Strategic Transport Study

St Leonards and Crows Nest Station Precinct

80017028

Prepared for

Department of Planning and Environment

3 October 2018

Cardno®

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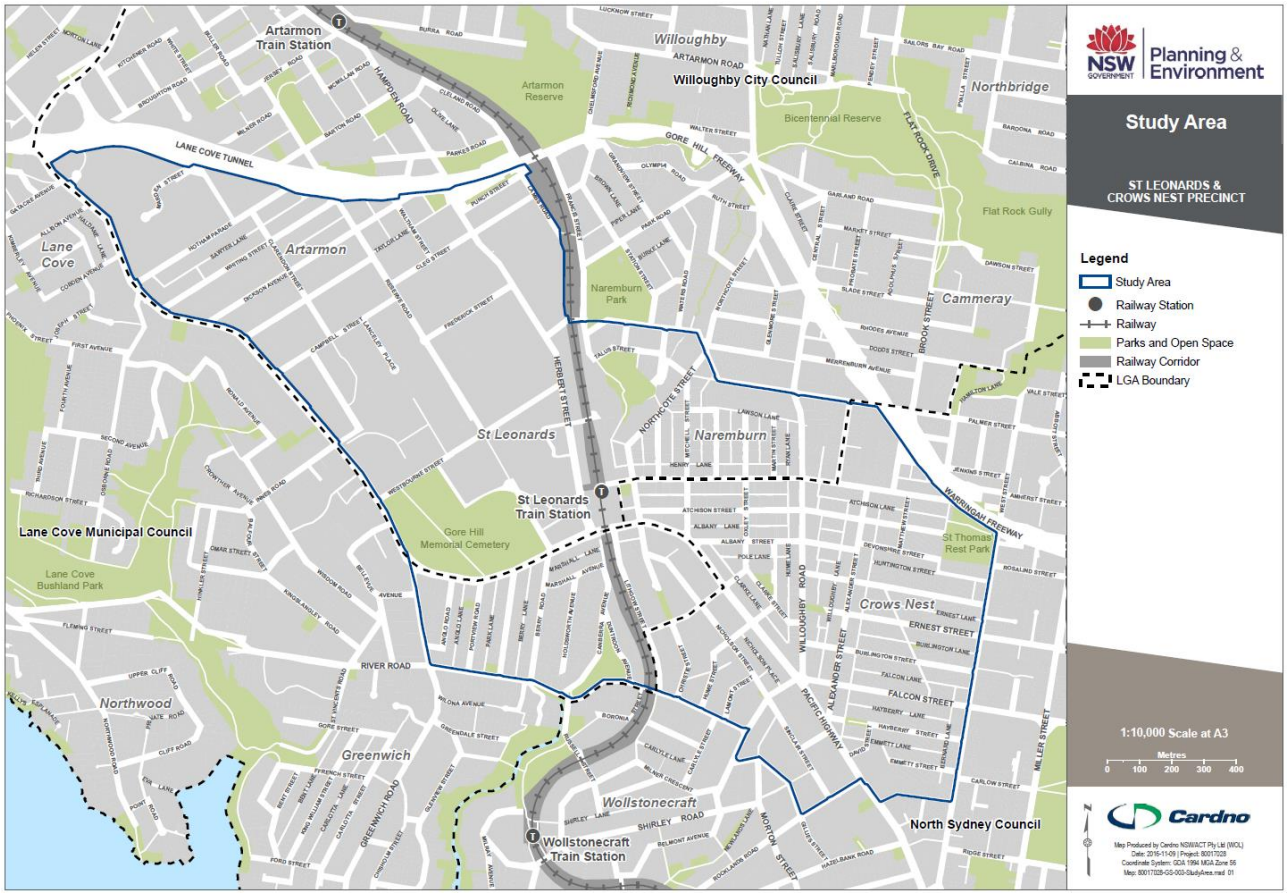
Executive Summary

The Department of Planning & Environment (DPE) engaged Cardno to prepare a Strategic Transport Study for the St Leonards and Crows Nest Station Precinct (Precinct). This Study will contribute to a Land Use and Infrastructure Implementation Plan (LUIIP) for the Precinct and help to guide future development and infrastructure investment.

The study commenced in October 2016 and has evolved during the study process and with emerging changes to the planning of Sydney.

The Precinct is located on the Lower North Shore, approximately 5km north of the Sydney CBD and 3.5km south of Chatswood. The Precinct includes all of St Leonards and parts of Artarmon, Naremburn, Greenwich, Crows Nest, North Sydney and Wollstonecraft. Three local government areas converge on the Precinct included Willoughby City Council, North Sydney Council and Lane Cove Council. A map is shown below.



Key transport infrastructure that already exists in the Precinct includes:

> Pacific Highway; a major route for general traffic and the majority of bus routes.

> North shore railway; this provides a high capacity public transport service with the approximate 30 minute catchment to stations including Waitara, Pennant Hills, Edgecliff, Sydenham and just short of Burwood.

> Warringah/ Gore Hill Freeway facilitates inter-region traffic movement and facilitates the bypass of through traffic external to the Precinct.

There are opportunities to improve pedestrian, cycling and public transport infrastructure to encourage more use of these modes and to support future growth in the Precinct.

The study commenced prior to the release of the NSW governments document, Future Transport Strategy 2056 (released March 2018). Notwithstanding, the strategic suggestions for the transport network align with the six state-wide outcomes, which are:

1. Customer focused	2. Successful places	3. A strong economy
4. Safety and performance	5. Accessible services	6. Sustainable

The proposed Sydney Metro City and Southwest (proposed to be operational by 2024) will provide significant capacity to the transport network in the Precinct with a station proposed at Crows Nest. Crows Nest Metro Station will increase the proportion of the Precinct within a convenient catchment of a high quality and high capacity rail transport infrastructure. This will improve the accessibility of the Precinct to other areas of Sydney and is expected to reduce the need for private vehicle ownership and car parking.

During the transport analysis, a preferred land use and built form outcome was still under investigation and had not been finalised. It was therefore necessary to make assumptions on a range of potential residential and employment growth scenarios in order to inform the recommendations in this report.

It is understood that the built form recommendations that are to be placed on exhibition in the LUIIP would result in a dwelling yield of approximately 6,800 dwellings to the year 2036 and this may alter the recommendations in this report. As at January 2018, there were approximately 7,200 dwellings in the Precinct

The extent and nature of the transport improvements recommended in this report will need to be reviewed once the built form and resultant growth solution is finalised).

The strategic level transport modelling undertaken for the Precinct as part of this study considers the 2016 population and four scenarios for the year 2036. These scenarios were determined with DPE over the course of the study as the areas limitations and opportunities were identified and understood. The employment figures were determined before the Greater Sydney Commission released the higher employment target of 63,500 jobs in 2036.

The final scenario is to be determined in the next stage of the study may not match any of the scenarios tested. The most suitable uplift is to be guided by more detailed analysis.

The tested scenarios include:

> **2016 (Base)**: The Precinct has approximately 15,000 residents and 45,600 jobs.

> **2036 Scenario 0 (S0)**: The lower end planned growth for the Precinct forecasts prior to this study. It is anticipated there would be 24,500 residents and 52,400 jobs in 2036.

> **2036 Scenario 1 (S1):** This proposes providing additional dwelling stock so the Precinct could accommodate 47,700 residents. Jobs would be consistent with S0.

> **2036 Scenario 2 (S2):** Uplift to provide dwellings with 40,600 residents and 61,400 jobs for the Precinct. (The Greater Sydney Commission proposed a 63,500 jobs high target after the modelling was undertaken, which is of a similar magnitude).

> **2036 Scenario 3 (S3):** A sensitivity analysis of S2 with additional 25% residents, 50,800, the job forecast of 61,400 remains capped.

The finding of the modelling indicates the road network (with some upgrade) has an ability to absorb the increased traffic expected although increase in demands along the Pacific Highway between Herbert Street and Christie Street place this part of the network under significant pressure under all scenarios. The demand is expected to exceed the capacity in this section of road for all tested future scenarios.

Future transport network strategic recommendations are listed as follows:

Pedestrian: Deliver new and upgraded pedestrian infrastructure to enhance movements within the Precinct to support both local trips (particularly between the St Leonards and Crows Nest centres where development is focused), and to access improved rail services within the critical 800 metre to one kilometre walking catchments. Provide missing pedestrian crossings at intersections where this does not have a significant detrimental impact on existing traffic conditions.

New footpaths will connect buildings in the commercial area east of St Leonards Station. Footpath widening and enhancement treatments are also recommended where needed. Pedestrian crossings are proposed at intersections that lack safe and convenient connections.

A link north of St Leonards Station is recommended. This would connect from the eastern side of the station at Chandos Street to the Herbert Street rail overpass and increase permeability for pedestrians and cyclists.

Bicycle: Integrate plans for bicycle facilities from the three councils to support trips to local centres as well as through movements along regionally significant routes connecting to other centres including Chatswood, North Sydney and the Sydney CBD. Opportunities for interchange between rail services with routes connecting to St Leonards Station and Crows Nest Station and supporting facilities included such as bicycle parking.

Proposed routes connect key destinations such as Royal North Shore Hospital, the Artarmon industrial area and the future Crows Nest Metro Station. They also connect to regional destinations such as south to Wollstonecraft and North Sydney and north-west to Lane Cove. These routes are a combination of shared paths, separated on-road paths and mixed traffic lanes. Improvements to the Precinct can integrate regionally for connectivity to Sydney CBD.

Rail: Support the use of the existing heavy rail services and proposed Sydney Metro by enhancing access via active transport and bus interchange to/ from stations.

Bus: Improve access to the network and accompanying services. Councils and state government should continue to work together to close gaps in coverage and service in the Precinct.

At St Leonards Station, suggestions address improvements to interchange between bus and rail as part of a future Lane Cove Council proposed interchange plaza development on the southern side of the Pacific Highway, and at the future Crows Nest Metro Station site, the improvements include consolidation of bus stops and consideration of pedestrian and bus customer conflict.

Road: It is considered appropriate that Roads and Maritime Services and Transport for NSW undertake and refine a Road Network Plan for the Precinct. This provides the depth of study required to identify issues, opportunities, and a more detailed level and to collate detailed feedback from key stakeholders.

Car parking: Car parking rates for future development, particularly close to the provision of high capacity and frequency public transport services should adopt a minimalist approach to reduce the impact of additional vehicle traffic in the Precinct. Investigate the feasibility of zero car parking allocations to some land uses.

The infrastructure schedule in this strategic report should be considered as initial suggestions only. These require further investigation to determine if the treatments are necessary and suitable dependent on the extent of uplift determined. The key purpose of specifying this transport infrastructure list of projects is to identify strategic opportunities and costing.

It is strongly recommended that DPE in conjunction with TfNSW and RMS undertake more detailed transport network modelling to analyse the impacts of the proposed land uses and development uplift and to test proposed infrastructure changes.

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1 Introduction

The Department of Planning & Environment (DPE) engaged Cardno to prepare a Strategic Transport Study for the St Leonards and Crows Nest Station Precinct (Precinct). This Study will contribute to a Land Use and Infrastructure Plan (LUIP), for the Precinct and help to guide future development and infrastructure investment.

DPE are also coordinating with other specialists to identify a comprehensive package of needs, urban form and infrastructure required to support development uplift including:

> Economic assessment;

> Heritage assessment;

> Building envelopes and shadowing;

> Street scaping and landscaping;

> Social infrastructure;

> Education facilities;

> Open space access;

> Public Domain; and

> Utilities.

There is high developer interest in the Precinct. Some of this could be attributed to the proposed Sydney Metro, which will have a station at Crows Nest and add significant capacity to the transport network and therefore development potential.

The Precinct is located at the convergence of three local government areas. This creates complexities in terms of facilitating land use and integrated transport network development in a coordinated approach that considers each development in the context of the whole Precinct instead of just one local government area.

By undertaking this study, DPE will help guide an integrated and coordinated plan between local government and state government to the approach and development in the Precinct over the next 20+ years.

The study explores a range of development options up to anticipated development yields that could occur around the year 2036.

The development of the Precinct considers the existing population, 2016 and four scenarios in the year 2036. These scenarios were developed by DPE over the course of the study as the areas limitations and opportunities were understood. The employment figures were determined before the Greater Sydney Commission release the higher employment target of 63,500 jobs in 2036.

The final scenario is to be determined in the next stage of the study may not match any of the scenarios tested. The most suitable uplift is to be guided by more detailed analysis.

The tested scenarios include:

> **2016 (Base)**: The Precinct has approximately 15,000 residents and 45,600 jobs.

> **2036 Scenario 0 (S0)**: The planned growth for the Precinct based on forecasts prior to this study. It is anticipated there would be 24,500 residents and 52,400 jobs in 2036.

> **2036 Scenario 1 (S1):** This proposes providing additional dwelling stock so the Precinct could accommodate 47,700 residents. Jobs would be consistent with S0.

> **2036 Scenario 2 (S2):** The most likely uplift potential based on likely limitations identified in the study to provide dwellings with 40,600 residents and 61,400 jobs for the Precinct. The Greater Sydney Commission proposed 63,500 jobs after the modelling was undertaken, which is of a similar magnitude.

> **2036 Scenario 3 (S3):** A sensitivity analysis of S2 with additional 25% residents, 50,800, the job forecast of 61,400 remains capped.

The scenarios figures have been assessed in the Public Transport Project Model version 5 (PTPM5) to understand the impacts on the transport network and assist to identify infrastructure needs.

1.1 Purpose of this report

The Precinct is a major employment centre in Sydney. The Precinct is nominated as one of Sydney's strategic centres and is located in the Global Economic Corridor. There are plans to grow residential and employment populations, and to enhance the health and education precinct around Royal North Shore Hospital and St Leonards TAFE.

A number of recent planning proposals for the Precinct advocate for increasing development densities, particularly around the St Leonards Train Station and the future Crows Nest Metro Station.

The Strategic Transport Study presents the transport networks that currently service the Precinct. With consideration to the opportunities and constraints identified, the Study presents, at a strategic level, the transport infrastructure required to support the anticipated growth and development in the area and integrate with proposed transport projects such as Sydney Metro City and Southwest. The Study is set out in the following structure:

1. **Introduction**: Provides study background, scope and objectives, and outlines the Precinct. The transport opportunities and constraints identified as part of this study are also presented in this section.
2. **Policy, planning and travel context**: Presents an overview of the relevant state and local government planning documentation relevant to the Precinct and documents existing travel behaviours, demands and trends
3. **Existing transport network:** Presents details on the current operation of the transport network, including information on existing infrastructure and services by mode.
4. **Strategic transport network evaluation**: Presents the analysis and outcomes of strategic modelling completed for the Precinct, with consideration given to different development scenarios prepared by DPE. This section contains future travel demands and the results of intersection modelling.
5. **Future transport network**: Presents strategic infrastructure suggestions for the Precinct by mode. The key purpose of nominating infrastructure is for costing purposes, more detailed studies are required to identify the most suitable infrastructure.
6. **Conclusion:** Summary and next steps.

1.2 The Precinct

The Precinct is located on the Lower North Shore, approximately 5km north of the Sydney CBD and 3.5km south of Chatswood. The Precinct includes all of St Leonards and parts of Artarmon, Naremburn, Greenwich, Crows Nest, North Sydney and Wollstonecraft. Three local government areas converge on the Precinct included Willoughby City Council, North Sydney Council and Lane Cove Council. A map of the Precinct is shown in **Figure 1-1**.

Within the Precinct lies a wide range of land uses. These include

> Industrial and bulky goods in Artarmon,

> TAFE, Bradfield Senior School and Health Precinct including the Royal North Shore Hospital on the western side of the railway line,

> Mixed use land uses in close proximity to St Leonards Station, and

> Retail in Crows Nest and along the Pacific Highway.

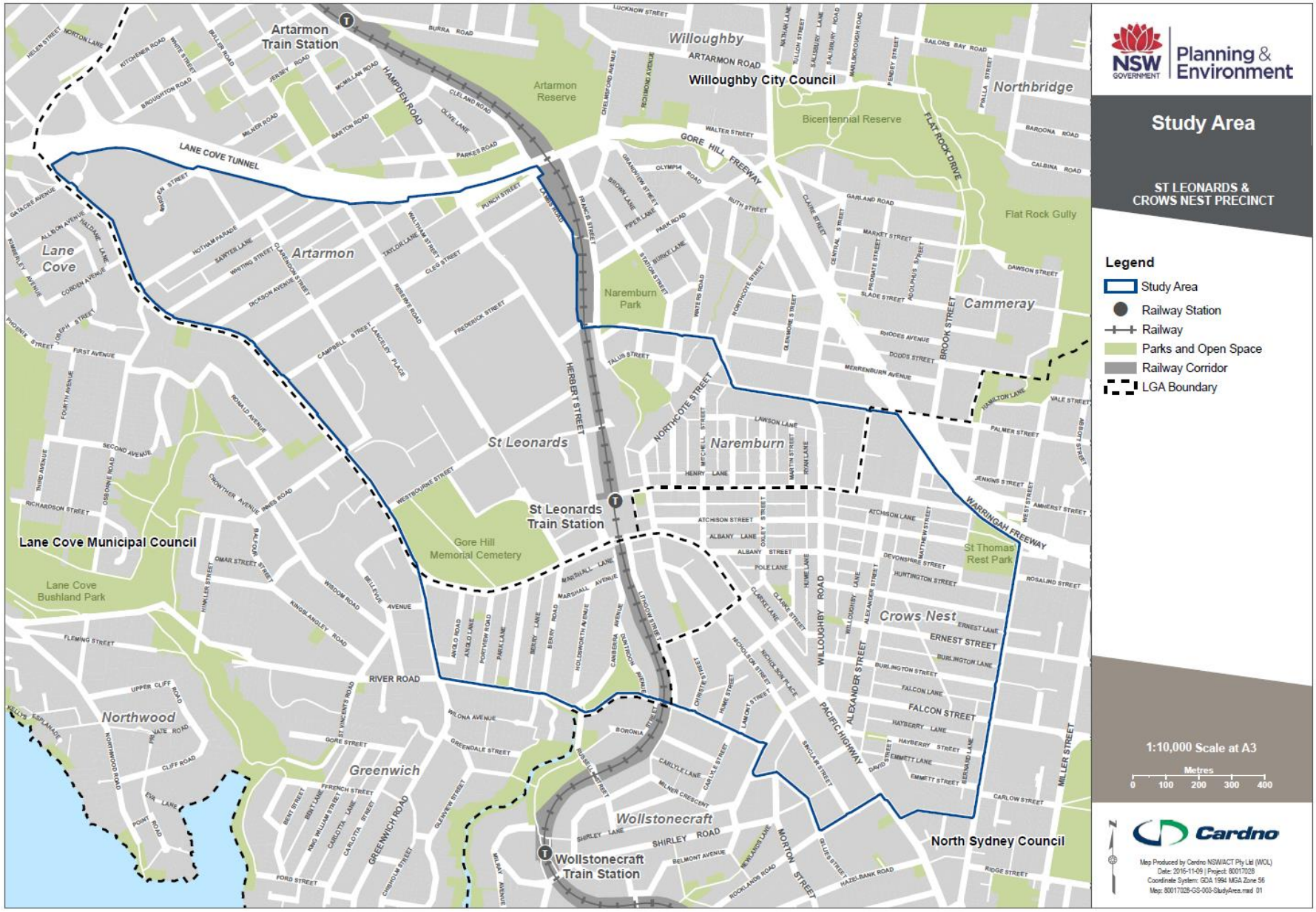
Low density/ detached housing is the predominant land use in the suburbs of Naremburn and Crows Nest. Medium to high density residential housing exists in Wollstonecraft and St Leonards and more high density residential uses is developed for St Leonards and Crows Nest.

The area is supported by public transport services including the T1 North Shore and Northern Line and a number of local and suburban bus services providing connections to other areas of Sydney. The Precinct is set to change in the future with the development of the metro line providing a station in Crows Nest.

Given the Precinct has a relatively high concentration of jobs and its proximity to Macquarie Park, Chatswood, North Sydney and Sydney CBD, it is in a desirable location for further residential and employment growth.

This study is the first step to plan for any transport infrastructure and associated services in a coordinated manner. This will support growth and take advantage of the existing and planned transport networks. This could include providing more through site links to aid the permeability of the Precinct and street reconfigurations to support lower environmental impact transport modes.

Figure 1-1 St Leonards and Crows Nest Precinct



1.3 Scope and limitations

The scope and limitations of the study are outlined as follows:

> The Precinct as shown in **Figure 1-1**.

> Review existing transport policy context and objectives including:

- Review of key policy documents in the broader context of the Precinct.
- Planned and committed transport infrastructure and services in the Precinct.

> Review existing transport conditions, opportunities and constraints including:

- Current land use.
- Relevant demographic and socioeconomic information to inform understanding of current travel task and how it may change.
- Current transport behaviour, including demand by purpose, mode, distance.
- Current transport networks and their performance, and safety.
- Current freight access, performance and interface issues and impacts.
- Key constraints and opportunities that could occur as part of renewal and revitalisation with a key focus on pedestrian amenity, safety and accessibility.

> Develop a transport infrastructure, service and policy strategy

- The functionality specification such as the Movement-Place typology that encompasses urban renewal and transport system needs and respects the place based aspirational outcomes of strategic planning initiatives.
- The future travel demands and behaviours that result from the proposed growth.
- An integrated, multi-modal network response that can cater for the proposed uplift in demand and is suited to the context of the locality as an established inner ring location.
- A clear staging plan for the delivery of transport infrastructure, services and policies to cater for the proposed growth.
- A delivery and funding framework that has costs and fits within the proposed staging plan.
- Strategic cost estimates for the proposed transport improvements to inform an infrastructure strategy and contributions framework.

> Undertake transport modelling utilising the Public Transport Project Model (PTPM).

- Modelling of study team developed land use (residential and employment) scenarios in 2036 using PTPM.
- Scenarios based on a higher level understanding of the precinct at the time of the study. More detailed analysis and scenario refinement is to occur in the next stage of the project.
- Critical review and interpretation of data from strategic modelling, with clear justification of no or any adjustment to outputs.

1.4 Consultation

The consultation process of this study aimed to determine each stakeholder's understanding of the transport network, current transport plans for the Precinct and discuss existing issues, constraints and opportunities, as well as obtain input on the preferred infrastructure and policy initiatives for implementation. Representatives attended consultation sessions from key stakeholders, which included:

> Transport for NSW (TfNSW);

> Roads and Maritime Services (Roads and Maritime);

> North Sydney Council;

> Lane Cove Council;

> Willoughby City Council;

> Sydney Metro Delivery Office;

> Specialist disciplines in the study team.

A summary of the feedback (broken down by transport mode) is presented in **Table 1-1.**

Table 1-1 Summary of consultation feedback

Transport mode	Summary of feedback
Pedestrian	▪ Walking demand is an important consideration for the Precinct given the planned development, transport infrastructure and anticipated uplift. ▪ The study is an opportunity to prioritise walking and deliver improvements for the pedestrian experience. ▪ Redeveloped blocks should incorporate through site links to improve permeability and activate laneways. ▪ The Pacific Highway presents a major barrier to pedestrians crossing from one side to the other due to a lack of crossing opportunities and long wait times. Different solutions include additional at-grade crossing legs, signal re-timing and grade separated crossings.
Cycle	▪ Cycling is popular along the Pacific Highway as this is a direct route. ▪ Conflict between cyclists and buses is an issue given the space is shared along the Pacific Highway. ▪ Cycle trips are limited in the Artarmon Industrial area, however the Gore Hill Freeway facility is popular and heavily used. ▪ Planning for cyclists should focus on connectivity to existing routes, and providing facilities at transport interchanges including St Leonards Station and Crows Nest Metro Station.
Bus	▪ The Pacific Highway is a difficult corridor to operate bus services on due to congestion and lack of priority. ▪ Bus stops rationalisation along the Pacific Highway is recommended to align with Sydney's Bus Future – 400 metre access catchment. ▪ The growth in bus demand will require new layover facilities – the current site at North Sydney is at capacity. ▪ Integration of the bus network with rail station interchanges will be an important consideration for both St Leonards Station and Crows Nest Metro Station – this presents an opportunity for a network redesign.
Rail	▪ The proposed Crows Nest Metro Station will provide an improved rail service into the Precinct. ▪ The Metro interchange precinct should focus on access to bus services and prioritising pedestrian and cycle access and movement in the surrounding area. ▪ Sydney Metro City and Southwest will result in a shift from existing public transport services through the Precinct. The freed capacity can be used for additional peak-time services and counter-peak running.
Roads and traffic	▪ Movement and Place functions should be used to present the road network hierarchy and street functions, both for the current and future scenario. ▪ The function of streets surrounding St Leonards Station and Crows Nest Metro Station should be reviewed and updated – these streets will evolve to more people-based functions as development uplifts occur. ▪ Potential road network improvements include new link roads to alleviate the lack of connections, particularly across the railway line. ▪ Rat-running is a problem across the Precinct and this should be a consideration where new road links are proposed to reduce the risk of inducing more traffic on local streets.
Parking	▪ There are differences in the on-street parking management policies and DCPs of the three councils. Agreement between the councils on the future parking policy for the Precinct will be beneficial, with consideration to site-specific requirements. ▪ There is support for increased car share facilities across the Precinct, both on-street and within new developments.

Transport mode	Summary of feedback
	▪ Decoupled parking is an option for the Precinct, where parking facilities for new developments are provided in one centralised location, and accessed or used only by those who really need it. ▪ Consideration should be given to restricting parking along the Pacific Highway to improve performance of bus services. ▪ Parking controls and limits to the provision of more car parking will assist to limit the impact of increased traffic. This must be supported by the improvement of active and public transport.

Additional consultation occurred towards the end of the study to understand support for and table infrastructure suggestions for further investigation.

1.5 Opportunities and constraints

This section provides an overview of the opportunities and constraints applicable to the Precinct, determined through the background review and consultation with stakeholders including local councils. References are made to different sections of this report where applicable.

A summary of the opportunities within the Precinct is provided in **Table 1-2**.

A summary of the constraints within the Precinct is provided in **Table 1-3**.

Table 1-2 Transport opportunities

Category	Summary of opportunity	Description	Report section
Travel demand	High public transport commuting mode share from Precinct	A high proportion of St Leonards residents commute by public transport. The percentage of commuters using public transport in Crows Nest is expected to increase with the introduction of the Crows Nest Metro Station.	2.2.5
	Demonstrated cycling demand for direct routes	Cycling along the Pacific Highway is popular among Strava (cycling and running smart phone application) users; there is an opportunity to harness Council plans to provide dedicated facilities along this corridor for the demonstrated demand.	3.4.5
	Popularity of, and support for, car share	More car share facilities will help to reduce private vehicle ownerships and is an initiative supported by the three Councils.	3.10
	Reduced need for vehicle ownership and parking spaces due to the potential for developments close to major transport interchanges	The introduction of the Crows Nest Metro Station will further reduce the need for private vehicle ownership in the Precinct. More of the Precinct will be in close proximity to a high quality rail service. Innovative parking rates and charges can be considered for this well connected Precinct.	2.1.8.1
Infrastructure and services	Increased and improved pedestrian crossings.	Both the Pacific Highway and the T1 rail corridor act as barriers to pedestrian movement. There are opportunities for additional crossing points across both corridors. Pedestrians can also experience long wait times at intersections and a lack of pedestrian crossings at some signalised intersections. The most common crash type involving pedestrians in the Precinct were those where a pedestrian was hit by a vehicle in the near side lane. Future development plans should consider pedestrian desire lines and the best location to provide new or improved crossing facilities. Access to the future Crows Nest Metro Station should consider high capacity low delay DDA compliant crossing(s) across the Pacific Highway.	2.1.7.1 3.3.3 3.3.1
	Comprehensive current and future public transport network	The existing public transport network provides good service coverage and frequency, with many major destinations within a 30-minute travel catchment. The proposed Sydney Metro will improve public transport access to destinations across Sydney even further.	3.5
	The introduction of Sydney Metro could be accompanied by optimisation of train and bus services	The shift of many passengers from the T1 North Shore line to the Sydney Metro presents an opportunity to reduce and reallocate services to meet other demands. There is also support for bus lanes along Pacific Highway to provide buses with priority and increase bus throughput.	2.1.7
	Roll out of TfNSW Wayfinding Strategy will improve public transport legibility	Improved public awareness of public transport options and access in the Precinct can be achieved with the rollout of Transport for NSW's Wayfinding Strategy.	3.3.5
	The Herbert Street bridge over the railway line could be extended to provide an active transport link to Chandos Street.	Providing the link over the railway line would reduce trip distance and travel time for pedestrians and cyclists travelling between Herbert Street and Chandos Street.	For further investigation

Category	Summary of opportunity	Description	Report section
	Crows Nest Metro Station provides the opportunity for the provision of cycling infrastructure.	The station should be equipped with secure bicycle parking and amenities. Bicycle network improvements and more routes to access the Crows Nest Metro Station can encourage greater cycling mode share.	2.1.7
Land use development / design / parking	Proximity to other strategic and district centres	The Precinct is located close to the Sydney CBD and other strategic centres including North Sydney, Chatswood and Macquarie Park. It is also in Sydney's Global Economic Corridor.	1.2
	Freight accessibility to Artarmon from Gore Hill and Warringah Freeways	The Artarmon sub-precinct has good heavy vehicle access from nearby regional roads such as the Lane Cove Tunnel and Gore Hill Freeway. This limits the heavy vehicle movements on the Pacific Highway.	3.7
	Urban renewal will allow for street reconfiguration to accommodate walking and cycling facilities, reduce vehicle space, provide new through site links, pedestrianise areas and activate laneways.	New developments in the Precinct should be used as an opportunity to deliver improvements to the pedestrian and cycle network, new through site links and active laneways. The new Sydney Metro Crows Nest Station could be accompanied by urban renewal of Oxley Street adjacent to the site (this is occurring during construction) to enhance pedestrian amenity.	1.2
	Steep grades south of the Pacific Highway support the case for an underpass to the Crows Nest Metro Station	An underpass below the Pacific Highway may be easier to achieve because of the steep grades to the south. Pedestrian journey time will also be less affected than grade-separated crossings which require additional travel time for vertical movements. Grade separated crossings require design considerations to ensure personal security of users and are most feasible at the time of land redevelopment.	2.1.7
	Diverse land uses support trip containment	The mix of land uses and the high proportion of Precinct residents who also work in the area support local trips by active transport.	1.2
	Extension of the public transport catchment with the new Sydney Metro station at Crows Nest	The new Crows Nest Sydney Metro Station at Crows Nest will extend the public transport catchment, increase capacity, and present an opportunity to improve bus and train interchange.	2.1.7
	Proposed plazas over the railway line will reduce barriers to movement	Proposed open space plazas over the railway line at St Leonards will enhance freedom of movement for pedestrians and cyclists across the railway line. The plaza proposed south of the Pacific Highway could also include an upgrade to the Lithgow Walk underpass to improve amenity and directness.	2.1.7
	Coordinated transport planning approach	A coordinated transport planning approach across the three Councils will ensure the delivery of integrated transport infrastructure, policy and management solutions for the Precinct as a whole.	1.1

Table 1-3 Transport constraints

ID	Summary of constraint	Description	Report section
Travel demand	Railway network at capacity in peak periods.	The existing T1 North Shore and Northern Line can only accommodate a maximum of 20 trains per hour in each direction. Some services are already at capacity in the AM and PM peaks and Sydney's Rail Future notes that total capacity will be exceeded on large sections of the line between Chatswood and Wynyard by 2031.	3.5.2
	Road network traffic congestion.	There is congestion on local and distributor roads in the Precinct in peak periods.	2.1.6.1
	Future traffic growth on the Pacific Highway.	Future developments in the Precinct are anticipated to result in additional vehicle trips along the Pacific Highway, which is already affected by congestion during peak periods.	Subject to further assessment
	High private vehicle mode share for St Leonards workers.	The majority of Precinct workers drive there. The continued car use for the majority of work trips contributes to traffic congestion and high parking demand.	2.2.5
	High demand for on-street parking.	There is high demand for on-street parking in the Precinct by commuters who have driven to work in the area. Commuters driving to St Leonards are parking in nearby non restricted residential streets up to a kilometre away from their workplaces. Vehicle circulating occurs after 8:00am when spaces are largely occupied. In Artarmon, on-street parking is heavily utilised by local car smash repair companies.	3.9
Infrastructure and services	Pedestrian security in some areas.	Pedestrian security concerns in some areas, particularly the Artarmon sub-precinct, due to a lack of land use activation, poor street lighting and passive surveillance could prevent some walking trips. At St Leonards the pedestrian underpass beneath the Pacific Highway could present personal security concerns late at night.	3.3.1
	Lack of pedestrian connectivity between land uses in the west of the Precinct	The west of the Precinct including Gore Hill Oval, TAFE NSW, Royal North Shore Hospital and the Gore Hill Cemetery consists of large non permeable blocks. This increases walking distance and time. Direct access to the west from the proposed Crows Nest Metro Station is limited to where Oxley Street intersects with Lithgow Street and the railway line. Development on the opposite side of the railway line limits the ability to provide crossing infrastructure.	3.3.5
	Lack of pedestrian amenity and inconsistent facilities	Pedestrian amenity is lacking in some parts of the Precinct, where facilities are not provided or are non-compliant, affecting pedestrian comfort and safety. Inconsistency in pedestrian facilities, including paving, lighting and street furniture across the three Council areas varies the pedestrian experience.	3.3.1
	Steep grades on pedestrian routes south of the Pacific Highway	Pedestrian trips south of the Pacific Highway are affected by steep grades which can reduce the attractiveness of walking for some people include mobility impaired or those who are carrying shopping.	3.3.1

ID	Summary of constraint	Description	Report section
	Poor amenity of grade-separated crossing	The grade-separated crossing linking Lithgow Street to St Leonards Station has poor pedestrian amenity, limited surveillance and does not serve as a direct route across the Pacific Highway	3.3.1
	Inconsistent wayfinding	Wayfinding for pedestrians and cyclists is inconsistent across council boundaries and could contribute to a lack of route legibility.	3.3.5
	Lack of cycling infrastructure on direct routes, and cycling network gaps	The current cycling network is incomplete and has many gaps. There is a lack of cycling facilities along major road corridors with the most direct routes like the Pacific Highway where some cycling demand is concentrated, as indicated by Strava demand maps.	3.4.2
	Limited TfNSW bus coverage in Artarmon	The Artarmon sub-precinct is not well served by TfNSW bus services. Council and privately operated shuttles run in the area to substitute the missing public transport coverage.	3.6
	Inconsistent and some poorly located bus stop facilities and bus interchange amenity	Bus stop infrastructure like shelters, seating, signage and Tactile Ground Surface Indicators (TGSI) is inconsistent across the Precinct. At some locations, facilities are poorly located and restrict pedestrian movement. The St Leonards bus interchange (south side of Pacific Highway) has poor amenity and legibility for waiting passengers.	3.6.4
	Reduced public transport services, including at night and on weekends	Bus and train service frequencies are lower during weekends and late at night which reduces the attractiveness of public transport at these times.	3.5.2 3.3.5
	Lack of efficient interchange between modes	Efficient interchange between different modes at St Leonards is affected by a long walking distance between north and west-bound buses and the train station and a lack of integration between train and bus timetables, particularly during non-peak periods.	3.6.1
	Lack of taxi ranks and pick up / drop off zones	Informal taxi pick up along the Forum side Pacific Highway can interfere with buses accessing the bus stop. There is limited opportunities to facilitate these movements legally on the north side of Pacific Highway in St Leonards. There are no safe locations to stop and pick up drop off on the southern side of the Pacific Highway near St Leonards Station.	3.5.2
	Restricted vehicle movements to enter and exit the Pacific Highway.	Through routes from River Road to the Pacific Highway are limited to Park Road and Parkview Road. The banned right-turn movement off the Pacific Highway in many locations causes traffic circulation in local streets, in particular in the Crows Nest village area.	Subject to later detailed assessment
Land use development / design / parking	Lack of integrated transport planning	There is a lack of a coordinated transport planning approach for the St Leonards sub-precinct due to the different planning controls, management policies and proposed infrastructure projects from the three Councils. This report is a first step towards integration.	1.1
	Lack of pedestrian activity at night-time	There is a lack of weekend and night-time activity in Artarmon and St Leonards sub-	3.3.1

ID	Summary of constraint	Description	Report section
		precincts which discourages walking as a mode choice at these times.	
	Road tolls contribute to through traffic	The toll imposed on the Falcon Street entry and exit ramps leading to the Warringah Freeway could act as a deterrent for motorists, who may prefer to use the Pacific Highway to access and leave the Precinct.	3.2.2

2 Policy, planning and travel context

2.1 Future strategic planning context

2.1.1 A Plan for Growing Sydney

A Plan for Growing Sydney (2014) outlines the transport infrastructure actions required to support Sydney's growing population. St Leonards is identified as a strategic centre for health, education and office-based employment markets, with many new jobs forecast for the Precinct. The plan identifies the need to remove pinch points in the transport network to increase accessibility and boost business activity. Further growth in employment and housing opportunities are also considered in association with the plans for a Sydney Metro train station at Crows Nest.

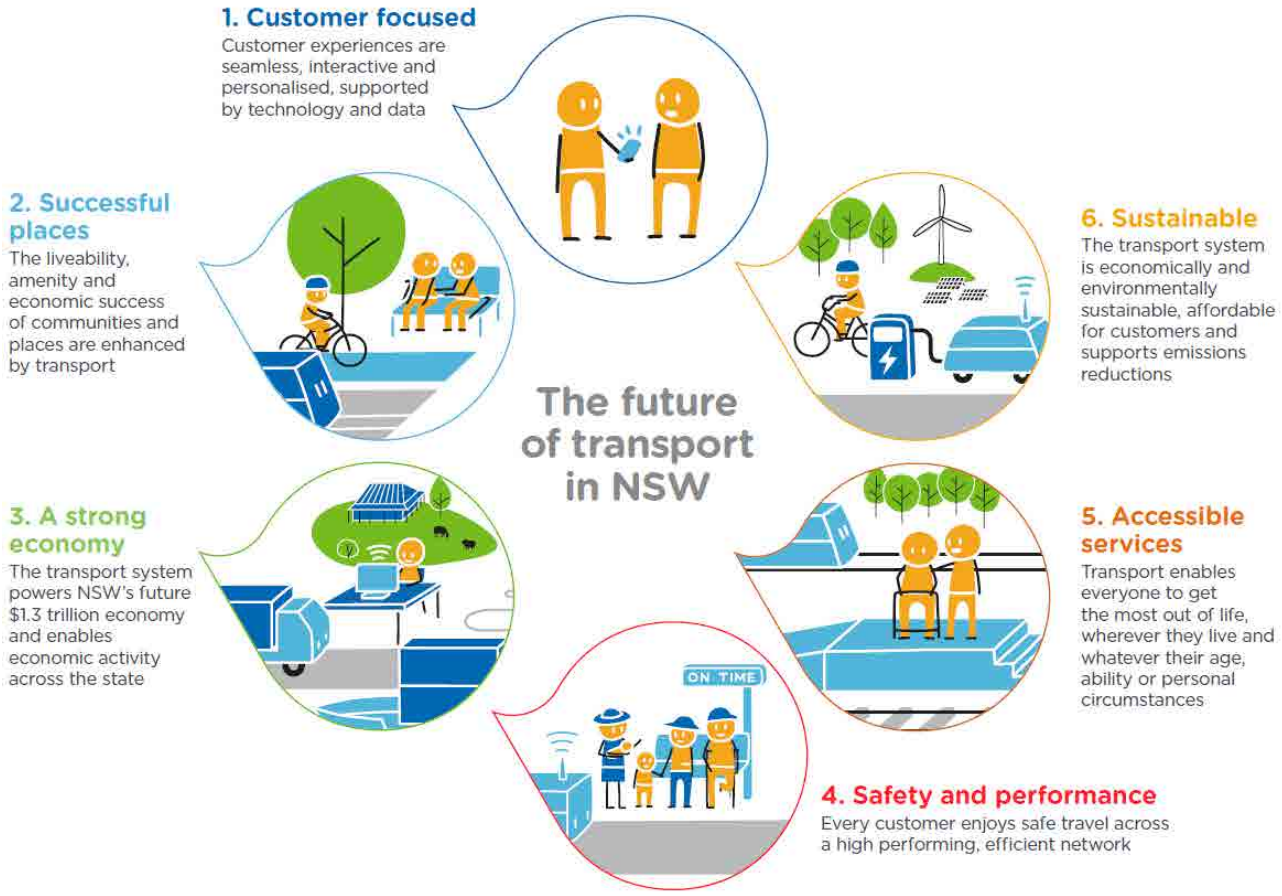
2.1.2 NSW Long Term Transport Master Plan

The NSW Long Term Transport Master Plan (TfNSW, 2012) identifies the need to improve the integration of all transport modes to maintain Sydney's role as a centre of economic and social activity. Seamlessly connected infrastructure that provides a high level of service is important for all major employment centres, such as St Leonards, to improve accessibility to local services and public transport. The plan notes the importance of a new North West rail link in connecting North West residents to North Shore employment centres like St Leonards. The residential and economic growth of St Leonards as a major employment hub is supported by this plan which mandates customer-focused transport planning practices.

