Woollahra Municipal Council

3 August, 2022

# Knox Street Pedestrianisation

## Review of Environmental Factors

## About us

WSP is one of the world's leading professional services consulting firms. We are dedicated to our local communities and propelled by international brainpower. We are technical experts and strategic advisors including engineers, technicians, scientists, planners, surveyors and environmental specialists, as well as other design, program and construction management professionals. We design lasting solutions in the Transport & Water, Property & Buildings, Earth & Environment, and Mining & Power sector as well as offering strategic Advisory, Engagement & Digital services. With approximately 6,100 talented people in more than 50 offices in Australia and New Zealand, we engineer future ready projects that will help societies grow for lifetimes to come. www.wsp.com/en-au/.

## Acknowledgment of Country

WSP acknowledges the Gadigal and Birrabirragal people who are the traditional custodians of this land and pay respects to elders past, present and emerging.

We acknowledge the Traditional Custodians of this Country and their continuing connection to culture, community, land, sea and sky.

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**Revision schedule**

| DATE | REVISION | ISSUE | PREPARED BY | REVIEWED BY |
|---|---|---|---|---|
| 2 August 2022 | A | Final | Linda Rodriguez | Callum Sangkuhl |

# Declaration

I certify that I have reviewed and endorsed the contents of this REF document, and, to the best of my knowledge, it is in accordance with the EP&A Act, the EP&A Regulation and the NSW DPE *Guidelines for Division 5.1 assessments* (June 2022) approved under clause 170 of the EP&A Regulation, and the information it contains is neither false nor misleading.

**REF prepared by**:

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| NAME | TITLE | AGENCY | SIGNATURE | DATE |
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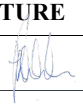
| Scott Pedder | Director Planning & Place | Woollahra Council |  | 18 August 2022 |

# Table of Contents

# 1 Executive summary

WSP have been engaged by Aspect Studios on behalf of Woollahra Municipal Council (Council) to provide a Review of Environmental Factors (REF) for the pedestrianisation of Knox Street, Double Bay.

The proposal intends to pedestrianise the four-lane carriageway between Bay Street and Goldman Lane and maintain a vehicular zone between Goldman Lane and New South Head Road.

*The State Environmental Planning Policy - Transport and Infrastructure 2021* (Transport and Infrastructure SEPP) allows certain works to be undertaken 'without consent'. The Site is defined as a 'public road' and the proposed work (including ancillary works) is defined as alterations and additions to a road. Development for the purpose of a road or road infrastructure facilities may be carried out by or on behalf of a public authority without consent on any land under the provisions of Clause 2.108 of the Transport and Infrastructure SEPP.

Assessment of the environmental impacts of the development is to be undertaken through a Part 5, Division 5.1 assessment under the *Environmental Planning and Assessment Act 1979* (EP&A Act) referred to as a review of environmental factors (REF). The document that records the Division 5.1 assessment is this REF document.

SCT Consulting was engaged to provide a Traffic and Parking Impact Study to support the proposed pedestrianisation of Knox Street. This Study concludes:

- Traffic impacts of the proposed pedestrianisation project are nominal. In some cases, the project reduces traffic delays due to intersection simplification.
- Parking impacts of the removal of the 28 on street car spaces can be accommodated in the on and off-street parking network within a short walk of the site.
- There are no bus impacts, as the street does not carry any public bus routes.
- The project is net positive for loading as the project delivers a new loading zone on Knox Street.
- Construction impacts are manageable. Diversions are provided to ensure access to properties.

This REF provides the determining authority adequate guidance to consider significance and meet responsibilities under Section 5.7 of the EP&A Act. In documenting the Division 5.1 assessment, the REF document:

- Complies with requirements under Part 5, Division 5.1 and Part 8, Division 1 of the *Environmental Planning and Assessment Regulation 2021* (EP&A Reg).
- Complies with the Department of Planning and Environment's *Guidelines for Division 5.1 Assessments* (March 2022).
- Contains all available information relevant to the assessment of the project and its environmental impacts to the fullest extent possible.
- Contains a consolidated description of the project.
- Identifies and address relevant statutory requirements, including EPIs or strategies, plans and policies (where relevant to the proposed activity).
- Summarises the findings of the technical assessment of the impacts (reports of which are appended to the REF).
- Contains an evaluation of the direct, indirect and cumulative impacts of the project
- Identifies mitigation measures to eliminate or reduce the detrimental effects of the proposal.

The assessment of the relevant environmental considerations provided in this REF concludes that the proposed development will not have an adverse impact on the environment or the surrounding locality, subject to the implementation of mitigation measures.

# 2 Introduction

## 2.1 Purpose of this Review of Environmental Factors

WSP have prepared this REF on behalf of Council to support the pedestrianisation of Knox Street and associated public domain works.

The purpose of this REF is to document the assessment of potential environmental impacts of the proposal and identify if there are likely to be any significant environmental impacts during construction and during the operation and use of the new facilities.

The REF has been prepared pursuant to Part 5 of the EP&A Act and Clause 228 of the EP&A Reg and is in accordance with the Department of Planning and Environment's (DPE) supporting Guidelines for Division 5.1 Assessments (June 2022).

The significance of any impacts was determined, and appropriate mitigation measures are recommended in **Section 9** and **Section 10** of this REF.

This REF should be read in conjunction with the accompanying documents listed in **Table 2**.

Table 2. Supporting documents

| DOCUMENT TITLE | PREPARED BY | ISSUED |
|---|---|---|
| Concept Design | Aspect Studios | 2022 |
| Concept Landscape Plan | Aspect Studios | 2022 |
| Excavation and Demolition Diagram | Aspect Studios | 2022 |
| Double Bay Commercial Centre – Pedestrianisation Study Recommendation Report | SCT Consulting | 7 September 2020 |
| Knox Street Plaza Traffic Engineering | SCT Consulting | 13 April 2022 |
| Traffic Management Plan | Woollahra Municipal Council | 2022 |
| Flood Assessment | Catchment Simulation Solutions | 17 January 2022 |
| Geotechnical Assessment | JK Geotechnics | 10 September 2021 |

The Transport and Infrastructure SEPP allows certain works to be undertaken 'without consent'. The site is defined as a public road under the control of, or vested in, Council. The proposed work is characterised as alterations and additions to a road and may be undertaken as works 'without consent under the provisions of Clause 2.108 of the Transport and Infrastructure SEPP, where development for the purpose of a road or road infrastructure facilities may be carried out by or on behalf of a public authority without consent on any land.

The proponent of the proposal is Council, a public authority, as defined by Section 4 of the EP&A Act.

If any EPI identifies an activity as 'development permitted without consent', a proponent will not need to obtain a development consent. Instead, they will need to assess the environmental impacts of the activity through a Division 5.1 assessment referred to as a Review of Environmental Factors ( REF). The document that records the Division 5.1 assessment is this subject REF document.

The potential impacts have been assessed in terms of the matters listed in clause 171(2) of the EP&A Reg, which lists the factors to be considered when an assessment is being given to the likely impact of a proposal on the environment. A summary of the factors is provided in **Section 9.**

To the fullest extent possible, all matters affecting or likely to affect the environment, for the purpose of protection and enhancement of the environment have been considered in this REF. The assessment concludes that the proposal is not likely to have a significant impact on the environment and therefore negating the requirement to prepare an Environmental Impact Statement (EIS).

## 2.2 Overview of the project

The proposal intends to pedestrianise the four-lane carriageway between Bay Street and Goldman Lane and maintain a vehicular zone between Goldman Lane and New South Head Road.Figure 1 Concept Plan

Source: Aspect Studios

### 2.2.1 Need for the project

Knox Street is considered the heart of Double Bay, both geographically and socially. It is the core of the Double Bay experience with a vibrant and active street life.

Historically outdoor dining started on Knox Street and is still a popular location for outdoor dining from early in the morning to well into the evening. There are currently around 100 outdoor dining seats on Knox Street and in locations footpath space is limited with cluttered and less than ideal seating arrangements compromising footpath circulation and *Disability Discrimination Act 1992* compliance.

Vehicle movements and kerbside parking of vehicles tends to dominate the streetscape at the expense of pedestrians and optimum outdoor dining experiences. Although vehicle movements are slow, the bend in the roadway and the lack of mid-block crossing points makes pedestrian movements difficult especially for older, disabled and younger pedestrians.

A review of published literature suggests there is an increase in business turnover and retail spending resulting from pedestrianisation of retail areas. Studies reviewing the impact of pedestrianisation on local businesses in the United Kingdom, Germany, and Hong Kong, all provide similar conclusions despite differences in geographical context, urban design, and culture.

Well-designed pedestrianisation schemes have seen significant increases in pedestrian traffic. This is directly correlated with improvements in pedestrian environment safety and connectivity, and, in some cases, improved public transport facilities. Increases of 20 -40% of pedestrian volumes within the first year are not uncommon and presents a driving factor for increases in business revenue. This cascades to increases in footfall trading by up to 40%, with individuals walking into shops spending up to 6 times more than drivers.

Some of these benefits are passed onto both local council and landlords as pedestrianisation often leads to increase in retail rental costs. A study in Hong Kong showed the complete pedestrianisation of a streetscape resulted in a 17% increase in retail rental value. However, increases in rental costs are sufficiently offset by

increases in business revenue from higher foot traffic. Furthermore, vacancy rates have been shown to drop within one year of pedestrianisation, with corresponding increases in employment and expected wage growth.

The project seeks to expand on Double Bay's vibrant commercial centre and create highly activated, safe and exciting pedestrian streets that attracts local and non-local residents by increasing pedestrian priority.

Knox Street is well-positioned to stand as a benchmark for a pedestrian-prioritised civic centre and a pilot project for the transformation of the Double Bay Commercial pedestrian precinct.

### 2.2.2 Relevant background

In 2019, Council considered a Notice of Motion and resolved to investigate the opportunities and formulate a plan for turning more of the Double Bay Commercial Centre into pedestrian only precincts. Suggested streets to include, but not necessarily be limited to:

i. Knox Street, and

ii. Transvaal Avenue.

On 5 August 2020, the NSW Government announced the launch of a $250 million NSW Public Spaces Legacy Program as part of ongoing work to protect the health of the community, provide economic and jobs stimulus in response to the COVID-19 pandemic and deliver a legacy of safe, quality public and open space.

SCT Consulting prepared the Double Bay Commercial Centre Pedestrianisation Study in 2020, which recommended that Knox Street between Bay Street to Goldman Lane could become a pedestrian plaza and one-way traffic could be implemented from Goldman Lane along Knox Street, exiting onto New South Head Road.

At the full Council Meeting held on 29 September 2020, Council resolved:

*A. THAT Council endorse the Double Bay Pedestrianisation Study.*

*B. THAT Council staff explore funding opportunities for the following projects identified in the Double Bay Pedestrianisation Study:*

*i. Knox Street Pedestrian Only Zone (between Bay Street & Goldman Lane)*

*ii. ....*

Council applied for the Knox Street Pedestrianisation and was successful in securing $4.75 million for the project. The funding is contingent on the project being constructed and open for use by December 2022.

### 2.2.3 Project objectives and principles

Council's vision is to increase the attractiveness of Double Bay, so that businesses attract more customers and customers travel by more sustainable modes of transport. The project aims to support Council's vision to enhance walking a connectivity between Double Bay and its surrounds.

The following design principles have been collaborated with community and represent the design aspirations for Knox Street:

**Figure 2** Design principles


Source: Aspect Studios

### 2.2.4 *Strategic justification*

#### Greater Sydney Commission (Greater Cities Commission) - Greater Sydney Region Plan and Eastern City District Plan

The Greater Sydney Commission's (Greater Cities Commission) *Eastern City District Plan* (March 2018) (District Plan) applies to the Woollahra Local Government Ara (LGA).

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

A key priority in the District Plan is liveability and creating places for people as well as fostering healthy, creative, culturally rich and socially connected communities.

The proposal assists to achieve the priorities of the District Plan where it seeks to pedestrianise Knox Street and improve walkability, public domain outcomes and create new public spaces to help activate the centre and serve the needs of the local and wider community.

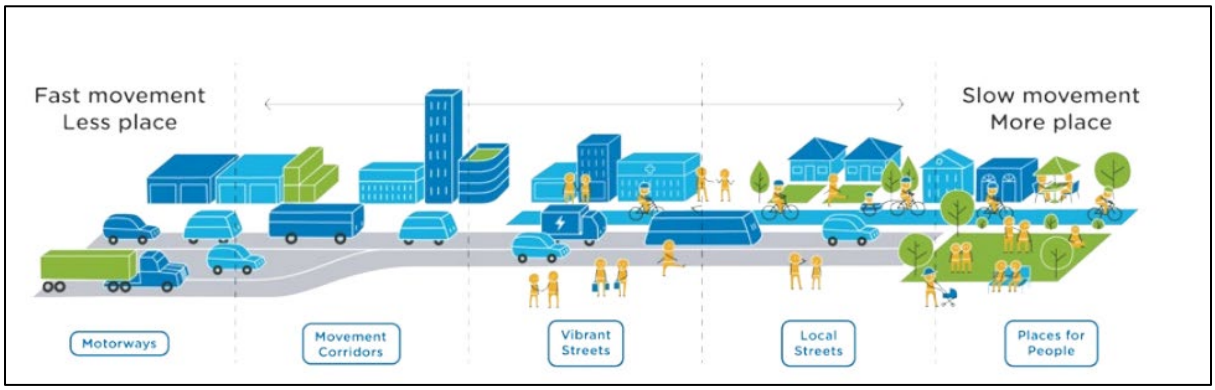
#### Transport for NSW - Future Transport 2056

The Transport for NSW's *Future Transport 2056* (March 2018) adopts an approach to balancing the dual functions of streets. It acknowledges that creating and renewing streets as great places is key to improving liveability. Walkable places, particularly streets, need to be designed, built and managed to encourage people of all ages and abilities to walk or cycle for leisure, transport or exercise. Walkable neighbourhoods support an active street life, which enhances community connections, safety and the success of local businesses, and improves social and economic participation. Improving walkability should guide decision-making on locations for new jobs and housing and prioritisation of transport, health, schools and social infrastructure investment.

Although streets differ in their function and character **(Figure 3**), maximising opportunities for walking, safe cycling and social interaction is a priority. This requires allocation of road space between footpaths, cycleways, public transport and vehicles that considers people's safety needs and balances movement and place functions in response to the type of street and local conditions.

The proposal seeks to pedestrianize Knox Street and create an enhanced public domain outcome, meeting the objectives of the Integrated Transport Strategy.

Figure 3 Movement and Place Framework – Integrated Transport Strategy




Source: Future Transport 2056 (TfNSW)

#### Woollahra 2030 Community Strategic Plan

*Woollahra 2030* is Council's community strategic plan (CSP) which sets out goals and strategies to guide all of Council's operations over a 10-year period. It is prepared under the *Local Government Act 1993.*

*Woollahra 2030* guides how Council budgets and plans for their services, operations and projects for social, economic, land use and environmental matters.

The vision statement for the Woollahra community as provided by the CSP is as follows:

- *Woollahra will continue be a great place to live, work and visit where places and spaces are safe, clean and well-maintained.*
- *Our community will offer a unique mix of urban villages with a good range of shops, services and facilities.*
- *We will make the most of the natural beauty, leafy streetscapes, open spaces, views and proximity to the water and the city.*
- *We will be a harmonious, engaged and connected community that looks out for each other.*

The project will support the above vision statement and the underlying values and priorities as provided in the CSP as follows:

- Contributes to community wellbeing where it:
    - Provides significant public domain improvements , enhanced safety and activation.
    - Supports cultural activities for all ages.
    - Supports a safe community through predestination of Knox Street.
    - Promotes active modes of transport, such as walking and cycling.
- Provides quality places and spaces through:
    - Retaining and enhancing the Double Bay village atmosphere.
    - Integrates sustainable measures into the design of the public domain improvements.
    - Represents renewed and upgraded infrastructure, especially footpaths, pedestrian ramps, kerb, guttering, stormwater drainage and local roads with good pedestrian and bicycling access.
    - Enhanced street trees and new parks.

### Woollahra Local Strategic Planning Statement 2020

The *Woollahra Local Strategic Planning Statement 2020* (LSPS) is a legal document that sets out a 20-year vision and planning priorities for managing future land use and preserving the community's values and the special characteristics of the area. It supports and guides Woollahra's planning controls to help ensure the area continues to be a great place to live work, play and visit.

Woollahra's vision as stipulated in the LSPS is provided as follows:

> *Outstanding heritage, lifestyle, leafy, boutique villages and an unrivalled open, sunny harbour-side landscape in Sydney's east.*

Placemaking opportunities such as the pedestrianisation of Knox Street will support the overarching LSPS vision where it will help to ensure that the communities' lifestyle, quality of life, heritage, neighbourhood social cohesion and healthy natural setting are sustainable for generations to come.

The project will support the objective to provide safe places which are liveable, sustainable and economically productive. It supports the Double Bay Centre and provides a new public space which will be safe and comfortable to be in and to meet people.

Underpinned by the LSPS vision are a number of local planning priorities addressed in table 4 below.

Table 1 LSPS Strategic Alignment

| ***PLANNING PRIORITY*** | ***STRATEGIC ALIGNMENT*** |
|---|---|
| **Infrastructure and collaboration** | |
| *Planning Priority 2* | The pedestrianisation of Knox Street will promote active and more sustainable modes of transport such as walking and cycling. |

| | |
|---|---|
| *Planning for a community supported by infrastructure that fosters health, creativity, cultural activities and social connections.*<br><br>*Key Actions:*<br><br>*7. Plan and create pedestrianised street settings across our area that prioritise people and placemaking.*<br><br>*11. Increase street plantings and tree canopy along streetscapes and pathways to provide shade and a healthy, visually appealing setting for walking, cycling and enjoying the public domain.* | The new public domain will support creative and cultural activities and enhance social connectivity and activation of uses along Knox Street.<br><br>The proposal seeks to extend existing activation events such as markets from Guilfoyle Park into Knox Street.<br><br>The pedestrianisation of Knox Street provides safe, high quality walking and cycling links that facilitate short trips to local destinations. |
| **Liveability** | |
| *Planning Priority 4*<br><br>*Placemaking supports and maintains the local character of our neighbourhoods and villages whilst creating great places for people.* | The concept picks up on the existing scale and character as well as the articulation of existing connections and laneways.<br><br>It continues the tree canopy and park character through Knox Street.<br><br>To ensure Knox Street Plaza achieves its bench-mark aspiration, designing for Country will incorporate key narratives. |
| **Productivity** | |
| *Planning Priority 8*<br><br>*Collaborating to achieve great placemaking outcomes in our local centres which are hubs for jobs, shopping, dining, entertainment and community activities.* | The proposed pedestrianisation of Knox Street creates a narrative to the street that caters to a range of experiences.<br><br>The proposal achieves a balance between dining experience with communal amenity.<br><br>The project introduces flexible edges and a variety of amenities to compliment various uses in the Double Bay Centre.<br><br>It locates proposed outdoor dining opportunities with existing food & beverage venues and complements food & beverage outdoor dining with a range of public seating and table opportunities. |
| **Sustainability** | |
| *Planning Priority 11*<br><br>*Conserving, enhancing and connecting our diverse and healthy green spaces and habitat, including bushland, tree canopy, gardens and parklands.* | The pedestrianisation of Knox Street seeks to continue tree canopy and park character provided by Guilfoyle Square into Knox Street, including canopy tree planting to provide a comfortable, connected and green public domain. |

| | |
|---|---|
| | The project will enhance tree canopy cover, public space connectivity and activation of the public domain, supporting a healthy lifestyle and connectivity to the natural environment. |

### Draft Woollahra Integrated Transport Strategy

Councils *draft Integrated Transport Strategy* (draft ITS) sets out a vision for a more accessible municipality where active, sustainable and efficient modes of transport are the most convenient choice for most trips.

One of the key objectives of the Draft ITS is to modify travel behaviour to reduce congestion and enhance liveability in Woollahra. This means addressing the many transport challenges facing the Woollahra municipality, including:

- The heavy dependence on cars for primary transportation.
- An incomplete active transport network that doesn't support trips to shops, schools and destinations.
- Access for children and people with disabilities and mobility issues.
- Pedestrian and cyclist safety.
- Traffic congestion.
- Excessive speed resulting in car crashes.
- Increased construction and delivery vehicles.
- Distance to jobs, services and amenities.

Council's draft ITS sets out the key principles, objectives, targets, policy commitments and actions relating to access and mobility, public transport, active transport and roads and parking for the LGA. It aims to reduce dependence on private vehicles by promoting and supporting viable public and active transport services.

The document identifies four key signature projects that Council will pursue to support the draft ITS transport objectives:

- The Paddington Greenway (Paddington Greenway Feasibility Study)
- **The Knox Street Plaza (Double Bay Pedestrianisation Study)**
- Transvaal Avenue Pedestrianisation (Double Bay Pedestrianisation Study)
- 30km/hr or 40km/hr zone for the Double Bay commercial centre

The project supports the implementation of the draft ITS as follows:

- Progresses the recommendations of the Double Bay Pedestrianisation Study (see below) as outlined in the draft ITS
- The pedestrianisation of Knox Street will meet the guiding principles of the Integrated Transport Strategy where the project will deliver a vibrant street that balances high pedestrian activity and densities attracted by significant commercial, tourism, leisure and entertainment venues.
- The project seeks to prioritise places for people and active modes of movement through promoting walking and cycling by way of closing the road to motor vehicle traffic and creating a space that is activated and safe through appropriate embellishments.

### Double Bay Commercial Centre Pedestrianisation Study

This Study seeks to provide guidance to Council on options to expand on Double Bay's vibrant commercial centre and create highly activated, safe and exciting pedestrian streets.

In 2019, Council considered a Notice of Motion and resolved to investigate the opportunities and formulate a plan for turning more of the Double Bay Commercial Centre into pedestrian only precincts. Suggested streets to include, but not necessarily be limited to:

- Knox Street
- Transvaal Avenue.

This study:

- Summarises the existing land use and transport context including road features, levels of traffic, public transport provision, as well as walking and cycling facilities;
- Identifies options to transform Double Bay Commercial Centre into a vibrant area that attracts local and nonlocals residents by increasing pedestrian priority; and
- Provides a summary of infrastructure works and cost estimate to achieve this vision.

This project aims to progress Council's vision to enhance walking and cycling connectivity between Double Bay and its surrounds as outlined in the Double Bay Pedestrianisation Study.

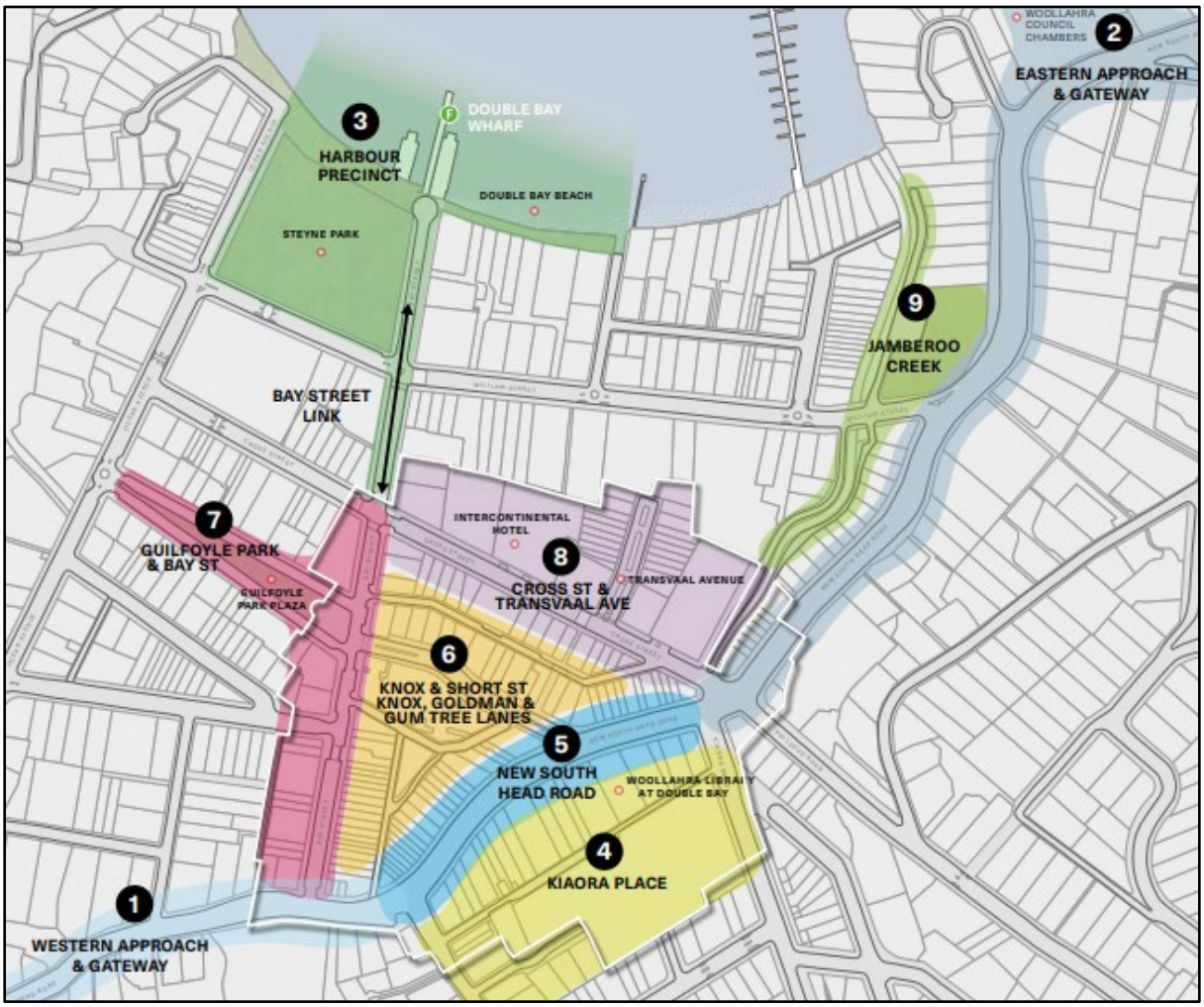
### Double Bay Centre Planning and Urban Design Study

Councils *Double Bay Centre Planning and Urban Design Study* aims to examine the existing strengths of the centre, identify the challenges and opportunities, and propose some overarching ideas that will create a better connected, stronger centre that can continue to grow and change to suit the local community. The Study builds on the existing successful public domain framework and urban palette of the 'Double Bay Suite', whilst retaining and refining certain elements and recommending locations for improvements and additions to the public domain where possible.

It includes key moves for the future such as those relevant to this project, including:

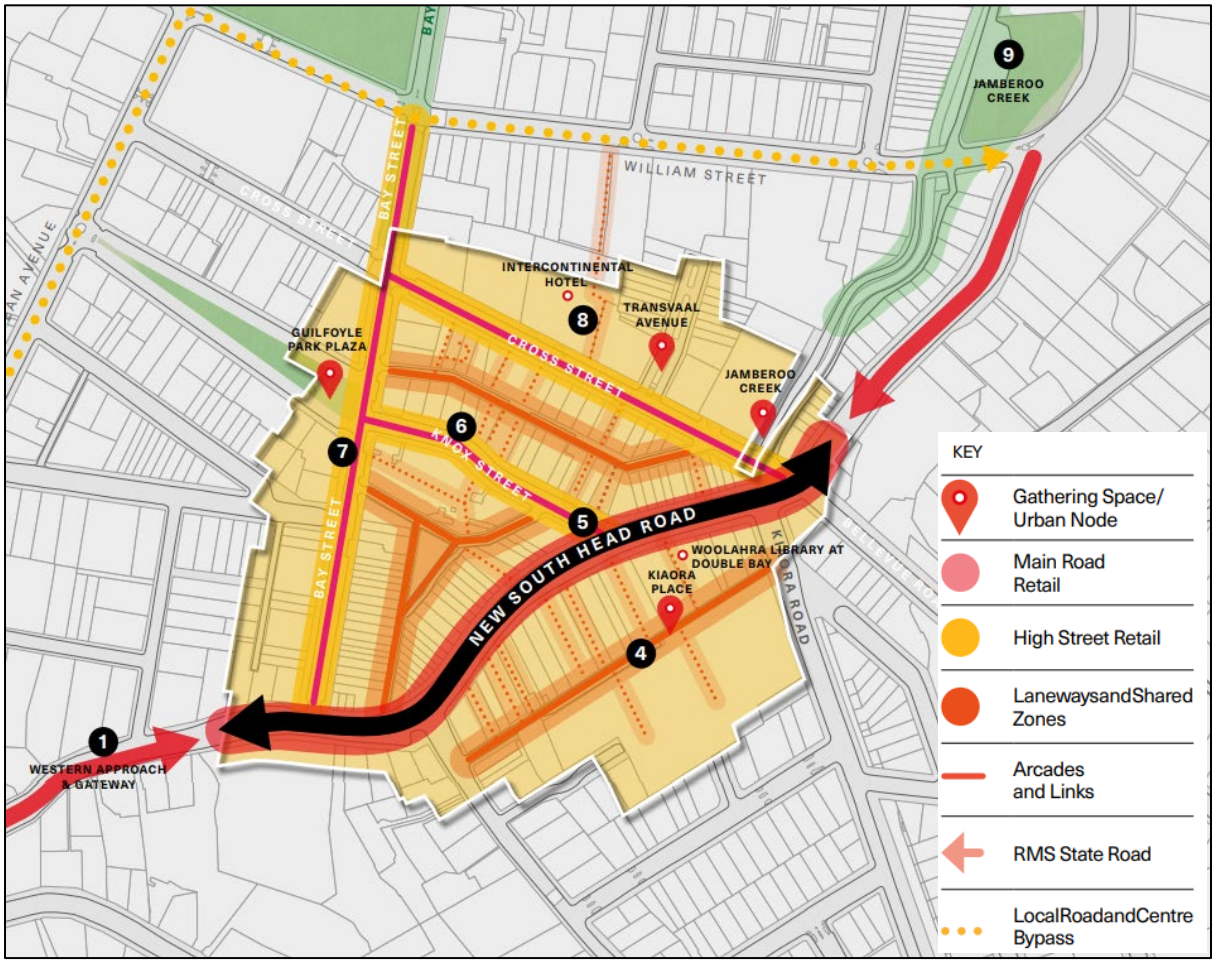
- Maintaining a strong emphasis on outdoor spaces, outdoor activities, street life and the pedestrian experience.
- Refocusing and rebalance the centre with upgraded streetscapes, laneways, public spaces and lighting.
- Upgrading laneways and Knox Street and Knox Lane core area to increase active frontages.

**Figure 3** Double Bay Precincts




Source: Double Bay Centre Public Domain Strategy

**Figure 4** Double Bay sub-precincts




Source: Double Bay Centre Public Domain Strategy

At the heart of Double Bay, Knox Street has long been identified as quintessential part of the village appeal with boutique shopping, hotels, cafés and a concentration of outdoor dining activity. Upgrading Knox Street and Knox Lane to strengthen the core that links Guilfoyle Park to New South Head Road and through to the library, Kiaora Place and the retail activity to the south of the centre is a key priority for the centre. Improving connectivity to laneways and arcades that link through to Knox Street is important for orientation within the centre and for the success of business in these secondary spaces.

The Strategy seeks to upgrade Knox Street as a central outdoor dining, café and shopping area linking Guilfoyle Park and New South Head Road through to the south precinct and Kiaora Place.

Accordingly, the project serves to implement a number of the key outcomes of the Double Bay Centre Public Domain Study.

## 2.3 Alternative options considered

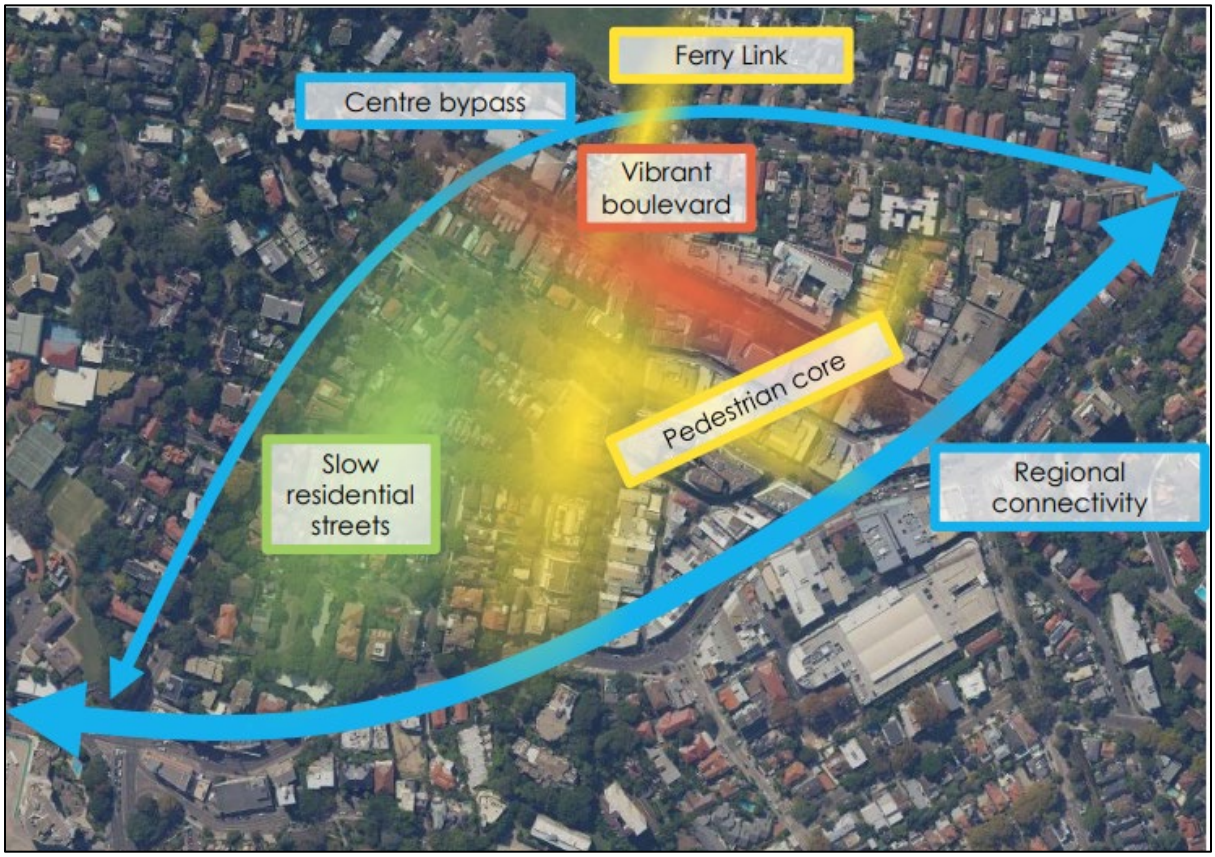
### *2.3.1 Project Vision*

Establishing a vision assists in informing how treatments 'fit' into the overall strategy for the centre. Key aspects of the vision are:

- Regional Connectivity - New South Head Road provides regional transport connections, where movement efficiency is paramount.

- Centre Bypass - This bypass is served by Ocean Avenue and William Street and encourages local traffic to avoid the centre and the high pedestrian areas.
- Vibrant Boulevard - Cross Street provides access for cars into the centre and accommodates a mix of movement and place.
- Pedestrian Core and Ferry Link - Streets like Knox Street, Transvaal Street and Bay Street are vibrant, pedestrian-focussed streets.
- Slow Residential Streets - Encouraging slow traffic for safety and so that walking or cycling to the centre is attractive.

