living units, a small residential aged care facility and 3,400 square metres of ancillary floor area comprising commercial/ retail and community facilities.
- The proposal would make a positive contribution in satisfying Central Sydney´s projected population growth and need for new dwellings in the Central City District. It is strategically located next to the fingers of the "Global Economic Corridor", between Parramatta and Macquarie Park. It is also adjacent to complementary uses (shopping, education, sports and recreation).
- Whilst the current public transport network is able to accommodate the increased patronage from a capacity perspective, several public transport improvements in terms of bus frequency, travel time and bus stop facilities are proposed, to ensure greater attractiveness of public transport and to achieve a sustainable mode share for the site.
- Improved walking and cycling infrastructure is proposed, with new links from the site to key local destinations, transport connections, and existing networks.
- The proposal is expected to generate 365 to 385 vehicle trips during the weekday peak hours, which represents a net increase of 235 to 305 vehicles over the traffic generated by the existing development. Furthermore, the proposal is also expected to generate 155-165 bus trips and some 40 train trips during the weekday peak hours.
- The proposal is required to provide 2,612 spaces based on the relevant Hills Development Control Plan parking requirements and 1,768 spaces based on City of Parramatta Council parking requirements. The City of Parramatta parking requirements are generally aligned with the recommended parking rates in the *Guide to Traffic Generating Developments* (TfNSW, 2002) (1,686 spaces) and should be adopted as maximum provisions.
- Provisions for motorcycle parking, electric vehicle facilities, car share pods, loading and service vehicle areas, waste collection and emergency vehicle parking will all be considered as part of any future development application(s) for specific uses/ buildings across the site.
- Various vehicle access options were assessed and found to be unsuitable from a site layout, urban design and/or community impact perspective, while also not resulting in a superior vehicle access and circulation outcome, or traffic movement/capacity outcome. The preferred vehicle access arrangement for the site is a new signalised intersection proposed at the existing eastern shopping centre access on North Rocks Road, which will achieve acceptable overall levels of service, whilst achieving significant improvements in safety and pedestrian connectivity between the two sites.
- The traffic generated by the proposal is insignificant when compared to the forecast unconstrained background traffic growth occurring at a metropolitan scale. As such, key road corridor upgrade works will ultimately be required whether or not the site is redeveloped (i.e. not triggered by the redevelopment), noting there are several road intersection improvements already in planning or delivery that this proposal (and the broader areas) will benefit from.

Overall, the site is in a good strategic location from a transport perspective, being adjacent to North Rocks Shopping Centre and within 30-minute commuting catchment of key employment areas such as Parramatta-Westmead, Norwest/ Bella Vista and Macquarie Park. It leverages existing schools and open space assets, provides community benefits such as a new sports oval and community facilities, as well as proposes a suite of improvements to existing transport infrastructure and services near the site to increase active and public transport trips and reduce the reliance on private vehicle trips. Finally, it provides a range of residential typologies that will bring a more diverse demographics to North Rocks. These demographics have been shown elsewhere to have lower reliance on private vehicle travel than the existing predominant low density residential dwellings.

On the basis of the above, the proposal has appropriate strategic and site-specific merit from a traffic and transport perspective and can be supported.

A. INTERSECTION CONCEPT DESIGN PLANS



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WARNING
BEWARE OF UNDERGROUND SERVICES
THE LOCATIONS OF UNDERGROUND SERVICES ARE APPROXIMATE ONLY AND THEIR EXACT POSITION SHOULD BE PROVEN ON SITE. NO GUARANTEE IS GIVEN THAT ALL EXISTING SERVICES ARE SHOWN.

DESIGNED	A. WHALE/ R.ZHANG/ E.YE
DESIGN CHECK	A. MODESSA
APPROVED BY	B. MAYNARD
DATE ISSUED	28 JANUARY 2021
SCALE	A3
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CAD FILE NO.	N174100-SK02-P8.dgn

361-365 NORTH ROCKS ROAD, NORTH ROCKS
PROPOSED SIGNALISED INTERSECTION

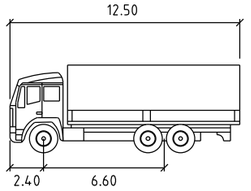
CONCEPT LAYOUT PLAN

DRAWING NO. N174100-SK02-01 SHEET 01 OF 04 ISSUE P8

SWEPT PATH KEY

- VEHICLE CENTRE LINE
- VEHICLE TYRE PATH
- VEHICLE BODY PATH
- 500mm CLEARANCE FROM VEHICLE BODY

ASSUMED SPEED 15km/h



HRV AS2890.2 meters

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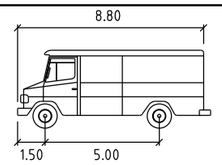
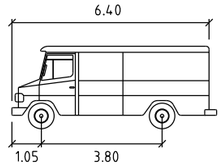
Track	: 2.50
Lock to Lock Time	: 6.0
Steering Angle	: 35.3



