ATTACHMENT H

SCT Consulting

NORWEST STATION SITE PLANNING PROPOSAL

Traffic and Transport Study

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Quality Assurance

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Executive Summary

Background and introduction

The NSW Government is currently building the Sydney Metro North West (SMNW) that is due to start operations in 2019. The SMNW is Stage 1 of the overall Sydney Metro project and involves the construction of eight new Metro stations and supporting infrastructure between Tallawong and Epping Stations, as well as converting five existing stations between Epping and Chatswood. Stage 2 will deliver a new Metro rail line from Chatswood through Sydney's CBD to Sydenham (Sydney Metro City and Southwest).

Landcom and Sydney Metro are working in collaboration to develop walkable, attractive, mixed use places around the SMNW stations. This includes using surplus government owned land located adjacent to the Norwest Station. The subject site, the Norwest Station site is bounded by the SMNW corridor to the north (which runs parallel to Norwest Boulevard) and Brookhollow Avenue to the south and west.

SCT Consulting was engaged to carry out a Traffic and Transport Study to support a Planning Proposal for the subject site. The illustrative development concept is a transit-oriented mixed-use development that could comprise approximately 52,000 sqm of gross floor area (GFA). This may include approximately 3,900 sqm of retail, 39,500 sqm of office space and 8,600 sqm short-term accommodation (hotel / serviced apartments. An underground car park area comprising circa 360 parking spaces is also proposed, based on the yield and land use mix of the Planning Proposal and the recommended maximum parking rates for each type of uses.

The Planning Proposal would facilitate development which supports best practice transit-oriented development principles, by providing increased employment density in proximity to existing and planned transport infrastructure upgrades that provides employees with greater access to public transport and employment options, while promoting the use of sustainable travel options. Vehicular access to the site is proposed at Brookhollow Avenue that provides two entries to underground car parks.

A review of public transport mode share across key centres shows the combination of high density mixed use development, good access to public transport services as well as low parking supply contribute to high public transport mode shares in Sydney CBD and North Sydney. For example in Macquarie Park, increasing public transport services enabled Council to reduce parking provision rates for developments within walking distance to train stations and frequent bus services. The increase of public transport services at the Norwest Station site also enables reduction of car parking provision as there is significantly less reliance on use of private vehicles.

The illustrative development concept responds to the opportunity to create a transit-oriented centre by reducing the amount of employee parking, reflecting the higher level of public transport services. The best approach to facilitate / influence reduced car use and to minimise additional congestion to the surrounding road network is to restrain parking provision at its destination for employment uses (while offering attractive public transport alternative in this case Sydney Metro and its connecting bus network). Hence the need to predict and provide parking provision based on historical data / trends does not align with the principle of the Norwest Station site. The recommended 360 car parking spaces is determined based on 1 space per 145m^2 GFA of office space, 1 space per 130m^2 GFA of retail space as well as 1 space per 2 hotel rooms, as part of the proposal to discourage private vehicle use and minimise traffic impacts.

Trip generation and traffic impacts

The illustrative development concept would generate 144 and 103 peak hour vehicular trips during the AM and PM peak hours respectively. The proposed cap on parking spaces below the Development Control Plan rates is one of the tools used to reduce the traffic impacts of this proposal. The illustrative development concept's traffic generation could be as much as 75% lower than a scheme that complies with current car parking controls.

The maximum increase (approximately 100 vehicles per hour at an intersection) is less than 5% of existing traffic experienced along Norwest Boulevard, which is well-within the daily variation of traffic experience on any major roads in Sydney. Hence, this level of increase in traffic as a result of the illustrative development concept will have no significant adverse impacts to the surrounding road network.

The traffic modelling shows that the performance of the intersections along Norwest Boulevard would operate at a lower level of service or performance, as a result of the cumulative traffic demands at the following intersections:

– Norwest Boulevard / Lexington Drive / Elizabeth Macarthur Drive (AM peak only); and
– Norwest Boulevard / Solent Circuit / Reston Grange (AM peak only);
– Norwest Boulevard / Century Circuit / Brookhollow Avenue (both peaks); and
– Norwest Boulevard / Columbia Court / Brookhollow Avenue (AM peak only).

However, all the intersections are still expected to perform at LoS D or better, which is considered acceptable in the urban context.

It is estimated the development would generate approximately 700 person-trips during the weekday AM and PM peak hours respectively – i.e. trips across all modes of transport. Given the site is located adjacent to the Norwest Station, most of the walking trips are expected to be using surrounding public transport services and a small proportion would be walking / cycling to / from local origins. The surrounding active transport network is expected to be able to handle this level of demand. The additional public transport trips generated during the peak hours can be accommodated through the high frequency Metro services (up to 4 minutes during the peak hours) and up to 21 bus services per hour in the peak travel demand direction during AM and PM peak hour periods.

Conclusion

This traffic and transport impact assessment concludes that:

– The location of the site directly adjacent to Norwest Station will provide employees with improved access to high frequency public transport services, which will provide an alternative to private vehicle use for site access;
– Restrained parking is proposed for the illustrative development concept to create a transit-oriented centre, reflecting the higher level of public transport services and to minimise additional congestion to the surrounding road network; and
– The proposed cap on parking spaces below the Development Control Plan rates is expected to reduce the traffic impacts of this proposal. The additional vehicle trips will not have any significant adverse traffic implications on the public road network.

1.0 Introduction

1.1 Background / context

SCT Consulting is engaged to carry out a Traffic and Transport Study to support a Planning Proposal for the Norwest Station site located in The Hills LGA. The planning proposal seeks to amend The Hills LEP 2012 for a 9,404 sqm site located at the future Norwest Station at 33 Brookhollow Avenue, Baulkham Hills. The site is bounded by the Sydney Metro Northwest (SMNW) corridor to the north (which runs parallel to Norwest Boulevard) and Brookhollow Avenue to the south and west, as shown in **Figure 1-1**.

The illustrative development concept, prepared by Scott Carver, models a potential built form outcome that is consistent with the proposed planning controls. It is a transit-oriented mixed-use development that could comprise approximately 52,000 sqm of gross floor area (GFA). This may include approximately 3,900 sqm of retail, 39,500 sqm of office space and 8,600 sqm short-term accommodation (hotel / serviced apartments. An underground car park area comprising circa 360 parking spaces is also proposed, based on the yield and land use mix of the Planning Proposal and the recommended maximum parking rates for each type of uses.

Figure 1-1 Location of the subject site

Source: Landcom, 2018

1.2 Planning background

In 2012, the NSW Government announced a plan to deliver Sydney Metro, a rapid transit service to transform and modernise Sydney's rail network to support Sydney's growing population. Once completed, Sydney Metro will deliver 31 Metro stations and more than 65 kilometres of new Metro rail.

Sydney Metro will be delivered in two stages:

– Stage One - Sydney Metro Northwest – from Tallawong to Chatswood, due for completion in 2019.

– Stage Two - Sydney Metro City & Southwest – from Chatswood to Bankstown via city stations is due for completion in 2024.

A third stage, Sydney Metro West, is under development and is currently in the public consultation phase. This stage involves an extension of the Metro from Sydney to Parramatta via the Bays Precinct and Sydney Olympic Park.

SMNW is the first stage of the overall project. It involves eight new stations and commuter car parking as well as upgrades to the existing railway line between Epping and Chatswood to meet Metro rail standards. Sydney Metro acquired large sections of land to support construction and delivery of SMNW. Land which was not required for either station development or the ongoing operation of the Metro are now available to be developed for other uses, including new homes and spaces for businesses and community uses. These sites are referred to within this report as Developable Government Land (DGL).

Landcom and Sydney Metro are planning for inviting, walkable, mixed use places surrounding SMNW stations. This program is known as Sydney Metro Northwest Places and includes projects at Tallawong (Rouse Hill), Kellyville, Bella Vista, Hills Showground, Norwest, Castle Hill and Cherrybrook Stations.

Landcom is the masterplanner for Sydney Metro owned land next to new SMNW stations, and in this role, will support planning for places that maximise the benefits of SMNW.

The site at Norwest Station is one of eight urban transformation projects under the SMNW Urban Transformation Program, with the other seven sites around new Metro stations being Cherrybrook, Castle Hill, Hills Showground, Bella Vista, Kellyville and Tallawong, as well as around the existing Epping Station. The context of the Norwest Station is shown in **Figure 1-2**.

Figure 1-2 Sydney Metro Northwest Places map

Source: Landcom, 2018

The Norwest Station site is currently envisaged as a transit-oriented mixed-use development that links with the station and may include hotel / serviced apartments, retail and commercial office land uses. Car parking provision will recognise the transit-oriented development nature of the development. The purchaser of the Norwest Station site, will then submit one or more development applications for the design and construction of the development in accordance with the concept approval and any imposed terms of sale.

Literature review of other relevant planning documents and their implications on the development of the illustrative development concept as well as the Traffic and Transport Study is included in Section 2 of the report.

1.3 Purpose of report

The purpose of this Traffic and Transport Study is to support the Planning Proposal for the Norwest Station site at Baulkham Hills.

The Traffic and Transport Study report has assessed the impact of the illustrative development concept in terms of the net increase in trips generated, connectivity and access to the surrounding road network, car parking requirements, public and active transport requirements and any potential mitigation measures required as a result of the development.

The Traffic and Transport Study has considered:

– The existing and future context of the site and the surrounding transport network;

– The principles of a transit-oriented development and the implementation of targeted travel demand management measures and green travel initiatives to reduce the need for and reliance on private vehicle travel;

– The potential impacts of net increase in development yield based on the illustrative development concept; and

– Inputs and feedback from relevant stakeholders to the overall approach of the Traffic and Transport Study.

1.4 Report structure

This report has been structured into the following sections:

– **Section 2** considers the transport planning context;

– **Section 3** describes the existing transport conditions for all modes of transport;

– **Section 4** describes the illustrative development concept and its access strategy as well as the likely parking requirements and trip generation as a result of the illustrative development concept;

– **Section 5** describes the likely impacts for all transport modes and parking impacts as a result of the illustrative development concept; and

– **Section 6** summarises the report content and presents the final conclusions.

2.0 Transport planning context

2.1 The NSW Government Future Transport 2056 Strategy

The Future Transport Strategy 2056 (The NSW Government, March 2018) is an update of NSW's Long-Term Transport Master Plan. It is a vision for how transport can support growth and the economy of New South Wales over the next 40 years. The strategy is underpinned by the Regional Services and Infrastructure Plan and the Greater Sydney Services and Infrastructure Plan, as well as a number of supporting plans including Road Safety and Tourism.

The Future Transport Strategy 2056 sets the long-term vision for mobility and transport provision in NSW, explains how the customer experience of transport will change and what this means for NSW. The Future Transport Strategy 2056 identifies that Sydney will grow as a global metropolis with benefits distributed more evenly across the City. It sets out a vision of three cities to guide many of the planning, investment and customer outcomes including faster, convenient and reliable travel times to major centres, as shown in **Figure 2-1**.

Existing and potential transit connections, together with new technology and innovation, will make the network surrounding the Site more responsive to demand and better able to manage congestion in the future.

For the three cities identified, more specific outcomes listed as part of the Strategy which will benefit the Site's transport context, include:

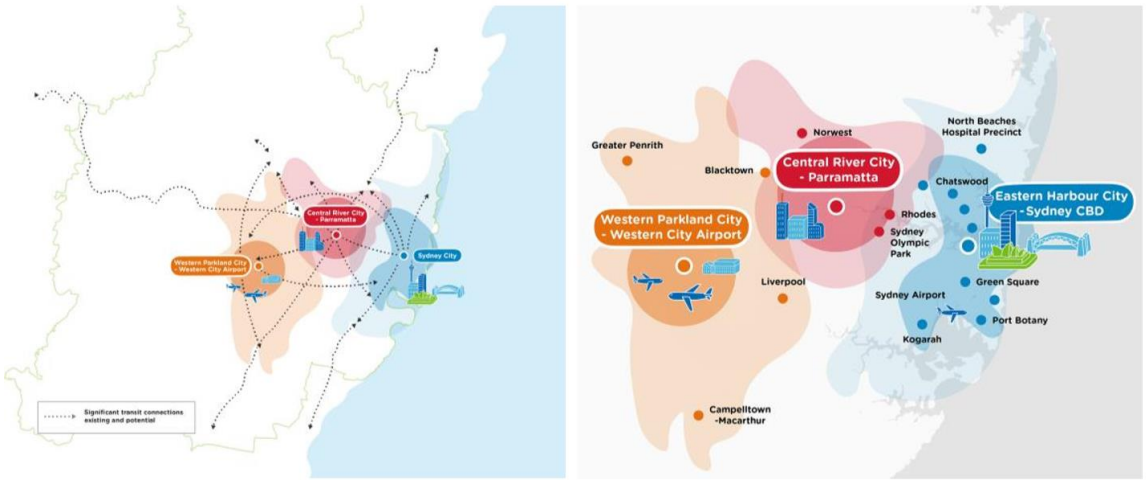
– A 30 minutes access for customers to their nearest Centre by public transport 7-days a week;

– Fast and convenient interchanging with walking times no longer than 5 minutes between services;

– Walking or cycling is the most convenient option for short trips around centres and local areas, supported by a safe road environment and attractive paths; and

– Fully accessible transport for all customers.

Figure 2-1 A future metropolis of three cities



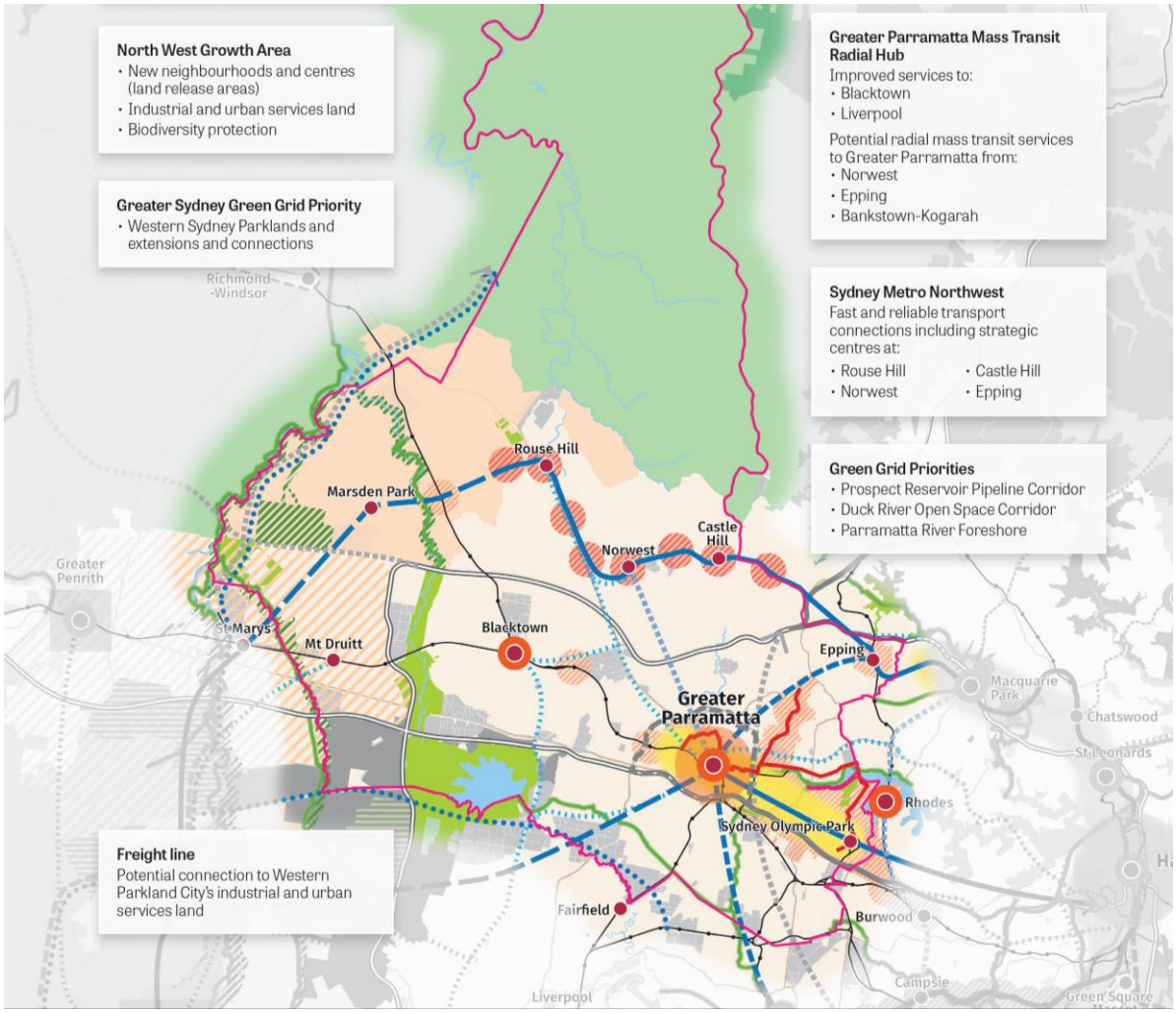
Source: The NSW Government Future Transport 2056 Strategy

Implications for Norwest Station site: Norwest is identified as a key centre in the Central River City. The site is located in proximity to a transport node and centre that supports the aspiration of 30-minute access. The transport plan will need to consider how to deliver seamless interchange and walking and cycling access between the illustrative development concept and Norwest Station.

2.2 Central City District Plan

The vision for the Central City District is to help residents have quicker and easier access to a wider range of jobs, housing types and activities as part of the transformation of their District. The vision will improve the District's lifestyle and environmental assets as shown in **Figure 2-2**.

Figure 2-2 Future of the Central City District



Source: https://www.greater.sydney/central-city-district-plan/future-of-central-city%C2%A0district, 2018

The Central City District covers the Blacktown, Cumberland, Parramatta and The Hills local government areas. The Central City District Plan is a 20-year plan to manage growth in the context of economic, social and environmental matters to achieve the 40-year version of Greater Sydney.

The District Plan informs local strategic planning statements and local environmental plans, the assessment of planning proposals as well as community strategic plans and policies. The District Plan also assists councils to plan for and support growth and change and align their local planning strategies to place-based outcomes. It guides the decisions of State agencies and informs the private sector and the wider community of approaches to manage for growth and change. Community engagement on the District Plan has contributed to a plan for growth that reflects local values and aspirations, in a way that balances regional and local considerations.

Norwest is identified as a strategic centre that has direct access to fast and reliable transport connections to the SMNW network. SMNW and new station at Norwest will provide the opportunity to transform the traditional 1990s-style business park model into a transit-oriented, more vibrant and diversified centre with higher employment densities and a mix of residential uses and supporting services. SMNW will also enable faster and more reliable business-to-business connections to other centres such as Macquarie Park.

Table 2-1 Job target range at Norwest for 2016 and 2036

Centre	Job target ranges by centre		
	2016 estimated jobs	2036 baseline target	2036 higher target
Norwest	32,400	49,000	53,000

Source: Greater Sydney Commission, 2018

The vision for Greater Sydney is one where people can access jobs and services in their nearest metropolitan and strategic centre. The 30-minute city is a long-term aspiration that will guide decision-making on locations for new transport, housing, jobs, tertiary education, hospitals and other amenities. It means that they will be planned for metropolitan and strategic centres and more people will have public transport access to their closest metropolitan or strategic centre within 30 minutes. This will enable more efficient access to workplaces, services and community facilities.