Figure 5 Double Bay Centre Access Vision

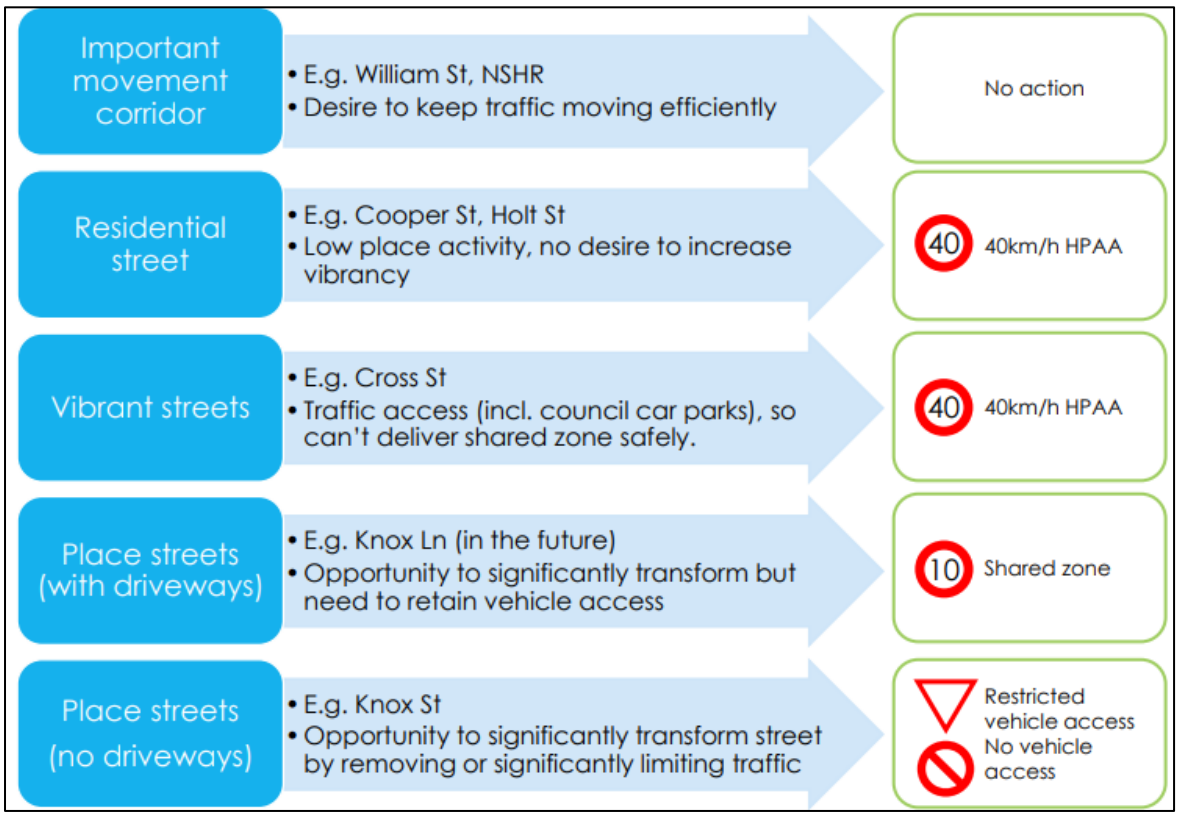



Source: Double Bay Pedestrianisation Study (SCT Consulting)

### 2.3.2 *Methodology*

The methodology illustrated in **Figure 6** below was used to long-list options for pedestrianisation in Double Bay. The intent of this methodology is to ensure the streets best suited to pedestrianisation were selected.

Figure 6 Project options analysis methodology




Source: Double Bay Pedestrianisation Study (SCT Consulting) 2020

As part of the Double Bay Pedestrianisation Study undertaken by SCT Consulting (7 September 2020) Knox Street was assessed to have high potential for pedestrianisation where:

- There are no driveway ways servicing the existing developments along Knox Street
- Provides a movement classification score of 3[1]
- Provides a place classification score of 4 [2]

### 2.3.3 *Evaluation of the options*

**Pedestrianisation – Option 1 (Preferred)**

Option 1 proposed the following changes:

- Pedestrianisation with no vehicle access along parts of Transvaal Avenue and Knox Street.
- This option allows for improved pedestrian priority in the commercial centre core while retaining vehicle access along Bay Street.
- Shared zones are proposed along roads with high pedestrian activity and driveway access to residential and commercial buildings.
- Options 2 and 3 can still be considered in the medium or long-term after option 1 is implemented.

[1] Movement classifications range between 1 and 4 with 1 being the lowest and 4 the highest.

[2] Place classifications range between 1 and 4 with 1 being the lowest and 4 the highest.

Figure 7 Option 1 Pedestrianisation Concept


Source: Double Bay Pedestrianisation Study (SCT Consulting) 2020

### Pedestrianisation -Option 2

Option 2 proposed the following changes:

- Pedestrianisation with no vehicle access along Double Bay's most vibrant streets like Knox Street, Transvaal Avenue and Bay Street while retaining access to Short Street from Bay Street.
- Connecting Guilfoyle Avenue on the eastern end to allow for road closures along Bay Street.
- Shared zones along roads with high pedestrian activity and driveway access to residential and commercial buildings.

Figure 8 Pedestrianisation Concept Option 2


Source: Double Bay Pedestrianisation Study (SCT Consulting) 2020

### Pedestrianisation -Option 3

Option 3 proposed the following changes:

- Pedestrianisation with no vehicle access along Double Bay's most vibrant streets like Knox Street, Transvaal Avenue and Bay Street.
- This option proposed the maximum amount of fully pedestrianised areas.
- Vehicles accessing Short Street will need to travel along Ocean Street and Cooper Street instead of Bay Street (current movement pattern).
- Connecting Guilfoyle Avenue on the eastern end to allow for road closures along Bay Street.
- Shared zones along roads with high pedestrian activity and driveway access to residential and commercial buildings.

Figure 9 Pedestrianisation Option Concept 3


Source: Double Bay Pedestrianisation Study (SCT Consulting) 2020

### 2.3.4 *The 'do-nothing' approach*

The do-nothing approach would retain the status quo where vehicles dominate the streetscape at the expense of pedestrians and optimum outdoor dining experiences.

### 2.3.5 *Justification of the preferred option*

In addition to the above, Option 1 was chosen as Knox Street has high pedestrian activity and there are no driveways requiring access.

# 3 Site

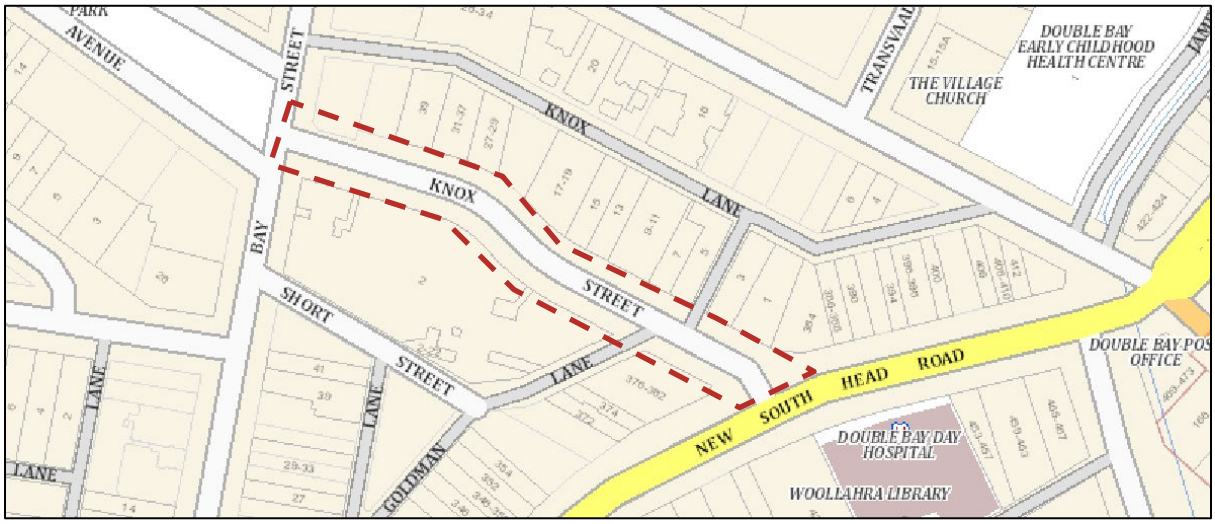
## 3.1 Location of the project

The site comprises the four-lane carriageway of Knox Street Double Bay, between Bay Street and Goldman Lane, Double Bay. The site adjoins New South Head Road to the east.

Figure 10 Aerial map of subject site

Source: SixMaps, 2021

Figure 11 Street map of subject site




Source: SixMaps, 2021

## 3.2 Site description and context

Knox Street is a 180-metre-long high street with a mix of retail, hospitality, hotel and office frontages running between New South Head Road and Bay Street. There are a total of eight existing arcades and laneways that connect Knox Lane through to Knox Lane and Short Street, including the Cosmopolitan Centre arcades.

Knox Street is the last street still paved in original concrete pavers which are at the end of their life and require replacement to match Cross and Bay Streets.

Table 4.1 Site summary

| ITEM | DESCRIPTION |
|---|---|
| Local Government Area | Woollahra Municipal Council |
| Street address | Knox Street Double Bay |
| Local Environmental Planning Instrument | Woollahra Local Environmental plan 2014 (WLEP 2014) |
| Zoning | B2 Local Centre |
| Permissibility | Yes |
| Existing land use | Public Road |
| Adjacent land uses | Commercial, retail and mixed use |
| Topography | Relatively flat |

Double Bay is a relatively unique centre, in that it is the largest full-service, mixed-use centre by area located directly adjacent to Sydney Harbour

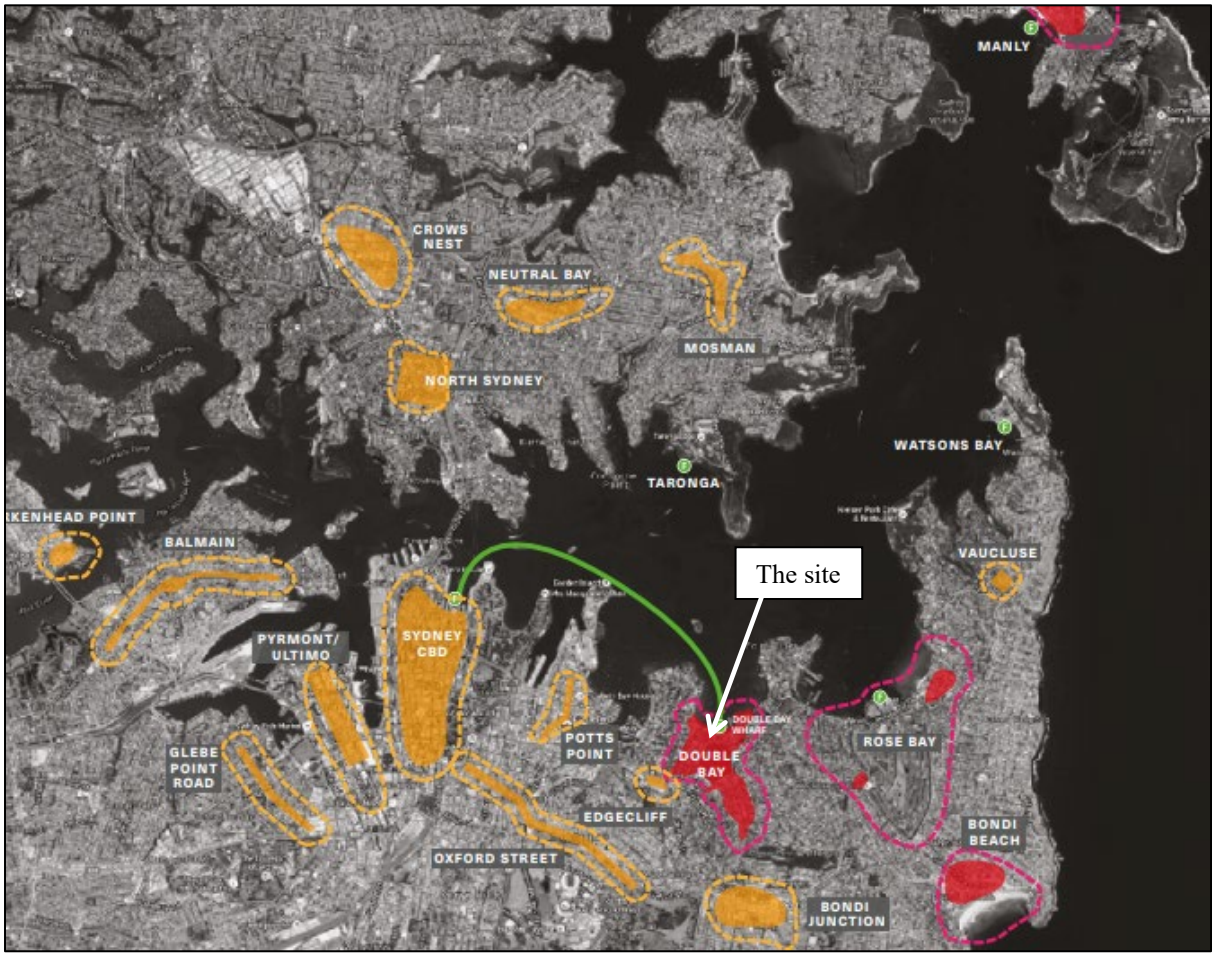
Double Bay is located just 2km from Kings Cross and Bondi Junction and less than 4km from both Sydney CBD and Bondi Beach. Double Bay is a diverse fine grain civic, retail and business centre surrounded by established dense residential neighbourhoods.

Double Bay has an excellent existing structure and public domain amenity that is a good base for continued refinement and improvements that can increase economic activity, liveability and visitation, whilst deepening the offer and success of the centre as a unique village east of the Sydney CBD.

The centre has a busy arterial road that runs east–west through it along New South Head Road, complemented and moderated by quieter adjacent streets, arcades and laneways that provide respite from the traffic and noise of this busy road.

The centre is highly permeable with a number of private retail arcades that connect parallel streets and activity nodes.

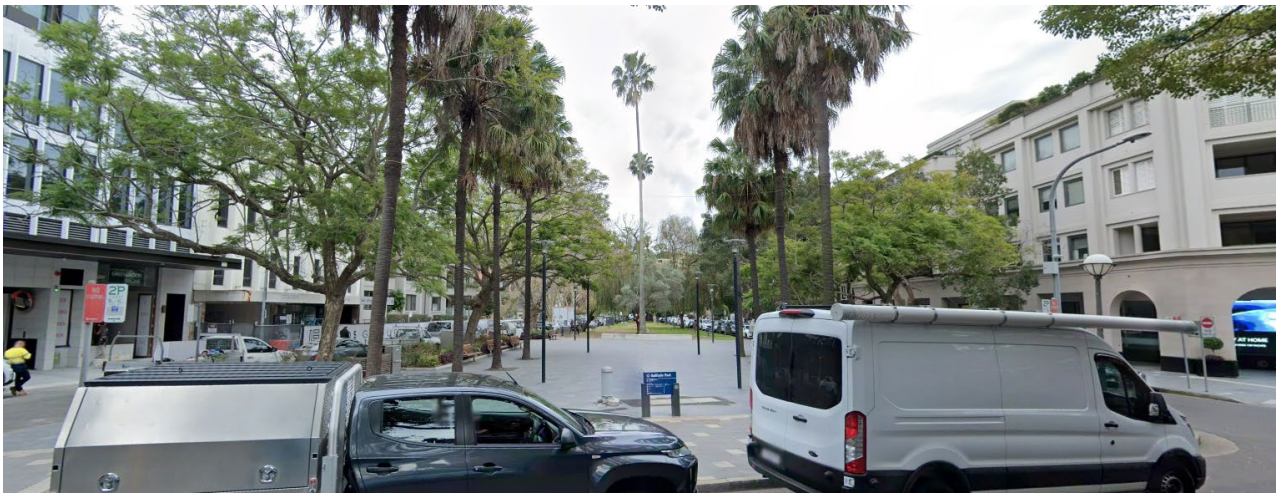
Figure 12 Site Context Map




Source: Double Bay Centre Public Domain Strategy (Aspect Studios)

## 3.3 Site photography

The following figures provides context photos of the site.



West end of Knox Street, view of Guilfoyle Park. Western aspect


West end of Knox Street, eastern aspect looking down Knox Street


Central Knox Street, western aspect


Central Knox Street, eastern aspect


Entrance of Goldman Lane South


Eastern end of Knox Street, western aspect

## 3.4 Land ownership

The site is classified as a local public road and is owned and managed by Woollahra Municipal Council. The site adjoins New South Head Road to the east which is a Classified Road owned and managed by TfNSW.

## 3.5 Site characteristics

The site area the subject of this assessment is a road corridor.

Much of its area retains the appearance of typical road surfaces, incorporating bitumen paving, asphaltic concrete kerb and guttering, intermittent landscaping and some public amenities such as public seats, street lighting and the like. Immediately beside the bitumen and kerb is the existing paved pedestrian footpath.

The street is typically lined by one to five storey mixed use buildings (including residential above commercial). Their form and age of public and private improvements within and adjoining the corridor vary significantly. based on a cursory inspection from the street frontage.

At some locations median gardens are present containing hedges and medium sized trees, particularly at each end of the road.

Vehicular traffic is two-way along the length of Knox Street.

There are no driveway crossings along Knox Street to the adjoining buildings.

### *3.5.1 Topography*

The site is located in relatively low-lying topography associated with the foreshore of Sydney Harbour to the north. The site initially has a gentle slope down from its eastern end and then flattens for the majority of the remainder of the site. The site is bound by New South Head Road to the east and Bay Street to the west.

### *3.5.2 Geology*

The Geological Map of Sydney (Geological Series Sheet 9130, Scale 1:100,000, 1983), published by the Department of Mineral Resources indicates that the site is mapped to be underlain by man-made fill overlying Quaternary age alluvial and estuarine soils consisting of medium to fine grained “marine” sand with podsols.

Geotechnical investigations (**Appendix D**) have been undertaken within various sites to the east, west and south of Knox Street. Based on the results of those investigations ,it is expected that the subsurface profile would comprise sandy fill possibly to depths of about 1.5m covering natural silty sand and then sandstone bedrock at considerable depth. Fill would also be present associated with the buried services that run below the road and footpath. Within our previous investigations, the natural sands were generally initially of very loose to relative density but improved to be of medium dense relative density around 2m to 2.5m depth. We expect the groundwater table to be relatively high at around RL1.0m.

### *3.5.3 Hydrology*

Part of the site (sections of Knox Street and Bay Street) is identified as flood affected. A Flood Assessment was prepared (**Appendix E**) to assess the impact that the proposed land use and topographic changes may have on existing flood behaviour.

Inundation on Knox Street in the 5% AEP (Annual Exceedance Probability) is concentrated at the western end of the street, with depths generally greater than 0.5 metres. Water depths of more than 0.9 metres are predicted near the intersection with Bay Street. Depths along the eastern portion of Knox Street are generally between 0.15 and 0.3 metres and generally contained to the gutter. Depths on Bay Street are predicted to be between 0.4 and 0.6 metres. Peak flood levels vary very little across the study area, with a peak level of around 3.5m AHD extending across most of Knox Street and Bay Street in the vicinity of the proposed works.

In the 1% AEP event, floodwater depths across the western end of Knox Street are predicted to vary between 0.6 metres and 1 metre. Peak water depths of over 0.6 metres are common on Bay St. Depths of up to 0.3 metres are predicted across the eastern section of Knox St, however, floodwater again is generally contained to the gutter. A peak flood level of ~3.6m AHD extends across Knox Street and Bay Street in the vicinity of the proposed works.

# 4 Project description

This chapter describes the project and summarises key design parameters as well as the construction and operation phases of the project. The description of the project is based on the concept design and is subject to further detailed design.

## 4.1 The project

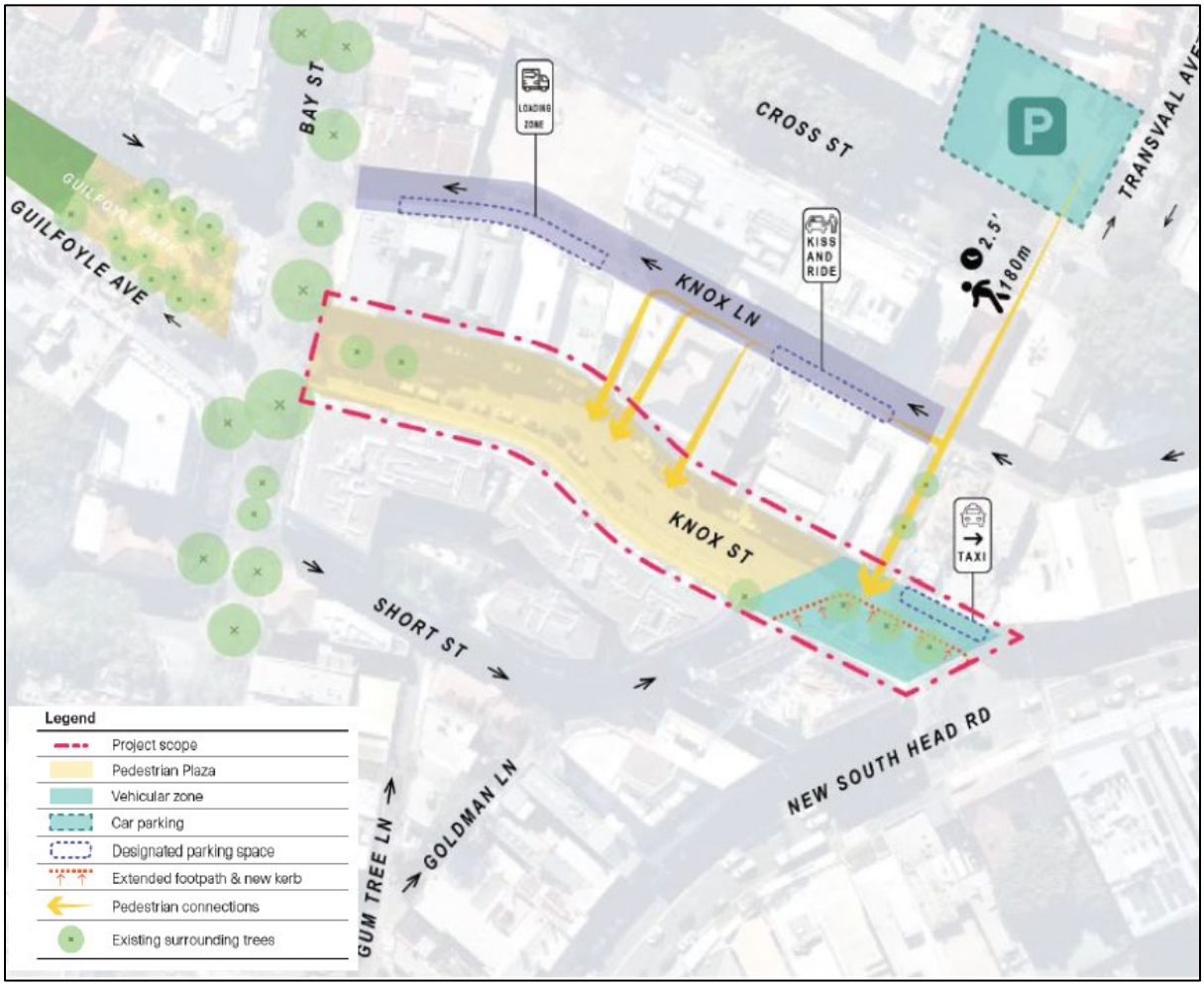
The project seeks to pedestrianise Knox Street Double Bay including associated public domain improvement works and embellishments.

## 4.2 Scope of works

The scope of works covered by this REF is detailed as follows:

- Demolition of existing elements.
- Excavation for trees, planting and landscaping elements.
- Pedestrianised plaza on Knox Street between Goldman Lane and Bay Street.
- Relocation of Taxi Zone in Knox Street.
- Removal of 28 (metered) car parking spaces.
- Relocation of short term parking in Knox Street.
- Removal of six (6) trees.
- Replacement of twenty (20) new large trees.
- Introduction of 'One-Way' eastbound traffic flow for Knox Street, from Goldman Lane to New South Head Road.
- Replacement of road carriageway with paved plaza space.
- Continuation of tree canopy and introduction of landscaping.
- Increased public seating both permanent and temporary.
- Opportunities for outdoor seating and dining.
- Provision of a pavilion structure to support activation.
- Prioritise pedestrian connection with Guilfoyle Park to Knox Street through paving treatment and raised trafficable thresholds.
- Extend existing activation events such as markets from Guilfoyle Park to support and grow on popular activations.
- High quality public domain lighting scheme with feature lighting.
- Pavilion structure at Bay Street
- Increase in bicycle hoops (five in total).

Figure 13 Placemaking concept




Source: Knox Street Plaza Traffic and Parking Impact Study (SCT, April 2022)

## 4.3 Construction activities

### 4.3.1 Works program

The duration of construction is expected to be from January 2023 to June 2023.

### 4.3.2 Construction description

Construction will involve:

- Demolition of existing road
- Capping off / diversion of existing services
- Construction of substructure
- Construction of plaza
- Commissioning and handover

### 4.3.3 Working hours

Per the Draft Construction Noise Guideline (EP&A act) recommended standard hours for construction work, the majority of construction activities are proposed to occur between the hours of 7am to 6pm on weekdays and 8am to 1pm Saturdays, with no work on Sundays or Public Holidays.

The work does not involve blasting.

To maintain access to businesses on Knox Street, some limited night work may be required.

### 4.3.4 Traffic access and vehicle materials

Final construction vehicle numbers are still being confirmed. As indicated in the Traffic Management Plan (**Appendix X**), the construction is estimated to generate the following traffic on a typical day:

- A workforce of about 30, with workers assumed to be arriving in the morning peak and leaving in the evening peak
- Heavy vehicle movements of typically up to 10 per day.

Construction workers would typically arrive in light vehicles. The potential heavy vehicles are shown in the table below:

| Construction vehicle | Vehicle length | Purpose |
|---|---|---|
| Heavy Rigid Vehicle | 12.5m | Mobile concrete booms, concrete trucks |
| Small or medium rigid vehicles | 6.4-8.8m | Delivery of other materials, removal of spoil and construction waste |

Heavy vehicles will generally park within the cordoned works zone. Work zones could be provided on Knox Lane if there are truck holding requirements during construction. Knox Lane has fewer retail frontages and is, therefore, less significant compared to other locations such as Bay Street.

New South Head Road is the closest state road that provides access to the site. Haulage routes for heavy vehicles should prioritise the use of Knox Street to avoid impacts on other streets in the centre. Access to potential work zones in Knox Lane should be via Cross Street.

### 4.3.5 Road closures during construction

The project involves the closure of Knox Street, which will be undertaken as part of the construction works.

### 4.3.6 Bulk earthworks

Based on the supplied information, it is anticipated that there will be relatively minor excavations required, less than 1m depth, primarily for the installation of buried services and construction of high-level footings.

## 4.4 Operation and ongoing maintenance

Upon completion, the newly installed assets will be added to Council's Asset Register for inclusion in Council's operation and renewal schedules. The site will be included in the various operational team's schedules.

# 5 Statutory considerations

## 5.1 Commonwealth legislation

### 5.1.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the Act as matters of National Environmental Significance (NES).

The proposed activity has been assessed against the EPBC Act. The location of the site, relatively minor nature of the activity and the mitigation measures outlined in this report should avoid significant impact on the following:

- a declared World Heritage Property.
- a National Heritage place.
- a declared Ramsar wetland.
- Commonwealth listed migratory species.
- Commonwealth listed threatened species or endangered community.
- Commonwealth marine areas.
- Commonwealth land.

Furthermore, the proposal was not considered to have a significant impact on matters of national environmental significance. As such a referral to Department of Agriculture, Water and the Environment (DAWE) is not required.

## 5.2 NSW legislation and regulations

### 5.2.1 Environmental Planning and Assessment Act 1979

As discussed in **Section 3.1** above, the subject activity does not require development consent in accordance with Part 4 of the EP&A Act but does require assessment according to Part 5 of the EP&A Act.

Section 5.1 of the EP&A Act defines a "determining authority" as "a Minister or public authority and, in relation to any activity, means the Minister or public authority by or on whose behalf the activity is or is to be carried out or any Minister or public authority whose approval is required in order to enable the activity to be carried out." Council is a public authority and is therefore the determining authority and the proponent for the activity.

Prior to proceeding with the activity, Section 5.5(1) of the EP&A Act requires a determining authority to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment as a result of the activity. This report, in particular Section 6 below, provides the necessary assessment.

Section 5.5(3) of the EP&A Act also requires that the determining authority consider the effect of an activity on any "wilderness area" as defined by the *Wilderness Act 1987*. The subject site is not a "wilderness area" and is not in proximity to any such area. It will, therefore, not have any impact on any "wilderness area". The provisions of this section are, therefore, satisfied.

### 5.2.2 Roads Act 1993 (Roads Act)

Section 3 – Objects of Act

The objectives of the *Roads Act 1993* are as follows:

*a) to set out the rights of members of the public to pass along public roads, and*

b) *to set out the rights of persons who own land adjoining a public road to have access to the public road, and*

c) *to establish the procedures for the opening and closing of a public road, and*

d) *to provide for the classification of roads, and*

e) *to provide for the declaration of RMS and other public authorities as roads authorities for both classified and unclassified roads, and*

f) *to confer certain functions (in particular, the function of carrying out road work) on RMS and on other roads authorities, and*

g) *to provide for the distribution of the functions conferred by this Act between RMS and other roads authorities, and*

h) *to regulate the carrying out of various activities on public roads*

Part 4 – Closing of Public Roads

This part outlines the approval pathway for the closure of public roads. Road closures which may be required for the purposes of this activity will be sought separately by Council.

The permanent road closure to crown lands will be considered following the finalisation of the detail design of this project. Mitigation measures will be included requiring Council to obtain any further necessary approvals.

The timeline dates of all actions undertaken by Council for the traffic approvals process to date is summarised as follows:

| Date | Action |
|---|---|
| 3 – 23 February 2022 | Public exhibition of concept including traffic plan |
| 1 March 2022 | The traffic and parking implications related to the proposed permanent road closure of Knox Street and the 'one-way' eastbound traffic flow were presented to Woollahra Council's Local Traffic Committee for consideration; |
| 20 April 2022 | Submissions close for advertisement of Permanent Road closure in local Newspaper in accordance with legislation; |
| 20 April 2022 | Traffic Management Plan sent to Transport for NSW for review and approval in relation to works adjacent to a classified road and closure of Knox Street. |
| 26 April 2022 | A further report was brought to an Extraordinary Local Traffic Committee to address the issues raised in the meeting of 1 March 2022. |
| 2 May 2022 | Minutes of the Extraordinary Local Traffic Committee approved at Council's Finance Community and Services Committee. |
| 2 May 2022 | Adoption by Council. |

Section 71 – Powers of Roads Authority with Respect to Road Work

Section 71, Part 6 of the *Roads Act 1993* provides that a "roads authority" may carry out road work on any public road. Council is a "roads authority" as prescribed in Section 7 of the *Roads Act 1993*. Therefore, Council may carry out the proposed activity.

Section 75 – Public authorities to notify RMS of proposal to carry out road work on classified roads

This section requires approval for road works by TfNSW within a classified road. The subject road (Knox Street) is not a classified road, however New South Head Road immediately to the east is a Classified Road, thus approval by TfNSW is required in this instance.

Section 76 – Roads authorities to notify RMS of proposal to carry out major road work

This section requires a roads authority to seek approval from TfNSW for any works within a public road with a value of $2 million. Approval from TfNSW is required regardless of Section 76, for the reasons discussed immediately above. This aside, it is understood that the proposal's cost of works is approximately $3.9million and referral to TfNSW is also required under Section 76.

Section 85 – Location of Conduits for Utility Services

This section requires the roads authority to consult with utility providers in relation to any road works which involve installation of conduits for utility services. The proposed activity includes the installation of various utilities. A mitigation measure is included which requires Council to consult with the relevant utility providers.

Section 88 – Tree Felling

This section provides that a roads authority may, despite any other Act or law to the contrary, remove or lop any tree or other vegetation that is on or overhanging a public road if, in its opinion, it is necessary to do so for the purpose of carrying out road work or removing a traffic hazard.

The concept plans demonstrate that approximately six (6) trees will be removed for the purposes of the proposal activity. Whilst addressed in this REF, Council may also rely on this section for their removal. The replacement trees will be of a healthier species of advanced maturity as recommended in the Arboricultural Impact Assessment (**Appendix B**).

Section 138 – Works and structures

In summary, this section provides that works cannot be undertaken to any public road without the consent of the appropriate "roads authority". In the case of a classified road, the consent of the RMS/TfNSW is also required. Consent from TfNSW is required in this instance where Knox Street adjoins New South Head Road, which is a Classified Road.

### 5.2.3 Summary of approvals under the Roads Act

- Obtain TfNSW approval for proposed works in accordance with Section 75 and 76 of the Roads Act.
- Consult relevant utility providers with regard to the installation of any utility conduits for the purposes of Section 85 of the Roads Act.
- Obtain approval for any further temporary road closures in accordance with Section 138 of the Roads Act 1993

### 5.2.4 Other NSW legislation and regulations

Other NSW legislation and regulations that are applicable to the project are discussed in Table 5.1.

Table 5.1 Other NSW legislation and regulations applicable to the project

| LEGISLATION | CONSIDERATIONS |
|---|---|
| *Contaminated Land Management Act 1997* (CLM Act) | The subject land is not generally recognised as contaminated land. It has been exposed to by-products from motor vehicles given its current use as an operational road. There may also be contamination beneath the road surface which cannot be confirmed at this stage. In this case, the CLM Act is a relevant consideration.<br><br>The mitigation measures outlined in **Section 9** and **Section 10** of this report ensure the obligations of the CLM Act are addressed. In summary, the contractor will be required to undertake contamination testing, by a recognised consultant, prior to commencing works. Should contamination be identified, remediation in accordance with the CLM Act will be required. |

| LEGISLATION | CONSIDERATIONS |
|---|---|
| *Local Government Act 1993* (LG Act) | The LG Act provides a legal framework for Local Government, guidance in operations, governance, and setting out the responsibilities and powers of Councils. The LG Act sets out the obligations and requirements for the use, development, operation and long-term management of land either owned by Council or under the control, care or management of Council. As such, Council is required to prepare either a specific Plan of Management that applies to a specific parcel of land or a generic Plan of Management that applies to multiple parcels of land.<br>Only a Council (or other public authority) may apply to close a Council public road.<br>A public road that was formerly vested in the council on closing remains vested in the council as operational land for the purposes of the *Local Government Act 1993*, except where the road was never constructed or used by the public. In these cases, an unformed road upon closure vests in the Crown and may comprise all or part of the residue of a certificate of title or old system deed.<br>Section 36 of the LG Act establishes clear instructions for the permitted use and management of Community land. The use and management of Community land must be consistent with the prescribed categories and core objectives of the land classification. |
| *Heritage Act 1977* (Heritage Act) | The subject land itself is not listed as an item of environmental heritage in the WLEP 2014, nor is it listed as an item of State heritage significance.<br>Any potential adverse impacts would be limited to artefacts which may be discovered during excavation. These can be managed with mitigation measures, however, including stop work and notify procedures as outlined in **Section 9** and **10** of this REF. |
| *Protection of the Environment Operations Act 1997* | The proposal does not trigger the need for licensing as outlined in the POEO Act and it is, therefore, not applicable in this instance. |

### 5.2.5 State Environmental Planning Policies

#### State Environmental Planning Policy (Transport and Infrastructure) 2021

As discussed in **Section 1.2** above, the proposal is for alterations to an existing road as referenced in Clause 2.108 of the Transport and Infrastructure SEPP. The proposal is, therefore, development permitted without consent. As such, the proposal does not require assessment and determination according to Part 4 of the EP&A Act.

#### State Environmental Planning Policy (Resilience and Hazards) 2021

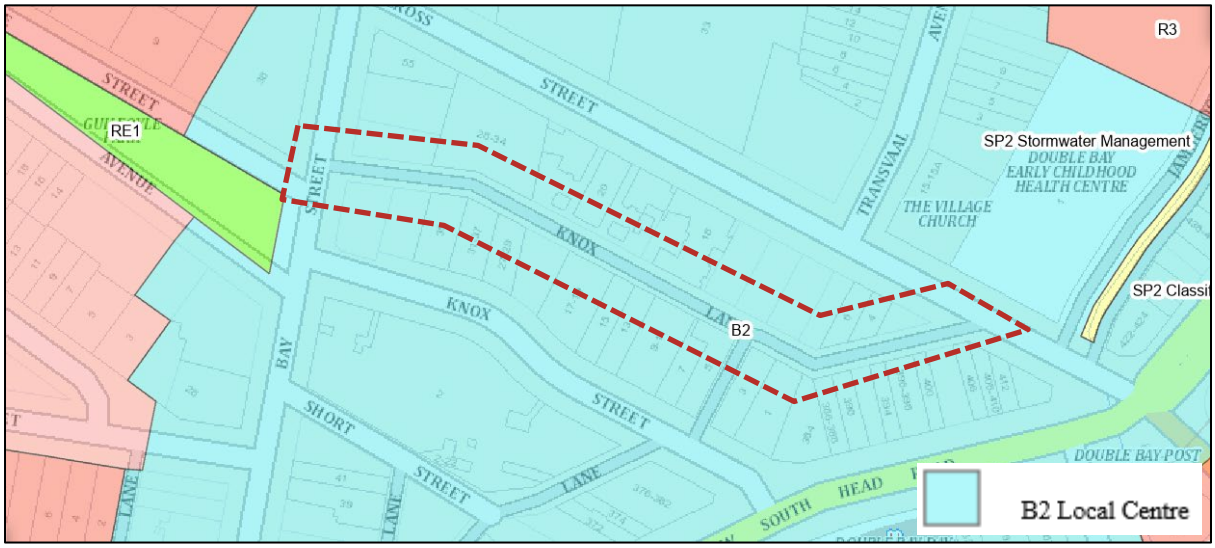
Specifies certain matters a consent authority must take into consideration when determining a development application, including contamination. As the Proposal is being determined under Part 5 of the EP&A Act, the provisions of this planning policy do not apply. Notwithstanding, consideration of contaminated land issues is provided in **Section 9.**

### 5.2.6 Woollahra Local Environmental Plan 2014

The *Woollahra Local Environmental Plan 2014* (WLEP 2014) is the prevailing environmental planning instrument for the majority of the LGA and applies to most forms of development that are not recognised under the Transport and Infrastructure SEPP (in terms of land use permissibility).