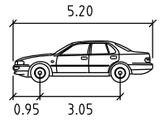
MRV AS2890.2 metres

Width	: 2.50
Track	: 2.50
Lock to Lock Time	: 6.0
Steering Angle	: 34.0



SRV metres

Width	: 2.30
Track	: 2.30
Lock to Lock Time	: 6.0
Steering Angle	: 38.0



B99 AS2890.1 metres

Width	: 1.94
Track	: 1.84
Lock to Lock Time	: 6.0
Steering Angle	: 33.9

PROPOSED DEVELOPMENT

PROPOSED DEVELOPMENT

NORTH ROCKS

NORTH ROCKS S.C. ACCESS ROAD

ROAD

NORTH ROCKS SHOPPING CENTRE

N

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361-365 NORTH ROCKS ROAD, NORTH ROCKS
PROPOSED SIGNALISED INTERSECTION

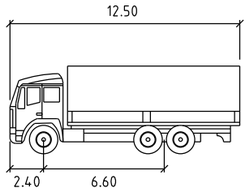
SWEPT PATH ASSESSMENT

DRAWING NO. N174100-SK02-AT01 SHEET 02 OF 04 ISSUE P8

SWEPT PATH KEY

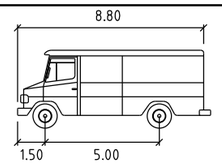
- VEHICLE CENTRE LINE
- VEHICLE TYRE PATH
- VEHICLE BODY PATH
- 500mm CLEARANCE FROM VEHICLE BODY

ASSUMED SPEED 15km/h



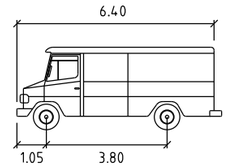
HRV AS2890.2 meters

Width	: 2.50
Track	: 2.50
Lock to Lock Time	: 6.0
Steering Angle	: 35.3



MRV AS2890.2 metres

Width	: 2.50
Track	: 2.50
Lock to Lock Time	: 6.0
Steering Angle	: 34.0



SRV metres

Width	: 2.30
Track	: 2.30
Lock to Lock Time	: 6.0
Steering Angle	: 38.0

PROPOSED DEVELOPMENT

PROPOSED DEVELOPMENT

NORTH ROCKS

NORTH ROCKS S.C. ACCESS ROAD

ROAD

NORTH ROCKS SHOPPING CENTRE

N

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361-365 NORTH ROCKS ROAD, NORTH ROCKS
PROPOSED SIGNALISED INTERSECTION

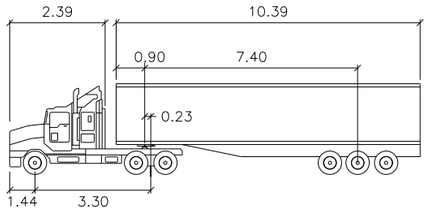
SWEPT PATH ASSESSMENT

DRAWING NO. N174100-SK02-AT02 SHEET 03 OF 04 ISSUE P8

SWEPT PATH KEY

- VEHICLE CENTRE LINE
- VEHICLE TYRE PATH
- VEHICLE BODY PATH
- 500mm CLEARANCE FROM VEHICLE BODY

ASSUMED SPEED 15km/h



ALDI SEMI 14M

	meters		
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Trailer Width	: 2.50	Steering Angle	: 32.4
Tractor Track	: 2.50	Articulating Angle	: 70.0
Trailer Track	: 2.50		

PROPOSED DEVELOPMENT

PROPOSED DEVELOPMENT

NORTH ROCKS

NORTH ROCKS S.C. ACCESS ROAD

ROAD

NORTH ROCKS SHOPPING CENTRE

N

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361-365 NORTH ROCKS ROAD, NORTH ROCKS
PROPOSED SIGNALISED INTERSECTION

SWEPT PATH ASSESSMENT

DRAWING NO. N174100-SK02-AT03 SHEET 04 OF 04 ISSUE P8

B. SIDRA MODELLING CALIBRATION TECHNICAL NOTES

B

TECHNICAL NOTE

SIDRA Model Calibration

GTAconsultants now Stantec

Project Code:	N174100	**Project Name:**	361-365 North Rocks Rd, North Rocks
Date:	13 April 2021	**Version No.**	2
Author:	Mansee Sachdeva		
SUBJECT:	**SIDRA Model Calibration**		
Page 1 of	4		

The role of the calibration process adopted for the project was to develop a model that is fit for purpose and produces results that can be used in the context of the overall study. This technical note outlines any assumptions and limitations of the Base model.