2.1.3 Future Transport Strategy 2056

Future Transport Strategy 2056 post dates the analysis undertaken in this study. Notwithstanding, this Transport Strategy aligns with the vision, which is built on six state-wide outcomes as shown in **Figure 2-1**.

Figure 2-1 Six state-wide outcomes



Future Transport Strategy 2056, TfNSW, March 2018

2.1.4 North District Plan

The Greater Sydney Commission's North District Plan (March 2018) provides a 20 year vision of northern Sydney's housing and employment growth opportunities and the supporting transport infrastructure plans. The strategic centre of St Leonards forms part of the identified 'North District', which generally includes the Sydney metropolitan area on the north side of Sydney Harbour/ Parramatta River.

Actions proposed include:

> leverage the new Sydney Metro Station at Crows Nest to deliver additional employment capacity

> grow jobs in the centre

> reduce the impact of vehicle movements on pedestrian and cyclist accessibility

> protect and enhance Willoughby Road's village character and retail/restaurant strip

> deliver new high quality open space, upgrade public areas, and establish collaborative place-making initiatives

> promote synergies between the Royal North Shore Hospital and other health and education-related activities, in partnership with NSW Health, and

> retain and manage the adjoining industrial zoned land for a range of urban services.

2.1.5 Other relevant State plans and strategies

Other state plans with relevant strategic transport directions for the Precinct include the NSW State Infrastructure Strategy and the future modal strategies: Sydney's Walking Future, Sydney's Cycling Future, Sydney's Rail Future and Sydney's Bus Future.

The NSW State Infrastructure Strategy prepared by Infrastructure NSW presents a vision for NSW in 2031 and makes recommendations for infrastructure investment over the next 20 years, grouped by short, medium and long-term priorities. The 2014 update to the Strategy provides detail of the proposed funding strategy for infrastructure projects, the Restart NSW Fund. The 2014 update identifies additional priorities for transport infrastructure including the need for the metro line and a second harbour crossing.

Sydney's Rail Future notes the importance of enhancing the capacity of the rail network with the second harbour crossing/ metro line, which will deliver a 60% increase in rail services, and a time saving of up to 8 minutes for commutes from Chatswood to the CBD. Sydney's Bus Future notes that direct links from the Northern Beaches to St Leonards would be assessed to improve access to and from the Northern Beaches.

Sydney's Walking Future demonstrates that the lower North Shore has one of the highest walking mode share in Sydney at over 25%. St Leonards and Crows Nest also sit within a corridor of centres, from Chatswood to the Sydney CBD. The strategy proposes that walking routes within two kilometres of centres should be prioritised. Sydney's Cycling Future notes the investigation of a North Shore link that passes close to the Precinct. As with walking, cycling routes close to centres will be prioritised.

2.1.6 Council Strategic Plans

2.1.6.1 North Sydney Community Strategic Plan

The North Sydney Community Strategic Plan (2013) provides a set of directions aimed at addressing prioritised transport issues identified by the community. These issues include the high level of vehicle congestion, lack of on street parking, and reduced pedestrian accessibility and amenity. The directions outlined by Council will promote the use of public and active transport by increasing the street space dedicated to sustainable modes, and integrating them with the network of pedestrian and cycle paths. These plans will also align with Council's economic direction of supporting employment growth and increasing social vitality by providing accessible transport options for the elderly and people with disability.

2.1.6.2 Willoughby City Strategy 2013 – 2029

The Willoughby City Strategy 2013 – 2029 outlines key strategic directions for planning transport infrastructure over the next 16 years. Council presents overarching principles that determine these strategic directions. The principle of improving health and wellbeing is to be achieved by providing connected walking and cycle paths. The principle of increasing mobility involves improving the level of service of public and active transport, improving integration between modes and managing traffic congestion. Sustainable

economic activity in the Precinct is a principle to be achieved in part from a sustainable and efficient transport network.

2.1.6.3 Lane Cove Community Strategic Plan 2025

The Lane Cove Community Strategic Plan 2025 is comprised of goals and strategies to achieve an integrated transport system that will link various centres, facilities and suburbs. The goals are the result of extensive community consultation, and resulting objectives are outlined. The goal of achieving an inclusive, interconnected and active community should be achieved by promoting integrated public and active transport options that link people to employment hubs, services and facilities. Incentives should be introduced that reduce reliance on private vehicles for example for carpooling, and parking supply should respond to parking demand. An improved transport network will also contribute to achieving the goal of creating a vibrant and sustainable local economy by improving access to local business centres.

2.1.7 Other strategies and plans considered

Additional documents considered in the preparation of this report to gather context and gain an understanding of the issues and plans for the St Leonards and Crows Nest transport network include:

> St Leonards and Crows Nest Station Precinct Structure Plan, 2016 (SJB Architects)

> St Leonards Strategy, 2006 (David Lock Associates)

> St Leonards/Crows Nest Planning Study Precinct 1, 2011 (North Sydney Council)

> St Leonards South Strategy Precinct report, 2013 (David Lock Associates)

> St Leonards South Masterplan Draft, 2014 (Annand Associates Urban Design)

> St Leonards Development Capacity, 2015 (Architectus)

> St Leonards Crows Nest Planning Study, 2015 (North Sydney Council)

> St Leonards and Crows Nest Strategic Employment Review, 2016 (SGS Economics and Planning)

> Gore Hill Park Plan of Management, 2016

> Gore Hill Park redevelopment- FAQ, Willoughby City Council website

> Willoughby Street Parking Strategy, Willoughby City Council 2016

2.1.8 Planned transport initiatives

2.1.8.1 Sydney Metro

Sydney Metro is Australia's largest public transport project currently under planning and construction across two stages. The project will comprise of 31 stations across 65 kilometres of dedicated metro rail, connecting the north-west and south-west suburbs of Sydney with the Sydney CBD. New fully automated single-deck metro trains will operate along the new line every four minutes in the peak, with capacity to move up to 40,000 customers per hour in each direction.

Forecast trip times from Crows Nest Metro Station to other key stations is shown in **Table 2-1**.

Table 2-1 Forecast trip time from Crows Nest Station to other key stations

Stations north of Crows Nest	Time (minutes)	Stations south of Crows Nest	Time (minutes)
Rouse Hill	39	Martin Place	7
Castle Hill	28	Pitt Street	9
Epping	19	Central	11
Macquarie Park	13	Sydenham	18
Chatswood	4	Bankstown	39

Source: Sydney Metro website (2017)

Stage 1 of the project is Sydney Metro Northwest, currently under construction and due for completion in 2019. Once complete, the project will deliver metro services along eight new stations from Cudgegong Road

to Epping, before continuing along the existing Epping to Chatswood Railway and terminating at Chatswood Station.

Stage 2 of the project is Sydney Metro City and Southwest, currently being planned and expected to be completed by 2024. The project proposes an extension of the metro alignment from Chatswood through to the City, before connecting to Sydenham Station and proceeding along the current T3 Bankstown Line to terminate at Bankstown. Between Chatswood and Sydney CBD, new Metro stations will be built at Crows Nest, Victoria Cross (North Sydney), Barangaroo, Martin Place, Pitt Street and Central. The proposed Crows Nest Metro Station provides the opportunity to support development uplift in its catchment.

The project's Environmental Impact Statement (EIS) proposes the new Crows Nest Metro Station will be located between the Pacific Highway and Clarke Street. The following supporting infrastructure (subject to design development) is proposed in as part of the scope of works for the new station:

> Two pedestrian crossings (zebra) at the intersection of Clarke Street and Hume Street;

> A pedestrian crossing (zebra) across Clarke Street, opposite Kelly's Place Children's Centre;

> An additional signalised pedestrian crossing leg across the Pacific Highway (north side) at the intersection with Oxley Street (subject to approval by Roads and Maritime);

> Enhanced pedestrian amenities around the station, with details agreed in consultation with North Sydney Council and Roads and Maritime;

> Wayfinding signage and Sydney Metro information;

> Kiss and ride and taxi bays on Clarke Street;

> Bike parking at the station entrances;

> On-road cycle facilities on Hume Street and Oxley Street; and

> Existing bus stops on Pacific Highway;

Bicycle parking facilities with 120 spaces are proposed at the Crows Nest Metro Station entrance plazas, located at the corner of the Pacific Highway and Oxley Street, and near the intersection of Hume Street and Clarke Street. A bus integration plan will need to be prepared for the new service.

Sydney Metro will prepare a Station Integration Plan to improve interchange with buses and provide efficient pedestrian and cycle access to Crows Nest Metro Station.

Crows Nest Metro Station is proposed to be located 25 metres underground with entrances at the intersection of Pacific Highway and Oxley Street, and the intersection of Clarke Street and Hume Street.

Crows Nest Metro Station will increase the proportion of the Precinct within a convenient catchment of a high quality and high capacity rail transport infrastructure. This will improve the accessibility of the Precinct to other areas of Sydney and could assist to reduce the need for private vehicle ownership and car parking.

2.1.8.2 Road network changes

2.1.8.2.1 Lithgow Street

As part of the proposed over-railway plaza and the development on Lithgow Street, the intersection of Lithgow Street and the Pacific Highway will be closed. This will direct traffic (heading outbound along the Pacific Highway) from Lithgow Street to Oxley Street to join the Pacific Highway. A new laneway will be created to the south of Christie Lane to provide vehicle access from Lithgow Street to Christie Street and Nicholson Street.

2.1.8.2.2 Hume Street

As part of the redevelopment of the Hume Street Park (described in **Section 2.1.8.3.2**) North Sydney Council proposed to close Hume Street adjacent to the park (between Pole Lane and Clarke Street) to traffic. Hume Street currently operates as one lane and one direction to the north.

A pedestrian link will also be created between the Hume Street Park and Willoughby Road for improved permeability.

2.1.8.2.3 Chandos Street / Alexander Street intersection

North Sydney Council is planning to signalise the intersection of Chandos Street and Alexander Street in Crows Nest. The T intersection currently operates with signed priority control.

2.1.8.2.4 Nicholson Street widening

Nicholson Street will be widened to support the new developments being built on the block between Nicholson Street and the Pacific Highway.

2.1.8.3 Cycling network changes

2.1.8.3.1 Lane Cove Council

The 2013 Lane Cove Council Draft Bicycle Plan provides recommendations based on a review of the 2008 Plan, and the status of works proposed in 2008. In the Precinct, three routes were proposed in the 2008 Plan, which remain incomplete.

> Regional Route B3: A shared path along the western side of the Pacific Highway, extending from the intersection of Longueville Road near the Gore Hill Freeway to the intersection with Albany Street, past the LGA border;

> Regional Route B4: A shared path along the northern side of River Road, extending from the intersection of Longueville Road to the intersection with Shirley Road; and

> Local Route B18: A combination of shared paths, on-road shoulder lanes and mixed traffic facilities connecting Greenwich Road with St Leonards Station.

An additional route (Route A9) was proposed in the 2013 Plan. This route extends from the intersection of the Pacific Highway with Berry Street, and proceeds via Marshall Lane, Canberra Avenue, Lithgow Street, Christie Lane, Christie Street and Nicholson Street to tie in with existing routes at the intersection of the Pacific Highway with Christie Street, and Oxley Street with Nicholson Street. The primary aim of this route is to complete a missing link in the network on the southern side of the Pacific Highway and facilitate travel across Council LGA boundaries.

Lane Cove Council is also investigating a new east-west cycle link between Greenwich and Wollstonecraft.

2.1.8.3.2 Willoughby City Council

The 2006 Willoughby City Council Bike Plan recommends 27 new routes or network links to be implemented across the Willoughby LGA. The routes were classed as low, medium or high priority, and were designated as either on or off-road facilities. Seven of the proposed routes proceed through the Precinct; a 2012 review of the Plan indicated that four of these remain incomplete.

> Route 22: A medium priority off-road route along the eastern side of the Pacific Highway between Longueville Road to Herbert Street;

> Route 23: A high-priority on-road route through the TAFE and Gore Hill precinct (former ABC studio);

> Route 24: A medium priority on-road route through the Royal North Shore Hospital property, between St Leonards Station and Westbourne Street; and

> Route 25: A medium priority off-road route running parallel to the T1 North Shore and Northern Line on the eastern side, between St Leonards Station and the Gore Hill Freeway.

2.1.8.3.3 North Sydney Council

The 2014 North Sydney Council Integrated Cycling Strategy outlines an infrastructure plan with five priority routes for implementation. Two of these routes pass through the Precinct:

> Route 1: Sydney Harbour Bridge to Cammeray via West Street (High priority); and

> Route 4: Cammeray to Crows Nest via Willoughby Road and Holtermann Street (Medium priority).

Route 1 is proposed along West Street, on the eastern boundary of the Precinct. The street already supports a large volume of cycling traffic. This route is a key north-south corridor, connecting the northern suburbs with the Sydney Harbour Bridge. It will also have connections to St Leonards Station via an existing east-west route along Atchison Street. Concept plans have been developed for a separated bi-directional facility

on the eastern side of the road reserve, between the intersections with Church Street and Palmer Street. The road reserve is flat and wide, making it ideal for accommodating a separated bi-directional facility.

Route 4 proposes to connect Chandos Street with the proposed cycleway along West Street via Willoughby Road and Holtermann Street. This route is planned as an on-road mixed traffic facility, with alterations planned for on-street parking and at key intersections.

The Greater Sydney Commission's Draft North District Plan (2016) outlines an action to develop a Principal Bicycle Network in the region. One of the proposed routes for this region will connect Hornsby to North Sydney; via St Leonards and Chatswood.

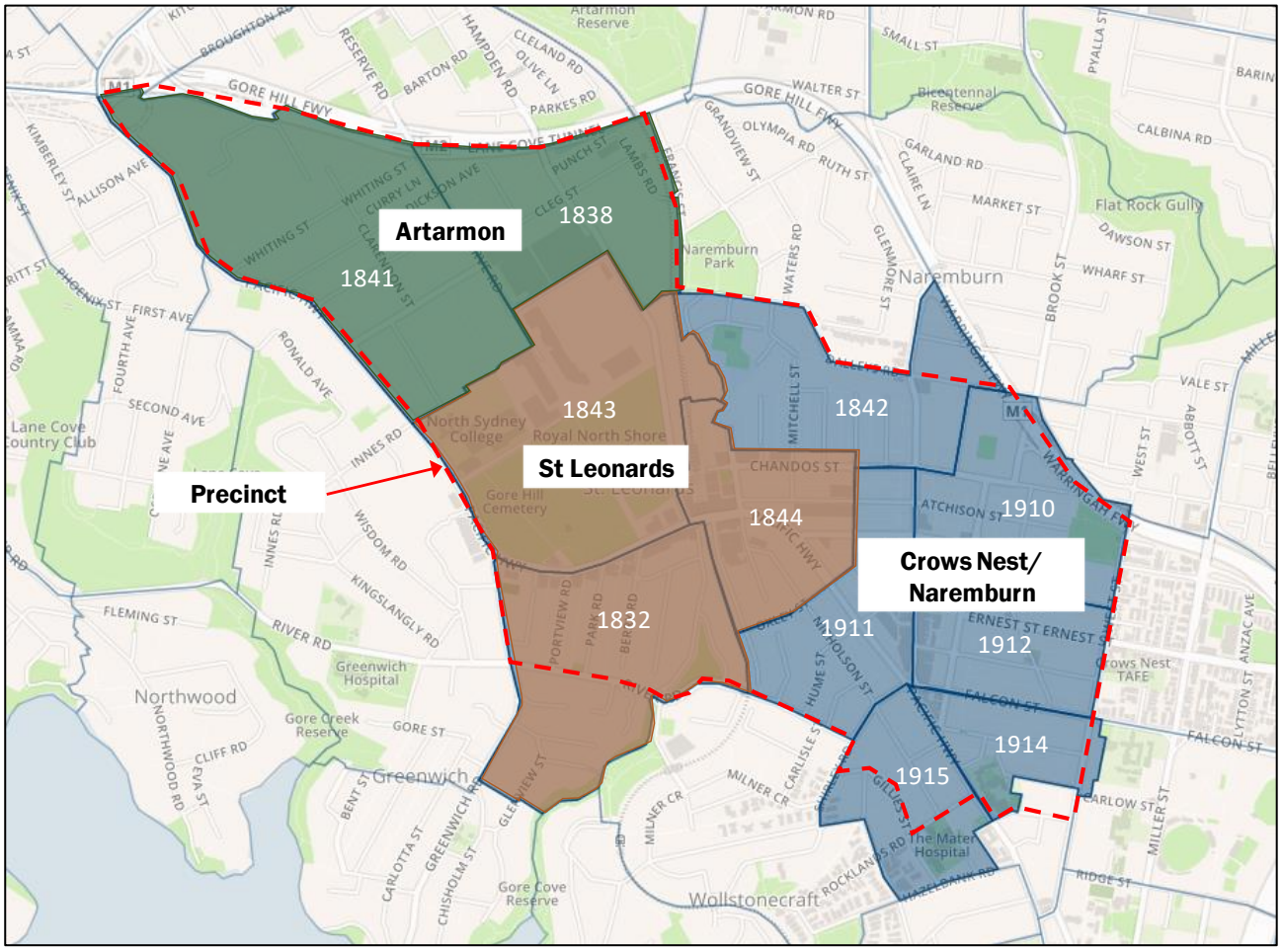
A summary map of the existing and proposed bicycle routes is provided in **Section 3.4.2**.

2.2 Existing travel behaviour

It is important to understand who is living in and accessing the Precinct, and the existing travel behaviour when planning for future movements in the Precinct. This chapter provides a summary of the population and employment, dwelling types and motor vehicle ownership, as well as how people are travelling and where they are coming from. Reported crashes in the Precinct are also analysed.

The Precinct was divided into three sub-precincts; Artarmon, St Leonards and Crows Nest/Naremburn to acknowledge different travel behaviours in each. Within each of the sub-precincts travel behaviour was analysed by travel zones where possible; the travel zones that make up each of the sub-precincts are shown in **Figure 2-2**.

Figure 2-2 Sub-precincts and travel zones within the Precinct



Base image source: TfNSW Transport Performance and Analytics (2016)

2.2.2 Population and employment

This section provides a summary of the existing population and jobs for the Precinct as it has a direct relationship with trip generation. The data is from TfNSW's Transport and Performance Analytics (TPA) website and uses Travel Zone explorer and Journey to Work data based on the Census by the Australian Bureau of Statistics and further refined by TPA.

2.2.2.1 Population

Approximately 6,900 residents lived in St Leonards, and 8,600 people lived in Crows Nest in 2016 There are no residents living in the Artarmon sub-precinct, the land use is primarily employment and bulky goods retail. Residential population for the Precinct is summarised in **Table 2-2**.

2.2.2.2 Employment

There were around 43,800 employees in the Precinct in 2016. Most employees worked in St Leonards (56%) while Artarmon represented 21% of workers and Crows Nest 22%. **Table 2-2** summarises the number of residents and employees in the Precinct.

Table 2-2 Population and employment – 2016

Sub precinct	Residential		Employment	
	Number	%	Number	%
Artarmon	0	0	9,839	22%
Crows Nest	8,625	56%	8,576	20%
St Leonards	6,915	44%	25,368	58%
Total	**15,540**	100%	**43,783**	100%

Source: TfNSW Transport Performance and Analytics, Travel Zone Explorer (2016)

2.2.3 Dwelling types

All of the suburbs in the Precinct have a low number of detached dwellings and a high number of Flats, Units and Apartments (FUA). FUA dwellings typically represent high-density residential development.

St Leonards has predominately FUA housing at 92% and less than 10% of housing is detached dwellings or semi. Crows Nest is more diverse in dwelling types with 50% FUA, 22% detached dwellings and 29% semi. The Sydney Metropolitan Area dwelling types are also listed for comparison. **Table 2-3** summaries the dwelling types in the Precinct.

Table 2-3 Dwelling types

Sub precinct	Dwelling types			
	Separate	Semi	FUA	Other
Artarmon	0	0	0	0
Crows Nest	394 (22%)	525 (29%)	884 (50%)	0 (0.2%)
St Leonards	110 (5%)	39 (2%)	1,927 (92%)	9 (0.4%)
Sydney Metropolitan Area	926,062 (70%)	194,171 (13%)	391,887 (26%)	7,004 (0.5%)

Source: TfNSW Transport Performance and Analytics, Journey to Work 2011

2.2.4 Motor vehicle ownership

Vehicle ownership is a key indicator of mode share. The portion of non-ownership indicates the need to rely on other transport modes. Compared to the Sydney Metropolitan Area, the Precinct has lower proportions of private vehicle ownership. A high proportion of households in the Precinct that do not own a private vehicle especially St Leonards at 30%, compared with the Greater Sydney Metropolitan Area where the proportion of households without a car is 12%. For the residents of the Precinct that do own private vehicles, the majority only own one vehicle. In Crows Nest, this is 58% and St Leonards is 54%, compared to the Greater Sydney Metropolitan Area, which is 38%. Vehicle ownership in the Precinct is detailed in **Table 2-4**.

Table 2-4 Residential motor vehicle ownership per household

Sub precinct	Vehicles per household				
	0 Vehicles	1 Vehicle	2 Vehicle	3 Vehicle	Not stated
Artarmon	0	0	0	0	0
Crows Nest	312 (17%)	1,042 (58%)	358 (20%)	57 (3%)	35 (2%)
St Leonards	615 (30%)	1,129 (54%)	287 (14%)	32 (2%)	23 (1%)
Sydney Metropolitan Area	184,242 (12.1%)	584,187 (38.4%)	500,581 (32.9%)	206,864 (13.6%)	45,524 (3%)

Source: TfNSW Transport Performance and Analytics, Journey to Work 2011

2.2.5 Transport mode share

Journey to Work data from 2011 is analysed in the following sections.

2.2.5.1 *Journey to Work – residents of the Precinct*

A large proportion of residents who live in St Leonards travel to work via train 48%, 26% via private vehicle, 6% catch a bus and 15% walk.

For residents in Crows Nest, 36% commute to work using a private vehicle, 22% use the bus, 19% walk and 17% catch a train. This indicates there is a relatively higher proportion of people in Crows Nest live within walking distance to their job.

2.2.5.2 *Journey to work - workers of the Precinct*

In the St Leonards sub-precinct, the majority of workers commute there by private vehicle (53%). Of this, 50% drive and 3% travel as a passenger. Train is the second most popular mode at 32%, followed by bus at 7%.

60% of the Crows Nest workers travel to work by private vehicle (4% of which are vehicle passengers). 19% catch a train and 10% catch a bus, whereas only 9% of people walked to work.

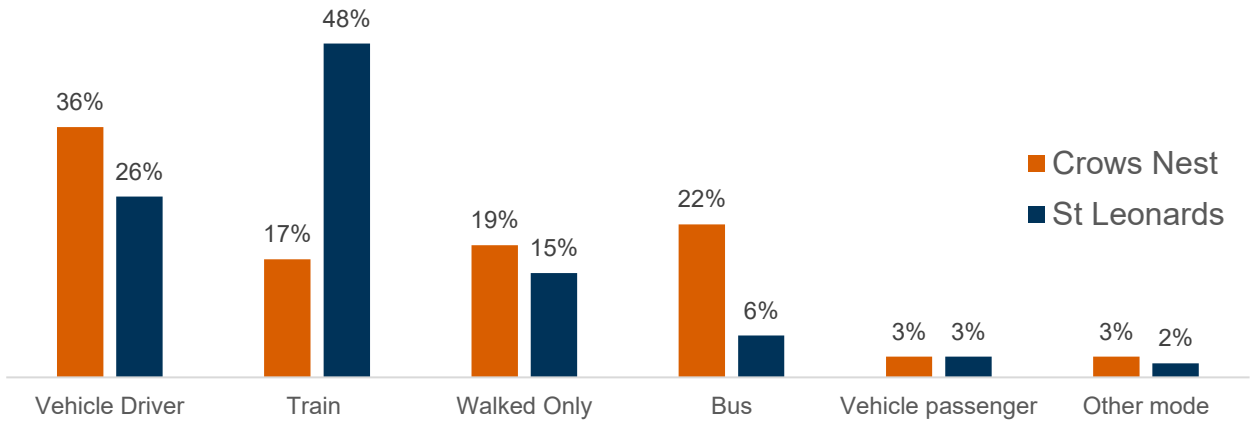
Most of the workers (75%) in the Artarmon sub-precinct commute by either driving or as a passenger in a private vehicle, 20% of the workers use public transport, 16% by train and 4% by bus.

The mode share split for commuting from the Precinct in shown in **Figure 2-3** and commuting to the Precinct in **Figure 2-4**.

There is a notable difference in the travel behaviour of residents from Precinct. A much higher proportion of residents commute by train from St Leonards than from Crows Nest. The Crows Nest Metro Station is anticipated to significantly increase the proportion of trips by rail in Crows Nest.

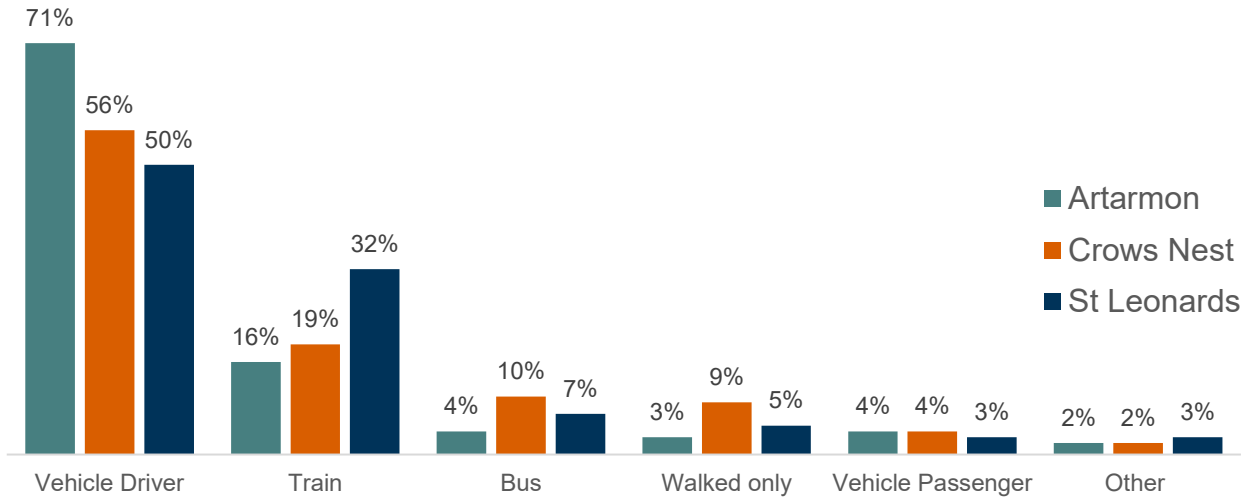
There is currently no residential population in Artarmon therefore no population is shown commuting from the Precinct.

Figure 2-3 Mode split commuting from the Precinct



Source: Journey to Work (2011, Bureau of Transport Statistics)

Figure 2-4 Mode split commuting to the Precinct



Source: Journey to Work (2011, Bureau of Transport Statistics)

There are more people commuting from the north shore to the Precinct than other areas across the Sydney Metro Area. The areas with a higher number of people commuting to the Precinct include the lower north shore, areas in St Leonards, Greenwich, Lane Cove, Neutral Bay and Wollstonecraft. In general, there is a low number of people commuting from the southwest of Sydney. A summary map showing where people are commuting from to get to the Precinct by travel zone is provided in **Figure 2-5**.

The Precinct has high commuter trip containment for residents, demonstrating a strong relationship between housing and employment in the area. People commuting from the Precinct mainly travel to jobs in Sydney CBD followed by jobs within the Precinct, or to Chatswood, North Sydney, Macquarie Park and Pyrmont.

A summary map showing where people are travelling from the Precinct is provided in **Figure 2-6**.

Figure 2-5 Commuting into the Precinct

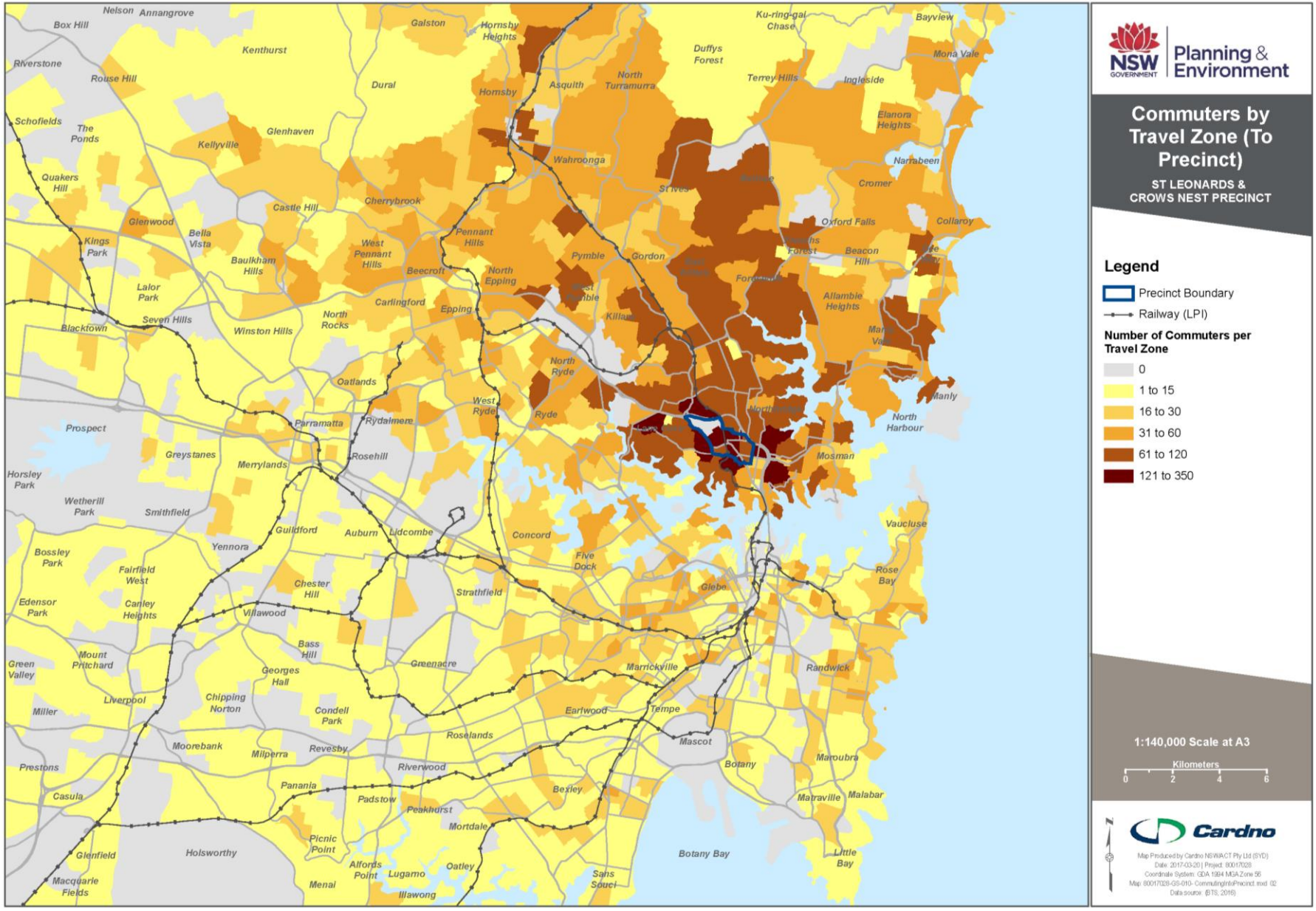
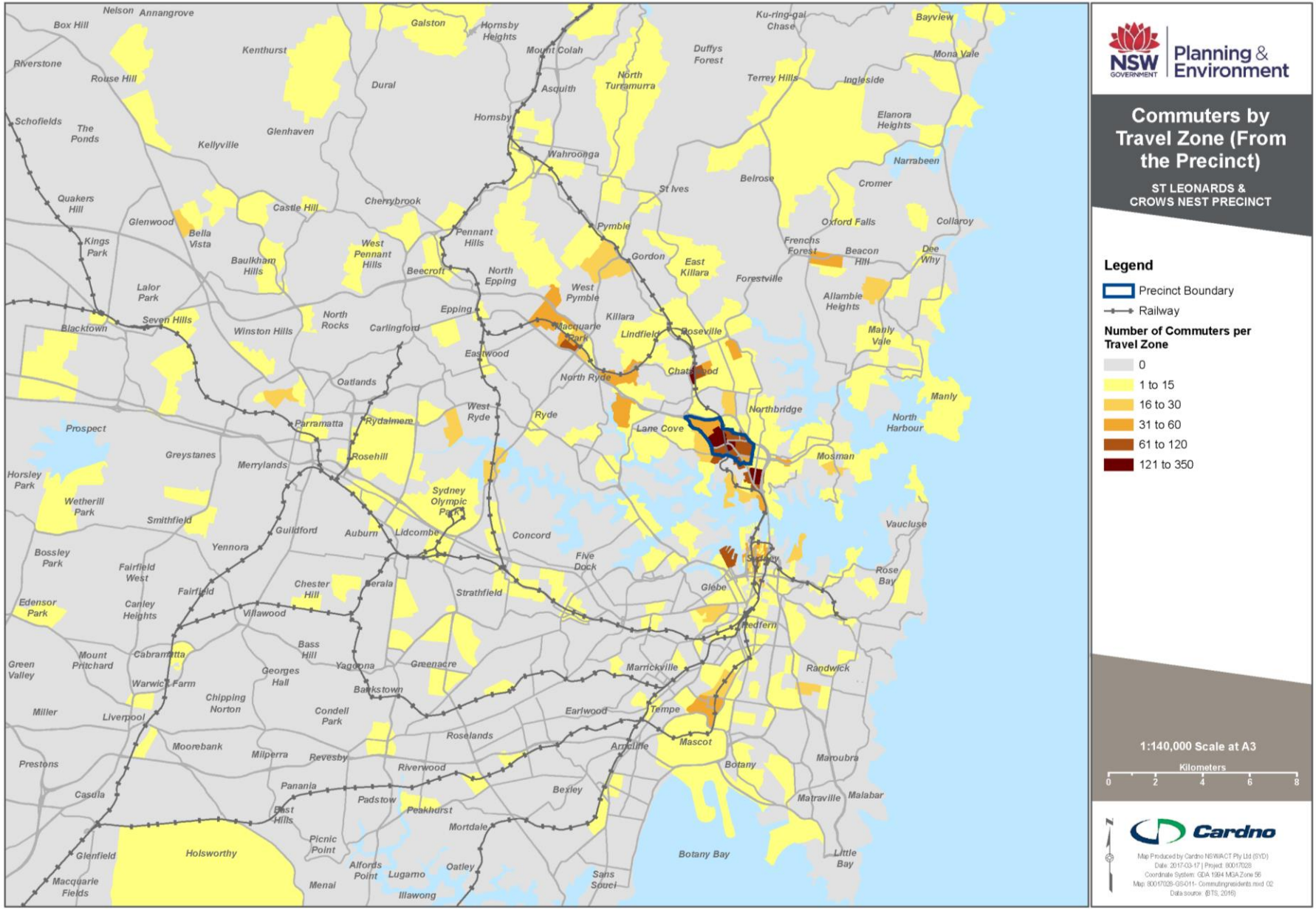


Figure 2-6 Commuting from the Precinct travel zones



2.2.6 Crash analysis

There were 543 reported crashes in the Precinct in the 5-year period 2011 to 2015 inclusive. This analysis excludes accidents in the Lane Cove Tunnel, Gore Hill Freeway and Warringah Freeway as this corridor bypasses the Precinct. The crashes include:

> Fifty-two (52) crashes involving pedestrians;

> One (1) fatal pedestrian crash; and

> Two (2) fatal vehicle crashes.

A summary map of the crash locations is provided in **Figure 2-7**.

2.2.6.1 Crash clusters

Several crash clusters within the Precinct involve at least ten crashes. These clusters are located along:

> Pacific Highway;

> Herbert Street;

> Falcon Street;

> Willoughby Road; and

> Miller Street.

The intersection between West Street and Falcon Street had the highest number of crashes (26 crashes in the 5-year period). This is closely followed by the intersection of Falcon Street, Willoughby Road and Pacific Highway with 25 crashes, followed by Herbert Street and Pacific Highway had 12 crashes. A density map summarising crashes in the Precinct is shown in **Figure 2-8**.

High-density cluster represent up to 50 crashes per 100 square meters and low density represents one crash per square 100 square meters.