As the proposal is reliant on the provisions of the Transport and Infrastructure SEPP, the provisions of the WLEP 2014 does not apply. Notwithstanding, the project meets the aims and objectives of the WLEP 2014 and land use requirements as summarised in the **Table 5** below.

Figure 14 Land use zoning map (dotted red line denotes Knox Street section of the Site)




Source: Woollahra LEP 2014

Table 5. Relevant provisions of the Woollahra LEP 2014

| PROVISION DESCRIPTION | RELEVANCE TO THE PROPOSAL |
|---|---|
| Clause 1.2(2) – Aims of Plan | The particular aims of the WLEP 2014 are as follows:<br>*(aa) to protect and promote the use and development of land for arts and cultural activity, including music and other performance arts,*<br>*a) to ensure that growth occurs in a planned and co-ordinated way,*<br>*b) to promote the management, development, conservation and economic use of property,*<br>*c) to provide for an appropriate balance and distribution of land for commercial, retail, residential and tourist development and for recreation, open space, entertainment and community facilities,*<br>*d) to provide greater population densities in and around centres that are well serviced by public transport,*<br>*e) to facilitate opportunities, in suitable locations, for diversity in dwelling density and type,*<br>*f) to conserve built and natural environmental heritage,*<br>*g) to protect amenity and the natural environment,*<br>*h) to minimise and manage stormwater and flooding impacts,*<br>*i) to protect and promote public access to and along the foreshores,*<br>*j) to promote a high standard of design in the private and public domain,*<br>*k) to minimise and manage traffic and parking impacts,*<br>*l) to ensure development achieves the desired future character of the area,*<br>*m) to minimise excavation and manage impacts.*<br>The proposal satisfies the relevant objectives of the SLEP 2012 for the following reasons:<br>• The streetscape enhancement will improve the amenity of the community through enhanced urban design and place making outcomes.<br>• The works will promote the use of the land for cultural activities improving activation and supporting social sustainability outcomes for the community.<br>• The streetscape enhancements are likely to create an environment that has the potential to benefit trading conditions for nearby businesses as well as pedestrians generally.<br>• The proposal will improve infrastructure for pedestrians, including seating, parklets and lighting.<br>• It will minimise stormwater impacts through increased permeable and landscaped surfaces.<br>• The proposal will not result in any significant impacts on any known heritage values.<br>• Mitigation measures are proposed to avoid unreasonable impacts to any unforeseen heritage value. |

| PROVISION DESCRIPTION | RELEVANCE TO THE PROPOSAL |
|---|---|
| Clause 2.3 – Zone objectives and Land Use Table | The site is zoned B2 Local Centre. The commercial centre of Double Bay is surrounded by a mix of R2 Low Density and R3 Medium Density Residential zones (Figure 2). Roads are permissible in the zone. |

# 6 Community and stakeholder consultation

Chapter 6 provides an overview of consultation undertaken to date for the project, including statutory consultation outcomes and the future planned consultation.

## 6.1 Stakeholder consultation during concept design

Between September and October 2021, Council undertook broad community consultation, specific consultation with key stakeholders, residents of the Cosmopolitan and Councillors that resulted in 156 submissions and identified the key principals that underpins the Knox Street Pedestrian Plaza design. Consultation activities are summarised as follows:

- Councillor Workshop undertaken on the 8 September 2021 (where opportunities and constraints to the site were identified as well as design principles and desired precedents).
- Community consultation from 23 September to 8 October 2021.
- Knox Street stakeholders' workshop on 30 September 2021.
- Meeting with residents of the Cosmopolitan Building held on 19 October 2021 (to discuss in greater detail the specific issues presented in their submissions). The discussion focused on understanding the current situation, the perceived impact of the proposed plaza and possible solutions to mitigate the concerns.

Over the submission period, 156 submissions were received. Based on the consultation, the following key design principles were identified and set the foundation for the concept development:

- Comfortable and leafy.
- A vibrant and inclusive village.
- Transformative and engaging.
- A bustling, cosmopolitan retail experience.

The resultant concept design is broken down into four unique areas taking into consideration outcomes of the consultation;

- Guilfoyle Square -

Situated at the Bay Street end of the plaza, this space is a connection with Guilfoyle Park. It is a transformative area, allowing for markets, events and other temporary activations. This includes a pavilion structure, large trees and public furniture.

- Outdoor Dining pads

The mid-section of the plaza contains opportunities for outdoor dining both public and private. Two dining pads are dedicated to being leased by food and beverage operators. The other furniture is available for the public to enjoy.

- Secret Garden

Located near Goldman Lane, the Secret Garden is a more enclosed area of the plaza providing sculptural/art opportunities and an area for quiet respite. The planting provides a buffer from New South Head Road.

- Knox Street

Knox Street will be 'One-Way' eastbound traffic flow from Goldman Lane to New South Head Road. There will be three short stay parking spaces and two taxi spaces. An additional loading zone will be located at the termination of the plaza. There will also be an expansion of the footpath in front of 376-382 New South Head Road to improve the streetscape.

Following a Council briefing, a second consultation on the concept design was placed on public exhibition from 3 – 23 February 2022 with the exhibition materials and an online submission form hosted on '*Your Say Woollahra'*. The public exhibition resulted in 97 submissions via the '*Your Say Woollahra*' webpage and 64 submissions via email.

Submissions via '*Your Say Woollahra*' were generally supportive of the removal of cars from the street and priority to pedestrians. It was also expressed that it will add '*vibrancy and vitality to the local area*'. On the counter argument, possible traffic congestion and the removal of parking were noted as the largest issues with the overall plan.

The main topics of discussion are summarised in the following **Table 6.1**

Table 6.1 Community and stakeholder consultation and response

| MATTER RAISED | RESPONSE |
|---|---|
| Use of Space | The layout of the plaza is designed to be flexible in use with generous paved areas on the property boundaries functioning as both access and possible footway dining. The open space beneath the pavilion in Guilfoyle Square and dining pads for food and beverage operators are non-prescriptive and can function as open space should no event or dining opportunity be forthcoming.<br><br>Submissions expressed that the plaza 'will provide additional outdoor and recreational space that is perfectly suited to the Double Bay precinct' and that it is 'an excellent use of space'. It was also said that it 'creates a seamless and uninterrupted connection from Bay Street to New South Head Road'. Others reiterated that the plaza must be flexible, simple and appropriate in scale. There was also a request for materials to be classic and timeless.<br><br>A desire was expressed for a water feature however Council staff determined that it was unsuitable due to the financial impact of construction and maintenance.<br><br>Council has considered that the plaza in Knox Street and Guilfoyle Park will effectively become extensions of each other, and with the success of events such as the regular Double Bay Markets on a Thursday, Council sees an opportunity to further develop the Double Bay Commercial Precinct with greater activation of the extended space.<br><br>It should be noted that lighting, Indigenous and heritage layers, amenities such as bubblers and garbage bins have not been included in this plan as they will be resolved during the detailed design phase of the project. |
| Plants and Greenery | The tree boulevard connects and extends the canopy network along Knox Street from Guilfoyle Park, Bay Street and Steyne Park. It is also reflective of the tree lined streets that the Woollahra LGA is known for. The landscaping delineates the areas within the plaza, providing a soft natural buffer in the heart of Double Bay.<br><br>The plan proposes more than 20 new large trees to be planted in large vaults allowing for the trees to grow healthy and unimpeded. Some submissions expressed concern in regards to the removal of the existing trees, however the concept as exhibited provides an unprecedented boost to the canopy of cover Double Bay.<br><br>Submissions noted their preference for native species and were pleased by the shade that would be provided from the trees. |
| Built Structures | The concept design proposes a Pavilion in the Guilfoyle Square to function as a gateway treatment to the Knox Street Pedestrian Plaza at the Bay Street end. Other built elements such as public art and the styles of outdoor furniture will be resolved |

| MATTER RAISED | RESPONSE |
|---|---|
| | during detailed design. The outdoor furniture is intended to be a mix of fixed furniture and movable furniture to allow flexibility of use. The image below shows that moveable furniture can be used to enhance the fixed furniture and provide the opportunity for large groups to enjoy the space together.<br><br>There was support for the flexibility of fixed and bespoke removable furniture, however it must not clutter the space. Another expressed that furniture should be for restaurants and cafes, whilst others said it should be for the public.<br><br>Submissions were generally supportive of a pavilion structure, furniture and artworks. A couple of submissions asked for something for children which has been incorporated in the plan with the possibility of temporary play structures beneath the pavilion.<br><br>There was a request for more shade and shelter from the elements. Shade can be provided through the tree canopy proposed. Additionally, if the dining pads are used by commercial operators, they may look to incorporate temporary options such as umbrellas. |
| Traffic and Parking | From a traffic perspective, Knox Street consists of no driveways and therefore, provides great opportunity to fully pedestrianise the area into a vibrant, attractive and liveable place.<br><br>Traffic and loss of parking were the most identified topics in the submissions received. Council have engaged transport consultants, SCT Consulting, to conduct an investigation of the proposal and to review both the current traffic conditions and the impact on the local traffic network of the proposed road closure. A report on traffic and parking, including SCT's investigation on the traffic and parking implications were presented at an extraordinary Local Traffic Committee meeting held on 26 April 2022 where the Committees' recommendation supported to approval of the concept design which involves the proposed permanent road closure for Knox Street, Double Bay, between Bay Street and Goldman Lane, and the proposed 'one-way' eastbound traffic flow for Knox Street, Double Bay, between Goldman Lane and New South Head Road, with proposed parking restrictions and associated signs and line markings. The minutes of this meeting will be presented to Council's Finance, Community and Services Committee on 2 May 2022.<br><br>Submissions stated that commercial premises will lose trade as a result of the parking loss. In this area, Council can draw on the experience of the Kiaora Place design that has revitalised the southern side of New South Head Road, and a key focus of this design is to create a space that brings greater and longer-term visitors to the area. Increased foot traffic has resulted in more people spending longer in the area on the southern side. It is envisaged that this proposal will result in this happening on the northern side.<br><br>The design of parking in Double Bay has long been established with a variety of parking restrictions, moving from shorter term in the middle of Double Bay, to longer-term parking further out, to ensure both a mix of parking options and to ensure turnover specifically to support businesses. Parking options include on-street metered parking and parking stations at the Cosmopolitan and Cross Street. Surveys of the off-street capacity indicate that there is sufficient |

| MATTER RAISED | RESPONSE |
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| | capacity in the surrounding public car parking facilities around the transport network to accommodate the parking space loss.<br><br>Of the traffic-related comments received from the community, concerns were raised regarding the redistribution of traffic in adjacent roads, particularly for vehicles wanting to turn right out of Double Bay onto New South Head Road westbound. Some of these comments received had requested that the intersection of Cross Street and New South Head Road be upgraded to complement the change in traffic conditions. Another concern raised was in relation to the vehicular capacity of Goldman Lane to withstand the detoured traffic from Knox Street whilst sufficiently catering for pedestrians.<br><br>The proposal will prevent vehicular access into Knox Street from New South Head Road and will ultimately improve safety at this intersection, particularly turning movements from New South Head Road into Knox Street, as there is no dedicated right turn lane on New South Head Road.<br><br>Right turn traffic movements from New South Head Road to the northern side of the Double Bay Commercial Centre will be diverted to William Street which is a classified regional road and can sustain the traffic volume. In addition, there is a dedicated right turn lane on New South Head Road at William Street.<br><br>Council's Traffic and Transport Engineers have assessed the traffic count data for a number of streets in Double Bay, as well as the intersection analysis of Knox Street and New South Head Road and impact on the performance of other nearby intersections along New South Head Road, and it is considered that the traffic volumes diverted and the intersection modelling following impacts would be satisfactory.<br><br>It is also noted that Council's Traffic and Transport Engineers have met with TfNSW to discuss the traffic implications on the New South Head Road corridor for the surrounding intersections. As such, a Traffic Management Plan has been submitted to TfNSW for consideration and approval. |
| Cosmopolitan Residents | Council staff met with residents of the Cosmopolitan in October 2021 to discuss their concerns and has incorporated the feedback as best as possible to achieve an outcome that benefits Double Bay. In regards to emergency access, this has been provided on both sides of the plaza parallel to the property boundaries, and is an essential component of a design such as this. Additionally, this provides access for removalist vehicles and cranes through the current stand plant application process in place through Council. This will be a safer and cost effective improvement to the current situation where Traffic Management or double parking is required. These benefits are also afforded with an additional loading zone and short term parking spaces provided on Knox Street toward New South Head Road.<br><br>Residents also raised concern about safety and security in regards to the night time activity once licensed premises in Double Bay close and patrons loiter the street. The relocation of the taxi zone will move those waiting for a taxi late at night away from the residences. The design incorporates CPTED principles such as low level planting, tall mature trees and pedestrian level lighting increasing passive surveillance and visibility throughout the plaza. Council's existing Public Safety |

| MATTER RAISED | RESPONSE |
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| | CCTV network will also continue in Double Bay.<br>Cosmopolitan residents also commented on outdoor dining and the noise associated with it. This matter was specifically addressed in the meeting with residents, where it was confirmed that these approvals are through Council and can be revoked due to noncompliance, and Council intends to take a firm approach to this impact. |

Council's staff across various departments have been consulted on this project and have been informed of the concept design. It is anticipated that this process will continue through the detail design phase for this project.

Council staff have also met and consulted with Eastern Suburbs Police Area Command on the design and considered their feedback, particularly around concerns with the night-time economy in Double Bay. It is anticipated that this process will continue through the detail design phase for this project.

The concept design has provided the best outcome for Knox Street Double Bay has been designed with the flexibility and adaptability to respond to changes as needed.

Reviews from published literature and local, national and international experience suggests that there is significant social, economic, transport and health benefits associated with pedestrianisation that results in;

- An increase in retail spending as pedestrians walking into shops typically spend more than people driving around in cars.
- A promotion of active transport modes and discourages unnecessary vehicular movements and improve safety in busy areas.
- Strong place making opportunities to transform streetscapes, create urban plazas and encourage al fresco dining and social events.

## 6.2 Exhibition requirements

The EP&A Regulation (clause 171(4)) requires publication for activity with a capital investment value (CIV) of more than $5 million. The CIV of the proposed works is $3.9 million, therefore this REF is not required to be publicly exhibited.

Notwithstanding, Council's intention is to make the final endorsed REF publicly available on Council's website.

## 6.3 Consultation strategy

In addition to the information in the Council report, representations were made by the community at the two meetings of the Local Traffic Committee (LTC) and the Finance, Community and Services Committee meeting.

Upon completion of the REF and a review of the TMP by TfNSW, the matter will be reported back to Council's Local Traffic Committee for a recommendation to Council. Further representations can be made when this item is tabled at the LTC.

# 7 Environmental impact assessment

## 7.1 Consideration of Clause 171(2) Factors

This Section identifies and addresses the potential environmental impacts that may occur as result of the proposed works and identifies mitigation and management measures to avoid or minimise impacts. It also identifies the potential level of impact before and after mitigation and management measures are implemented.

Table 2 Consideration of Clause 171 factors

| Factors for consideration under Clause 171(2) of the EP&A Reg | Assessment |
|---|---|
| a. *Any environmental impact on a community* | The Proposal may result in traffic, noise, dust, visual amenity and socio-economic impacts during construction works. However, these would be minor and short-term.<br>By implementing mitigating measures identified in the REF and preparing a Construction Environment Management Plan (CEMP), the potential environmental impacts would be minimised.<br>There would be an improvement in water quality, ecological value, visual aesthetic and value of the community space along with no significant negative operational impacts as a result of the proposal**.** |
| b. *Any transformation of a locality* | The proposal would provide improved amenity to the locality through pedestrianisation of Knox Street to provide a public space including tree cover, as well as pedestrian links, parks and activation events.<br>The project will have beneficial streetscape and accessibility impacts. These are likely to create an environment that has the potential to benefit trading conditions for nearby businesses as well as pedestrians generally.<br>The Proposal would be positive transformation of the local environment in keeping with the objectives of the locality. |
| c. *Any environmental impact on the ecosystems of the locality* | The site is not habitat for any threatened species or ecological communities recorded in the surrounding areas and has low ecological value.<br>The proposal's ecological impacts will be negligible given the extent of necessary excavation is minimal.<br>The proposal may involve a sizeable amount of excavation in terms of lineal metres, but such excavation is largely confined to a modest 1m from the existing surface.<br>Similarly, the proposal does not involve extensive tree removal and any trees which will be removed, will be more than adequately compensated for.<br>Implementing the mitigating measures outlined in the REF would ensure that impacts on any local ecosystems on the site and downstream of the site are minimised. |
| d. *Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality* | The proposal will improve the aesthetic, recreational and general environmental quality of the subject locality given it involves new paving, wider footpaths, new public facilities such as seats and the like, and additional street trees. It is considered that the road surface does not have any notable scientific value and the proposal would not, therefore, unreasonably impact any such value. |

| | |
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| | Aesthetic and recreational qualities of the site would be temporarily disturbed during the construction phase of the proposal.<br>There are no scientific or other environmental qualities of note at the site that would be reduced as a result of the works.<br>Implementing the mitigating measures outlined in this REF would minimise impacts to the identified qualities of the locality during construction. |
| *e. Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generatiosn* | The Proposal undertaken in accordance with the REF would not affect any locality, place or building having aesthetic, anthropological, known archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations.<br>The proposed streetscape improvements are likely to have marginally positive effects on such values of adjoining development and the locality generally.<br>There may be archaeological value within the land which is proposed to be excavated to deliver proposed new utilities, paving, trees and the like.<br>Mitigation measures can be implemented to avoid significant adverse archaeological impacts. |
| *f. Any impact on the habitat of protected animals (within the meaning of the Biodiversity Conservation Act 2016)* | There is no significant habitat of protected fauna present on the site that would be affected by the Proposal. |
| *g. Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air* | The Proposal would not endanger the general population of species of animal, plant or other life form, whether living on land, in water or in the air. |
| *h. Any long-term effects on the environment* | There will be no long-term adverse impacts on the environment as result of the proposed works.<br>The long-term impacts are likely to be positive and the public domain will be significantly improved by the proposal. This has direct positive impacts for pedestrians and are likely to create an environment that has the potential to benefit trading conditions for nearby businesses |
| *i. Any degradation of the quality of the environment* | The proposed works will not result in any significant degradation of the quality of the environment, where it currently holds very little environmental value.<br>Degradation is limited to the construction phase, such as noise, sedimentation, dust generation and the like. Adequate mitigation measures can be implemented for such possibilities.<br>Overall, however, the proposal is likely to result in positive impacts to the social, cultural and economic environment.<br>Construction impacts will be managed through appropriate mitigation measures detailed in **Section 9** and **10** below. |
| *j. Any risk to the safety of the environment* | The operation of the proposed development is not considered to pose any significant risk to the safety of the environment and any potential for risks will be appropriately managed. |

| | |
|---|---|
| | As discussed immediately above, risks to the environment are principally limited to the construction phase. Relevant mitigation measures can be implemented, as discussed in **Section 9** of this report. |
| *k. Any reduction in the range of beneficial uses of the environment* | There will be no reduction in the range of uses of the land, rather the implementation of the project will enhance patronage of Knox Street for a wide range of users.<br>The proposed works will improve the amenity of the public domain and increase useability and accessibility of Knox Street for the surrounding community.<br>Arguably, the proposal increases options for use of the environment given it will extend footpaths and improve the amenity generally with additional street trees, public seating and the like. |
| *l. Any pollution of the environment* | Pollution is likely to be limited to during the construction phase from construction related machinery and potential noise, dust and water management. These are temporary and/or can be mitigated such that they are not significant and, therefore, not unreasonable.<br>Mitigation measures including those contained within the Construction Management and Construction and Traffic Management Plans as well as those outlined in **Section 8 and 9** will ensure surrounding environment is not polluted. |
| *m. Any environmental problems associated with the disposal of waste* | The proposal's construction phase is likely to result in some waste, such as removed bitumen, concrete and the like. **Section 9** outlines how any associated impacts can be mitigated. In summary, mitigation measures revolve around recycling and/or reuse of such waste products.<br>Construction and operational waste will be disposed of in accordance with legislative requirements and management systems. |
| *n. Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply* | New and replacement landscaping will require intermittent watering.<br>The proposal will also increase demand for paving however, we are not aware of any related shortages.<br>There will be no increased demands on resources that will be in short supply. |
| *o. Any cumulative environmental effect with other existing or likely future activities* | The proposal is small in scale and operation. In this case, any cumulative environmental impacts would be negligible, manageable and broadly positive.<br>Future activities on the site are not expected to result in any adverse cumulative environmental impacts. |
| *p. Any impact on coastal processes and coastal hazards, including those under projected climate change conditions,* | Coastal hazards do not impact the site. |
| *q. applicable local strategic planning statements, regional strategic plans or district strategic plans made under the Act, Division 3.1,* | Alignment with relevant strategic statements and plans has been demonstrated under **Part 2.2.4** |
| *r. other relevant environmental factors.* | Other relevant environmental factors have been considered under **Part 8 and 9** |

# 8 Environmental Assessment and mitigation measures

## 8.1 Traffic and transport

### *8.1.1 Environmental assessment and potential impacts*

The project seeks to transform the four lane carriageway of Knox Street between Bay Street to Goldman Lane to a pedestrian plaza and propose a vehicular zone between Goldman Lane and New South Head Road (potentially one-way traffic from Goldman Lane along Knox Street, exiting onto New South Head Road).

The proposal also considers services such as kiss and ride, loading zone, pedestrian connections, and taxi zone to ensure public amenity and functions. The proposal would result in a loss of up to 28on-street parking spaces. Surveys of on-street and off-street capacity indicate that there is sufficient capacity in the network around the transport network to accommodate the parking space loss.

The proposal would alter traffic flows to one way eastbound (exit to New South Head Road) between Goldman Lane and New South Head Road. As a result of the one-way Knox Street option (exit to New South Head Road only), traffic from the northeast may need to turn right at Williams Street while traffic from the southwest may need to turn left at Bay Street or Cross Street.

A loading zone is provided at the eastern extent of the fully pedestrianised zone. The bay would be accessed via a roll kerb. Emergency access will be retained through the plaza to allow for access by NSW Police, emergency vehicles as well as controlled access by plaza users (e.g. food trucks). The northern section has been designed to allow for the swept path of an ambulance headed eastbound and the southern section allows for the swept path of an ambulance headed westbound.

SCT Consulting was engaged to provide a Traffic and Parking Impact Study to support the proposed pedestrianisation of Knox Street. This transport assessment shows that:

- Traffic impacts of the proposed pedestrianisation project are nominal. In some cases, the project reduces traffic delays due to intersection simplification.
- Parking impacts of the removal of the 28 parking spaces can be accommodated in the on and off-street parking network within a short walk of the site.
- There are no bus impacts, as the street does not carry any public bus routes.
- The project is net positive for loading as the project delivers a new loading zone on Knox Street.
- Construction impacts are manageable but will result in the temporary closure of Bay Street. Diversions are provided to ensure access to properties.

A summary of the Study findings and recommendations is provided below. The full report is attached in **Appendix B.**

Existing transport conditions

*Movement and Place categorisation*

In Double Bay, roads with higher place function but lower movement function include Knox Street, Transvaal Avenue, Knox Lane, Goldman Lane (partial) and Bay Street (partial), which are relatively close to Knox Street and service the local retail and amenities of the town centre. Bay Street (partial) and Cross Street provide high-level functions for both movement and place.

*Intersection performance*

SIDRA intersection models have been developed/updated for New South Head Road / William Street and New South Head Road / Knox Street based on the previous work undertaken for the Double Bay Transport Study to understand the existing network performance and to test the impacts of the proposed development uplift and pedestrianisation.

Intersection performance has been assessed for the weekday AM and PM peak hours.

The SIDRA results indicate that both intersections are operating at a satisfactory level of service (LoS B or better) from a road delay perspective. The largest DoS recorded was 0.92 for New South Head Road / Knox Street. This was noted in the AM peak hour period.

*Active transport*

Bay Street, William Street and Cross Street are identified as main bicycle routes whereas Cooper Street and part of Ocean Road are identified as local bike routes, which extend to New South Head Road to the west. Cycling to and from Double Bay is currently observed to be difficult and potentially unsafe due to a lack of dedicated cycling infrastructure and topographical constraints. Multiple roads with steep grades make it difficult for cyclists to ride uphill with limited protection for cyclists.

Cycle facilities on Bay Street and Cross Street are classified as mixed traffic lanes on a quiet local street and expect moderate preference ranking. There are currently no cycleways within the Double Bay where ">75% feel quite or very safe and comfortable".

Double Bay Town Centre is an attractive destination with high pedestrian activity along streets like Cross Street, Knox Street and Transvaal Avenue. It is appealing as a local destination combined with Double Bay's high-quality walking environment makes it easy to encourage residents to walk instead of drive.

*Bus network*

Double Bay is serviced by many bus routes on New South Head Road, William Street and Ocean Road. During the AM peak hour, there are approximately 15 citybound services, whereas, in the PM peak hour, 11 services travel in the eastbound direction.

*Parking*

The majority of the on-street parking around the Double Bay Town Centre is time-restricted parking (1/2P and 2P). Short Street is a dedicated loading zone, servicing the retail premises facing Knox Street. A taxi zone is available on the western side of Knox Street (north of Goldman Lane), accommodating about five parking spaces.

A parking occupancy survey was undertaken in June 2019 showing that the majority of the on-street parking was over 50 per cent occupied during AM and PM peak hours. Bay Street, Knox Street and Transvaal Avenue had relatively high parking demand, resulting in a limited remaining capacity for the on-street parking.

Surveys of on-street and off-street capacity indicate that there is sufficient capacity in the network around the transport network to accommodate the parking space loss. For instance, there is a minimum of 31 parking spaces available across all three multi-storey off-street car parks.

<u>Potential impacts</u>

*Road network*

The closure of westbound flows on Knox Street removes the left and right turn movement from New South Head Road to Knox Street. As a result, the model will have the following trip redistribution assumptions:

- Left turn traffic to Knox Street is assumed to be relocated to New South Head Road / Bay Street and New South Head Road / Cross Street.
- Right turn traffic to Knox Street is assumed to be redistributed to New South Head Road / William Street.

The traffic modelling shows minimal impacts from the delivery of Knox Street. Modelling indicates the impacts are as follows:

- Cross Street / New South Head Road: an improvement by 6 seconds in the morning and a worsening by 2.8 seconds in the evening peak.
- Knox Street / New South Head Road: an improvement by 3.9 seconds in the morning peak and no change in the evening peak.
- William Street / New South Head Road: a worsening by 0.8 seconds in the morning peak and 0.5 seconds in the evening peak.

The removal of westbound traffic is also expected to reduce queuing on Guilfoyle Avenue east of the Cosmopolitan entrance. By removing the give way, traffic no longer needs to wait to find a gap. Drivers will be able to drive directly to Knox Street, which should reduce the queueing occurring.

*Bus transport*

Knox Street is not a bus corridor, so there will not be any services affected by the closure. There are no spaces for bus parking, so the road is unlikely to be used for private bussing either.

*Parking*

The pedestrianisation of Knox Street will result in the loss of 28 on-street parking spaces in total. Surveys of on-street and off-street capacity indicate that there is sufficient capacity in the network around the transport network to accommodate the parking space loss. For instance, there is a minimum of 31 parking spaces available across all three multi-storey off-street car parks.

*Servicing*

There are no current loading zones provided on Knox Street, however, it is expected that drivers use paid parking for early morning deliveries. To mitigate this, the design includes a loading zone at the eastern extent that is designed to cater for a medium rigid vehicle (8.8m in length). This improves the quality of servicing access for businesses with a dedicated loading zone. This space can also be used for moving days for residents of the cosmopolitan.

Further, the cross-section of the pedestrianised zone and the materials chosen to allow for infrequent access by vehicles for closer delivery.

### 8.1.2 Mitigation measures

- Prepare a Site Specific Construction Traffic Management Plan which includes the detailed recommendations provided in the Traffic and Parking Impact Study (Appendix C) and outlines of the construction project with detailed methodology and associated traffic control plans.
- Prepare a Road Closure Plan.
- Council should undertake a 'dial-before-you-dig' search to determine which authorities may have infrastructure within the road. Council should then approach the authorities which have infrastructure within the road to see if they object to the road closure or require an easement to be created as a condition of the road closure.

## 8.2 Public safety and crime prevention

### 8.2.1 Existing environment and potential impacts

Eastern Suburbs Police Area Command have advised that currently in Double Bay there are issues with anti-social behaviour, alcohol related crime, noise disturbance both pedestrian and vehicular during later evening and early morning hours consistent with late trading licensed venues.

At the request of the Police, Woollahra Council installed CCTV throughout Double Bay in 2018 and has remained operational since then.

### 8.2.2 Mitigation measures

- Council's Double Bay CCTV system should remain in operation.
- Provide clear visual lines throughout the public domain through ensuring planting does not exceed 1.2 m in height and tree canopies are maintained above 3m in heights.
- Provide opportunities for natural surveillance within the public domain.

- Maintain opens views through the public domain by removing existing high visual barriers.
- Retain and install additional lighting throughout the public domain to ensure facial recognition from a distance and to enhance feeling of safeness.
- Ensure that adjoining buildings have good vision to external spaces by carefully planning placement of trees and plants, allowing for passive surveillance to occur.
- Create of a legible, generous, pedestrian circulation network that is well connected to building and primary site entries.

## 8.3 Noise and vibration

### *8.3.1 Environmental assessment and potential impact*

The proposal's construction process will rely on mechanical equipment, including delivery vehicles, which will result in noise and vibration impacts. Commercial tenancies and dwellings in close proximity to the subject site may in particular be impacted. Such impacts will be temporary but can nevertheless be mitigated with the implementation of the Construction Noise and Vibration Management Plan (CNVMP) developed for the construction of the CSELR (with the exception of its recommended extended construction hours).

### *8.3.2 Mitigation measures*

- Develop and implement a Construction Noise and Vibration Management Plan for the duration of the construction process including the following recommendations:
    - Per the Draft Construction Noise Guideline (EP&A act) recommended standard hours for construction work, the majority of construction activities are proposed to occur between the hours of 7am to 6pm on weekdays and 8am to 1pm Saturdays, with no work on Sundays or Public Holidays. In those cases where the safety of workers is at greatest risk, works can be undertaken outside of normal business hours, such as between 1am – 5.30am.
    - Materials would be delivered, and spoil removed during standard construction hours.
    - Avoidance of idling trucks alongside sensitive receivers.
    - Neighbouring properties would be notified of construction works and timing. Any comments would be recorded and taken into consideration when planning construction activities.

## 8.4 Aboriginal and non-indigenous heritage

### *8.4.1 Existing environment*

As discussed earlier, the subject site does not contain any items of environmental heritage according to the WLEP 2014. Several items of heritage are in proximity to the subject site, but the physical separation is sufficient to avoid any likely impacts.

Given the extended period of time Knox Street has been in operation, and the extent of maintenance and/or reconstruction it would have been subject to, it is unlikely that any unforeseen aboriginal or non-indigenous material would be found as part of the proposal's construction, including excavation.

Despite the above, mitigation measures are warranted given the likely significance of any potential aboriginal or non-indigenous material that might be found.

### *8.4.2 Mitigation measures*

- Review the results of geotechnical testing for any evidence of aboriginal or nonindigenous material.
- Stop work in the event any material or potential material is identified during the construction phase.
- Nominate potential for aboriginal or non-indigenous heritage as part of any site induction process.

## 8.5 Socio-economic

### 8.5.1 Environmental assessment and potential impacts

The proposal does not impact directly or indirectly on any existing administrative, professional, or community services such as medical facilities, schools, childcare centres or the like.

The proposal's construction phase has the potential to impact on adjoining businesses and the like as a result of noise, dust, vibration, transportation and accessibility impacts outlined earlier. These impacts are temporary and acceptable with mitigation measures already discussed. Access to premises will be maintained.

Upon completion of the proposed works, the streetscape will be substantially improved with new paving, additional trees, public amenities and a wider footpath. As such, not only will the general atmosphere be improved, but this is likely to improve trading conditions for nearby places of business. Overall, this will assist with reinforcing Knox Street as the premier street within the Double Bay centre as a key focus point.

### 8.5.2 Mitigation measures

- In light of the above, specific amenity impacts such as noise, dust and the like, can be managed acceptably subject to previously outlined mitigation measures so as not to impact upon the economic performances of businesses in the vicinity.

## 8.6 Biodiversity

### 8.6.1 Environmental assessment and potential impacts

The subject site is highly urbanised and does not contain any high volume of flora, fauna or native trees. For these reasons, the impact on flora, fauna and trees is minimal.

Eight (8) trees located on the site comprise a mix of Australian native and exotic species including *Cinnamomum camphora* (Camphor Laurel), *Ficus rubiginosa* (Port Jackson Fig), *Platanus x acerifolia* (London Plane Tree) and *Sapium sebiferum* (Chinese Tallowood). None of the trees are listed in the Woollahra Council Register of Significant Trees (1991) or Woollahra Local Environmental Plan Schedule 5, Environmental Heritage (2014).

It is acknowledged that the proposal involves the replacement of six (6) existing street trees. This impact is considered acceptable given the replacement includes species of healthier variety, and the proposal involves planting of approximately 45 new street trees (between 400 – 200L pot size).

Refer to **Appendix B** for Arboricultural Assessment which includes detailed assessment and recommendations.

### 8.6.2 Mitigation measures

- Preparation of a detailed landscape plan which confirms, amongst other items, the exact number of replacement trees, exact number of new trees, their species, and measures relating to their ongoing management to ensure they become adequately established. Any landscape plan must be prepared by a suitably experienced landscape architect.
- Works are to be undertaken in accordance with the detailed recommendations provided in the Arboricultural Assessment Report prepared by Tree IQ dated 30 November 2021.

## 8.7 Air quality

### 8.7.1 Environmental assessment and potential impacts

The proposal involves surface related excavation as well as a range of other construction related procedures, such as sawing of paving, concrete pouring, and construction related delivery vehicles, which are likely to generate dust, which may affect air and water quality without adequate mitigation measures. The machinery involved for these procedures is also likely to result in exhaust fumes.

### 8.7.2 Mitigation measures

- Preparation and implementation of a Construction Environmental Management Plan (CEMP). Some of the items the CEMP is required to include are:
  - Ongoing management of soils and sediment in accordance with Australian and New Zealand Environment and Conservation Council (ANZECC) (2000) Guidelines for Fresh and Marine Water Quality.
  - Ongoing management of soils and sediment in accordance with Landcom's (2004) Managing Urban Stormwater: Soils and Construction.
  - Ongoing management of soils and sediment in accordance with Volume 2D of Managing Urban Stormwater: Soils and Construction (DECC 2008).
  - Undertaking servicing of machinery to avoid excessive exhaust fumes.
  - Ongoing monitoring of the construction site and its immediate surrounds to address any potential non-compliances with mitigation measures.
  - Truckloads would be covered during transportation off-site

## 8.8 Soils and contamination

### 8.8.1 Environmental assessment and potential impacts

The road pavement will be replaced with pavers and new and/or upgrade poles and other streetscape features, such as seating and planters, will be installed. From a geotechnical perspective, it is expected that there will be relatively minor subsurface work (i.e no greater than 1m in depth) as the redevelopment will essentially be constructed at existing grade.

The subject land is not generally recognised as contaminated land. It has been exposed to by-products from motor vehicles given its current use as an operational road. There may also be contamination beneath the road surface which cannot be confirmed at this stage.

The site is classified as containing Class 2 Acid Sulfate Soils. Works will require some level of excavation therefore a preliminary assessment of the proposed works in accordance with the Acid Sulfate Soils Manual is required for this classification of acid sulfate soil affectation.

The proposal involves surface excavation which is likely to impact existing soils. However, as the proposal relates to mostly superficial works, rather than major utility works, for example, which require deep excavation, the proposal's likely soil related impacts should be minor.

### 8.8.2 Mitigation measures

- Acid sulfate soils management plan be prepared for the proposed works in accordance with the Acid Sulfate Soils Manual.
- Works to be undertaken in accordance with the detailed recommendations in the Geotechnical Report prepared by JK Goetechnics dated 10 September 2021.

## 8.9 Stormwater and flooding

### 8.9.1 Environmental assessment and potential impacts

The site is identified as flood prone. The proposal will not adversely affect flood behaviour in a way that results in detrimental increases in the potential flood affectation of other development or properties. Furthermore, the proposed works will not adversely affect the safe occupation and efficient evacuation of people or exceed the capacity of existing evacuation routes for the surrounding area in the event of a flood.