This technical note should be read in conjunction with the N174100 North Rocks Planning Proposal Transport Assessment prepared by GTA, now Stantec (GTA) as the model development and detailed modelled results are discussed in that report.

Modelling Assumptions

The following outlines a number of adjustments to model parameters and assumptions made during the process of model development and calibration:

- Sites chosen for intersection networking have been developed on the basis of the below conditions:
  - part of linked signals (as confirmed from SCATS data)
  - closely spaced intersections.
- All model cycle times are taken as the average cycle time (as observed from SCATS) during their respective peak hours. User given cycle times were applied to align SCATS phase timings to modelled timings.
- Unified cycle times for each respective linked network were adopted (as observed from SCATS data).
- Any specific phase time will not reach over the SCATS recorded maximum phase time
- Any recorded illegal movements are omitted from this modelling assessment
- Calibration has been based on previously observed traffic conditions and Google traffic. Model calibration does not include queues and delays beyond capacity.

Model Calibration and Validation

Signal timings obtained from SCATS Data and observed site conditions (site visits conducted in 2016, 2018 and survey videos) were the primary source of model calibration and validation.

Queue lengths are not reliable as a validation measure because quantifying the length of the queue can be difficult due to the ambiguity around the definition of a queue. However, general qualitative checks were conducted to ensure queues predicted by the model are an approximate match to those observed on-site during the various site visits.

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Site Observations

Some observed site conditions for AM peak period of 7:00am to 9:00 am are presented in Figure 1 to Figure 3.

Figure 1: Northbound Queues at New North Rocks Road – AM Peak

Figure 2: Westbound Queues at North Rocks Road – AM Peak

Figure 3: Signal Coordination in AM Peak – looking eastbound at North Rocks Road/ Barclay Road intersection

The following site observations were made:

- The morning peak queues at New North Rocks Road (south approach) were observed to extend just past the shopping centre access at around 8:30 am.
- In general, between 1-2 vehicles queues were observed at shopping centre access points at North Rocks Road. The signals at either end of the access points provided sufficient gaps for the vehicles to exit safely from the shopping centre to North Rocks Road.
- Traffic signals operated in good coordination along North Rocks Road. During most of the times vehicles travelling eastbound or westbound along North Rocks Road experienced a straight run through our study intersections.

Area Type Factor

Based on knowledge of the area and Google traffic, the three North Rocks Road intersections with Church Street, Oakes Road/ Jenkins Road and Pennant Hills Road operate at or exceed capacity during the peak periods. SIDRA recommended calibration technique refers to altering saturation flows to match approximately 100 per cent capacity, to model saturated intersection conditions. This has been adopted in the models by changing the area type factor for a select few intersection as shown in Table 1.

Table 1: Location of changes to Area Type Factor

ID	Intersection	Default	Adjusted AM	Adjusted PM
9	Church Street/ North Rocks Road	1.0	0.55	0.7
10	North Rocks Road/ Pennant Hills Road	1.0	1	0.87 (south approach)

These factors were applied to simulate the impacts of upstream queues that impact the operation of these intersections.

Extra Bunching and Gap Acceptance

During site visits and from the video observations at North Rocks Road, motorists were able to find sufficient gaps in through traffic to turn right from the shopping centre onto North Rocks Road. Therefore, the extra bunching factor was adjusted for the two-shopping centre access on North Rocks Road. The adopted factors are presented in Table 2

Table 2: Location of changes to Extra Bunching

ID	Intersection	Default	Adjusted AM	Adjusted PM
4	North Rocks Road/ Shopping Centre Access (western access)	0%	20%	20%
5	North Rocks Rd/ RIDBC/ Shopping Centre Access (eastern access)	0%	20% (west) 35% (east)	20% (west) 35% (east)

In addition, the Two Way Sign Control (TWSC) Calibration parameter was set to Low for these two intersections.

Calibration Summary

In order to simulate the on-ground conditions, calibration factors such as Area Type factors, Extra Bunching and Gap Acceptance parameters were adjusted in the Base SIDRA models. These factors have been carried to the future models.

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