Figure 2-7 Crash locations

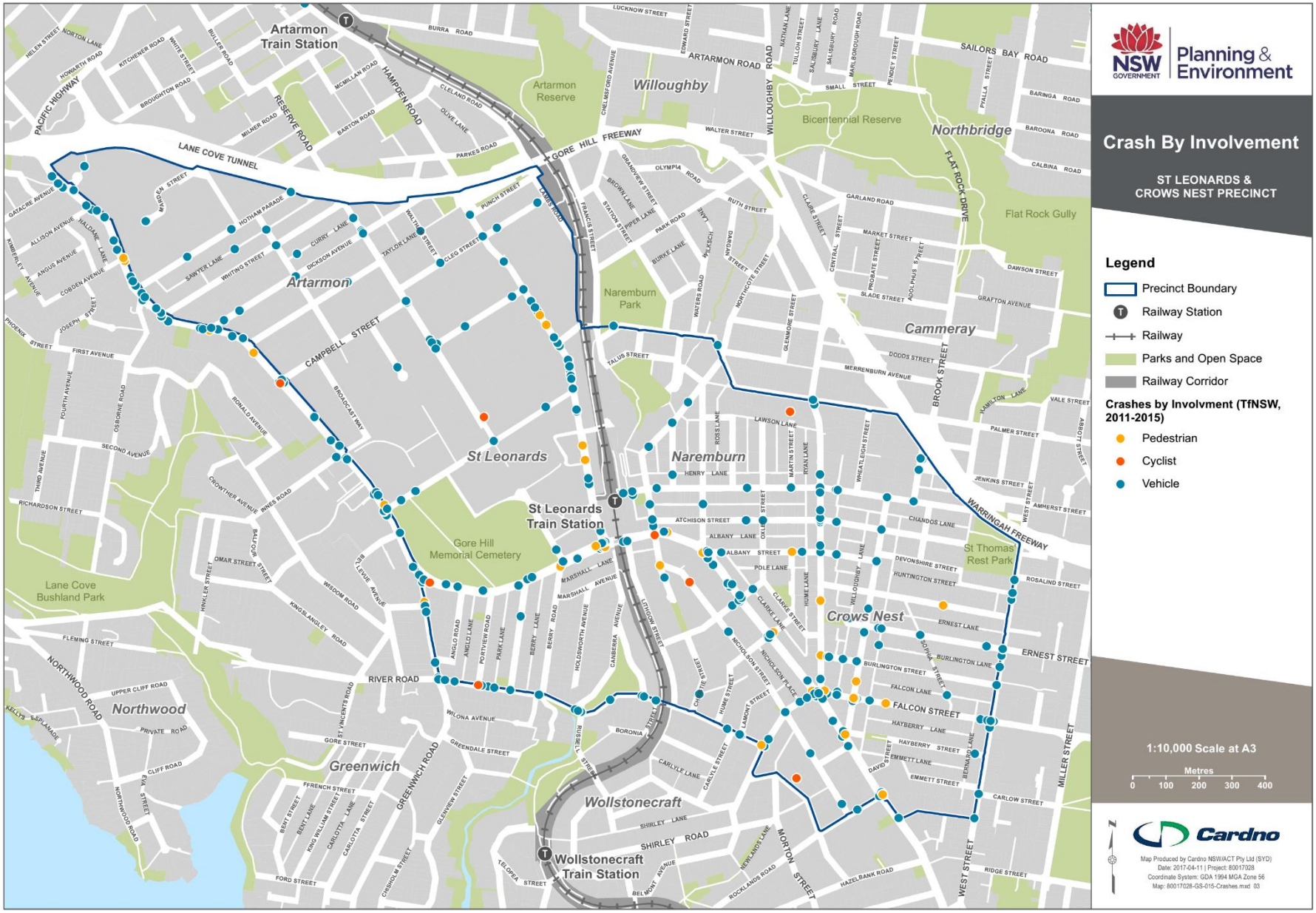
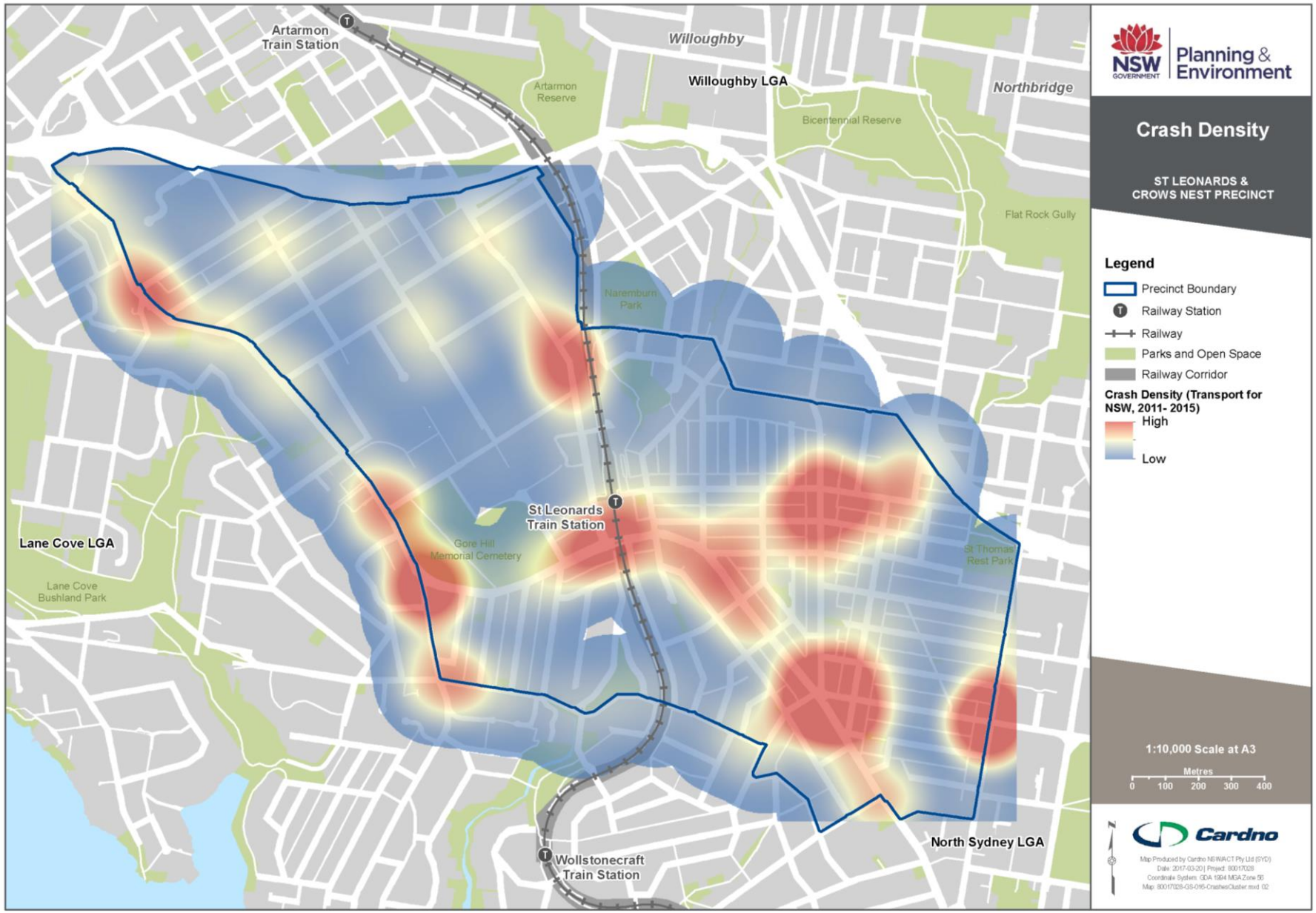


Figure 2-8 Crash cluster locations



2.2.6.2 Crash types

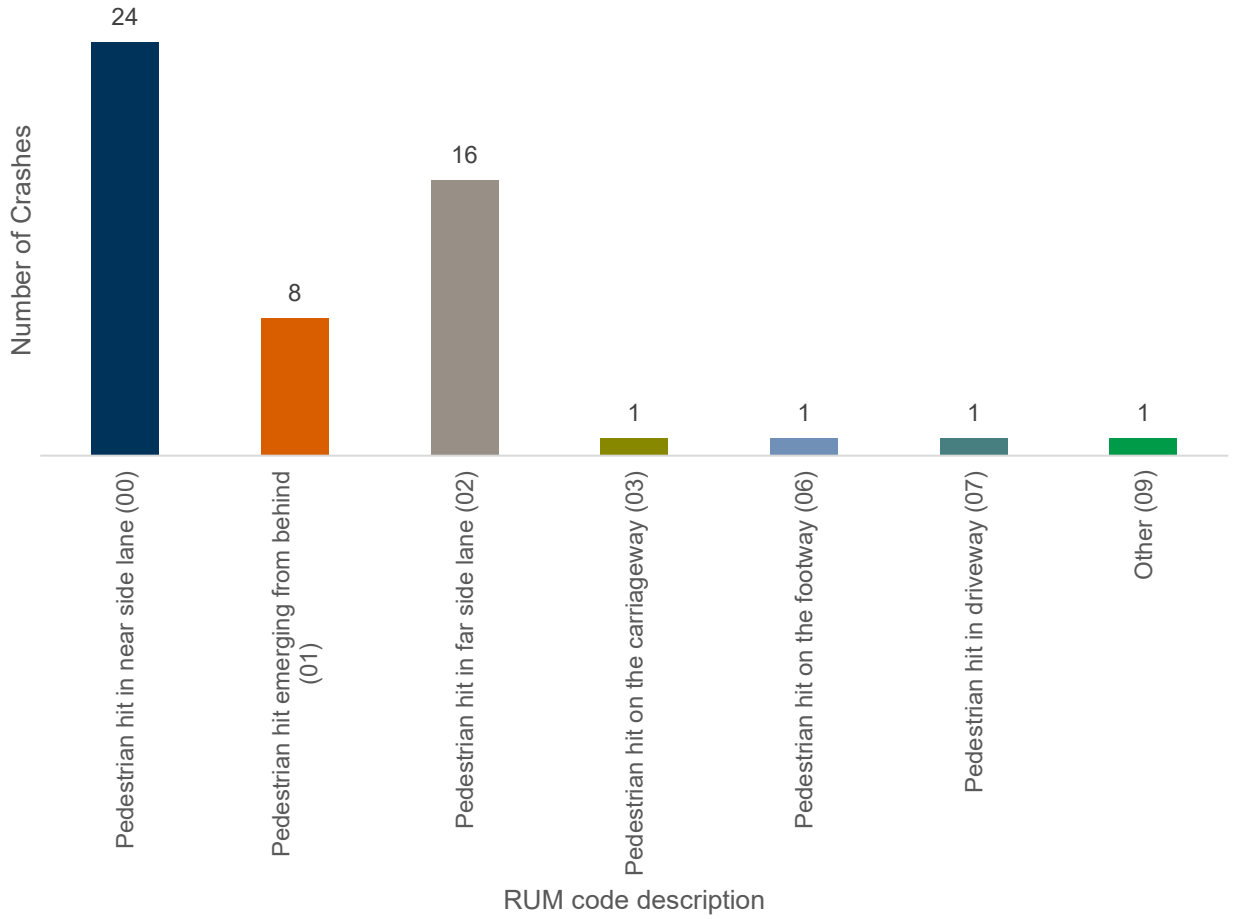
One of the basic tools for understanding what happened in a crash is the road user movement (RUM) which describes the first cause for the crash.

2.2.6.2.1 Pedestrian crashes

The crash types that involve pedestrians are identified in the Road and Maritime accident database under RUM codes 00 to 09.

There was 52 pedestrian crashes within the Precinct between 2011 - 2015. The most common occurring crash types are RUM crash codes 00, where a pedestrian is hit in the near side lane and 02, where a pedestrian is hit in the far side lane. These crashes occurred 24 and 16 times respectively over the five-year period. The number of pedestrian crashes by RUM code in shown in **Figure 2-9**.

Figure 2-9 Pedestrian crash type

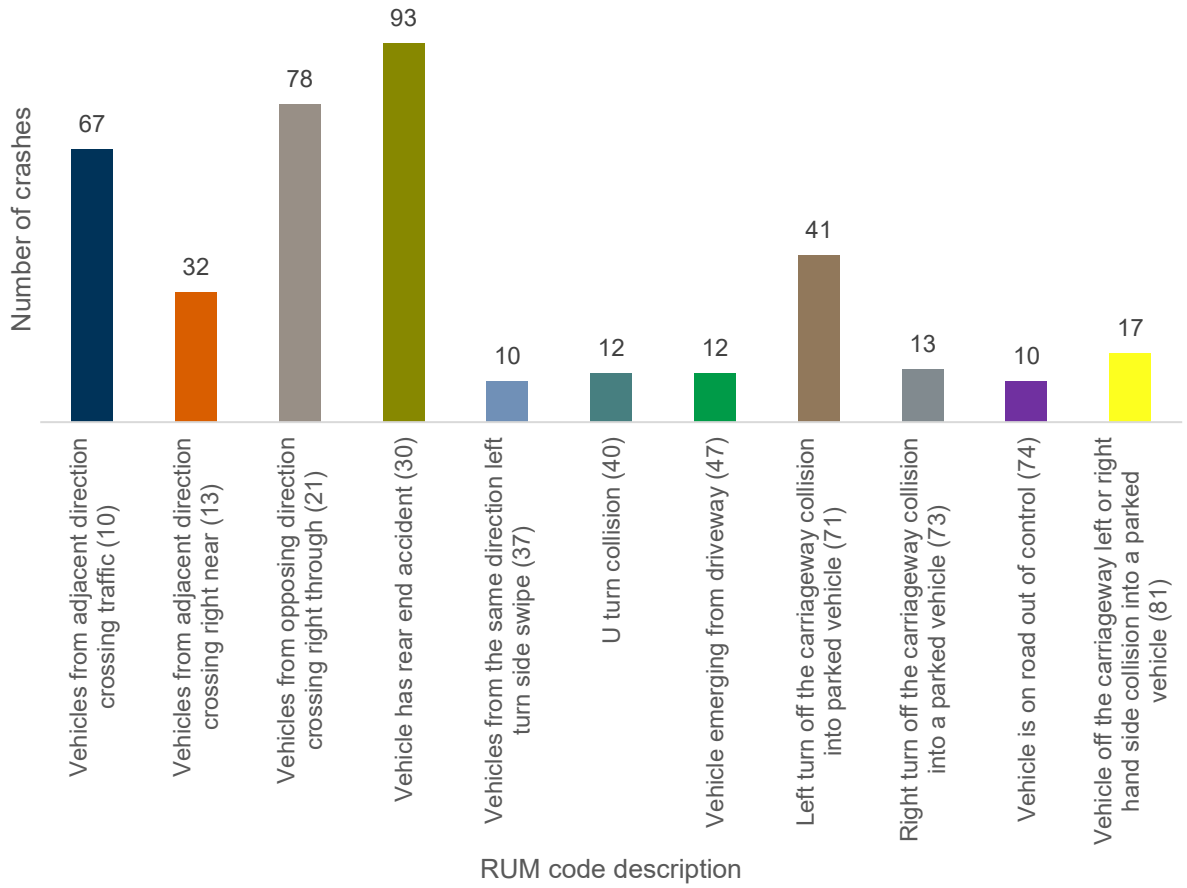


The high prevalence of pedestrians hit on the near and far side is indicative of a lack of crossing facilities, driver behaviour and road conditions and environment in the Precinct.

2.2.6.2.2 Vehicle crashes

There were 385 reported vehicle crashes in the five-year period 2011 – 2015 inclusive. In relation to vehicle crashes, rear ending was the most common crash type across the Precinct with 93 occurrences in the past five-year period. This was followed by vehicles from the opposing direction crossing right through (RUM 21), and vehicles from the adjacent direction crossing traffic (RUM 10). A summary of the number of vehicle crashes by RUM code is shown in **Figure 2-10**.

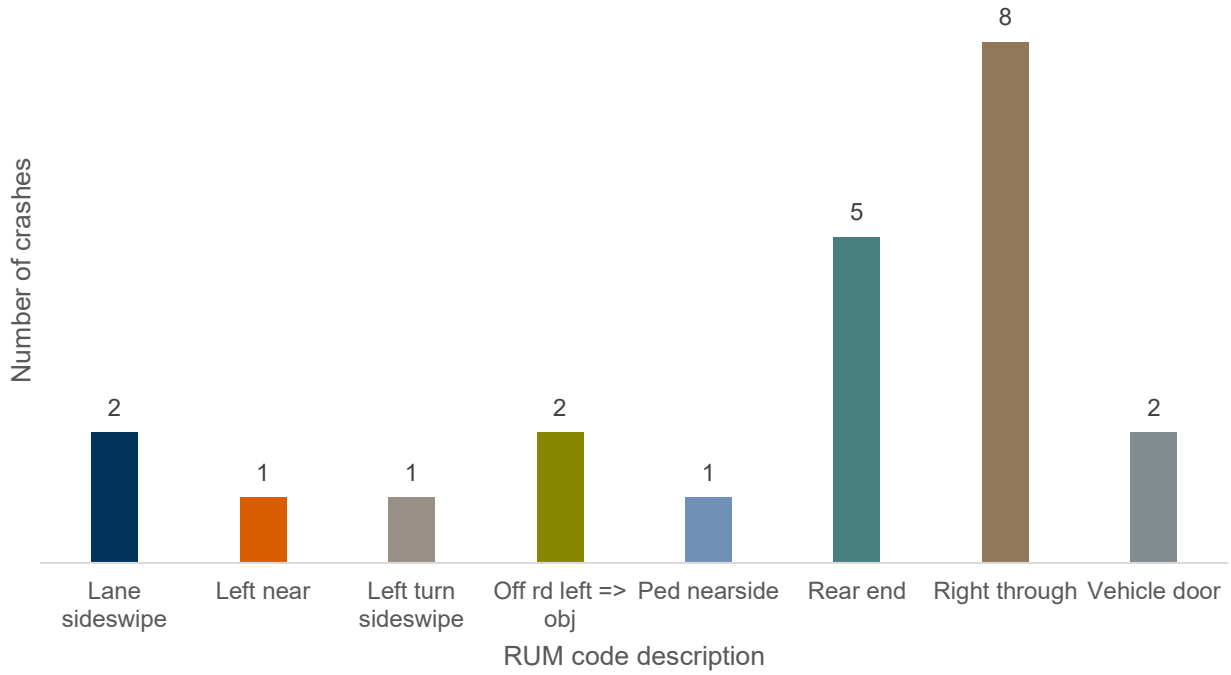
Figure 2-10 Vehicle crash type



2.2.6.2.3 Bicycle crashes

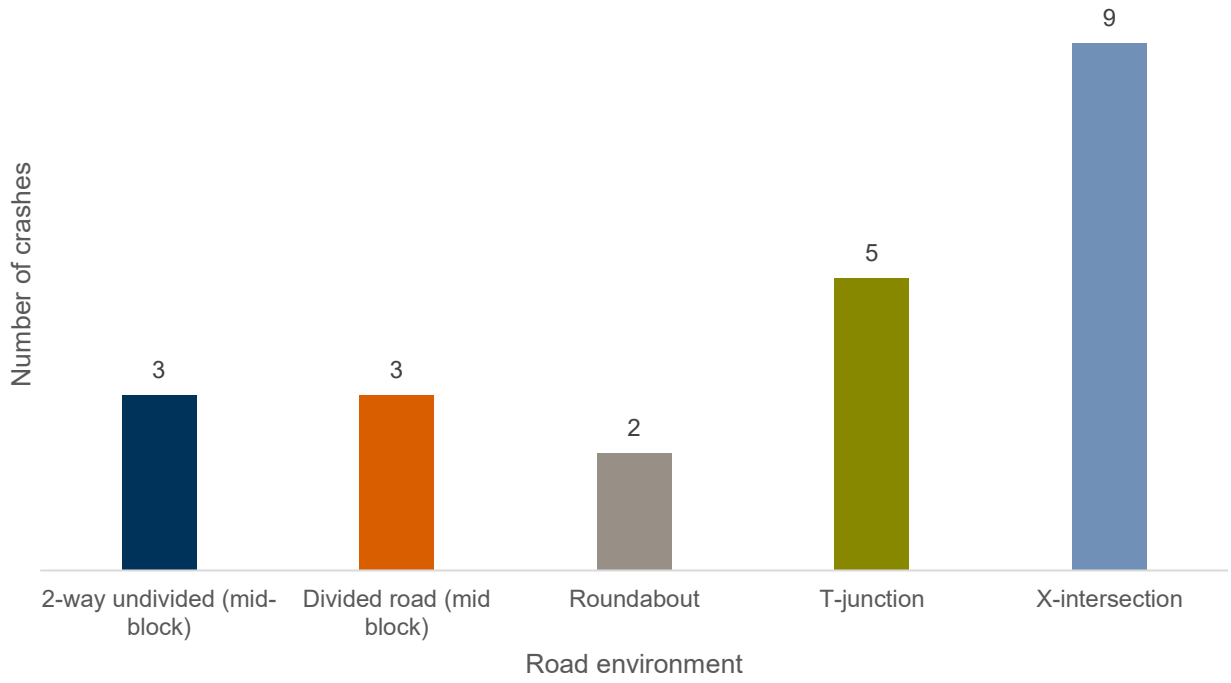
As a subset of reported vehicle and pedestrian crashes, over the five-year period were 22 crashes that involved cyclists in the Precinct. One of these involved a pedestrian and 21 involved another vehicle. The majority of these crashes were located on the eastern side of the rail line. Over 85 percent of these crashes occurred during daylight. The most common type of crash occurred when there was a right turn movement across opposing traffic (RUM Code 21) which occurred eight times. This type of crash can be due to several reasons including poor sight lines from either vehicles or cyclists and misjudgement of timing to cross opposing direction. Rear ending was the second most common type of crash involving cyclists, this occurred five times. The crashes involving cyclists are shown by type in **Figure 2-11**.

Figure 2-11 Cyclist crash type



Most crashes involving cyclists occurred at intersections; over 40 percent of cyclist crashes occurred at four-way intersection and over 20 percent at T- intersections. Crash by road environment is shown in **Figure 2-12**.

Figure 2-12 Crashes by road environment

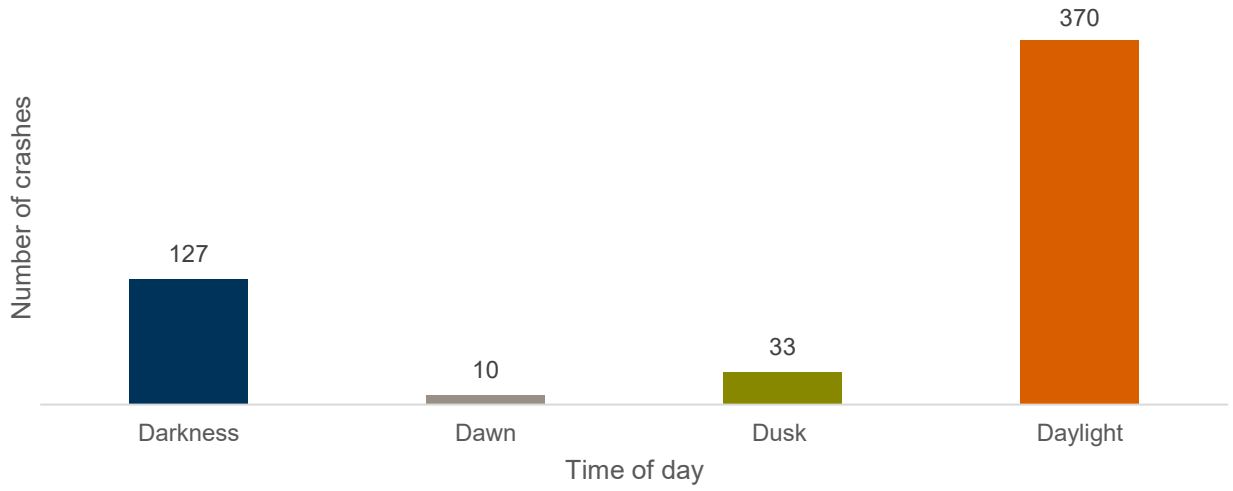


2.2.6.3 Crash time of day

The majority of crashes occurred in daylight hours (370) in the Precinct. This was followed by crashes occurring in hours of darkness (127). There were fewer crashes occurring during dawn and dusk (33)

periods. A summary of pedestrian and vehicle crashes, broken down by the occurrence time is provided in **Figure 2-13**.

Figure 2-13 Crashes by time of day



2.3 Summary of policy, planning and travel context

St Leonards has been identified as a strategic centre for health, education and office-based employment markets. Crows Nest has also been earmarked for additional employment and housing growth to correspond with the proposed Sydney Metro station.

The public transport network in the Precinct will undergo significant change along with Sydney Metro and a restructured bus network improving travel times and connectivity for customers.

Transport infrastructure in the Precinct should aim to provide seamless connections and interchange opportunities, improve general accessibility and support local trips.

The Draft North District Plan emphasises the need to leverage off the opportunities provided by the new Crows Nest Metro Station to improve active and public transport networks and reduce vehicular impacts on accessibility.

The lower North Shore has one of the highest walking mode shares in Sydney at over 25 per cent. The Precinct is also located along a corridor of centres from Chatswood to the Sydney CBD. State plans propose prioritisation of walking routes within two kilometres of centres.

Council community strategic plans outline improving active and public transport facilities as a key priority, with emphasis on improving sustainability, community health and wellbeing and managing traffic congestion.

3 Existing transport network

The assessment of the Precinct's existing transport networks and performance relied on:

> Desktop and site investigations

> Intersection counts at signalised intersections along the Pacific Highway

> Review of passenger data and vehicle counts.

3.1 Major transport corridors

The Precinct sits within a series of major transport corridors that provide connections to regional and strategic centres throughout the Greater Metropolitan Area. These include:

> T1 North Shore & Northern Line operates between Berowra and the Hornsby to the City. In peak periods some T1 services extend to the Central Coast;

> Pacific Highway: A major arterial road corridor connecting the northern suburbs, and the Sydney Harbour Bridge or Tunnel; and

> The Warringah / Gore Hill Freeway: a key state road corridor forming part of the Sydney Motorway network, it connects to the Lane Cove Tunnel and M2 to the north-west, and the Sydney Harbour Bridge and Tunnel, and Eastern Distributor to the south. It carries high volumes of traffic facilitating bypass of the Precinct.

3.2 Road network

The NSW road network can be described in terms of administrative and functional classification. The general relation between the two classifications and road function priority is shown in **Table 3-1**.

Table 3-1 Road classification comparison

Administrative classification (Roads and Maritime)	Functional classification (AustRoads)	Road function priority	Description
State roads (Roads and Maritime responsibility)	Motorways/, freeways	Movement	High mobility, movement function, limited if any land access function. Generally higher speed limits apply, 60km/h+
	Primary arterials		
Regional roads (Local government responsibility, some with funding from Roads and Maritime)	Secondary/ sub-arterials		Intermediate roads, these can have a high mobility or access function and are generally a combination of the two.
Local roads (Local government responsibility)	Distributor/ collector		Higher access function to land uses. Generally lower speed limits of 60km/h or less.
	Local road		
	Access street	Access	

The road network layout and spacing is an indication of the land uses it supports. The north-west side of the Precinct generally has large blocks supporting light industrial, bulk goods, retail, education and health related land uses. Elsewhere, the road network is denser, supporting residential, retail and commercial office land uses. The road network is the densest (finer grain) in the Crows Nest sub-precinct, which contributes to a lower speed road environment.

3.2.2 Warringah / Gore Hill Freeway access

Access to the Warringah/ Gore Hill Freeway from the Precinct is provided at:

> Pacific Highway at the intersection of Longueville Road;

> Reserve Road;

> Willoughby Road off-ramp from the Sydney CBD direction only;

> Brooke Street access to/ from Sydney CBD direction only; and

> Falcon Street.

Precinct links to the Warringah/ Gore Hill Freeway provide more opportunities for trips travelling towards the Sydney CBD than for north-west bound trips. Access away from the CBD is only available at Pacific Highway to the north east, Reserve Road and Falcon Street. The Falcon Street entry and exit points to the north are tolled which may act as a deterrent for some motorists. This means than any vehicle in the southern part of the Precinct that needs to continue north or north-west may travel through the Precinct along Pacific Highway, rather than deviate to the Falcon Street entry to the freeway and pay a toll.

3.2.3 Pacific Highway

The Pacific Highway is a state road and a key route through the Precinct with a high movement function. It is generally configured with three through lanes in each direction, but occasionally with two lanes where turning lanes are provided at some intersections.

Where there are three lanes, parking is generally allowed in the kerbside lane during off-peak periods. Through the Precinct, there are 14 signalised intersections. It is obvious from the frequent change in the number of through lanes that the corridor is space constrained by surrounding development.

The high movement function along the Pacific Highway is prioritised with restrictions to pedestrian crossing movements and vehicle turning movements at several locations within the corridor. This configuration leads to the circuitous movement of vehicles through the Precinct. In some locations, there are limited opportunities to turn right from Pacific Highway. Vehicles may be required to first turn left, traverse local streets to then go back to the Pacific Highway to cross to the opposite side.

3.2.4 Falcon Street

Falcon Street is a state road and is a key primary arterial to the Precinct. It links directly to Military Road, providing a key access point to the Northern Beaches region. It is generally configured with two lanes in each direction, with a combination of through and turning lanes. Kerbside parking is restricted during most of the day, but is available at some locations overnight.

3.2.5 Sub-arterial and distributor roads

Other key roads in the Precinct are described in **Table 3-2**.

Table 3-2 Sub-arterial and distributor roads

Road name	Managing authority	Description
Shirley Road/ River Road	Roads and Maritime (Regional road 2070)	Shirley Road/ River Road provides a key link to suburbs to the west of the Precinct, including Greenwich, Longueville and Lane Cove. This corridor also connects across the Pacific Highway to Falcon Street.
Reserve Road/ Frederick Street	Council	Reserve Road provides a key access point between the Artarmon sub-precinct and the Sydney motorway network. Frederick Street provides a direct link between Reserve Road and Herbert Street.
Herbert Street	Council	Herbert Street provides a parallel route to the Pacific Highway, connecting Artarmon and St Leonards.
Campbell Street	Council	Campbell forms the key east-west link between the Pacific Highway and Reserve Road.
Dalleys Road	Council	Dalleys Road forms a key east-west link between Herbert Street and Willoughby Road. It traverses through a residential area and has several local traffic management features of one-lane speed humps in an effort to reduce speeds and discourage through traffic.

Road name	Managing authority	Description
Willoughby Road	Roads and Maritime (Regional road 2029)	Willoughby Road provides a key north-south link that can be used as an alternative access point from the northern suburbs, including the Northern Beaches. Through Crows Nest, it provides access to the activity centre along Willoughby Road and has Local Area Traffic Management measures to encourage lower vehicle speeds and enhance pedestrian amenity and safety.
Chandos Street/ Brooke Street/ Christie Street between Chandos Street and Pacific Highway	Roads and Maritime (Regional road 2091)	Chandos Street/ Brooke Street/ Christie Street provides a key link between St Leonards and the Warringah Freeway. This provides an alternative access point to the freeway, bypassing the Pacific Highway.
Northcote Street/ Christie Street	Council	Northcote Street provides access to the Naremburn residential area.
Greenwich Road	Roads and Maritime (Unclassified regional road 7341)	Greenwich Road forms a link between the Pacific Highway and River Road and this is the only section of Greenwich Road that forms the Roads and Maritime road. The road continues south as a distributor from the intersection of River Road.

3.2.6 Local roads

There is a lack of capacity on some side streets off the Pacific Highway[1]. A number of local roads in the Precinct are cul-de-sacs that directs general traffic onto the roads through the Precinct that connect to the wider network. Some of the roads closed to reduce vehicle permeability and improve pedestrian amenity include Mitchell Street at Pacific Highway in St Leonards, and Ernest Street between Willoughby Road and Willoughby Lane in Crows Nest. Lane Cove Council has tried to prevent 'rat-running' in the planning and design of the street network in the area south-west of the Pacific Highway[2]. The road widths and available linkages or no-through roads were planned to discourage through traffic but still allow servicing such as garbage trucks.

The lack of right-turn movements from the Pacific Highway into the surrounding street network increases vehicle circulation around Albany Street and Oxley Street in the North Sydney LGA[3]. Traffic travelling inbound and headed for destinations south of the Pacific Highway (e.g. to Nicholson Street), cannot turn right into the area and so must turn left into Albany Street and right into Hume Street or Oxley Street to cross the Pacific Highway. This particularly occurs in the PM peak period.

Most local roads in the Precinct have one lane in each direction.

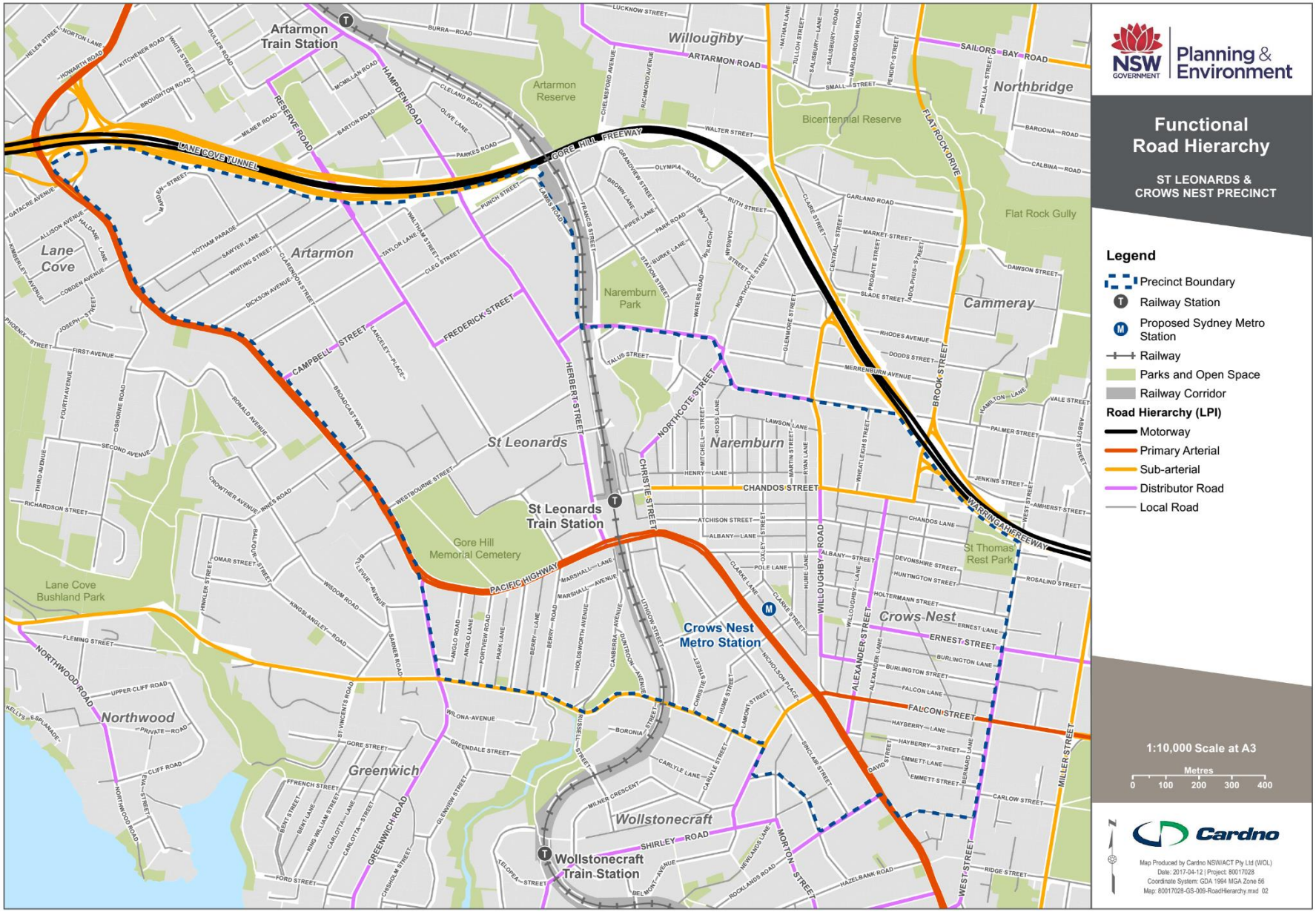
The general function (as set out by Austroads) of key roads in the Precinct are shown in **Figure 3-1**.

1 Transport for NSW – Roads and Maritime and Freight Strategy meeting December 2016

2 Lane Cove Council meeting, November 2016

3 North Sydney Council meeting, November 2016

Figure 3-1 Functional road hierarchy



3.2.7 Road network functions

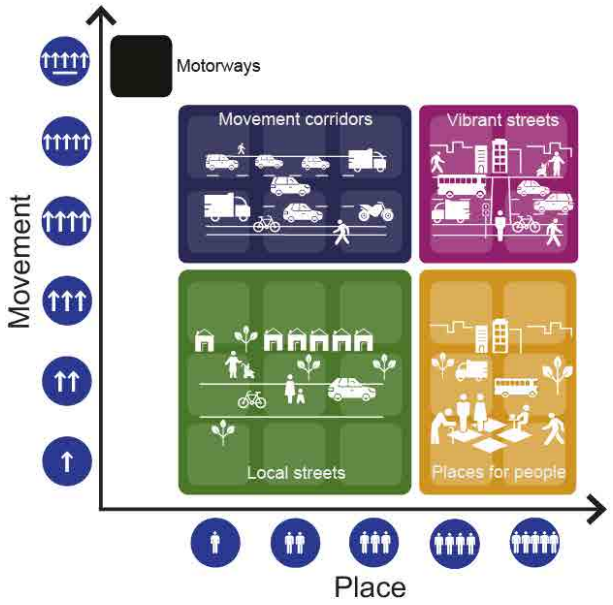
Roads support a wide range of functions. They are places for people and they support movement, access to buildings and spaces, parking and provide space for utilities, drainage, signage and street lighting. Of these functions, 'place' and 'movement' are considered the most important for assessing a road's character and role within a network. Professor Peter Jones from the University College of London notes in Link and Place: A New Approach to Street Planning and Design (2009) that the purpose of the movement function is to *save* time while the purpose of the place function is to *spend* time. An ideal road in an urban context supports both to some degree.

A road's movement function supports through movement as part of a trip. The road is part of a route connecting someone or something from their origin to their destination in a seamless journey. A road's place function acknowledges that roads can be end destinations themselves. Activities such as shopping, sitting, eating and meeting people can occur on or adjacent to the road. Movement and place are shown in **Figure 3-2**, with different types of streets sitting along the spectrums of each.

In busy centres with a range of land uses and travel demands, a single road can support both movement and place functions. A road's functions can change along its length, as the land uses and travel demands along it change. It can also change across a day or week as people use the road for different purposes at different times. Furthermore, and importantly as the Precinct transforms, road functions can transition over time. As sites are redeveloped, they can be designed to enhance the movement and place functions of their surrounding road network.

The draft NSW Road Planning Framework defines the movement and place functions of the road network for five categories of road: motorways, movement corridors, vibrant streets, places for people and local streets. For each category, the typical characteristics and features are described including land uses, trip types, speed limits, intersection treatments, parking, and pedestrian and bicycle facilities. The road categories are shown visually and described in **Figure 3-2**.

Figure 3-2 Movement and Place functions and road categories

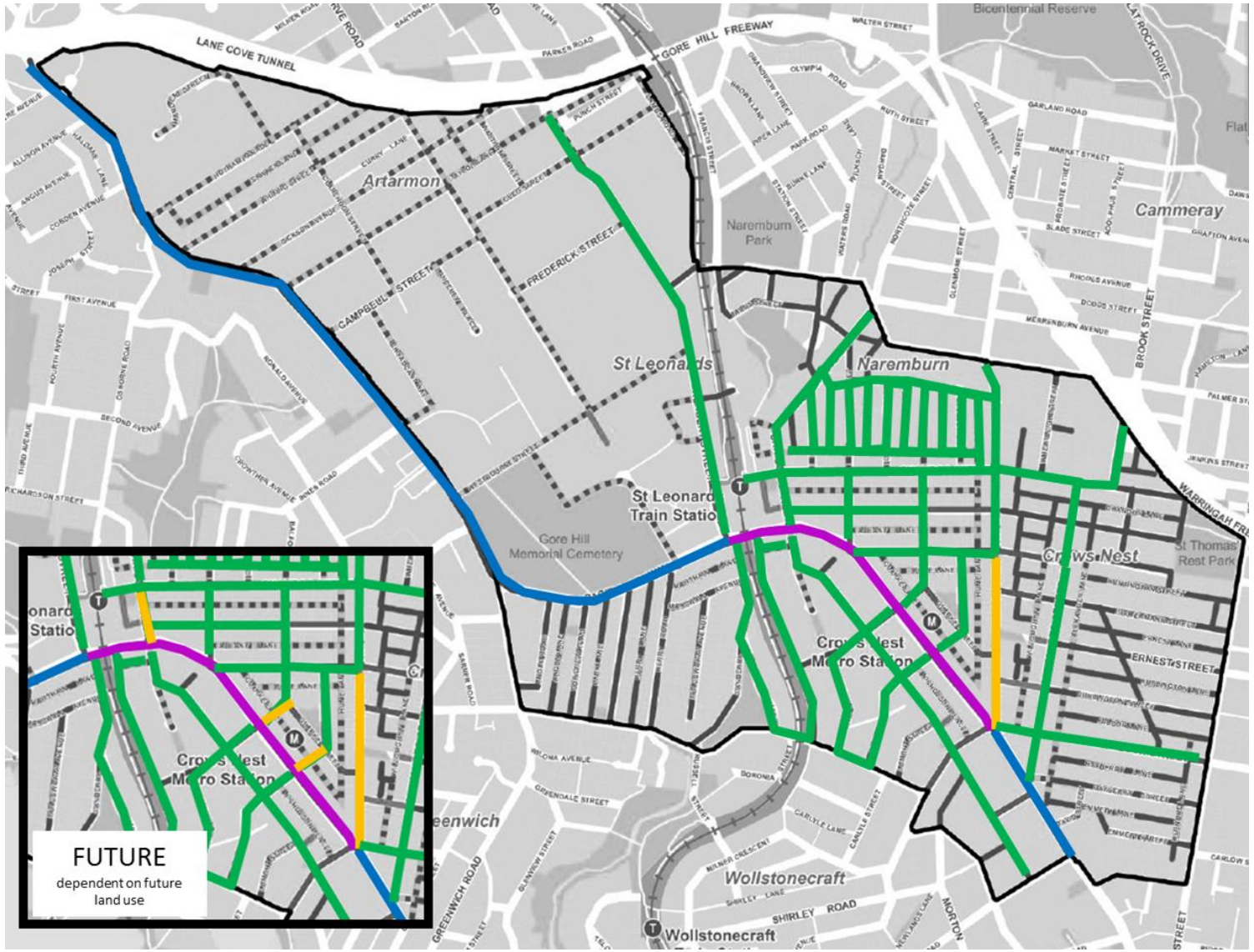


Motorways	Motorways move people and goods over long distances.
Movement corridors	Movement corridors are main roads providing safe, reliable and efficient movement between our regional centres and within our urban areas.
Vibrant streets	Vibrant streets combine high demand for movement and high pedestrian activity with often limited road space within our urban areas and regional centres.
Places for people	Places for people combine higher pedestrian activity and lower levels of vehicle movements, creating places of value for local communities and visitors.
Local streets	Local streets are part of the fabric of the suburban neighbourhoods where we live our lives and facilitate local community access.