The outcomes of the flood level difference mapping undertaken in the Flood Assessment (**Appendix E**) indicates that the proposed works are not predicted to produce any significant change in flood level across the study area. This is primarily driven by this area of Double Bay acting as a large flood storage area with

generally slow-moving water. The loss of flood storage by the changes in roadway level/profile are considered insignificant in the scale of the wider Double Bay catchment, and therefore produce only small and localised changes in flood level, which appear to be generally limited to within road reserves. Furthermore, the predicted reduction in water depths (due to the raised pedestrian plaza) is likely to afford improvements to flood hazard for any pedestrians who happen to be in the area during future floods.

The outcomes of the flood modelling indicates that the proposed works will generate small, localised increases and decreases in existing flood levels. However, widespread flood level increases are not predicted to exceed 0.03 metres and are generally contained to the road reserves.

### 8.9.2 Mitigation measures

- Stormwater and flood risk management report to be undertaken outlining flood management measures.

## 8.10 Waste

### 8.10.1 Environmental assessment and potential impacts

The proposal is likely to involve the removal of the existing road surface and disturbance of the existing road base. Such waste could escape the subject site in the form of erosion and sedimentation, some of which may be contaminated. There is also likely to be various 'off cuts' from construction materials such as pavers, concrete and the like.

### 8.10.2 Mitigation measures

- A Phase 1 contamination assessment shall be undertaken to determine the likelihood of contaminated material throughout the construction site. Treatment of contaminated material, if any, should also be undertaken in accordance with any Phase 2 assessment.
- General construction waste shall be managed in accordance with the *Waste Avoidance and Resource Recovery Act 2001*. This legislation generally seeks to avoid waste generation or divert any waste to recycling.

## 8.11 Sustainability

The proposal is likely to result in some waste materials as well as carbon dioxide emissions from construction related machinery in particular. Overall, however, the proposal contributes significantly towards ecologically sustainable development and sustainability generally, for the following reasons:

- There will be a substantial net increase in trees in the subject site.
- Rain gardens are proposed which assist with natural water infiltration.
- A non-potable, recycled water supply system is proposed for the new proposed landscaping, where practicable.
- Wider footpaths and an improved streetscape generally, will increase opportunities for 'green transport', in particular, walking.

## 8.12 Climate change

The site is located within a highly urbanised setting and is not prone to bushfire risk and is not in the immediate vicinity of natural water bodies so sea level rise is not considered to be a likely impact.

Similarly, the proposal is of a minor nature in relative terms and does not necessitate any significant long term carbon dioxide emissions. Therefore, the proposal itself is not likely to impact on sea levels.

The proposal will reduce hardstand and enhance canopy tree planting which will help to mitigate urban heat island effect and combat increase in extreme heat events.

## 8.13 Cumulative impacts

### *8.13.1 Environmental assessment and potential impacts*

The proposal's overall impacts are considered to be beneficial and would outweigh the identified adverse impacts. This is largely because the proposal would result in significant streetscape upgrades, including new paving, trees and other public amenities.

Similarly, the proposal will increase the width of existing footpath substantially. This increases accessible public space, increases the opportunity for pedestrians to view and interpret their surroundings and increases opportunities for walking or 'green transport'.

# 9 Environmental management

## 9.1 Summary of mitigation measures

A summary of mitigation measures provided in **Part 8** of the REF is provided in the table below.

Table 9 Summary of mitigation measures

| NO. | MITIGATION MEASURE |
|---|---|
| **Traffic and transport** | |
| 1. | Prepare a site specific Construction Traffic Management Plan including detailed recommendations in the Traffic and Parking Impact Study and which outlines of the construction project with detailed methodology and associated traffic control plans. |
| 2. | Prepare a Road Closure Plan. |
| 3. | Undertake a 'dial-before-you-dig' search to determine which authorities may have infrastructure within the road. |
| **Public Safety and Crime Prevention** | |
| 4. | Council's Double Bay CCTV system is to remain in operation |
| 5. | Incorporate CPTED principles into the design of the proposal |
| **Noise and vibration** | |
| 6. | Develop and implement a Construction Noise and Vibration Management Plan. |
| **Aboriginal and non-aboriginal heritage** | |
| 7. | Review the results of geotechnical testing for any evidence of aboriginal or nonindigenous material. |
| 8. | Stop work in the event any material or potential material is identified during the construction phase. |
| 9. | Nominate potential for aboriginal or non-indigenous heritage as part of any site induction process. |
| **Socio-economic** | |
| 10. | Specific amenity impacts such as noise, dust, vibration and the like, can be managed acceptably subject to previously outlined mitigation measures. |
| **Biodiversity** | |
| 11. | Preparation of a detailed landscape plan prepared by a suitably experienced landscape architect. |
| 12. | Works are to be undertaken in accordance with the detailed recommendations provided in the Arboricultural Assessment Report prepared by Tree IQ dated 30 November 2021. |
| **Air quality** | |
| 13. | Preparation and implementation of a Construction Environmental Management Plan (CEMP). |
| **Soils and contamination** | |
| 14. | Acid sulfate soils management plan in accordance with the Acid Sulfate Soils Manual. |
| 15. | Works to be undertaken in accordance with the detailed recommendations contained in the Geotechnical Report prepared by JK Goetechnics dated 10 September 2021. |

| NO. | MITIGATION MEASURE |
|---|---|
| **Stormwater and flooding** | |
| 16. | Stormwater and Flood Risk Management Study to be undertaken outlining flood and stormwater management measures. |
| **Waste** | |
| 17. | General construction waste shall be managed in accordance with the *Waste Avoidance and Resource Recovery Act 2001*. |

## 9.2 Summary of separate approvals

- Obtain TfNSW approval for proposed works in accordance with Section 75 and 76 of the *Roads Act 1993*.
- Consult relevant utility providers with regard to the installation of any utility conduits for the purposes of Section 85 of the *Roads Act 1993*.
- Obtain approval for any further temporary road closures in accordance with Section 138 of the *Roads Act 1993*

## 9.3 Cumulative impacts

The proposed works are unlikely to result in significant adverse cumulative impacts which would affect the amenity of the site or surrounding development and residents.

Any cumulative impacts associated with the construction works considered to be minor, temporary and acceptable, subject to the implementation of mitigation measures.

Any cumulative impacts associated with the ongoing operation of the space is considered to have a positive cumulative impact where:

- It will remove westbound traffic expected to reduce queuing on Guilfoyle Avenue east of the Cosmopolitan entrance. By removing the give way, traffic no longer needs to wait to find a gap. Drivers will be able to drive directly to Knox Street, which should reduce the queueing occurring.
- Reviews from published literature and local, national and international experience suggests that there is significant social, economic, transport and health benefits associated with pedestrianisation that results in;
  - An increase in retail spending as pedestrians walking into shops typically spend more than people driving around in cars.
  - Supporting active transport modes and discourages unnecessary vehicular movements and improve safety in busy areas.
  - Presenting strong place making opportunities to transform streetscapes, create urban plazas and encourage al fresco dining and social events.

# 10 Conclusion

This REF provides the determining authority adequate guidance to consider significance and meet responsibilities under Section 5.7 of the EP&A Act. In documenting the Division 5.1 assessment, the REF document:

- Complies with requirements under Part 5, Division 5.1 and Part 8, Division 1 of the *Environmental Planning and Assessment Regulation 2021* (EP&A Reg)
- Complies with the Department of Planning and Environment's *Guidelines for Division 5.1 Assessments*
- Contains all available information relevant to the assessment of the project and its environmental impacts to the fullest extent possible
- Contains a consolidated description of the project
- Identifies and address relevant statutory requirements, including EPIs or strategies, plans and policies (where relevant to the proposed activity)
- Summarises the findings of the technical assessment of the impacts (reports of which are appended to the REF)
- Contains a straightforward evaluation of the direct, indirect and cumulative impacts of the project
- Identifies mitigation measures to eliminate or reduce the detrimental effects of the proposal.

The assessment of the relevant environmental considerations provided in this REF concludes that the proposed development will not have an adverse impact or cumulative adverse impact on the environment or the surrounding locality, subject to the implementation of mitigation measures.

To the fullest extent possible, all matters affecting or likely to affect the environment, for the purpose of protection and enhancement of the environment have been considered in this REF. The assessment concludes that the proposal is not likely to have a significant impact on the environment and therefore negating the requirement to prepare an Environmental Impact Statement (EIS).

# 11 References and Relevant Guidelines


1 Australian Standard 1742.3 - 1996 Manual of Uniform Traffic Control Devices Part 3: Traffic Control Devices for Works on Roads

2 Australian Standard 2601-2001 The Demolition of Structures

3 Australian Standard 2436-2010 Guide to Noise Control on Construction, Maintenance and Demolition Sites

4 Department of Environment, Climate Change and Water (now Office of Environment and Heritage), 2009, Interim Construction Noise Guideline

5 Department of Planning and Environment, supporting Guidelines for Division 5.1 Assessments, February 2022

6 Bewsher Consulting, 'Double Bay Floodplain Risk Management Study and Plan', 2011

7 Landcom, 2004, Managing Urban Stormwater: Soils and Construction, 4th Edition (The Blue Book)

# Appendix

- **Appendix A** – Concept Plans
- **Appendix B** – Arboricultural Impact Assessment
- **Appendix C** – Traffic and Parking Impact Study
- **Appendix D** – Geotechnical Assessment
- **Appendix E** – Flood Assessment

## Appendix A – Concept Plans

# KNOX STREET PLAZA

Concept Design


ASPECT Studios

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**ASPECT Studios acknowledges the traditional owners of the land we work on and travel through and we pay our respects to elders past, present and emerging.**

We acknowledge the Traditional Custodians of this Country and their continuing connection to culture, community, land, sea and sky.

We also pay respect to all First Peoples of the Sydney area, who have continued through strength and courage to retain and reclaim their culture, languages, identities and connections to Country, and recognise the valuable contribution made by Aboriginal people in Sydney to community, narratives, spaces and places in the past, present and future.

# Contents

# VISION + PRINCIPLES

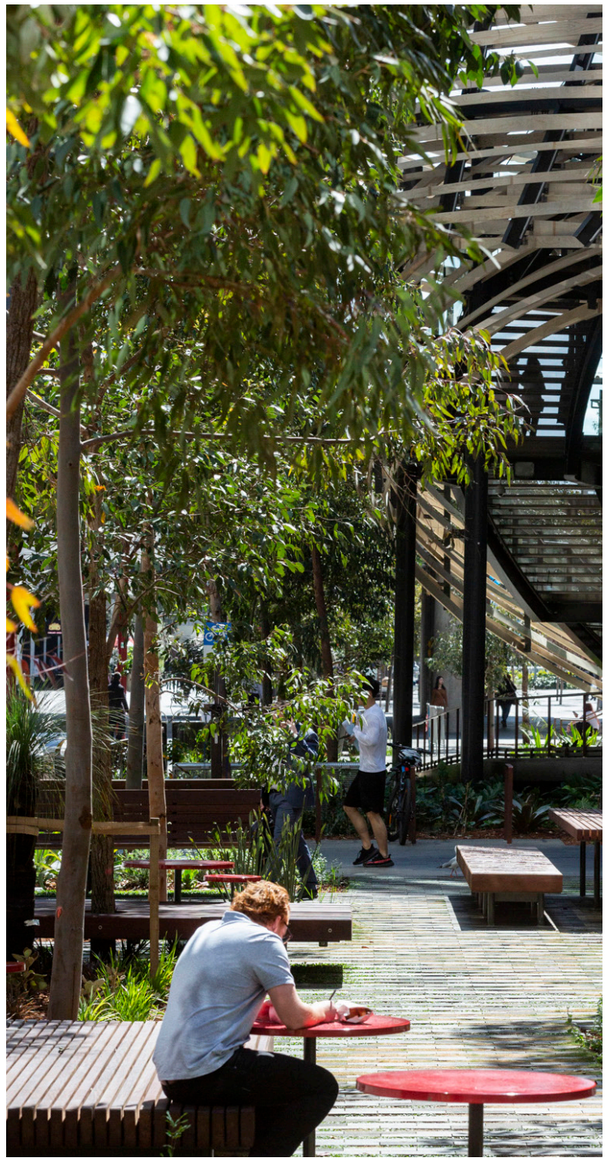
At the heart of Double Bay, Knox Street is a quintessential part of the **Village appeal** with it's lively and engaging streets, lanes, arcades and public spaces.

# Plaza Principles

The following design principles have been collaborated with community and represent the design aspirations for Knox Street.




# Plaza Precedents

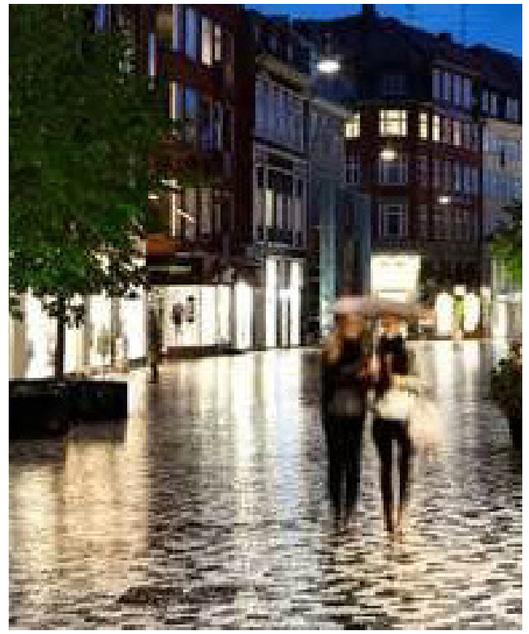


Comfortable seating + table underneath tree canopy

Cultural festivals

Vibrant and colourful planting palette

Feature custom furniture



Places to gather and sit under tree canopy

Floral gardens

# CONCEPT DESIGN

# Key Moves

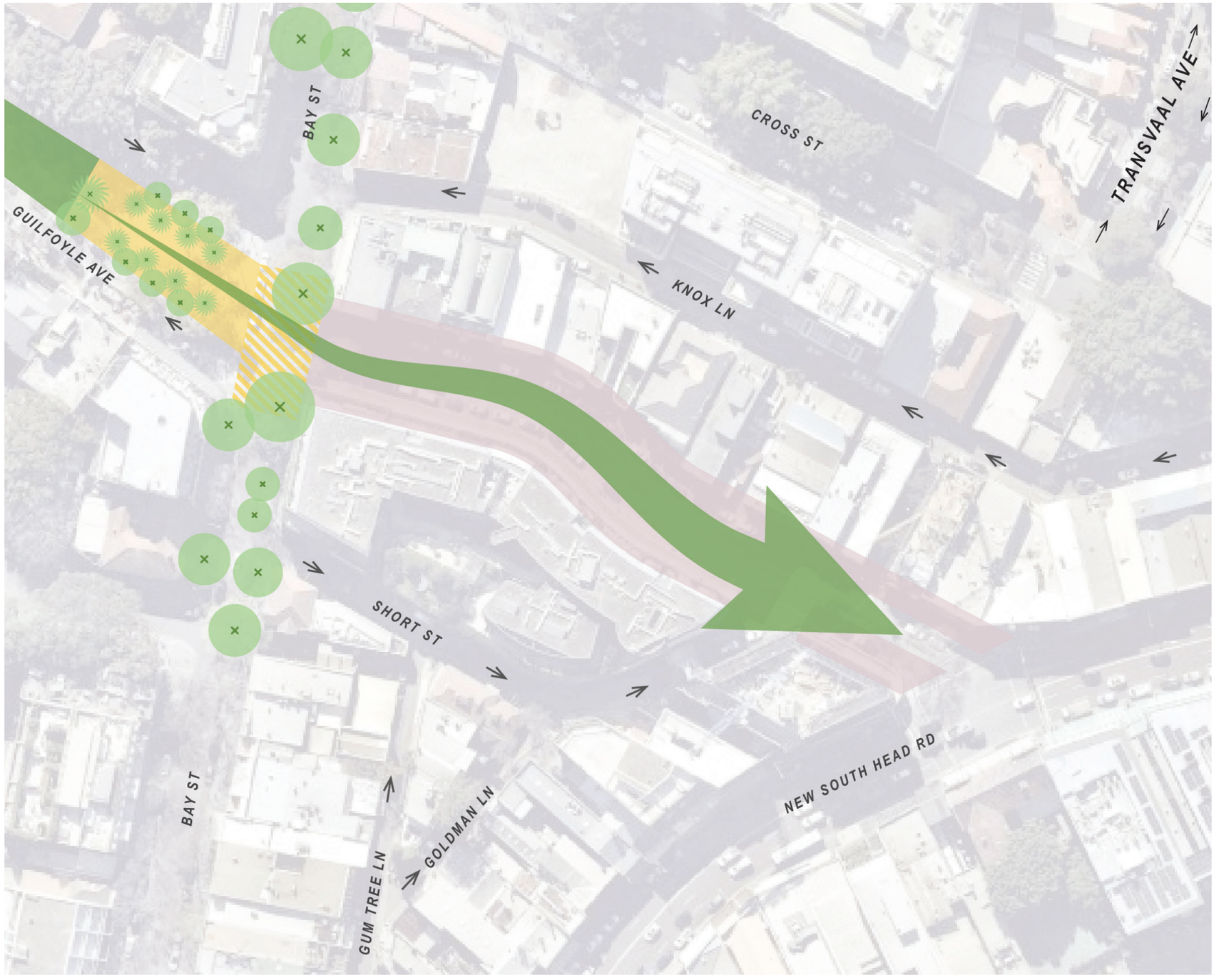
## 1. Influence of Guilfoyle

### *EXTENDING GUILFOYLE PARK INTO KNOX STREET*

Prioritise pedestrian connection from Guilfoyle Park to Knox Street through paving treatment and raised trafficable thresholds

Extend existing activation events such as markets from Guilfoyle into Knox Street to support and grow on what works

Continue tree canopy and park character into Knox Street



# Key Moves

## 2. Not just a regular street

### *CIRCULATION AND SCALE*

Pick up on existing scale and character the articulation of existing connections and laneways

Introduce flexible edges and variety of amenity to compliment various uses

# Key Moves

## 3. A fine dining experience

***ACHIEVING A BALANCE BETWEEN FINE DINING EXPERIENCE WITH COMMUNAL AMENITY***

Locate proposed outdoor dining opportunity with existing food & beverage venues

Complement food & beverage outdoor dining with a range of public seating and table opportunities

# Key Moves

## 4. A bustling place to sit, shop, relax, eat and play

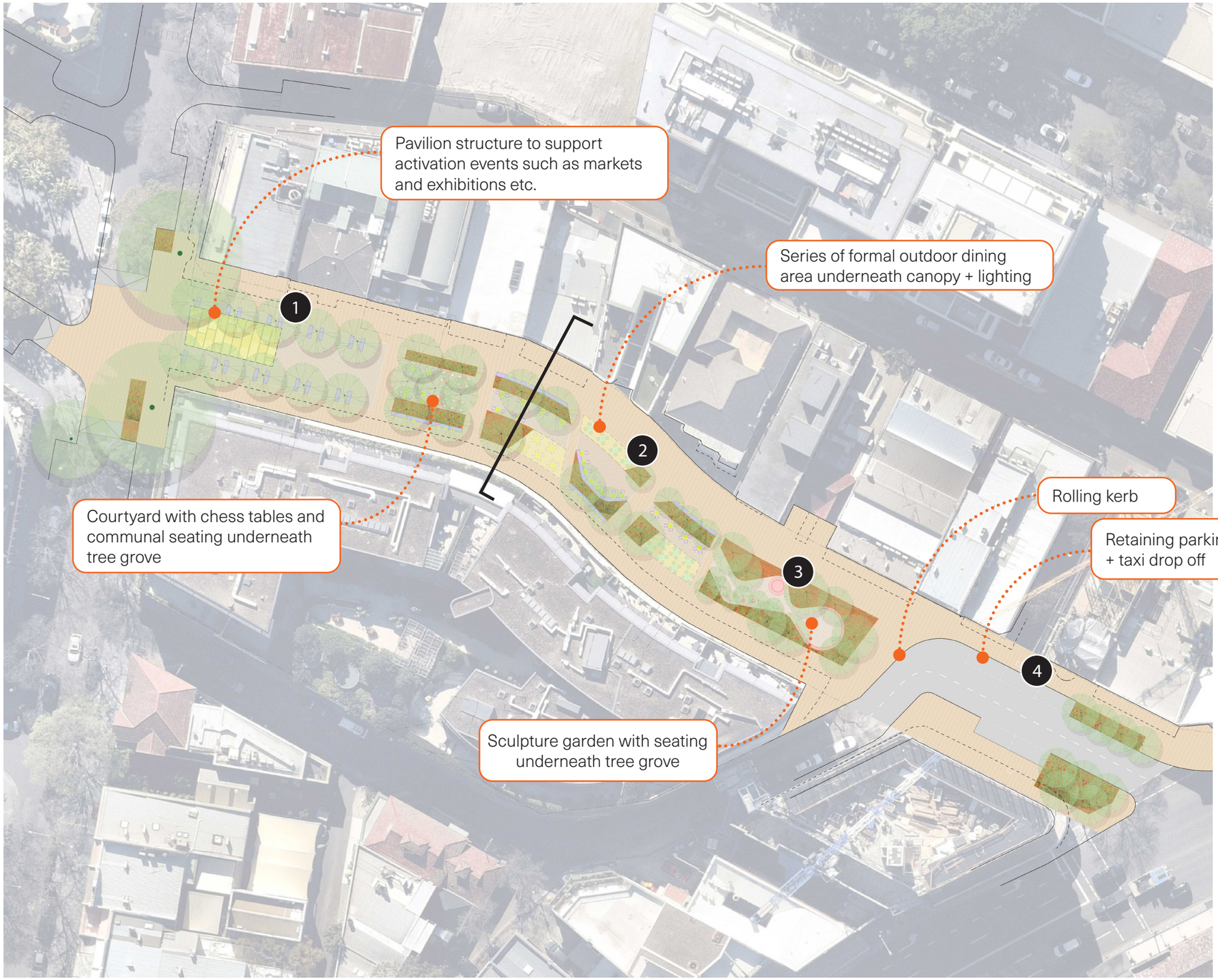
### *A STREET THAT DOES IT ALL*

Creating a narrative to the street that caters to a range of experiences

# Key Areas

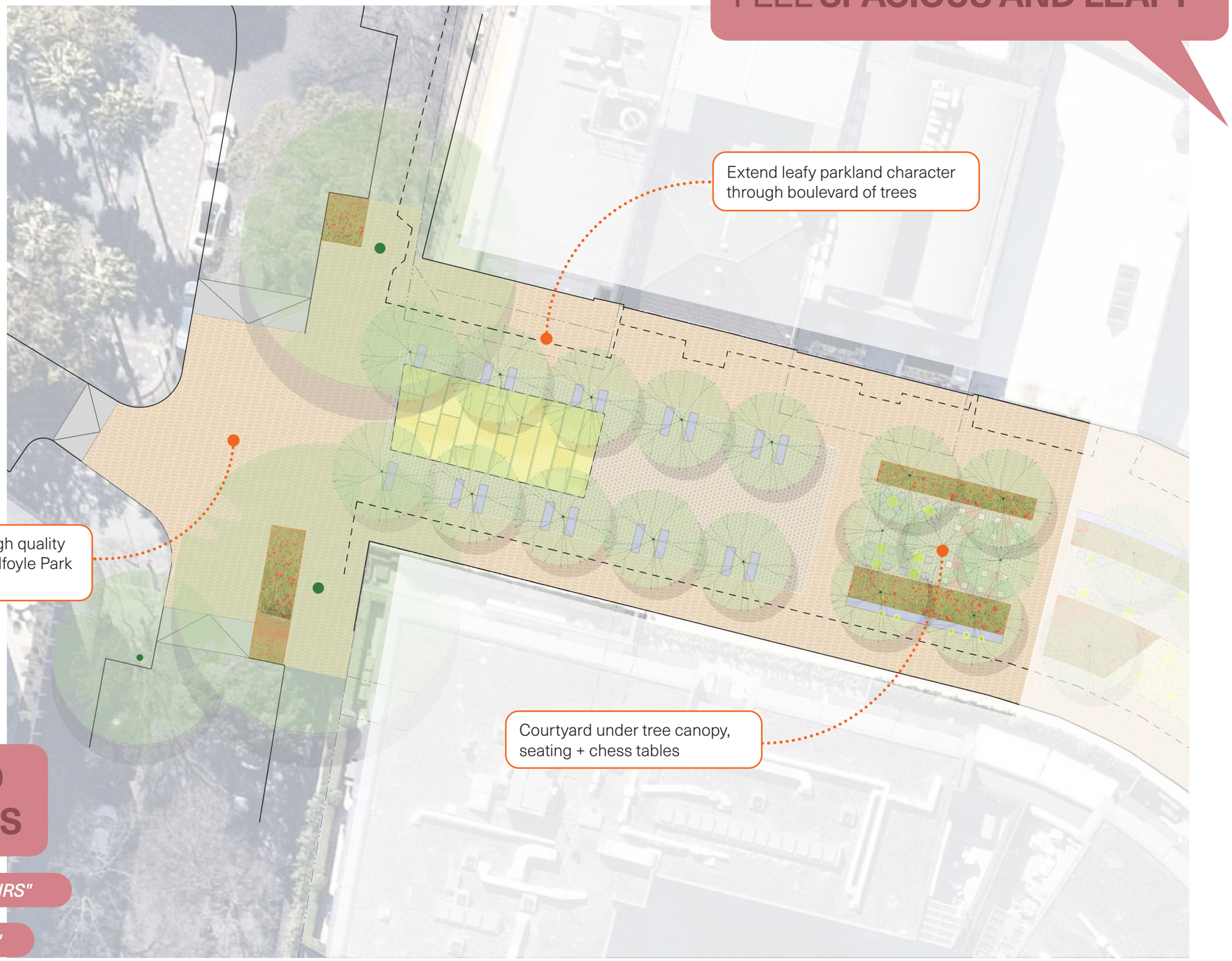
**The transformation of Knox Street will include four key areas:**

1. **Guilfoyle Square**
2. **Outdoor dining pads**
3. **Secret garden**
4. **Knox Street**



# Guilfoyle Square

**86%** WANTED THE SPACE TO FEEL **SPACIOUS AND LEAFY**




**76%** OF PEOPLE WANTED TO SEE **MARKETS & FOOD FAIRS**

*"RETAIL AND ART FAIRS"*

*"LOCAL COMMUNITY EVENTS"*

# Guilfoyle Square

Continuation of greenery from Guilfoyle Park


Continuous tree boulevard

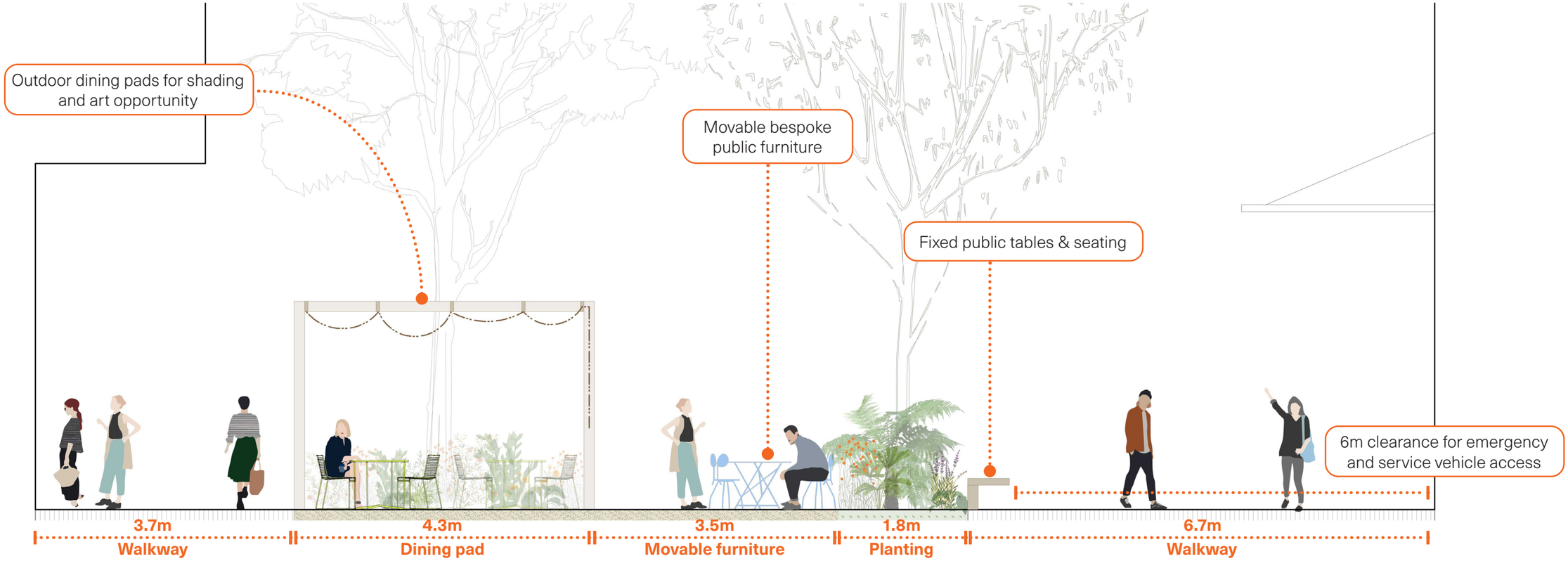
Warm paving tones

Chess tables

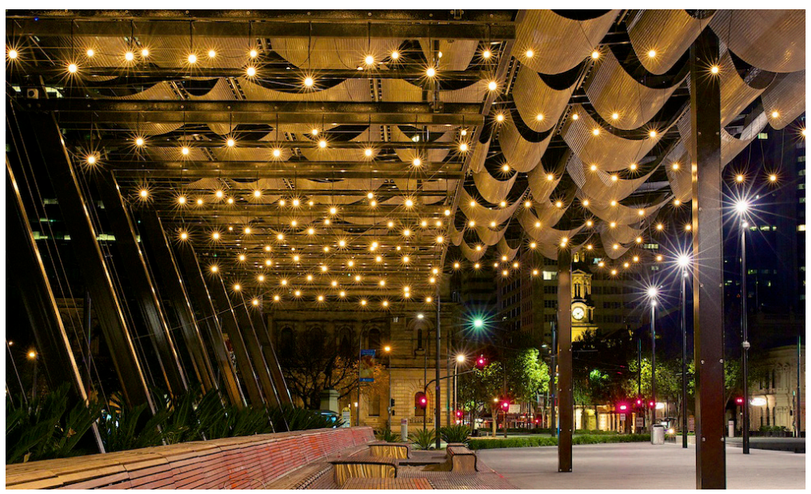
# Outdoor Dining Pads

**91%** OF PEOPLE WANTED TO SEE **OUTDOOR DINING IN THIS SPACE**

# Outdoor Dining Pads




Opportunity for bespoke public furniture



Dining pads with catenary lighting

Seating and table amenities under tree canopy

# Secret Garden

**89%** OF PEOPLE WANTED TO SEE **PLANTING & TREE CANOPY** IN THIS SPACE

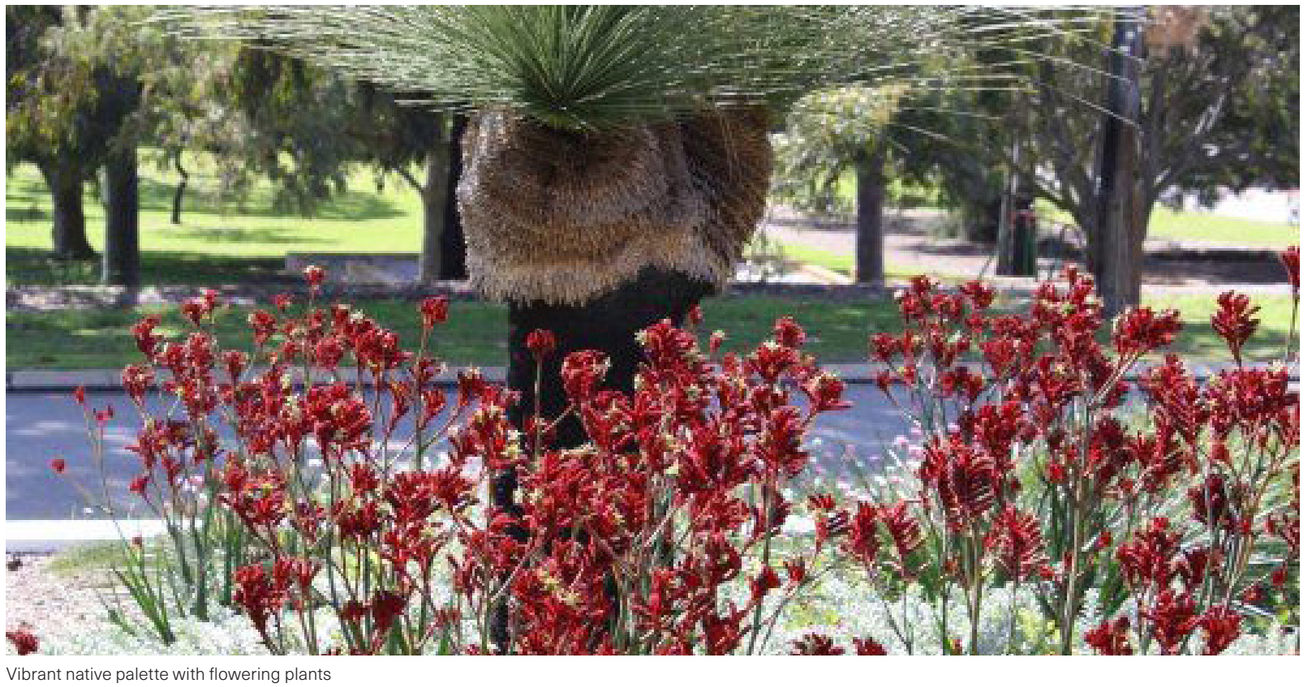
*"RECOGNITION OR EDUCATION ABOUT INDIGENOUS HISTORY"*

*"A WATER FEATURE TO CONNECT KNOX STREET TO THE HARBOUR"*

*"GREEN SHADED SEATING"*

# Secret Garden

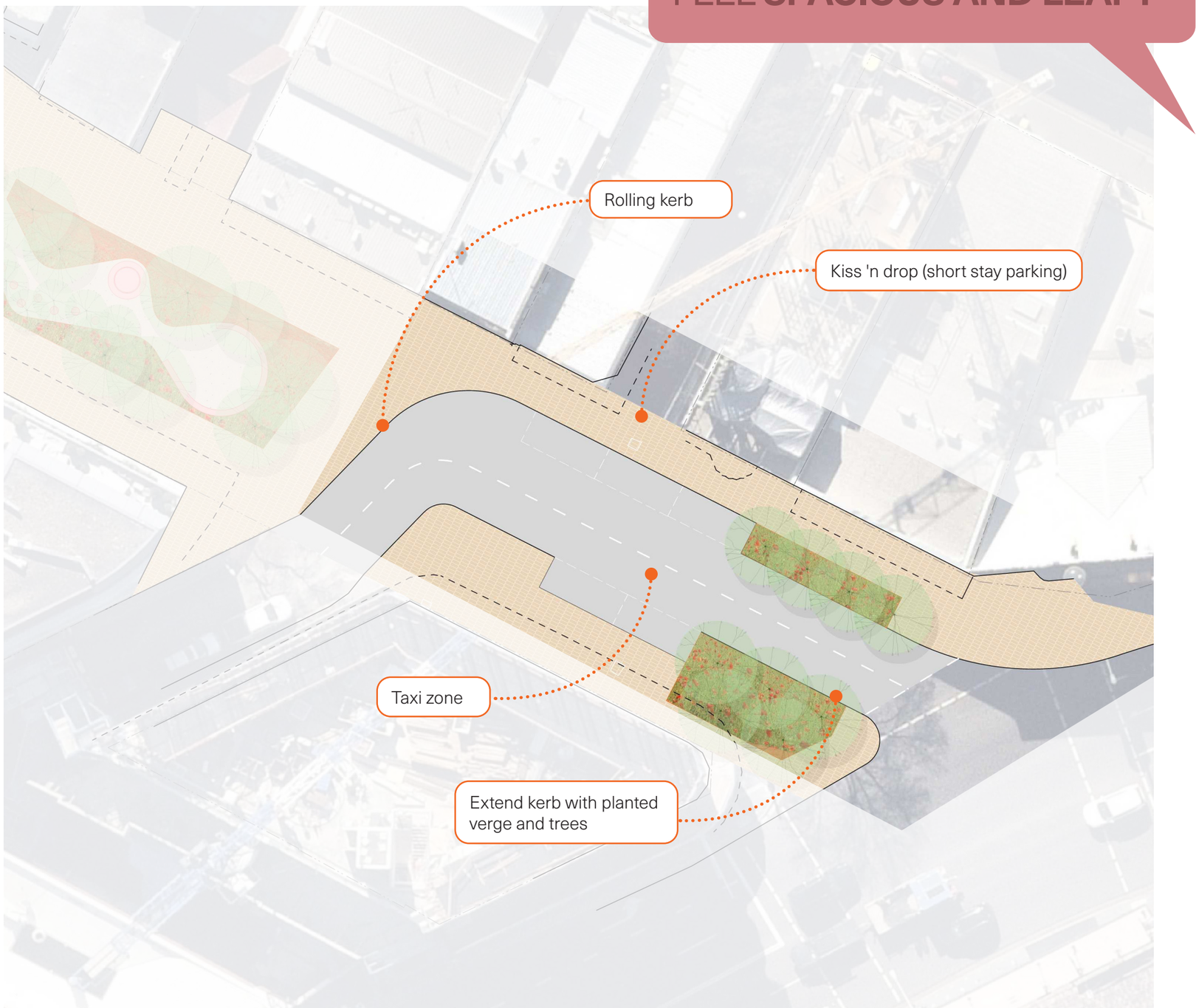
Seating amongst vibrant and colorful planting palette



Vibrant native palette with flowering plants

# Knox Street

**86%** WANTED THE SPACE TO FEEL **SPACIOUS AND LEAFY**



# Outdoor Furniture Strategy

Knox Street Plaza seating and table amenities are made up of:

1. Fixed public furniture
2. Movable public furniture
3. Private outdoor dining

# Lighting Palette


# Materials Palette

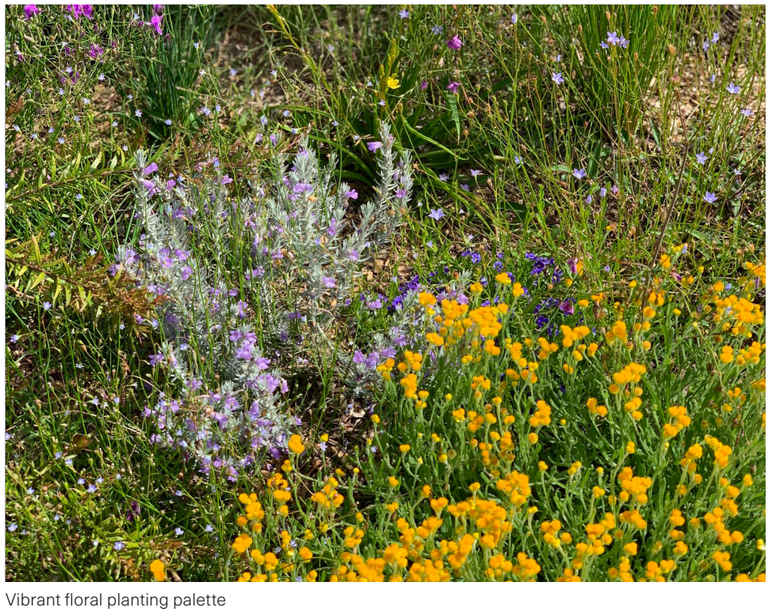
Warm tones of paving

Bronze detailing in furniture

Custom furniture

Porphyry provides a warm textural element to the ground surface

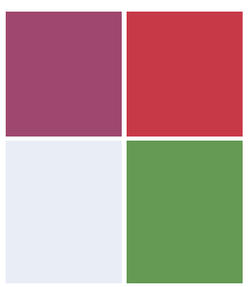
Retail Canopy structures in proposed retail pads  with lighting



Vibrant floral planting palette

# Planting Palette

## Exotic



*Echium fastuosum*

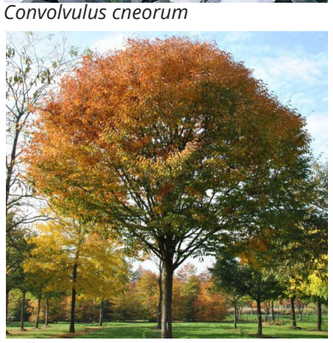
*Convolvulus cneorum*

*Allium Schoenoprasum*

*Aeonium arboreum*

*Salvia officionalus 'Schwartzkopf'*

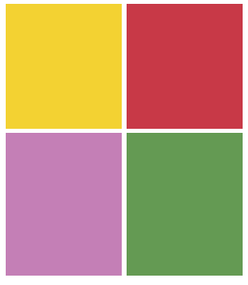
*Jacaranda*



*Zelkova serrata*

*Magnolia grandiflora*

## Native



*Anigozanthos*

*Brachyscome multifida*

*Carpobrotus glaucsens*

*Craspedia globosa*

*Melaleuca thymifolia 'Purple Lace'*

*Angophora costata*

*Elaeocarpus reticulatus*

*Tristaniopsis laurina*

# ABORIGINAL KEY NARRATIVES

# Designing with Country

To ensure Knox Street Plaza achieves its bench-mark aspiration, designing for Country will incorporate key narratives identified by Yerrabingin in the Desktop research report.