As the population of the Central City District grows, land use, transport and infrastructure planning will be integrated. Initiatives to support integration in line with population and economic growth include:

– City-shaping transport providing faster services for a larger number of commuters to better connect people to centres and services – committed and proposed links to the Harbour CBD and the Western Sydney Airport and Badgerys Creek Aerotropolis;

– Capacity and reliability improvements on existing transport corridors serving Greater Parramatta and surrounding centres;

– Improved city-serving and centre-serving transport links between strategic centres, and as feeders into city-shaping corridors including bus priority infrastructure to support new services;

– Improvements to the strategic road network which may include both new roads and road space reallocation to prioritise the efficient movement of people and goods on transport corridors and key intersections to improve movement through the District and access to strategic centres;

– Strategic freight network improvements including the Northern Sydney Freight Line and the Southern Sydney Freight Line;

– Travel behaviour change programs to help manage demand on the transport network;

– On-demand bus services on selected local bus routes, currently being trialled in Greystanes, to provide more convenience and choice for customers, and improving the efficiency of the transport network and providing more choice for first and last mile access to the train network; and

– Investment in Smart Roads, which will support the financial sustainability of the transport system by better using existing road infrastructure and enable future forms of mobility such as connected and automated vehicles.

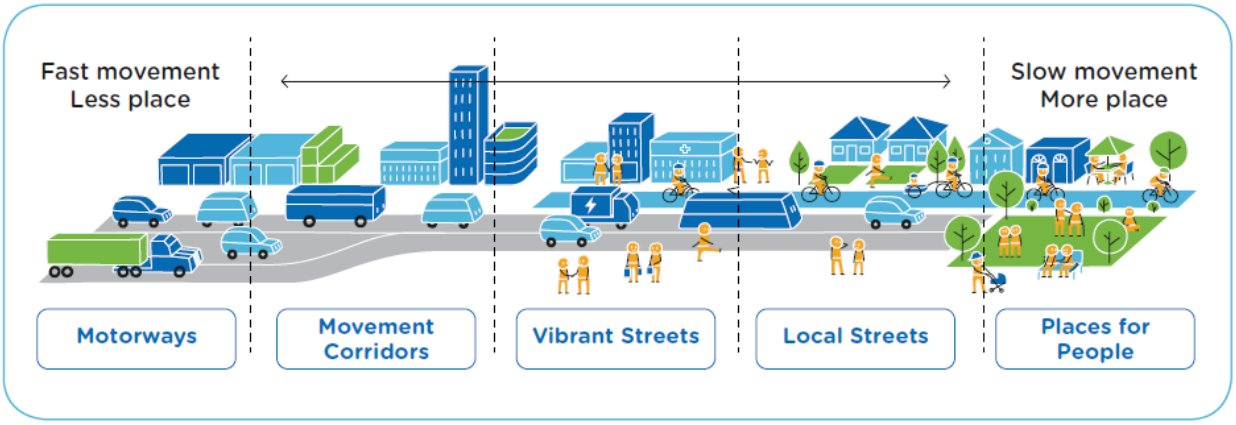
Implications for Norwest Station site: Given a strategic centre with excellent access to SMNW, Norwest can play an important role as a transit-oriented development. Transit-oriented developments must aim to adopt car parking rates that provide a balance between meeting car parking demand whilst encouraging sustainable and active transport use. New developments are encouraged to minimise car parking provision and demonstrate the inclusion of supportive mix of land uses and transport alternatives or strategies to reduce trip generation and discourage private motor vehicle use. The illustrative development concept will support future employees who choose to work in a transit-oriented centre with low parking provision and excellent access to public and active transport.

2.3 Greater Sydney Services Infrastructure Plan

The Greater Sydney Services and Infrastructure Plan is a 40-year plan for transport in Sydney. It is designed to support the land use vision for Sydney. Building on the state-wide transport outcomes identified in the Future Transport Strategy 2056, the Plan establishes the specific outcomes transport customers in Greater Sydney can expect and identifies the policy, service and infrastructure initiatives to achieve these.

To support the liveability, productivity and sustainability of places for the transport network, a Movement and Place Framework was developed. The Framework acknowledges that transport networks have different functions and roles and serve as both a destination and as a means to move people and goods. The Movement and Place Framework will enable us to plan, design and operate the transport network to meet these different needs by providing greater transparency, supporting collaboration between those responsible for land use, transport and roads while also encouraging input from the community. Through the framework we will be able to design a future network that is better used and supports the safe, efficient and reliable movement of goods and the need for liveability of places along it.

Figure 2-3 Different movement environments under the Movement and Place Framework



Source: https://future.transport.nsw.gov.au/sites/default/files/media/documents/2018/Future_Transport_2056_Strategy.pdf, 2018

Implication for Norwest Station site: Brookhollow Avenue would be classified as a local street as it is a part of the fabric of the suburban neighbourhood where customers live their lives. The road will also facilitate local community access to the station.

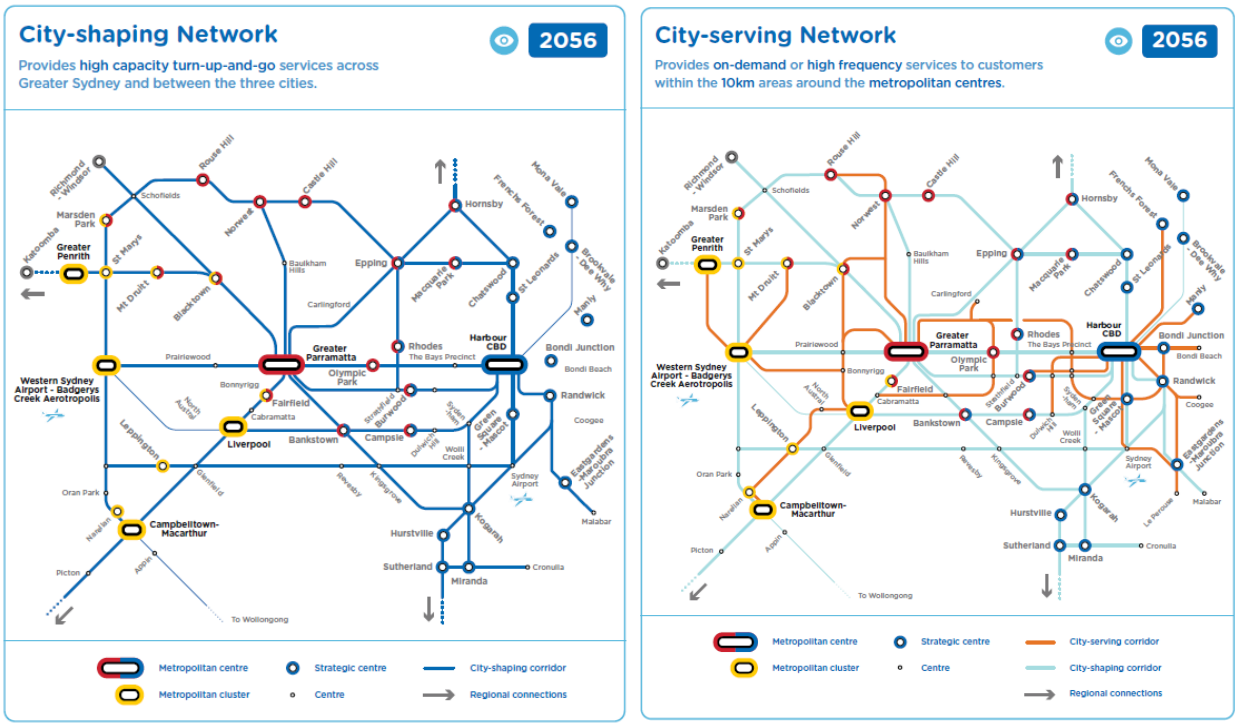
2.3.1 Future Transport Network

2.3.1.1 City-shaping network

The city-shaping network includes higher speed and volume linkages between our cities and centres (**Figure 2-4**). The function of this network is to enable people living in any of the three cities to access their nearest metropolitan centre within 30 minutes and to be able to travel efficiently between these metropolitan centres.

As Greater Sydney transitions to a metropolis of three cities, the city-shaping network will need to expand to provide improved access to and between each metropolitan city/centre, particularly Greater Parramatta and centres in the Metropolitan cluster in the Western Parkland City.

Figure 2-4 City-shaping and City Serving networks - 2056



Source: https://future.transport.nsw.gov.au/wp-content/uploads/2018/plans/Greater_Sydney_Services_Infrastructure_Plan.pdf (April, 2018)

2.3.1.2 City-serving network

The city-serving network will provide high-frequency services within a ~10km radii of the three metropolitan cities/centres (**Figure 2-4**). This will support access within some of the densest land use in Greater Sydney where demand for travel is most concentrated. As these urban areas in each of the three cities develop and become denser, the Government will investigate the prioritisation of on-street public transport services and invest in higher frequency services, providing more travel options for employees and visitors to Norwest Business Park and the site.

Implication for Norwest Station site: Norwest is part of both city-shaping and city-serving networks that would connect Norwest to Campbelltown via Western Sydney airport, Parramatta as well as the Harbour CBD. This would bring Norwest into reach of all three cities by high frequency and high capacity public transport links.

2.3.1.3 Bicycle Network

Building on the existing network, the immediate focus for State Government is working with local councils to deliver committed Priority Cycleway projects to address key missing links around the Harbour CBD, Greater Parramatta, Greater Penrith, Blacktown and Liverpool, such as the Nepean River Green Bridge and Inner West Greenway. Council partnership programs are delivering local bicycle infrastructure. Bicycle parking is also being rolled out at interchanges.

By 2056:

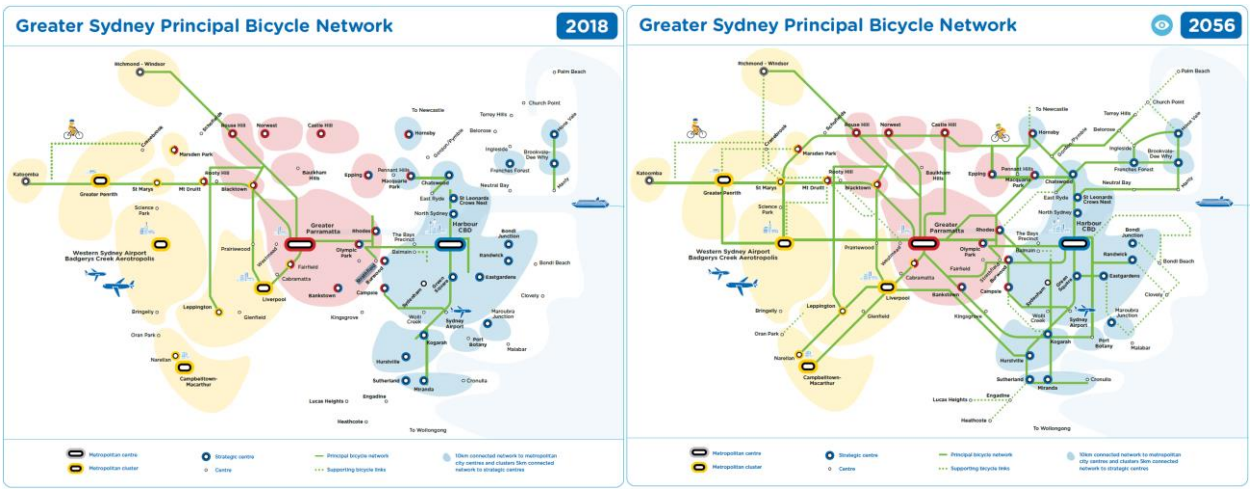
– Walking and cycling network coverage will be improved by using state held corridors for public transport, pipelines, waterways, crown land and service easements for bicycle network infrastructure;

– That all strategic centres have connected walking and cycling networks, including strategic centres across the Western Parkland City; and

– Further investment in connections to strategic centres and in the Principal Bicycle Network will support walking or cycling being the most convenient option for short trips, improving health outcomes, safety and convenience for customers as well as boosting the productivity, liveability and sustainability of Greater Sydney.

Figure 2-5 shows the current/committed Greater Sydney Bicycle Network alongside the envisioned 2056 Bicycle Network.

Figure 2-5 Current / committed and 2056 Greater Sydney Principal Bicycle Network



Source: https://future.transport.nsw.gov.au/wp-content/uploads/2018/plans/Greater_Sydney_Services_Infrastructure_Plan.pdf (April, 2018)

Implication for Norwest Station site: Transport for NSW, Roads and Maritime and Council will work together to investigate the delivery of Principle Bicycle Network that connects Norwest with surrounding centres including Rouse Hill, Castle Hill and also Greater Parramatta.

2.4 North West Rail Link Corridor Strategy

The North West Rail Link (NWRL – now SMNW) Corridor Strategy was prepared in 2013 to identify future visions for precincts surrounding NWRL stations and establish frameworks for managing future land use change. This will allow infrastructure agencies to identify, prioritise and co-ordinate the delivery of infrastructure upgrades in accordance with each precinct's long-term growth potential, providing increased transparency about the area's growth infrastructure pipeline.

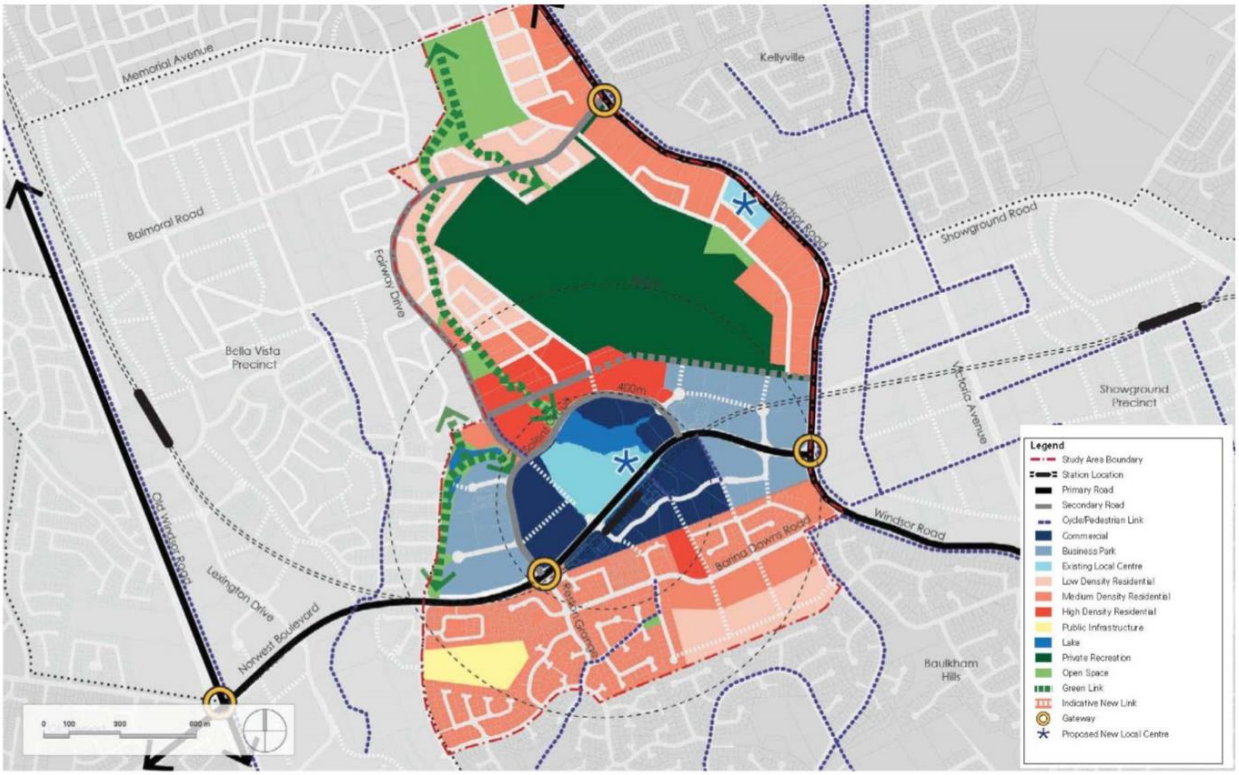
The North West Rail Link (NWRL) Corridor Strategy highlights the role of transit-oriented development in maximising the benefits of the rail investment in delivering dwelling and employment growth for the area. It identifies objectives to grow patronage, increase access to public transport, help communities access jobs and services closer to home, build liveable centres and improve housing affordability.

The SMNW has the potential to improve travel time reliability compared with bus and private car and will provide travel time savings, both for trips within north west Sydney, and from many areas of the region to Sydney's Global Economic Corridor.

The document states that SMNW will also support positive changes in travel behaviour arising from mode shift to rail. The project will facilitate reduced private vehicle movements, in turn addressing capacity constraints on the road network and reducing traffic congestion, including reduced bus congestion in the CBD in the longer term. The SMNW will also provide increased opportunities for sustainable transport alternatives, through the provision of cycling and walking networks to the SMNW stations.

The introduction of SMNW and a station at Norwest has the potential to further reinforce Norwest as a Specialised Precinct (as shown in **Figure 2-6**) and the largest employment centre for Sydney's North West. A new station, located within the existing Norwest Business Park, will provide further impetus for Norwest to evolve as a vibrant and active Centre of business for the region, comprising offices, retail, community facilities, recreation, cultural, education and housing to serve the 650,000 people of the North West by 2036.

Figure 2-6 Norwest Station Structure Plan



Source: North West Rail Link Corridor Strategy (NSW Department of Planning and Transport for NSW, 2013)

2.5 The Hills Corridor Strategy

The Hills Corridor Strategy identifies SMNW as a significant transport project that enhances the liveability of the Hills Shire. It is transformational in that it provides a fast and efficient connection to the global arc but importantly within The Hills Shire itself. It is important that the land used around the station support each station's role, achieve housing and jobs targets and create vibrant and safe places.

A key consideration is the capacity of roads and intersections to take more growth whilst accounting for mode shift. As a result of SMNW, there would be a potential for shift from private vehicles to public transport modes. This is based upon a review of other key transit centres within the Sydney Metropolitan Region such as Chatswood, Hurstville and Meadowbank-West Ryde and indicates there is likely to be an increase in the proportion of employed residents catching public transportation to work in the areas closest to the station.

The strategy notes that such a mode shift will take time and a careful response will be needed to ensure the additional yield does not compromise residents' ability to get where they need to go in a reasonable time.

2.6 Guide to Traffic Generating Developments

The Roads and Maritime Guide to Traffic Generating Developments (2002) (RTA Guide) sets out traffic generation rates based on survey data collected in New South Wales for a range of land uses. This guide is referred to in the AustRoads Guide which is used by Roads and Maritime Services and is generally regarded as the standard for metropolitan development characteristics.

The Roads and Maritime Guide to Traffic Generating Developments, in particular Section 2 has been used as a guide to the contents of the Traffic and Transport Impact Assessment, including vehicle trip generating rates for both daily and peak hour vehicle trips.