Source: NSW Road Planning Framework, Draft TfNSW, September 2017

TfNSW preliminary suggested road categories for the Precinct are shown in **Figure 3-3**. Roads and Maritime collaborate with TfNSW to plan for the existing and future use of key roads. It is anticipated key roads in the Precinct could fall into this program for more detailed assessment.

Figure 3-3 Preliminary Movement and Place classifications across the Precinct



TfNSW, March 2018

3.3 Pedestrian

3.3.1 The pedestrian experience

The pedestrian experience in the Precinct varies dependent on the sub-precinct, which is closely linked to land use, block sizes and infrastructure.

In Artarmon, pedestrians encounter large blocks without active street frontages, a lack of mid-block crossings and minimal facilities at intersections, narrow footpaths, no weather protection and some steep hills, particularly north of the Royal North Shore Hospital along Reserve Road. Outside of business daytime hours the sub-precinct could present personal security concerns from the lack of passive and active surveillance. This is somewhat offset by the limited need to be in the area.

The St Leonards sub-precinct presents different pedestrian experiences, dependent on location. To the south of the Pacific Highway steep grades affect all north-south routes. Currently a low-medium density residential area, there is a lack of street lighting, active surveillance and pedestrian activity. Around the RNS Hospital, pedestrians are affected by large block sizes, similar to those in the Artarmon sub-precinct. While Herbert Street has several pedestrian crossings, vehicle speeds can be high, blocks are large, buildings are private with entrances set back from the street, and there is little weather protection. There are many driveways with alternative pavement treatment further emphasising the lack of pedestrian priority.

The road network adjacent to the eastern side of St Leonards Station generally has better pedestrian amenity. Northbound from St Leonards Station and to the east of the railway line has opportunities for improvement. Paths are shared with laneways with minimal lighting at night, however this actually improves further north away from the station.

Pedestrians heading east from St Leonards Station have a range of direct routes options. The permeable grid network, awnings and active street frontages during the day encourage short walking trips between diverse land uses but queued traffic, pedestrian refuges that are too narrow at the intersection of Christie Street and Chandos Street, and the illegibility of the Christie Street Reserve, contribute to constrained pedestrian movements to and from the station.

The Crows Nest Village centre around Willoughby Road, Alexander Street and Clarke Street provides a pleasant pedestrian experience with priority road crossings, small block sizes and a network of laneways for permeability, active street frontages at all times of the day and week, civic spaces, weather protection from awnings and landscaping. Away from Willoughby Road there is less pedestrian amenity; Albany Street and Oxley Street are unpleasant roads to cross; vehicles speed towards intersections which either have no crossing facilities or small, non-compliant pedestrian refuges offer little protection for people attempting to cross. In particular, roundabouts in the area have poor pedestrian amenity[4]; including the ones at the intersections Chandos Street/Christie Street, Oxley Street/Albany Street and Burlington Street/Alexander Street.

The pedestrian experience along the Pacific Highway changes little between the sub-precincts. Throughout the day, pedestrians experience a low of priority at intersections, limited crossing opportunities, high traffic volumes in the AM and PM peak and high traffic speeds at other times. This can give pedestrians the sense that the Pacific Highway is a dangerous road[5] and could cause pedestrian frustration resulting in crossings against the red light or away from signalised intersections[6]. While the section of the Pacific Highway through Crows Nest has an active retail strip, west of Hume Street there are less engaging street frontages and west of Reserve Road long blocks with building entrances set back from the road create an isolated walking experience.

3.3.2 Network

The Precinct has a well-established pedestrian network, with walking connections throughout.

Primary walking routes are defined as key corridors that generally support higher volumes of pedestrians and provide the most direct and convenient connections between key trip-generating destinations. In the Precinct, the current primary walking routes converge on St Leonards Station at The Forum and connect key commercial and mixed land uses in the neighbouring Artarmon and Crows Nest sub-precincts.

4 North Sydney Council meeting, November 2016

5 Transport for NSW – Centre for Road Safety meeting, December 2016

6 Willoughby City Council meeting, November 2016

In St Leonards, a primary route runs along Christie Street, connecting to businesses and high-density residential areas.

Towards Artarmon, the primary walking routes proceed along the Pacific Highway and Reserve Road, connecting to the RNSH and businesses along the south side of Pacific Highway. Another route proceeds north along Herbert Street and Frederick Street, connecting to the SBS studio and Home HQ Homemaker Centre.

Towards Crows Nest, the primary walking routes along the Pacific Highway, Atchison Street and Willoughby Road provide direct connections to local restaurants, cafes and retailers in the Crows Nest Village.

Secondary routes provide a support function to the primary routes. These generally connect to fewer trip-generating land uses and facilitate lower volumes of pedestrian movement than primary routes.

In the St Leonards sub-precinct, two secondary routes proceed south along Canberra Avenue and Lithgow Street, supporting trips between St Leonards Station and low-density residential areas in St Leonards and Wollstonecraft.

In the Artarmon sub-precinct, secondary routes provide connections to local businesses along Reserve Road and Herbert Street, and extend towards the Artarmon local centre and train station. Another secondary route located further north-west along the Pacific Highway, connects to the Gore Hill technology park.

In the Crows Nest sub-precinct, secondary routes along Albany Street, Alexander Street, Oxley Street and Chandos Street provide connections to local retailers surrounding the major activity areas along Willoughby Road, and in the creative precinct between Willoughby Road and St Leonards Station. An additional route connects the Pacific Highway and Falcon Street intersection with Wollstonecraft Station via Shirley Road.

The primary and secondary walking routes and key pedestrian desire lines in the Precinct are shown in **Figure 3-4**.

3.3.3 Pedestrian desire lines

Key pedestrian desire lines radiate out from St Leonards Station and Crows Nest activity centre. There is a strong desire lines between the Royal North Shore Hospital and St Leonards Station and between St Leonards Station and Crows Nest activity centre.

In commuter periods, notable numbers of pedestrians travel to and from the Artarmon employment precinct, however the northern half of the Precinct is closer to Artarmon Station and pedestrians are generally attracted to the closer station.

Strong orbital links are not evident as these are longer distances and relatively few trips would be generated between low-density residential land uses to other residential land uses or the employment and bulky retail areas of Artarmon.

Pedestrian desire lines from Crows Nest activity centre to residential land uses to the north, east and south are well served. The desire line west of the railway line is less well served by existing infrastructure towards St Leonards south and Greenwich.

The key pedestrian desire lines for the Precinct are shown on **Figure 3-4**.

3.3.4 Walking catchments

Once the Sydney Metro Crows Nest Station is operational in 2024, the majority of the Precinct will be within a 10-minute walk of a train station. **Figure 3-5** presents the combined 400-metre and 800-metre walking catchment from St Leonards Station and the proposed Crows Nest Metro Station site as well as stations external to the Precinct.

Figure 3-4 Primary and secondary walking routes

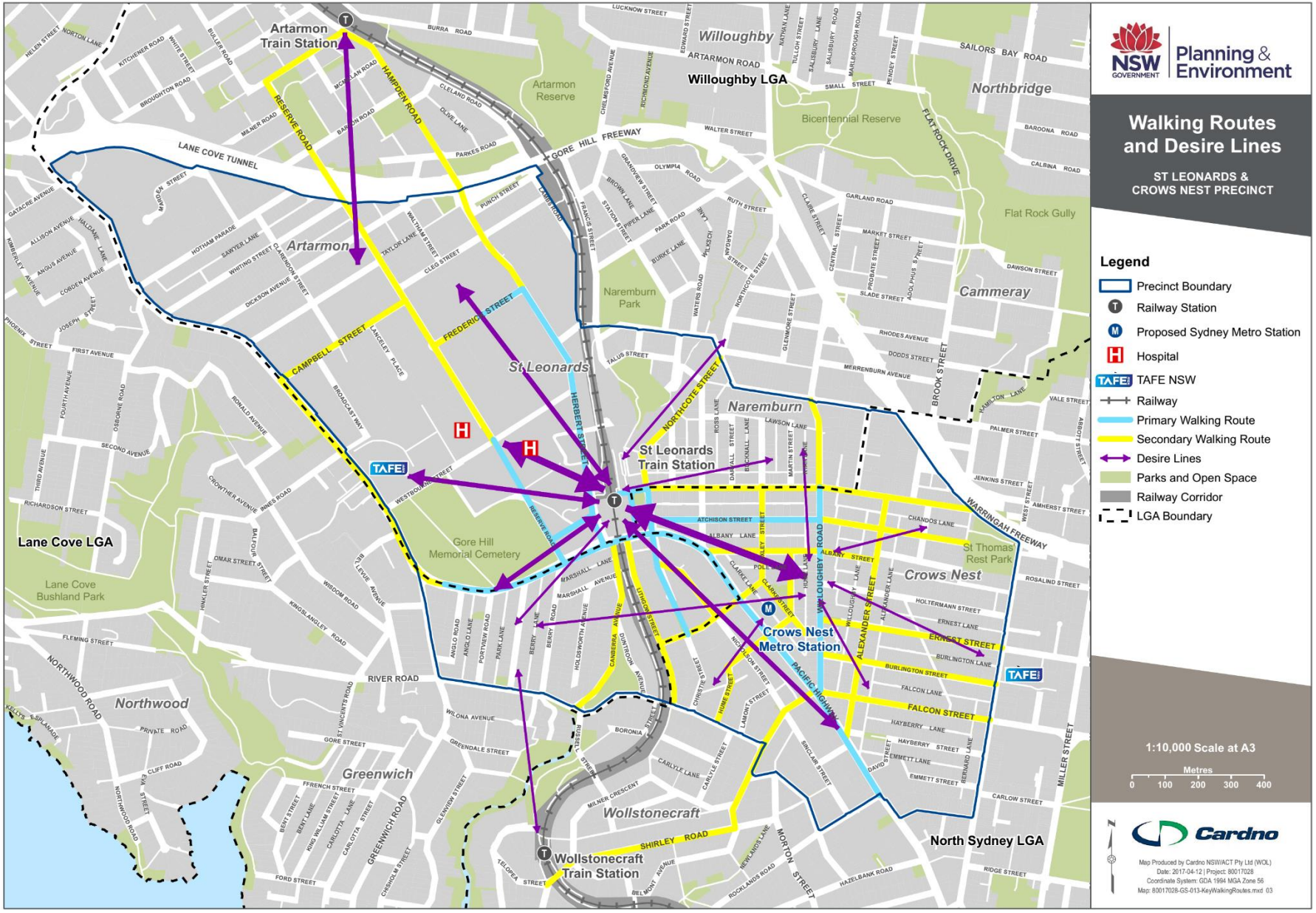
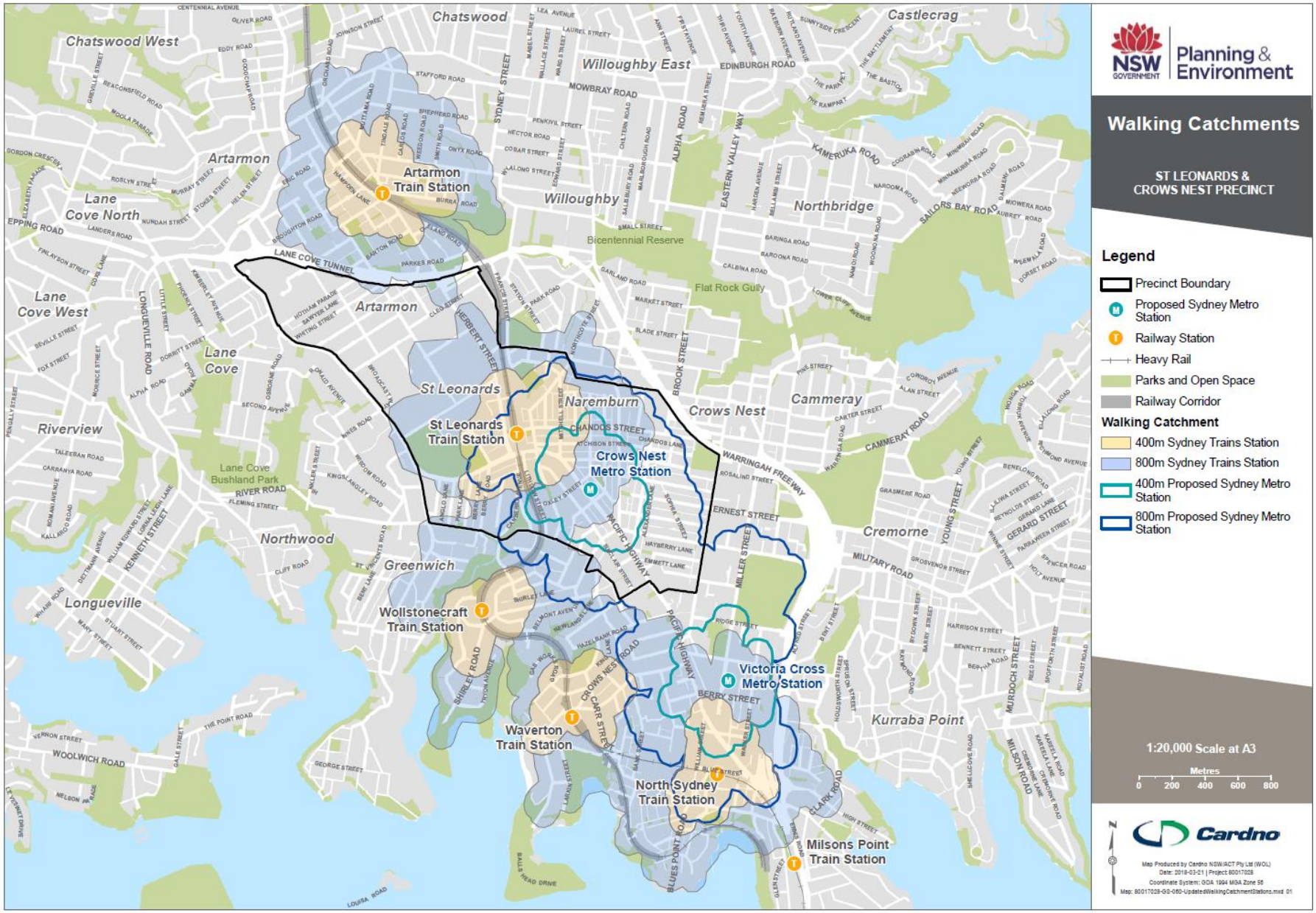


Figure 3-5 Walking catchments from existing stations and proposed metro stations



3.3.5 Infrastructure

3.3.5.1 Footpaths

Footpaths around the St Leonards sub-precinct are provided on both sides of roads. Footpaths are generally wide, (over 1.8 metres) adjacent to business and retail land uses and in many cases extend from the property boundary to the kerb. On the southern side of the Pacific Highway, footpath connections are limited along key north-south streets proceeding towards St Leonards Station including Lithgow Street, Canberra Avenue and Christie Street. Footpaths along these streets are smaller in width and are provided directly adjacent to property boundaries.

In the Artarmon sub-precinct, footpath quality and width is dependent on the road. Along the Pacific Highway, footpaths are wide and in good condition. Reserve road has generally average footpaths of approximately 1.5 metres wide. On minor roads such as Dickson Avenue, Campbell Street, Clarendon Street and Hotham Parade, footpath widths are generally between 1 to 2 metres, with grassy nature strips separating them from the roadside. Around the RNS Hospital the footpath network is too narrow (less than 1.8 metres wide) for the volume of pedestrians and the requirements of mobility impaired people. The footpath network in the more industrial parts of the sub-precinct is missing in some sections and subject to interactions with driveway access for heavy vehicles.

Around the Crows Nest sub-precinct, footpath facilities are wide and in generally good condition. Links are provided to the proposed Sydney Metro Station site and key bus stops along the Pacific Highway and Willoughby Road. Where footpaths are provided, they are generally restricted in width, and intersect frequently with driveways.

Recent improvements in the Crows Nest sub-precinct include a widening of the footpath on the southern side of Albany Street, between Oxley Street and Hume Lane, and building frontage improvements, including new footpaths associated with the redeveloped Woolworths supermarket at the corner of Falcon Street and Alexander Street. To the south-west of the Pacific Highway, footpaths are provided on both sides of the local roads in residential areas. Footpaths along streets south-west of the Pacific Highway including Oxley Street, Hume Street, Nicholson Street and River Road are generally restricted in width (average width is 1.5 metres), but in serviceable condition and are well connected to the Pacific Highway corridor.

Recent developments along the Pacific Highway have larger setbacks which allows for a wider footpath in some locations.

3.3.5.2 Wayfinding

The Precinct contains several forms of wayfinding implemented either by private landholders, notably around The Forum at St Leonards Station and by Council, more noticeable around Crows Nest village. In some locations, additional green and white text wayfinding signs support road / street name poles and signs. TfNSW orange “T” symbols are located at three entrances to The Forum.

There is a high reliance on general signage that serves all road users.

There is an opportunity to improve wayfinding with a more consistent approach. The Crows Nest Metro Station will require wayfinding that should integrate into the Precinct and with wayfinding for St Leonards Station and other key land uses.

3.3.5.3 Crossings

In the St Leonards sub-precinct, signalised pedestrian crossings are provided at intersections of the Pacific Highway and Christie Street, Herbert Street and Berry Road, however marked pedestrian crossings are not provided across all legs at these locations that results in reduced pedestrian connectivity and informal crossings made across the Pacific Highway. An underpass between The Forum and Lithgow Street provides an alternative north south crossing across the Pacific Highway however, the amenity is poor with potential security concerns and it does not provide a direct route between either side of the road. To the east, signalised pedestrian crossings and pedestrian refuges provide access to the Crows Nest sub-precinct, while a pedestrian bridge over Herbert Street links the Gore Hill and Artarmon Loop bus stop to the St Leonards Station’s western entrance.

Formal pedestrian crossings are very limited in the Artarmon sub-precinct. They are restricted to signalised crossings at four intersections and two pedestrian refuges at the intersection of Carlotta Street and Clarendon Street. Recent improvements include reconstruction of a crossing on Herbert Street opposite the RNSH Community Health Centre to a raised pedestrian crossing (zebra).

Crossing facilities are provided at most intersections in the Crows Nest sub-precinct including raised crossings (zebra) and signalised crossings. Pedestrian refuges are also provided along Chandos Street and Albany Street; however, these are not compliant to Roads and Maritime current standards and provide only small waiting spaces, introducing a potential conflict risk with vehicles approaching the crossing at the posted 50km/h speed.

A summary of the existing pedestrian crossing facilities in the Precinct is presented in **Figure 3-6.**

Both the rail corridor and the Pacific Highway act as major barriers for pedestrians, with limited places to cross. The distance required for pedestrians to travel before approaching a crossing of the Pacific Highway varies across the Precinct; generally, pedestrians are required to travel further to arrive at a formalised crossing in the Artarmon sub-precinct compared to the St Leonards and Crows Nest sub-precinct.

In the Artarmon sub-precinct, the longest distance between two crossings is located along the Pacific Highway, between the intersection of Longueville Road and Hotham Parade at 530 metres. This is followed by the distance along the rail corridor between the Gore Hill Freeway and Ella Street at 520 metres and along the Pacific Highway between Hotham Parade and Campbell Street at 495 metres.

In the St Leonards sub-precinct, the longest distance between pedestrian crossings is located along the rail corridor between the Pacific Highway and River Road at 480 metres. Along the Pacific Highway between Greenwich Road and Reserve Road the distance is 450 metres, and north of St Leonards Station, the distance between the station plaza and the Herbert Street bridge is 365 metres. This bridge only provides access to residents at 15 Herbert Street. General public access across the railway line is 680 metres north of St Leonards at Dalleys Road.

In the Crows Nest precinct, the distance required to travel between crossings is significantly shorter when compared to the St Leonards and Artarmon sub-precincts, with crossing facilities provided more frequently along the Pacific Highway. The longest distance between crossings in this area is located between the intersections of Alexander Street and Rocklands Road at 220 metres.

A map summarising the distances between formal pedestrian crossing facilities along the T1 rail corridor and the Pacific Highway is provided on **Figure 3-7**.

Figure 3-6 Existing pedestrian crossing facilities

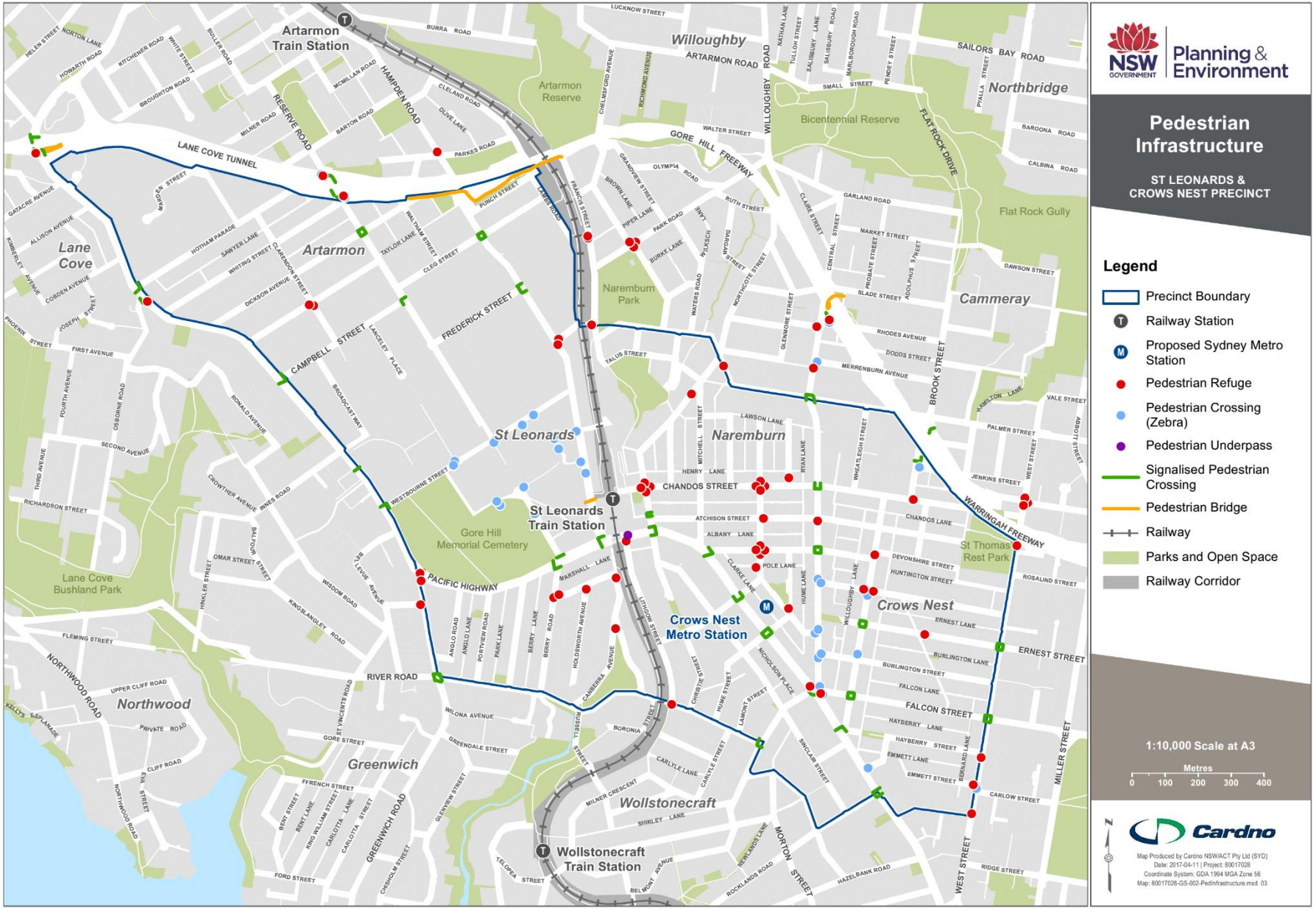
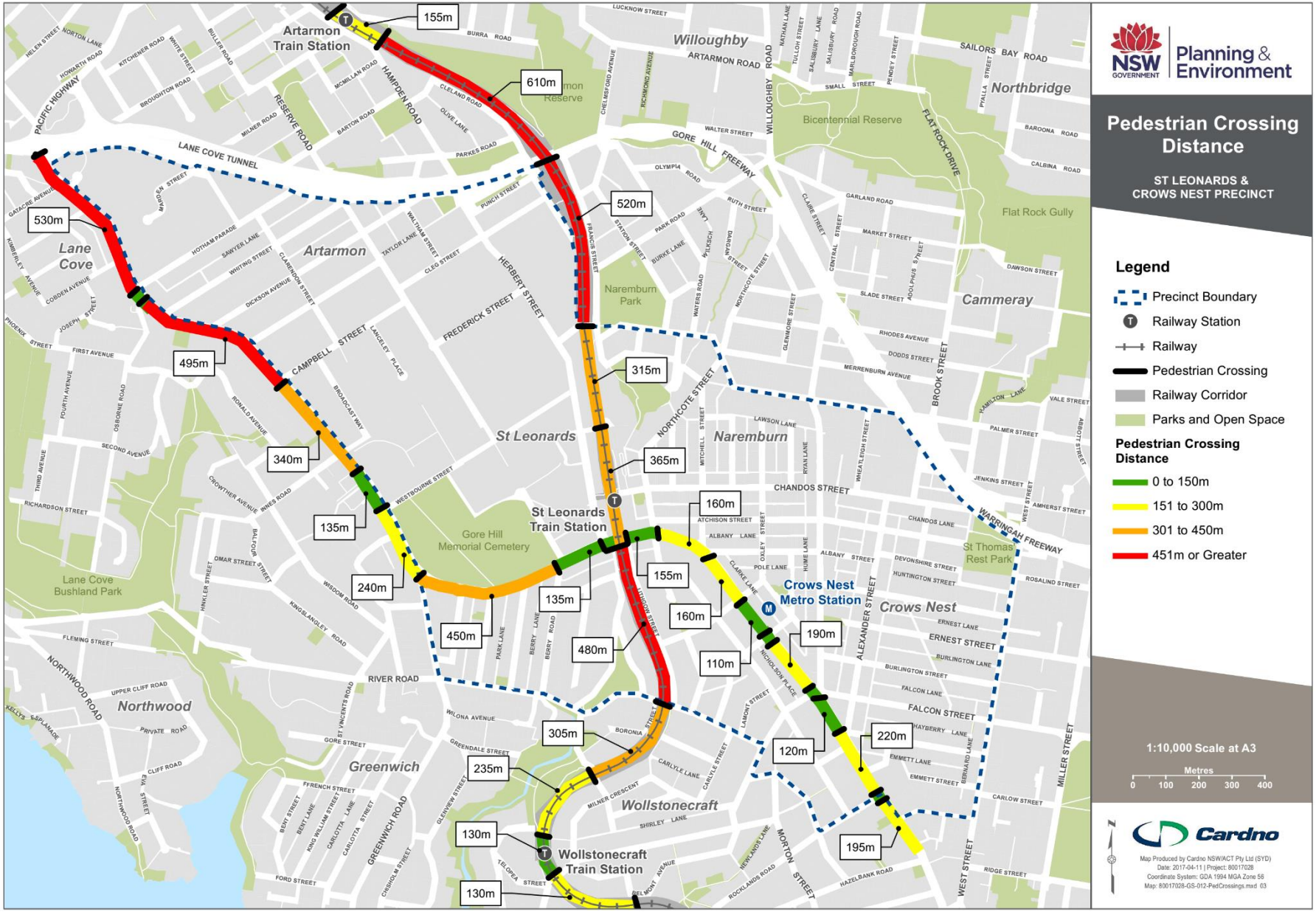


Figure 3-7 Distances between formal crossings in the Precinct – Pacific Highway and T1 rail corridor



3.3.6 Demand

Pedestrian counts were completed on the 17th November 2016 at 18 locations throughout the Precinct. The highest pedestrian volumes were found to be along the Pacific Highway, in close proximity to the St Leonards Station, and towards Crows Nest. Two-way daily pedestrian volumes at count locations surrounding St Leonards Station were a minimum of 2,800 pedestrians per day.

The pedestrian underpass at Pacific Highway adjacent to the east of the railway line at St Leonards has two-way pedestrian volumes of 4,700 pedestrians. This is well below that of the pedestrian crossings of Pacific Highway at Herbert Street and Christie Street that cater for 13,000 and 8,000 pedestrians two-way respectively. 2016 pedestrian intersection volumes are shown in **Figure 3-8**.

Pedestrian counts were also completed at select locations in the Lane Cove LGA as part of the 2013 Lane Cove Council Pedestrian Access and Mobility Plan, prepared by GTA Consultants. Surveys were completed across three time periods at ten locations. Two of these locations are situated within the Precinct, near St Leonards Station. These included Location 6 (Intersection of Pacific Highway and Berry Road) and Location 7 (Intersection of Pacific Highway and Reserve Road).

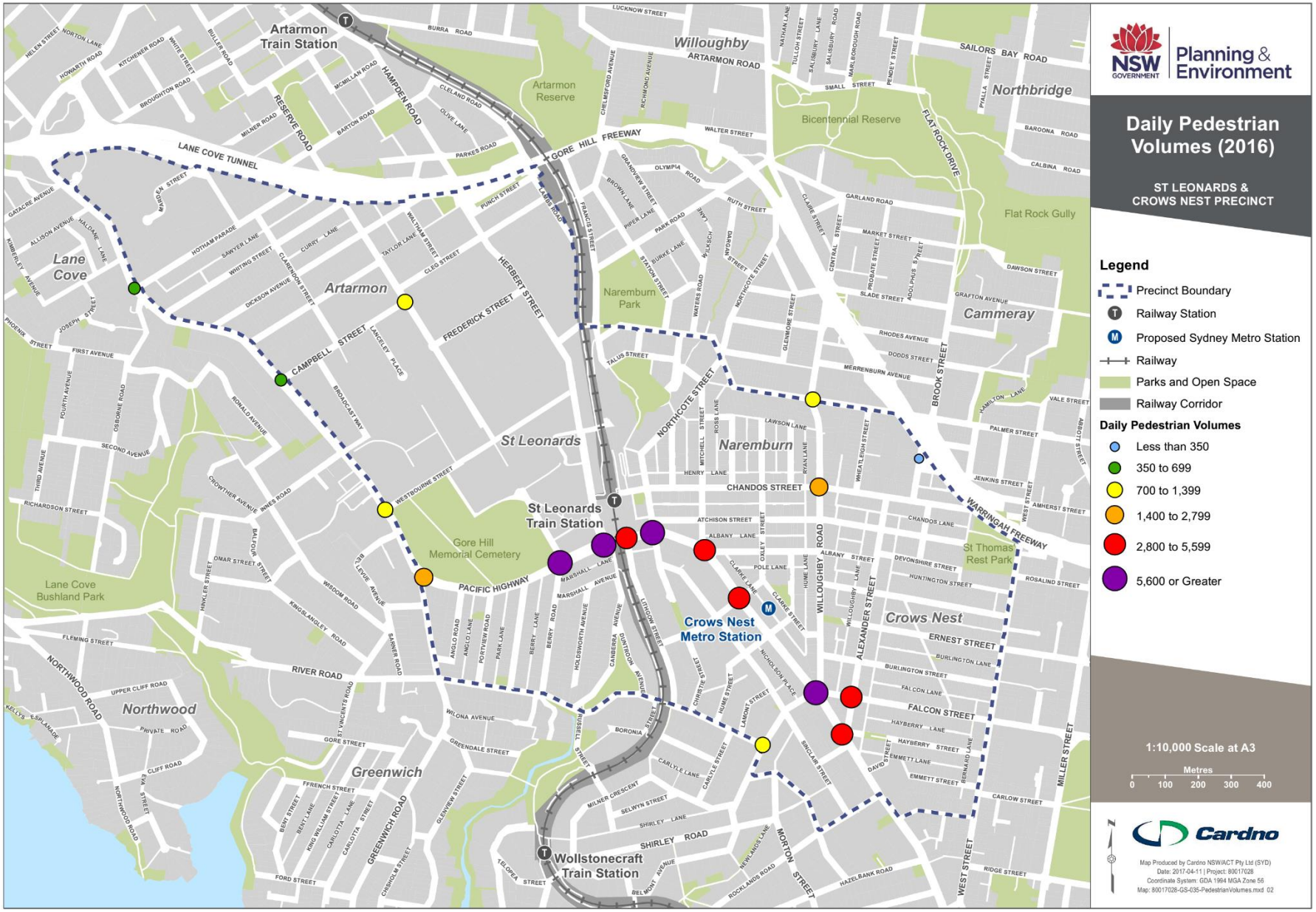
A summary of the pedestrian volumes captured at these locations is provided in **Table 3-3**.

Table 3-3 Summary of two-way pedestrian volumes – 2011

Survey location	7am – 9am	AM Peak	12pm – 2pm	MID Peak	4pm - 6pm	PM Peak	Total
Pacific Highway / Berry Road	493	414 (8am – 9am)	805	515 (12:30pm – 1:30pm)	506	251 (5pm – 6pm)	1,804
Pacific Highway / Reserve Road	708	527 (8am – 9am)	1,131	713 (12:30pm – 1:30pm)	675	279 (5pm – 6pm)	2,514

Source: Lane Cove Council PAMP (GTA Consultants, 2013)

Figure 3-8 Daily pedestrian volumes - 2016



3.4 Cycling

3.4.1 The cycling experience

The Precinct features challenging topography and high volume roads reducing the attractiveness of cycling as a mode option for many users. The prevalence of kerbside parking further reduces the safety and attractiveness of cycling through the Precinct. The limited provision of shared paths and separated cycleways means that cyclists can either share the road or illegally use footpaths.

Where shared paths are provided, these are generally of good quality with linemarking and lighting.

Road lanes are generally standard widths, although some streets have wider lanes that assist the shared use of the road. On-street infrastructure is provided in some locations in the form of painted bicycle lanes and contra-flow lanes for one-way streets. Cyclists need to be prepared to use a range of cycling infrastructure typologies to complete a trip. Dedicated bicycle routes are supported by wayfinding signage and painted bicycle stencils and turning arrows.

Just as the Pacific Highway provides a direct route through the Precinct for motorist, the same applies for cyclists. The cyclist willing to do so would likely be categorised as “Strong and Fearless” by the Portland Bureau of Transportation. This corridor is noted to attract a high proportion of cyclists who use the tracking application Strava. This provides an indication of preferred cycling routes and where possible, infrastructure improvements should consider this.

Bicycle parking areas are provided at St Leonards Station and racks and hoops are provided in the Crows Nest activity centre, however these generally have no weather protection. Bicycle lockers are located on the east side of St Leonards Station and despite being next to the station, the walking distance to the station is circuitous.

Bicycle parking loops are integrated into parking sign poles along Willoughby Road in Crows Nest providing better opportunities for cyclists to park near to where they want to go.

3.4.2 Network

The Precinct’s cycling network varies from a dense spaced network in some parts to limited and disjointed coverage depending on the sub-precinct. There is a general lack of directness and continuity along the existing network routes, as many avoid arterial road corridors such as the Pacific Highway and Falcon Street; they instead run along local and distributor roads. These roads are characterised by their lower traffic volumes and speeds, making them more suitable for mixed traffic cycling facilities.

North-south cycling routes in the existing network run predominately through the Crows Nest sub-precinct; the most direct route runs along West Street, connecting to routes along the Warringah and Gore Hill Freeways and proceeding towards Chatswood. The route along West Street also proceeds south to connect to North Sydney. An alternative north-south route runs through the Crows Nest village centre along Hayberry Street, Alexander Street, Clarke Street and Oxley Street, and proceeds through Naremburn before also connecting to the regional routes to Chatswood. In the Artarmon sub-precinct, a north-south route proceeds along Herbert Street and Hampden Road, connecting St Leonards Station and Artarmon Station.

Two key east-west routes are provided through the Precinct. To the north of the Precinct, a shared path facility is provided along the southern perimeter of the Warringah and Gore Hill Freeways. This facility forms part of a key regional route from Naremburn to Macquarie Park via Lane Cove and North Ryde. This provides several access points to the Artarmon employment land Precinct. A second route runs along River Road and through suburban streets in Greenwich, connecting Lane Cove with Wollstonecraft and routes proceeding south towards North Sydney.

Cycling access to St Leonards Station is limited to two routes approaching from the north and east of the Precinct. The first of the key access routes approaches from Herbert Street, with the second arriving from the east along Henry Lane and Christie Street. Access to St Leonards Station from the south is limited due to the lack of routes connecting to and across the Pacific Highway. The two routes in this area closest to St Leonards Station include a route along Greenwich Road (ending at the intersection with the Pacific Highway) and Nicholson Street (ending at the intersection with Oxley Street). Both routes are incomplete, with no additional facilities connecting to the St Leonards Station. Cycling access to the future Crows Nest Metro Station is currently available via a route along Clarke Street. A summary map of the existing and proposed cycling routes is provided in **Figure 3-9**. Proposed routes are described in **Section 3.6**.