The report draws upon existing resources including Woollahra council's Aboriginal Heritage Study, 2021.

Three key narratives have been outlined to be of particular importance to Knox Street, Double Bay.

## 1 | Rocks, sand and shells

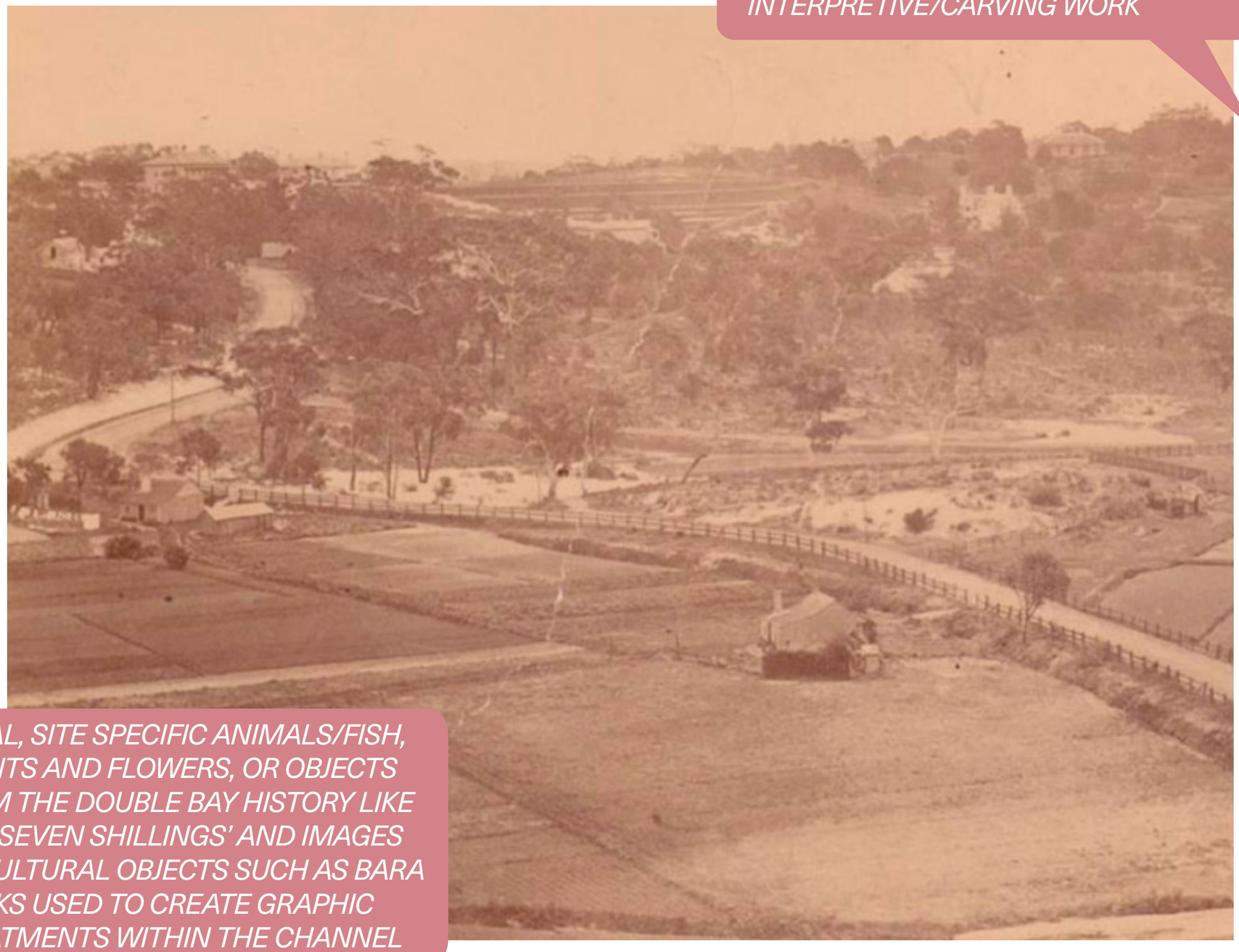
## 2 | Negotiating spaces

## 3 | Looking again at Country

**The integration of these narratives will be designed in parallel to the concept development to ensure a seamless design outcome that is meaningful and holistic. Potential design collaboration consists of**

— Planting Palette
— Wayfinding and signage
— Feature lighting
— Material selection and colour palette
— Public Art

*BARA SHELL HOOKS AND LINE COULD BE USED AS REFERENCE FOR INTERPRETIVE/CARVING WORK*

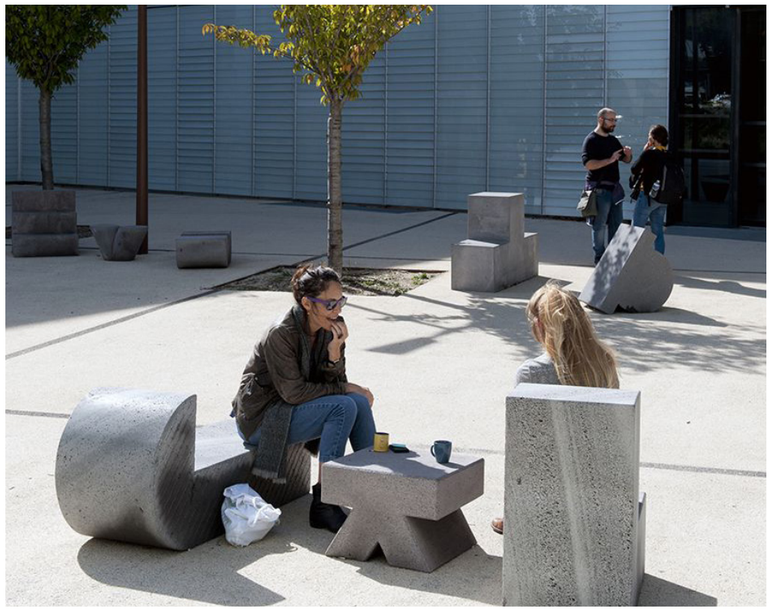


*LOCAL, SITE SPECIFIC ANIMALS/FISH, PLANTS AND FLOWERS, OR OBJECTS FROM THE DOUBLE BAY HISTORY LIKE THE 'SEVEN SHILLINGS' AND IMAGES OF CULTURAL OBJECTS SUCH AS BARA HOOKS USED TO CREATE GRAPHIC TREATMENTS WITHIN THE CHANNEL*

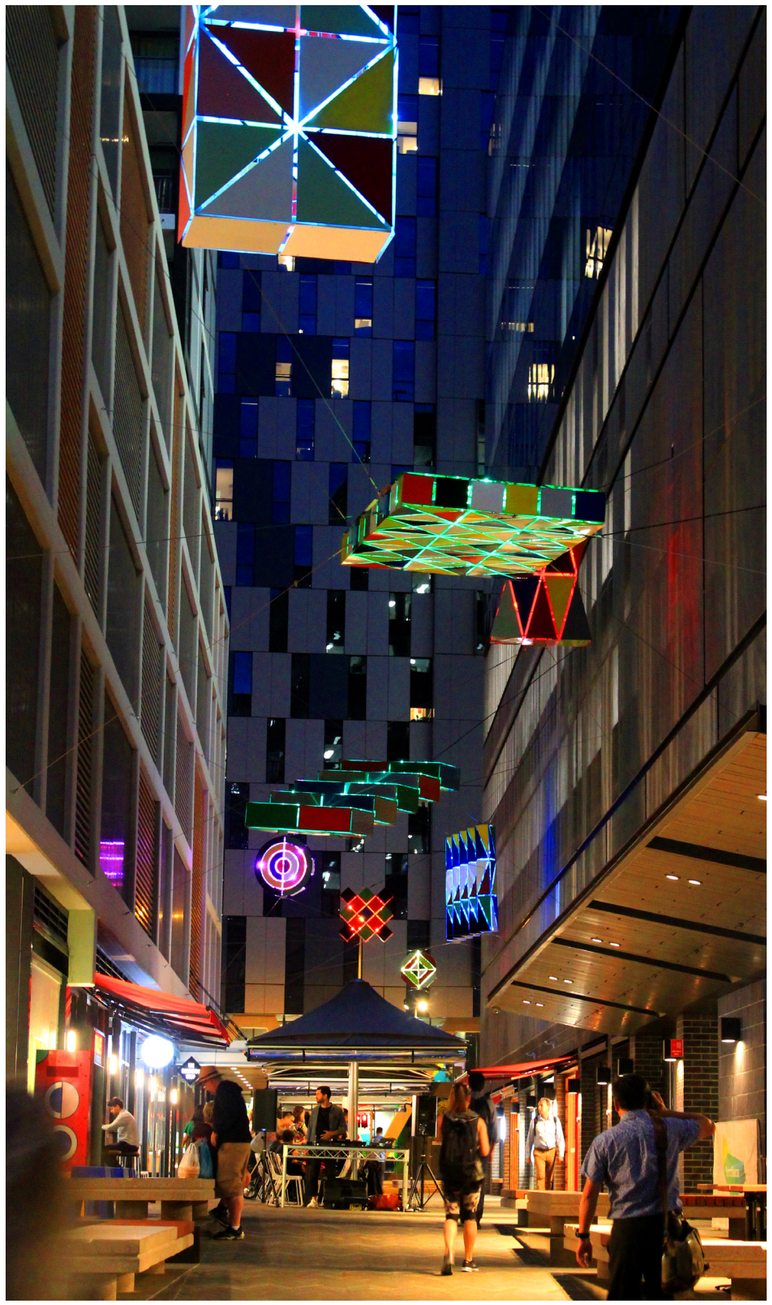
Figure 1: 1870s photo of New South Head Road at Double Bay. Raised over drained swamps turned into markets/Anon C. 1875-1885 SLNSW SPF651(Source: Coast History and Heritage, 2021)

# Art Integration

## Sculptural seating & art elements

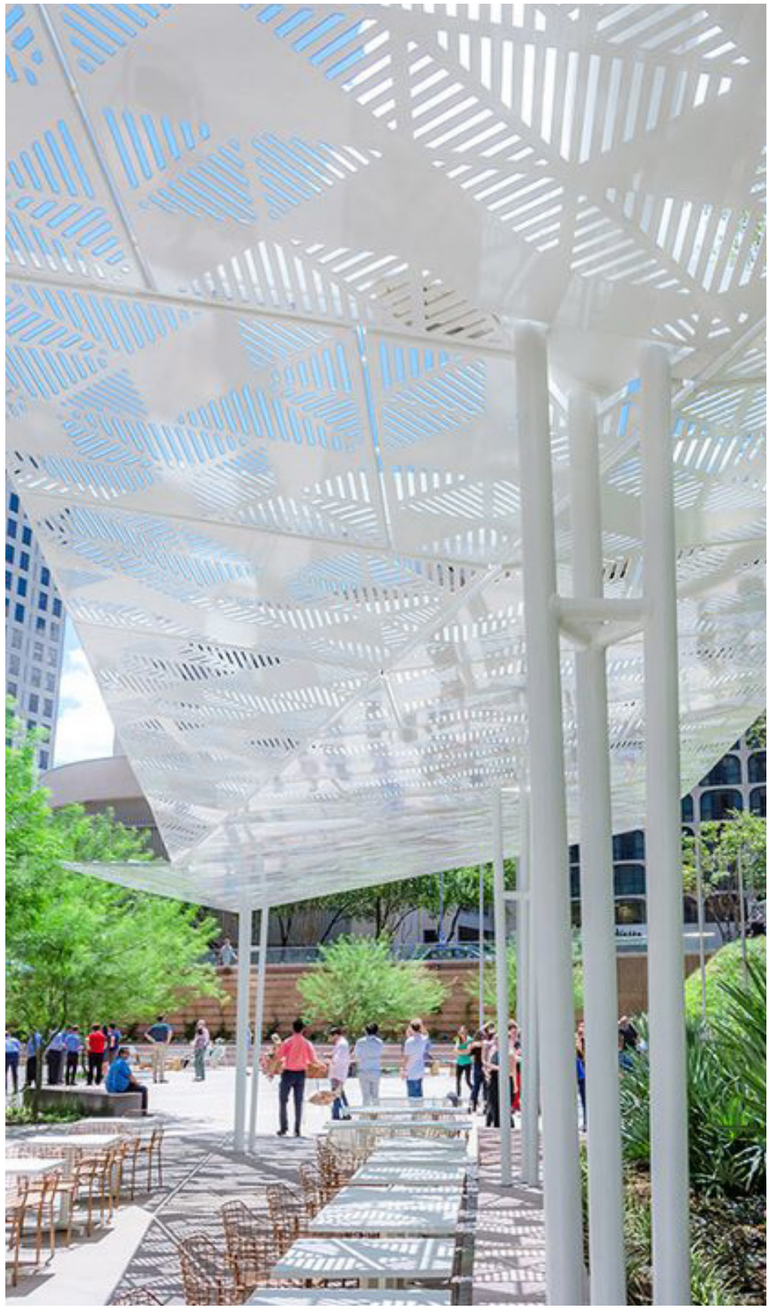


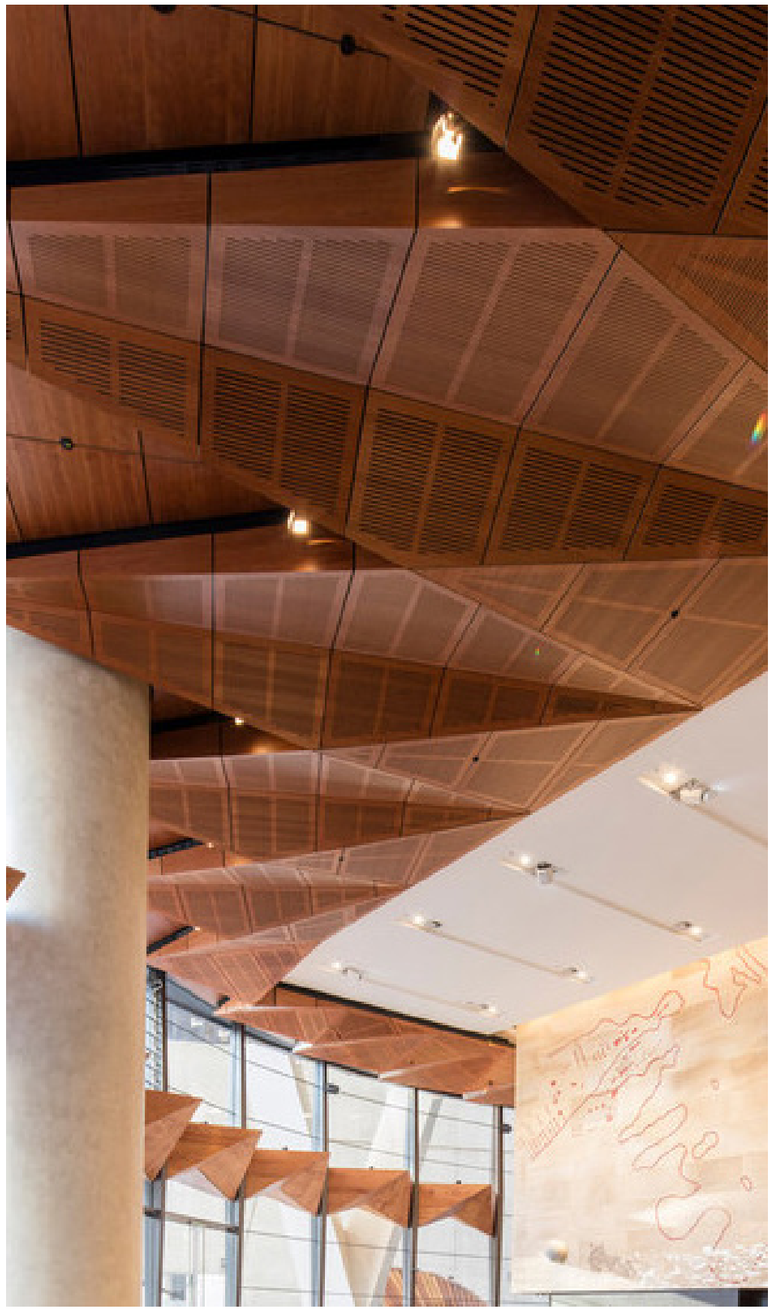
## Lighting



# Art Integration

## Pavillion





## Mural by Indigenous Artists

Native garden, UTS, Artist: Maddison Gibbs

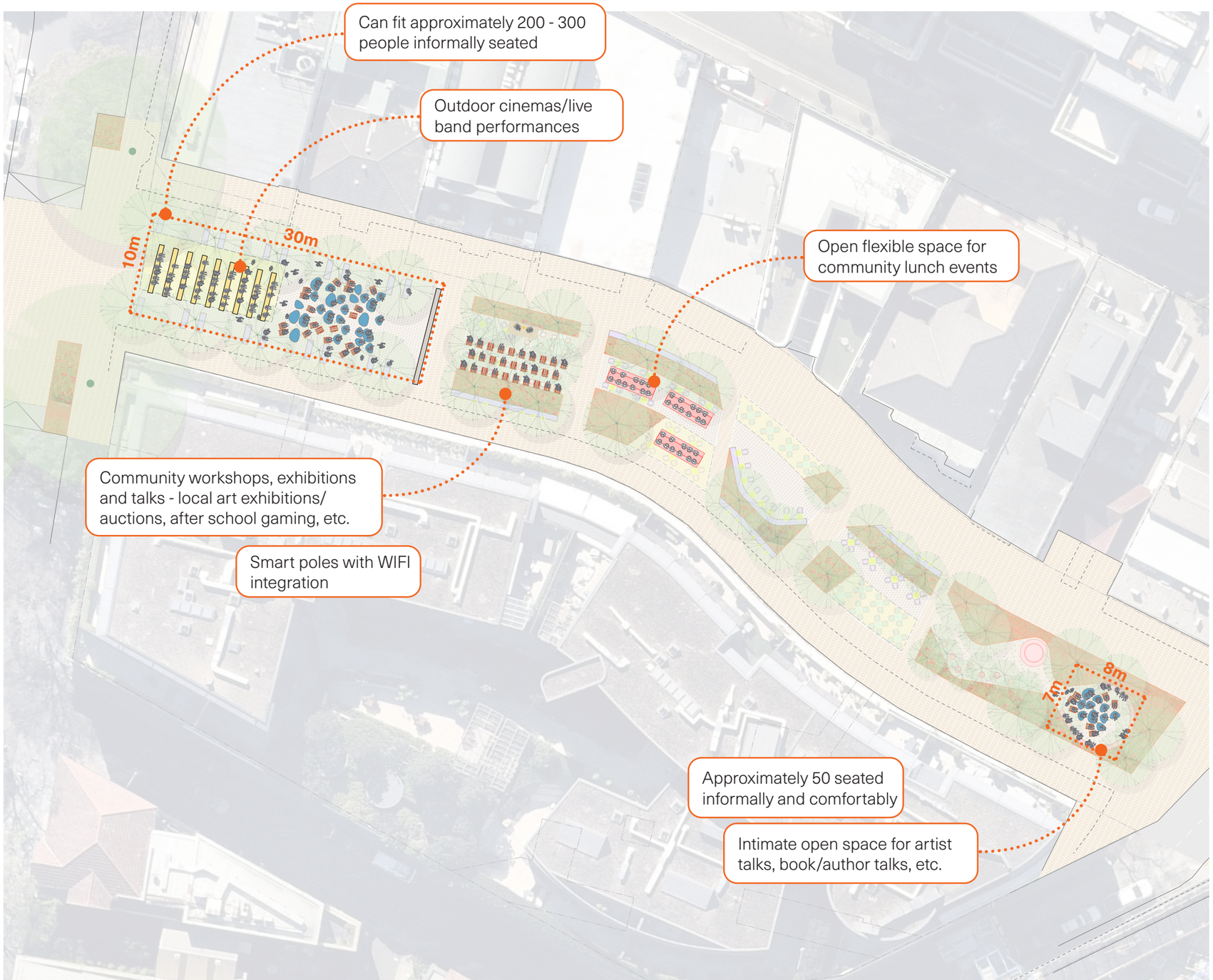
In Between two worlds, City of Sydney, Artist: Jason Wing

# ACTIVATION DIAGRAMS

# Community Activation - Small to medium sized events

**Flexible spaces offer opportunity to cater small to medium sized events such as:**

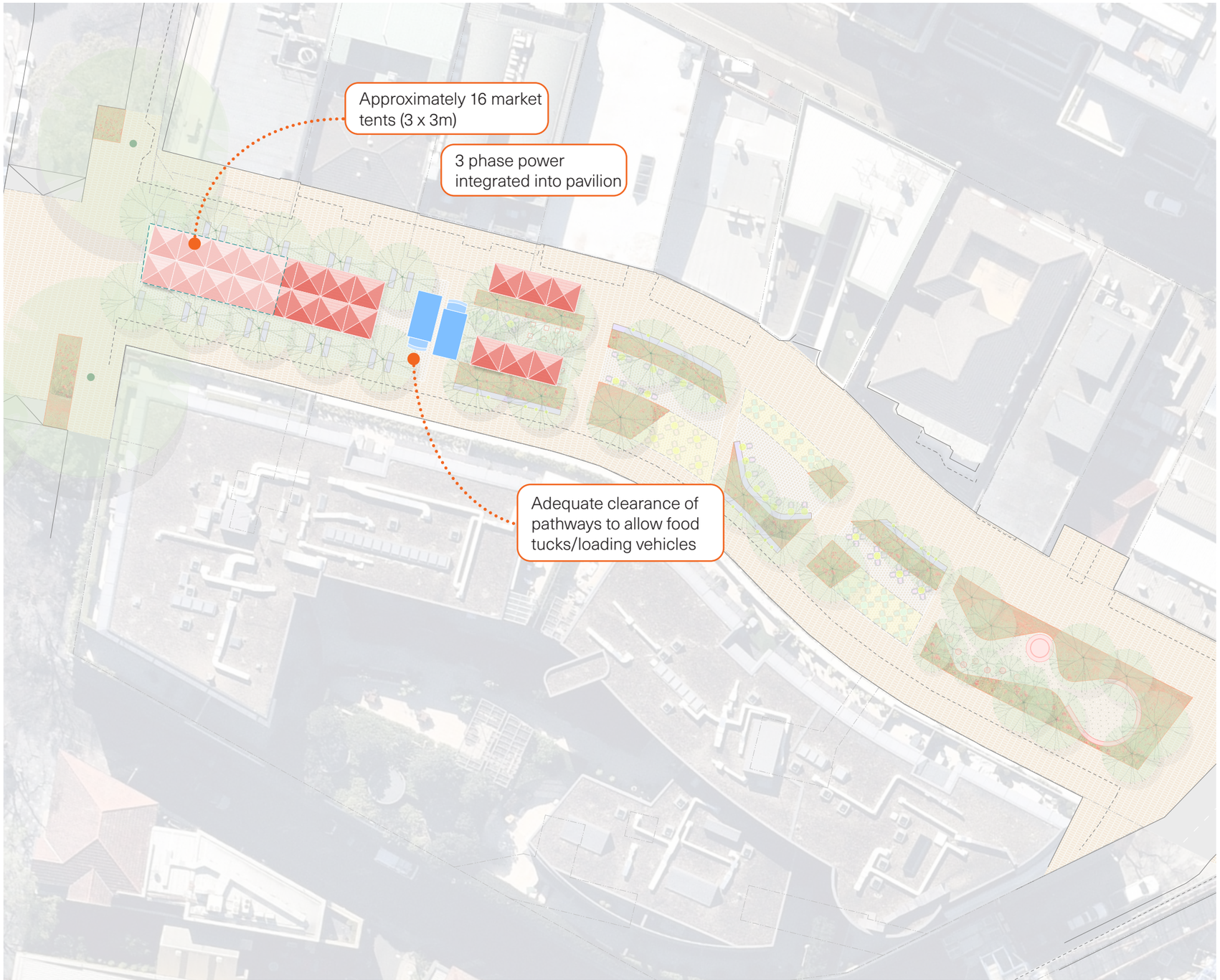
- Local community group lunch events
- Community outdoor workshops
- After school children's workshops
- Art exhibitions & auctions
- Author meet & greets
- Artist talks



# Community Activation - Large sized events

**Flexible spaces and pavilion structure offer opportunity to cater large community sized events such as:**

- Local markets with tents and food trucks
- Community exhibitions
- Community presentations
- Music festivals & live performances
- Night markets

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## Appendix B – Arboricultural Impact Assessment

Project No: KNOX/DOUBLE/21  Report No: KNOX/DOUBLE/AIA/A

# ARBORICULTURAL IMPACT ASSESSMENT
# TREE PROTECTION SPECIFICATION

## Knox Street
## Double Bay

Prepared for: ASPECT

30th November 2021
Revision A


Authors:

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Dip. Horticulture (Arboriculture)
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# Contents





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## 1.0 INTRODUCTION

### 1.1 Background

1.1.1 This Arboricultural Impact Assessment Report and Tree Protection Specification was prepared for Aspect, on behalf of Woollahra Municipal Council, in relation to the Knox Street Plaza project. The purpose of this Report is to undertake a Visual Tree Assessment[1] (VTA), determine the impact of the proposed works on the subject trees, and where appropriate, recommend the use of sensitive construction methods and tree protection measures to minimise adverse impacts.

1.1.2 In preparing this report the authors are aware of and have considered the objectives of the following:

- *State Environmental Planning Policy Vegetation in Non-Rural Areas (2017*)
- *Woollahra Local Environmental Plan (2014)*
- *Woollahra Development Control Plan Chapter E3 (Tree Management)* and *DA Guide (Attachment 4)*
- *Woollahra Council Register of Significant Trees (1991)*
- *Australian Standard 4970-2009 Protection on Tree Development Sites*
- *Australian Standard 4373-2007 Pruning of Amenity Trees*
- *Australian Standard 2303-2015 Tree Stock for Landscape Use*
- *Safe Work Australia Guide for Managing Risks of Tree Trimming and Removal Work (2016)*

Refer to Methodology **(Appendix 1)**

1.1.3 This impact assessment is based on an assessment of the following supplied documentation/plans only:

- Plan showing Details & Levels 202964
  prepared by Veris, dated 25.08.2021
- Concept Design
  prepared by Aspect, not dated
- Tree Removal & Retention Plan
  prepared by Aspect, dated 29.11.2021

Refer to Plans **(Appendix 2)**

### 1.2 The Proposal

1.2.1 The supplied plans show that the proposed works are for the pedestrianisation of Knox Street which includes:

- Demolition of existing structures and pavements
- Removal of trees
- Construction of pavilion structure
- Construction of taxi drop off area, on-street parking and other new pavement areas
- Installation of outdoor dining pads and water garden
- Installation of landscape fixtures, tree planting and soft landscaping

[1] Mattheck & Breloer (2003)



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## 2.0 RESULTS

### 2.1 The Site

2.1.1 The site includes the Knox Street carriageway and road reserve. The site is bound by Bay Street to the west, New South Head Road to the east, and multistorey commercial/retail buildings to the north and south.

2.1.2 The carriageway comprises an asphaltic concrete pavement. There are four (4) narrow median gardens within the centre of carriageway which contain trees and hedges. Light poles, signposts, seating, planters and other street furniture/fixtures are located along the footpath either side of the carriageway. The footpath is surfaced with concrete unit paving. The site relatively level with a gentle slope from east to west.

2.1.3 The Double Bay commercial centre is zoned B2 Local Centre.[2]

### 2.2 The Trees

2.2.1 Eight (8) trees were assessed using the VTA criteria and notes and comprise a mix of Australian native and exotic species including *Cinnamomum camphora* (Camphor Laurel), *Ficus rubiginosa* (Port Jackson Fig), *Platanus* x *acerifolia* (London Plane Tree) and *Sapium sebiferum* (Chinese Tallowood).

2.2.2 None of the trees are listed in the Woollahra Council *Register of Significant Trees (1991)* or *Woollahra Local Environmental Plan Schedule 5 Environmental Heritage (2014)*.[3]

2.2.3 Aerial images of the site from 1943 shows trees in similar locations to Tree 1 *Cinnamomum camphora* (Camphor Laurel) and Tree 2 *Ficus rubiginosa* (Port Jackson Fig).[4] These species were commonly planted in the late 19th and early 20th century which suggests they are likely to be those trees shown in the 1943 aerial photographs.

2.2.4 *Sapium sebiferum* Chinese Tallowood (Tree 8) is listed in Appendix 2 Other Weeds of Regional Concern within the *Greater Sydney Regional Strategic Weed Management Plan (2017– 2022)*.[5]

2.2.5 As required by Clause 2.3.2 of *Australian Standard 4970 2009 Protection of Trees on Development Sites (AS-4970)*, each tree has been allocated a Retention Value. TreeiQ allocates one of four Retention Value categories based on a combination of Landscape Significance and Useful Life Expectancy (ULE). The assessment of Landscape Significance and ULE involves a degree of subjectivity and there will be a range of tree quality and value within each of the Retention Value categories. The Retention Values do not consider any proposed development works and are not a schedule for tree retention or removal. The trees (and tree groups) have been allocated one of the following Retention Values:

- Priority for Retention
- Consider for Retention
- Consider for Removal
- Priority for Removal

Refer to Tree Assessment Schedule **(Appendix 3)**

[2] Woollahra Municipal Council (2014)
[3] Woollahra Municipal Council (1991); Woollahra Municipal Council (2014)
[4] Six Maps (1943)
[5] Local Land Services Greater Sydney (2019)



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## 3.0 ARBORICULTURAL IMPACT ASSESSMENT

### 3.1 Trees 1 & 2

3.1.1 Trees 1 and 2 were identified as *Cinnamomum camphora* (Camphor Laurel) and *Ficus rubiginosa* (Port Jackson Fig) respectively and are late-mature specimens located on the junction of Knox and Bay Streets. The trees are in fair health as evidenced by a reduced crown density and the presence of deadwood and epicormic growth within their crowns. Tree 2 is in fair structural condition as it has been previously lopped with most of its crown comprising of mature epicormic growth. Wounds with advanced stages of decay are evident at the lopping points. Both trees are partially suppressed by the adjacent buildings and have been significantly Reduction Pruned for building clearance. The trees are of high Landscape Significance and have been allocated a Retention Value of *Consider for Retention.*

3.1.2 The supplied plans show that Trees 1 and 2 are to be retained with new deep soil tree pits, garden beds and pavement areas proposed within their Tree Protection Zone (TPZ) areas. The extent of works represent *Major Encroachments* as defined by *Australian Standard 4970-2009 Protection of Trees on Development Sites* (AS-4970). Clause 3.3.4 of AS-4970 outlines that design factors and tree sensitive construction methods should be considered when determining the potential impact of the encroachment. The following tree sensitive methods should be utilised within the TPZ areas to minimise adverse impacts:

#### 3.1.3 Recommendations

- The existing pavement surfaces should be lifted in small sections using handheld breakers or a compact excavator (guided by a spotter) without disturbing the underlying sub-base layer. Demolition machinery should work from areas of the existing pavement area. Demolition works within the SRZ areas should be undertaken using hand tools only.

- If required, sub-base layers should be carefully removed using hand tool only. Roots (>25mmø) present within sub-base layers should be retained and protected from sunlight and desiccation with a covering of damp hessian or geotextile fabric.

- New pavement surfaces and sub-base layers should be installed above existing grade within the TPZ areas. Pavements may be installed at existing grade only where replacing existing paving and utilising existing sub-base layers. Roots (>25mmø) identified with sub-base layers should be retained, and surfaces and sub-base layers should be thinned/modified as required with appropriate root protection installed. Root pruning should be undertaken by the Project Arborist only.

- Deep soil tree pits within TPZ areas should be excavated under the supervision of the Project Arborist and be undertaken in small increments using an excavator fitted with a flat bladed bucket. The excavator operator should be guided by a spotter to identify and expose roots (>25mm diameter) using hand tools. Roots (>25mm diameter) should be retained and protected where required by the Project Arborist.

- Metal edging for the tree surround and garden beds should be installed using hand excavation with the edging modified (cut away) to bridge over and enable the retention of roots (>25mmø) as required by the Project Arborist. Pegs/pins to which the edging is affixed should be located as to avoid roots (>25mmø).



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3.1.4 A detailed aerial assessment of the structural condition of the trees should be undertaken by a climbing Arborist (AQF level 3). Cavities (where present) should be probed, and where found to be extensive, further internal diagnostic testing (using a Resistograph or Tomograph) should be undertaken. The lighting installed in the trees should also be assessed to determine if cables are or have the potential to constrict trunks/branches and impact the vascular function of the trees.