Technical Direction: TDT 2013/04a provides a summary of the updated information. Of particular relevance to this Traffic and Transport Impact Assessment are the reference trip rates for commercial developments where traffic surveys were undertaken for developments that are close to public transport, which were used to define traffic generation of the illustrative development concept.

2.7 NSW Planning Guidelines for Walking and Cycling

Walking and cycling are environmentally-friendly, low-cost ways of getting around. They play an important role in our integrated transport system and provide a range of personal and community benefits too.

Cycling and walking for short local trips instead of driving reduces congestion on our roads and frees up capacity on public transport for customers travelling further.

Through effectively planning for an active future in NSW, the NSW Government will deliver the infrastructure, education programs and facilities to encourage people to walk and cycle. The NSW Government is working with councils, communities and the development industry to make walking and cycling more convenient, safer and enjoyable for people across NSW.

Currently there is a wide diversity of practice in the way that NSW local councils address walking and cycling issues in the planning of land use and control of development. To improve practice in planning for walking and cycling, the NSW Government departments have jointly developed and published a document, Planning Guidelines for Walking and Cycling.

The guidelines will help land use planners and related professionals to improve the consideration of pedestrians' and cyclists' requirements in their work. The guidelines have been designed to provide a walking and cycling focus for the NSW Government's *Integrating Land Use and Transport Planning Policy P*ackage, and to provide a planning complement to the RMS's *NSW Bicycle Guidelines* as well as to the RMS's *How to Prepare a Pedestrian Access and Mobility Plan*.

It is anticipated that improving practice in planning for walking and cycling provide will create more opportunities for people to live in places with easy walking and cycling access to urban services and public transport. This will help reduce car use and create healthier neighbourhoods and cities.

The principles specified in this guide have been used as one of the resources to define and refine the walking and cycling network in the Precinct such that the opportunities for future residents and employees to walk and ride are maximised.

3.0 Existing conditions

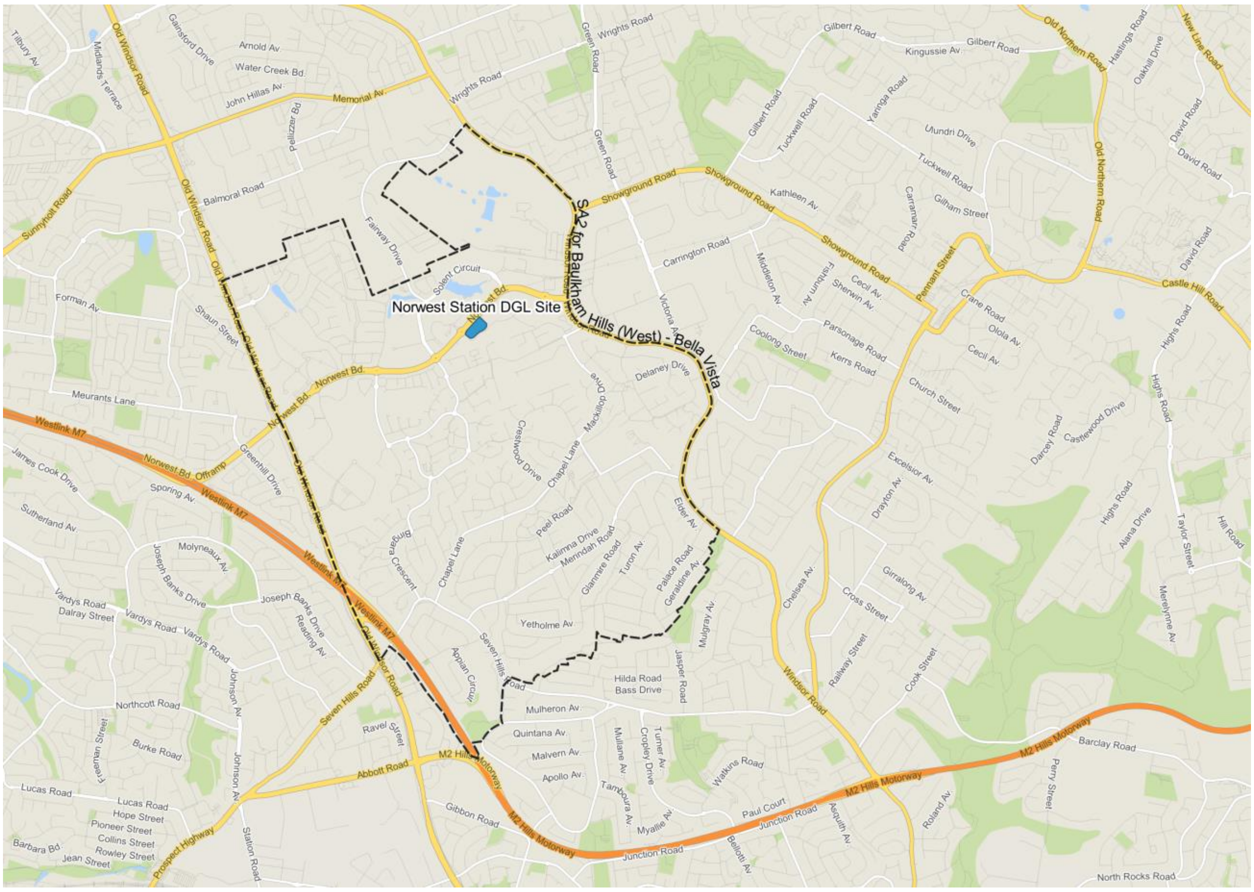
3.1 Travel behaviour

3.1.1 Method of travel to work

2016 Method of travel to work data from Australian Bureau of Statistics was analysed to determine current travel behaviour of the existing employees of the site and surrounding areas. Census data is only available to the Statistical Area 2 level for 2016.

The site is located within the SA2 titled "Baulkham Hills (West) – Bella Vista", which is shown in **Figure 3-1**.

Figure 3-1 Statistical Area 2 geography analysed for the travel behaviour



Source: © OpenStreetMap Contributors, styles by Anita Grazer, ABS, 2018

The SA2 contains a wide range of employment activities, including B7 Business Park, B2 Local Centre, B3 Commercial Core, and Low-High Density residential. The arrival travel mode split is shown in **Table 3-1**.

Table 3-1 Arrival modes for 2016

Mode	Baulkham Hills (West) – Bella Vista	All of Sydney
Train	2.1%	17.5%
Bus	3.3%	6.4%
Ferry	0.0%	0.1%
Taxi	0.1%	0.3%
Car, as driver	79.4%	51.7%
Car, as passenger	3.3%	3.8%
Truck	0.3%	0.7%
Motorbike/scooter	0.4%	0.7%
Bicycle	0.2%	0.8%
Walked only	0.8%	4.2%
Other Mode	0.3%	0.5%
Worked at home	2.8%	4.4%
Did not go to work	6.2%	7.6%
Not stated	0.8%	0.9%

Source: ABS, 2019

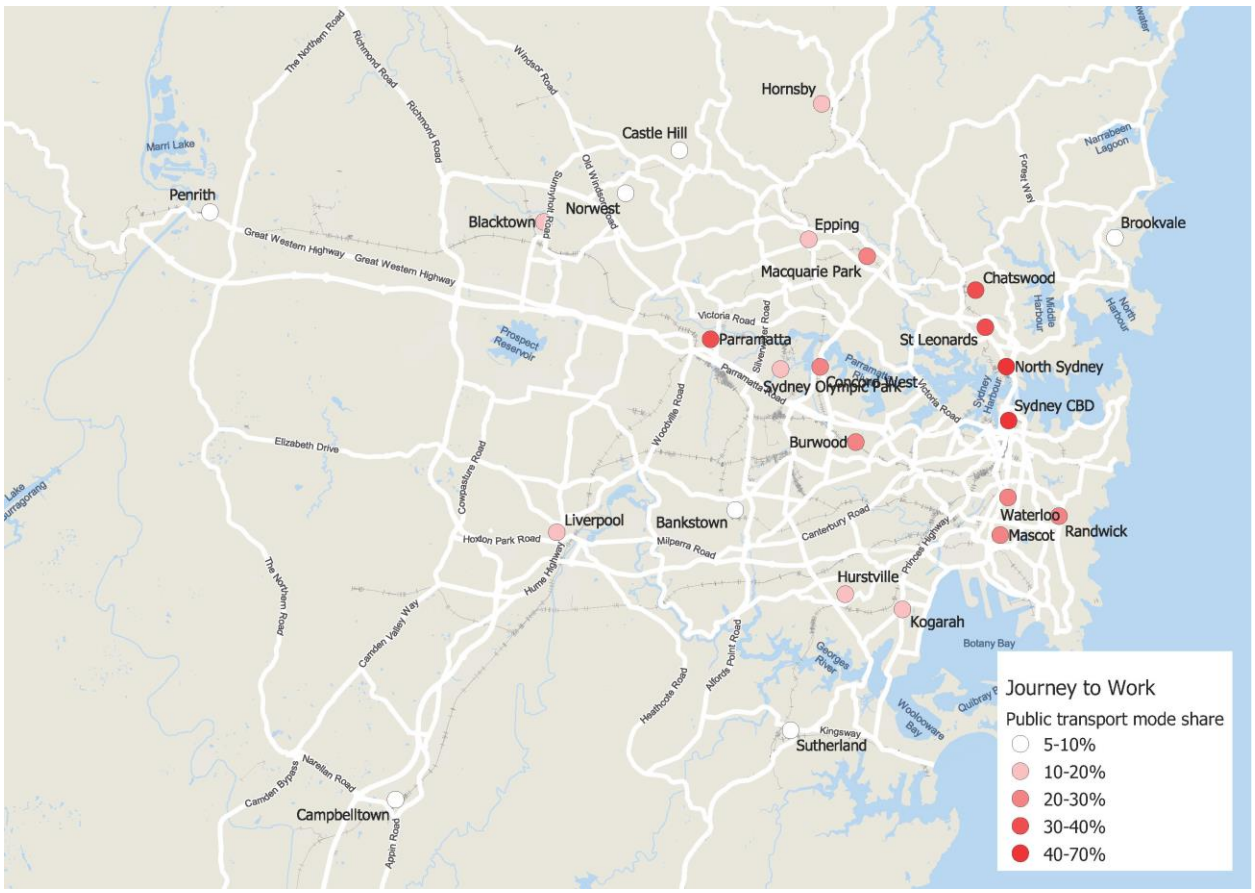
Census data for the Baulkham Hills (West) – Bella Vista SA2 from 2016 indicates a total of 5% use public transport, up from 4% in 2011. Car driver represents 82% of travel for the SA2, the significant majority of all trips. This demonstrates that employees in the areas (at the time of the survey), are heavily reliant on private vehicles to get to work supported by ample parking provision.

The journey to work data for Norwest shows significantly higher private vehicle dependence compared to Sydney Greater Metropolitan Area (GMA). This is attributed to fewer public transport options available compared with those across the Sydney GMA. A benchmarking analysis of 2011 and 2016 public transport mode share of other centres across Sydney were undertaken. The 2011 and 2016 mode share data for all centres considered are included in **Table 3-2** and summarised in **Figure 3-2**.

Table 3-2 2011 and 2016 Journey to Work mode share analysis

Location	Public transport modes available	Job Density	Main type of jobs			2016		2011		Mode share change
			Office	Service	Retail	Total trips	PT Mode Share	Total trips	PT Mode Share	
Sydney CBD	train, bus, ferry	747	✓		✓	320,827	70%	270,210	68%	3%
North Sydney	train, bus	256	✓			48,969	58%	46,120	53%	5%
Parramatta	train, bus	59	✓		✓	50,226	37%	46,828	31%	6%
Chatswood	train, bus	55	✓		✓	27,648	37%	23,937	31%	6%
St Leonards	train, bus	107	✓	✓	✓	29,416	33%	27,757	30%	4%
Burwood	train, bus	30	✓	✓	✓	13,300	30%	12,759	26%	4%
Macquarie Park – North Ryde	train, bus	45	✓	✓	✓	48,402	24%	41,493	19%	5%
Rhodes	train, bus	39	✓	✓	✓	19,824	23%	16,592	19%	4%
Green Square	train, bus	73	✓	✓		52,502	23%	50,442	18%	5%
Mascot - Alexandria	train, bus	62		✓	✓	60,487	23%	58,697	17%	6%
Randwick	bus	63		✓	✓	21,358	23%	15,351	16%	7%
Kogarah	train, bus	50	✓	✓	✓	11,125	19%	10,085	14%	5%
Epping	train, bus	5		✓	✓	4,846	16%	5,899	14%	2%
Hurstville	train, bus	37	✓	✓	✓	13,290	16%	12,988	14%	2%
Hornsby	train, bus	21	✓	✓	✓	13,045	14%	15,566	13%	1%
Sydney Olympic Park	train, bus	24	✓	✓		26,524	14%	24,932	12%	3%
Liverpool	train, bus	31	✓	✓	✓	19,536	11%	20,700	10%	2%
Blacktown	train, bus	25	✓		✓	20,202	11%	19,773	9%	2%
Dee Why-Brookvale	bus	30	✓	✓	✓	21,831	10%	21,020	10%	0%
Bankstown	train, bus	63	✓	✓	✓	17,151	9%	17,552	8%	2%
Castle Hill	bus	11		✓	✓	7,641	8%	16,750	5%	2%
Penrith	train, bus	19	✓	✓	✓	20,160	7%	18,672	7%	0%
Sutherland	train, bus	14	✓	✓	✓	10,536	7%	9,910	7%	0%
Campbelltown	train, bus	13	✓	✓	✓	18,317	6%	16,627	6%	0%
Norwest	**bus**	**22**	**✓**	**✓**	**✓**	**23,586**	**5%**	**19,150**	**4%**	**2%**

Figure 3-2 2016 Journey to Work mode share analysis across centres in Sydney



Source: ABS, 2019

The data indicate that:

– There has been a general increase in public transport to centres ranging from 0% to 6%, with a weighted average increase of 3.3% from 2011 to 2016;

– Sydney CBD is a clear outlier, attracting about three times the number of trips of the nearest comparable centre, having a public transport mode share of more than double the closest alternative;

– The high public transport mode shares in Sydney CBD and North Sydney also a result of high density mixed use development, good access to public transport services and low parking supply;

– Norwest has a public transport mode share of 5%, which is up two percentage points from 2011;

– The closest geographic centres that have similar levels of access to that of the future Norwest Precinct are Blacktown, Hornsby, Epping and Macquarie Park. These have public transport mode shares of 11%, 14%, 16%, and 24%, respectively; and

– The data does not capture the public transport travel speeds. Centres that have a train station, though, appear to have higher public transport mode share than equivalent centres (by density and distance).

The low public transport mode share at Norwest is expected to change significantly with the introduction of SMNW and Norwest Station – as larger catchment of residential areas along the Sydney Metro / Rail network would now have direct and frequent access to Norwest (as an employment area) via improved public transport.

Based on the Journey to Work mode share analysis, it is therefore reasonable to expect that the future public transport mode share of Norwest could vary between 11% and 24% with the introduction of Sydney Metro Northwest, subject to other complementary planning policies. However, with the wide geographic area of the SA2, large areas of business park are captured for Macquarie Park, Hornsby and Blacktown, that have much lower public transport preferences. It is therefore expected on benchmarking that the mode share would exceed 24% due to the more similar land uses in Macquarie Park to the proposed station site at Norwest.

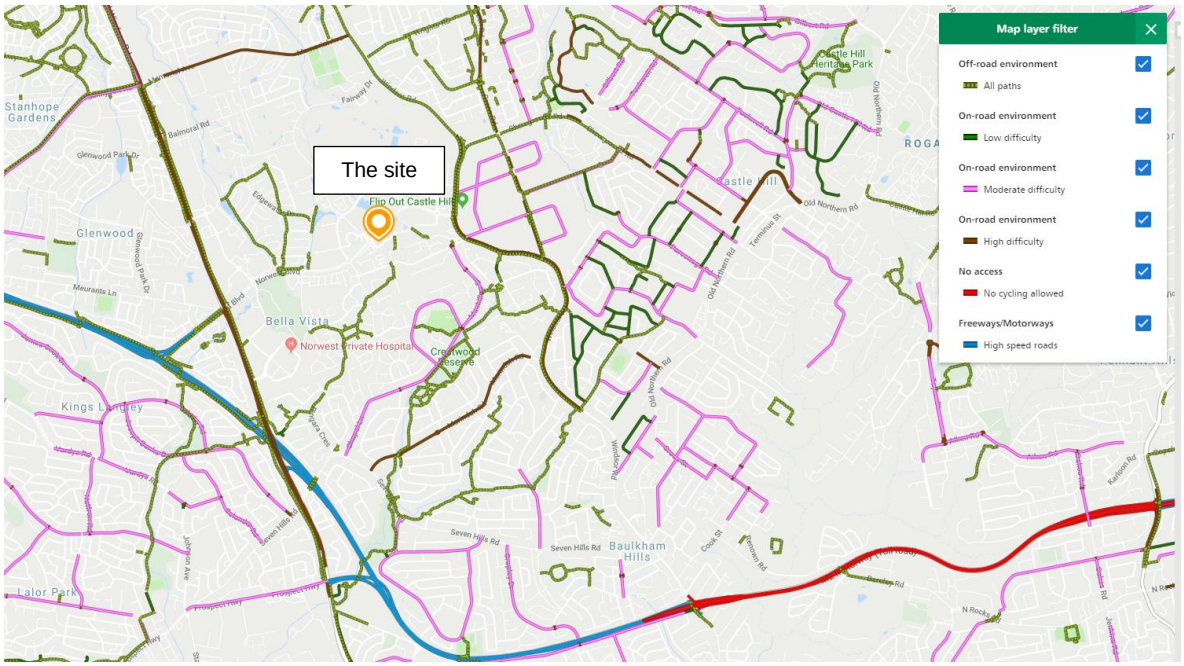
3.2 Walking and cycling

Cycle paths in proximity to the site are currently limited to two off road north-south connections between Brookhollow Avenue and Fairmont Avenue which is east of the site and between Brookhollow Avenue and Evesham Court south of the site.

At the end of Evesham Court, a shared path connection is provided that connects with the Westlink M7 shared path via the Village Green Park and Francesco Crescent Reserve. To the east of the site, a shared path is provided along Windsor Road, providing north-south connectivity between the suburbs of Baulkham Hills and Kellyville, south and north of the site. An on-road cycle path is also provided along Mackillop Drive, connecting to Seven Hills Road in the south via Chapel Lane. Footpaths are provided along both sides of Norwest Boulevard and Brookhollow Avenue in proximity of the site.

The existing cycle network in proximity to the site is presented in **Figure 3-3**.