The majority of the Precinct is within a 15-minute cycle of the St Leonards and Crows Nest stations. **Figure 3-10** presents the combined 2.5 kilometre cycling catchment from St Leonards Station and the proposed Crows Nest Metro Station site

Figure 3-9 Existing and proposed cycling routes

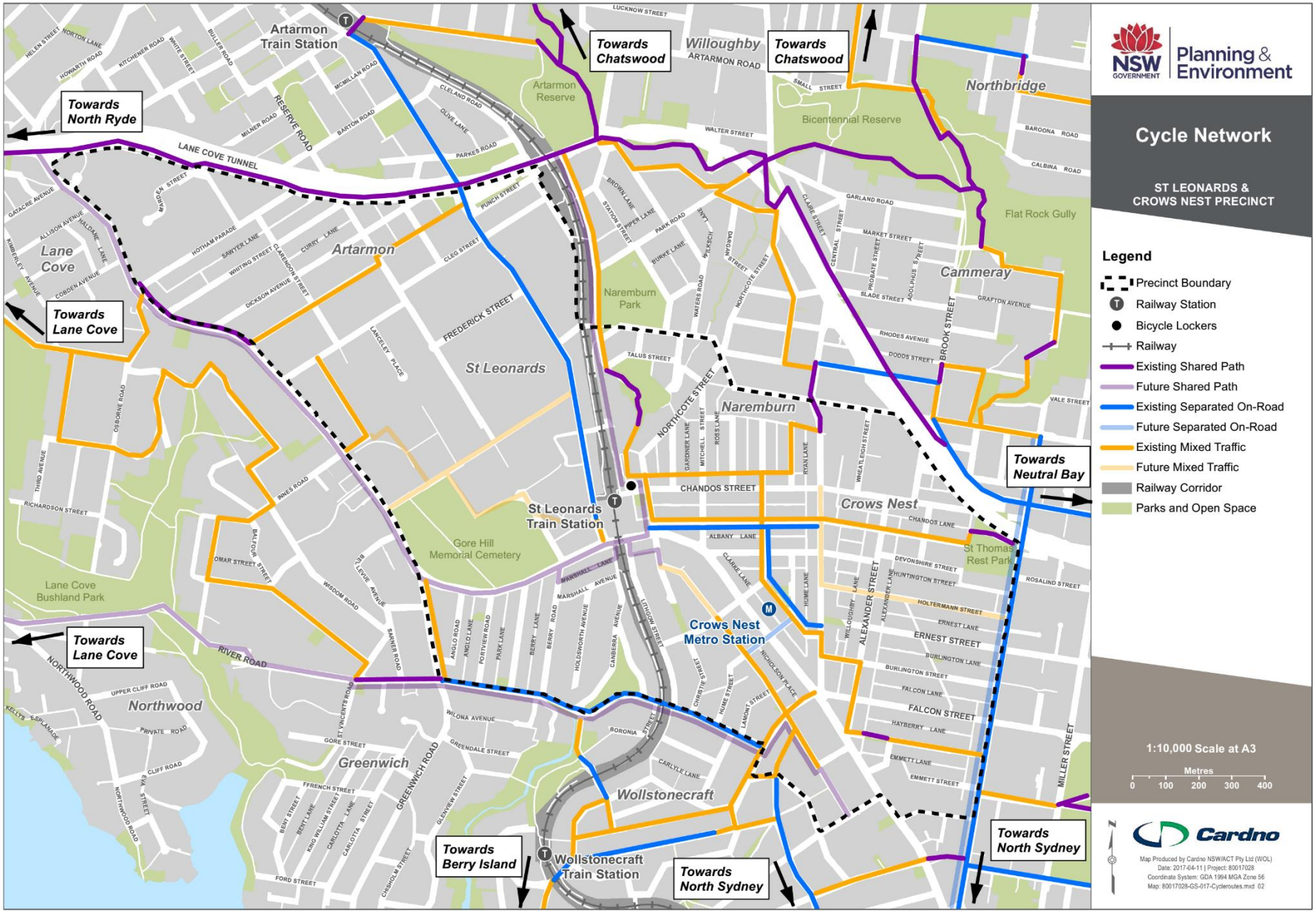
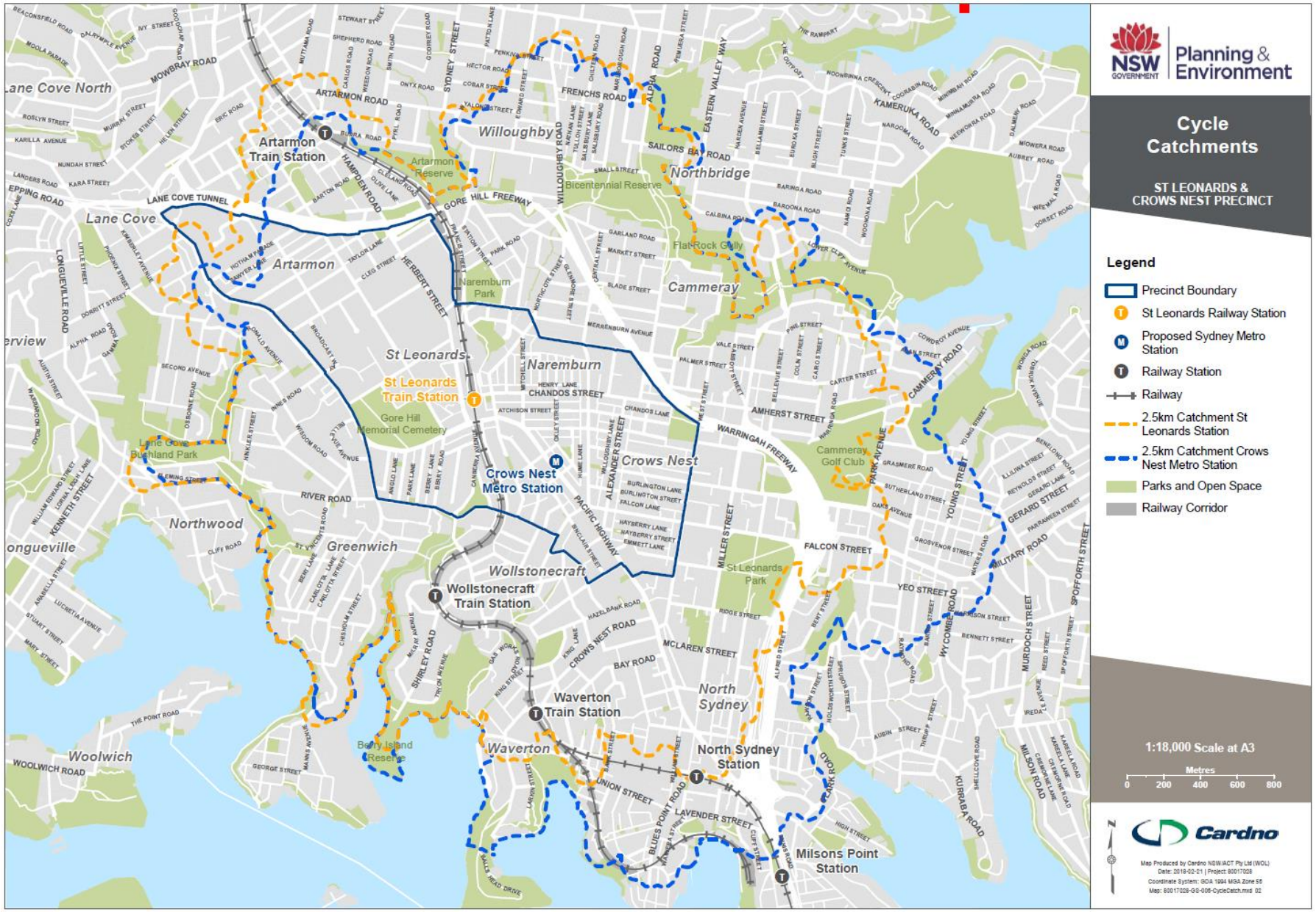


Figure 3-10 2.5 kilometre cycling catchment



3.4.3 Infrastructure

Along existing routes there is limited dedicated cycling infrastructure, many are unmarked with no accompanying signage and wayfinding. Off-road facilities are limited, however along some routes; facilities such as shared paths provide links between disconnected or incomplete on-road routes.

To the north of the Precinct, a shared path is provided along the southern perimeter of the Gore Hill Freeway.

In the St Leonards sub-precinct, an on-road separated lane is provided in both directions along most of Herbert Street, reverting to mixed traffic on approach to the Pacific Highway. On the eastern side of the railway line, a combination of mixed traffic and shared paths run parallel to the rail corridor. To the east, a mixed traffic facility is provided on Henry Lane and Atchison Street (eastbound). For westbound movements along Atchison Street, a 1.4-metre wide contraflow on-road lane was recently implemented. The only facilities provided on the south side of the Pacific Highway include a combination of mixed traffic and separated on-road lanes run along the Precinct boundary on Greenwich Road and River Road.

In the Artarmon sub-precinct, formal cycling facilities are provided along major routes. A mixed traffic route with painted markings is provided running east-west on Carlotta Street, connecting a short section of shared path on Pacific Highway to a separated on-road facility on Herbert Street leading to St Leonards Station. This separated on-road facility on Herbert Street extends north to Artarmon Station via Hampden Road.

In the Crows Nest sub-precinct, most routes operate with mixed traffic arrangements. These include Atchison Street east of Willoughby Road, and the route along Oxley Street (northbound), Clarke Street (northbound), Alexander Street and Hayberry Street. Southbound along Oxley Street and Clarke Street, a separated on-road lane is provided. The Roads and Maritime Services Cycleway Finder also rate two segments of this route as high difficulty; these include:

> The roundabout intersection of Chandos Street and Christie Street; and

> Oxley Street, between Chandos Street and Albany Street.

In the Crows Nest sub-precinct, no dedicated facilities are available to facilitate crossing of the Pacific Highway by bike.

Some cycling does occur in bus lanes, and along bus routes as the Pacific Highway is the most direct through route to traverse the Precinct. This interaction between buses and bicycles in the same space may cause conflict.

3.4.4 Bike parking for developments

Each DCP nominates bicycle parking requirements for new developments, all referencing AS 2890.3 for the of bicycle facilities to be provided.

The rates of bicycle parking required generally vary between each DCP, particularly for residential requirements and business premises. For these land uses, North Sydney requires the highest level of parking provision, followed by Lane Cove and Willoughby requires the least amount.

Two sets of rates of measure for bicycle parking are required by each DCP, outlined in **Table 3-4**. The first rate of measure is generally for residents and employees and the second rate of measure is generally for visitors to the land use. More land uses are specified in the respective documents.

Table 3-4 Bicycle parking rates for each council

		Lane Cove	North Sydney	Willoughby
Rate 1 measure		Residents/ Employees	Occupants	Bicycle lockers
Rate 2 measure		Customers/ Visitors	Visitor/ Customer	Bicycle rail/ racks
Land use				
Resident accommodation	Rate 1	1 per 4 dwellings[1]	1 per dwelling	1 per 10 units
	Rate 2	1 rack + 1 rack per 10 dwellings[1]	1 per 10 dwellings	1per 12 units
Office or business premises	Rate 1	1 per 300sq.m GFA	1 per 150sq.m GFA	1 per 600sq.m
	Rate 2	1 rack + 1 rack per 800sq.m GFA	1 per 400sq.m GFA	1 per 2,500sq.m

[1] Residential flat buildings

3.4.5 Network demand

Intersection counts were completed on 17th November 2016 at 18 locations throughout the Precinct. These counts showed the Pacific Highway being used by between 80 to 160 cyclists per day, with the higher end of the range being recorded in Crows Nest.

The highest recorded ridership within the Precinct was along Alexander Street with 288 cyclists northbound and Falcon Street with 500 cyclists eastbound counted. 2016 daily cyclist volumes are shown in **Table 3-5**.

In addition to the survey counts, Roads and Maritime collects bicycle volume data using counters across Greater Sydney. The counters provide daily counts of passing bicycles, with average daily counts reported by month and year. There are currently no survey facilities installed in the Precinct, however three counters are provided at the following nearby locations that indicate volume:

> Merrenburn Avenue (ramp onto the Warringah Freeway), Naremburn;

> Falcon Street pedestrian bridge, Neutral Bay; and

> Ridge Street bridge, North Sydney.

The most recent average daily counts by year are provided in **Figure 3-11**.

Table 3-5 Roads and Maritime average daily cycling volumes

	Merrenburn Avenue	Falcon Street pedestrian bridge	Ridge Street bridge
2016	342	16	90
2015	310	16	85

Source: ROADS AND MARITIME Cycling Statistics (Viewed November 2016)

Willoughby City Councils reports a lack of cycling in their part of the Precinct, but notes that the Gore Hill Freeway bike links are popular[7].

3.4.6 Parking demand

Bicycle parking demand appear to be low through the Precinct. The St Leonards Station bicycle racks are generally well used on both sides of the station. The ones on Herbert Street appear to have abandoned bicycles, indicative by flat tyres and repeated observations. Use of the station lockers is not known. These have graffiti vandalism and appear difficult to access.

The Royal North Shore has undercover bicycle parking on the north side of the building with moderately used parking.

Spot checks of racks around Crows Nest village indicate low usage.

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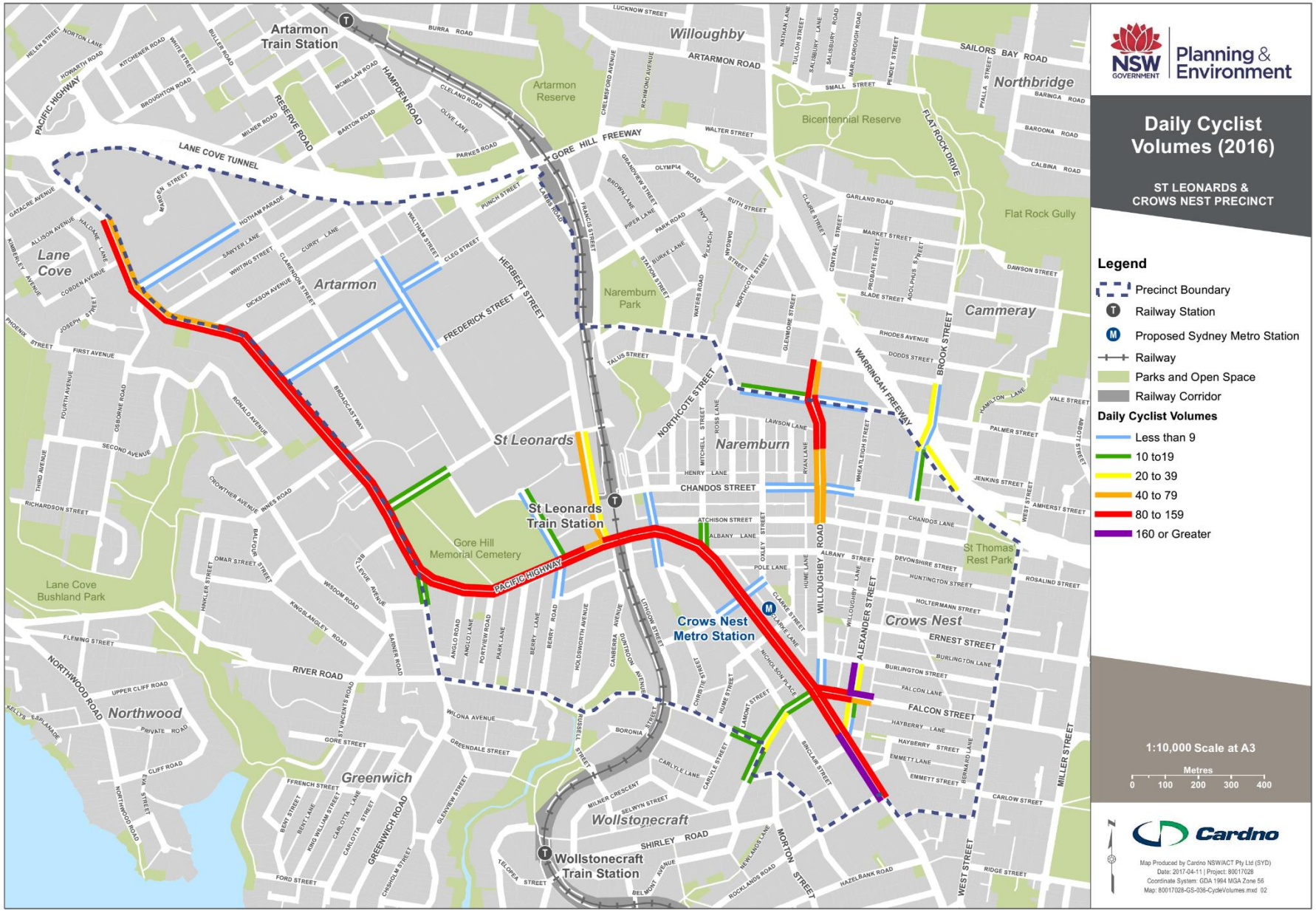
Figure 3-11 Daily cyclist volumes – 2016



3.5 Train

3.5.1 Network

St Leonards Station is located at the centre of the Precinct, at The Forum, a commercial and residential development. The station, served by Sydney Trains, operates services along the T1 North Shore and Northern Lines. Customers can travel to Berowra via Gordon, Hornsby via Macquarie Park or Penrith, Epping and Richmond via the City. Customers can also interchange at Hornsby Station for NSW TrainLink intercity services to Hamilton, or at Town Hall for the T2, T3 and T4 lines on the Sydney Trains network.

With 2016 timetable arrangements, from St Leonards Station, the 30-minute rail catchment extends to stations on the following lines:

> T1 North Shore Line: Waitara Station (via Gordon);

> T1 Northern Line: Pennant Hills Station (via Macquarie Park);

> T1 Western Line: Redfern Station;

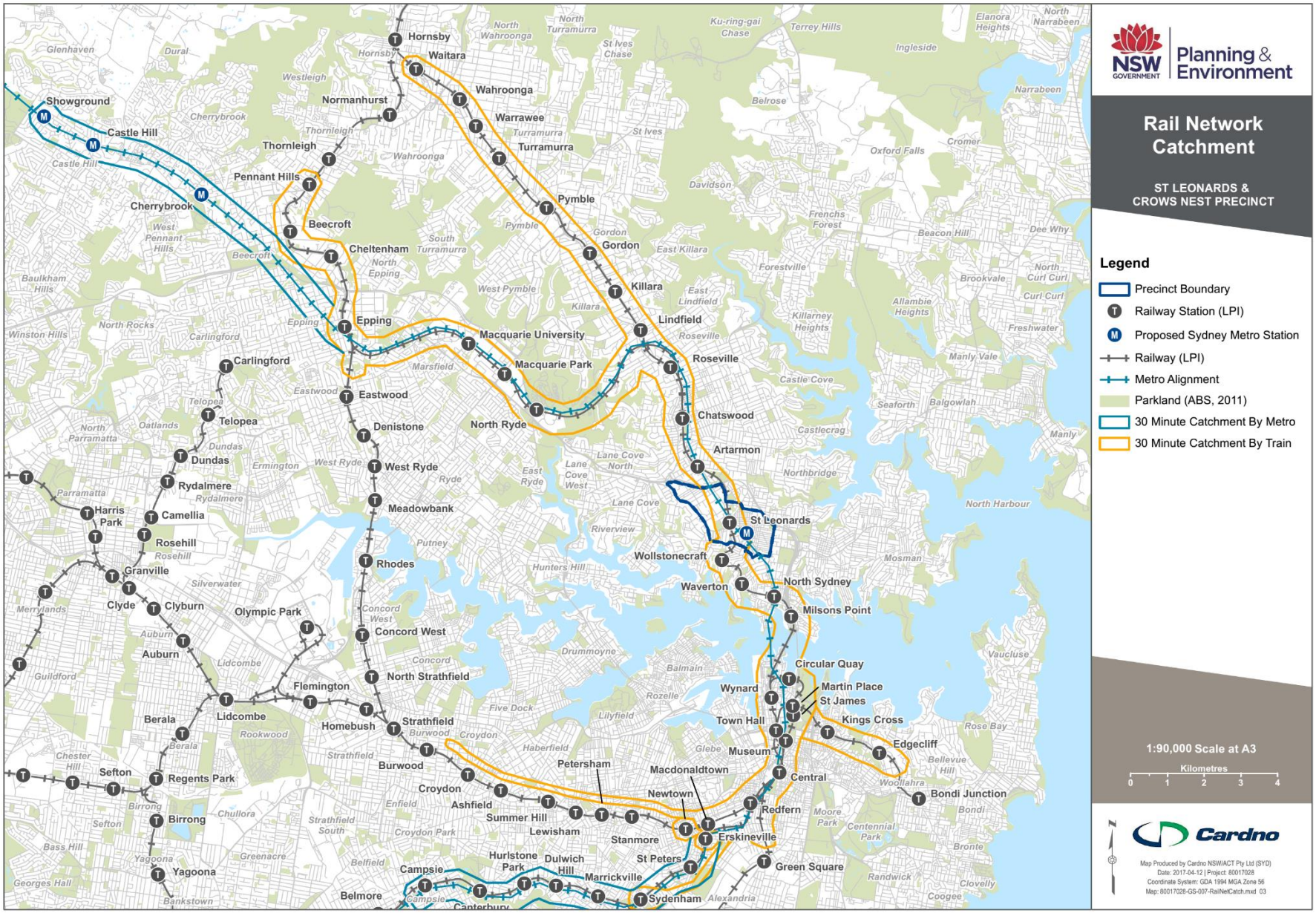
> T2 Inner West Line: Newtown Station;

> T3 Bankstown Line: Erskineville Station; and

> T4 Eastern Suburbs and Illawarra Line: Edgecliff and Sydenham Stations.

A map showing the extent of the 30-minute rail catchment is provided in **Figure 3-12**.

Figure 3-12 30 minute rail catchment



3.5.2 Infrastructure and services

St Leonards Station is configured as two island platforms; however, space is available for an additional two platforms on either side of the current Platforms 2 and 3. The railway network has capacity for 20 trains per direction per hour.

The station is wheelchair accessible; with lifts connecting both platforms with the concourse and accessible toilet, facilities are provided. Access to the station is available from the Pacific Highway and Christie Street, and an accessible path is available via Herbert Street. Interchange opportunities are available with bus services departing from the Pacific Highway and non-TfNSW bus services on Herbert Street. No dedicated taxi rank is provided at the interchange. No dedicated commuter parking is available, however Council and privately operated parking facilities are provided on the eastern side of the station. Bicycle parking is available, in addition to Kiss & Ride facilities on Sergeants Lane.

Trains operate between 4:47am and 12:02am to the City and between 4:44am and 12:55am towards Hornsby. During AM and PM peak hour, 15 trains serve St Leonards Station via the T1 North Shore Line in both directions, and four services operate in both directions on the T1 Northern Line via Macquarie Park. Outside of peak periods, eight trains per hour operate through the station in both directions, four each along the T1 North Shore and Northern Lines respectively. During weekend and public holiday periods, four trains per hour operate all day along the T1 North Shore Line via Gordon in both directions, and two trains per hour, in both directions along the T1 Northern Line via Macquarie University.

A summary of the St Leonards Station services is provided in **Table 3-6**.

Table 3-6 St Leonards Station train services

Line	Direction	Daily services (Weekday)	AM Peak 06:00-09:30	Daytime 09:30-16:00	PM Peak 16:00-18:30	Daily services (Saturday)
T1 North Shore Line (via Gordon)	From City	122	33	32	26	73
	To City	118	32	30	24	74
T1 Northern Line (via Macquarie Park)	From City	76	19	26	10	38
	To City	80	14	26	18	39

Source: Sydney Trains timetable (viewed November 2016)

3.5.3 Demand

An average of 35,180 customers used St Leonards Station over a 24-hour period in 2014. Station Out and In volumes are particularly concentrated during the AM and PM peaks respectively, with commuters travelling to the Precinct to work making up the dominant movement. A summary of the peak and daily customer volumes through the station is provided in **Table 3-7**.

Table 3-7 In and Out volumes at St Leonards Station - 2014

	24 Hour	AM Peak (6:00am–9:30am)	PM Peak (3:00pm–6:30pm)
Station Ins	17,590	3,420	8,780
Station Outs	17,590	8,900	3,230

Source: TfNSW Transport Performance and Analytics (viewed November 2016)

During the AM peak hour, approximately 18,000[8] people pass through on trains in the Sydney CBD bound direction. Given the assumed suburban rail line capacity of 24,000 trips per hour one-way (20 services x 1,200 capacity per train), the line is nearing capacity.

[8] March 2014 peak train load survey, TPA, TfNSW

3.6 Bus

3.6.1 TfNSW services

TfNSW bus services travelling through the Precinct provide connections to key centres including Chatswood, North Sydney, Manly, the Sydney CBD and Bondi. They also connect with northern residential areas such as Lane Cove, Epping, the Hills District and Dural. The only direct connection to the Northern Beaches is from Manly bound services.

TfNSW buses operated are generally confined to primary and sub-arterial road network such as the Pacific Highway; some services also operate along River Road and Willoughby Road. The Pacific Highway is the most direct route to travel north-west to the CBD through the Precinct.

Interchange is provided at Pacific Highway bus stops near St Leonards Station. The southbound stop provides a relatively simple interchange experience. Northbound stops near the station are across the Pacific Highway in several locations. The interchange between the northbound stops and St Leonards Station is longer and circuitous.

Service coverage is limited in the Artarmon sub-precinct. Customers generally need to access major corridors to board services. Exceptions include:

> The 144 is the route between Manly Wharf and Chatswood, it provides direct connection to the Royal North Shore Hospital entrance; saving visitors a 200 metre uphill walk from the Pacific Highway.

> The M20 start/ end is on Campbell Street near Reserve Road.

> The N90 and N91 (Nightride only 12am – 4am) operates via Herbert Street but does not stop in the Precinct along Herbert Street.

Service coverage is higher in the Crows Nest sub-precinct, with a combination of local and suburban routes connecting to commercial and local land uses.

3.6.2 Gore Hill Shuttle Bus

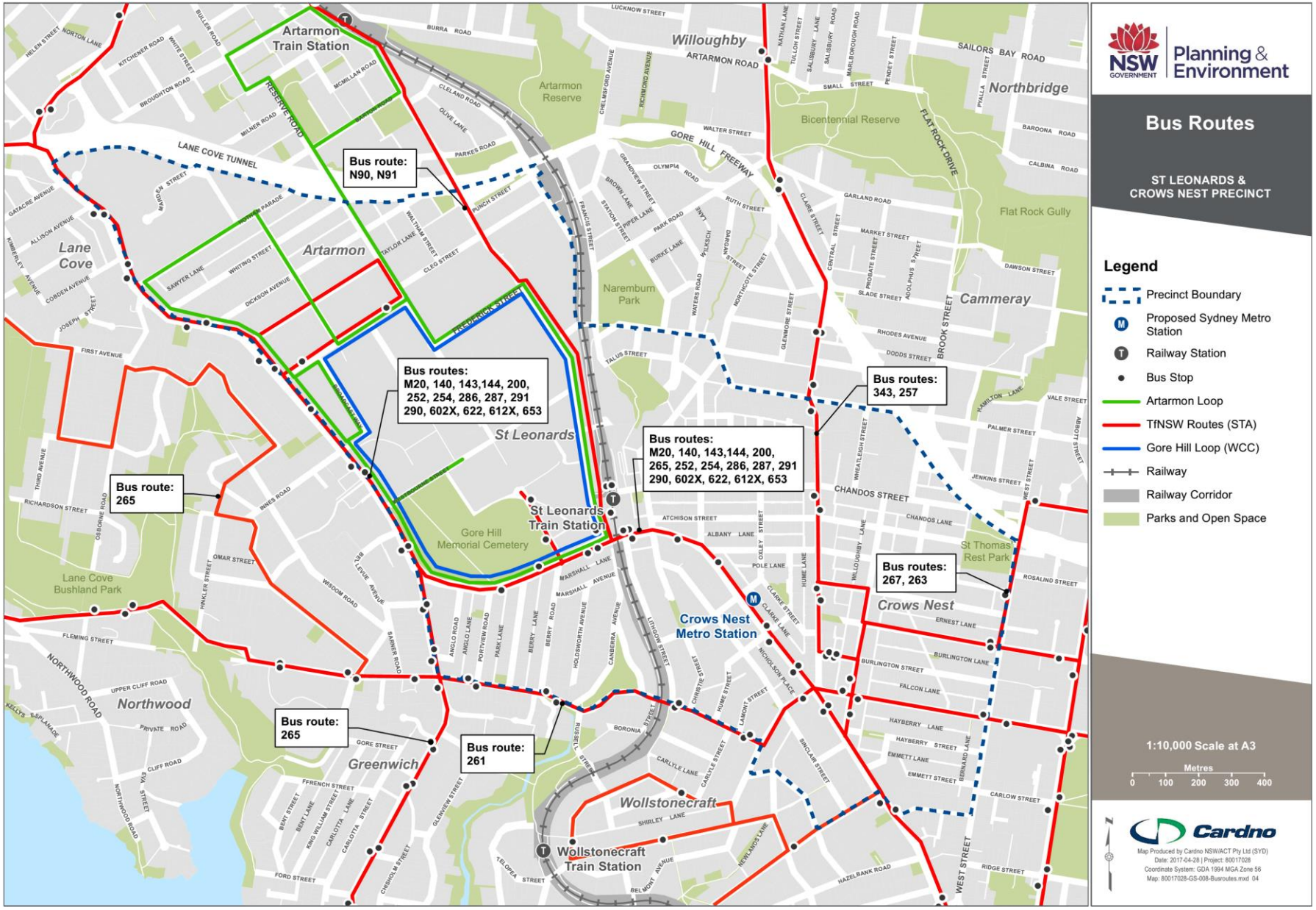
The Gore Hill Loop is a free shuttle bus service that connects St Leonards Station with the Gore Hill business and technology precinct, providing a dedicated public transport connection for employees transferring from train services. The service runs between a shared stop (with the Artarmon Loop) on the western side of Herbert Street and two stops adjacent to the Fox Sports and Australian Stock Exchange buildings at Gore Hill.

3.6.3 Artarmon Loop

The Artarmon Loop is a free Willoughby City Council bus service that operates along three routes, connecting St Leonards Station with the Artarmon sub-precinct, Artarmon train station, or Royal North Shore Hospital depending on the time of day. During peak periods, the shuttle connects the shared bus stop (with the Gore Hill Loop) on Herbert Street with 16 designated stops through the industrial area. Outside of peak periods, the shuttle proceeds further north to service the Artarmon local centre and train station and diverts along Westbourne Street to link to the Royal North Shore Hospital.

A map summarising the Precinct bus routes is provided in **Figure 3-13**.

Figure 3-13 Bus network



3.6.4 Infrastructure

Bus stop infrastructure varies in the Precinct by LGA. All bus stops are identifiable by J-Pole or newer TfNSW “B” Mode ID signage at their respective boarding points, and most bus stops provide additional facilities including shelters and seating. Where stops are located beneath building awnings, these are used as shelters in favour over prefabricated shelter structures.

Traffic lane restrictions that benefits bus reliability is provided along sections of the Pacific Highway such as peak T3 travel lanes, peak bus lanes and exceptions to left turn movements for buses.

No weather protection is provided at stops along River Road, and on the western side of Greenwich Road.

Willoughby City Council engaged JCDecaux in 2013 for the supply and maintenance contract for bus shelters. As part of the engagement, new shelters with seating and boarding point TGSI were installed at most stops within the LGA. Some stops were not included in the upgrade program; one of the key stops where a shelter is not provided is the M20 Artarmon terminus stop on Campbell Street.

The Pacific Highway and its associated traffic congestion detrimentally affect bus service delivery, particularly with limited bus priority infrastructure along the Pacific Highway. This impacts bus travel times and the overall customer experience. It should also be noted that bus operations are significantly restricted in Artarmon due to limited available road widths and on-street parking arrangements.

Bus layover in lower North Shore is currently at capacity; growth in service frequency would require additional layover options[9].

3.6.5 Services

During weekdays, eight out of the 21 routes operate until the early evening; seven operate during the peak periods only, and four provide all day services until late in the evening. 11 out of the 21 routes operate on weekends, with services on five routes each extending to the late afternoon and late night respectively, and route 290 restricted to the early morning.

A summary of the bus services travelling through the Precinct, their weekday and weekend frequencies and areas served is provided in **Table 3-8**.

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Table 3-8 Summary of bus service frequency and coverage

Route	Operator	Route start/ end locations	General frequency (services per hour)		AM Peak service frequency 7:45am 8:45am	First service		Last service		Sub-precinct coverage		
			Weekday	Weekend	Weekday	Weekday	Weekend	Weekday	Weekend	Artarmon	St Leonards	Crows Nest
602X	Hillsbus	Rouse Hill to North Sydney	4	0	6	05:39	-	08:29	-	✓	✓	✓
612X	Hillsbus	Kellyville to Milsons Point	4	0	13	05:30	-	09:06	-	✓	✓	✓
143	STA	Chatswood to Manly Wharf	2	0	1	06:41	-	18:09	-	✓	✓	✓
144	STA	Chatswood to Manly Wharf (via RNSH)	2	4	6	05:04	07:10	23:55	23:55	✓	✓	✓
200	STA	Chatswood to Bondi Junction	4	0	4	06:25	-	19:10	-	✓	✓	✓
252	STA	Lane Cove West to City – King Street Wharf	2	2	3	06:00	06:24	23:00	00:00	✓	✓	✓
257	STA	Chatswood to Balmoral Beach	2	2	2	06:52	06:19	18:22	17:42	X	X	✓
261	STA	Chatswood to City (via Longueville & Northwood)	1	1	4	06:14	07:45	20:21	17:28	X	✓	✓
263	STA	Cammeray to City – Bridge Street	2	2	1	06:04	07:06	18:56	19:05	X	X	✓
286	STA	Denistone East to Milsons Point (via St Leonards)	4	0	3	06:24	-	07:52	-	✓	✓	✓

Route	Operator	Route start/ end locations	General frequency (services per hour)		AM Peak service frequency 7:45am 8:45am	First service		Last service		Sub-precinct coverage		
			Weekday	Weekend	Weekday	Weekday	Weekend	Weekday	Weekend	Artarmon	St Leonards	Crows Nest
287	STA	Ryde to Milsons Point	4	0	4	06:27	-	07:51	-	✓	✓	✓
290	STA	Epping to City	2	2	0	04:05	04:35	05:25[1]	05:15[2]	✓	✓	✓
291	STA	Epping to McMahons Point	1	1	4	06:01	05:58	21:57	21:57	✓	✓	✓
343	STA	Chatswood to Kingsford	6	4	8	04:45	05:00	23:37	00:30	X	X	✓
622	Hillsbus	Dural to Milsons Point	3	0	3	06:10	-	07:50	-	✓	✓	✓
653	Hillsbus	West Pennant Hills to Milsons Point	3	0	3	06:25	-	08:05	-	✓	✓	✓
M20	STA	Metrobus Gore Hill to Botany via City	4	4	6 (Approximately every 10 minutes)	06:31	07:38	20:13	19:35	✓	✓	✓
254	STA	Riverview to McMahons Point	1	1	3	06:33	06:49	22:45	22:45	✓	✓	✓
265	STA	Lane Cove to McMahons Point	1	1	3	05:53	08:50	17:37	17:58	X	✓	✓
267	STA	Chatswood to Crows Nest	1	1	2	06:39	08:27	18:38	17:47	X	X	✓
Gore Hill Loop	Private operator	Loop service from St Leonards to Gore Hill	Unknown	0	9	Unknown	-	Unknown	-	✓	✓	X
Artarmon Loop	Willoughby Council	Loop Service from St Leonards to	5	0	8	06:00	-	18:00	-	✓	✓	X

Route	Operator	Route start/ end locations	General frequency (services per hour)		AM Peak service frequency 7:45am 8:45am	First service		Last service		Sub-precinct coverage		
			Weekday	Weekend	Weekday	Weekday	Weekend	Weekday	Weekend	Artarmon	St Leonards	Crows Nest
		Artarmon Industrial and Station or RNS Hospital										
N90	STA	Hornsby to City Town Hall via Chatswood	Hourly between 00:00 and 04:30	Half-hourly between 00:00 and 04:30	0	00:00	4:30	00:00	04:30	✓	✓	X
N91	STA	Macquarie Park to Bondi Junction	Hourly between 00:00 and 04:30	Hourly between 01:00 and 04:30	0	00:35	01:35	05:13	05:08	X	✓	✓
Total (routes per sub-precinct)										**16**	**19**	**21**

Source: State Transit Authority of NSW, CDC Hillsbus, Gore Hill Business Precinct and Willoughby City Council
[1] One additional 290 service operates at 23:00
[2] Four additional 290 services operate hourly from 23:00 to 01:53

3.6.6 Demand

The Pacific Highway, along with the North Sydney and Sydney CBD, experiences bus congestion in peak periods[10]. The majority of routes that use the Pacific Highway are affected by congestion on the Pacific Highway that can affect services from Chatswood. In the long term, bus capacity in the North Sydney and Sydney CBD may need to be addressed by reshaping the bus network to facilitate greater interchange from bus to railway from the CBD.

Bus to rail interchange occurs at St Leonards Station. The Hills Bus routes that stop at St Leonards see people transferring to the rail service[10]. However even due to the transfer, bus demand along the Pacific Highway is still between 1,000 to 1,999 commuters during the AM Peak in the city-bound direction, likely due to schools and employment easily assessable by the bus services. During the AM Peak in the Chatswood direction, it is evident that bus commuters interchange at St Leonards Station, as bus volumes decrease from 500-999 commuters at St Leonards to less than 500 commuters after St Leonard Station. This is likely due to commuters wishing to continue north on the railway line, or arriving at employment in St Leonards.

Although the Artarmon Loop Shuttle Service is well utilised and receives positive feedback from customers, Council is reviewing the service frequency[11].

Existing bus services on Opal enabled buses to the Royal North Shore Hospital cater for less than 500 commuters during peak periods. TfNSW has indicated demand is growing for bus services to and from the Royal North Shore Hospital.

Outside of the Precinct, along the Lane Cove Tunnel, Gore Hill Freeway and Warringah Freeway, there are high volumes of bus commuters that bypass the Precinct, accounting for over 5,000 commuters during the AM peak period. These commuters are from predominantly from the Hills District, and North Shore Regions. This bypass of the Precinct is important to be kept as it provides a fast and efficient trip into the CBD, decreasing traffic within the Precinct.

3.7 Freight

3.7.1 Network

Freight movements are essential to support the employment land uses in Artarmon and general deliveries to retail, business and residential land uses throughout the Precinct. The Precinct's freight network comprises of designated on-road routes, providing access to the wider NSW network and air, port, rail and intermodal terminals.

The Precinct is accessible to heavy vehicles up to 19 metres long such as short combination trucks, semi-trailers, B-doubles and truck and dog combinations. Access is available along the Pacific Highway through the Precinct; this is generally not used as a through route given the convenience and efficiency of the Warringah/ Gore Hill Freeway.

Special exemptions identified on Roads and Maritime restricted access vehicles map apply as follows. These all link to the Gore Hill Freeway/ Lane Cove Tunnel.

> General Mass Limit (GML)19 metre B-double routes (Over 50 tonnes):
  - Pacific Highway between Gore Hill Freeway and Campbell Street,
  - Campbell Street (between Pacific Highway and Lanceley Place) and Lanceley Place, and
  - Hotham Parade (between Pacific Highway and Mclachlan Avenue), Mclachlan Avenue and Marden Street
> Higher Mass Limits (HML):
  - Reserve Road between Gore Hill Freeway and Campbell Street,
  - Campbell Street between Reserve Road and Lanceley Place, and
  - Lanceley Place.
> 25/ 26 metre B-double routes (noting these designated routes do not connect to a broader network)

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- Campbell Street between Pacific Highway and Lanceley Place
- Lanceley Place

A summary map of the Roads and Maritime designated freight routes is provided in **Figure 3-14**.