## 3.2 Trees 3-6

3.2.1 Trees 3-6 were identified as *Platanus* x *acerifolia* (London Plane Tree) and are located within narrow median garden beds at each end of Knox Street. The trees are good health and structural condition although Tree 4 has developed a poor crown form due to previous pruning. The trees are of moderate Landscape significance and have been allocated a Retention Value of *Consider for Retention.*

3.2.2 The supplied plans show Trees 3 and 4 are to be removed to accommodate the proposed event pavilion areas. Trees 5 and 6 are to be removed to accommodate the proposed parking/taxi stand area.

## 3.3 Tree 7

3.3.1 Tree 7 was identified as *Platanus* x *acerifolia* (London Plane Tree) and is located within a narrow median garden bed at the eastern end of Knox Street. The tree is in good health and structural condition. Tree 7 is of moderate Landscape significance and has been allocated a Retention Value of *Consider for Retention.*

3.3.2 The supplied plans show that Tree 7 is to be retained with new pavement areas and deep soil tree pits proposed within its TPZ. The extent of works represents a *Major Encroachment* as defined by AS-4970. The following tree sensitive methods should be utilised within the TPZ to minimise adverse impacts:

### 3.3.3 Recommendations

- The existing pavement surfaces should be lifted in small sections using handheld breakers or a compact excavator (guided by a spotter) without disturbing the underlying sub-base layer. Demolition machinery should work from areas of the existing pavement area. Demolition works within the SRZ should be undertaken using hand tools only.
- If required, sub-base layers should be carefully removed using hand tool only. Roots (>25mmø) present within sub-base layers should be retained and protected from sunlight and desiccation with a covering of damp hessian or geotextile fabric.
- New pavement surfaces and sub-base layers should be installed above existing grade within the TPZ. Pavements may be installed at existing grade only where replacing existing paving and utilising existing sub-base layers. Roots (>25mmø) identified with sub-base layers should be retained, and surfaces and sub-base layers should be thinned/modified as required with appropriate root protection installed. Root pruning should be undertaken by the Project Arborist only.
- The kerb and sub-base on northern side of the tree should be left in situ within the TPZ and incorporated into the new road layout to minimise root disturbance. It should be noted that displacement of the kerb to the north of the tree is likely to occur in the medium term. Where the kerb becomes displaced, its removal and replacement with a thinner structure (e.g. a steel edge or similar) should be considered. In addition, the installation of bollards may be required along the kerb line on either side of the tree's trunk to prevent vehicle impact damage. The installation of a steel edge and bollards will require input from a qualified arborist (AQF level 5) to outline appropriate tree sensitive design and installation methods.



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- The kerb on the southern side of the tree within the SRZ should be cut to ground level with the inground portion of the kerb left in-situ to prevent potential root plate instability issues. In the event that the sub- base/sub grade below the kerb is highly compacted and represents a potential barrier to root spread extending into the new deep soil area, the sub-base/subgrade at the face of the excavation should be loosened with a garden fork.

- Deep soil tree pits within TPZ should be excavated under the supervision of the Project Arborist and be undertaken in small increments using an excavator fitted with a flat bladed bucket. The excavator operator should be guided by a spotter to identify and expose roots (>25mm diameter) using hand tools. Roots (>25mm diameter) should be retained and protected where required by the Project Arborist.

- Metal edging for the tree surround and garden beds should be installed using hand excavation with the edging modified (cut away) to bridge over and enable the retention of roots (>25mmø) as required by the Project Arborist. Pegs/pins to which the edging is affixed should be located as to avoid roots (>25mmø).

3.3.4 A branch of Tree 7 has been lopped at approximately 3.5 above grade on the western side of the tree's crown. The lopped branch stub should be pruned back to the branch collar in accordance with *Australian Standard 4373 Pruning of Amenity Trees (2007).*

## 3.4 Tree 8

3.4.1 Tree 8 was identified as *Sapium sebiferum* (Chinese Tallowood) and is located on the corner of Knox and Short Street. The tree is in good health and structural condition. The tree is of moderate Landscape significance and has been allocated a Retention Value of *Consider for Retention.*

3.4.2 The supplied plans show Tree 8 is to be removed to accommodate the widening of Short Street.

## 3.5 Other Works within Areas

### 3.5.1 Demolition Works

Demolition works within TPZ areas should be supervised by the Project Arborist and utilise tree sensitive methods. Structures should be demolished in small sections ensuring demolition machinery/equipment does not contact with any parts of the trees.

### 3.5.2 Underground Services

Underground services should be located outside of TPZ areas. Where this is not possible, services should be installed using tree sensitive excavation (hand/hydrovac etc) methods with the services located around/below roots as deemed necessary by the Project Arborist.

### 3.5.3 Landscape Planting

The installation of plants within TPZ areas should be undertaken using hand tools and roots should be protected. No mechanical cultivation/ripping of soils should be undertaken within TPZ areas.



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## 4.0 NEW TREE PLANTINGS

### 4.1 Soil Volumes & Depths

4.1.1 Artificial soil profiles may need to be installed in the deep soil trees pits within the plaza with the new trees being planted below paving or in areas where the existing site soil is unsuitable for plant growth. Limited soil volumes, especially in paved areas can be a major limitation to tree health and development.

4.1.2 Indicative soil volumes should be based on the *Apartment Design Guide (2015)* of 35m3 for medium trees and 80m3 for large trees. Planting pits should be linked to form continuous trenches in order to meet these volumes. Indicative soil depths should also be based on the *Apartment Design Guide (2015)* of 800mm + drainage layers for small trees, 1000mm + drainage layers for medium trees and 1200mm + drainage layers for large trees.

4.1.3 Low organic mixes should be used for new soil imported to site to reduce the risk of anaerobic conditions, nitrogen draw down and soil hydrophobia. A dual horizon soil profile should be installed with the A horizon limited to a depth no greater than 300mm.

### 4.2 Tree Selection & Spacings

4.2.1 The selection of appropriate tree species is critical to achieving a good quality canopy cover at the site over the medium to long term. Within a landscape, a range of tree sizes and habits adds a level of structure and complexity which when used effectively can complement and enhance the surrounding environment. Small and upright, columnar and fastigiate trees can be utilised in restricted growing environments to provide the greening of a space while minimising ongoing maintenance requirements and conflict with adjacent structures.[6]

4.2.2 Although small tree species can be important design elements in the landscape, their contribution to the canopy cover is minimal. Research shows the cost benefits provided by large trees to be proportionately much greater than that of small trees due to their ability to shade, screen, absorb greater volumes of carbon dioxide and pollutants, and help reduce the scale of large buildings.

4.2.3 The correct spacing of trees to promote the development of good quality specimens in maturity is essential. Whilst overplanting can initially enhance the greening of a space and increase canopy cover percentages, in the long term, the overall quality and Useful Life Expectancy of the tree population will be reduced due to suppression. A single, well-developed tree is likely to provide a greater contribution to the amenity and canopy cover in the long term than multiple closely-spaced, suppressed trees.

### 4.3 Stock Selection & Procurement

4.3.1 Selecting a healthy and structurally sound tree with attributes appropriate to site constraints can help to prevent future problems. Poorly grown stock will greatly reduce a tree's potential and is likely to result in greater maintenance costs over its lifetime. *Australian Standard 2303: Tree Stock for Landscape Use (2015)* provides recommendations and specifications for the production of quality nursery stock. All new trees installed should meet these standards.

4.3.2 Where large numbers, rare species or super advanced size trees are to be installed, stock should be pre-ordered and grown-on to ensure availability at the time of installation. Nurseries selected for the provision, growing on or hardening off of tree stock should be inspected both prior to and during the contract growing period to ensure quality production standards are complied with.

[6] TreeiQ (2013)



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## 5.0 CONCLUSION

5.1.1 Eight (8) trees were addressed within this report and comprise a mix of Australian native and exotic species. Aerial images of the site from 1943 shows trees in similar locations to Tree 1 *Cinnamomum camphora* (Camphor Laurel) and Tree 2 *Ficus rubiginosa* (Port Jackson Fig).[7] These species were commonly planted in the late 19th and early 20th century which suggests they are likely to be those trees shown in the 1943 aerial photographs.

5.1.2 The supplied plans show that five (5) trees (Trees 3-6 & 8) are proposed for removal. These trees have been allocated a Retention Value of *Consider for Retention.* Replacement tree planting using healthy, advanced-size specimens could replace the loss of amenity from tree removal within a short to medium timeframe.

5.1.3 The supplied plans show that three (3) trees (Trees 1, 2 & 7) are to be retained as part of the proposed development. Works within TPZ areas should utilize tree sensitive methods (as outlined within Section 3) to minimise adverse impacts. The trees to be retained should be protected as outlined within the Tree Protection Specification **(Appendix 5)** and Typical Tree Protection Details **(Appendix 6)**.

5.1.4 Replacement trees should be planted to help off-set the loss of amenity and canopy cover from the tree removal. New trees should be grown in accordance with *Australian Standard 2303 Tree Stock for Landscape Use (2015).*

5.1.5 The structural condition of Trees 1 and 2 and the existing lighting installed within the trees should be assessed via aerial inspection and future tree management recommendations provide based on the results of the inspection.

5.1.6 The lopped branch stub from Tree 7 should be pruned back to the branch collar in accordance with *Australian Standard 4373 Pruning of Amenity Trees (2007).*

[7] Six Maps (1943)



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## 6.0 LIMITATIONS & DISCLAIMER

TreeiQ takes care to obtain information from reliable sources. However, TreeiQ can neither guarantee nor be responsible for the accuracy of information provided by others. Plans, diagrams, graphs and photographs in this Arboricultural Report are visual aids only and are not necessarily to scale. This Report provides recommendations relating to tree management only. Advice should be sought from appropriately qualified consultants regarding design/construction/ecological/heritage etc issues.

This Report has been prepared for exclusive use by the client. This Report shall not be viewed by others or for any other reason outside its intended target or without the prior written consent of TreeiQ. Unauthorised alteration or separate use of any section of the Report invalidates the Report.

Many factors may contribute to tree failure and cannot always be predicted. TreeiQ takes care to accurately assess tree health and structural condition. However, a tree's internal structural condition may not always correlate to visible external indicators. There is no warranty or guarantee, expressed or implied that problems or deficiencies regarding the trees or site may not arise in the future. Information contained in this report covers only the trees assessed and reflects the condition of the trees at the time of inspection. Additional information regarding the methodology used in the preparation of this Report is attached as Appendix 1. A comprehensive tree risk assessment and management plan for the trees is beyond the scope of this Report.

Reference should be made to any relevant legislation including Tree Management Controls. All recommendations contained within this Report are subject to approval from the relevant Consent Authority.



## 7.0 BIBLIOGRAPHY & REFERENCES

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## 8.0 APPENDICES



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## Appendix 1: Methodology

**1.1** **Site Inspection**: This report was determined as a result of a comprehensive site inspection during August 2021.

**1.2** **Visual Tree Assessment (VTA)**: The subject tree(s) was assessed using the Visual Tree Assessment criteria and notes as described in *The Body Language of Trees – A Handbook for Failure Analysis.*[8] The inspection was limited to a visual examination of the subject tree(s) from ground level only. No internal diagnostic or tissue testing was undertaken as part of this assessment. Trees outside the subject site were assessed from the property boundaries only.

**1.3** **Tree Dimensions**: The dimensions of the subject tree(s) are approximate only.

**1.4** **Tree Locations:** The location of the subject tree(s) was determined from the supplied plans. Trees not shown on the supplied plans have been plotted in their **approximate location only.**

**1.5** **Trees & Development**: Tree Protection Zones, Tree Protection Measures and Sensitive Construction Methods for the subject tree were based on methods outlined in *Australian Standard 4970-2009 Protection of Trees on Development Sites*.

The *Tree Protection Zone* (TPZ) is described in AS-4970 as a combination of the root area and crown area requiring protection. It is an area isolated from construction disturbance, so that the tree remains viable.

The *Structural Root Zone* (SRZ) is described in AS-4970 as the area around the base of a tree required for the tree's stability in the ground. Severance of structural roots within the SRZ is not recommended as it may lead to the destabilisation and/or demise of the tree.

In some cases it may be possible to encroach into or make variations to the theoretical TPZ. A *Minor Encroachment* is less than 10% of the area of the TPZ and is outside the SRZ. The area lost to this encroachment should be compensated for elsewhere and contiguous with the TPZ. A *Major Encroachment* is greater than 10% of the TPZ or inside the SRZ. In this situation the Project Arborist must demonstrate that the tree would remain viable. This may require root investigation by non-destructive methods or the use of sensitive construction methods.

**1.6** **Tree Health**: The health of the subject tree(s) was rated as *Good*, *Fair* or *Poor* based on an assessment of the following factors:

I. Foliage size and colour
II. Pest and disease infestation
III. Extension growth
IV. Crown density
V. Deadwood size and volume
VI. Presence of epicormic growth

**1.7** **Tree Structural Condition**: The structural condition of the subject tree(s) was rated as *Good*, *Fair* or *Poor* based on an assessment of the following factors:

I. Assessment of branching structure
(i.e co-dominant/bark inclusions, crossing branches, branch taper, terminal loading, previous branch failures)
II. Visible evidence of structural defects or instability
(i.e root plate movement, wounds, decay, cavities, fungal brackets, adaptive growth)
III. Evidence of previous pruning or physical damage
(root severance/damage, lopping, flush-cutting, lions tailing, mechanical damage)

**1.8** **Useful Life Expectancy (ULE)**: The ULE is an estimate of the longevity of the subject tree(s) in its growing environment. The ULE is modified where necessary to take in consideration tree(s) health, structural condition and site suitability. The tree(s) has been allocated one of the following ULE categories (Modified from Barrell, 2001):

I. 40 years +
II. 15-40 years
III. 5-15 years
IV. Less than 5 years

[8] Mattheck & Breloer (2003)



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**1.9** **Landscape Significance**: Landscape Significance was determined by assessing the combination of the cultural, environmental and aesthetic values of the subject tree(s). Whilst these values are subjective, a rating of high, moderate, low or insignificant has been allocated to the tree(s). This provides a relative value of the tree's Landscape Significance which may aid in determining its Retention Value. If the tree(s) can be categorized into more than one value, the higher value has been allocated.

| Landscape Significance | Description |
|---|---|
| Very High | The subject tree is listed as a Heritage Item under the *Local Environmental Plan* with a local or state level of significance. |
| | The subject tree is listed on Council's Significant Tree Register or meets the criteria for significance assessment of trees and/or landscapes by a suitably qualified professional. The criteria are based on general principles outlines in the Burra Charter and on criteria from the Register of the National Estate. |
| High | The subject tree creates a 'sense of place' or is considered 'landmark' tree. |
| | The subject tree is of cultural or historical importance or is widely known. |
| | The subject tree is a prominent specimen which forms part of the curtilage of a heritage item with a known or documented association with that item. |
| | The subject tree has been identified by a suitably qualified professional as a species scheduled as a Threatened or Vulnerable Species for the site defined under the provisions of the NSW *Biodiversity Conservation Act (2016)* or the Commonwealth *Environmental Protection and Biodiversity Conservation Act* (1999). |
| | The subject tree is known to contain nesting hollows to a species scheduled as a Threatened or Vulnerable Species for the site as defined under the provisions of the NSW *Biodiversity Conservation Act (2016)* or the Commonwealth *Environmental Protection and Biodiversity Conservation Act* (1999). |
| | The subject tree is an excellent representative of the species in terms of aesthetic value. |
| | The subject tree is of significant size, scale or makes a significant contribution to the canopy cover of the locality. |
| Moderate | The subject tree makes a positive contribution to the visual character or amenity of the area. |
| | The subject tree provides a specific function such as screening or minimising the scale of a building. |
| | The subject tree is a good representative of the species in terms of aesthetic value. |
| Low | The subject tree is a known environmental weed species or is exempt under the provisions of the local Council's Tree Management Controls |
| | The subject tree makes little or no contribution to the amenity of the locality. |
| | The subject tree is a poor representative of the species in terms of aesthetic value. |

**1.10** **Retention Value**: Retention Value was based on the subject tree's Useful Life Expectancy and Landscape Significance. The Retention Value was modified where necessary to take in consideration the subject tree's health, structural condition and site suitability. The subject tree(s) has been allocated one of the following Retention Values:

I. Priority for Retention
II. Consider for Retention
III. Consider for Removal
IV. Priority for Removal

| ULE | | Landscape Significance | | |
|---|---|---|---|---|
| | Very High | High | Moderate | Low |
| 40 years + | Priority for Retention | Priority for Retention | | Consider for Removal |
| 15-40 years | | Priority for Retention | Consider for Retention | |
| 5-15 years | | Consider for Retention | | |
| Less than 5 years | Consider for Removal | Priority for Removal | | |

The above table has been modified from the Footprint Green Tree Significance and Retention Value Matrix.



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**Appendix 2: Plans**



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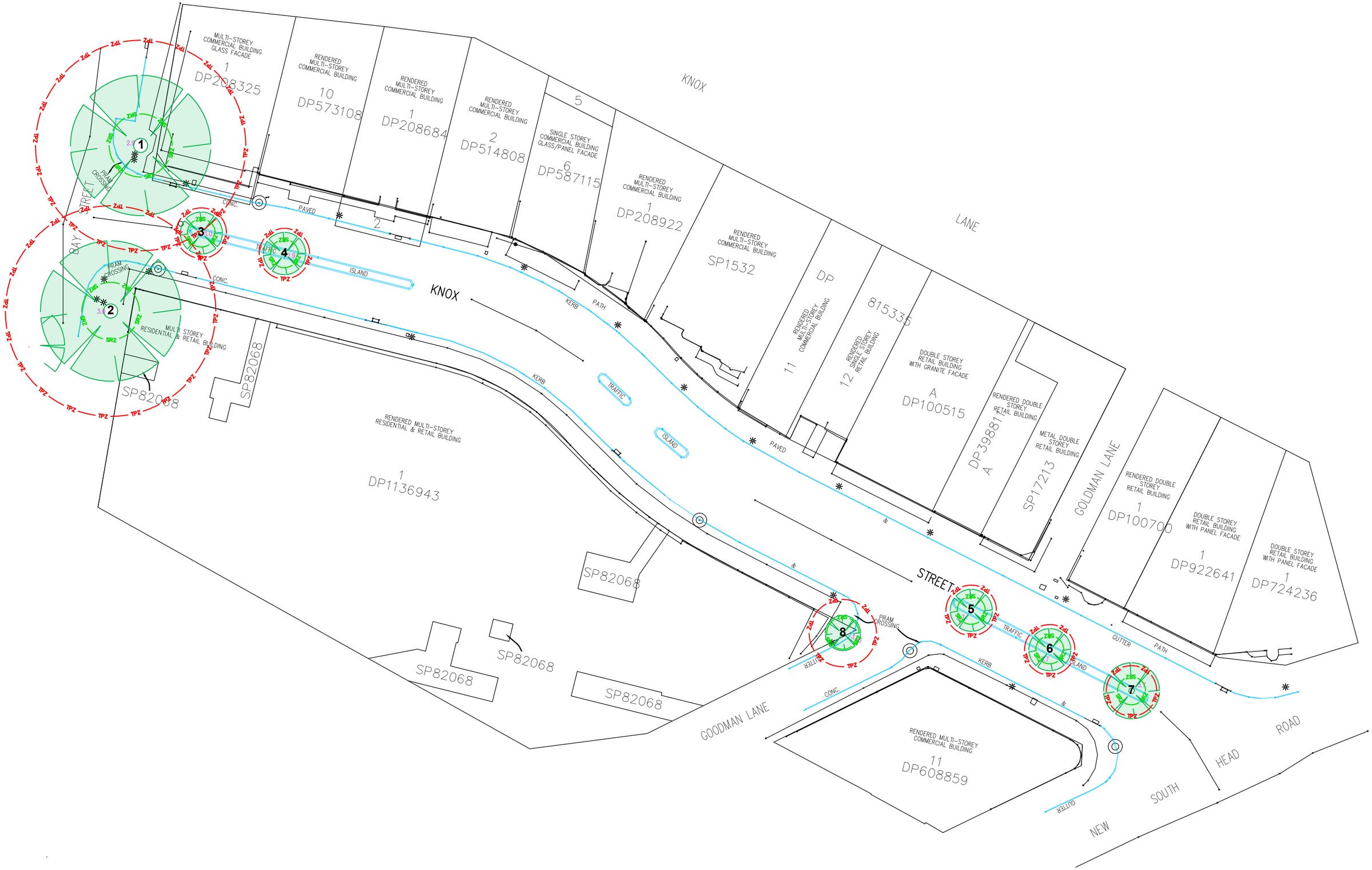


Tree Protection Zone  Structural Root Zone

0 2 4 6 8 10 12 14 16 18 20

SCALE 1:500

Knox Street, Double Bay
TPZ SRZ Plan
Client: Woollahra Municipal Council
date: 5th October 2021
scale: 1:500 (A3)

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**29.11.2021**
**KNOX STREET - TREE REMOVAL AND RETENTION PLAN**

## Appendix 3: Tree Assessment Schedule

| Tree No. | Species | DBH comb. (mm) | Height (m) | Radial Crown Spread (m) | Health Rating | Structural Condition Rating | Comments | Age Class | ULE (years) | L/Sign | Retention Value | Radial TPZ (m) | Radial SRZ (m) | Implication |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | *Cinnamomum camphora* (Camphor Laurel) | 2000 | 16 | 15 | Fair | Good | Crown density 75-95%. Partially suppressed. Small (<25mmø) deadwood growth in low volumes. Small (<25mmø) epicormic growth in moderate volumes. Reduction Pruned for building clearance. Small self-seeded Fig at crown break may indicate cavity. Mechanical damage to exposed surface roots. Wound(s), various stages of decay. Lights fixed (nails and straps to trunk & branches. Straps restricting cambium and starting to ringbark branches. Barbed wire in crown. | Late Mature | 15-40 | High | Consider for Retention | 15.0 | 4.5 | Retain & protect. |
| **2** | *Ficus rubiginosa* (Port Jackson Fig) | 1600 | 16 | 20 | Fair | Fair | Crown density 75-95%. Partially suppressed. Small (<25mmø) deadwood growth in moderate volumes. Previously lopped with most of crown comprised of mature epicormic growth, wound(s) with advanced stages of decay at lopping points. Reduction Pruned for building clearance. Bark inclusion(s), major. Wound(s), advanced stages of decay. Previous branch failure(s). Lights fixed (nails and straps to trunk & branches. Straps restricting cambium and starting to ringbark branches. | Late Mature | 5-15 | Moder ate | Consider for Retention | 15.0 | 4.1 | Retain & protect. |
| **3** | *Platanus x acerifolia* (London Plane Tree) | 300 | 12 | 7 | Good | Good | Not in full leaf at time of assessment. Cracking of asphaltic surface may indicate roots within road. Lights fixed (nails and straps to trunk & branches. Straps restricting cambium and starting to ringbark branches. Located in small, linear garden bed with restricted soil volume. | Early Mature | 15-40 | Moder ate | Consider for Retention | 3.6 | 2.0 | Remove. |
| **4** | *Platanus x acerifolia* (London Plane Tree) | 300 | 12 | 7 | Good | Good | Not in full leaf at time of assessment. Poor crown form. Lights fixed (nails and straps to trunk & branches. Straps restricting cambium and starting to ringbark branches. Located in small, linear garden bed with restricted soil volume. | Early Mature | 15-40 | Moder ate | Consider for Retention | 3.6 | 2.0 | Remove. |
| **5** | *Platanus x acerifolia* (London Plane Tree) | 300 | 12 | 7 | Good | Good | Not in full leaf at time of assessment. Lights fixed (nails and straps to trunk & branches. Straps restricting cambium and starting to ringbark branches. Located in small, linear garden bed with restricted soil volume. | Early Mature | 15-40 | Moder ate | Consider for Retention | 3.6 | 2.0 | Remove. |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **6** | *Platanus x acerifolia* (London Plane Tree) | 300 | 12 | 7 | Good | Good | Not in full leaf at time of assessment. Lights fixed (nails and straps to trunk & branches. Straps restricting cambium and starting to ringbark branches. Located in small, linear garden bed with restricted soil volume. | Early Mature | 15-40 | Moderate | Consider for Retention | 3.6 | 2.0 | Remove. |
| **7** | *Platanus x acerifolia* (London Plane Tree) | 300 | 12 | 7 | Good | Good | Not in full leaf at time of assessment. Lights fixed (nails and straps to trunk & branches. Straps restricting cambium and starting to ringbark branches. Located in small, linear garden bed with restricted soil volume. | Early Mature | 15-40 | Moderate | Consider for Retention | 3.6 | 2.0 | Retain & protect. |
| **8** | *Sapium sebiferum* (Chinese Tallowood) | 400 | 7 | 7 | Good | Good | Partially suppressed. | Mature | 15-40 | Moderate | Consider for Retention | 4.8 | 2.3 | Remove. |

## Appendix 4: Plates

**Plate 1:** Showing Tree 1

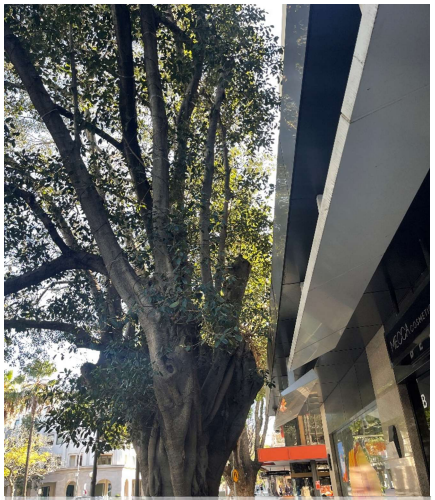

**Plate 2:** Showing Tree 2

**Plate 3:** Showing Trees 3 & 4

**Plate 4:** Showing Trees 5-7

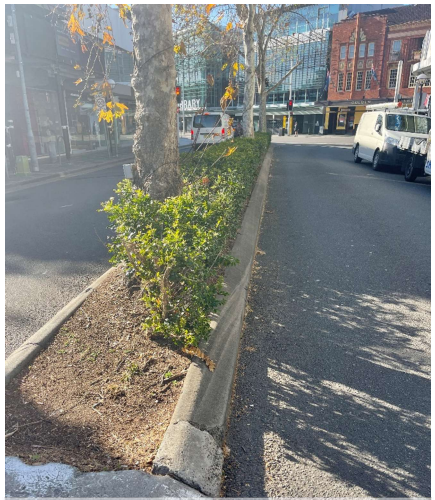

**Plate 5:** Showing median at eastern end of Knox St

**Plate 6:** Showing Tree 8

## Appendix 5: Tree Protection Specification

### 1.0 Appointment of Project Arborist

A Project Arborist shall be engaged prior the commencement of work on-site and monitor compliance with the protection measures. The Project Arborist shall inspect the tree protection measures and Compliance Certification shall be prepared by the Project Arborist for review by the Principal Certifying Authority prior to the release of the Compliance Certificate.

The Project Arborist shall have a minimum qualification equivalent (using the Australian Qualifications Framework) of NSW TAFE Certificate Level 5 or above in Arboriculture.

### 1.1 Compliance

Contractors and site workers shall receive a copy of these specifications a minimum of 3 working days prior to commencing work on-site. Contractors and site workers undertaking works within the Tree Protection Zone shall sign the site log confirming they have read and understand these specifications, prior to undertaking works on-site.

The Project Arborist shall undertake regular site inspections and certify that the works are being undertaken in accordance with this specification.

Compliance Documentation shall be prepared by the Project Arborist following each site inspection. The Compliance Documentation shall include documentary evidence of compliance with the tree protection measures and methods as outlined within this Specification. Upon the completion of the works, a final assessment of the trees shall be undertaken by the Project Arborist and future recommended management strategies implemented as required.

### 1.2 Tree & Vegetation Removal

Tree removal works shall be undertaken in accordance with the *Safe Work Australia Guide for Managing Risks of Tree Trimming and Removal Work (2016)* and other applicable codes and legislation.

Tree removal shall not damage the trees to be retained. Other vegetation to be removed within a TPZ shall be carefully lifted by hand/hand tools to avoid damaging roots (>25mmø) within the surrounding soil profile.

### 1.3 Tree Protection Zone

The trees to be retained shall be protected prior and during construction from activities that may result in an adverse effect on their health or structural condition. The area within the Tree Protection Zone (TPZ) shall exclude the following activities, unless otherwise stated:-

- Modification of existing soil levels, excavations and trenching
- Mechanical removal of vegetation
- Movement of natural rock
- Storage of materials, plant or equipment or erection of site sheds
- Affixing of signage or hoarding to the trees
- Preparation of building materials, refueling or disposal of waste materials and chemicals
- Lighting fires
- Movement of pedestrian or vehicular traffic
- Temporary or permanent location of services, or the works required for their installation
- Any other activities that may cause damage to the tree

NOTE: If access, encroachment or incursion into the TPZ is deemed essential, prior authorisation is required by the Project Arborist.

### 1.4 Site Management

Materials, waste storage, and temporary services shall not be located within the TPZ.

### 1.5 Works within the Tree Protection Zones

In some cases works within the TPZ may be authorized by the determining authority. **These works shall be supervised by the Project Arborist**. When undertaking works within the TPZ, care should be taken to avoid damage to the tree's root system, trunks and lower branches.



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If roots (>25mmø) are encountered during the demolition, excavation and construction works, these roots must be retained in an undamaged condition and advice sought from the Project Arborist. Adjustment of final levels and design shall remain flexible to enable the retention of roots (>25mmø) where deemed necessary by the Project Arborist.

### 1.6 Trunk Protection

Trunk protection shall be installed onto Trees 1, 2 and 8 or as required by the Project Arborist. Trunk protection shall include wrapping padding (either carpet underlay or 10mm thick jute geotextile mat) around the trunk and first order branches to a minimum height of 2m. Timber battens (90 x 45mm) spaced at 150mm centres shall be strapped together and placed over the padding. Timber battens must not be fixed to the trees. Refer to Typical Tree Protection Details (3) **(Appendix 5)**.

Branch protection shall be installed as deemed necessary by the Project Arborist.

### 1.7 Ground Protection

Ground protection shall be installed to any unfenced areas of the TPZ. Machinery movements shall be restricted to areas of existing pavement or from areas of temporary ground protection such as ground mats or steel road plates. Where possible existing sub-base layers shall be retained in situ as ground protection until the later stages of the project. Upon removal sub-base layers shall be replaced with ground protection where machinery access is required. Refer to Typical Tree Protection Details (3) **(Appendix 5).**

### 1.8 Structure & Pavement Demolition

Demolition of existing structures/pavement within the TPZ shall be supervised by the Project Arborist. Machinery is to be excluded from the TPZ unless operating from the existing slabs, pavements or areas of ground protection (refer to Section 1.6). Machinery should not contact the tree's roots, trunk, branches and crown.

The existing pavement shall be carefully lifted to minimise damage to the underlying soil profile (or sub-base materials) and to prevent damage to tree roots. Wherever possible, existing sub-base materials shall remain in-situ.

When removing slab sections within TPZ, machinery shall work backwards out of the TPZ to ensure machinery remains on un-demolished sections of slab at all times. Wherever possible, footings or elements below grade shall be retained to minimise disturbance to the tree's roots.

Where deemed necessary by the Project Arborist, the structures shall be shattered prior to removal with a hand-operated pneumatic/electric breaker.

If roots (>25mmø) are encountered during the demolition works, these roots must be retained in an undamaged condition and advice sought from the Project Arborist. Exposed roots shall be protected from direct sunlight, drying out and extremes of temperature by covering with a 10mm thick jute geotextile fabric. The geotextile fabric shall be kept in a damp condition at all times. Where the Project Arborist determines that the tree is using underground elements (i.e footings, pipes, rocks etc.) for support, these elements shall be left in-situ.

### 1.9 Footings

Footings within the TPZ shall be supported on isolated piers. Pier hole locations should be flexible to enable the retention of roots (>25mmø) as determined by the Project Arborist. Where required, pier/post holes shall be sleeved to prevent encapsulation of roots in concrete.

### 1.10 Underground Services

Underground service installation within the TPZ shall be supervised by the Project Arborist.

The installation of underground services shall be located outside of the TPZ. Where this is not possible, they shall be installed using tree sensitive excavation methods (hand/hydrovac/airspade) with the services installed around/below roots (>25mmø, or as determined by the Project Arborist). Excavation using compact machinery fitted with a flat bladed bucket is permissible where approved by the Project Arborist. Excavation using compact machinery should be undertaken in small increments, guided by a spotter who is to look for and prevent damage to roots (>25mmø).

Alternatively, boring methods may be used for underground service installation where the obvert level (highest interior level of pipe) is greater than 1200mm below existing grade. Excavations for starting and receiving pits for boring equipment shall be located outside of the TPZ areas or located to avoid roots (>25mmø) as deemed necessary by the Project Arborist. OSD tanks (where required) should be located outside of the TPZ areas.



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### 1.11 Excavations, Root Protection & Root Pruning

Excavations and root pruning within the TPZ shall be supervised by the Project Arborist. Excavations within the TPZ shall be avoided wherever possible.

Excavations within the TPZ shall be undertaken by hand or using hydro vacuum excavation methods (or similar approved device) to protect tree roots. If there is any delay between excavation works and backfilling, exposed roots shall be protected from direct sunlight, drying out and extremes of temperature by covering with a 10mm thick jute mat. The mat shall be kept in a damp condition at all times.

No over-excavation, battering or benching shall be undertaken beyond the footprint of any structure unless approved by the Project Arborist. Hand excavation and root pruning shall be undertaken along the excavation line prior to the commencement of mechanical excavation to prevent tearing and shattering damage to the roots from excavation equipment.

Roots (>25mmø) shall be pruned by the Project Arborist only. Roots (<25mmø) may be pruned by the Principal Contractor. Root pruning shall be undertaken with clean, sharp secateurs or a pruning saw to ensure a smooth wound face, free from tears.

Damaged roots shall be pruned behind the damaged tissues with the final cut made to an undamaged part of the root.

### 1.12 Landscape Planting

Planting of new trees, shrubs and ground covers and the installation of turf within the TPZ areas shall be undertaken using hand tools and roots (>25mmø) shall be protected. No mechanical cultivation/ripping of soils shall be undertaken within TPZ areas.

Landscape planting shall be completed in the final stage of the development works and tree protection fencing and trunk protection shall remain in place until these works are due to commence.



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**Appendix 6: Typical Tree Protection Details**



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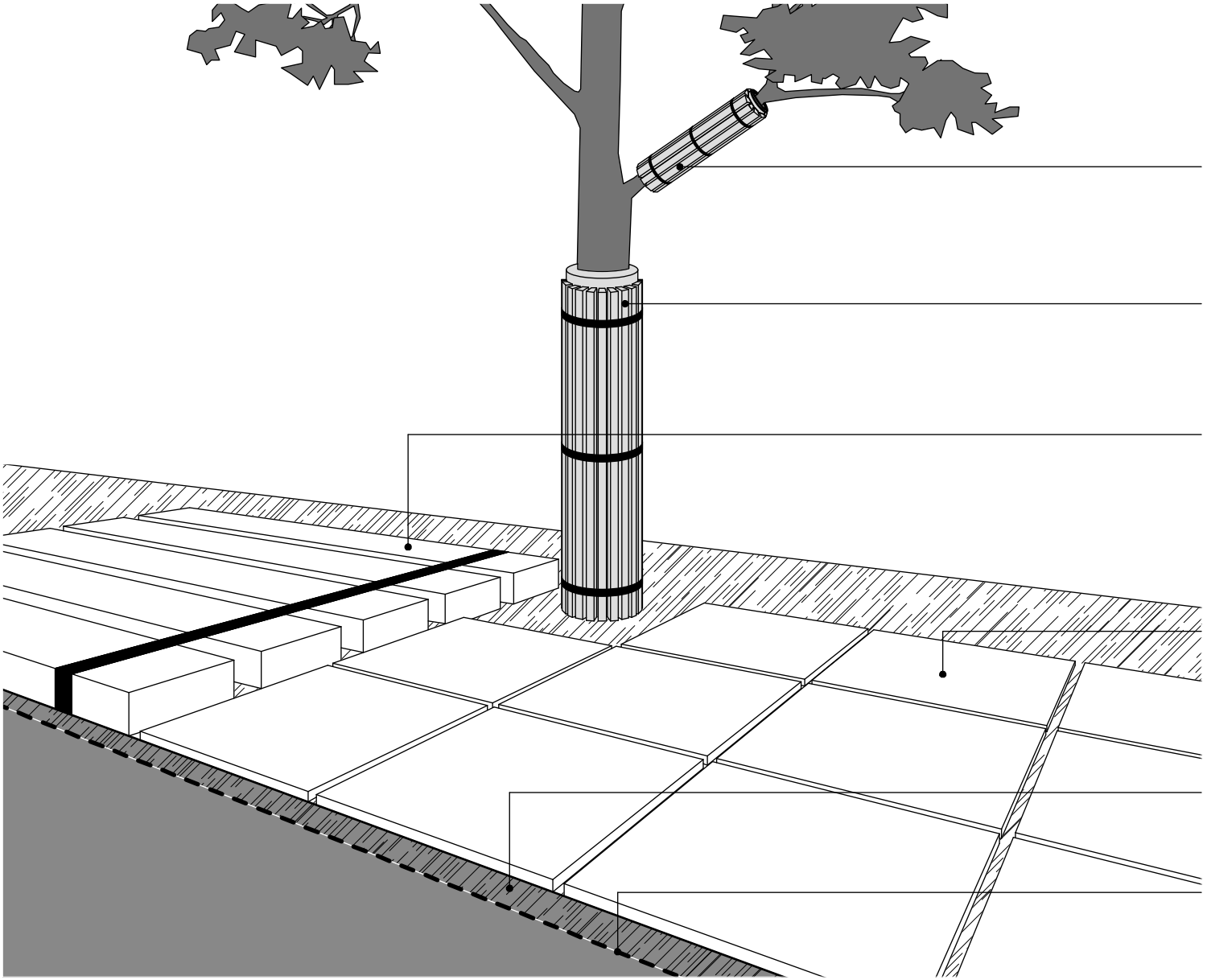


**Branch Protection** - use boards and padding to prevent damage to bark on branch. Boards are to be strapped, not screwed or nailed to the branch.