Figure 3-3 Existing cycle paths in proximity to the site



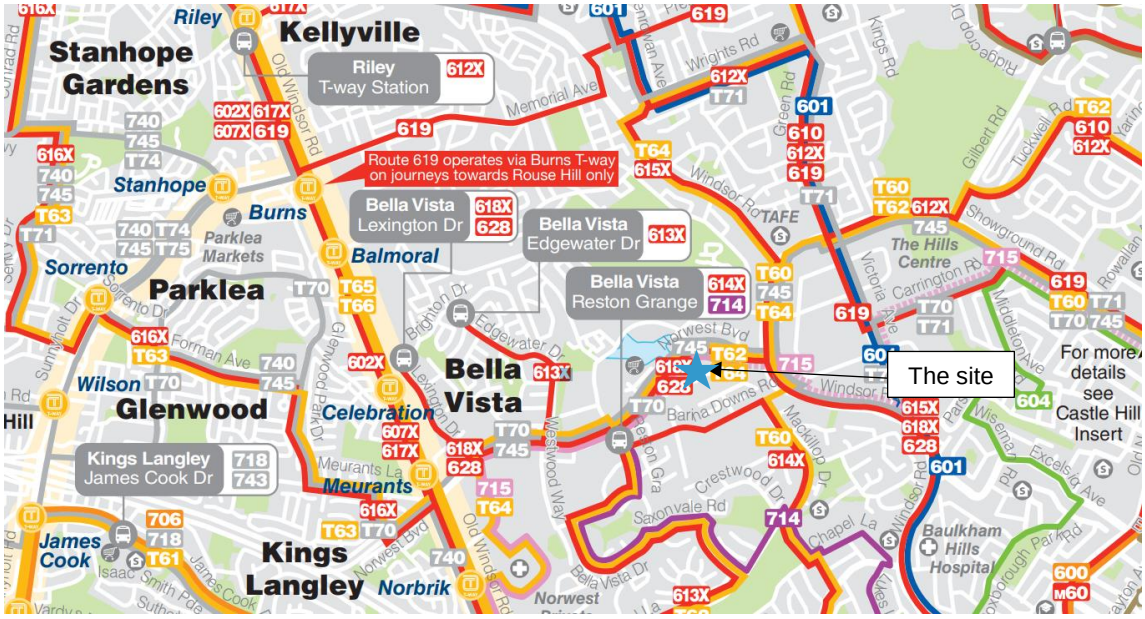
Source: Roads and Maritime Services Cycleway Finder, 2018

3.3 Public transport

Currently, bus stops in proximity to the site are located on both sides of Norwest Boulevard, approximately 150m north east of the site. There are currently a number of bus services that operate in proximity to the site, along Norwest Boulevard, Reston Grange, Windsor Road and Barina Downs Road. Routes 618X, 628, 715, T62 and T64 (which all run along Norwest Boulevard just north of the site), as shown on **Figure 3-4**.

The routes that run along Norwest Boulevard provide access to destinations including the City, Chatswood, Seven Hills, Blacktown and Parramatta from the Norwest Business Park, Norwest or Castle Hill. The Reston Grange routes run between the City and Bella Vista or Crestwood and between Seven Hills and Bella Vista. The bus services located in proximity to the site provide good accessibility between the site and the key destinations listed above.

Figure 3-4 Bus routes in proximity to the site



Source: https://www.cdcbus.com.au/hillsbus-timetables-maps, May 2018

The frequency of public transport services available in proximity to the site are shown in **Table 3-3**. All bus routes operate with between 1 and 4 services per hour, during both AM and PM weekday peak hours, with the most frequent routes being T62, T64, and T70.

During the weekends, there are four routes (745, T62, T64 and T70) that operate along this corridor, with route T70 being the most frequent route, providing up to 2 services per hour during the weekends. The total number of services that operate in proximity to the site is up to 42 services per hour during the weekday and 9 services per hour during the weekend.

Table 3-3 Existing bus routes and service frequencies

Route	Corridor	From	To	Average number of services / peak hour (both directions)			
				Weekday		Weekend	
				AM	PM	Sat	Sun
613x	Reston Grange	Bella Vista	City QVB	3	-	-	-
		City QVB	Bella Vista	-	3	-	-
614x	Reston Grange	Crestwood	City QVB	4	-	-	-
		City QVB	Crestwood	-	4	-	-
618x	Norwest Boulevard	Norwest Business Park	City QVB	-	3	-	-
		City QVB	Norwest Business Park	3	-	-	-
628	Norwest Boulevard	Norwest	Chatswood	-	4	-	-
		Chatswood	Norwest	4	-	-	-
714	Reston Grange	Seven Hills	Bella Vista	2	-	-	-
		Bella Vista	Seven Hills	-	2	-	-
715	Norwest Boulevard	Seven Hills	Norwest Business Park	2	-	-	-
		Norwest Business Park	Seven Hills	-	2	-	-
745	Showground Road	St Marys	Castle Hills	2	1	1	-
		Castle Hill	St Marys	1	1	1	-
T62		Castle Hill	Parramatta	3	2	1	1

Route	Corridor	From	To	Average number of services / peak hour (both directions)			
				Weekday		Weekend	
				AM	PM	Sat	Sun
	Norwest Boulevard	Parramatta	Castle Hill	4	3	1	1
T64	Norwest Boulevard	Rouse Hill Town Centre	Parramatta	3	3	1	1
		Parramatta	Rouse Hill Town Centre	4	3	1	1
T70	Norwest Boulevard	Blacktown	Castle Hill	4	3	1	1
		Castle Hill	Blacktown	3	3	2	1
			Total	**42**	**37**	**9**	**7**

Source: https://transportnsw.info/routes#/, May 2018

^ White cells are eastbound bus routes and grey cells are westbound bus routes

There is currently no operational train station in proximity to the site. The nearest train station is the Seven Hills Train Station (on the T5 Cumberland Line between Leppington and Richmond and the T1 Western Line between Emu Plains or Richmond and the City), which is located approximately 5.4km to the south west of the site. However, it should be noted that SMNW project will be open in 2019 and the site is located adjacent to Norwest Station.

3.4 Road network

The site is bounded by Norwest Boulevard to the north and Brookhollow Avenue to the west and south. Norwest Boulevard provides regional connections to Windsor Road in the east and Old Windsor Road and the Westlink M7 in the west. The characteristics of the key road network surrounding the subject site are shown in **Figure 3-5**.

Figure 3-5 Road network in proximity to the site

Source: SCT Consulting, October 2018

The road network that services the site includes:

– Old Windsor Road – a four to six lane, two-way divided arterial road that travels in the north-south direction west of the site, linking the Westlink M7 to the south to Windsor Road to the north. No on-street parking is provided on Old Windsor Road;

– Windsor Road – a four to six lane, two-way divided arterial road that runs east of the site, connecting to the M2 Motorway and James Ruse Drive in the south. No parking is provided on Windsor Road in proximity to the site;

– Norwest Boulevard - a two-way, four lane divided arterial road that runs in an east-west direction north of the site between Old Windsor Road and the Westlink M7 in the west and Windsor Road in the east. It is the main east – west route in proximity of the site, providing direct access (via Brookhollow Avenue) to the surrounding regional road network from the site;

– Brookhollow Avenue – a two-way, two lane undivided local road that runs south of the site in an east-west direction and connects to Norwest Boulevard at two access points, east and west of the site respectively. Unrestricted parallel parking is currently provided at both the northern and southern side, at various locations along the road, however this will change when Norwest Station opens in 2019. Brookhollow Avenue will act as the main access route to and from the site;

– Barina Downs Road – a two-way, two lane undivided local and collector road that runs in an east-west direction south of the site and parallel to Brookhollow Avenue, between Reston Grange in the west and Windsor Road in the east. Informal parallel parking is provided along the northern side of the road at various locations; and

– Reston Grange / Bella Vista Drive - a two-way, two lane undivided collector road that runs in a north-south direction between Norwest Boulevard in the north and Westwood Way in the west. Bella Vista Drive also connects to Providence Drive in the south which, via Bingara Crescent, connects to Seven Hills Road south of the site. Reston Grange together with Windsor Road and Mackillop Drive, provides the most direct access from the site to the south.

3.4.1 Existing traffic conditions

Traffic data was collected in November 2018 for the following intersections along Norwest Boulevard to understand the existing traffic conditions surrounding the future Norwest Station and the Norwest Station site.

– Norwest Boulevard / Old Windsor Road;

– Norwest Boulevard / Lexington Drive / Elizabeth Macarthur Drive;

– Norwest Boulevard / Edgewater Drive / Westwood Way;

– Norwest Boulevard / Solent Circuit / Reston Grange;

– Norwest Boulevard / Century Circuit / Brookhollow Avenue;

– Norwest Boulevard / Columbia Court / Brookhollow Avenue; and

– Norwest Boulevard / Windsor Road.

The peak hours that were identified from the traffic counts are 8-9AM and 5-6PM. The peak hour traffic volumes of the seven intersections along Norwest Boulevard are summarised in **Appendix A**. The intersection performance based on assessment undertaken in SIDRA 8.0 using existing peak hour traffic volumes are summarised in **Table 3-4**.

Table 3-4 2018 AM and PM Peak intersection performance

	2018 AM Peak			2018 PM Peak		
Intersection	Delays (seconds)	LOS	95th Percentile Queue – Longest approach	Delays (seconds)	LOS	95th Percentile Queue – Longest approach
Norwest Boulevard / Old Windsor Road	45.5	D	340m (west approach)	33.6	C	234m (east approach)
Norwest Boulevard / Lexington Drive / Elizabeth Macarthur Drive	27.4	B	240m (west approach)	16.6	B	114m (east approach)
Norwest Boulevard / Edgewater Drive / Westwood Way	10.0	A	78m (west approach)	6.9	A	48m (west approach)
Norwest Boulevard / Solent Circuit / Reston Grange	10.4	A	55m (west approach)	9.0	A	52m (east approach)
Norwest Boulevard / Century Circuit / Brookhollow Avenue	5.8	A	26m (west approach)	5.8	A	26m (west approach)

Intersection	2018 AM Peak			2018 PM Peak		
	Delays (seconds)	LOS	95th Percentile Queue – Longest approach	Delays (seconds)	LOS	95th Percentile Queue – Longest approach
Norwest Boulevard / Columbia Court / Brookhollow Avenue	13.0	A	238 (west approach)	10.0	A	69m (west approach)
Norwest Boulevard / Windsor Road	32.5	C	199m (west approach)	51.3	D	394m (south approach)

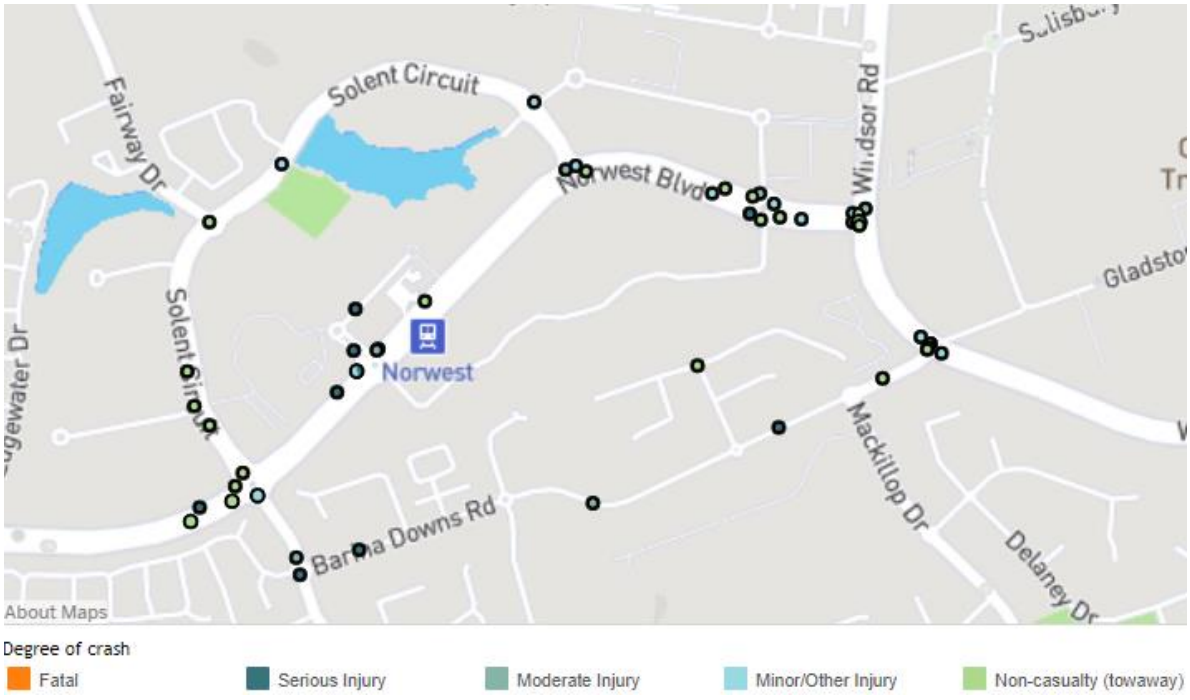
Source: SCT Consulting, 2018

Site observations suggested that traffic congestion and queueing are evident during peak hours along Norwest Boulevard. Queuing on the approach of Brookhollow Avenue is minimal. The intersection modelling confirms that the worst performing intersections along the Norwest Boulevard are Windsor Road and Old Windsor Road – operating at LoS D during one of the peak hours.

3.4.2 Crash analysis

A crash analysis was undertaken based on crash data from Centre of Road Safety and provided in **Figure 3-6**.

Figure 3-6 Crash map around Norwest Station



Source: Centre of Road Safety, 2018

As shown in the crash map, 55 crashes were recorded in the last five years (2013 - 2017). Norwest Boulevard has had 36 crashes during the five-year period. Out of those crashes, seven involved serious injuries.

– Two serious pedestrian injuries were recorded, both crossing from far side of the cars;

– Two serious injuries that were right off carriageway into object were recorded, both occurred at the roundabout at Brookhollow Avenue / Century Circuit;

– Two serious injuries were recorded involving vehicles from same direction (rear end); and

– One serious injury crash occurred in 2017 due to temporary road works.

It should be noted that that most crashes along Norwest Boulevard are concentrated around intersections which are currently operating as a roundabout without signalised controlled pedestrian crossings across a 4-lane road.

4.0 The proposal

4.1 Norwest Station

Norwest Station is located within the existing business park area with expected high density commercial activity and adjacent to local shops and low density residential. The area also contains Norwest Marketown Shopping Centre and Hillsong Church. Sydney's north west is going through significant changes that leverages off the improvement in transport accessibility and connectivity to the rest of Sydney, as a result of the SMNW (as shown in **Figure 4-1**).

Sydney Metro is delivering part of the infrastructure and public domain around Norwest Station that includes:

– Station access and entry via the corner of Norwest Boulevard and Brookhollow Avenue;

– Construction of retail space at station entry;

– New traffic lights and road widening at the intersection of Norwest Boulevard and Brookhollow Avenue;

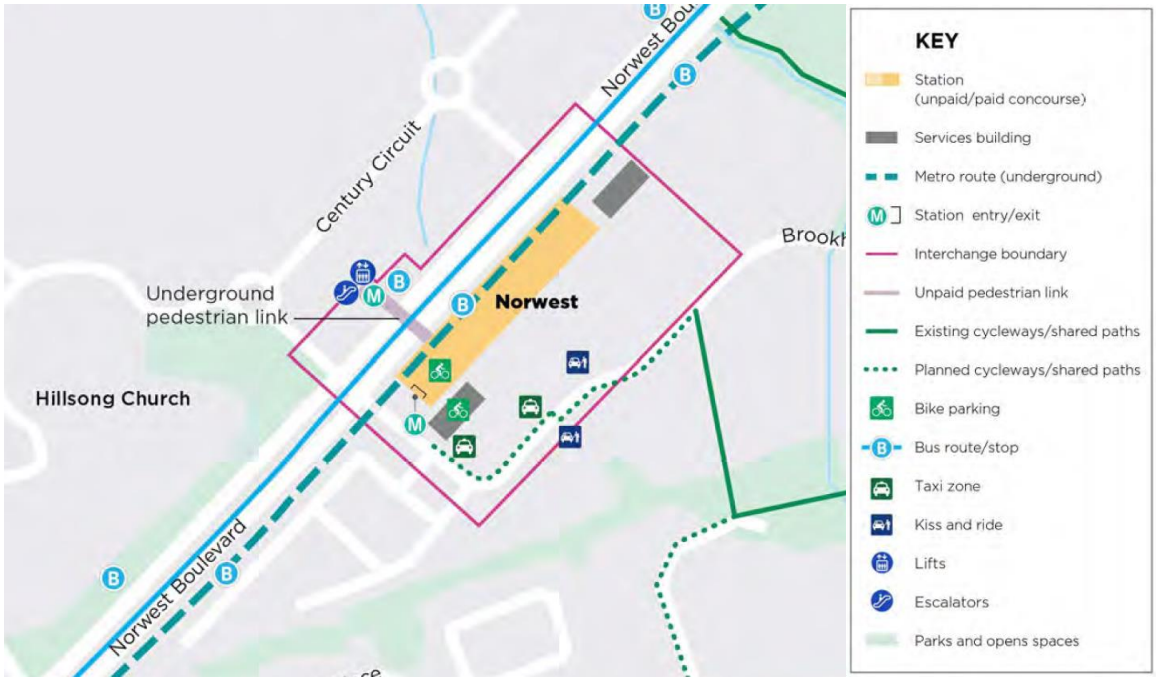
– Pedestrian and bicycle upgrades along Norwest Boulevard and Brookhollow Avenue;

– A pedestrian tunnel under Norwest Boulevard linking into Norwest Station; and

– The area of land to the north east of the station entrance will be landscaped, including planting along Norwest Boulevard.

As shown in **Figure 4-1**, the station will have bus bays on both sides of Norwest Boulevard, bicycle storage at the station as well as kiss and ride spaces and taxi ranks along Brookhollow Avenue.