3.7.2 Infrastructure

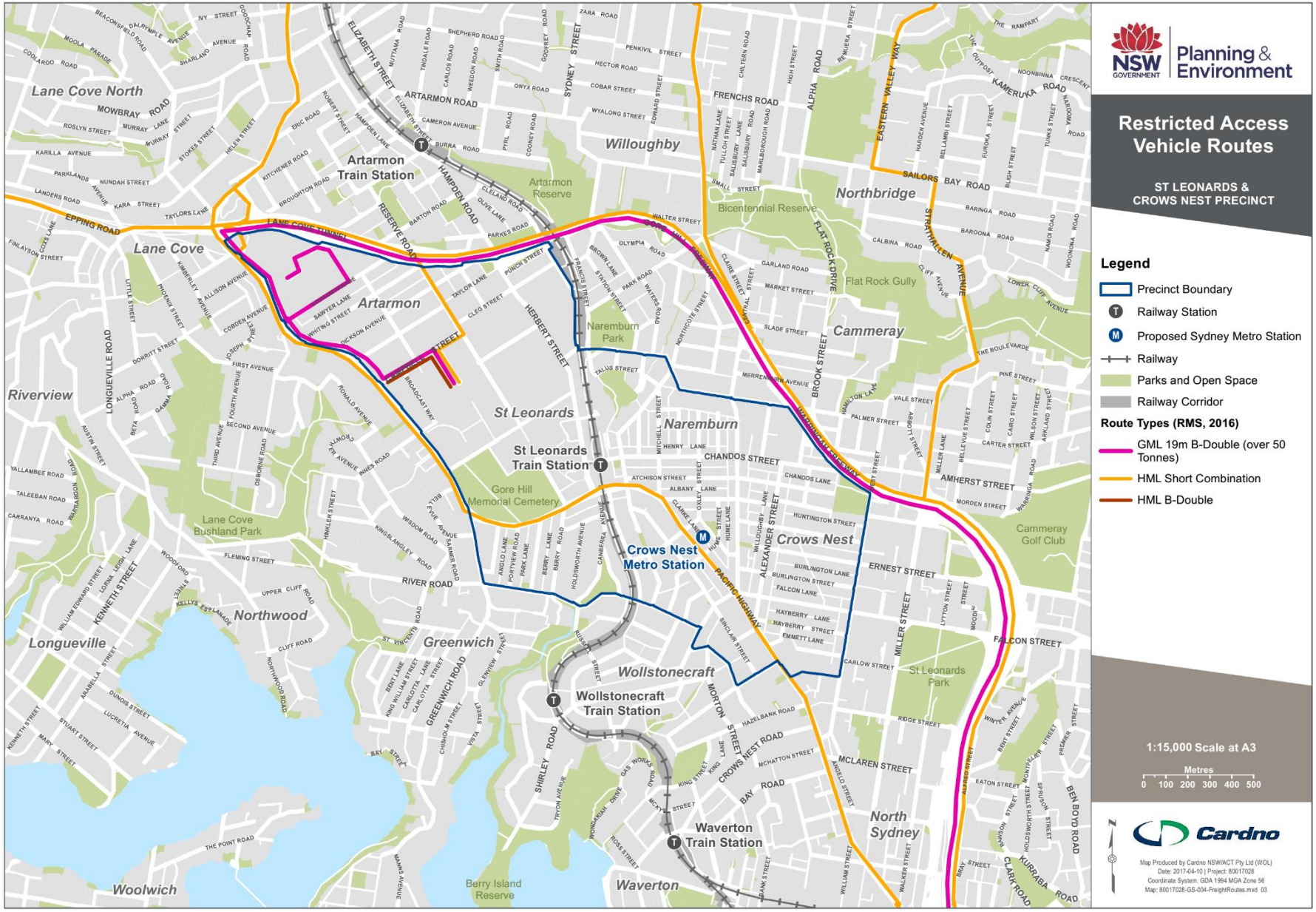
All freight corridors in this Precinct are road-based; there is no freight access via the rail line. The Gore Hill Freeway/ Lane Cove Tunnel provides a bypass route for general road traffic including freight vehicles past the Precinct.

To meet the needs of the Artarmon industrial area, designated freight routes are provided for access between the Lane Cove Tunnel/ Gore Hill Freeway and Artarmon.

The core of the Artarmon industrial estate is also supported by rear access laneways. These provide access for smaller vehicles to on-site car parks and loading bays.

No issues have been identified in terms of major impacts of freight vehicles through the Precinct.

Figure 3-14 Restricted access vehicle routes



3.8 Private vehicles

3.8.1 Demand and performance

The performance of Pacific Highway between Lane Cove and North Sydney indicates the overall demand to the arterial road network has in the Precinct. The performance of the highway was measured by two variables, including:

> Average speed (km/h); and

> Percentage of Speed Limit (%) (The posted speed limit along the Pacific Highway is 60 km/h).

The average speed is a mean of all the vehicle speeds travelling along a road in a particular timeframe. The percentage of speed limit is a measure of how many vehicles are travelling at the designated speed for the road, the higher the percentage of speed limit the better flow along the road. The data used for this analysis only considers weekdays during the period from November 2015 to November 2016.

This analysis shows that this section of the Pacific Highway is not flowing at the designated speeds. The AM peak inbound and PM peak outbound are the worst performing periods with average vehicle speeds below 40 km/h and percentage of speed limit below 70%. The performance data is summarised in **Table 3-9** and **Table 3-10**.

Table 3-9 Pacific Highway inbound – Lane Cove to North Sydney

	AM Peak (6am- 9am)	PM Peak (3pm- 7pm)
Average speed (km/h)	37.0	41.1
Percentage of vehicles achieving 60 km/h speed limit (%)	69	76

Source: http://roadsreport.rms.nsw.gov.au/#/chart?location=71&dateStart=2016-06-01&dateEnd=2016-08-31&peak=AM&type=period-plot

Table 3-10 Pacific Highway outbound – North Sydney to Lane Cove

	AM Peak (6am- 9am)	PM Peak (3pm- 7pm)
Average speed (km/h)	43.4	35.7
Percentage of vehicles achieving 60 km/h speed Limit (%)	80	66

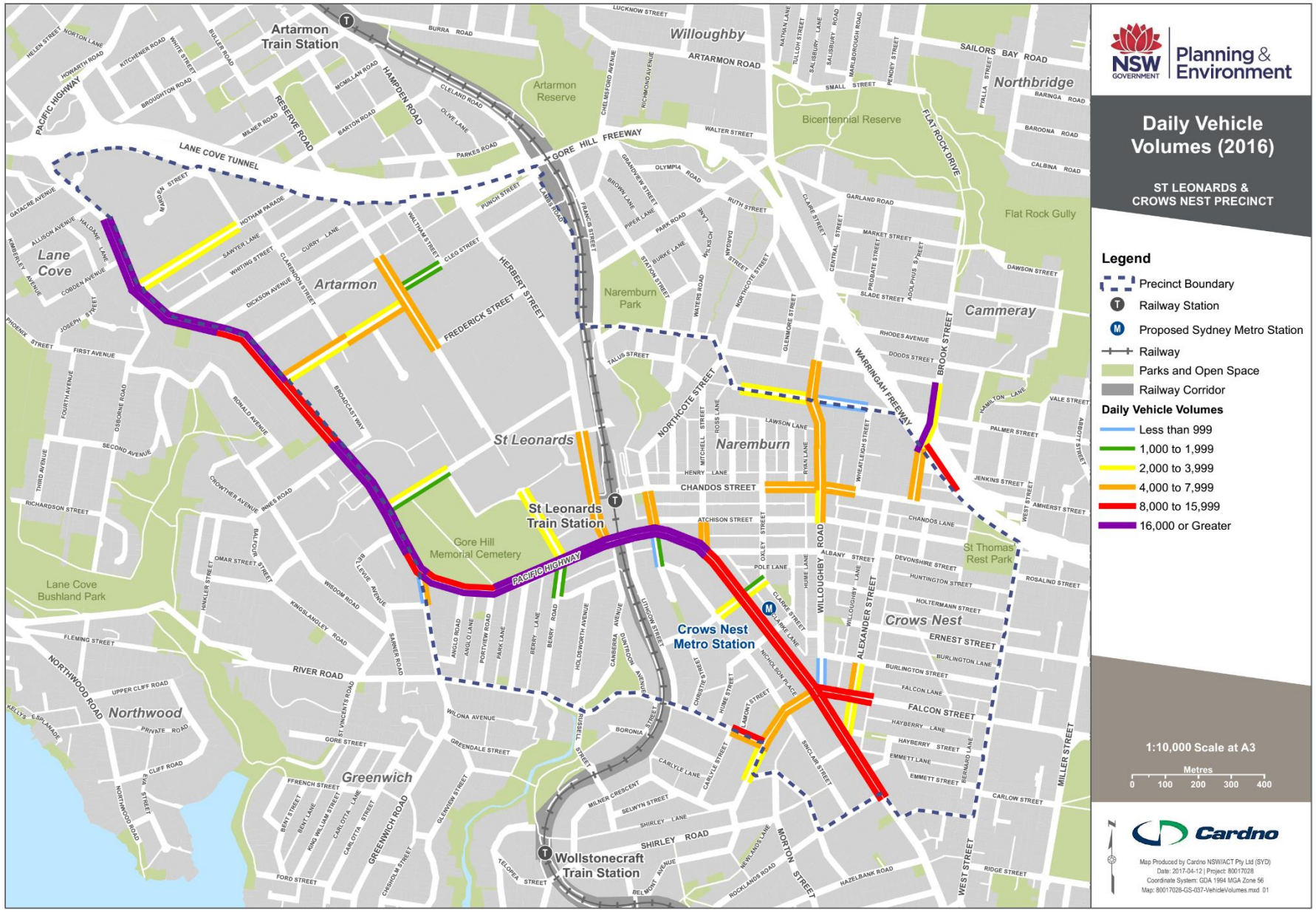
Source: http://roadsreport.rms.nsw.gov.au/#/chart?location=71&dateStart=2016-06-01&dateEnd=2016-08-31&peak=AM&type=period-plot

Daily vehicle volumes from the traffic surveys completed on 17th November 2016 at 18 locations throughout the Precinct confirm that the Pacific Highway is the main thoroughfare for drivers with over 20,000 vehicles using certain stretches of this road in both directions. There is also a high level of vehicles on Falcon Street, with approximately 10,000 vehicles in both directions. This is primarily due to Falcon Street providing direct access to the Warringah Freeway in both directions.

Key distributor roads, providing access to the Pacific Highway currently have a demand of between 4000 – 8000 vehicles per day.

A summary of the daily vehicle volumes for 2016 is provided in **Figure 3-15**.

Figure 3-15 Daily vehicle volumes – 2016



3.9 Parking

3.9.1 Infrastructure

A range of car parking options are available through the Precinct. This includes private parking spaces, and publicly accessible (paid and free) on and off-road facilities. As part of this study, a separate car parking issues paper was prepared which is provided in **Appendix A**. Information from this is summarised in this section of the report.

3.9.1.1 On-street parking

Each Council has a different approach to on-street parking management in the St Leonards sub-precinct. North Sydney Council and Lane Cove Council have paid parking on the streets that fall within their LGA but Willoughby City Council does not, leading to higher parking demand in the Willoughby LGA[12].

In some parts of the Artarmon sub-precinct, in particular on Dickson Street, on-street parking intended for customers of surrounding businesses has been used by car smash repair companies[13]. A previous plan to introduce paid parking to the Artarmon Industrial Estate to address this issue has not had business support. It has only been implemented in Dickson Street but the meters there are subject to vandalism.

3.9.1.2 Off-street publicly available car parking

Publicly accessible off-street car parking areas within the Precinct generally have fees (that vary by location) and are mainly managed by private operators including Wilson Parking and Secure Parking.

Council owned parking provisions generally offer two hours of free parking. This maintains parking for people making relatively quick trips to the area and discourages all day parking.

Key off-street car parking locations are summarised in **Table 3-11**.

Table 3-11 Key off-street car parking in the Precinct

Car Park	Location	Fee
Home HQ multi-level parking	Frederick Street, Artarmon	3 hours free parking on weekdays, free parking all weekend
Bunnings	Reserve Road, Artarmon	Free for customers, maximum stay is 3 hours
Two multi-story car parks at the Royal North Shore Hospital	Reserve Road, Artarmon	All day - $33.60
Artarmon Reserve	Artarmon Reserve off of Burra Road	Free
Alexander Street above Woolworths	Alexander Street, Crows Nest	2 hours free Monday to Sunday. Monday to Saturday maximum daily fee- $52.00
Clemenger Garage	Pacific Highway	All day - $50.00
Holtermann Street garage	Holtermann Street	All day - $52.00
486-494 Pacific Highway	Pacific Highway	All day - $42.00
Forum Parking, Willoughby City Council	Chandos Street, St Leonards	All day - $34.00
Norths Rugby Club Wilson Parking	Christie Street	All day - $35.00
Charter Grove garage	Christie Street	All day - $35.00
Chandos Street Car Park Willoughby City Council	Chandos Street, St Leonards	All day - $24.00
Hume Street car park, North Sydney Council	Hume Street, Crows Nest	2 hours free Monday to Saturday. Free all day Sunday.

12 Willoughby City Council meeting, November 2016

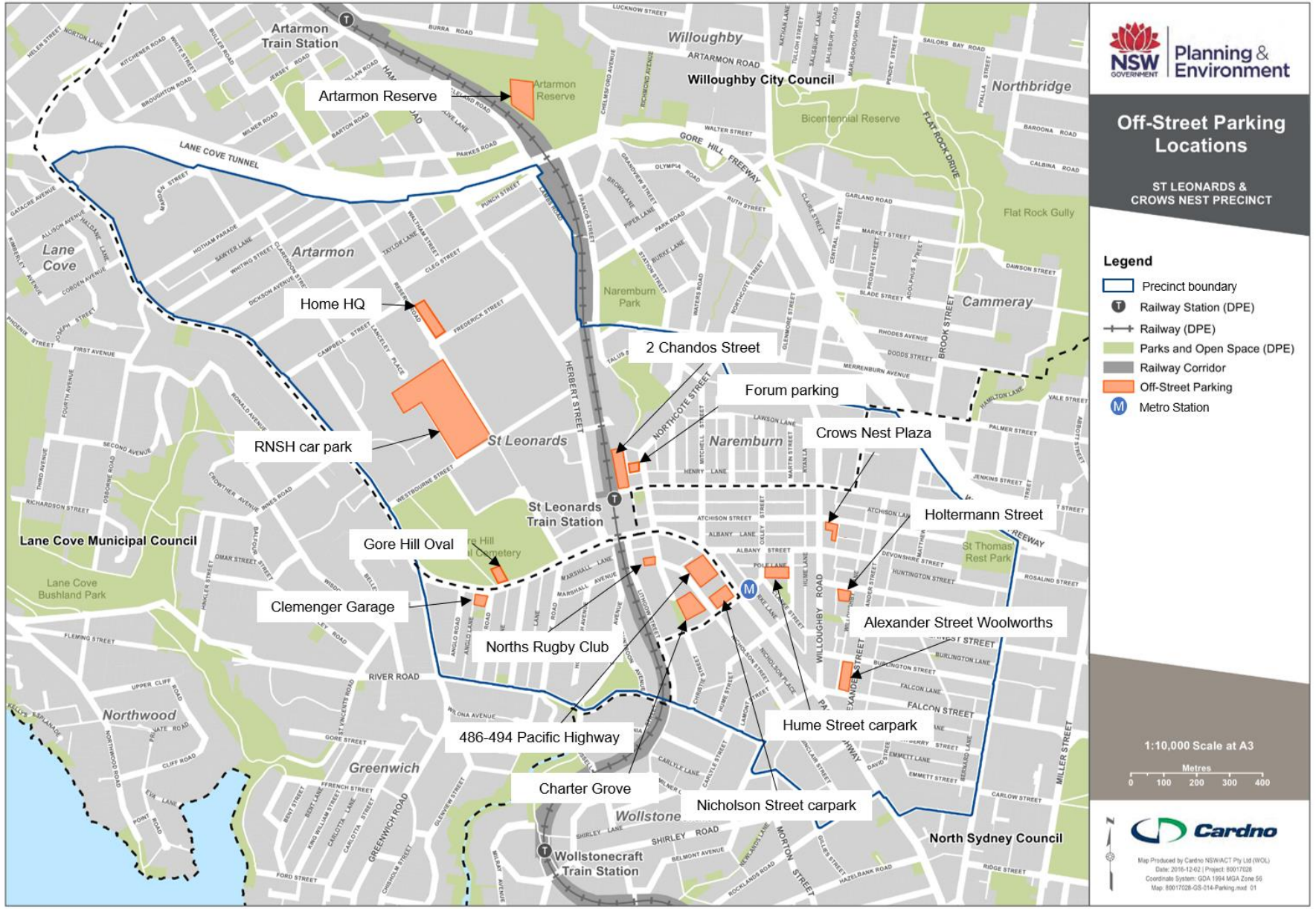
13 Willoughby City Council meeting, November 2016

Car Park	Location	Fee
		Maximum daily fee - $52.00
Nicholson Street car park, North Sydney Council	Nicholson Street, Crows Nest	2 hours free Monday to Saturday. Free all day Sunday. Monthly - $375.00
Gore Hill Oval, Willoughby City Council	St Leonards, Pacific Highway	Three sections with different restrictions: > 2 hours free > 4 hour limit @ $3.50 per hour > All day $11.00
Crows Nest Plaza, North Sydney Council	Holtermann Street, Crows Nest	2 hours free (with shopping docket or stamp) Maximum - $52.00 Monthly - $420.00

Many other publicly accessible car parks exist as part of developments. These vary between casual availability and on a month-by-month basis.

A summary map of the locations of key off-street parking in the Precinct is provided in **Figure 3-16**.

Figure 3-16 Key off-street parking locations



3.9.2 Demand

Parking demands within close proximity to high traffic-generating land uses are generally managed through restrictions and fees.

Where no on-street restrictions exist, parking demands occur a considerable distance from activity centres on weekdays. This demand is most likely from employees of the St Leonards sub-precincts. Residential streets in Naremburn (north of Chandos Street) close to St Leonards have high levels of commuter parking associated with the employment centre.

Local businesses in Crows Nest are concerned about a lack of parking for customers[14].

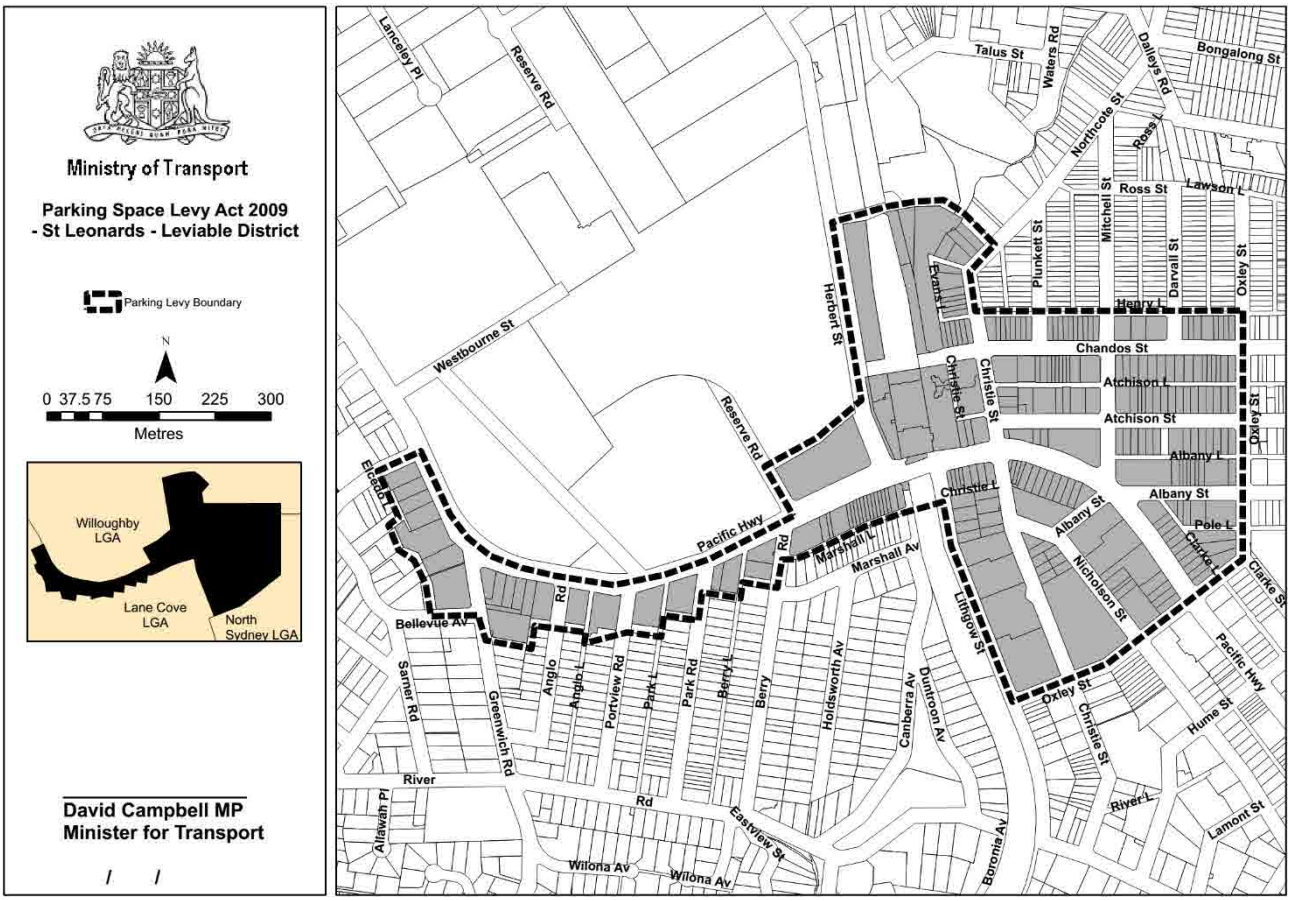
3.9.3 Car parking levy

The NSW Government imposes a Parking Space Levy (PSL) in key business districts in Sydney with the intent to discourage car use and fund improvements to public transport. The levy applies in areas that are well served by public transport. This currently raises in the order of $100 million per annum. It generally applies to all residential and non-residential off-street car parking spaces[15]. A map of the inclusion area in St Leonards is shown in **Figure 3-17**.

St Leonards is classed as a Category 2 area, which at 1 July 2016 was subject to an $840 annual fee per space.

The application of the PSL in St Leonards acknowledges the high level of public transport accessibility and the high parking demand and traffic congestion issues in the Precinct.

Figure 3-17 St Leonards Parking Space Levy area



Source: https://www.transport.nsw.gov.au/programs/parking-space-levy (viewed June 2017)

14 North Sydney Council meeting, November 2016

15 *http://www.osr.nsw.gov.au/taxes/psl*

3.9.4 Existing parking rates

This section discusses existing car, motorcycle and bicycle parking rates for new development with a comparison of North Sydney Council, Lane Cove Council, and Willoughby City Council, as well as City of Sydney parking rates for key land uses.

Multiple Development Control Plans (DCP) apply to the Precinct as it intersects three LGAs. Each Council has developed their parking rate provisions independently and this has resulted in sometimes inconsistent requirements for new development in the Precinct located in close proximity to each other.

3.9.4.1 Lane Cove Council

Lane Cove Council nominates two sets of car parking “rates to be satisfied” for the LGA. One set of rates is for the LGA in general and one set of lower rates applies to developments located within 400 metres of St Leonards Station. The Lane Cove DCP also provides developers the flexibility to reduce car parking spaces by allocating car share space(s) if site constraints do not allow adequate on-site parking. There is also the option for developers to undertake a transport study to identify parking rates suitable for their development. These can be lower or higher parking provisions than in the DCP.

3.9.4.2 North Sydney Council

The North Sydney DCP nominates maximum parking rates for developments. There are also variations to specified maximum car parking rates based on location. The DCP also offers the flexibility to provide car share spaces in developments as a portion of required spaces.

3.9.4.3 Willoughby City Council

The Willoughby DCP parking provisions are neither maximum nor minimum rates. The rates nominated are to be satisfied in any application, applicants may nominate lower or higher rates if this can be justified to Council in a Statement of Environmental Effects or Traffic Study. The current approach to parking provision is to ensure on-street parking in neighbourhoods is not impacted by demand from new nearby developments.

3.9.4.4 City of Sydney

For comparative purposes, the City of Sydney rates are included in the following section. The City of Sydney has maximum car parking rates set in their LEP. These rates are the lowest base rate in the metropolitan context.

Different parking rates apply in different areas generally based on transport accessibility. Two maps are available in the City of Sydney LEP to determine the site context and the applicable parking rates:

> Land use and Transport Integration Map (generally used to assess residential parking provision requirements); and

> Public Transport Accessibility Map (generally used to assess business land use parking provision requirements).

The City of Sydney car parking rate legislation is harder to interpret compared to a typical Council DCP car parking rate schedule.

3.9.4.5 Motorcycle

The provision of motorcycle parking assists to reduce the spatial impacts of motorised vehicle parking. In the context of parking provisions, motorcycles also include scooters and mopeds. Each DCP has requirements for motorcycle parking based on the number of car parking spaces provided. Similar to bike parking requirements, North Sydney require a greater number of spaces followed by Lane Cove and Willoughby with the lowest requirement.

3.9.4.6 Parking rate comparison

Each Council’s car and bicycle parking rates for multi-unit residential developments and for key business land uses are compared in this section. These are for comparison purposes only and they generally do not apply uniformly across the respective LGA. Rates have been calculated to provide a consistent comparison point and may be rounded. For residential land uses, parking rates are shown per dwelling and for business land uses parking rates have been calculated per 100sq.m GFA.

Table 3-12 provides a comparison of multi-unit residential parking rates.

Table 3-12 Multi-unit residential parking rate per dwelling (residential flats)

	North Sydney Council excluding St Leonards Precincts 2 & 3 *(maximum for residential flats)*	**North Sydney Council St Leonards Precincts 2 & 3** *(maximum for residential flats)*	**Lane Cove Council** *(minimum for residential flat buildings)*	**Lane Cove Council, near St Leonards Station** *(minimum for residential flat buildings)*	**Willoughby City Council** *(minimum rate for within Railway Precincts)*	**Willoughby City Council** *(minimum for Medium density (Outside Railway Precincts or Major Public Transport Corridors)*	**City of Sydney (Land Use and Transport Category) (maximum)** *The categories A, B and C refer to the proximity of a development site to public transport. Category A sites are very close, Category C furthest away.*		
							A	B	C
Source:	2013 DCP Part B – Section 10	2013 DCP Part B – Section 10	DCP 2016 (Part R)	DCP 2016 (Part R)	DCP Part C4	DCP Part C4	DCP 2012		
Studio	0.5	0.25	0.5	0.5	0.5	1	0.1	0.2	0.4
1 bedroom	0.5	0.25	1	0.5	1	1	0.3	0.4	0.5
2 bedroom	1	0.5	1.5	0.9	1	1.2	0.7	0.8	1
3+ bedroom	1	0.5	2.0	1.4	1.25	1.5	1.0	1.1	1.2
4+ bedroom				2					
Visitor	0.25	0.25	0.25	0.2	0.25	0.25	-	0.167 (each dwelling up to 30)/ 0.10 (dwelling 30 to 70)/ 0.05 (dwelling over 70)	0.2 (each dwelling up to 30)/ 0.125 (dwelling 30 to 70)/ 0.067(dwelling over 70)
Motorcycle/ Scooter	1 per 10 spaces	1 per 10 spaces	1 per 15 spaces	1 per 15 spaces	1 per 25 spaces	1 per 25 spaces	1 per 12 spaces	1 per 12 spaces	1 per 12 spaces
Bicycle (resident)	1	1	0.25	0.25	0.1	0.1	1	1	1
Bicycle (visitor)	0.1	0.1	(1 +) .1	(1 +) .1	0.08	0.08	0.1	0.1	0.1
Adaptable dwelling			1	1			1	1	1
Accessible visitor space			Min 1, 1 per 50 visitor spaces	Min 1, 1 per 10 visitor spaces			1 per 20 spaces	1 per 20 spaces	1 per 20 spaces

The City of Sydney has the lowest nominated car parking rates and these are maximums. Compared to Lane Cove and Willoughby, its parking rates can be half. It has rate bands that reduce as the quantity of residential dwellings increases. North Sydney Council has the lowest allowable studio car parking rate in the Precinct 2 and 3, which is half other rates but aligns close to City of Sydney's area B category. Visitor parking rates are uniform in Lane Cove Council, North Sydney Council and Willoughby City Council.

Both the City of Sydney and North Sydney have the highest bicycle parking rates for residents and visitors, and these are consistent between both councils, Lane Cove and Willoughby Council are 25% and 10% of the rates respectively.

Table 3-13 outlines parking provisions for key business land uses per 100sq.m GFA.

Table 3-13 Key business land use parking rates per 100sq.m of GFA

	North Sydney (maximum)	Lane Cove Council	Lane Cove Council, near St Leonards Station	Willoughby City Council	City of Sydney (Area category) (maximum) *The categories D, E and F refer to a site's Public Transport Accessibility Level. Category D sites have a high public transport accessibility level, Category F sites have the lowest level.*		
					D	E	F
Commercial (Office)	0.25	1.67	1	0.91	0.57 (FSR 3.5:1 or less)	0.8 (FSR 2.5:1 or less)	1.33 (FSR 1.5:1 or less)
Shop	Location dependent 0.25, 1.0 or 1.66	2.5	0.91	4	1.11 (2,000 sq.m or less GFA)	1.67 (2,000 sq.m or less GFA)	2 (2,000 sq.m or less GFA)
Motorcycle/ Scooter	1 per 10 spaces	1 per 15 spaces	1 per 15 spaces	1 per 25 spaces	1 per 12 spaces	1 per 12 spaces	1 per 12 spaces
Commercial bicycle employee	0.67	0.33	0.33	0.17	0.67	0.67	0.67
Commercial bicycle visitor	0.25	(1+) 0.125	(1+) 0.125	0.04	0.25	0.25	0.25
Shop bicycle employee	4	2	2	0.22	4	4	4
Shop bicycle customer	(2 for first 100sq.m) Over 100sq.m, 1	(2 for first 200sq.m) Over 200sq.m, 0.5	(2 for first 200sq.m) Over 200sq.m, 0.5	0.67	(2 for first 100sq.m) Over 100sq.m, 1	(2 for first 100sq.m) Over 100sq.m, 1	(2 for first 100sq.m) Over 100sq.m, 1
Commercial accessible		Min 1, 1 per 10 spaces	Min 1, 1 per 10 spaces		1 per 20 spaces	1 per 20 spaces	1 per 20 spaces
Shop accessible		Min 1, 1 in 20 spaces	Min 1, 1 per 20 spaces		1 per 20 spaces	1 per 20 spaces	1 per 20 spaces

North Sydney Council generally has the lowest car parking rates and highest bicycle parking rates. Willoughby Councils vehicle parking rates are the highest and bicycle parking rates the lowest. Lane Cove Councils vehicle and bicycle parking rates fall in the middle.

For FSR greater than those stated in City of Sydney rates (Office) or Retail greater than 2,000sq.m, a formula applies to determine the maximum car parking provision that can be provided on-site. The formula is provided as follows:

M = (G x A) / (50 x T), where:

M = the maximum number of parking spaces

G = Gross Floor Area, sq.m

A = Site Area, sq.m

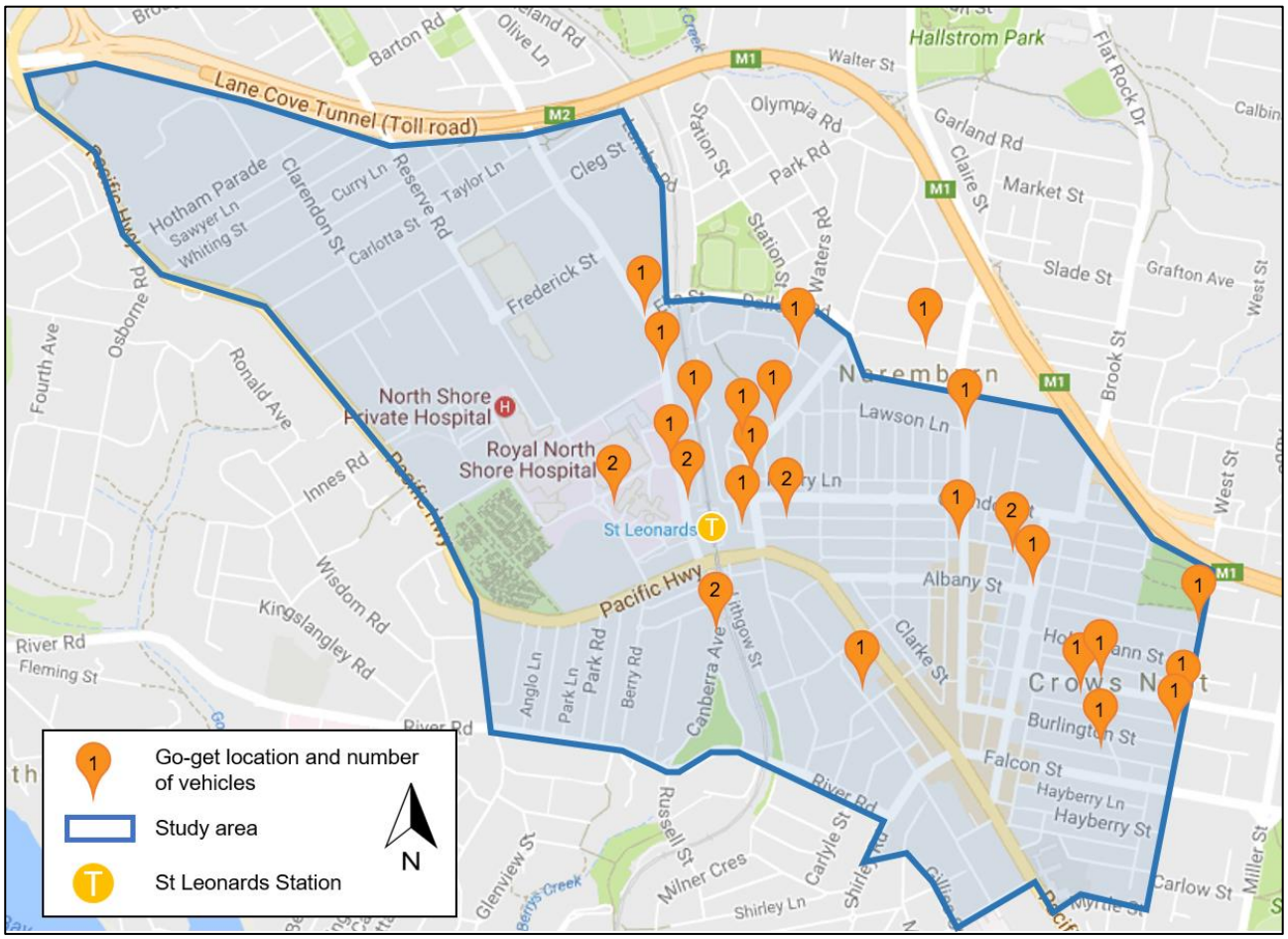
T = Total GFA for all buildings on the site.

3.10 Car share

Car share decreases the need for some people to own a car or a second car and can therefore reduce parking demand and traffic generation. It differs from traditional car hire companies in that cars can be hired by half hour increments and cars are located near to where people live or work. Car share is available from either companies that own a vehicle fleet or peer-to-peer services for individual owners to share their vehicles.

Within the Precinct, GoGet is currently the sole operator. A map of the GoGet parking locations is shown in **Figure 3-18**. There are approximately 30 Go Get cars in the Precinct. Car share parking locations are located in the central and southeast of the Precinct, generally close to higher density residential and business land uses.

Figure 3-18 GoGet car share parking locations



Source: https://www.goget.com.au (viewed March 2017)

Peer to peer car share services generally offer both cheaper and more expensive hire rates than GoGet depending on the value of the vehicle. Peer to peer car share services available in the Precinct include:

> Car next door; and

> Drive my car.

3.10.2 Car share car parking rates

Some Councils allow developers to reduce the provision of parking spaces where car share car parking is proposed on-site.

Lane Cove Council allows developers to provide one car share space in lieu of three residential spaces. This only applies to developments more than 400 metres from St Leonards Station and each dwelling with one or more bedrooms must still be provided with at least one car parking space.

North Sydney Council allows a reduction in parking spaces of up to 25% across all land uses on a site. For residential land uses, one car share space is not to replace less than three or more than four residential spaces.

Willoughby City Council encourages developers to provide car share parking in basements, although no specific requirement is provided.

The City of Sydney requirements for car share parking spaces are shown in **Table 3-14**.

Table 3-14 City of Sydney car share parking requirements

	Residential development other than single or dual occupancies. Land category as per Land Use and Transport Integration Map in the 2012 LEP			Office, business or retail premises. Land category shown on the Public Transport Accessibility Level Map.		
Land category	A	B	C	D	E	F
One car share car park requirement per number of other provided parking spaces.	50	60	90	30	40	50

Source: Sydney DCP 2012, Section 3 General Provisions (December 2012)

Car share is generally encouraged by Councils in the Precinct, whereas the City of Sydney has a clear requirement to provide car share parking in significantly sized car parks.

3.11 Point to point transport

Point to point transport services operate similar to, and compete, with taxi services. In the Precinct, these include Uber, Taxify and Go Catch and are booked using mobile phone applications. They generally offer cheaper alternatives to taxi's.

3.12 Summary of existing transport network

Pedestrian network:

> The pedestrian network is well developed with opportunities to provide wider paths and more formal crossings in key locations to improve access and safety.

> Major pedestrian demands are centred on St Leonards Station.

> The Pacific Highway and the railway line reduce the pedestrian network permeability.

> On a typical weekday there were high pedestrian demands surrounding St Leonards Station and Crows Nest at Pacific Highway/ Falcon Street.

Cycling network:

> Topography is challenging for cyclists in some areas that will reduce the appeal of this mode.

> A mixture of cycling infrastructure is provided, however there are limited separated facilities as most are shared with pedestrians or vehicles.

> All LGAs require bike parking for new developments, however the rates for each LGA are inconsistent.

Train network:

> The rail network generally offers the highest speed public transport services to St Leonards.

> The rail network provides good north south regional connectivity.

> The 30-minute rail catchment extends to Waitara, Pennant Hills, Erskineville, Newtown, Edgecliff, Sydenham and just short of Burwood. Catchments may be reduced in off-peak periods due to lower connecting train service frequencies.

> The train network carries the highest volume of public transport customers.

Bus network:

> A high number of services operate along the Pacific Highway corridor.

> Bus services are provided by TfNSW, Willoughby Council and private landholders. There are a high number of bus services provided along Pacific Highway.

> The Artarmon area has limited TfNSW bus service coverage. It relies more on the Gore Hill Shuttle and Artarmon loop for servicing.

> Several local and suburban routes serve Crows Nest village.

> The N90 service from Town Hall to Hornsby via St Leonards provides 30-minute frequencies between 12:00am and 4:30am.

Freight network:

> The majority of freight movements occur in the Artarmon employment area. The adjacent Gore Hill and Warringah Freeway provides good access to the area, limiting heavy vehicle movements through other parts of the Precinct.

Road network:

> The Warringah/ Gore Hill Freeway facilitates the bypass of traffic through the Precinct.

> The Pacific Highway experiences the highest volume of private vehicles through the Precinct, and road network congestion is evident during peak periods.

> A range of parking is available in the Precinct; all day parking is generally priced at or above $24 per day.

> Free parking is available on residential streets in Naremburn, which results in very high occupancy on weekdays.

> Car parking rates are inconsistent across each of the three LGAs.

> GoGet provide car share within the Precinct, focused around higher density residential and commercial areas.

4 Transport modelling

This section presents the assessment of the transport network for the Precinct to understand the future travel demands, and performance of the road network. It considers the existing road network and projects known at the time the modelling was completed.

Transport modelling was undertaken in 2017. Since the completion of modelling, major new transport projects have been announced which are likely to have an impact on the results.

During the transport analysis, a preferred land use and built form outcome was still under investigation and had not been determined. It was therefore necessary to make assumptions on a range of potential residential and employment growth scenarios in order to inform the recommendations in this report.

It is understood that the built form recommendations that are to be placed on exhibition in the LUIIP would result in a dwelling yield of approximately 6,800 dwellings to the year 2036 and this may alter the recommendations in this report. As at January 2018, there were approximately 7,200 dwellings in the Precinct

The extent and nature of the transport improvements recommended in this report will need to be reviewed once the built form and resultant growth solution is finalised.

This section provides a summary of the key model inputs, outputs and results based on five development scenarios that were tested. Details of the full assessment process and results are provided in the Strategic Modelling Note, attached in **Appendix B**.

The assessment included two phases of transport modelling; these were:

> Strategic transport modelling, using the Sydney Strategic Transport Model (STM) and the Public Transport Project Model (PTPM); and

> Intersection modelling at nominated locations, using SIDRA analysis software.

4.1 Strategic transport modelling

4.1.1 Purpose of strategic modelling

Strategic models are used to understand travel trends and outline the need for further analysis in particular areas, for example investigate road corridor capacity. They provide a method to understand transport networks at a high level and can identify capacity constraints and issues at a broad level.