**Trunk Protection** - use boards and padding to prevent damage to bark (minimum 2m). Boards are to be strapped, not screwed or nailed to the trunk.

**Ground Protection** - use device strapped over mulch or aggregate layer. Ground protection device should be of a suitable thickness to prevent soil compaction and root damage.

Steel plates (or approved equivalent) with or without mulch or aggregate layer below.

Maximum 100mm and minimum 50mm depth mulch or aggregate layer.

Geotextile fabric underneath mulch or aggregate layer.

04 Examples of Branch, Trunk and Ground Protection

Not to Scale

Branches may require pruning to erect scaffolding. Pruning may be subject to local regulations. Flexible branches should be tied back in preference to pruning.

Minimum 1.8m high hoarding. Temporary fencing may be incorporated into scaffolding as either containment screening or as hoarding.

**Note:**
If excavation is required for installation of support post for fencing, the Project Arborist should assess any pruning of roots greater than 20mm diameter.

Scaffold planks

Boards or plywood to be installed over mulch or aggregate layer for any areas requiring access within the TPZ.

Soleplate over geotextile. No excavation for soleplate within TPZ.

Maximum 100mm and minimum 50mm depth mulch or aggregate layer within TPZ.

Geotextile fabric

05 Indicative Scaffolding within a Tree Protection Zone (TPZ) Not to Scale

## Appendix C – Traffic and Parking Impact Study

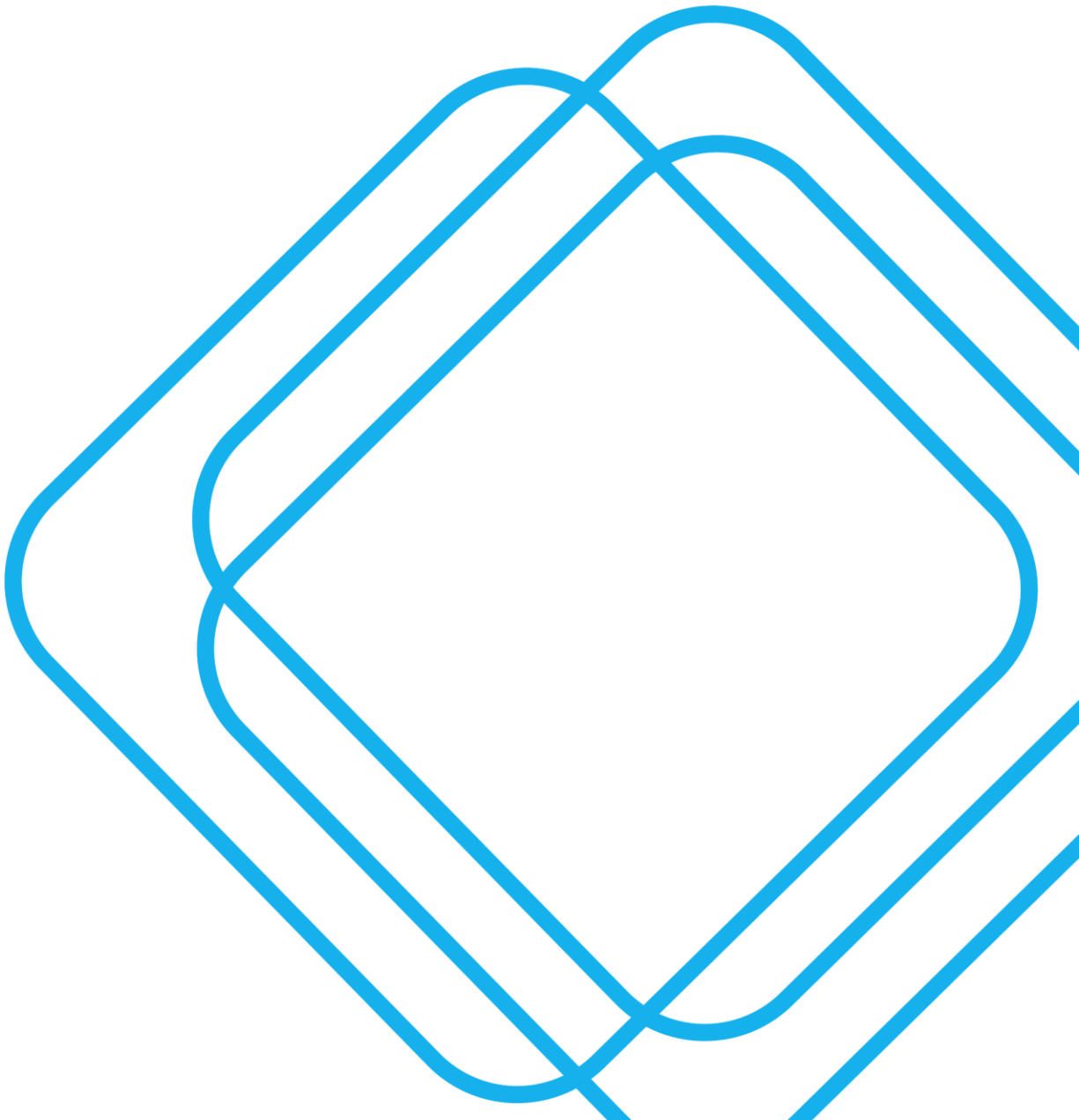
SCT Consulting


# Knox Street Plaza Traffic Engineering

## Traffic and Parking Impact Study

**13 APRIL 2022**

SCT Consulting



# Quality Assurance

| | | | |
|---|---|---|---|
| **Project:** | Knox Street Plaza Traffic Engineering | | |
| **Project Number:** | SCT_00272 | | |
| **Client:** | Aspect Studios | **ABN:** | 11 120 219 561 |
| **Prepared by:** | SCT Consulting PTY. LTD. (SCT Consulting) | **ABN:** | 53 612 624 058 |

| **Quality Information** | |
|---|---|
| **Document name:** | Knox Street Plaza Traffic Engineering |
| **Prepared:** | Shawn Cen, Senior Consultant<br>Jonathan Chung, Consultant<br>Nafisa Nishandar, Consultant |
| **Reviewed:** | Jonathan Busch, Associate Director |
| **Authorised:** | Andy Yung, Director |

| Revision | Revision Date | Details |
|---|---|---|
| 1.0 | 13 April 2022 | Draft report |
| | | |
| | | |

# Contents

# Appendices

# Executive summary

## Purpose of this report

SCT Consulting was engaged by Aspect Studios to provide traffic advisory services to support the preparation of the required design and documentation for the lifecycle of the Knox Street Plaza project. The project would transform Knox Street between Bay Street to Goldman Lane to a pedestrian plaza and propose a vehicular zone between Goldman Lane and New South Head Road (potentially one-way traffic from Goldman Lane along Knox Street, exiting onto New South Head Road).

## Existing transport conditions

### *Movement and Place categorisation*

In Double Bay, roads with higher place function but lower movement function include Knox Street, Transvaal Avenue, Knox Lane, Goldman Lane (partial) and Bay Street (partial), which are relatively close to Knox Street and service the local retail and amenities of the town centre. Bay Street (partial) and Cross Street provide high-level functions for both movement and place.

### *Intersection performance*

SIDRA intersection models have been developed/updated for New South Head Road / William Street and New South Head Road / Knox Street based on the previous work undertaken for the Double Bay Transport Study to understand the existing network performance and to test the impacts of the proposed development uplift and pedestrianisation. Intersection performance has been assessed for the weekday AM and PM peak hours.

The SIDRA results indicate that both intersections are operating at a satisfactory level of service (LoS B or better) from a road delay perspective. The largest DoS recorded was 0.92 for New South Head Road / Knox Street. This was noted in the AM peak hour period.

### *Active transport*

Bay Street, William Street and Cross Street are identified as main bicycle routes whereas Cooper Street and part of Ocean Road are identified as local bike routes, which extend to New South Head Road to the west. Cycling to and from Double Bay is currently observed to be difficult and potentially unsafe due to a lack of dedicated cycling infrastructure and topographical constraints. Multiple roads with steep grades make it difficult for cyclists to ride uphill with limited protection for cyclists.

Cycle facilities on Bay Street and Cross Street are classified as mixed traffic lanes on a quiet local street and expect moderate preference ranking. There are currently no cycleways within the Double Bay where “>75% feel quite or very safe and comfortable”.

Double Bay Town Centre is an attractive destination with high pedestrian activity along streets like Cross Street, Knox Street and Transvaal Avenue. It is appealing as a local destination combined with Double Bay’s high-quality walking environment makes it easy to encourage residents to walk instead of drive.

### *Bus network*

Double Bay is serviced by many bus routes on New South Head Road, William Street and Ocean Road. During the AM peak hour, there are approximately 15 citybound services, whereas, in the PM peak hour, 11 services travel in the eastbound direction.

### *Parking*

The majority of the on-street parking around the Double Bay Town Centre is time-restricted parking (1/2P and 2P). Short Street is a dedicated loading zone, servicing the retail premises facing Knox Street. A taxi zone is available on the western side of Knox Street (north of Goldman Lane), accommodating about five parking spaces.

A parking occupancy survey was undertaken in June 2019 showing that the majority of the on-street parking was over 50 per cent occupied during AM and PM peak hours. Bay Street, Knox Street and Transvaal Avenue had relatively high parking demand, resulting in a limited remaining capacity for the on-street parking.

## Proposed development

The proposal (see below) intends to pedestrianise the four-lane carriageway between Bay Street and Goldman Lane and maintain a vehicular zone between Goldman Lane and New South Head Road.

The proposal also considers services such as kiss and ride, loading zone, pedestrian connections, and taxi zone to ensure public amenity and functions. The proposal would result in a loss of up to 34 on-street parking spaces.

The proposal would alter traffic flows to one way eastbound (exit to New South Head Road) between Goldman Lane and New South Head Road. As a result of the one-way Knox Street option (exit to New South Head Road only), traffic from the northeast may need to turn right at Williams Street while traffic from the southwest may need to turn left at Bay Street or Cross Street.

There are two treatment options on the New South Head Road interface if the one-way Knox Street option were progressed. The left turn bay on the western approach of New South Head Road could become parking. Alternatively, additional right turn storage capacity could be provided through re-channelisation of the western approach of New South Head Road.

## Transport appraisal

The Traffic Impact Assessment includes testing the following scenarios:

1. **2022 existing conditions**: traffic models previously prepared by SCT Consulting were updated to capture queue length and intersection turning count data.
2. **2022 with the closure of westbound flows on Knox Street**: This scenario includes consideration of the pedestrianisation of Knox Street which incorporates the closure of westbound flows on Knox Street, removing the left and right turn movement from New South head Road to Knox Street.

The SIDRA results show that both intersections were performing at a satisfactory level of service (LoS B or better) with reserve capacity during AM and PM peak hours to accommodate future growth for both future year scenarios.

The modelling shows the following impacts on the broader road network with the project:

– **Cross Street / New South Head Road:** an improvement by 6 seconds in the morning and a worsening by 2.8 seconds in the evening peak

– **Knox Street / New South Head Road**: an improvement by 3.9 seconds in the morning peak and no change in the evening peak

– **William Street / New South Head Road:** a worsening by 0.8 seconds in the morning peak and 0.5 seconds in the evening peak.

The pedestrianisation of Knox Street will result in the loss of 31 on-street parking spaces in total. Surveys of on-street and off-street capacity indicate that there is sufficient capacity in the network around the transport network to accommodate the parking space loss. For instance, there is a minimum of 31 parking spaces available across all three multi-storey off-street car parks.

# 1.0 Introduction

## 1.1 Purpose of the report

SCT Consulting was engaged by Aspect Studios to provide traffic advisory services to support the preparation of the required design and documentation for the lifecycle of the Knox Street Plaza project as shown in **Figure 1-1**.

**Figure 1-1 Proposed Knox Street Plaza study area**


Source: Aspect Studios, 2021

SCT Consulting prepared the Double Bay Commercial Centre Pedestrianisation Study in 2020, which recommended that Knox Street between Bay Street to Goldman Lane could become a pedestrian plaza and one-way traffic could be implemented from Goldman Lane along Knox Street, exiting onto New South Head Road.

At the full Council Meeting on 29 September 2020, Council resolved:

*A. THAT Council endorse the Double Bay Pedestrianisation Study.*

*B. THAT Council staff explore funding opportunities for the following projects identified in the Double Bay Pedestrianisation Study:*

*i. Knox Street Pedestrian Only Zone (between Bay Street & Goldman Lane)*

*ii. …..*

On 5 August 2020, the NSW Government announced the launch of a $250 million NSW Public Spaces Legacy Program as part of ongoing work to protect the health of the community, provide economic and jobs stimulus in response to the COVID-19 pandemic and deliver a legacy of safe, quality public and open space.

Woollahra Council applied for the Knox Street Pedestrianisation and was successful in securing $4.75 million for the project. The funding is contingent on the project being constructed and open for use by December 2022.

## 1.2 Project requirements

Pedestrianisation is about increasing the priority given to pedestrians in the transport network. Pedestrians are often required to give way to cars, making walking less desirable. There is a range of different treatments to improve pedestrian priority, from implementing 40km/h High Pedestrian Area signage to completely banning vehicles from entering a street.

It is acknowledged that the pedestrianisation of the Knox Street proposal involves the closure of an existing road for vehicular traffic. Hence, the following relevant legislation and technical directions were identified.

### 1.2.1 TfNSW TTD 2016/001 Design and implementation of shared zones including provision for parking

A shared zone is a road or network of roads or a road-related area where space is shared safely by vehicles and pedestrians and where pedestrian priority and quality of life take precedence over ease of vehicle movement. The approval of a shared zone will focus on the following aspects:

– A shared zone will only be considered where adequate footpaths cannot be retained within the road reserve and where there are very low numbers of slow-moving vehicles. Footpaths can be retained in a shared zone where footway parking is in place.

– A shared zone should not look like a normal road environment and requires a self-enforcing road environment. Kerbs should generally not be provided in a shared zone to ensure a discernible change in the environment from the surrounding roads and facilitate the ease of movement and indicate the priority for pedestrians, especially disabled pedestrians.

– Traffic control devices (i.e. signs and markings) referred to in this Technical Direction shall meet TfNSW specifications.

– The maximum speed limit in shared zones is always 10 km/h. All speed zones and shared zone schemes must be authorised by TfNSW as per the delegations under the Roads Act.

– Shared zones are designed and constructed by local councils in consultation with the local community.

### 1.2.2 TfNSW TTD 2020/03 Shared environment intersection treatment

Shared environment intersection treatments have been developed as a way of improving amenities for pedestrians and bicycle riders where bi-directional bicycle paths cross low volume side streets. A few concepts of the shared environment intersection include:

– Contrast paving to differentiate the intersection from adjacent road and footpath areas and highlight that the area is different from normal intersections.

– Give way line marking to be installed on all vehicular approaches, i.e. road and bicycle path, to create a four-way give way operation.

– The approach ramps should be suitably designed for vertical clearance requirements. A gradient of 1:6 is recommended to help reduce vehicle speeds across the treatment.

– Kerb extensions are recommended where possible to create a buffer between the bicycle path and the parallel road.

– Where continuous footpath treatments are installed, there should be no gradient difference between the footpath and the contrast paving area.

– Adequate sight distances must be maintained to ensure visibility between path users and drivers approaching the intersection, including good illumination at night.

– The shared environment intersection treatment is not typically installed as a shared zone primarily because the level of signage and line markings required is out of proportion to the size of the treatment. However, the treatment may be used as a threshold to a shared zone, in which case shared zone signs and line markings must be installed.

## 1.3 Report structure

This report has been structured into the following sections:

- **Section 2.0** describes the existing transport conditions
- **Section 3.0** provides an overview of the proposed pedestrianisation project
- **Section 4.0** outlines the traffic appraisal which describes the likely trip redistribution, and indicative impact of the project
- **Section 5.0** discussed the preliminary construction traffic management plan
- **Section 6.0** summarises the study findings and presents the conclusions.

# 2.0 Existing conditions

## 2.1 Movement and Place categorisation

The Movement and Place framework delivers on NSW policy and strategy directions to create successful streets and roads by balancing the movement of people and goods with the amenity and quality of places.

Movement and Place consider the whole street including footpaths, from property line to property line. It considers the needs of all users of this space including pedestrians, cyclists, deliveries, private vehicles and public transport, as well as people spending time in those places, whether moving around the place or enjoying street life including outdoor dining, waiting for a bus or watching the world go by.

Roads with high movement functions will prioritise the thorough movement of vehicles as they travel along a street safely and without interruptions. Roads with high places functions will prioritise the movement of people as they move between shops and cafes and open spaces. Roads with a high place and low movement are more desirable for creating shared zones and road closures for pedestrianisation.

**Figure 2-1** categorises the roads in the vicinity of Knox Street based on the Movement and Place framework.

**Figure 2-1 Movement and Place categorisation**


Roads with higher movement functions but lower place functions include Ocean Road, Cooper Street, Guilfoyle Avenue and William Street. Those roads are generally located to the west and north of Double Bay Town Centre. Short Street and Goldman Lane (between Short Street and Knox Street) in the town centre also have higher movement functions than place functions.

Roads with higher place function but lower movement function include Knox Street, Transvaal Avenue, Knox Lane, Goldman Lane (partial) and Bay Street (partial), which are relatively close to Knox Street and service the local retail and amenities of the town centre.

Bay Street (partial) and Cross Street provide high-level functions for both movement and place.

## 2.2 Road network

### 2.2.1 Road hierarchy

The major access to Double Bay from the Sydney Metropolitan area is via New South Head Road, which is the only state road (controlled and maintained by the TfNSW) in the area. Ocean Avenue and William Street are two regional roads whereas all other roads are local roads, under the control of WMC.

Road widths indicate the number of vehicles travelling along the road:

– Wider roads are often associated with larger traffic volumes as well as larger vehicles. These roads are often strategically important and will often need to be retained for their traffic function. Wider roads are also more costly and difficult to design because there is more space to fill.

– Narrower roads often generate less traffic and discourage heavy vehicles like trucks to travel along with them. Narrow roads also encourage a slower speed of travel, making them more appropriate for pedestrianisation.

**Figure 2-2** shows the approximate road width for the streets in Double Bay.

**Figure 2-2 Road width**


Roads with a higher level of movement function usually have larger width, which includes Ocean Avenue, William Street, Cross Street, Cooper Street and South Avenue. Knox Street also has a road width of over 10 m albeit it has more place function than movement. Bay Street, being a road with relatively equal movement and place function, has a width of 7.2 to 10 m. Short Street and Goldman Lane (between Short Street and Knox Street) are about 5.6 to 7.2 m wide and currently operate in a one-way eastbound direction. Gum Tree Lane and Goldman Lane (south of Short Street) are the narrowest roads in Double Bay, i.e. 3 to 3.6 m, which operate in a one-way northbound direction.

**Figure 2-5** indicates different access driveway types along the roads in Double Bay. Roads to the west of Bay Street all have residential driveways whereas most of the streets in the town centre have commercial/retail driveways. Knox Street and Bay Street (between Knox Lane and New South Head Road) do not have any driveways, which have the

opportunity to be fully pedestrianised as vehicles do not use the road for access and driveways do not need to be relocated.

**Figure 2-3 Access driveway type**


## 2.3 Intersection performance

The New South Head Road/Knox Street model prepared as part of the Double Bay Transport Study has been updated based on new traffic intersection data for New South Head Road / Knox Street, New South Head Road / Cross Street/Bellevue Road/ Kiora Road and New South Head Road / William Street. The intersection of New South Head Road/Bay Street and New South Head Road/Manning Road is modelled based on data from 2017. The following periods were identified as the peak hour within the survey AM and PM data:

– AM peak (7.15am – 8.15am)

– PM peak (5pm – 6pm)

For modelling purposes, the intersections layouts were derived from a combination of Nearmap, Google street view and Six maps imagery.

### 2.3.1 Model calibration

The model was calibrated using the surveyed queue lengths for New South Head Road/Cross Street/Bellevue Road/ Kiora Road intersection to reflect observations of traffic behaviours around the site.

One of the key goals is to calibrate the models such that the degree of saturation of all movements was 1.0 or below. This is a standard procedure to ensure that the models are not over-predicting congestion under current conditions. The setting of gap acceptance follows default as stipulated in Transport for NSW's (ex-Road and Maritimes Services) modelling guideline.

It was found that the Kiaora Road and Cross Street approaches were not able to meet queue lengths without exceeding a degree of saturation of 1.0. Demand was added in reflecting the oversaturation of these approaches above the turning flows observed. Overall, queue lengths generally matched between the model and the survey.

### 2.3.2 Performance metrics

The performances of key intersections were assessed using the SIDRA Network 7.0 software package. Intersection performance is measured in terms of the following:

– Degree of Saturation (DoS): The ratio of arrival (demand) flow rate to capacity during a given flow period. Acceptable intersection performance requires DoS < 1.0

– Level of Service (LoS): An index of the operational performance of traffic for a given intersection during a given flow period. Acceptable intersection performance normally requires a minimum of LoS D

– Average Vehicle Delay in seconds: The delay experienced by a vehicle traversing a signalised intersection.

**Table 2-1** provides a summary of the LoS performance bands.

**Table 2-1 Level of Service index**

| Level of Service | Average delay per vehicle (sec) | Performance explanation |
|---|---|---|
| A | Less than 14.5 | Good operation |
| B | 14.5 to 28.4 | Good with acceptable delays and spare capacity |
| C | 28.5 to 42.4 | Satisfactory |
| D | 42.5 to 56.4 | Operating near capacity |
| E | 56.5 to 70.4 | At capacity, at signals, incidents will cause excessive delays. Roundabouts require other control methods. |
| F | 70.5 or greater | |

Source: Guide to Traffic Generating Developments; RMS, 2002

### 2.3.3 Intersection performance results

The outcomes of the existing intersection performance are present in **Table 2-2** based on a modelling assessment by SIDRA software.

**Table 2-2 Base year intersection performance**

| Intersection | AM Peak | | | | PM Peak | | | |
|---|---|---|---|---|---|---|---|---|
| | Delay | LoS | DoS | Volume | Delay | LoS | DoS | Volume |
| **New South Head Rd / Knox St (2022)** | 9.8s | A | 0.89 | 3,267 | 5.1s | A | 0.70 | 3,006 |
| **New South Head Rd / Cross St / Bellevue Rd / Kiora Rd (2022)** | 36.2s | C | 1.11 | 3,867 | 27.6 | B | 0.76 | 3,525 |
| **New South Head Rd / William St (2022)** | 13.5s | A | 0.72 | 3,651 | 14.7s | B | 0.71 | 3,395 |
| **New South Head Rd / Manning Rd (2017)** | 33.4 | C | 0.97 | 3,368 | 12.7 | C | 0.80 | 3,316 |
| **New South Head Rd / Bay St (2017)** | 0.2 | A | 0.38 | 3,280 | 0.4 | A | 0.44 | 3,198 |

Source: SCT Consulting, 2021

The SIDRA results indicate that both intersections are operating at a satisfactory level of service (LoS B or better) from a road delay perspective. The largest DoS recorded was 1.11 for New South Head Road / Cross Street.

## 2.4 Cycling

### 2.4.1 Existing cycling network

Cycling facilities provide better access to the Double Bay commercial centre for residents in surrounding areas and will help to reduce traffic on nearby roads and parking demands in the centre. Current and future cycle routes would benefit from pedestrianisation along these routes to reduce conflicts with general traffic, making it safer and more attractive to access Double Bay by cycling. An overview of key cycling routes is provided in **Figure 2-4**.

**Figure 2-4 Cycleways**


Bay Street, William Street and Cross Street are identified as the main bicycle routes on the Woollahra Municipal Council (WMC)'s "Cycling in Waverley and Woollahra Cycle Map". These routes surround or traverse the town centre and connect to the wider network via Manning Road and Bellevue Road to the southeast and via William Street to the northeast. Cooper Street and part of Ocean Road are identified as local bike routes, which extend to New South Head Road to the west.

No dedicated cycle routes are shown along New South Head Road within the Double Bay Town Centre, as identified in the Woollahra Bicycle Strategy (2009).

### 2.4.2 Existing cycling conditions

Cycling to and from Double Bay is currently observed to be difficult and potentially unsafe due to a lack of dedicated cycling infrastructure and topographical constraints. Multiple roads with steep grades make it difficult for cyclists to ride uphill with limited protection for cyclists.

Ocean Avenue between Cooper Street and New South Head Road and William Street between Sherbrooke Avenue and New South Head Road, in particular, have very steep gradients making them a challenging environment for cyclists.

Sydney's Cycling Future released by TfNSW in 2013 classified Sydney's cycleway network into six and grouped them into three customer preference categories (shown in **Figure 2-5**).

**Figure 2-5 Sydney's cycling future – facilities classification**

| Facility Type | Preference |
|---|---|
|  Off road separated bicycle path (separated from pedestrians) | |
|  On road separated bicycle path (physically separated from vehicles/ pedestrians) | |
|  Mixed traffic lane on quiet local street | |
|  Road shoulder | |
|  Bicycle logo beside a parked car | |
|  Mixed traffic lane on busy street | |

| Facility Type Preference Ranking | |
|---|---|
| | >75% feel quite or very safe and comfortable |
| | As many feel safe and comfortable as unsafe and uncomfortable |
| | >75% feel quite or very unsafe and uncomfortable |

Source: TfNSW, 2013, modified by SCT Consulting; 2021

Double Bay has three different class cycleways:

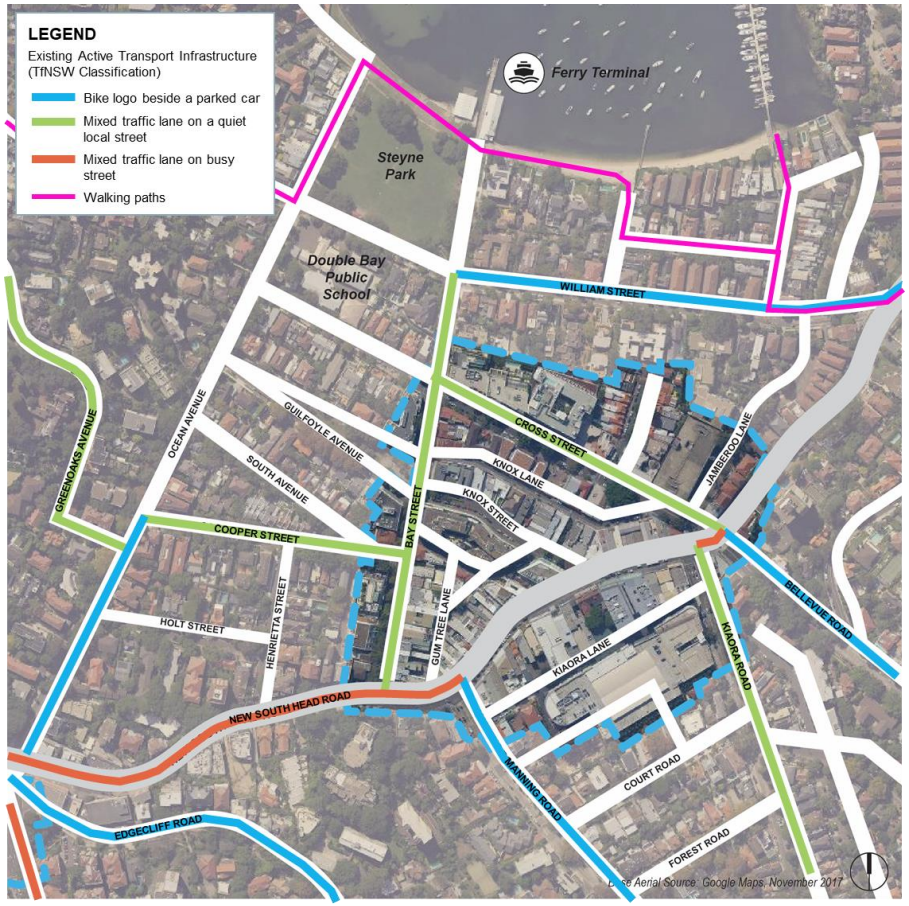
– "Mixed traffic lane on busy street" where the designated cycleway is located on a major arterial road such as New South Head Road

– "Bicycle logo beside a parked car" where the designated cycleway is located on a major council road such as Ocean Avenue or where painted cycleways are located next to a parked car such as Bellevue Road

– "Mixed traffic lane on a quiet local street" where the designated cycleway is located on a minor council road such as Cooper Street.

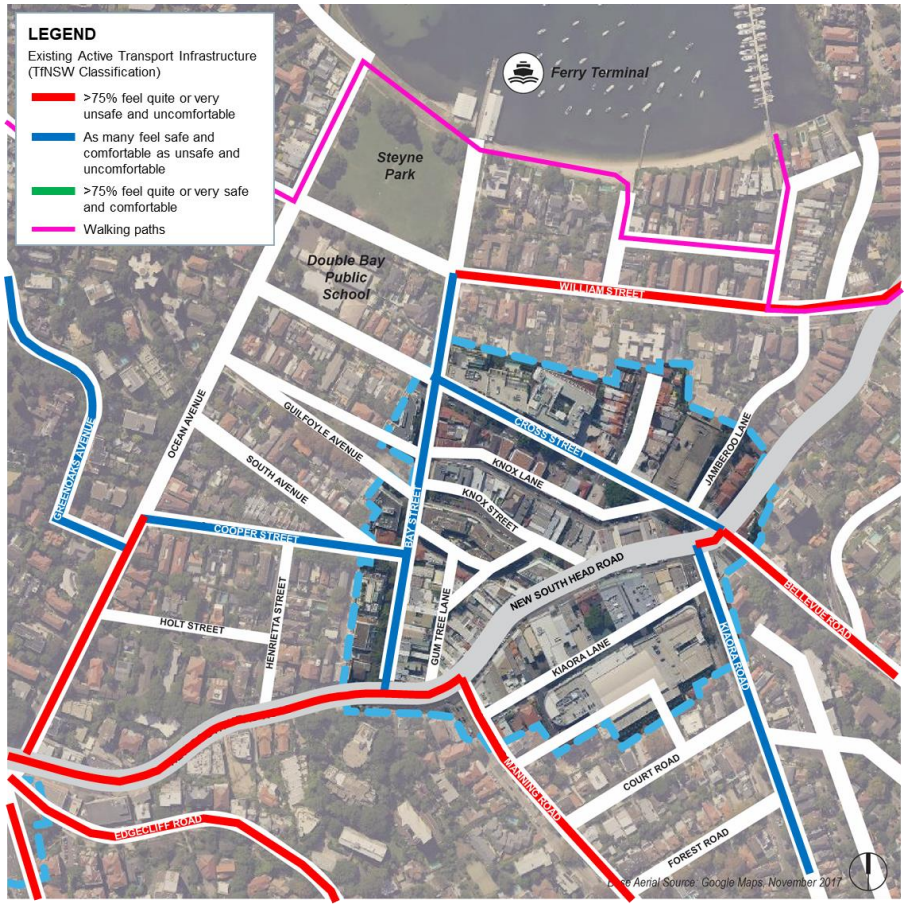
A summary of active transport facilities in the Double Bay and their preference rankings are shown in **Figure 2-6** and **Figure 2-7**, respectively. Cycle facilities on Bay Street and Cross Street are classified as mixed traffic lanes on a quiet local street and expect moderate preference ranking. There are currently no cycleways within the Double Bay where ">75% feel quite or very safe and comfortable".

**Figure 2-6 Existing active transport facility types**




Source: WMC; 2007, modified by SCT Consulting; 2021

**Figure 2-7 Existing active transport facility type preference ranking**




Source: WMC; 2007, modified by SCT Consulting; 2021

### 2.4.3 Cyclist volumes

To provide an estimate of current ridership volumes within the Double Bay Town Centre data was obtained from Strava for the period July 2015 to June 2017. Whilst only representing a subset of the cycling population the series profile that is provided across the multiple routes within the study area highlights a key travel pattern of this subset of cyclists.

**Figure 2-8**, which highlights the utilised routes visually, indicates that New South Head Road is the most frequently used route for cyclists within the Double Bay Town Centre for this subset. All remaining roads within the study area recorded a low patronage range total of between 1 and 1,718 cyclists over the two years.

Cyclist counts at key intersections within the Double Bay area (surveyed in August 2017) indicated that New South Head Road, Ocean Avenue and William Street were the most frequently used roads for cyclists within the Double Bay Area as shown in **Figure 2-8**. Cyclist counts at the intersection of Ocean Avenue and Greenoaks Avenue indicated a northbound desire line from Ocean Avenue to William Street was the highest instead of WMC's route designation of Bay Street to William Street.

Additionally, cycle counts showed that cyclists were more willing to cycle downhill in the Double Bay area where the volume of cyclists travelling downhill along New South Head Road, Ocean Avenue and William Street were significantly higher when compared to the cyclist volumes of those travelling uphill.

**Figure 2-8 Cycle counts**

Source: Strava; 2017, modified by SCT Consulting; 2021

## 2.5 Walking

### 2.5.1 Walking catchment

Walking is a very accessible travel model for residents living in the Double Bay. The Department of Infrastructure and Transport notes that generally people are prepared to walk approximately 800 m to a high frequency, direct public transport services such as trains and ferries. For indirect or local services such as buses, people are willing to walk about 400 m[1].

Concerning the Double Bay, almost all residents live within an 800 m walking catchment to either Edgecliff Train Station or Double Bay Ferry Wharf as shown in **Figure 2-9**. For buses, most residents live within a 400 m walking catchment to at least one bus stop located along New South Head Road, the primary road for buses travelling into Sydney CBD. Similarly, key destinations (as shown in **Figure 2-10**) such as Double Bay Town Centre and Double Bay Primary School are accessible within an 800 m catchment for all residents living within the Double Bay study area.

Double Bay Town Centre is an attractive destination with high pedestrian activity along streets like Cross Street, Knox Street and Transvaal Avenue. It is appealing as a local destination combined with Double Bay's high-quality walking environment makes it easy to encourage residents to walk instead of drive.