Figure 4-1 Norwest Station Interchange Access Plan



Source: Sydney Metro Interchange Access Plan, October 2018

Norwest Station will support state and local strategic and planning controls by enabling opportunities for urban renewal including housing diversity and employment intensification, meeting the needs of residents, workers and visitors, and creating a vibrant, sustainable community that reaches its full economic and social potential. It is expected that a Metro station at Norwest will have the following specific benefits:

– The station will form part of the interchange that provides safe and direct access to residential and mixed-use land uses surrounding the station that will directly benefit from additional transport connectivity to the Global Economic Corridor;

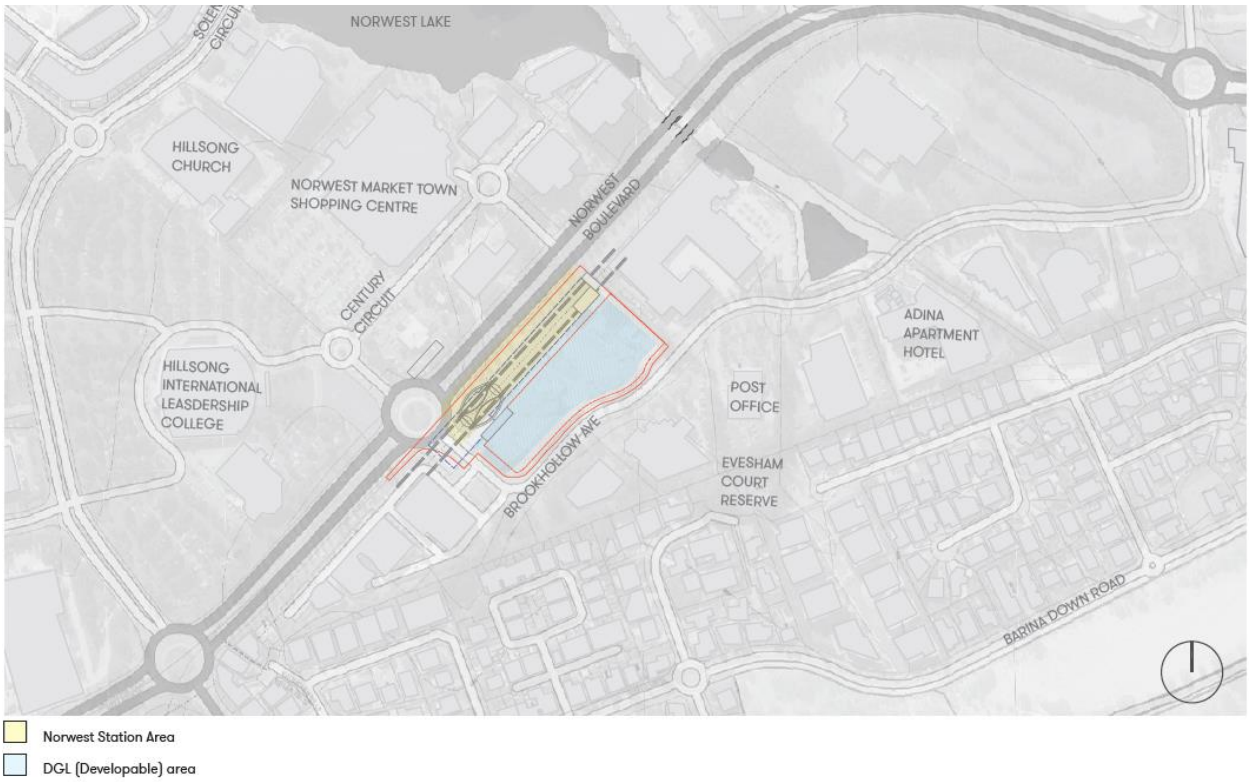
– The station will provide the opportunity for further development of the area as a vibrant and active centre with strong public transport links to North Sydney, the Sydney CBD and other centres throughout the Global Economic Corridor; as well as to offices, retail, housing, and community, recreational, cultural, leisure and educational facilities; and

– The station will provide opportunities to increase residential densities within walking distance of the station.

4.2 Illustrative development concept

The Planning Proposal would facilitate development which supports best practice transit-oriented development principles at the Norwest Station located in The Hills Shire. The site which is approximately 9,404 sqm in size is bounded by the SMNW corridor to the north (which runs parallel to Norwest Boulevard west of the site) and Brookhollow Avenue to the south and west of the site, as seen in **Figure 4-2**.

Figure 4-2 Location of the illustrative development concept



Source: Scott Carver, August 2018

The illustrative development concept presents a potential development scenario under the proposed planning controls, which comprise increased development density (floor space ratio) and increased building height. It is based on a vision to transform Norwest into a transit-oriented, more vibrant and diversified centre with higher employment densities enhanced by high quality public domain.

The illustrative development concept will:

– Mark the Norwest station on the Sydney Metro Northwest Line in the Norwest Business Park;

– Assist in transforming the traditional business park model into a transit-oriented, activated and diversified centre;

– Become the gateway to Norwest Business Park for commuters using the Sydney Metro Northwest; and

– Create new employment offering and be climate responsive set amongst high quality public domain.

The illustrative development concept is a transit-oriented mixed-use development of approximately 52,000 sqm comprising:

– Approximately 3,900 sqm of retail of which 1,000 sqm could be a neighbourhood supermarket;

– Approximately 39,500 sqm of commercial office space;

– Approximately 8,600 sqm of short-term accommodation (hotel / serviced apartments); and

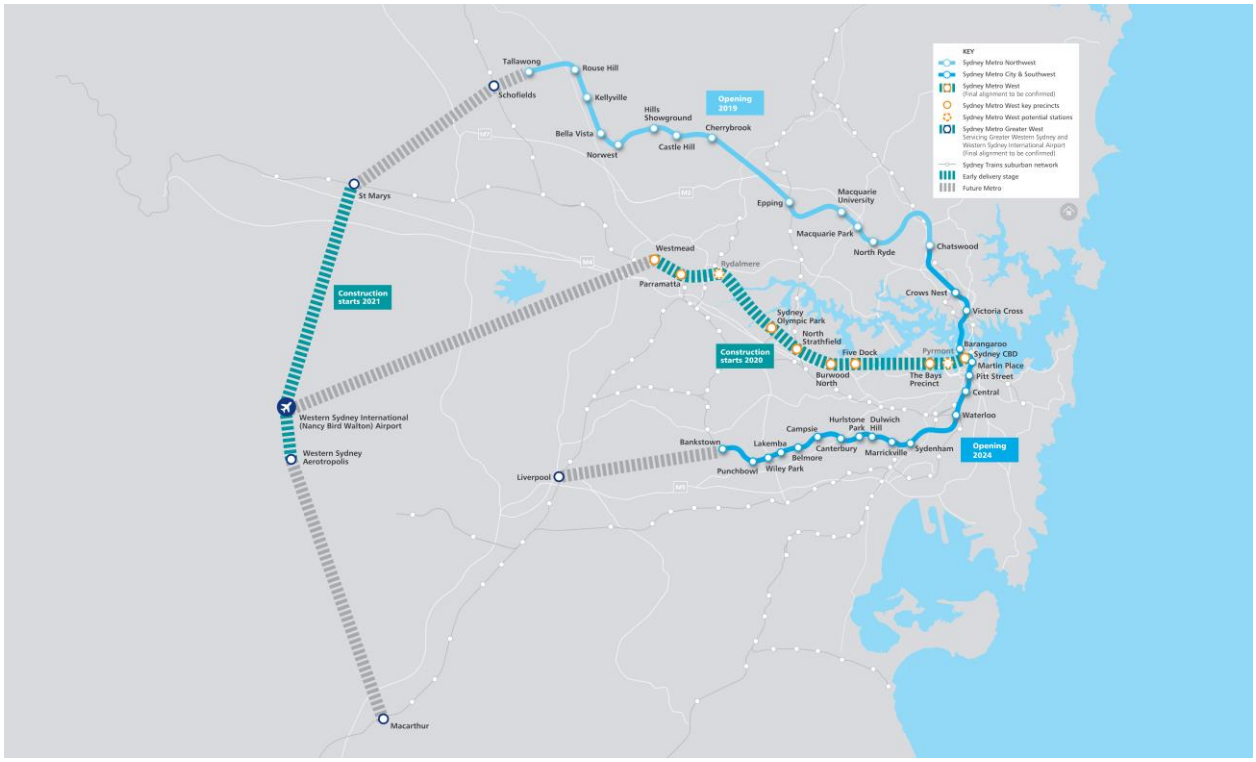
– An underground car park area comprising circa 360 parking spaces is also proposed, based on the yield and land use mix of the illustrative development concept and the recommended maximum parking rates for each type of uses.

4.3 Proposed access arrangements

4.3.1 Public transport access

The new Norwest Station of the SMNW project is shown in **Figure 4-3**, which will provide direct access to Chatswood to the south east and Rouse Hill and Tallawong Station to the north west, with fifteen services in an hour during the peak. SMNW will be open in 2019, and customers will also have a new direct Metro service to Crows Nest, Barangaroo and Martin Place when Sydney Metro City and Southwest opens in 2024.

Figure 4-3 Sydney Metro Line



Source: Sydney Metro, 2019

Upon completion, the indicative time to travel to major destinations by Metro from Norwest Station would take much less time. For example, it will only take four minutes to go to Castle Hill, 13 minutes to Epping, 19 minutes to Macquarie Park, 28 minutes to Chatswood, and 48 minutes to Wynyard. Travel time within 30 minutes could attract more people to work at Norwest as a result of its improvements in transport accessibility and connectivity.

The increased network coverage, train frequency, journey-time reliability and improved customer offering of Sydney Metro, will encourage public transport usage and increase journey to work trips by non-car modes. Norwest Station will have a bus-rail interchange station serving the Norwest Business Park, with no park-and-ride spaces.

The Norwest Station Interchange Access Plan describes access requirements for the station precinct. The interchange strategy has been taken into account in the illustrative development concept, as it provides high quality access to the station and surrounds.

Proposed bus interchange and transfer requirements are shown in **Figure 4-4**. Bus stands are located on both sides of Norwest Boulevard and will continue to service bus routes that operate along Norwest Boulevard connecting residents and employees between the future station and other surrounding centres. Any potential changes to existing bus routes to the station are still under investigation by Transport for NSW.

Figure 4-4 Proposed bus access arrangements and facilities at Norwest Station

Source: Sydney Metro Interchange Access Plan, October 2018

Sydney Metro will provide existing and future residents and employees with greater access to public transport and employment options and promote sustainable travel options. The proximity to bus stops to the station will allow efficient access of future employees and patrons to the Norwest Station site. The illustrative development concept has been developed to facilitate efficient access by bus and Metro passengers through the station plaza.

SCT Consulting has undertaken benchmarking analysis of public transport mode share of other centres across Sydney and a multiple regression analysis for the density, size of centre and distance to Sydney CBD with the dependent variable of public transport mode share. Refer to **Appendix B** for full summary of the technical analysis.

The closest geographic centres that have similar levels of access to that of the future Norwest Station are Blacktown, Hornsby, Epping and Macquarie Park. These have public transport mode shares of 11%, 14%, 16%, and 24%, respectively. It is therefore expected on benchmarking with other similar centres that the mode share would exceed 24% due to the more similar land uses in Macquarie Park to the proposed station site at Norwest.

As part of Sydney Metro's precinct planning, many of the planning policies align with variables identified in literature and the statistical analysis that public transport mode share will improve as the development density and land use mix increases. With these variables having a significant role in shaping public transport preferences, the analysis indicates that the Norwest Station site could have a public transport mode share of 61% assuming complementary transport and built form policies.

4.3.2 Pedestrian access

The Norwest Station Interchange Access Plan describes walking access requirements for the station precinct as shown in **Figure 4-5**. Norwest Station is an origin and destination station. The pedestrian demand at station would be generated from all directions along Norwest Boulevard, Brookhollow Avenue and Century Circuit. Pedestrian activity will cluster around station entry points and dissipate further afield from entrance points. Pedestrian infrastructure provides safe and accessible access for pedestrians to station entry points, which also service the site.

Figure 4-5 Proposed walking access arrangements and facilities at Norwest Station

Source: Sydney Metro Interchange Access Plan, October 2018

Norwest Station will be accessible from a plaza on the corner of Norwest Boulevard and Brookhollow Avenue. Improved pedestrian access to the new Norwest Station will be provided via:

– New traffic lights at the intersection of Norwest Boulevard and Brookhollow Avenue;

– New pedestrian (zebra) crossing at Brookhollow Avenue; and

– A pedestrian tunnel under Norwest Boulevard linking into Norwest Station.

The overall pedestrian environment in the catchment accommodates pedestrian movement associated with employment, community and residential areas surrounding the station, including the illustrative development concept located adjacent to the Norwest Station.

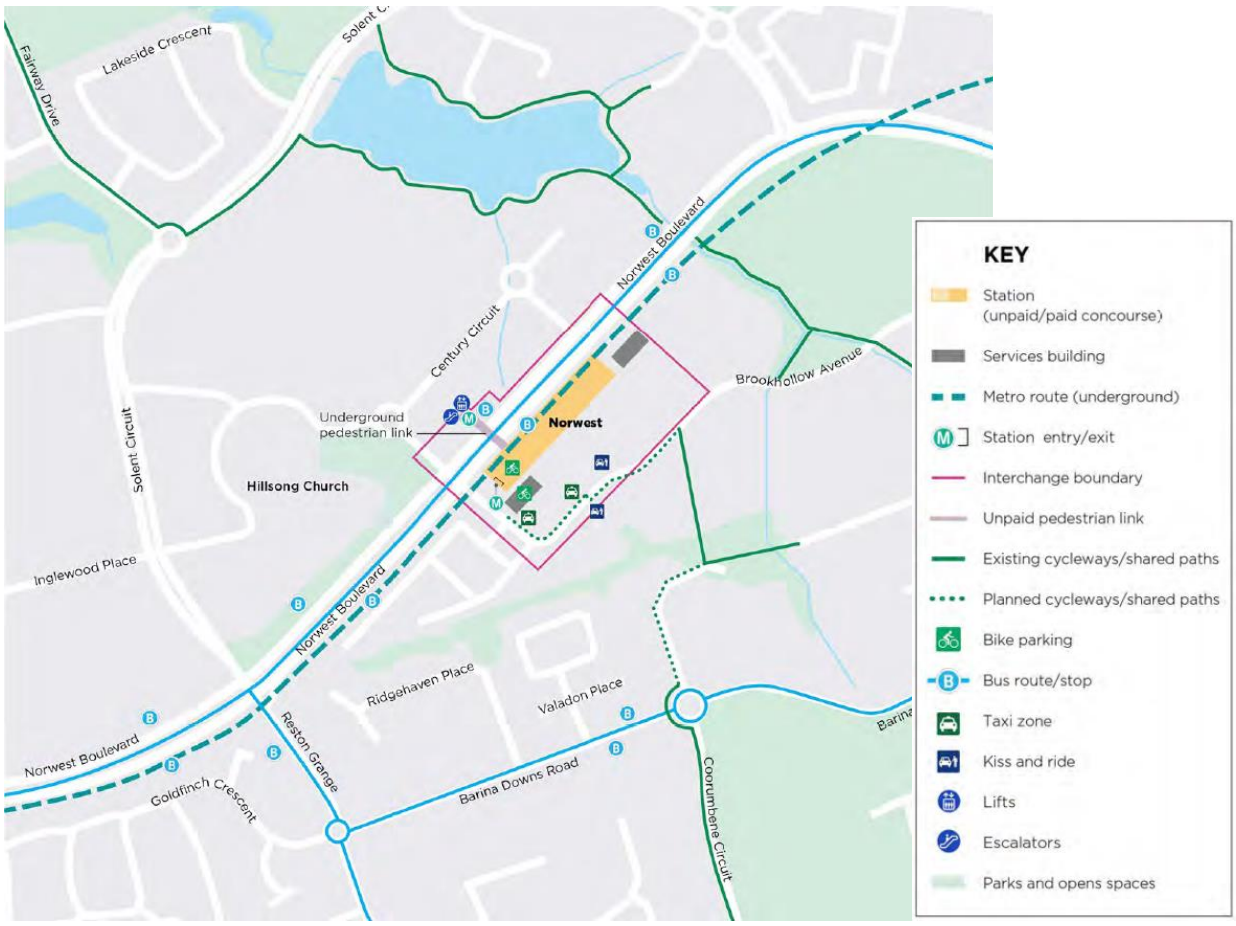
Pedestrian access between the illustrative development concept and the station and its interchange facilities will be provided mainly via a new pedestrian plaza that also connects with the proposed shared paths on the northern side of Brookhollow Avenue and the southern side of Norwest Boulevard.

4.3.3 Cycling access

The Norwest Station Interchange Access Plan describes cycling access requirements for the station precinct as shown in **Figure 4-6**. An off-road shared path will be installed on north side of Brookhollow Avenue within the station precinct between the station entry plaza and recommended crossing of Brookhollow Avenue to facilitate connections to the existing cycle network.

To facilitate cycle transfer within the interchange, bike parking will be provided at the southern side of the station entrance plaza on Brookhollow Avenue. Bike sheds will be provided for 25 bicycles as well as bike racks for 10 bicycles.

Figure 4-6 Proposed cycling access arrangements and facilities at Norwest Station



Source: Sydney Metro Interchange Access Plan, October 2018

Cycling access to and from the Norwest Station site, the station and its interchange facilities will be provided mainly via the proposed shared paths on the northern side of Brookhollow Avenue. The Norwest Station Interchange Access Plan also suggested a number of cycle routes to be considered by others to improve regional access to the future station which would also benefit the illustrative development concept:

– Install separated path on the southern side of Norwest Boulevard between Windsor Road and boundary of station precinct to link to existing shared path on Windsor Road;

– Install a separated path on the northern side of Norwest Boulevard between Brookhollow Avenue and Edgewater Drive to link to existing shared path on Edgewater Drive to improve connection with the regional network to the north; and

– Link the shared path between Brookhollow Avenue and Norwest Boulevard. Safeguards for extension of the sub-surface pedestrian link are also provided for new development in the north.

4.3.4 Vehicular access

The Norwest Station Interchange Access Plan describes vehicle access requirements for the station precinct as shown in **Figure 4-7**. In order to ensure the safety of pedestrians and protect them from other road users, direct paths of travel along pedestrian desire lines within low speed environments will be provided. Nine new taxi ranks and nine kiss-and-ride spaces (including one accessible space) will be provided at Brookhollow Avenue within a 200m walk from the station gate lines.

Figure 4-7 Proposed vehicle access arrangements and facilities at Norwest Station

Source: Sydney Metro Interchange Access Plan, October 2018

As shown in **Figure 4-8**, the illustrative development concept will be accessed via two new driveways proposed along Brookhollow Avenue. Both driveways will provide access to underground off-street loading / unloading facilities as well as parking areas to support the illustrative development concept.

Figure 4-8 Potential arrangements to cater for proposed driveways

Source: Scott Carver, 2018

As a result of accommodating the new driveways and to ensure efficient and safe pedestrian movements and vehicular access to the station, a number of changes to the kerbside operations along Brookhollow Avenue are suggested to accommodate the required modal facilities on Brookhollow Avenue:

– Relocation of the mid-block pedestrian (zebra) crossing at Brookhollow Avenue to align with the new pedestrian plaza;

– Relocation of three taxi bays to the north of the new pedestrian plaza;

– Reallocation of kiss and ride spaces to both sides of Brookhollow Avenue;

– Provision of up to two coach parking spaces on the northern side of Brookhollow Avenue; and

– Removal of central island on Brookhollow Avenue currently located near the northern car park access of the illustrative development concept. The removal of the island will enable vehicle access and egress to the proposed driveways in both directions of travel on Brookhollow Avenue and hence reduce circulation of traffic on the surrounding road network.

The suggested changes to the kerbside operations as a result of the illustrative development concept are consistent with the requirements of the station access plans and pedestrian cyclist strategy. The illustrative development concept demonstrates that these arrangements are practical and feasible and shows how two basement entries could be configured while accommodating the required modal facilities on Brookhollow Avenue. However, approval to these suggested changes will be sought at the appropriate time.

4.4 Travel Demand Management

Sustainable transport and Travel Demand Management (TDM) strategies involve the application of policies, objectives, measures and targets to influence travel behaviour, to encourage uptake of sustainable forms of transport, i.e. non-car modes, wherever possible. TDM measures have proven to reduce congestion created by growth within urban areas and unlock urban renewal opportunities. They result in travel behaviour that uses less road space than a single occupant vehicle commute and takes advantage of spare transport capacity outside the morning and afternoon peaks.

TDM strategies generally guide all relevant customers (residents, employees and visitors) in changing the travel behaviour in the following ways:

– Reduce travel;

– Re-mode (consideration of travel via alternative modes);

– Re-time (consideration of travel at alternative times); and

– Re-route.