Mesoscopic (meso) and microsimulation (micro) models are suitable for detail design of transport infrastructure and provide detailed information such as turning movements at an intersection.

4.1.2 Strategic modelling scope

The area assessed as part of the strategic modelling process used travel zones within the Precinct as presented in **Figure 2-2**.

Five development scenarios were tested during the strategic modelling process; these are outlined below:

> **2016 (Base)**: The Precinct has approximately 15,000 residents and 45,600 jobs.

> **2036 Scenario 0 (S0)**: The lower end planned growth for the Precinct aligning with forecasts prior to this study. It is anticipated there would be 24,500 residents and 52,400 jobs in 2036.

> **2036 Scenario 1 (S1):** This proposes providing additional dwelling stock so the Precinct could accommodate 47,700 residents. Jobs would be consistent with S0.

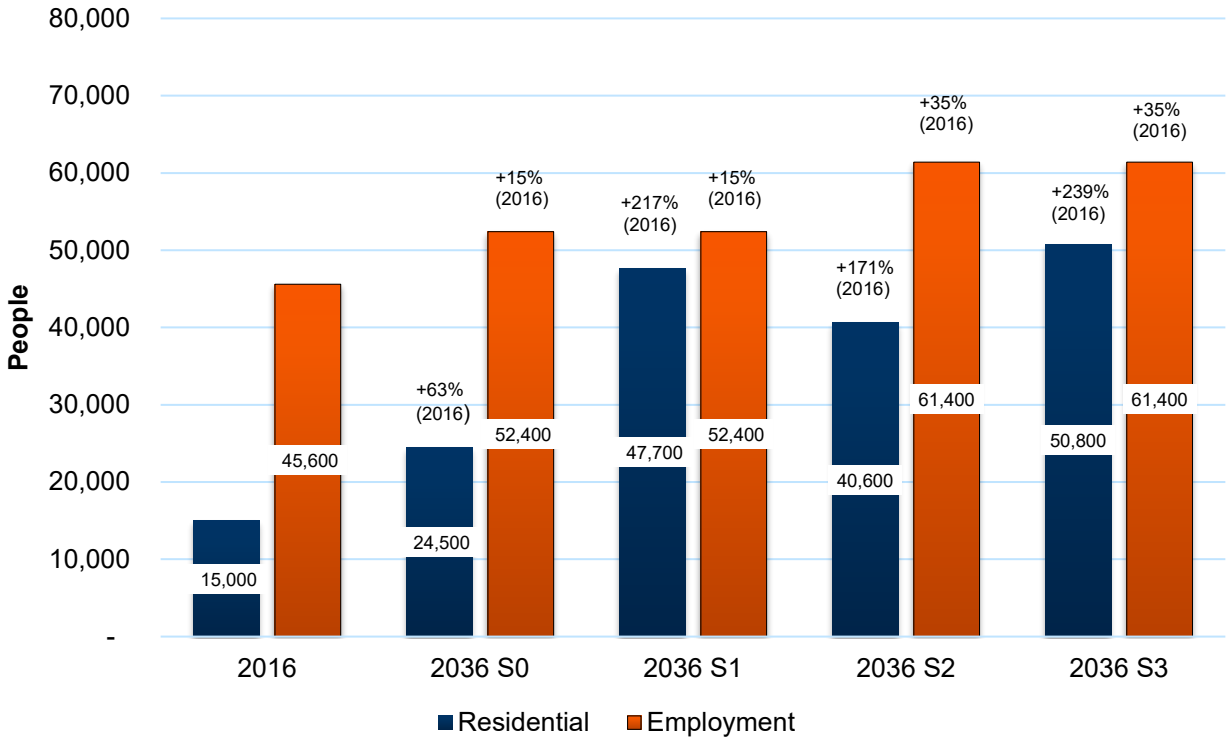
> **2036 Scenario 2 (S2):** Uplift to provide dwellings with 40,600 residents and 61,400 jobs for the Precinct. (The Greater Sydney Commission proposed a 63,500 jobs high target after the modelling was undertaken, which is of a similar magnitude).

> **2036 Scenario 3 (S3):** A sensitivity analysis of S2 with additional 25% residents, 50,800, the job forecast of 61,400 remains capped.

The population figures for each of the five scenarios is presented in **Figure 4-1**. For forecast scenarios, the proportional growth with respect to the base case is also presented.

The population and employment figures for 2016 and S0 were known and forecast by the NSW government prior to the commencement of this study. Population figures in 2016 and S0 for both residential and employment were extracted from the PTPM5 model. DPE provided population figures for S1, S2 and S3 that were then input into the PTPM5 model for testing.

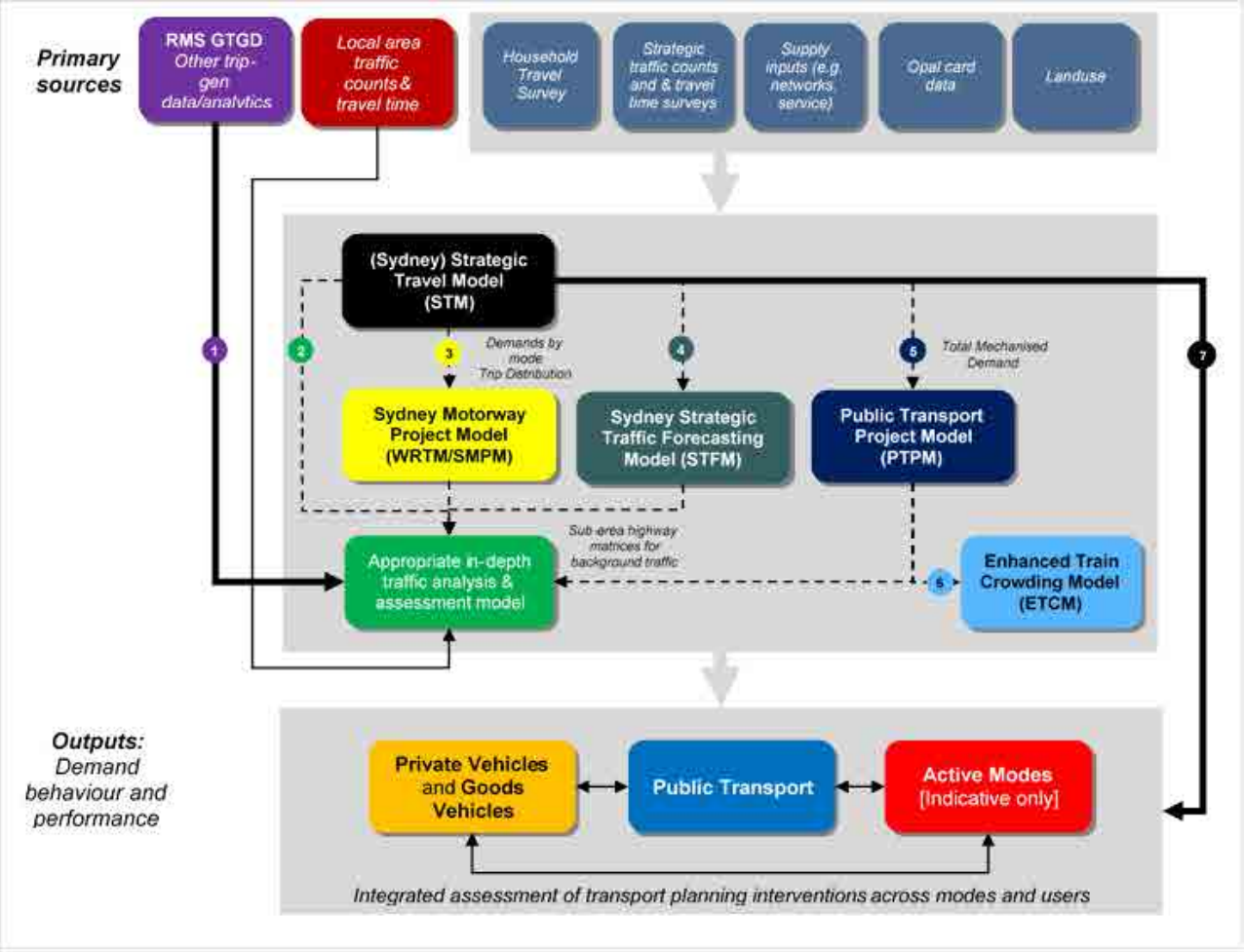
Figure 4-1 Population figures (2016 and forecast scenarios)



4.1.3 Models used

The travel zones were assessed in the PTPM5. This model is based on the Sydney Strategic Travel Model (STM). The relationship of the STM to the PTPM5 is shown in **Figure 4-2**. While the PTPM5 is based on the STM, the outputs from each model will not necessarily match. Each derivative model has a specific focus and benefits for assessment purposes.

Figure 4-2 Strategic transport models and relationships



Source: Transport Strategy (TfNSW, 2017)

4.1.4 Infrastructure assumptions

Transport infrastructure improvements in Sydney have the potential to affect the Precinct's transport network and demands, so it is important to understand which new infrastructure is included in the modelling. The PTPM5 2036 included and not included infrastructure improvements are outlined in **Table 4-1**.

Table 4-1 Projects included and not included in 2036 PTPM5

	Projects included	Projects not included
Road projects	▪ WestConnex Stages 1 and 2 ▪ M2 to F3 Tunnel (NorthConnex) ▪ M12 ▪ WestConnex Stage 3 ▪ Southern Connector Motorway ▪ Northwest Growth Centre ▪ Western Harbour Tunnel (WHT) ▪ Southwest Growth Centre ▪ M7 and M2 widening	▪ Castlereagh Motorway ▪ Outer Sydney Orbital stage 1 (Hume Highway to Windsor Road) ▪ Beaches Link Tunnel (BLT)
Rail/ light rail projects	▪ Sydney Metro Northwest ▪ CBD and South East Light Rail ▪ Light Rail extension to Malabar ▪ Sydney Metro City and Southwest ▪ Parramatta Light Rail	▪ Sydney Metro West (West Mass Transit) ▪ BSORT Light Rail

4.1.5 Modelling outputs – road network

Modelling outputs have been compared to existing traffic volume surveys. The road network outputs of PTPM5 are provided for the 2-hour AM peak. The future year increase in traffic as a percentage identified in the modelling has been added to existing survey data to understand future traffic potential. This provides an added level of calibration to modelling results. The results for S1, S2 and S3 are provided in **Figure 4-3, Figure 4-4** and **Figure 4-5**.

Figure 4-3 S1 traffic volume comparison increase 2-hour AM peak

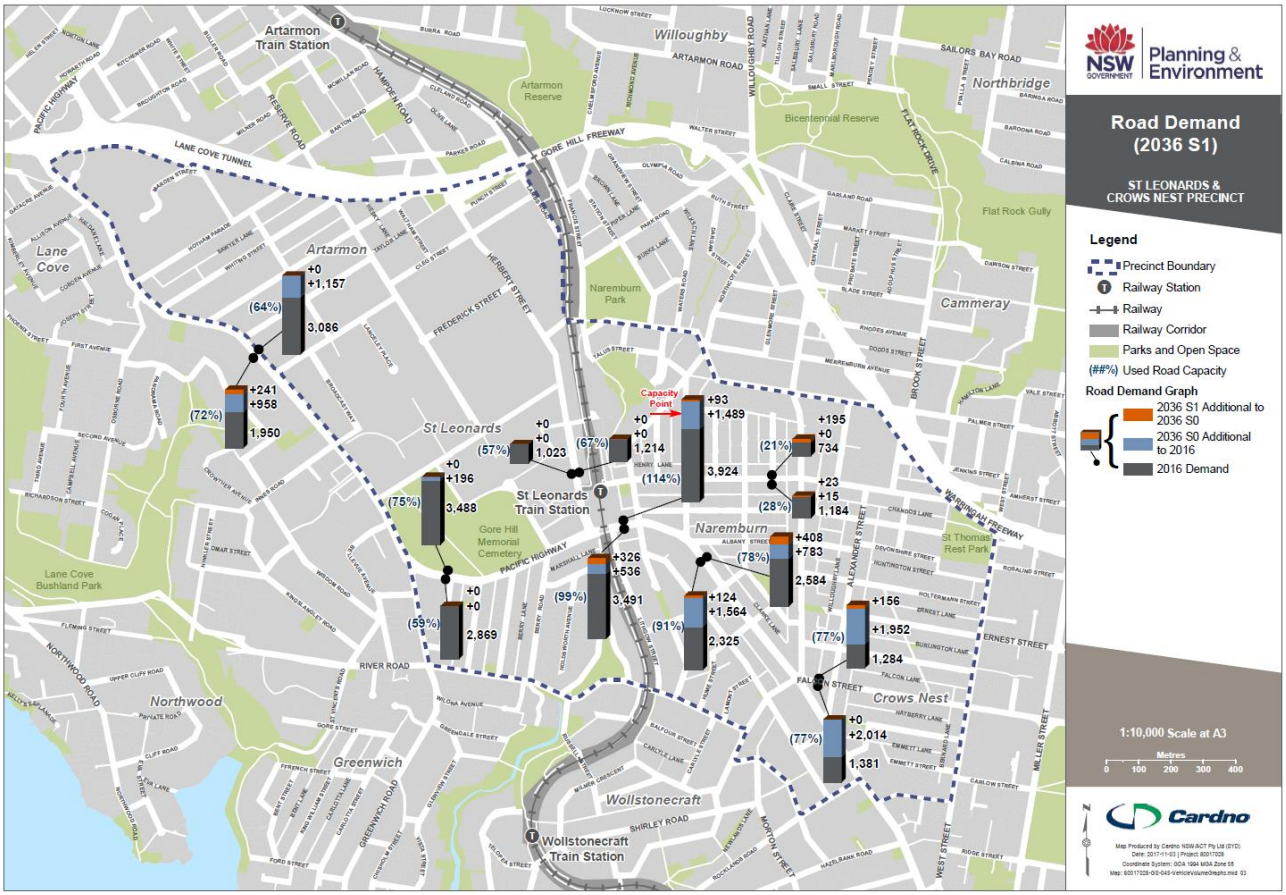


Figure 4-4 S2 traffic volume comparison increase, 2-hour AM peak

Figure 4-5 S3 traffic volume comparison increase, 2-hour AM peak

The modelling indicates that without additional uplift (i.e. under S0), the road network would experience demands that would exceed road capacity on the Pacific Highway between Herbert Street and Christie Street. The additional demands for S1, S2 and S3 are expected to be moderate additional volumes compared to S0.

4.1.6 Travel demand

Travel demands obtained from the PTPM5 for mechanised modes over the 3.5 hour AM peak period cover:

> Train;

> Bus;

> Light rail

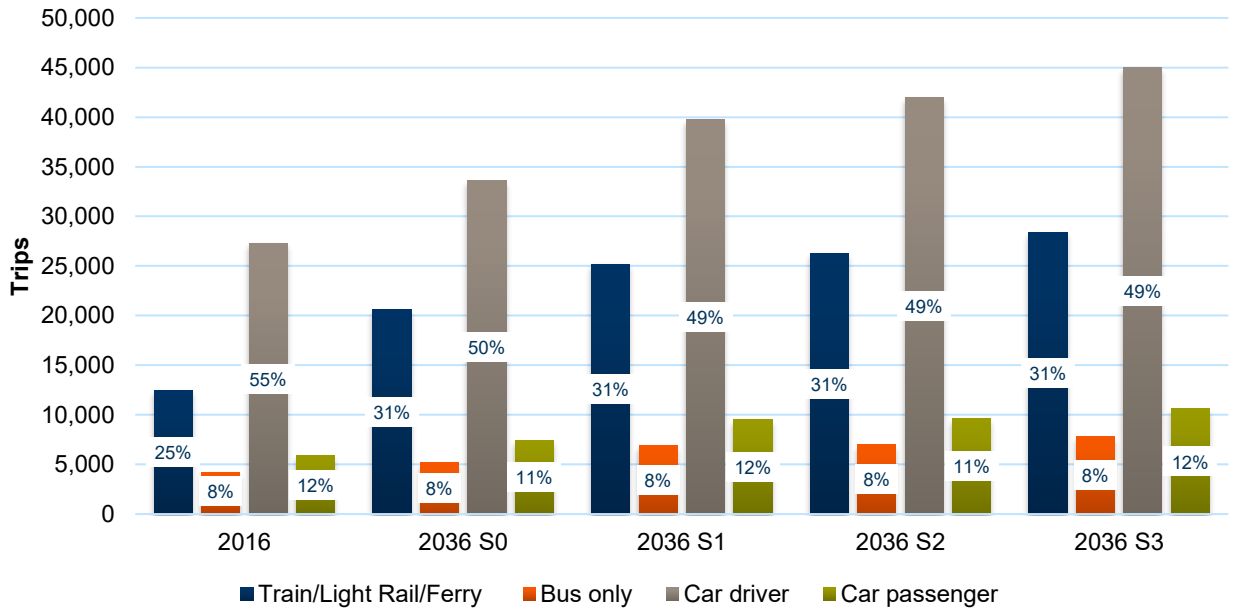
> Ferry; and

> Car driver and passenger.

The PTPM5 model does not account for trips taken by active transport modes (walking and cycling) or trips taken wholly within a travel zones (intra travel zone trips). Given the size of the travel zones in the Precinct and car parking constraints, it is assumed that there would be a low volume of intra travel zone mechanised trips.

The modelled demands by mechanised travel modes are shown in **Figure 4-6**. Mode shares for each scenario are also presented. The tabulated data and increase from the 2016 base case is presented in **Table 4-2**.

Figure 4-6 Mechanised transport demand by mode (3.5 hour AM peak)



Source: PTPM5 (September 2017)

Table 4-2 Mechanised transport demand by mode (3.5 hour AM peak)

Mode	2016	2036 S0	2036 S1	2036 S2	2036 S3
Train/Light Rail/Ferry	12,500 (Base)	20,600 (+65%)	25,200 (+102%)	26,300 (+110%)	28,400 (+127%)
Bus only	4,200 (Base)	5,200 (+24%)	6,900 (+64%)	7,000 (+67%)	7,800 (+86%)
Car driver	27,300 (Base)	33,600 (+23%)	39,800 (+46%)	42,000 (+54%)	45,000 (+65%)
Car passenger	5,900 (Base)	7,400 (+25%)	9,500 (+61%)	9,600 (+63%)	10,600 (+80%)
Total	**49,900 (Base)**	**66,800 (+34%)**	**81,400 (+63%)**	**84,900 (+70%)**	**91,800 (+84%)**

Source: PTPM5 (September 2017)

Mechanised transport demand growth is generally aligned with the increase in residential and employment population and the provision of Sydney Metro has a high influence on Train demand.

In the context of the Precinct, trips to, from and wholly within will increase. This is a result of increased residential land uses within the Precinct. Trips from the outside travel zones for employment would reduce indicating more of the local residential population would be employed in the Precinct. This is higher in 2036 S1, S2, and S3 uplift scenarios compared to 2036 S0.

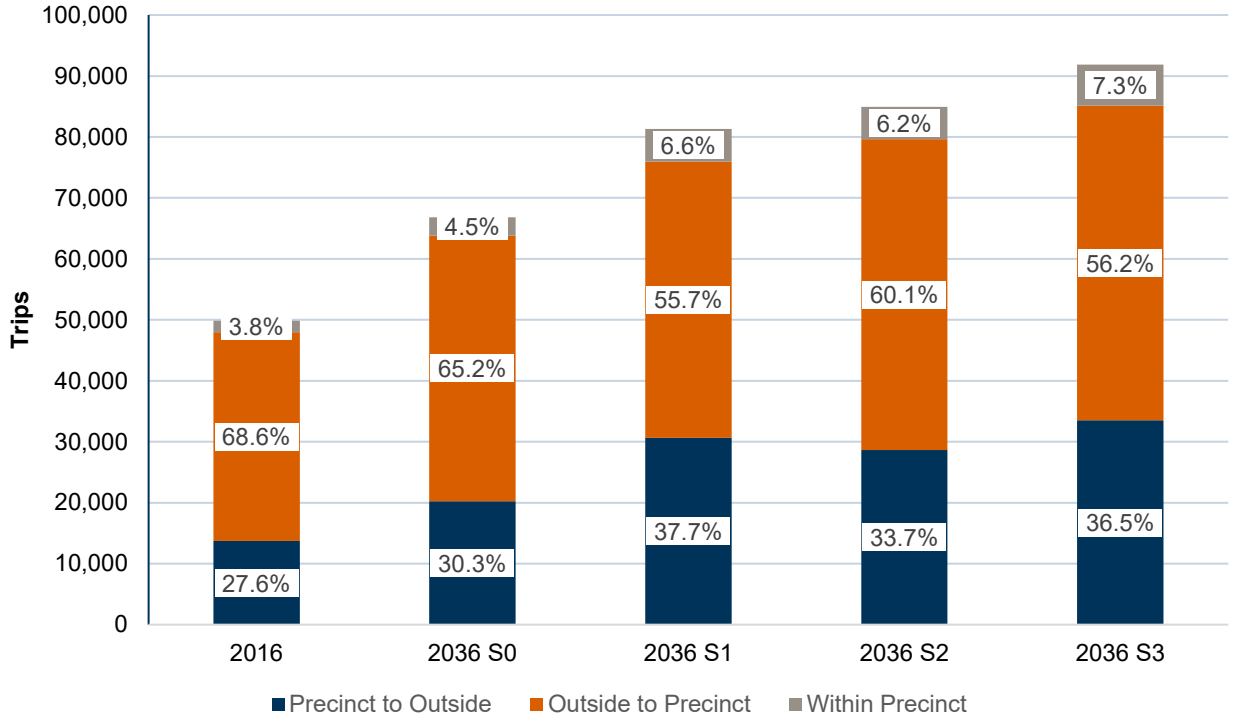
Overall, the road network would continue to carry the highest volume of people. As a network, it is far more extensive than the rail network. This means that the road network can cater for a larger range of trips. The rail network will continue to offer only a north-south connection through the Precinct. The rail network's use in all scenarios are high in the context of the area they service.

4.1.7 Trip origins and destinations

For the modelled population scenarios, there is a general trend of increased trips from within the Precinct to outside the Precinct in the 3.5 hour AM peak, a corresponding reduction in trips from outside to the Precinct, and an increase in inter Precinct trips. The additional dwellings in the Precinct will lead to higher trip containment. This is evident in the change of percentage of each of the three trip origin destination categories shown in **Figure 4-7**, e.g. "Within Precinct" trips increase from 3.8% in 2016 to 7.3% in S3.

Note intra travel zone trips are not reported by PTPM5.

Figure 4-7 Mechanised travel demand trip origin and destination by Precinct (3.5 hour AM Peak)



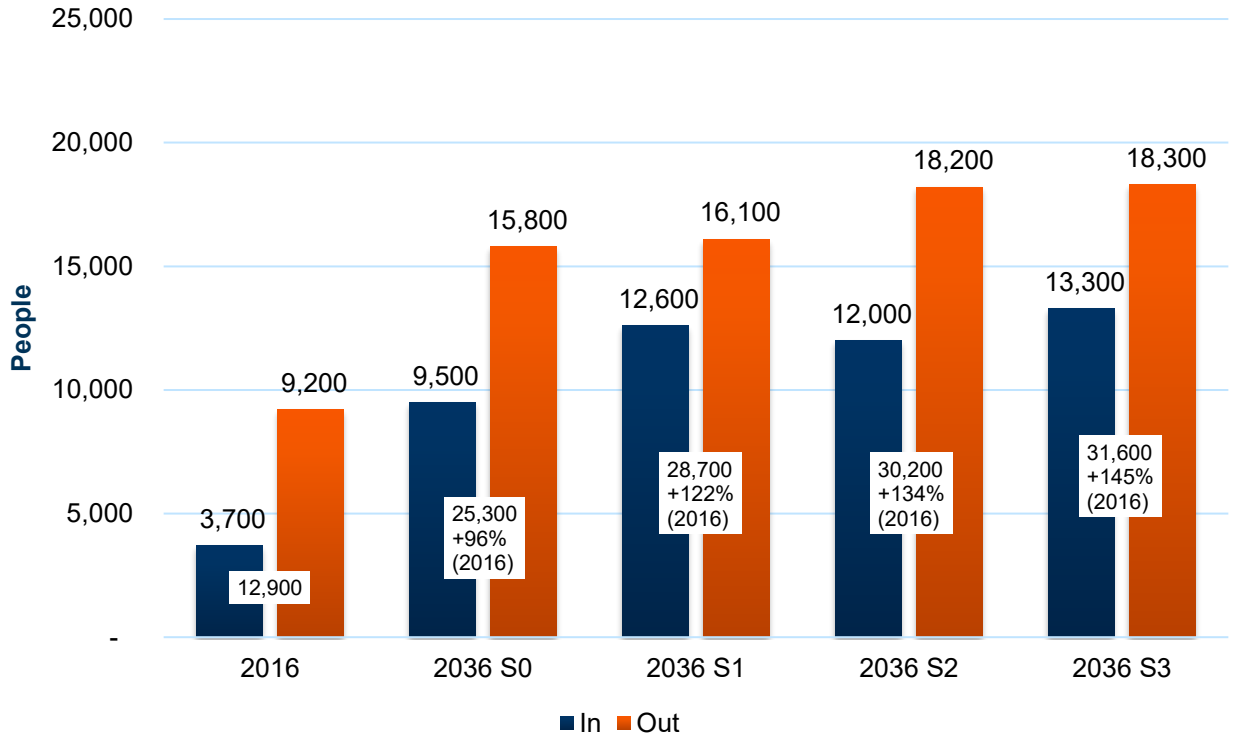
Source: PTPM5 (September 2017)

4.1.8 Train station In / Out movements

The introduction of Sydney Metro will more than double the current capacity of the rail network through the Precinct and expand the rail catchment. The rail network maximum capacity is approximately 24,000 people in each direction and the Sydney Metro capacity will be approximately 40,000 people in each direction. The expansion of the rail (including Sydney Metro) catchment will increase the use of rail.

The forecast increase in rail patronage in the Precinct is shown in **Figure 4-8**.

Figure 4-8 Station in / out movements St Leonards and Crows Nest stations (3.5 hour AM peak)



Source: PTPM5 (September 2017)

The modelling indicates the provision of Sydney Metro is a large influencer of rail mode share. There is almost a 100% increase in rail usage between 2016 and S0. This increase is beyond the combined rise of residential and employment populations, indicating that rail is catering for a higher proportion of trips in future scenarios. In S1, S2 and S3 the increase in rail mode share correlate more closely with population increase.

4.1.9 Summary of modelling outcomes

A summary of the modelling results are presented in the following sections. Details on the strategic modelling analysis and outputs are provided in the Strategic Modelling Note, attached in **Appendix B**.

2016 (Base)

Demands on the mechanised transport network were modelled at approximately 50,000 trips in the 3.5 hour AM Peak.

The transport network generally operates well, although high demands are noted during peak on all mechanised modes. Notably, the network (road and rail) experiences high demands for trips towards North Sydney and Sydney CBD. On the road network there is also moderate demand noted westbound along Falcon Street that extends northbound up the Pacific Highway to near St Leonards Station.

2036 Scenario 0 (Future base)

Expected demands on the mechanised transport network are 66,800 trips in the 3.5 AM peak.

Demand on the heavy rail network reduces from 2016 volumes; this is due to people transferring to metro services, particularly as the Epping to Chatswood link will be replaced with Sydney Metro.

Sydney Metro is expected to accommodate very high demands through the Precinct, this remains consistent for all future scenarios tested.

No section of the bus network is expected to accommodate more than 3,000 people per hour in this, or other future scenarios.

The road network generally operates below capacity with the exception of the eastbound section of Pacific Highway between Herbert Street and Christie Street. This remains the case for the following three scenarios.

2036 Scenario 1

Expected demands on the mechanised transport network are 81,400 trips in the 3.5 AM peak.

The demands on some parts of the road network as a slightly higher than Scenario 0, with others modelled as not being impacted at all.

2036 Scenario 2

Demands on the mechanised transport network are second highest in this scenario with 84,900 trips in the 3.5 AM peak.

The demands on some parts of the road network are slightly higher than Scenario 1. Demands on the westbound section of Pacific Highway between Christie Street and Herbert Street are expected to exceed capacity. This could cause long queuing on the approaches to this section of road.

2036 Scenario 3

Demands on the mechanised transport network are highest in this scenario with 91,800 trips in the 3.5 hour AM peak.

Road demands along Pacific Highway between Herbert Street and Christie Street would continue to exceed capacity, with the remainder of the network indicating demands less than total capacity.

4.1.10 Strategic modelling – key recommendations

TfNSW will be required to undertake further assessments of these results and work with DPE to determine the public transport needs of the Precinct.

Detailed modelling is required for the road network to further understand the impacts from the proposed scenarios.

4.2 Intersection modelling

4.2.1 Purpose of intersection modelling

Intersection modelling was undertaken to test the impacts of providing additional pedestrian crossing legs at signalised intersections. Additional crossings would improve pedestrian access, permeability and reduce travel time. Pedestrian crossings can affect vehicle capacity at intersections that are already close to capacity during road network peak periods.

4.2.2 Intersection modelling scope

Intersection modelling was completed at 17 signalised intersections within the Precinct to determine current performance and understand the potential impacts associated with introducing additional pedestrian legs where they are currently missing. The intersections assessed are summarised in **Table 4-3**.

Table 4-3 Intersections assessed

Sub-precinct	Designation	TCS Number	Intersection	Proposed additional crossing leg location
Artarmon	A1	579	Pacific Highway, Hotham Parade and Osbourne Avenue	Pacific Highway northern approach
	A2	585	Pacific Highway and Campbell Street	No change
	A3	3622	A3: Reserve Road and Campbell Street	Pacific Highway northern approach
St Leonards	S1	1111	S1: Pacific Highway and Westbourne Street	Reserve Road southern approach
	S2	883	S2: Pacific Highway and Greenwich Road	Pacific Highway southern approach
	S3	771	S3: Pacific Highway and Berry Road	Pacific Highway southern approach
	S4	770	S4: Pacific Highway and Herbert Street	Pacific Highway southern approach
	S5	769	S5: Pacific Highway and Christie Street	Pacific Highway southern approach
	S6	768	S6: Pacific Highway and Albany Street	Pacific Highway northern approach

Sub-precinct	Designation	TCS Number	Intersection	Proposed additional crossing leg location
	S7	767	S7: Pacific Highway and Oxley Street	Pacific Highway northern approach
Crows Nest	C1	765	C1: Pacific Highway and Falcon Street / Shirley Road	Pacific Highway northern approach
	C2	763	C2: Pacific Highway and Alexander Street	No change
	C3	1870	C3: Shirley Road and River Road	Pacific Highway southern approach
	C4	764	C4: Falcon Street and Alexander Street	Shirley Road northern approach
	C5	564	C5: Willoughby Road and Chandos Street	No change
	C6	600	C6: Willoughby Road, Dalleys Road / Donnelly Road	Willoughby Road northern approach
	C7	1362	C7: Warringah Freeway (northbound St Leonards exit) and Brook Street	Willoughby Road southern approach

Traffic and pedestrian movements at each intersection were obtained through surveys completed on Thursday 17th November 2016 from 6:00AM to 8:00PM. The AM and PM peak hours were identified as:

> AM peak: 7:45AM – 8:45AM; and

> PM peak: 5:15PM – 6:15PM.

4.2.3 Performance analysis criteria

In an urban area, the capacity of a road network is largely determined by the capacity of the controlling intersections. The intersection operating performance was assessed using the SIDRA software package to determine the Level of Service (LoS) and degree of saturation (DoS).

The key indicator of intersection performance is LoS, where results range from 'A' to 'F' as shown in **Table 4-4**. This section will focus on the LoS metric, the SIDRA diagrammatic outputs, including results for DoS in **Appendix C**.

The Degree of Saturation (DoS) is another measure of the operational performance of individual intersections. For intersections controlled by traffic signals, both the queue length and delay increase rapidly as the DOS approaches 1. It is usual to attempt to keep the DoS to less than 0.9. DoS values in the order of 0.7 generally represent satisfactory intersection operation, while queues can be expected when the DoS exceeds 0.9.

Table 4-4 Intersection Level of Service (LoS) and Degree of Saturation (DoS)

Level of Service	Traffic conditions at signalised / roundabout intersections	Degree of Saturation	Theoretic road capacity used, 1 = 100%
A	Good operation.	**A**	Less than 0.6
B	Good operation with acceptable delays and spare capacity.	**B**	0.6 – 0.7
C	Satisfactory operation.	**C**	0.7 – 0.8
D	Operating near capacity.	**D**	0.8 – 0.9
E	At capacity. Incidents at signalised intersections will cause excessive delays.	**E**	0.9 – 1.0
F	Unsatisfactory operation and requires additional capacity. Roundabout intersections would require another control mode.	**F**	>1.0

4.2.4 Assessment of intersection layouts (existing and proposed)

The performance assessment of each intersection considers two scenarios:

1. A base case with the 2016 surveyed traffic volumes through the current intersection layout with existing pedestrian crossing legs (during both the AM and PM peaks); and
2. A scenario with the 2016 surveyed traffic volumes through the proposed intersection layout with added pedestrian crossing legs (during both the AM and PM peaks).

The results and recommendations are presented by intersection in **Table 4-5**. LoS and DoS ratings are provided for the overall intersection performance and individual approach lanes in **Appendix C**.

4.2.5 SIDRA results

Table 4-5 SIDRA analysis results

Intersection		Intersection Level of Service (LoS)				Intersection Degree of Saturation (DoS)				Recommendation
TCS	Location	AM existing	AM extra pedestrian crossing.	PM existing	PM extra pedestrian crossing.	AM existing	AM extra pedestrian crossing.	PM existing	PM extra pedestrian crossing.	
564	Willoughby Road / Chandos Street, Crows Nest	B	B	B	B	0.59	0.59	0.63	0.72	Low impact, provide additional crossing.
579	Pacific Highway / Hotham Parade, Artarmon	B	B	B	B	0.60	0.64	0.51	0.57	Low impact, provide additional crossing.
585	Pacific Highway / Campbell Street, Artarmon	B	B	B	B	0.60	0.64	0.51	0.57	Low impact, provide additional crossing.
600	Willoughby Road / Dalleys Road / Donnelly Road, Crows Nest	A	B	B	B	0.49	0.48	0.48	0.48	Low impact, provide additional crossing.
763	Pacific Highway / Alexander Street, Crows Nest	B	F	B	B	0.65	1.14	0.67	0.92	Detrimental to vehicle capacity. Consider merits of implementation, including demand and safety.
767	Pacific Highway / Oxley Street, Crows Nest.	B	B	B	B	0.53	0.53	0.60	0.60	Low impact, provide additional crossing.
768	Pacific Highway / Albany Street, St Leonards.	B	C	B	B	0.75	0.80	0.76	0.77	Low impact, provide additional crossing.
769	Pacific Highway / Christie Street, St Leonards.	B	B	B	B	0.60	0.73	0.60	0.71	Moderate impacts, investigate further in network modelling.
770	Pacific Highway / Herbert Street, St Leonards.	C	C	C	C	0.72	0.79	0.67	0.70	Moderate impacts, investigate further in network modelling.

Intersection		Intersection Level of Service (LoS)				Intersection Degree of Saturation (DoS)				Recommendation
TCS	Location	AM existing	AM extra pedestrian crossing.	PM existing	PM extra pedestrian crossing.	AM existing	AM extra pedestrian crossing.	PM existing	PM extra pedestrian crossing.	
771	Pacific Highway / Reserve Road / Berry Road, St Leonards.	B	B	B	B	0.64	0.67	0.56	0.56	Low impact, provide additional crossing.
883	Pacific Highway / Greenwich Road, Greenwich.	B	C	B	F	0.70	0.71	0.70	1.10	Detrimental to vehicle capacity. Consider merits of implementation, including demand and safety.
1111	Pacific Highway / Westbourne Street, St Leonards.	A	A	A	A	0.55	0.55	0.67	0.67	Low impact, provide additional crossing.
1870	Shirley Road / River Road, Wollstonecraft.	C	D	D	C	0.62	0.82	0.78	0.65	Mixed results. Modelling optimisation requires some intersection reconfiguration that is detrimental to the AM peak and beneficial to the PM peak.
3622	Reserve Road / Campbell Street, Artarmon	C	C	B	C	0.92	0.93	0.81	0.86	Low impact, provide additional crossing.

4.3 Summary of transport modelling

The road network is expected to experience notable increase in demands along Pacific Highway between Herbert Street and Christie Street under S0 (Future Base). The demand is expected to exceed the capacity in this section of road for all future scenarios.

Road demands from uplift under S1, S2 and S3 are anticipated to be moderate in comparison to the uplift forecast under S0 Future Base conditions.

Based on the scenarios tested, the mechanised transport demand in the 3.5 hour AM peak in 2036 is expected to rise by 34% in S0, 63% in S1, 70% in S2 and 84% in S3.

In all future scenarios, during the 3.5 hour AM peak, as a percentage, trip origins and destinations are expected to gradually readjust as follows:

> Precinct to outside of Precinct:
  - 2016 27.6%;
  - S0 30.3%;
  - S1 37.7%;
  - S2 33.7%; and
  - S3 36.5%.

> Outside of Precinct to Precinct:
  - 2016 68.6%;
  - S0 65.2%;
  - S1 55.7%;
  - S2 60.1%; and
  - S3 56.2%.

> Within Precinct:
  - 2016 3.8%;
  - S0 4.5%;
  - S1 6.6%;
  - S2 6.2%; and
  - S3 7.3%.

A summary of these results are that Precinct to outside of Precinct trips would increase, outside of Precinct to Precinct would reduce and within Precinct trips would increase.

The provision of Sydney Metro is expected to increase rail mode share without additional forecast development uplift. Modelling for S1, S2 and S3 would increase rail mode share further, this is expected to be correlated with population increase in these scenarios.

Assessment of existing signalised intersections with missing pedestrian crossing legs indicate many could facilitate an additional pedestrian crossing leg with low impacts to traffic function.

The intersections along Pacific Highway at Alexander Street and Greenwich Road experienced a reduction in LoS and DoS with the implementation of additional pedestrian crossing legs should consider pedestrian safety and demand. Moderate impacts were identified at Pacific Highway at Christie Street and Herbert Street, any changes to the configuration of these intersections should be modelled further for a fully informed decision.

The intersection of Shirley Road/ River Road has mixed results. Modelling indicates the intersection could be configured to operate better in PM peak conditions with an additional crossing leg, the LoS and DoS would reduce in the AM peak under the same conditions.

5 Future transport network

This section discusses the future transport network for the Precinct. For the purpose of costing, infrastructure has been suggested. The strategic infrastructure suggestions close gaps that currently exist as well as improve the accessibility and connectivity for future users. Detailed assessments are required at all locations to identify the most appropriate infrastructure. This should be guided and refined by more detailed studies. These studies and the potential lead agency(s) of these studies is outlined in **Table 5-1**.

Table 5-1 Detailed transport studies

Study	Potential lead agency.
Pedestrian Access and Mobility Plan	Council, Roads and Maritime Services
Bike Plan	Council
Bus Network and Services Plan	TfNSW
Car Parking Plan	Council
Local Area Traffic Management	Council
Road Network Plan	TfNSW/ Roads and Maritime
Detailed traffic modelling	DPE/ Roads and Maritime
Precinct Travel Plan(s)	Developers/ Council.

The infrastructure suggestions have been developed following consultation with local Councils, TfNSW, Roads and Maritime and DPE. They consider the opportunities and constraints identified in **Section 1.4** and modelling outcomes in **Section 4**. Where possible, the suggestions also align with, and incorporate the initiatives proposed in the landscape architecture and urban design studies prepared by others.

5.2 Context and rationale

The Precinct will transform into a higher density urban centre. The proposed uplift in density scenarios requires the planning and function of the transport network to support an active and productive residential and workforce population.