Landcom and Sydney Metro set up a framework for a more sustainable travel, which has been used as a key principle of planning for the development. A Travel Plan should be developed by future developers and monitored by strata management for the Norwest Station Precinct community to deliver best practice travel programs and initiatives to manage travel demand for a transit-oriented development. Key initiatives and measures of Travel Demand Management Strategies should be further developed into a Travel Plan to:

– Reduce the need to travel

  - Planning of Norwest Station Precinct as a mixed use community to maximise trip containment within the precinct and encourage use of active transport (walking and cycling) for short trips.

– Re-think the mode of travel

  - Walking and cycling:
    - A highly permeable and safe pedestrian network throughout the development.
    - Dedicated cycle routes that connect to the regional routes and major transport hubs.
    - Key design principles to integrate walking and cycling network and facilities into the planning and delivery of the development.
    - High quality, safe and accessible end-of-trip facilities (centralised cycle hubs that are integrated within development at convenient locations, on-street secure bicycle storage located conveniently at end of cycle destinations, parking hubs for shared bikes, lockers and showers).
    - Promotion of bicycle initiatives – NSW bicycle week, cycle to work day, free bike check-up events.
    - Establishment of a Bicycle User / Consultation Group.
  - Public transport:
    - Provision of frequent public transport services to establish a non-car travel behaviour.
    - Good quality public transport stops in the vicinity of the development.
    - Tailored information with clear mapping and walking catchments at public transport stops.
    - Provision of public transport information from home via television channel or community app.
  - Parking measures to encourage alternative modes of travel:
    - Reduced parking rates with flexibility in parking arrangements such as shared parking between non-conflicting uses, shared vehicles parking and / or carpooling to accommodate parking needs of all employees.
    - Parking spaces dedicated to electric vehicles, with charging stations.
    - Parking spaces dedicated to car share scheme and community car-share vehicles, both on-street and incorporated in easily-accessed public car parks.
  - Development and use of carpooling app for the wider precinct and community.

– Re-time and Re-route journeys:

  - Development of specific community app / community engagement program to enable changing travel behaviour which includes:
    - Active and public transport maps
    - Personalised journey planner
    - Notifications to latest travel information
    - Shared vehicles information
    - Car-pooling opportunities
    - Other precinct-related information
  - Real-time information embedded into development and public transport stops.
  - Employers to promote and encourage flexible working hours and arrangements.

While it is important to develop a Travel Plan that is aimed at managing travel demand and reducing reliance on car travel, it is more important to monitor and evaluate the effectiveness of individual measures and the need to adjust the measures. The planning and implementation of a targeted Travel Plan with the above green travel initiatives / principles could support the delivery of a transit-oriented development at Norwest Station that provides significant opportunities for alternative travel options and reduces the need for car travel.

4.5 Parking requirements and provision

4.5.1 Car parking facilities

In line with the principle of promoting sustainable travel, opportunities to influence travel behaviour via use of car parking supply limits were considered. Landcom and Sydney Metro are proposing reduced car parking provision for the Norwest Station site to facilitate:

– An exemplar transit-oriented development (maximising the benefits of fast frequent Metro connections with services every 4 minutes in the peak and 10 minutes in off-peak);

– An alternative development production to the current stock of office facilities with extensive and expensive parking facilities;

– A centre not dominated by cars;

– Active and pedestrian-friendly streets; and

– A reduction in the congestion of the wider road network.

The Hills Shire Council Development Control Plan (DCP) forms the baseline for this car parking assessment, in that it contains the rates that would normally be required for a development of this type at this location.

A review was conducted of the Hills Shire Council DCP, which indicated that the current parking controls would not satisfy the principle of sustainable transport for the site. The date of publication of the DCP was adopted in 2012, well before commencement of construction of the Metro. The DCP does not have any provision for reduced parking requirements around train stations, which is typical for councils with similar geographies and rail lines – potentially because the DCP does not anticipate delivery of rail station precincts. For the above reasons, alternative parking levels were considered based on comparable Council DCPs.

4.5.1.1 Merits and feasibility of reduced car parking rates

Sydney has several precincts with parking maximums that operate successfully:

– Sydney CBD, which has very restrictive parking maximums;

– North Sydney; and

– Emerging precincts in Green Square, Parramatta North, Lachlans Line (North Ryde), and Rhodes East.

Based on decades of research into parking policies in cities, Donald Shoup, provides the below further benefits of removing minimum parking rates (Shoup, 2018):

– Influence on travel behaviour;

– Reduce costs to lower income households;

– Reduce sprawl; and

– Reduce greenhouse gas emissions.

The recently prepared Trip Generation Surveys High Density Residential (Car Based) Analysis Report (Bitzios Consulting, 2017) study conducted a large number of traffic generations surveys at a range of metropolitan, sub-metropolitan and regional sites to inform better policy on trip generation for residential uses. The study found that for metropolitan and sub-metropolitan sites, the number of parking spaces rather than units was a better predictor of traffic generation. As a result, the traffic generation rates for residential uses in those contexts were measured as trips per parking space – not per unit.

No such analysis exists for commercial or other types of uses. With similar factors influencing behaviour, it is suggested that a similar result would likely occur for commercial premises. This means that Councils can influence travel behaviour by the use of car parking policies that limit the number of spaces.

As discussed in Section 3.1.1, the combination of high density mixed use development, good access to public transport services as well as low parking supply contributes to high public transport mode shares in Sydney CBD and North Sydney. For example in Macquarie Park, increasing public transport services enabled Council to reduce

parking provision rates for developments within walking distance to train stations and frequent bus services. The increase of public transport services at the Norwest Station site (as discussed in Section 4.3.1) also enables reduction of car parking provision as there is significantly less reliance on use of private vehicles.

A comparison of the relevant parking rates applicable to the various (office, retail, hotel) components of the illustrative development concept is presented in **Table 4-1**, **Table 4-2** and **Table 4-3** respectively.

4.5.1.2 Commercial car parking requirements

Table 4-1 Car parking requirements for offices / commercial premises

Parking rate by jurisdiction	Indicative yield	Parking requirement	Proposed parking
The Hills Shire Council DCP: 1 space per 40m^2	39,500sqm	**988**	~275 (max)
RMS: 1 space per 40m^2		988	
City of Ryde DCP – North Ryde Station Precinct: 1 space per 90m^2		439	
City of Ryde DCP – Macquarie Park Corridor: 1 space per 100m^2		395	
Parramatta Council – Special Precincts (Westmead): 1 space per 100m^2 (Max)		395	
Green Square (City of Sydney): 1 space per 125m^2 (Max)		316	
Rhodes updated Precinct Plan (2018): 1 space per 150m^2 (Max)		263	
Occupied building – Eclipse (60 Station St, Parramatta): 1 space per 178m^2		222	
Occupied building – North Sydney (close to the train station surveyed by RMS as documented in Technical Direction 2013): 1 space per 230m^2		172	
North Sydney Council DCP: 1 space per 400m^2		99	

Source: SCT Consulting, 2018

As seen in **Table 4-1**, there is a wide range of guidelines that are relevant to this site from a current geographic perspective (The Hills Shire Council DCP and RMS guidelines) and other DCPs that could be applicable given the future context of this site's location in proximity to a train station. According to The Hills Shire Council DCP, the office component would require providing 988 spaces which does not reflect its location adjacent to Norwest Station.

The illustrative development concept responds to the opportunity to create a transit-oriented centre by reducing the amount of employee parking, reflecting the higher level of public transport services. The best approach to facilitate / influence reduced car use and to minimise additional congestion to the surrounding road network is to restrain parking provision at its destination for employment uses (while offering attractive public transport alternatives in this case Sydney Metro and its connecting bus network). Hence the need to predict and provide parking provision based on historical data / trends does not align with the principle of the Norwest Station site.

The characteristics of the Norwest Station site within a business park which is similar to Macquarie Park. However, the site is located directly adjacent to a Metro station with access to bus services, with reduced parking provision which makes the site more similar to the North Sydney / Parramatta examples shown in **Table 4-1**. Therefore, a rate of one car parking space per 145m^2 of office space is deemed more appropriate to discourage private vehicle use and minimise traffic impacts. This recommended rate sits between the one suggested for Macquarie Park and the occupied building examples in North Sydney and Parramatta. The recommended rate is also very similar to the one proposed for Rhodes Precinct Plan that is recently released by the Department of Planning & Environment, that seeks to minimise vehicular traffic generated in the precinct and encourage the use of alternative modes of transport.

4.5.1.3 Retail car parking requirements

Table 4-2 Car parking requirements for retail premises

Parking rates	Indicative yield	Parking requirement	Proposed parking
RMS (Shopping Centre of <10,000m^2): 1 space per 16.4m^2	3,900 sqm	238	30 (shared between retail and neighbourhood supermarket)
The Hills Shire Council DCP: 1 space per 18.5m^2		**211**	
City of Ryde DCP – Macquarie Park Corridor: 1 space per 25m^2		156	
City of Ryde DCP – North Ryde Station Precinct: 1 space per 100m^2 of retail and 1 space per 60m^2 of supermarket		45 = 30 for retail and 15 for neighbourhood supermarket	
Rhodes updated Precinct Plan (2018): 1 space per 100m^2 (Max)		39	

Source: SCT Consulting, 2018

According to The Hills Shire Council DCP, the retail component would require providing 211 spaces which does not reflect its location adjacent to a Metro station.

Research in Sydney has found that residents in higher density developments close to rail stations with ready access to neighbourhood supermarkets are highly likely to walk to do their shopping, reducing the demand for parking (Ellis and Parolin 2010).

Given Norwest Station is surrounded mainly by businesses, the retail uses proposed would serve passing trade to / from station by employees working within the local walk-up catchment and convenience shopping for residents leaving the station to travel home to surrounding residential suburbs. The majority of the retail customers would not be driving and parking at this location during the business operating hours, but would be more like IGA offering at St Leonards Station and the growing number of 'express' retail offers located at key public transport interchanges. The parking demand for the retail component during the day (say between 6AM to 6PM) would be minimal when this period overlaps with the peak commercial parking demand.

With the proximity to other existing retail areas that have ample parking provisions (the nearest at Norwest Marketown) and other regional centres that have higher parking provisions (such as Rouse Hill Regional Centre), local residents would be attracted to surrounding centres if car access is needed for weekly (large trolley) shopping. The only exception may be the residential areas immediate to the south of the development where this retail offer would be the nearest and residents may want to drive to this retail offer in the evenings / weekends when the commercial parking demand is minimal.

With the low parking demand for neighbourhood supermarket uses during the day and the complementary low demand for retail uses during the evening, a complementary approach to parking is proposed. This would involve the retail and neighbourhood supermarket sharing 15 out of the 45 proposed spaces. The remaining 30 spaces would be allocated to the overall retail / neighbourhood supermarket offer, equivalent to a rate of approximately 1 space per 130m^2 of overall retail offer.

The shared operation of this portion of the car park can be further considered and incorporated into the detailed design of the illustrative development concept and car park at the DA stage.

This level of car parking for the retail and neighbourhood supermarket uses is considered to be sufficient based on:

– The retail uses proposed within the Norwest Station site will serve the local community and businesses, which is expected to have a limited travel catchment within walking distance. The retail is not designed to serve a wider car access market, which have access to alternatives at Rouse Hill Regional Centre, Castle Towers, Norwest Marketown and other centres;

– The other major customer market for the proposed retail / neighbourhood supermarket at Norwest Station site is Metro station users, who will be using Metro and provided with kiss-and-ride spaces and bus access, thus removing the need for off-street parking; and

– The local nature of the non-residential uses, located at the station, will serve the local population, where the ability to use active transport instead of private cars will be higher.

4.5.1.4 Hotel car parking requirements

Table 4-3 Car parking requirements for hotels / serviced apartments

Parking rates	Indicative yield	Parking requirement	Proposed parking
The Hills Shire Council DCP / RMS: 1 space per room plus 1 space per two employees	8,600sqm (110 rooms)	**175**	~55
City of Ryde DCP – Macquarie Park Corridor: 1 space per 1.5 keys / rooms		73	
Parramatta Council – Special Precincts (Westmead): 1 space per 5 rooms plus 1 space per 3 employees		65	
RMS Guide to Trip Generating Developments: 1 space / 4 bedrooms in 3-4-star hotels		28	
North Sydney Council DCP: 1 space per 5 rooms		22	

Source: SCT Consulting, 2018

According to The Hills Shire Council DCP, the hotel component would require providing 175 spaces which does not reflect its location adjacent to a Metro Station.

Of all the additional guidelines considered, the three that are particularly relevant to the hotel development of the illustrative development concept are the ones specific for Macquarie Park, Westmead and North Sydney as these precincts are all located close to train stations. Hence, based on the average provision of these three DCP, it is estimated the hotel of the illustrative development concept should provide 55 car parking spaces. This is equivalent to a rate of approximately 1 space per 2 rooms.

4.5.1.5 Shared vehicle parking

Further opportunities are considered to minimise parking provision by introducing shared vehicle parking spaces within the development, that fully leverage the opportunities offered by Sydney Metro Norwest and the principles of a transit-oriented development.

Since there are no requirements or guidance of providing car share parking spaces in The Hills Shire Parking DCP, other Council guidelines are considered:

– North Sydney Council does not provide a minimum rate of car share parking;

– City of Parramatta Council DCP prescribes 1 car share parking space is to be provided for any business development within a floor space of 5,000m^2. 1 car share space can be provided in lieu of 3 car parking spaces; and

– There are three car share parking spaces currently provided by GoGet in the vicinity of the illustrative development concept (one at Fairway Drive near Solent Circuit and the other two at Adina Apartment Hotel, Baulkham Hills both located within 5-minute walk to the site).

Given the increase in density and quantity of development surrounding the station, it is proposed that 5-10 car share parking spaces can be provided within the car park of the Norwest Station site, to support the reduced on-site car parking provision.

4.5.2 Disabled parking facilities

The Hills Shire Parking DCP (Part C – Parking) specify the following requirements for disabled parking spaces:

– Retail / commercial development at a rate of two percent of total car parking – 6 out of 312 proposed; and

– Hotel / serviced apartments which are not specified in DCP – 1 out of 54 proposed (assuming two percent of total).

4.5.3 Bicycle and motorcycle parking facilities

To encourage the use of bicycles to help reduce the dependence on motor vehicles in accordance with The Hills Shire Council's Environmental Sustainable Development objective. The development controls are listed below:

– Bicycle parking should be located in close proximity to building entrances and clustered in lots not exceeding 16 spaces;

– Bicycle parking facilities should not impede pedestrian or vehicular circulation;

– Bicycle parking facilities should be located in highly visible, illuminated areas to minimise theft and vandalism; and

– Provision of shower and change facilities for bicycle riders should be provided.

For commercial component of the illustrative development concept, the minimum number of bicycle parking spaces is specified by The Hills Shire City Council Development Control Plan 2016. The Hills Shire DCP suggests a minimum provision of bicycle parking spaces that equates to approximately 5% of the total parking spaces. In this case, only 18 bicycle parking spaces are required.

Research of other Council DCPs and business centres with best practice of cycle parking provision for non-residential development has been undertaken and summarised in **Table 4-4**. These DCPs are specifically referenced as they have bicycle parking rates expressed as floorspace, but not as a percentage of vehicle parking spaces that is similar to The Hills Shire DCP.

Table 4-4 Bicycle parking requirements

Other Council DCP	Office	Retail / Shops	Hotel	Bicycle parking requirement
City of Sydney	1 per 125sqm GFA	2 plus 1 per 70sqm GFA	1 per 20 rooms	372
North Sydney Council	1 per 125sqm GFA	2 plus 1 per 20sqm GFA	1 per 20 rooms	500
City of Parramatta	1 per 200sqm GFA	1 per 200sqm GFA	1 per 5 rooms	235

Source: SCT Consulting, 2018

As discussed in **Section 4.4**, one of the key principles to change people's travel behaviour in the study area is to provide high quality, safe and accessible end-of-trip facilities. Cycle access will be a key opportunity for workers living within 2.5km of the site given the extensive cycle paths in the area. Hence, it is recommended that the design of the illustrative development concept considers provision of bicycle spaces significantly above the minimum requirements – similar to those proposed by City of Sydney DCP, i.e. 372 bicycle parking spaces should be integrated within development at convenient locations with lockers and showers facilities.

Employees will tend to leave their bicycles unattended, often in low-activity areas, for long periods of time (8-10 hours) and require higher security than visitors. Parking cages are often the best choice for workplace parking as they provide increased security over bicycle racks alone but offer better space utilisation than bicycle lockers.

Motorcycle parking is to be provided for all developments with on-site parking of more than 50 car parking spaces, at a rate of 1 motorcycle parking space for every 50 car parking spaces or part thereof. Hence, seven motorcycle parking spaces are required. Six motorcycle parking spaces should be provided for commercial/retail components and one motorcycle parking space should be provided for the hotel/serviced apartment components.

4.5.4 Loading and delivery parking facilities

The Hills Shire Parking DCP (Part C – Parking) specify the following requirements for loading and delivery facilities:

– Supermarket at a rate of 2 bays for the first 930m^2 of GLFA, plus 2 bays for the next 930m^2, plus 1 bay for each extra 930m^2, therefore requiring 2 loading bays for the neighbourhood supermarket component;

– Mixed small shops at a rate of 2 bays for the first 4,645m^2 of GLFA, plus 2 bays for the next 4,645m^2, plus 1 bay for each extra 4,645m^2, therefore requiring 2 loading bays for the retail shop component;

– Offices at a rate of 1 bay for the first 1,860m^2 of GFA, plus 1 bay for the next 3,720m^2, plus 1 bay for the next 3,720m^2, plus 1 bay for each extra 9,250m^2, therefore requiring 6 loading bays for the office component; and

– Hotel / serviced apartments which are not specified in DCP – to be confirmed based on operation needs.

According to the DCP, up to 10 loading bays / facilities could be required to service the illustrative development concept. However, loading and delivery parking facilities could be shared between different uses, subject to the final leasing arrangements of the proposed development. Hence the loading dock design of the illustrative development concept will be further refined once the target tenants and the operation details are available.

4.5.5 Parking summary

According to The Hills Shire Council DCP, the illustrative development concept would require providing 1,374 spaces which does not reflect its strategic location adjacent to a Metro station.

Additional mode share analysis in **Appendix B** suggests that there could be a significant shift to public transport use, from currently less than 10% to between 24% and 61% depending on the types of transport and built form policies implemented for this development given its location and density, which then complements a proposed reduction in parking supply. The increase in public transport services at the Norwest Station site enables reduction of car parking provision as there is significantly less reliance on private vehicles.

Restrained parking is proposed for the illustrative development concept to create a transit-oriented centre, reflecting the higher level of public transport services and to minimise additional congestion to the surrounding road network. Based on a parking review of other relevant DCPs and similar development examples that are located close to train station, it is proposed that the following car parking rates be adopted and applied to the illustrative development concept of the Norwest Station site:

– 1 space per 145m^2 GFA of office space;

– 1 space per 130m^2 GFA of retail space; and

– 1 space per 2 hotel rooms.

These parking controls could be achieved by a site-specific DCP or other planning tool to enforce the recommendations. The general parking spaces rate would need to be detailed as a maximum (not minimum) to achieve the proposed outcome.

Based on the yield and land use mix and the recommended maximum parking rates for each type of uses, the illustrative development concept would supply 360 car parking spaces. This represents a 75% reduction in car parking space to maximise the full potential of its strategic location adjacent to the Metro station and to reduce trip generation and discourage private motor vehicle use.