With the key drivers of this study being the planned development scenarios and proposed Sydney Metro station at Crows Nest. The proposed suggestions address a combination of both new and upgraded infrastructure and focus on increasing the attractiveness of active transport (walking and cycling) and public transport. As this study has progressed, the need for such a program of works was informed by the following rationale:

5.2.1 Pedestrian

> Rationale: Key pedestrian movements, particularly when interacting with the Pacific Highway, are characterised by poor pedestrian amenity, safety and connectivity.

- Recommendation: Deliver new and upgraded pedestrian infrastructure to enhance movements within the Precinct to support both local trips (particularly between the St Leonards and Crows Nest centres where development is focused), and to access to improved rail services within the critical 800 metre to one kilometre walking catchments. Provide missing pedestrian crossings at intersections where this does not have a significant detrimental impact to existing traffic conditions.

There is a range of views for the provision of new crossings of Pacific Highway in terms of at-grade or grade separated. Grade separated suggestions are reliant of specific land development outcomes which have lower certainty. At-grade solutions can have greater traffic impacts but have significantly lower costs than grade separated solutions.

Due to cost, at-grade crossings of roads are preferred with grade separated considered now for long term implementation subject to a merits test of pedestrian and vehicle volumes.

It is understood that North Sydney Council has a preference to use kerb buildouts to improve pedestrian safety on local streets.

Any additional crossing or improvements will be subject to detailed analysis by the relevant agencies to understand and mitigate impacts.

5.2.2 Bicycle

> Rationale: The bicycle network is incomplete, with inconsistencies observed in existing facilities and poor connectivity between local centres and regional links.

- Recommendation: Integrate plans for bicycle facilities from the three councils to support trips to local centres as well as through movements along regionally significant routes connecting to other centres including Chatswood, North Sydney and the Sydney CBD. Opportunities for interchange between rail services with routes connecting to St Leonards Station and Crows Nest Station and supporting facilities included such as bicycle parking.
- Recommendation: Enhance local routes and consider bicycles during all road and LATM changes.

5.2.3 Rail

> Rationale: Rail provides the highest mode share of public transport users through the Precinct, and will continue to do so. The high person capacity of the rail network provides an opportunity to support uplift and increase the value of its investment. There will be a potential shift and increase interchange demand at Crows Nest.

- Recommendation: Support the use of the existing heavy rail services and proposed Sydney Metro by enhancing access via active transport and bus interchange to/ from stations.

5.2.4 Bus

> Rationale: The bus network within the Precinct should be reviewed to support access to Crows Nest Metro Station, align with Lane Cove Council plans to deliver new integrated transport interchanges, and deliver on the objectives outlined in Sydney's Bus Future, including new service tiers and adjusted stop spacing.

- Recommendation: Improve access to the network and accompanying services. Council and state government should continue to work together to close gaps in coverage and service in the Precinct.

TfNSW indicated that opportunities to improve the bus network within the Precinct will be considered as part of future planning to support Crows Nest Station and deliver on the objectives outlined in Future Transport Strategy 2056, including new service tiers and adjusted stop spacing. Key routes through the Precinct including Pacific Highway, Falcon Street and Willoughby Road are likely to remain.

5.2.5 Road

> Rationale: Roads support a range of modes. The movement and place classification prepared presents a preliminary step in the categorisation of the road network and identifying and optimising the use of road space.

- Recommendation: Roads and Maritime and Transport for NSW undertake a Road Network Plan for the Precinct. This provides the depth of study required to identify issues, opportunities, and a more detailed level and to collate detailed feedback from key stakeholders. The assessment should also consider traffic speeds on local streets, particularly opportunities to improve pedestrian safety on local streets through lower speed limits or other measures.

5.2.5.1 Pacific Highway

> Rationale: The Pacific Highway will continue to have high demands during peak periods and operate as a key movement corridor through the Precinct. Modelling indicates the section of Pacific Highway between Herbert Street and Christie Street may have demands higher than capacity.

- Recommendation: Consider the needs of users and the person capacity of the corridor. Focus investment on active transport and public transport to reduce the impacts of additional private vehicle traffic on the corridor.

5.2.6 Parking

> Rationale: Private vehicle mode share should be reduced as the road network already accommodates high demands. The provision of additional car parking should be minimised, more car parking results in more private vehicle trips. A proportion of land uses near high quality, regular and reliable public transport services and car share could be provided without any car parking provision.

- Recommendation: Car parking rates for future development, particularly close to the provision of high capacity and frequency public transport services should adopt a minimalist approach to reduce the impact of additional vehicle traffic in the Precinct. Investigate the feasibility of zero car parking allocations to some land uses.

5.2.7 Freight and servicing

Larger developments, which require regular servicing or receiving significant deliveries, are generally required to have on-site loading facilities as part of development consent and these controls. For new developments , the provision and adequacy of loading zones are currently and will continue to be outlined in Traffic Impact Assessments.

Most new development is anticipated to be residential and commercial and freight impacts are not anticipated to be high.

5.3 Approach

The shift to more sustainable transport initiatives and increase their respective mode shares improves social equity and the health of communities. Active and public transport modes yield benefits to their users as they are:

> Safe – active and public transport are the safest modes of transport for individuals;

> Space efficient – they result in the good utilisation of space for movement;

> Environmentally friendly – produce lower levels of emissions; and

> Healthy – people who walk, cycle and use public transport have higher levels of physical health.

The suggestions should inform future decision making for the Precinct's transport network, pending detailed analysis and assessments where required.

This was informed from review of strategic documentation, research, council consultation, site visits and desktop review. Through this process, network gaps and opportunities have been identified. Infrastructure suggestions require detailed investigations to determine the optimum solutions considering safety, cost, other benefits and impacts.

5.4 Infrastructure suggestions

The proposed transport network improvements incorporate infrastructure suggestions for detailed investigation across the Precinct. The infrastructure suggestions are a combination of works proposed in existing documentation, works suggested by other disciplines and proposals identified in this study. The delivery of infrastructure will be the responsibility of both state and local government and also developers where appropriate dependant on the location, type of infrastructure and key beneficiaries.

The provision of any infrastructure is subject to approval by the relevant authorities, i.e. TfNSW, Roads and Maritime Services or Council.

The proposed pedestrian, road and bus infrastructure improvements/ opportunities for the Precinct are presented in **Figure 5-2** The proposed cycle network improvements for the Precinct is presented in **Figure 5-2**.

Infrastructure has not been documented within the St Leonards South area. A separate study was undertaken by Council to identify the needs in this locality in conjunction with the planning proposal. These are to be delivered as part of the Lane Cove Council Planning Proposal 25 (dated 29th September 2017) and would integrate into the broader Precinct. The key transport recommendations in this study include of:

> A series of footpaths 1.5 metres wide;

> A series of share paths 2.5 metres wide;

> Lifts;
> Pedestrian connections (laneways);
> Vehicular connections (laneways);
> Pedestrian refuges and crossings;
> Stairs and ramps;
> A consolidated bus interchange on the south side of Pacific Highway at St Leonards; and
> Signalised pedestrian crossing at River Road/ Canberra Avenue

Figure 5-1 Pedestrian, road and bus infrastructure improvements

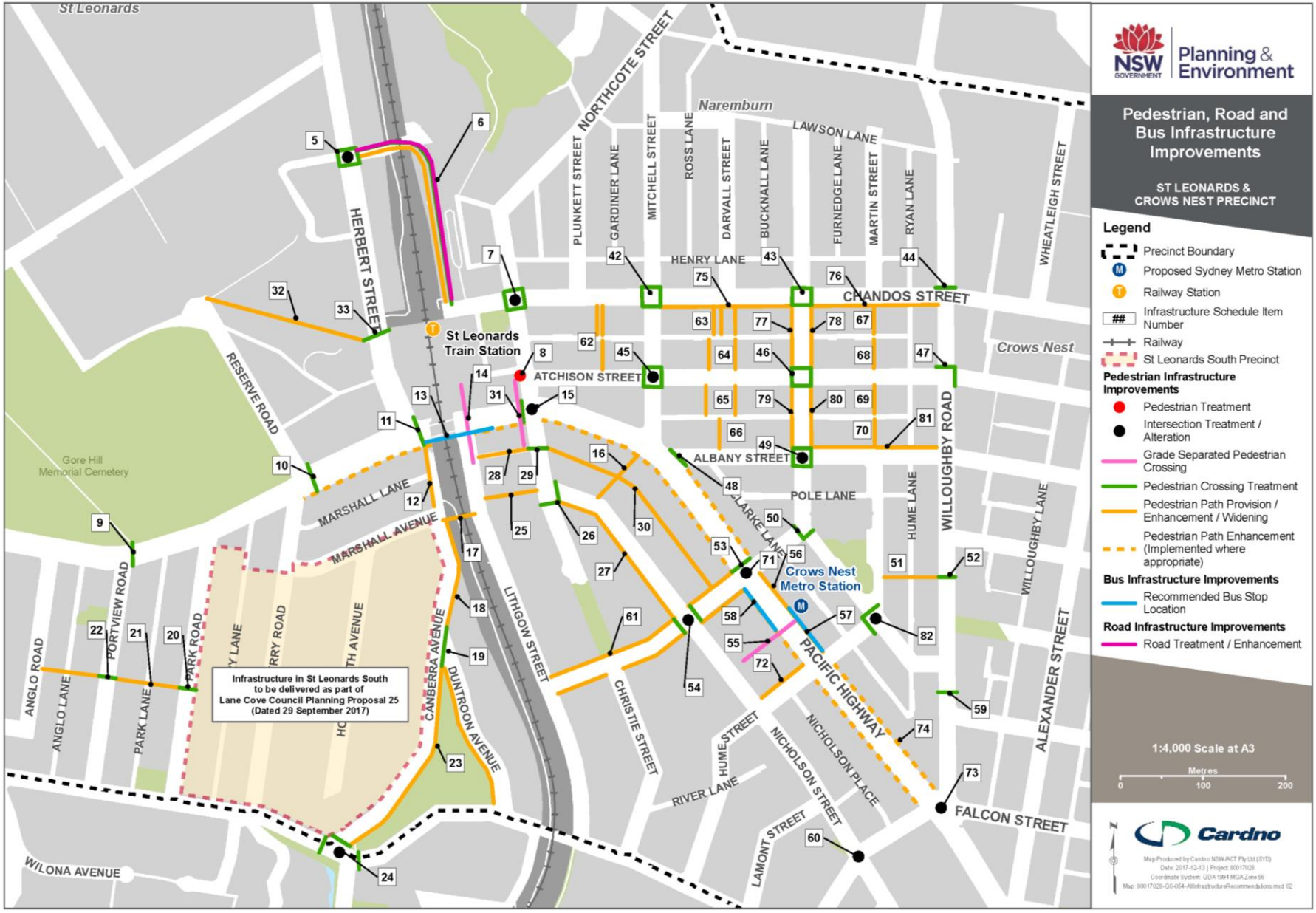
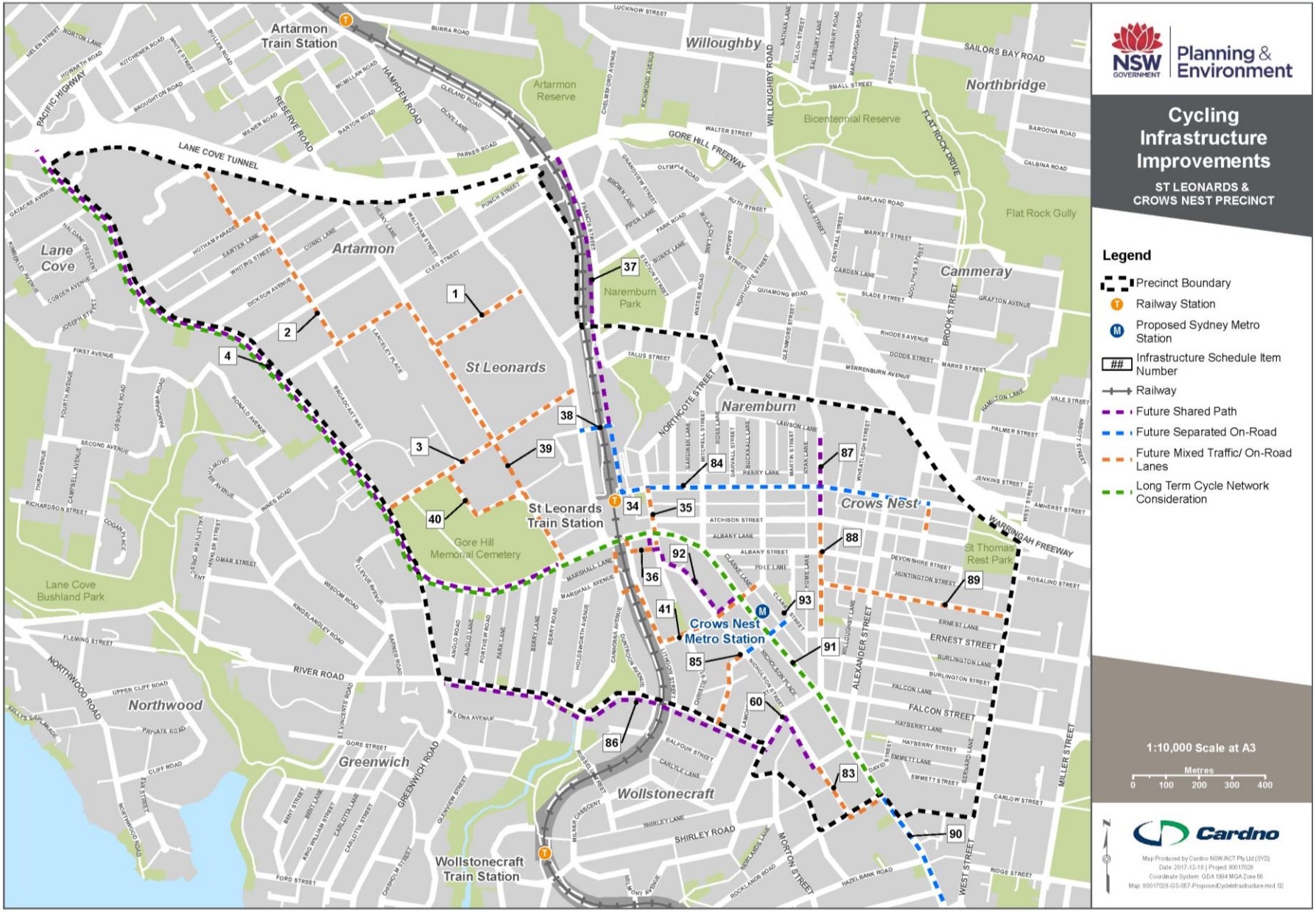


Figure 5-2 Cycling infrastructure improvements



5.4.2 Pedestrian

Proposed pedestrian network improvements include treatments to pedestrian crossings and enhancement of footpaths throughout the Precinct. These will complete gaps in the pedestrian network and improve overall safety and connectivity.

All proposed pedestrian crossings on state roads require detailed analysis and have not been approved by Roads and Maritime.

New footpaths will connect buildings in the commercial area east of St Leonards Station. Footpath widening and enhancement treatments are also recommended where needed. Pedestrian crossings are proposed at intersections that lack safe and convenient connections.

A link north of St Leonards Station is recommended. This would connect from the eastern side of the station at Chandos Street to the Herbert Street rail overpass and increase permeability for pedestrians and cyclists.

Grade separated crossings must be designed in alignment with Crime Prevention Through Environmental Design (CEPTED) principles and detailed Cost Benefit Ratio analysis. These should only supplement at-grade options.

5.4.3 Bicycle

Improvements to bicycling infrastructure are focused around linking gaps within the network. These include new cycling routes, treatments for cyclist safety at intersections, and end of trip facilities at St Leonards Station.

Proposed routes connect key destinations such as Royal North Shore Hospital, the Artarmon industrial area and the future Crows Nest Metro Station. They also connect to regional destinations such as south to Wollstonecraft and North Sydney and north-west to Lane Cove. These routes are a combination of shared paths, separated on-road paths and mixed traffic lanes. Improvements to the Precinct can integrate regionally for connectivity to Sydney CBD.

Infrastructure proposals that reallocate existing road space on state roads is subject to detailed analysis of traffic impacts and approval by Roads and Maritime.

A long-term initiative is to consider a separated cycleway along the Pacific Highway. This would require traffic management measures to ensure sufficient capacity for people and freight movement. It is anticipated that in the long term future autonomous vehicles will be able to utilise road space more efficiently that would facilitate this. Given the contentiousness of this initiative, it is not listed in the infrastructure schedule.

5.4.4 Rail

Rail infrastructure improvements are beyond the scope of this study and are already proposed by the NSW government. The study seeks to leverage of existing and proposed infrastructure.

5.4.5 Bus

Bus infrastructure and service improvements are beyond the scope of this study. This study seeks to maximise the use of existing services and improve access.

At St Leonards Station, suggestions address improvements to interchange between bus and rail as part of a future interchange plaza development on the southern side of the Pacific Highway, and at the future Crows Nest Metro Station site, the improvements include consolidation of bus stops and consideration of pedestrian and bus customer conflict.

5.4.6 Road network

The road network should be planned with consideration of the Precinct. It appears some road network changes have been gradually implemented by the relevant authority without optimal integration with the overall network.

Road network improvements include a right-hand turn lane at the Pacific Highway and Oxley Street intersection to provide dedicated access for proposed developments in the block bound by Pacific Highway, Lithgow Street and Oxley Street. This eliminates the need for southbound drivers to first proceed to the eastern side of the Pacific Highway and then cross back over to the western side.

5.4.7 Parking

No additional public car parking facilities are proposed in the infrastructure suggestions. This initiative aims to minimise the wider impacts to the road network. A car parking working paper was prepared with this study. It was recommended than if any major additional parking facility is provided, it be located on the periphery of the core of the Precinct and that it be adaptable for other uses.

Car parking rates for new development should adopt a minimalist policy to reduce the impact of more traffic on the Precincts road network. It may be appropriate to have new land uses without car parking provisions if they are located close to high capacity and frequency public transport and co-located with interdependent land uses.

The allocation of kerb side parking space requires review to ensure adequate space is provided for:

> Accessible parking;

> Public transport stops;

> Service and loading, short stay only for smaller delivery/ pick-up vehicles;

> Passenger pick-up/ drop-off spaces near transport interchanges and near street corners. This need is increasing with the increase in use of ride share and potentially will increase further from autonomous vehicles.

> Short stay spaces near activity centres;

> Car Share; and

> Motorcycle/ Scooter parking

Long term use of kerbside parking is not encouraged or an effective use of space in high density locations. Long term parking requirements should be serviced off-street.

5.5 Draft infrastructure

All infrastructure/ projects require more detailed investigation by others and assessment of both the most suitable infrastructure. The strategic infrastructure suggestions are listed in **Table 5-2**.

Table 5-2 Transport infrastructure schedule

Item	Description
1	Pedestrian link, cycleway - New cycleway along the full length of Frederick Street provides a direct east-west connection between Herbert Street and Reserve Road.
2	Cycleway link - Improve north-south cycle connectivity through the Artarmon Industrial Area connecting the Royal North Shore Hospital with the Gore Hill Freeway.
3	Cycleway link - Improve east-west cycle connectivity through the Royal North Shore Hospital and TAFE NSW. To be considered and delivered as part of an integrated strategy for Health and TAFE sites.
4	Shared path - Provides a strategic north-south connection from the Artarmon Industrial Area to St Leonards and Crows Nest.
5	Improved pedestrian and vehicle safety measures - Improve pedestrian connectivity and safety to the north of St Leonards Station. Should be implemented as part of the Herbert Street/ Chandos Street link.
6	Active transport bridge link north of St Leonards Station at 15 Herbert Street - Improve walking and cycling permeability around St Leonards Station.
7	Improved pedestrian and vehicle safety measures - Improves pedestrian crossing safety and road capacity. Should be implemented as part of the Herbert Street/ Chandos Street link.
8	Separation of pedestrians and vehicles at Sergeants Lane/ Christie Street intersection - The shared space at the intersection increases conflict with high pedestrian demands and vehicles. Separate pedestrians and vehicles at the intersection, shared zone is likely to be appropriate away from the intersection. Consider reducing to one exit lane at the intersection of Christie Street and Sergeants Lane.
9	Mid-block pedestrian crossing or signalise intersection Portview Road and Pacific Highway with pedestrian crossings - Improve connectivity between Gore Hill Oval/ Park and South St Leonards. Increases connectivity of nearby bus stop.
10	Pedestrian crossing, east leg - Improve north south connectivity and reduce delays for pedestrians.

Item	Description
11	Pedestrian crossing, east leg - Improve north south connectivity and reduce delays for pedestrians. Improved feasibility supported by Herbert Street, Chandos Street link.
12	Pedestrian path widening. Consistent 1.8 metre width - This is an important link between St Leonards Station and Newlands Park. Uplift will increase demand along this route for users accessing the St Leonards Station precinct. Potentially identify direct access to The Forum under Pacific Highway to avoid steep grade.
13	Consolidated/ rationalised bus interchange - Improve public transport legibility at St Leonards Station. Increase ease of use and improve bus rail interchange as well as a general pedestrian network benefit.
14	Pedestrian underpass enhancement. Improve lighting and accessibility - Improve bus/ rail interchange at St Leonards Station. Package with Plaza project. This would require a design approach to improve personal safety of users. (subject to approach taken by DPE re grade separated crossings of Highway). Enhanced at-grade crossing(s) could be provided in lieu of this recommendation.
15	Reconfigured intersection, including west crossing leg - Improve pedestrian connectivity and provide an at grade option to the grade separated link adjacent to the Pacific Highway.
16	Improve pedestrian link. (Widened path, resting areas and seating) - Provide for increase demand and cross Pacific Highway connectivity.
17	Railway crossing - Support movement from uplift in St Leonards South and pedestrian access to Crows Nest Metro and Crows Nest village. (This crossing could be moved to the River Road region or widening of River Road to provide for improved pedestraian crossing of the railway at this location. May be associated with pedestrian crossing improvements of River Road).
18	Pedestrian link - Provide pedestrian link to support north-south movements along Canberra Avenue and link River Road with the Pacific Highway.
19	Pedestrian crossing - Enhance pedestrian crossing to link with proposed footpaths on the eastern side of Canberra Avenue.
23	Widened pedestrian path. - Widen pedestrian path on the eastern side of Canberra Avenue and the western side of Duntroon Avenue to 1.5 metres to support anticipated uplift in pedestrian movements. This is consistent with Lane Cove Council plans for St Leonards South.
24	Signalised intersection with pedestrian crossings on Canberra Avenue and River Road legs - Improve pedestrian connectivity and safety along River Road and to/from the St Leonards South development. This is consistent with Lane Cove Council plans for St Leonards South.
25	Pedestrian through site link - Provide through site link connecting Lithgow Street and Christie Street to enhance east-west movements and connections through St Leonards South. This is consistent with Lane Cove Council plans.
26	Pedestrian refuge crossings - Provide pedestrian refuge facilities across the southern leg on Christie Street and across Nicholson Street to improve pedestrian connectivity and safety. This is consistent with Lane Cove Council plans for St Leonards South.
27	Widened pedestrian path/ setback (through planning controls) - Widen pedestrian path on western side of Nicholson Street to minimum 1.5 metres (1.8 metre preferred) to support anticipated uplift in pedestrian movements. This is consistent with Lane Cove Council plans for St Leonards South.
28	Pedestrian through site link (through planning controls) - Provide through site link along Christie Lane to enhance east-west movements and connections through St Leonards South. This is consistent with Lane Cove Council plans.
29	Pedestrian crossing - Provide pedestrian crossing to link with the new east west through site links between Nicholson Street and Pacific Highway. This is consistent with Lane Cove Council plans for St Leonards South. This requires special consideration given the proximity to the Pacific Highway/ Christie Street intersection.
30	Indicative pedestrian through site link (through planning controls) - Provide through site link connecting Christie Street and Oxley Street to enhance movements through St Leonards South and connectivity between St Leonards Station and Crows Nest Metro Station. This is consistent with existing Lane Cove Council Development Control plans.
31	Grade separated pedestrian link or enhanced at-grade crossing. - Improve pedestrian crossing of Pacific Highway at the intersection of Christie Street (western side) to connect with new development on either side. This is consistent with Lane Cove Council plans.

Item	Description
32	Pedestrian through site link - Provide through site link between Reserve Road with a crossing of Herbert Street to enhance pedestrian connections between St Leonards Station and the Royal North Shore Hospital and TAFE facility. To be considered and delivered as part of an integrated strategy for Health and TAFE sites.
33	Grade separated pedestrian link - Provide an improved grade separated pedestrian crossing of Herbert Street to enhance pedestrian movements to and from St Leonards Station and the Royal North Shore Hospital / TAFE facility precinct. To be considered and delivered as part of an integrated strategy for Health and TAFE sites.
34	Improve bicycle parking, kiss-and-ride and provide a designated taxi zone. - Encourage more cycling to St Leonards Station, reduce requirement for car parking and discourage taxi's using the bus zone on Pacific Highway.
35	Cycle route - Link north and south of Pacific Highway in a legible and logical location minimising pedestrian conflicts.
36	Enhance/ complete cycle link - Provide cycle link where appropriate parallel to Pacific Highway.
37	Cycleway - New off-street cycleway along Herbert Street (east of the railway line) to Gore Hill Freeway provides a new north-south link parallel to the railway corridor and connecting to existing bridges across the railway line
38	Cycleway - New cycleway facilities on the bridge to provide full separation of bicycles from vehicles
39	Cycleway link - Improve north-south cycle connectivity through the Royal North Shore Hospital. To be considered and delivered as part of an integrated strategy for Health and TAFE sites.
40	Cycleway link - Provides a connection between Royal North Shore Hospital and TAFE NSW. To be considered and delivered as part of an integrated strategy for Health and TAFE sites.
41	Cycleway link - Improved connectivity between St Leonards South and the proposed Crows Nest Metro Station.
42	Pedestrian crossings (i.e. raised/ refuges/ signalised), all legs - Improve crossing safety and increase pedestrian priority on all approaches.
43	Pedestrian crossings (i.e. raised/ refuges/ signalised), all legs - Roundabouts offer the lowest priority for pedestrians. Existing refuges do not appear compliant with current Roads and Maritime standards. Additional pedestrian movements are anticipated from uplift.
44	Pedestrian crossing (signalised), north leg - Missing crossing leg on the north leg reduces pedestrian safety and increase delay.
45	Pedestrian crossing (North Sydney Council proposed raised tabletop), with four crossing legs - Anticipated area with higher future demand. Opportunities to improve pedestrian safety reduce their risk through crossing treatments and/ or traffic calming.
46	Pedestrian crossings (raised/ refuges/ signalised), all legs - Improve crossing safety and increase pedestrian priority on all approaches to support additional pedestrian movement anticipated from uplift.
47	Pedestrian crossing (raised/ refuge), north leg, east leg - Improve pedestrian connectivity and safety. Recent street scaping works have already been completed at the intersection to the west and south leg.
48	Pedestrian crossing, east leg - Increase pedestrian connectivity. Improve safety on east leg. Previous Arup report suggested a kerb outstand, this would reduce crossing distance and geometrically encourage lower vehicle speeds.
49	Pedestrian crossings, all legs - It is understood that North Sydney Council is working to improve pedestrian connectivity at this intersection that is proposed to include retention of the roundabout and implementation of "marked" crossings on all four legs. The design for this crossing is currently (October 2017) at concept phase.
50	Marked pedestrian crossings - Crows Nest Metro could notability increase pedestrian movements at this location.
51	Pedestrian + Bicycle link - As proposed as part of existing strategies and Crows Nest Metro Station interchange requirements. Improve access and connectivity between Willoughby Road (Crows Nest village) and Crows Nest Metro Station.
52	Pedestrian crossing - Support pedestrian connectivity and proposed link to Hume Street.
53	Pedestrian crossing, north west leg - Improve pedestrian connectivity and reduce delay. Sydney Metro propose to deliver this.

Item	Description
54	Intersection treatment for pedestrians and cyclists (Signals/ traffic calming/ refuges) - Upgrade of the intersection of Oxley Street and Nicholson Street to enhancement movements for cyclists on the south leg (closed to vehicle traffic) into Nicholson Street. Provision of two pedestrian crossing legs across Oxley Street to improve north-south pedestrian movements and safety.
55	Grade separated pedestrian link or enhanced at-grade pedestrian crossing - Crows Nest Metro and uplift on the opposite side of the Pacific Highway is highly likely to increase pedestrian demands. Sydney Metro propose to retain a provision for an underground link at the station.
56	Widened pedestrian path - The path in this section of Pacific Highway will have increased demands from Crows Nest Metro Station, interchanging passengers with the bus network and the activated uses along this section. Sydney Metro propose to provide a wider path.
57	Bus stop enhancement - Suitable interchange is required between Pacific Highway bus services and Crows Nest Metro.
58	Bus stop - There are two bus stops in the space of 209 metres. Consider consolidating these into one stop.
60	Intersection treatment for cyclists (refuge/ signals) - Improve connectivity and safety of cycle network.
61	Pedestrian footpath improvements and cycle link - Provide widened footpath along Oxley Street on both sides between Lithgow Street and Pacific Highway to support increased demand to and from new developments in the area and Crows Nest Metro Station. Oxley Street forms part of route to access St Leonards South and Nicolson Street bicycle route.
62	Developer provision and delivery, pedestrian through site links - Provide through site link to improve pedestrian connectivity connecting Chandos Street with Atchison Lane and the existing through link as provided by the Air Apartment development. Two options are proposed at 25 Chandos Street and an additional link adjacent to the current Air Apartment through link. This is consistent with North Sydney Council plans.
63	Developer provision and delivery, pedestrian through site links - Provide through site link to improve pedestrian connectivity between Chandos Street with Atchison Lane. Three options are proposed at 71-73 Chandos Street. This is consistent with North Sydney Council plans.
64	Developer provision and delivery, pedestrian through site links - Provide through site link to improve pedestrian connectivity between Atchison Lane with Atchison Street. Two options are proposed at 50 Atchison Street. This is consistent with North Sydney Council plans.
65	Developer provision and delivery, pedestrian through site links - Provide through site link to improve pedestrian connectivity between Atchison Street with Albany Lane. Two options are proposed at 21 Atchison Street. This is consistent with North Sydney Council plans.
66	Developer provision and delivery, pedestrian through site links - Provide through site link to improve pedestrian connectivity between Atchison Street with Albany Lane. The link is currently under construction at 22 Albany Street. This is consistent with North Sydney Council plans.
67	Developer provision and delivery, pedestrian through site links - Provide through site link to improve pedestrian connectivity between Chandos Street and Atchison Lane as adjacent sites are redeveloped.
68	Developer provision and delivery, pedestrian through site links - Provide through site link to improve pedestrian connectivity between Atchison Lane and Atchison Street as adjacent sites are redeveloped.
69	Developer provision and delivery, pedestrian through site links - Provide through site link to improve pedestrian connectivity between Atchison Street and Albany Lane as adjacent sites are redeveloped.
70	Developer provision and delivery, pedestrian through site links - Provide through site link to improve pedestrian connectivity between Albany Lane and Albany Street as adjacent sites are redeveloped.
71	Right hand turn lane on Pacific Highway (southbound) at Oxley Street - Investigate a dedicated right-hand turn lane on Pacific Highway (southbound) at Oxley Street to support access and egress of new development in St Leonards South. A local traffic management plan is required to determine a suitable configuration for access to the area bound Lithgow Street, River Road, Shirley Road and Pacific Highway.
72	Widened pedestrian path. - Widen pedestrian path on the northern side of Hume Street to support anticipated increase in pedestrian movements to and from Crows Nest Metro Station.
73	Intersection treatment / alteration - Alteration of five-ways intersection to support vehicular traffic movements. This is consistent with North Sydney Council plans.
74	Development controls to facilitate widened pedestrian path and frontage activation - Provide pedestrian path widening and activate frontages to encourage and support increased pedestrian movements along the Pacific Highway on both sides as land parcels are redeveloped. To be enabled by planning controls.

Item	Description
75	Development controls to facilitate widened pedestrian path - Widen pedestrian path on the southern side of Chandos Street to support anticipated uplift in pedestrian movements in the Crows Nest precinct.
76	Development controls to facilitate widened pedestrian path - Widen pedestrian path on the southern side of Chandos Street to support anticipated uplift in pedestrian movements in the Crows Nest precinct.
77	Development controls to facilitate widened pedestrian path - Widen pedestrian path on the western side of Oxley Street to support anticipated uplift in pedestrian movements in the Crows Nest precinct.
78	Widened pedestrian path - Widen pedestrian path on the eastern side of Oxley Street to support anticipated uplift in pedestrian movements in the Crows Nest precinct.
79	Development controls to facilitate widened pedestrian path - Widen pedestrian path on the western side of Oxley Street to support anticipated uplift in pedestrian movements in the Crows Nest precinct.
80	Widened pedestrian path - Widen pedestrian path on the eastern side of Oxley Street to support anticipated uplift in pedestrian movements in the Crows Nest precinct.
81	Widened pedestrian path - Widen pedestrian path on the northern side of Oxley Street to support anticipated uplift in pedestrian movements in the Crows Nest precinct.
82	Sydney Metro proposed intersection treatment - Upgrade intersection of Clarke Street and Hume Street to enhance safety for all users following the commissioning of Crows Nest Metro Station.
83	Cycleway - Increase the attractiveness and connectivity of cycle network through infrastructure improvements and work with North Sydney to connect to the proposed Pacific Highway separated cycleway. This may require amendments to the existing designs to extend the Pacific Highway cycleway to Rocklands Road for an integrated link through St Leonards. The recommended infrastructure includes a combination of shared paths and mixed traffic / on-road lanes.
84	Cycleway - Separated bi-directional cycleway.
85	Sydney Metro proposed cycleway link - Improved connectivity across from new development west of Pacific Highway to the proposed Crows Nest Metro Station.
86	Shared path - Improved east-west connectivity along the southern boundary of the Precinct. Provides an alternative connection between St Leonards South and North Sydney.
87	Shared path - Extension of the existing shared path along Willoughby Road connecting to proposed links along either Chandos Street or Atchison Street.
88	Cycleway link - Provides a convenient north-south connection linking to existing facilities along Clarke Street and Burlington Street.
89	Cycleway link - Improve east-west cycle connectivity from the Crows Nest centre to the West Street cycleway.
90	Separated bi-directional cycleway - Provide cycle connection along Pacific Highway in line with North Sydney Council plans.
92	Shared path - Provide a shared path facility to connect the St Leonards centre with Crows Nest Metro Station. Provides an off-street alternative to the Pacific Highway.
93	Sydney Metro proposed bicycle parking - Provide bicycle parking facilities as part of the future Crows Nest Metro Station interchange.

5.6 Summary of future transport network

After consultation with local Councils, TfNSW, Roads and Maritime and DPE and review of relevant strategic planning document and policies and transport modelling outcomes a schedule of recommended transport infrastructure was developed. Council, Roads and Maritime require more detailed assessments of infrastructure prior to endorsement.

The infrastructure schedule prioritises improvements to the walking and cycling network that supports sustainable travel and access to the public transport network. The rail network and proposed Sydney Metro are broader regional projects and will support transport movement in the Precinct.

Minimal road network improvements are proposed. Major improvements are likely to be counter to the desire to encourage shift to more sustainable modes.

A list of infrastructure items was developed. These are focused around the core of the Precinct where most development is forecast. Suggestions away from the core area generally provide a regional benefit to encourage longer active transport trips.

6 Conclusion and next steps

The Precinct is well developed with a large range of land uses including residential, industrial, commercial, retail, recreational, education, and health. The Precinct also has good public transport services and access. The north shore railway and St Leonards Station facilitate the highest volume of public transport users in the Precinct.

Existing local and state government strategy and policy is focused around increasing sustainable transport mode share. This is achieved by improving pedestrian and bicycle networks, state government to improving public transport and limiting additional capacity for private vehicles including roads and parking.

Opportunities

There are opportunities to improve the existing transport network for existing users and facilitate additional demand, these include:

> The pedestrian network lacks crossing opportunities along Pacific Highway and the railway corridor. The bicycle network is disjointed and parts of the network are shared with busy roads.

> The Artarmon area of the Precinct has minimal TfNSW bus service coverage, which is substituted by the Gore Hill Shuttle Bus and Artarmon Loop.

> Private vehicle traffic causes road network congestion in peak periods that can affect bus services.

> Parking issues generally apply to most of the precinct and there is a high infiltration of parking associated with employment land uses in residential areas.

> Parking controls for bicycles and vehicles differ between the three council areas.

Initiatives

A range of transport initiatives are already proposed by Council and the State Government. These include;

> The improvement of the bus interchange at St Leonards Station on the south side of Pacific Highway;

> Improvements to local intersections to improve pedestrian safety; and

> Sydney Metro with a station at Crows Nest and improved access provisions.

Future considerations

Sydney Metro is a catalyst to support development uplift in the precinct. It is the most significant public transport infrastructure proposed for the precinct.

The strategic modelling indicated:

> The key driver of mode shift in the 3.5 hour AM peak between 2016 and 2036 appears to be Sydney Metro. Rail mode share is indicated to change from 25% to 31%. Analysis under the uplift scenarios indicates rail mode share would remain static, although more people would use rail in line with the increase in population.

> The road network will experience higher demands in the future that are likely to exceed the capacity of the Pacific Highway between Herbert Street and Christie Street.

> The addition of Sydney Metro is expected double the public transport rail ridership by 2036 in the 3.5 hour AM peak. Uplift scenarios indicate this would increase further by 26 to 49 percent in S1, S2 and S3.

SIDRA intersection modelling indicated that in many locations, it would be possible to provide additional pedestrian crossing legs without significant impacts to the subject intersections.

Suggestions

Transport infrastructure suggestions are focused around local and state government strategy, policy, consultation, deficiencies and opportunities identified in the study. The suggestions include:

> Pedestrian network: Improving and providing new crossing opportunities across roads and the rail network.

> Bicycle network: Joining the network around the St Leonards Station, the proposed Crows Nest Metro Station and linking these to the regional network.

> Crows Nest Metro: This will provide a significant benefit to the Precinct. Additional to Sydney Metro's proposed access improvements, other transport improvements are proposed to further enhance the opportunity from Sydney Metro.

> Bus network: Improvements to existing stops proposed by Council at St Leonards and by Sydney Metro at the proposed Crows Nest Metro Station are supported by this study. It is recommended that Council and state government work together to close the service gap through Artarmon.

> Parking: No new private vehicle parking facilities are recommended. If any major standalone facilities are provided, it is recommended that these structures be adaptable to other land uses.

6.1 Next steps

Additional investigations are recommended to confirm the transport requirements and impacts of uplift and to refine the infrastructure suggestions to recommendations. This includes:

> A peer review of complimentary studies is undertaken to ensure consistency and compatibility of suggestions/ recommendations.

> Undertake a PAMP and Bike Plan for the Precinct. This can be used to undertake updated and detailed audits of the network and create a detailed GIS dataset of infrastructure conditions. This could be used to facilitate consistent infrastructure in the Precinct. The Bike Plan should also suggest parking rates for developments and end of trip facilities where recommended.

> Undertake more detailed road network modelling to understand in more detail the deficiencies of the network and movement through the precinct.

> Undertake a road network plan for key roads in the precinct.

> Council and state government work together to improve bus network coverage and services.

> Investigate and plan for the freight movements from increased development in the precinct.

> Investigate a planning approach that ensures the development of the whole Precinct is considered when planning investigations are being undertaken in more detailed studies.

> Develop and implement Travel Plans to integrate with land use and transport planning will help to influence travel behaviour and organisational working practices and contribute to the creation of a more efficient and sustainable Precinct environment.

> Involve TfNSW in all subsequent modal specific transport studies as well as other studies that can have impacts on the transport network.

St Leonards and Crows Nest Station Precinct

APPENDIX A

CAR PARKING ISSUES PAPER

St Leonards and Crows Nest Station Precinct

APPENDIX B

STRATEGIC MODELLING NOTE

St Leonards and Crows Nest Station Precinct

APPENDIX C

SIDRA RESULTS