The recommended parking rates for the Norwest Station site is shown in **Table 4-5**.

Table 4-5 Recommended parking rates for Norwest Station site

	Maximum car parking rates	Bicycle parking rates
Office / commercial	1 space per 145m^2 GFA	1 per 125m^2 GFA
Retail	1 space per 130m^2 GFA	2 plus 1 per 70m^2 GFA
Hotel	1 space per 2 rooms	1 per 20 rooms

Source: SCT Consulting, 2019

4.6 Trip generation

Work by Matthew McKibbin (McKibbin, 2011) indicates that there are several factors that influence travel behaviour and that the strongest relationships are associated with demographics, car ownership and public transport access. A summary of the findings is provided in **Table 4-6**.

Table 4-6 Findings of built environment variables and their influence on travel behaviour

Category	Built environment variables	Model coefficient	Elasticity
Density	Residential density (pop/ha)	0.0004	0.05
	Employment density (jobs/ha)	0.0003	0.02
Diversity	Jobs/housing diversity (0 = single use, 1 = mixed use)	0.0247	0.03
Design	Street density (m/ha)	-	-
	Not statistically significant		
Destination accessibility	% of jobs accessible by public transport in 30 mins	0.4019	0.11
	% of jobs accessible by car in 30 mins	-0.1044	-0.05
Distance to transit	Distance to the nearest CityRail station (log km)	-0.0537	-0.02
Control variables	Weekly income per person ($ per week)	0.0001	0.17
	Cars per household	-0.2216	-0.98
	% workers travelling to Sydney CBD	0.5415	0.24

Note: The model intercept coefficient was 0.4313. The number of locations (Travel Zones) analysed was 1553.

Source: McKibbin, 2011

McKibbin's work also provides a relationship between the level of car ownership and the non-car mode share / car trip generation. The relationship between these variables is an elasticity of -0.98, indicating that a 100% decrease in car ownership would result in a 98% increase in non-car mode share or vice-versa. As the original data does not include parking supply at place of work, it's not possible to estimate the exact response to this policy. When viewed together with research that indicates that low parking supply for households results in less car ownership, it can be concluded that parking supply can be used to influence travel behaviour.

In this case, proposed 75% reduction in car parking spaces due to the site's proximity to the Metro should result in 75% reduction in vehicular trip generation.

The illustrative development concept will support future employees who choose to work in a transit-oriented centre with low parking provision, while there are other existing / proposed / approved commercial developments around the Norwest Station with higher parking provision.

4.6.1 Vehicle trip generation

Roads and Maritime published a Technical Direction that described vehicular trip rates for commercial developments where traffic surveys were undertaken for developments that are close to public transport. Included in this Technical Direction were surveys at North Sydney, Chatswood, Macquarie Park and Parramatta, which are similar in terms of scale of development and proximity to the train stations.

Since the parking provision is significantly lower given the site's strategic location to Norwest Station as well as potential changes in land use mix in the future, trip generation rates per parking space have been used to estimate the likely trip generation of the Norwest Station site. The average peak hour trip rates per parking space for the surveyed locations were estimated to be 0.40 and 0.25 trips per parking space during the AM and PM network peak hour respectively. The surveyed data for these sites is highlighted in **Table 4-7**.

Table 4-7 Peak hour vehicle trip generation per parking space of similar office sites

Surveyed location	North Sydney	Chatswood	Macquarie Park	Parramatta	Average
AM peak hour trips	51	47	119	185	100
PM peak hour trips	44	36	72	75	57
Parking spaces	136	150	269	402	239
AM trip rate	**0.38**	**0.31**	**0.44**	**0.46**	**0.40**
PM trip rate	**0.32**	**0.24**	**0.27**	**0.19**	**0.25**

Source: Roads and Maritime, Technical Direction 2013/14

The proposed retail component of the development is expected to serve the local walk-up catchment and passing trade to/from station, especially during the peak hours. Given the context of the site as well as the limited parking space proposed, it is assumed that the generation of the retail component will be very low, and the rates adopted are similar to office uses.

It is also assumed that peak hour trips associated with hotel uses would be minimal given the check-in/out hours do not align with the road network peak hours.

Given the location of the site directly adjacent to the Norwest Station and policies to minimise car parking provision and discourage private vehicle use, it is expected vehicular trip generation by the illustrative development concept would be relatively low. The likely estimated peak hour vehicle trip generation of the Norwest Station site is shown in **Table 4-8**.

Table 4-8 Peak hour vehicle trip generation of Norwest Station site

Land Use	Indicative Yield	Parking Spaces	Proposed AM Peak trip rates	AM Peak trip generation	Proposed PM Peak trip rates	PM Peak trip generation
Commercial	39,500 sqm	275	0.40 per space	110	0.25 per space	69
Retail	3,900 sqm	30	0.40 per space	12	0.40 per space	12
Hotel	110 rooms	55	0.20 per room / 0.44 per space	22	0.20 per room / 0.44 per space	22
Total	**52,000 sqm**	**360**		**144**		**103**

Source: SCT Consulting, 2018

Based on the adopted trip generation rates of the respective land uses, it is estimated the illustrative development concept would generate between 144 and 103 peak hour vehicular trips during the AM and PM peak respectively.

4.6.2 Person trip generation

Surveys at several locations were chosen from the Roads and Maritime Technical Direction for person trip generation estimation. The average peak hour person trip rates were estimated to be 1.45 and 1.14 trips per 100m^2 during the AM and PM network peak hour respectively for similar office areas. Average peak hour trip rates were 3.05 and 6.94 person-trips per 100m^2 during the AM and PM network peak hour respectively for retail sites. The surveyed data for these sites is highlighted in **Table 4-9** and **Table 4-10**.

Table 4-9 Peak hour person trip generation of similar office sites (commercial and hotel)

Surveyed location	North Sydney	Chatswood	Macquarie Park	Parramatta	Average
AM peak hour trips	391	111	142	266	-
PM peak hour trips	338	90	86	298	-
GFA (sqm)	31,400	10,214	5,748	27,000	-
AM trip rate / 100sqm	**1.25**	**1.09**	**2.47**	**0.99**	**1.45**
PM trip rate / 100sqm	**1.08**	**0.88**	**1.50**	**1.10**	**1.14**

Source: Roads and Maritime, Technical Direction 2013/14

Table 4-10 Peak hour person trip generation of similar retail sites

Surveyed location	Burwood	Liverpool	Rouse Hill	Warriewood	Average
GFA (sqm)	63,404	91,115	69,000	22,143	-
AM trip rate / 100m^2	**3.27**	**3.68**	**2.08**	**3.18**	**3.05**
PM trip rate / 100m^2	**8.00**	**6.65**	**6.30**	**6.80**	**6.94**

Source: Roads and Maritime, Technical Direction 2013/14

It should be noted that these retail areas are significantly larger than the retail component of the illustrative development concept, but this approach provides an estimation of likely person trip generation by the retail component.

Person trip generation for the site was estimated as shown in the **Table 4-11** below with the peak hour trip generation rates estimated in the previous tables.

Table 4-11 Peak hour person trip generation of Norwest Station site

Land Use	Indicative Yield	Proposed AM Peak trip rates	AM Peak trip generation	Proposed PM Peak trip rates	PM Peak trip generation
Commercial	39,500m^2	1.45 per 100m^2 GFA	573	1.14 per 100m^2 GFA	450
Retail	3,900m^2	3.05 per 100m^2 GFA	119	6.94 per 100m^2 GFA	270
Hotel	8,600m^2	1.45 per 100m^2 GFA	125	1.14 per 100m^2 GFA	98
Total	**52,000m^2**	**-**	**817**	**-**	**818**
Less persons in vehicle trips	**-**	**-**	**-175^**	**-**	**-125^**
Total person trips	**-**	**-**	**642**	**-**	**693**

Source: SCT Consulting, 2018

^Assuming the car occupancy for the vehicle trip generation is 1.2 person / vehicles. AM Peak trip generation = 146*1.2 = 175 persons and PM Peak trip generation = 104*1.2 = 125 persons.

Given its location directly adjacent to the Norwest Station and peak hour travel purposes, most of these person-trips associated with the Norwest Station site will be using surrounding public transport services, some will be to other businesses and some would be walking / cycling from trip origins. Hence, it is estimated the illustrative development concept is forecast to could generate approximately 700 person-trips during the AM and PM peak hours respectively, of which the majority of them will be associated with Metro and bus customers. A small proportion would be walking / cycling to or from the origins of their trips.

According to the RMS survey of similar office sites, between 20-30% of staff travel during peak periods. Based on the illustrative development concept is estimated to cater for 2,800 jobs, the proposal could generate approximately 560 to 840 person-trips during the peak hours, which is consistent with that estimate.

5.0 Traffic and transport impact assessment

5.1 Public and active transport

5.1.1 Public transport impacts

The Norwest Station site would be located directly adjacent to Norwest Station of the SMNW project which will provide direct access to Chatswood. The increased network coverage, train frequency, journey-time reliability and improved customer offering of Sydney Metro, will encourage public transport usage and increase journey to work trips by non-car modes.

The Planning Proposal would facilitate development which supports best practice transit-oriented development principles, by providing increased employment density in proximity to existing and planned transport infrastructure upgrades. Sydney Metro will provide employees with greater access to public transport and employment options, while promoting the use of sustainable travel options.

On this basis, **Section 4.6.2** estimated the majority of an additional 700 person-trips during the peak hours that generated by the illustrative development concept will be using public transport or active transport to access the development. These additional trips during the peak hours can be accommodated through the high frequency Metro services and frequent bus services.

5.1.2 Active transport impacts

Pedestrian and cyclist access to the site has been identified in the Interchange Access Plan (IAP) via the cycle and pedestrian paths along Brookhollow Avenue. These routes will connect cyclists and pedestrians to future station and Norwest Boulevard. It should be noted that additional shared path on the southern side of Norwest Boulevard is recommended by the IAP and requires further investigation and consultation with other relevant stakeholders to determine the funding and construction arrangements.

As discussed in **Section 4.6.2**, the increased yield of the illustrative development concept could generate approximately 700 person-trips per peak hour, of which only a small proportion would be walking / cycling to / from the origins of their trips.

The station layout and interface with the illustrative development concept has several features to support the expected large amount of pedestrian volumes. There are multiple access points to the station, reducing pressure on each of the access points. There is also spacious public domain with multiple plazas, which provides waiting or meet and greet space for customers, which reduces queue build-up near station gates. Lastly, with the large frequency of train services, the peak factor for pedestrian demands is more balanced compared with a conventional heavy rail station. These features make it highly likely that queueing resulting from the additional walking and cycling trips can be thoroughly mitigated during the DA stage.

Further detailed analysis / modelling of the impacts of increase in pedestrian and cyclists surrounding the station and the illustrative development concept could be undertaken at the DA stage, if required.

5.2 Road network

As discussed in **Section 4.6.1**, the illustrative development concept would generate between 144 and 103 peak hour vehicular trips during the AM and PM peak hours respectively. The proposed cap on parking spaces below the Development Control Plan rates is one of the tools used to reduce the traffic impacts of this proposal. The illustrative development concept's traffic generation could be as much as 75% lower than a scheme that complies with current car parking controls.

Despite the current road network capacity issues along Norwest Boulevard during the peak hours, the increased network coverage, train frequency, journey-time reliability and improved customer offering of Sydney Metro, will encourage public transport usage and reduce vehicular journey to work trips especially during the peak hours.

The additional traffic generation were considered together with the future traffic (kiss and ride and bus) movements associated with Norwest Station, to understand the cumulative impacts of the illustrative development concept as well as the Norwest Station respectively. The development traffic generation are distributed to the wider road network based on latest Journey to Work data in the following ways:

– 31% in the AM peak and 47% in the PM peak via Windsor Road;

– 48% in the AM and PM peak via Old Windsor Road; and

– 21% in the AM peak and 5% in the PM peak via Lexington Drive.

The additional development-related traffic forecast at each of the seven intersections along Norwest Boulevard are shown in **Appendix A**. **Table 5-1** shows that the traffic generation associated with the Norwest Station site has marginal increase to the existing traffic along Norwest Boulevard. The maximum increase (approximately 100 vehicles per hour at an intersection) is less than 5% of existing traffic experienced along Norwest Boulevard, which is well-within the daily variation of traffic experience on any major roads in Sydney. Hence, this level of increase in traffic as a result of the illustrative development concept will have no significant adverse impacts to the surrounding road network.

Table 5-1 Development trip increase along Norwest Boulevard

	2018 AM Peak			2018 PM Peak		
Intersection	Background traffic	Additional development traffic	% traffic increase	Background traffic	Additional development traffic	% traffic increase
Norwest Boulevard / Old Windsor Road	3,036	69	2%	3,892	52	1%
Norwest Boulevard / Lexington Drive / Elizabeth Macarthur Drive	3,432	102	3%	3,915	58	1%
Norwest Boulevard / Edgewater Drive / Westwood Way	3,359	102	3%	3,551	57	2%
Norwest Boulevard / Solent Circuit / Reston Grange	3,640	102	3%	3,698	57	2%
Norwest Boulevard / Century Circuit / Brookhollow Avenue	2,703	102	4%	2,756	57	2%
Norwest Boulevard / Columbia Court / Brookhollow Avenue	3,913	45	1%	3,603	48	1%
Norwest Boulevard / Windsor Road	4,466	45	1%	4,885	47	1%

Source: SCT Consulting, 2018

All seven intersections were assessed in SIDRA 8.0 using forecast peak hour traffic volumes (existing traffic volumes + Norwest Station kiss and ride + Future bus movements along Norwest Boulevard + Norwest Station site traffic generation). The intersection performance of AM and PM peak are summarised in **Table 5-2** and **Table 5-3** respectively.

Table 5-2 2018 AM Peak intersection performance (with and without development)

	2018 AM Peak (existing)			2018 AM Peak (with Metro associated traffic and Norwest Station site development traffic)		
Intersection	Delays (seconds)	LOS	95th Percentile Queue – Longest approach	Delays (seconds)	LOS	95th Percentile Queue – Longest approach
Norwest Boulevard / Old Windsor Road	45.5	D	340m (west approach)	45.4	D	340m (west approach)
Norwest Boulevard / Lexington Drive / Elizabeth Macarthur Drive	27.4	B	240m (west approach)	49.5	D	488m (west approach)
Norwest Boulevard / Edgewater Drive / Westwood Way	10.0	A	78m (west approach)	13.8	A	119m (south approach)
Norwest Boulevard / Solent Circuit / Reston Grange	10.4	A	55m (west approach)	16.0	B	109m (west approach)

	2018 AM Peak (existing)			2018 AM Peak (with Metro associated traffic and Norwest Station site development traffic)		
Intersection	Delays (seconds)	LOS	95th Percentile Queue – Longest approach	Delays (seconds)	LOS	95th Percentile Queue – Longest approach
Norwest Boulevard / Century Circuit / Brookhollow Avenue	5.8	A	26m (west approach)	53.8	D	394m (east approach)
Norwest Boulevard / Columbia Court / Brookhollow Avenue	13.0	A	238 (west approach)	19.1	B	327m (east approach)
Norwest Boulevard / Windsor Road	32.5	C	199m (west approach)	37.6	C	222m (north approach)

Source: SCT Consulting, 2018

Table 5-3 2018 PM Peak intersection performance (with and without development)

	2018 PM Peak (existing)			2018 PM Peak (with Metro associated traffic and Norwest Station site development traffic)		
Intersection	Delays (seconds)	LOS	95th Percentile Queue – Longest approach	Delays (seconds)	LOS	95th Percentile Queue – Longest approach
Norwest Boulevard / Old Windsor Road	33.6	C	234m (east approach)	33.1	C	209m (east approach)
Norwest Boulevard / Lexington Drive / Elizabeth Macarthur Drive	16.6	B	114m (east approach)	24.2	B	193m (east approach)
Norwest Boulevard / Edgewater Drive / Westwood Way	6.9	A	48m (west approach)	7.7	A	58m (west approach)
Norwest Boulevard / Solent Circuit / Reston Grange	9.0	A	52m (east approach)	12.0	A	86m (east approach)
Norwest Boulevard / Century Circuit / Brookhollow Avenue	5.8	A	26m (west approach)	44.9	D	237m (west approach)
Norwest Boulevard / Columbia Court / Brookhollow Avenue	10.0	A	69m (west approach)	11.7	A	92m (west approach)
Norwest Boulevard / Windsor Road	51.3	D	394m (south approach)	48.6	D	284m (south approach)

Source: SCT Consulting, 2018

The traffic modelling shows that the performance of the intersections along Norwest Boulevard would operate at a lower level of service or performance, as a result of the cumulative traffic demands at the following intersections:

– Norwest Boulevard / Lexington Drive / Elizabeth Macarthur Drive (AM peak only); and

– Norwest Boulevard / Solent Circuit / Reston Grange (AM peak only);

– Norwest Boulevard / Century Circuit / Brookhollow Avenue (both peaks); and

– Norwest Boulevard / Columbia Court / Brookhollow Avenue (AM peak only).

However, all the intersections are still expected to perform at LoS D or better, which is considered acceptable in the urban context.

The conversion of the existing roundabout at the intersection of Norwest Boulevard / Century Circuit / Brookhollow Avenue to a signalised intersection, as part of the SMNW project, is the main reason for the projected increase in delays. The additional delays to traffic are generated as a result of catering for safe and increased pedestrian access

to the station entrance while maintaining efficient traffic access along Norwest Boulevard and access to the station interchange and the Norwest Station site.

It is noted that at the intersection of Norwest Boulevard / Lexington Drive / Elizabeth Macarthur Drive, the west approach is currently operating at LOS E with Degree of Saturation of 0.921 which indicates that this approach is currently operating near capacity. With the forecast increase in traffic on this approach, it is predicted that this approach would operate with delays of over 100 seconds during the AM peak, with Degree of Saturation of over 1.05 which would suggest that the demands at this approach exceeds its capacity. However, the overall intersection still expects to operate at LoS D in the AM peak.

5.3 Parking

The number of car parking spaces provided as part of the proposal is complemented by the excellent level of access to frequent public transport (rail / Metro and buses) within short walking distance to the site and good access to alternative cycle parking and facilities provided within the development.

As a result of the opening of Norwest Station, on-street parking surrounding the station will likely to be converted to short-term parking such that they will not be available for long-term users or commuters. Hence the reduced parking rates of the illustrated development concept, combined with the limited availability of long-term on-street parking, will further encourage the uptake of public transport use and assist in reducing the traffic generating impacts of the proposal.

372 secure bicycle parking spaces with end-of-trip facilities are proposed in this development to provide an alternative to driving for shorter distance trips and to encourage future employees to adopt sustainable transport modes.

6.0 Summary and conclusions

6.1 Summary

This report has been prepared by SCT Consulting, to support a Planning Proposal for the Norwest Station site located in Baulkham Hills. The illustrative development concept is a transit-oriented mixed-use development that comprise approximately 52,000 sqm of GFA. This may include approximately 3,900 sqm of retail, 39,500 sqm of office space and 8,600 sqm short-term accommodation (hotel / serviced apartments. Underground car park area comprising circa 360 car parking spaces and 372 bicycle parking spaces are also proposed.

In summary:

– The proposal is supported by TDM strategies with a number of green travel initiatives / principles developed specifically for a transit-oriented development at this location that provide significant opportunities for alternative travel options and reduce the need of car travel. A Travel Plan will be developed by the future developers to deliver best practice travel programs and initiatives to manage travel demand for a transit-oriented development;

– The illustrative development concept will have excellent access to the public transport system, with the Norwest Station located directly adjacent to the site. The increased network coverage, journey-time reliability and improved customer offering of Sydney Metro services together with nearby frequent bus services, will encourage public transport patronage and increase all trips to be made by non-car modes;

– The illustrative development concept promotes pedestrian and cyclist movements that could provide good connection to the surrounding cycling and walking network, and to public transport;

– Vehicular access to the site are proposed to be accessed via two new driveways proposed along Brookhollow Avenue;

– The Planning Proposal would facilitate development which responds to the opportunity to create a transit-oriented centre by reducing the amount of employee parking, reflecting the higher level of public transport services. The best approach to facilitate / influence reduced car use and to minimise additional congestion to the surrounding road network is to restrain parking provision at its destination for employment uses (while offering attractive public transport alternative in this case Sydney Metro and its connecting bus network). Hence the need to predict and provide parking provision based on historical data / trends does not align with the principle of the Norwest Station site. The recommended 360 car parking spaces is determined based on 1 space per 145m^2 GFA of office space, 1 space per 130m^2 GFA of retail space as well as 1 space per 2 hotel rooms, as part of the proposal to discourage private vehicle use and minimise traffic impacts; and

– The illustrative development concept would generate between 144 and 103 peak hour vehicular trips during the AM and PM peak hours respectively. The maximum increase (approximately 100 vehicles per hour at an intersection) is less than 5% of existing traffic experienced along Norwest Boulevard, which is well-within the daily variation of traffic experience on any major roads in Sydney. Hence, this level of increase in traffic as a result of the illustrative development concept will have no significant adverse impacts to the surrounding road network.

– The traffic modelling shows that the performance of the intersections along Norwest Boulevard would operate at a lower level of service or performance, as a result of the cumulative traffic demands at the following intersections:

  - Norwest Boulevard / Lexington Drive / Elizabeth Macarthur Drive (AM peak only); and
  - Norwest Boulevard / Solent Circuit / Reston Grange (AM peak only);
  - Norwest Boulevard / Century Circuit / Brookhollow Avenue (both peaks); and
  - Norwest Boulevard / Columbia Court / Brookhollow Avenue (AM peak only).

  However, all the intersections are still expected to perform at LoS D or better, which is considered acceptable in the urban context.

6.2 Conclusions

This traffic and transport impact assessment concludes that:

– The location of the site directly adjacent to Norwest Station will provide employees with improved access to high frequency public transport services, which will provide an alternative to private vehicle use for site access;

– Restrained parking is proposed for the illustrative development concept to create a transit-oriented centre, reflecting the higher level of public transport services and to minimise additional congestion to the surrounding road network; and

– The proposed cap on parking spaces below the Development Control Plan rates is expected to reduce the traffic impacts of this proposal. The additional vehicle trips will not have any significant adverse traffic implications on the public road network.

7.0 Bibliography

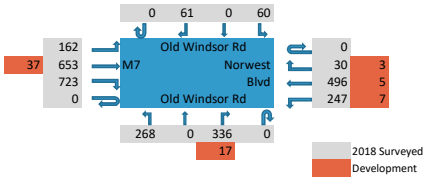
McKibbin, M. (2011). The influence of the built environment on mode choice – evidence from the journey to work in Sydney. *Australasian Transport Research Forum 2011 Proceedings*.

Shoup, D. (2018). *Parking and the City.* New York: Taylor & Francis Group.

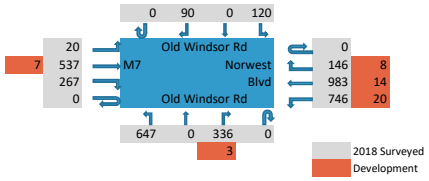
APPENDIX A

Traffic Volumes

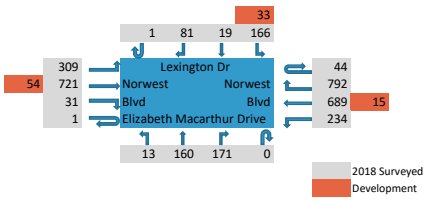
Norwest Boulevard / Old Windsor Road
AM Peak



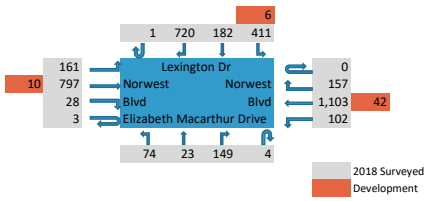
Norwest Boulevard / Old Windsor Road
PM Peak



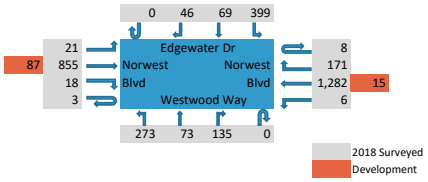
Norwest Boulevard / Lexington Drive / Elizabeth Macarthur Drive
AM Peak



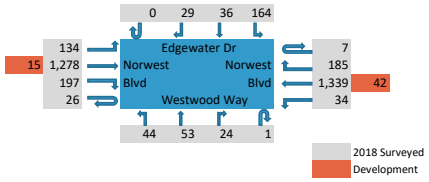
Norwest Boulevard / Lexington Drive / Elizabeth Macarthur Drive
PM Peak



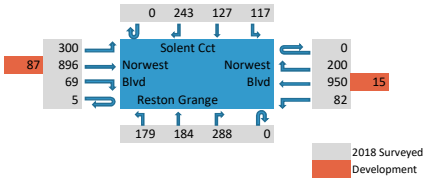
Norwest Boulevard / Edgewater Drive / Westwood Way
AM Peak



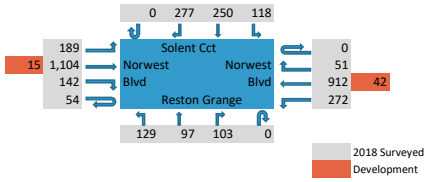
Norwest Boulevard / Edgewater Drive / Westwood Way
PM Peak



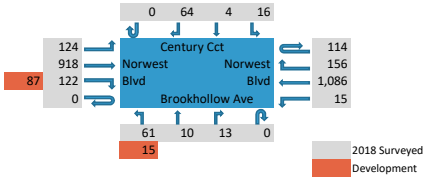
Norwest Boulevard / Solent Circuit / Reston Grange
AM Peak



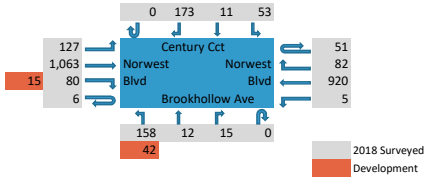
Norwest Boulevard / Solent Circuit / Reston Grange
PM Peak



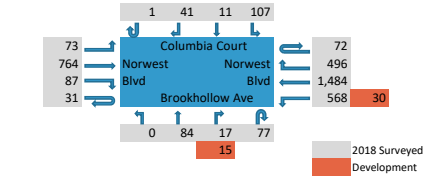
Norwest Boulevard / Century Circuit / Brookhollow Avenue
AM Peak



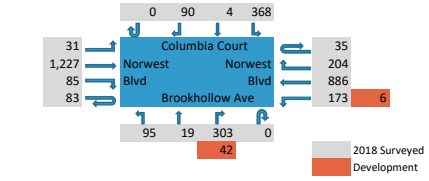
Norwest Boulevard / Century Circuit / Brookhollow Avenue
PM Peak



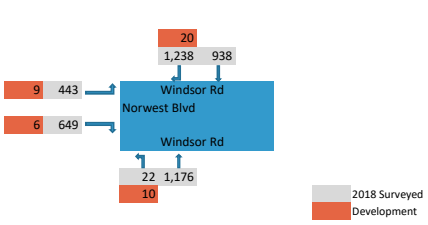
Norwest Boulevard / Columbia Court / Brookhollow Avenue
AM Peak



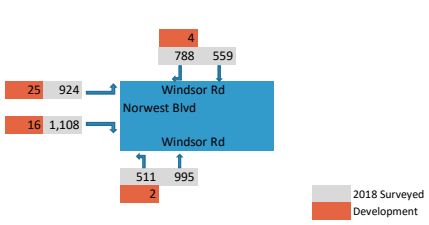
Norwest Boulevard / Columbia Court / Brookhollow Avenue
PM Peak



Norwest Boulevard / Windsor Road
AM Peak



Norwest Boulevard / Windsor Road
PM Peak



APPENDIX B

Mode Share Analysis

Technical Memorandum

Quality Information	
Project:	Norwest Station Site Planning Proposal
Project Number:	SCT_00062
Document Name:	Norwest DGL Journey to Work Comparison
Date:	10 May 2019
Prepared:	Jonathan Busch, Associate Director
Reviewed:	Andy Yung, Director
Authorised:	Andy Yung, Director

Background

SCT Consulting is engaged to carry out a Traffic and Transport Study to support a Planning Proposal for the Norwest Station site located in The Hills LGA. This development site is one of eight urban transformation projects under the Sydney Metro North West (SMNW) Urban Transformation Program, with the SMNW due to start operations in 2019. The location of the site is shown in **Figure 1**.

Figure 1 Location of the subject site

Source: Landcom, 2018

The indicative development concept is a transit-oriented mixed-use development that could comprise approximately 52,000 sqm of gross floor area (GFA).

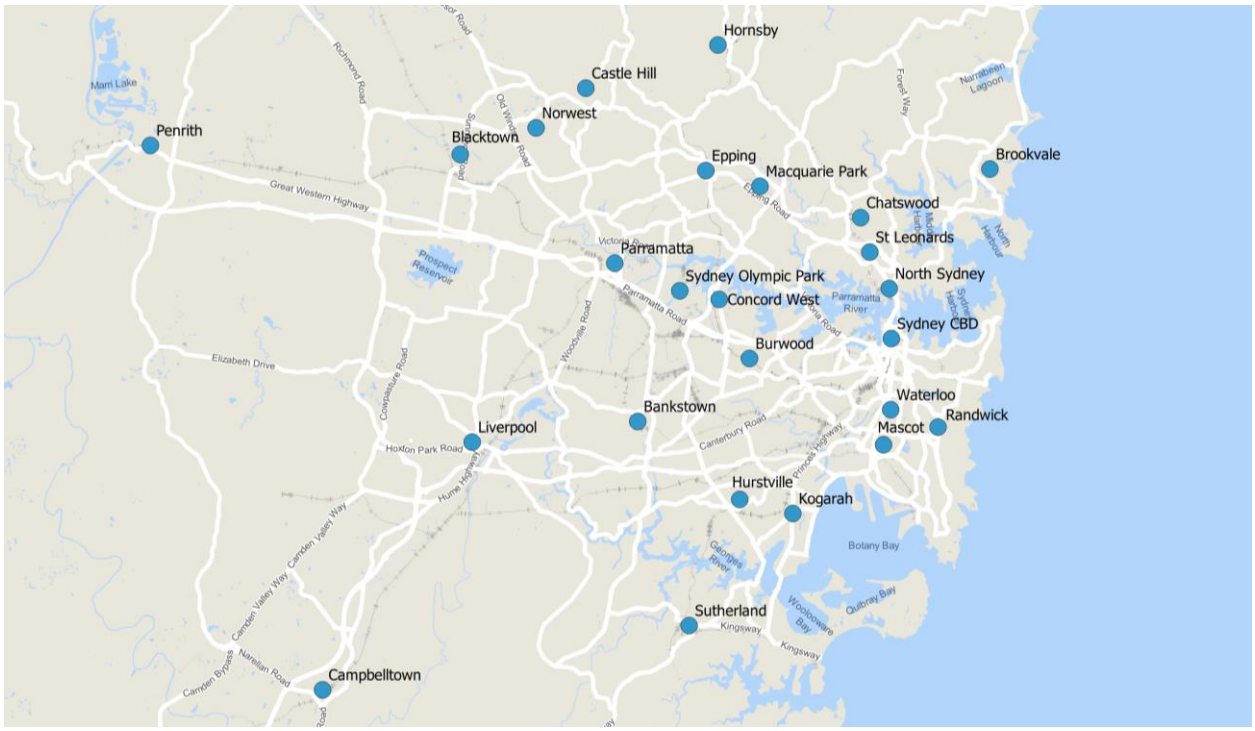
Data Review

Data was made available from the Australian Bureau of Statistics for the Method of Travel to Work data set for places of work. This data covered the mode of travel for the journey to work trip to fifteen different mode categories:

- Train
- Bus
- Ferry
- Tram
- Taxi
- Car, as driver
- Car, as passenger
- Truck
- Motorbike/scooter
- Bicycle
- Walked only
- Other Mode
- Worked at home
- Did not go to work
- Not stated

This data refers to the choice of mode for trips that have a destination at each of the centres. The geography available was limited to SA2 data, which is approximate to the size of a suburb. The location of centres reviewed is shown in **Figure 2**.

Figure 2 Location of Centres



The method of travel to work analysis is shown in **Table 1**.

Table 1 Journey to Work mode share analysis

Location	Public transport modes available	Job Density	Main type of jobs			2016		2011		Mode share change
			Office	Service	Retail	Total trips	PT Mode Share	Total trips	PT Mode Share	
Sydney CBD	train, bus, ferry	747	✓		✓	320,827	70%	270,210	68%	3%
North Sydney	train, bus	256	✓			48,969	58%	46,120	53%	5%
Parramatta	train, bus	59	✓		✓	50,226	37%	46,828	31%	6%
Chatswood	train, bus	55	✓		✓	27,648	37%	23,937	31%	6%
St Leonards	train, bus	107	✓	✓	✓	29,416	33%	27,757	30%	4%
Burwood	train, bus	30	✓	✓	✓	13,300	30%	12,759	26%	4%
Macquarie Park – North Ryde	train, bus	45	✓	✓	✓	48,402	24%	41,493	19%	5%
Rhodes	train, bus	39	✓	✓	✓	19,824	23%	16,592	19%	4%
Green Square	train, bus	73	✓	✓		52,502	23%	50,442	18%	5%
Mascot - Alexandria	train, bus	62		✓	✓	60,487	23%	58,697	17%	6%
Randwick	bus	63		✓	✓	21,358	23%	15,351	16%	7%
Kogarah	train, bus	50	✓	✓	✓	11,125	19%	10,085	14%	5%
Epping	train, bus	5		✓	✓	4,846	16%	5,899	14%	2%
Hurstville	train, bus	37	✓	✓	✓	13,290	16%	12,988	14%	2%
Hornsby	train, bus	21	✓	✓	✓	13,045	14%	15,566	13%	1%
Sydney Olympic Park	train, bus	24	✓	✓		26,524	14%	24,932	12%	3%
Liverpool	train, bus	31	✓	✓	✓	19,536	11%	20,700	10%	2%
Blacktown	train, bus	25	✓		✓	20,202	11%	19,773	9%	2%
Dee Why-Brookvale	bus	30	✓	✓	✓	21,831	10%	21,020	10%	0%
Bankstown	train, bus	63	✓	✓	✓	17,151	9%	17,552	8%	2%
Castle Hill	bus	11		✓	✓	7,641	8%	16,750	5%	2%
Penrith	train, bus	19	✓	✓	✓	20,160	7%	18,672	7%	0%
Sutherland	train, bus	14	✓	✓	✓	10,536	7%	9,910	7%	0%
Campbelltown	train, bus	13	✓	✓	✓	18,317	6%	16,627	6%	0%
Norwest	**bus**	**22**	✓	✓	✓	**23,586**	**5%**	**19,150**	**4%**	**2%**

The data indicate:

- There has been a general increase in public transport to centres ranging from 0% to 6%, with a weighted average increase of 3.3% from 2011 to 2016;
- Sydney CBD is a clear outlier, attracting about three times the number of trips of the nearest comparable centre, having a public transport mode share of more than double the closest alternative;
- Norwest has a public transport mode share of 5%, which is up two percentage points from 2011;
- The closest geographic centres that have similar levels of access to that of the future Norwest Precinct are Blacktown, Hornsby, Epping and Macquarie Park. These have public transport mode shares of 11%, 14%, 16%, and 24%, respectively; and
- The data does not capture the public transport travel speeds. Centres that have a train station, though, appear to have higher public transport mode share than equivalent centres (by density and distance).

It is therefore reasonable to expect that the future public transport mode share of Norwest could vary between 11% and 24% with the introduction of Sydney Metro Northwest, subject to other complementary planning policies.

However, with the wide geographic area of the SA2, large areas of business park are captured for Macquarie Park, Hornsby and Blacktown, that have much lower public transport preferences. It is therefore expected on benchmarking that the mode share would exceed 24% due to the more similar land uses in Macquarie Park to the proposed station site at Norwest.

Statistical analysis

A multiple regression was conducted for the density, size of centre and distance to Sydney CBD with the dependent variable of public transport mode share. This analysis extracts the underlying trends in the data so that relationships between density, size of centre and distance to CBD with public transport mode share can be determined. The results of the analysis are provided below.

Table 2 Summary regression statistics

Regression Statistics	
Multiple R	0.89
R Square	0.79
Adjusted R Square	0.76
Standard Error	0.078
Observations	25

Source: SCT Consulting, 2019

Table 3 Statistical results by independent variable

	Coefficient	Standard Error	t Statistic	P-value
Intercept	0.247	0.034	7.38	$3x10^{-7}$
Density (jobs/Ha)	0.0012	0.0004	2.92	0.0082
Distance to Sydney CBD (km)	-0.0048	0.0015	-3.23	0.0040
Centre size (jobs)	$-1.13x10^{-6}$	$9.30 x10^{-7}$	-1.21	0.24

Source: SCT Consulting, 2019

The multiple R of 0.90 indicates that the independent variables of density, size of centre and distance to Sydney CBD are together a good predictor of public transport mode share. There are variables that are likely masked by the analysis, as the quality of the public transport access was not included due to limited data available. That being said, research (Cervero, 2002) indicates that the built environment variables such as job density are good predictors of public transport use. Variables that are also significant contributors to public transport mode share for job locations are ratio of footpath km to road km and land use diversity.

The analysis indicates that increased density is associated with increased public transport mode share. Centres closer to Sydney CBD also have a higher public transport mode share.

Numerical relationships are measured using this analysis. For instance, a doubling of the density of Norwest would translate to 2.4 percentage point increase in public transport use, while centre size is not significant at the $p < 0.05$ level.

As part of Sydney Metro's precinct planning, many of the planning policies align with variables identified in literature and the statistical analysis that public transport mode share will improve as the development density and land use mix increases.

The Central City District Plan targets significant growth in jobs in Norwest, from 32,400 in 2016 to 49-53,000 jobs by 2036.

With these variables having a significant role in shaping public transport preferences, the analysis indicates that the Norwest Station site could have a public transport mode share of 61% assuming complementary transport and built form policies.

Conclusion

For the Norwest Station site, the public transport mode share could range between 24% and 61% depending on the types of transport and built form policies implemented.

Bibliography

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