[1] Walking, Riding and Access to Public Transport, Department of Infrastructure and Transport

**Figure 2-9 Walking catchment to Edgecliff Station and Double Bay Ferry Wharf**

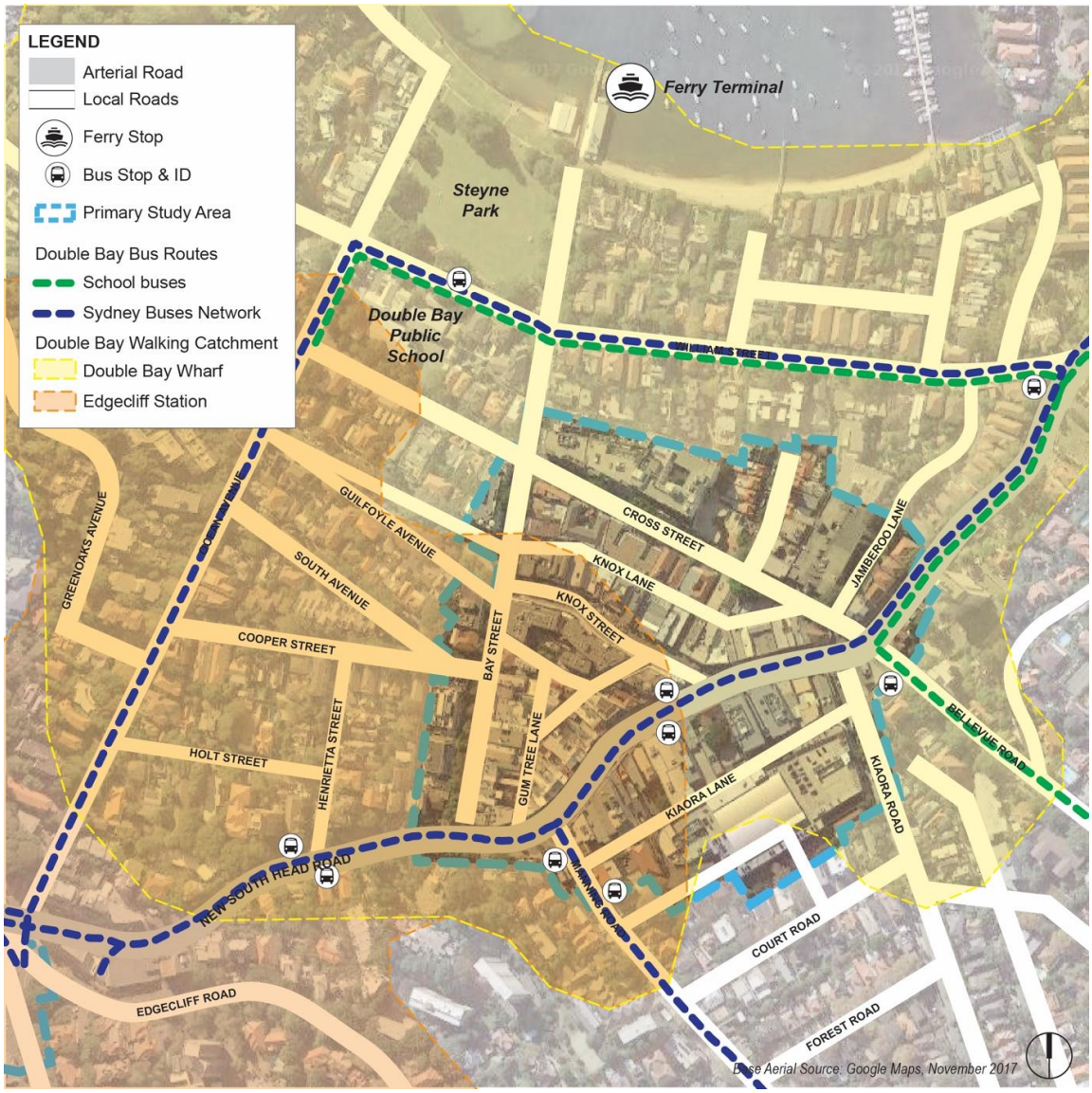


Figure 2-10 Points of interest in Double Bay


## 2.5.2 Existing walking conditions

Walking conditions within the Double Bay area are generally pleasant with wide footpaths on either side of almost all local roads and large street trees providing pedestrians with protection from the weather.

All crossing opportunities identified as a key walking route in Double Bay (refer to **Figure 2-11**) have kerb ramps installed on both sides of crossing opportunities.

Concerning topography, the Double Bay area is mostly flat where the profile of the area varies between 0 to 14 m above sea level (see **Figure 2-12**). The area outside Double Bay however is quite high with profiles ranging from 14 to 104 m above sea level. This difference in height between Double Bay and its surrounding areas creates steep roads and footpaths making it difficult for surrounding residents to access Double Bay Town Centre by walking.

**Figure 2-11 Key Walking routes in Double Bay**


**Figure 2-12 Double Bay topography**

## 2.6 Bus network

Double Bay is serviced by many bus routes on New South Head Road, William Street and Ocean Road, as illustrated in **Figure 2-13**.

**Figure 2-13 Bus network**

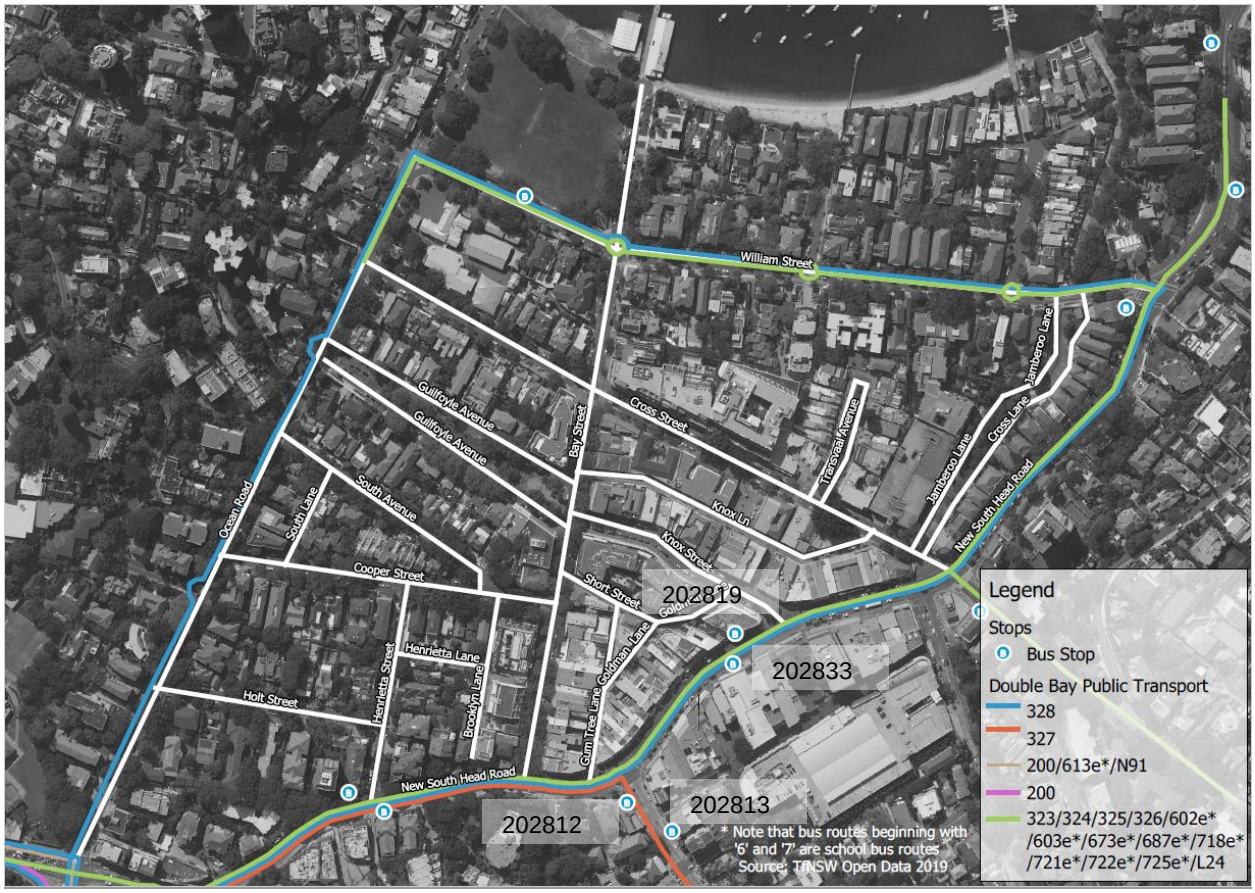



**Table 2-3** summarises bus stops and associated services in the vicinity of Double Bay Town Centre.

**Table 2-3 Double Bay Town Centre: bus stops and services**

| Stop ID | Location | Services |
|---|---|---|
| 202819 | New South Head Road (EB), near Knox Street | – Route 323: North Bondi <> Edgecliff<br>– Route 324: Walsh Bay <> Watsons Bay<br>– Route 325: Walsh Bay <> Watsons Bay<br>– Route 326: Edgecliff <> Bondi Junction |
| 202833 | New South Head Road (WB), opposite Knox Street | – Same routes as Stop ID “202819”<br>– Route 328: Darling Point <> Bondi Junction<br>– Route L24: Vaucluse <> City Wynyard |
| 202812 | Manning Road (NB), near New South Head Road | – Route 327: Edgecliff <> Bondi Junction |
| 202813 | Manning Road (SB), near New South Head Road | |

Source: SCT Consulting; 2021

During peak hour periods, bus stops adjacent to the town centre are offered a high frequency of services with Double Bay being well connected to surrounding areas and Edgecliff Station. During the AM peak hour, there are approximately 15 citybound services, whereas, in the PM peak hour, 11 services travel in the eastbound direction.

## 2.7 Parking

### 2.7.1 On-street parking

The exiting on-street parking conditions are shown in **Figure 2-14**.

**Figure 2-14 Parking conditions**


The majority of the on-street parking around the Double Bay Town Centre is time-restricted parking (1/2P and 2P). Ticket parking is available on Bay Street, Knox Street, Knox Lane, Cross Street, Guilfoyle Avenue and Transvaal Avenue. Parking is prohibited on Short Street, Goldman Lane, Gum Tree Lane, Jamberoo Lane and Cross Lane. Short Street is a dedicated loading zone, servicing the retail premises facing Knox Street.

Permit holders are exempted from the parking restriction in the area, who are mostly residents in Double Bay.

There is a taxi zone accommodating about five parking spaces on the western side of Knox Street (north of Goldman Lane).

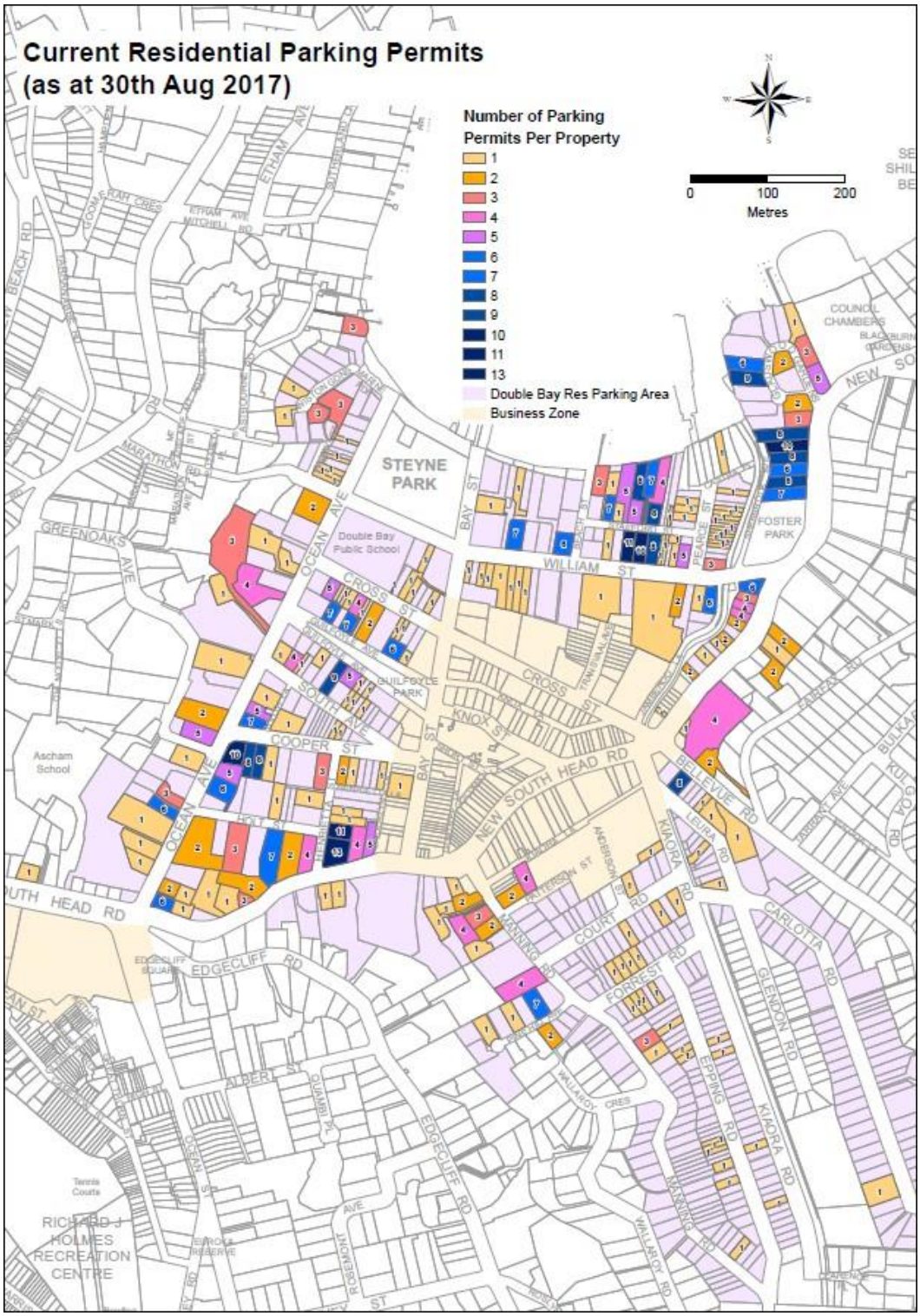
A parking occupancy survey was undertaken in June 2019 which is shown in **Figure 2-15** and **Figure 2-16**. The majority of the on-street parking was over 50 per cent occupied during AM and PM peak hours. Bay Street, Knox Street and Transvaal Avenue had relatively high parking demand, resulting in a limited remaining capacity for the on-street parking.

**Figure 2-15 Parking occupancy (Friday 8 am)**


**Figure 2-16 Parking occupancy (Friday 4 pm)**

Council also operates a residential parking permit scheme, which is shown in **Figure 2-17**.

**Figure 2-17 WMC Current Residential Parking Permit Scheme**




Source: WMC; 2017

## 2.7.2 Off-street parking

There are three off-street car parks in the vicinity of Knox Street, of which two are privately owned and one car park on Cross Street owned by WMC. **Figure 2-18** below indicates the location of the three off-street car parks.

**Figure 2-18 Locations of off-street parking facilities**


Source: SCT Consulting site visits, 2022

The occupancy for the off-street car park was examined on Monday 4 and Tuesday 5 April 2022. The following peak periods were used for the occupancy checks:

– 9.00am – 9:30am

– 12:30pm-1:00pm

– 5:00pm – 5:30pm.

The car park capacity of each car park is provided in **Table 2-4**.

**Table 2-4 Off-street parking capacities**

| Off-street car park | Capacity |
|---|---|
| 1 Cross Street car park (Council) | 369 (excluding car wash spaces) |
| 33 Cross Street car park (Wilson Parking) | 173 |
| Cosmopolitan Centre (Private) | 78 |
| Total off-street capacity | 620 |

Source: SCT Consulting site visits, 2022

The WMC car park is located on Cross Street at the corner of Jamberoo Lane, Double Bay. It is a multi-level car park having a capacity of approximately 381 spaces, inclusive of the 12 spaces designated for the car wash service on lower level 2 and level 1.

Lifts and stairs provide pedestrian access between the levels and to Cross Street. Level 5 and lower level 5 have uncovered parking spaces with faded line marking.

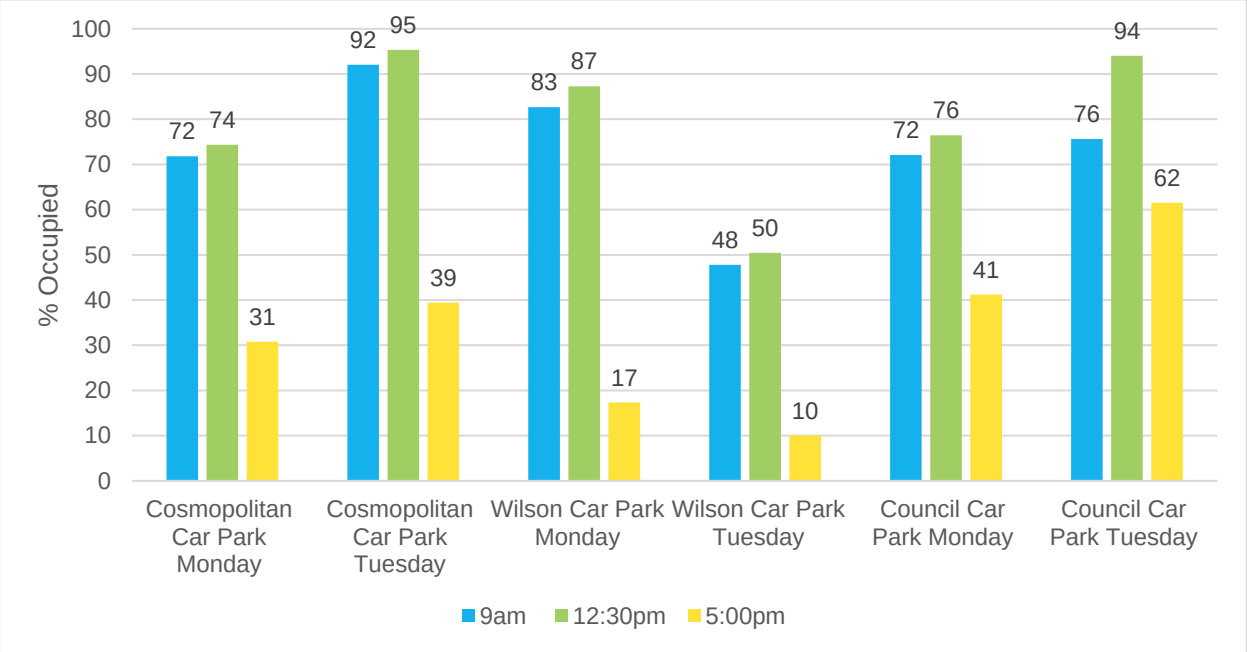
**Table 2-5 Breakdown of types of parking spaces for Cross Street Council car park**

| Off-street car park | Capacity |
|---|---|
| Accessibility parking | 10 |
| Parents/pram friendly parking | 6 |
| General parking | 353 |
| Car wash parking | 12 |
| Total | 381 |

Source: SCT Consulting site visits, 2022

The overall occupancy levels of each car park are provided in **Figure 2-19**.

**Figure 2-19 Off street car park occupancy levels**




Source: SCT Consulting site visits, 2022

The data indicate that peak occupancy occurs in the middle of the day when some of the parking facilities approach capacity.

At the very peak of demand, there are a total of 31 parking spaces available across all three facilities.

# 3.0 Knox Street Pedestrianisation Project

## 3.1 Project description

Knox Street is well-positioned to stand as a benchmark for a pedestrian-prioritised civic centre and a pilot project for the transformation of the Double Bay Commercial pedestrian precinct. The project will transform the four-lane carriageway between Bay Street and Goldman Lane into a fully pedestrianised street and retain a vehicular zone between Goldman Lane and New South Head Road (**Figure 3-1**).

**Figure 3-1 Proposed project**

Source: Aspect Studios, 2022

The project will retain eastbound traffic on Knox Street east to ensure that drivers can exit the Cosmopolitan hotel and access the road network. Parking will be provided on the north and south side of Knox Street to function as a taxi zone and a kiss ‘n drop zone, respectively.

## 3.2 Walking and placemaking benefits

The pedestrianisation of Knox Street considers and relocates certain services to ensure that Knox Street continues to function and service its commercial and F&B venues. These considerations will holistically connect surrounding streets such as Knox Lane and associated pedestrian laneway/arcades and car parking to ensure public amenity is not lost.

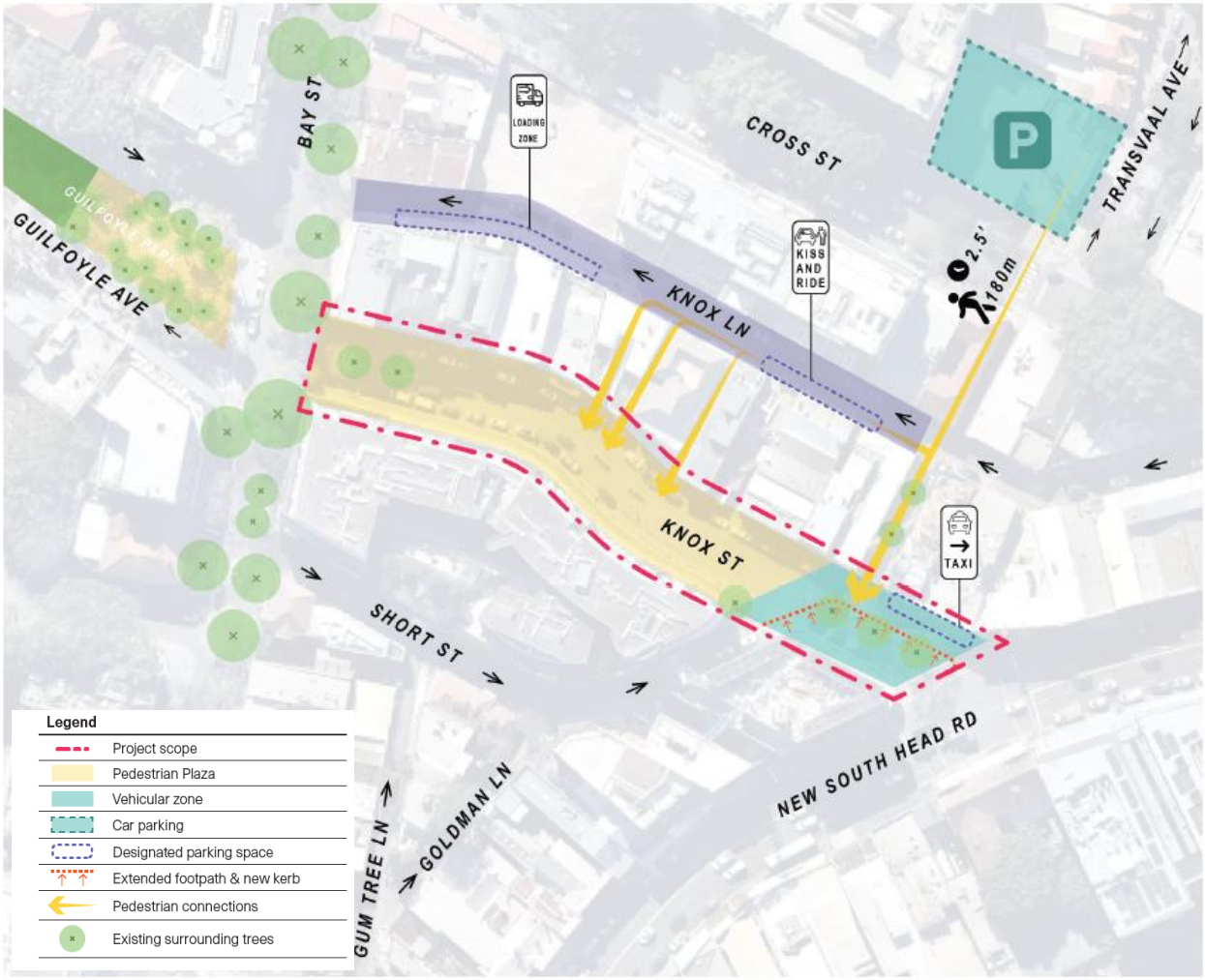
As shown in **Figure 3-2**, the design would include:

– **Knox Lane**: New loading zone, kiss and ride, pedestrian connection through existing laneways and arcades

– **Knox Street South**: Taxi rank zone, bicycle parking

– **Cross Street car park**: reinstate the primary pedestrian route from Cross Street car park to Knox Street.

**Figure 3-2 Placemaking scheme**




The northern part of Knox Street would be well-connected with the existing Guilfoyle Park via the proposed pedestrian crossing/raised intersection. This further harnesses the pedestrianisation area and avoids the vehicular zone towards New South Head Road.

**Figure 3-3 Connection to Guilfoyle Avenue**


It is expected that well-designed pedestrianisation schemes have seen significant increases in pedestrian traffic. This is directly correlated with improvements in pedestrian environment safety and connectivity, and, in some cases, improved public transport facilities.

Some of these benefits are passed onto both local councils and landlords as pedestrianisation often leads to an increase in retail rental costs. A study[2] in Hong Kong showed the complete pedestrianisation of a streetscape resulted in a 17 per cent increase in retail rental value. However, increases in rental costs are sufficiently offset by increases in business revenue from higher foot traffic. Furthermore, vacancy rates have been shown to drop within one year of pedestrianisation, with corresponding increases in employment and expected wage growth.

## 3.3 Proposed parking changes

The proposed pedestrianisation would remove 28 on-street parking spaces on Knox Street (between Goldman Lane and Bay Street) and three spaces on Bay Street (north side between Guilfoyle Avenues). It is noted that the three spaces on Knox Street (south side between Goldman Lane and New South Head Road) might be removed as part of the one way Knox Street proposal. Hence, 31 parking spaces would be removed.

The taxi zone would be relocated on Knox Street south in the one way Knox Street option (between Goldman Lane and New South Head Road) (**Figure 3-2**).

[2] Chung 2011, Impact of Pedestrian Scheme on Retail Rent: Empirical Test in Hong Kong, Journal of Place Management and Development, vol. 4, no. 3, pp. 231-242.

## 3.4 Service access

A loading zone is provided at the eastern extent of the fully pedestrianised zone. The bay would be accessed via a roll kerb.

## 3.5 Emergency vehicles

Emergency access will be retained through the plaza to allow for access by NSW Police, emergency vehicles as well as controlled access by plaza users (e.g. food trucks). The northern section has been designed to allow for the swept path of an ambulance headed eastbound and the southern section allows for the swept path of an ambulance headed westbound.

## 3.6 Options for New South Head Road interface

With the closure of traffic in Knox Street, traffic accessing the vehicular zone would terminate just east of Goldman Lane. Vehicles would then need to conduct a U-turn and exit via Knox Street as Goldman Lane is a one-way road headed eastbound.

Two options were evaluated for how this section is treated.

### 3.6.1 Option 1: retain westbound traffic on Knox Street

This option has the least impact on traffic flows, by retaining some level of access off Knox Street. However, with the requirement for vehicles to conduct a U-turn manoeuvre, there would be a need to provide a substantial U-turn facility. Given the road could be accessed by a bus or heavy rigid vehicle, a turning circle of about 25m would need to be provided. This would impact heavily on the streetscape and is potentially infeasible as it would impact adjacent properties.

### 3.6.2 Option 2: Closure for westbound traffic on Knox Street

This option would prevent westbound traffic on Knox Street from New South Head Road, making this section eastbound only. Egress for the Cosmopolitan and other road users would be retained.

The benefit of this option is that it provides a smaller impact on the public domain for vehicle turning compared with option 1. It also enables the reallocation of road space on New South Head Road. Two alternatives have been developed for how the current left turn bay is adjusted:

– The left turn bay on the western approach of New South Head Road becomes parking rather than a left turn bay.

– Additional right turn storage capacity could be provided through re-channelisation of the western approach of New South Head Road. This may be supported by TfNSW to address eastbound right turn performance issues at Kiaora Road (**Figure 3-4**).

**Figure 3-4 Proposed additional right turn bay**


Source: Nearmap, 2022

Overall, the impacts of westbound traffic and a U-turn facility were considered significant, and this option was progressed.

# 4.0 Traffic impacts

## 4.1 Road network impact

The closure of westbound flows on Knox Street removes the left and right turn movement from New South Head Road to Knox Street. As a result, the model will have the following trip redistribution assumptions:

– Left turn traffic to Knox Street is assumed to be relocated to New South Head Road / Bay Street and New South Head Road / Cross Street

– Right turn traffic to Knox Street is assumed to be redistributed to New South Head Road / William Street.

The intersection performance with Double Bay development traffic is presented in **Table 4-1**.

**Table 4-1 Intersection performance in 2022 with project**

| Intersection | AM Peak | | | | PM Peak | | | |
|---|---|---|---|---|---|---|---|---|
| | Delay | LoS | DoS | Volume | Delay | LoS | DoS | Volume |
| **New South Head Rd / Knox St (2022)** | 5.9s | A | 0.84 | 3,199 | 5.1s | A | 0.70 | 2,907 |
| **New South Head Rd / Cross St / Bellevue Rd / Kiora Rd (2022)** | 29.9s | C | 1.24 | 3,883 | 30.4 | B | 1.14 | 3,525 |
| **New South Head Rd / William St (2022)** | 14.3s | A | 0.76 | 3,667 | 15.2s | B | 0.72 | 3,425 |
| **New South Head Rd / Manning Rd (2017)** | 33.4s | C | 0.97 | 3,383 | 12.7 | C | 0.80 | 3,316 |
| **New South Head Rd / Bay St (2017)** | 0.3 | A | 0.38 | 3,334 | 0.5 | A | 0.46 | 3,268 |

Source: SCT Consulting, 2021

The traffic modelling shows minimal impacts from the delivery of Knox Street. Modelling indicates the impacts are as follows:

– **Cross Street / New South Head Road:** an improvement by 6 seconds in the morning and a worsening by 2.8 seconds in the evening peak

– **Knox Street / New South Head Road**: an improvement by 3.9 seconds in the morning peak and no change in the evening peak

– **William Street / New South Head Road:** a worsening by 0.8 seconds in the morning peak and 0.5 seconds in the evening peak.

The removal of westbound traffic is also expected to reduce queuing on Guilfoyle Avenue east of the Cosmopolitan entrance. By removing the give way, traffic no longer needs to wait to find a gap. Drivers will be able to drive directly to Knox Street, which should reduce the queueing occurring.

## 4.2 Bus transport impact

Knox Street is not a bus corridor, so there will not be any services affected by the closure. There are no spaces for bus parking, so the road is unlikely to be used for private bussing either.

## 4.3 Parking impact

The pedestrianisation of Knox Street will result in the loss of 31 on-street parking spaces in total. Surveys of on-street and off-street capacity indicate that there is sufficient capacity in the network around the transport network to accommodate the parking space loss. For instance, there is a minimum of 31 parking spaces available across all three multi-storey off-street car parks.

## 4.4 Servicing impact

There are no current loading zones provided on Knox Street, however, it is expected that drivers use paid parking for early morning deliveries. To mitigate this, the design includes a loading zone at the eastern extent that is designed to cater for a medium rigid vehicle (8.8m in length). This improves the quality of servicing access for businesses with a dedicated loading zone. This space can also be used for moving days for residents of the cosmopolitan.

Further, the cross-section of the pedestrianised zone and the materials chosen allow for infrequent access by vehicles for closer delivery.

# 5.0 Preliminary construction traffic management plan

A contractor has yet to be appointed to the project. This construction traffic management plan is preliminary and subject to change as the contractor brings construction insights.

## 5.1 Description of works

Construction will involve:

– Demolition of existing road

– Capping off / diversion of existing services

– Construction of substructure

– Construction of plaza

– Commissioning and handover

## 5.2 Works program

The duration of construction is expected to be from November 2022 to April 2023.

## 5.3 Construction traffic impacts

Per the Draft Construction Noise Guideline (EP&A) recommended standard hours for construction work, the majority of construction activities are proposed to occur between the hours of 7am to 6pm on weekdays and 8am to 1pm Saturdays, with no work on Sundays or Public Holidays. The work does not involve blasting.

To maintain access to businesses on Knox Street, some limited night work would be required.

Final construction vehicle numbers are still being confirmed. The construction is estimated to generate the following traffic on a typical day:

– A workforce of about 30, with workers assumed to be arriving in the morning peak and leaving in the evening peak

– Heavy vehicle movements of typically up to 10 per day.

### 5.3.1 Heavy vehicle demands and parking

Construction workers would typically arrive in light vehicles. The potential heavy vehicles are shown in **Table 5-1**.

**Table 5-1 Heavy vehicle types accessing the site**

| Construction vehicle | Vehicle length | Purpose |
|---|---|---|
| Heavy Rigid Vehicle | 12.5m | Mobile concrete booms, concrete trucks |
| Small or medium rigid vehicles | 6.4-8.8m | Delivery of other materials, removal of spoil and construction waste |

Source: SCT Consulting, 2022

Heavy vehicles will generally park within the cordoned works zone. Work zones could be provided on Knox Lane if there are truck holding requirements during construction. Knox Lane has fewer retail frontages and is, therefore, less significant compared to other locations such as Bay Street.

### 5.3.2 Haulage routes

New South Head Road is the closest state road that provides access to the site. Haulage routes for heavy vehicles should prioritise the use of Knox Street to avoid impacts on other streets in the centre. Access to potential work zones in Knox Lane should be via Cross Street.

Figure 5-1 Construction management summary


New South Head is not a B-Double approved route, so construction should avoid vehicles of this size. Drivers need to select their route in advance, minimising the impact on residential streets and consistent with their legal obligations.

### 5.3.3 Construction worker parking

Construction workers should park in one of the multi-storey car parking facilities available to minimise the impact on the community.

### 5.3.4 Road closures

The project involves the closure of Knox Street, which will be undertaken as part of the construction works.

Access must always be provided for cars exiting the Cosmopolitan via Knox Street eastbound. There are no alternative egress points to the broader road network for traffic from this car park.

Bay Street will require road closure while the crossing facilities are delivered. Guilfoyle Avenue's westbound section would be affected by this closure. To retain access to Guilfoyle Avenue and avoid night works, the following is recommended:

– The entirety of the southern side be temporarily signposted as no stopping
– The first 20 metres of the northern side be temporarily signposted as no stopping
– Temporary signage be provided on the western end to signify drivers may enter
– Traffic management to control entries and exits to the roundabout.

The width of Guilfoyle Avenue is 8m, allowing two cars to pass under this arrangement.

This would result in the loss of about 28 parking spaces during the construction of the Bay Street crossing facilities.

Signage would be provided on Bay Street to signify that the road terminates and is (temporarily) no longer a through road.

Footpath closures on Bay Street and Knox Street are expected during the construction window. However, access must be generally maintained to the businesses on Knox Street. As works include footpath modifications, there may be some night works required to avoid businesses being denied access.

The works boundary is not confirmed at this stage. An indicative works boundary has been drawn to illustrate a potential size.

After the contractor is appointed, individual road occupancy licenses would be applied for with traffic control plans.

## 5.4 Mitigations

Road network impacts by worker traffic to the site will be mitigated by the construction workers generally starting earlier and finishing earlier than the commuter peak periods and would likely not coincide with the school or road network peak periods.

Construction workers will be encouraged to carpool and arrange a lift service from Edgecliff Station, further reducing the impact on the road network and local parking demands.

Other mitigations are:

– Truckloads would be covered during transportation off-site

– Neighbouring properties would be notified of construction works and timing. Any comments would be recorded and taken into consideration when planning construction activities

– All activities, including the delivery of materials, would not impede traffic flow along local roads

– Materials would be delivered, and spoil removed during standard construction hours

– Avoidance of idling trucks alongside sensitive receivers

– Deliveries would be planned to ensure a consistent and minimal number of trucks arriving at the site at any one time.

To manage driver conduct the following measures are to be implemented:

– All truck movements will be scheduled

– Vehicles are to enter and exit the site in a forward direction along the travel path shown on delivery maps

– Drivers are to always give way to pedestrians and plant.

Pedestrian and cyclist access and safety need to be prioritised and alternative routes should be provided where the footpath is closed. Footpaths adjacent to work sites would be traffic controlled to manage the conflict between construction vehicles and pedestrians. Where work sites have an impact on footpaths, consideration will be given to the requirements of all pedestrians and especially users with specific requirements (e.g. elderly, strollers, disabled).

Traffic controllers will be used to stop traffic on the public streets to allow trucks to enter or leave the site. Where possible, vehicles must enter and exit the site in a forward direction. They must wait until a suitable gap in traffic allows them to assist trucks to enter or exit the site. The Roads Act does not give any special treatment to trucks leaving a construction site, the vehicles already on the road have the right-of-way. Vehicles entering, exiting, and driving around the site will be required to always give way to pedestrians.

Traffic controllers will be provided:

– At any vehicular site gates to control truck entry and egress and avoid safety risks with other road users

– At the western end of Guilfoyle Avenue to allow vehicles into the typically only westbound section

– On Knox Street at the eastern end to manage safe egress of vehicles from the Cosmopolitan hotel.

The mitigating works are summarised in **Figure 5-2**.

**Figure 5-2 Construction management summary**

# 6.0 Conclusion

This transport assessment shows that:

– Traffic impacts of the proposed pedestrianisation project are nominal. In some cases, the project reduces traffic delays due to intersection simplification.

– Parking impacts of the removal of the 31 parking spaces can be accommodated in the on and off-street parking network within a short walk of the site.

– There are no bus impacts, as the street does not carry any public bus routes.

– The project is net positive for loading as the project delivers a new loading zone on Knox Street.

– Construction impacts are manageable but will result in the temporary closure of Bay Street. Diversions are provided to ensure access to properties.

APPENDIX A

# SIDRA modelling output

# MOVEMENT SUMMARY

## Site: [NEW_BAY_17_AM_Exisiting Condition]

## Network: N101 [AM_22_Existing Condition]

NEW_BAY_17_AM_X
Giveway / Yield (Two-Way)

**Movement Performance - Vehicles**

| Mov ID | OD Mov | Demand Flows Total veh/h | HV % | Arrival Flows Total veh/h | HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | 95% Back of Queue Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East: New South Head Road (E leg) | | | | | | | | | | | | | |
| 5 | T1 | 2176 | 4.5 | 2161 | 4.5 | 0.380 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 59.9 |
| Approach | | 2176 | 4.5 | 2161 N1 | 4.5 | 0.380 | 0.0 | NA | 0.0 | 0.0 | 0.00 | 0.00 | 59.9 |
| North: Bay Street (N leg) | | | | | | | | | | | | | |
| 7 | L2 | 65 | 3.2 | 65 | 3.2 | 0.077 | 6.3 | LOS A | 0.2 | 1.7 | 0.45 | 0.64 | 42.6 |
| Approach | | 65 | 3.2 | 65 | 3.2 | 0.077 | 6.3 | LOS A | 0.2 | 1.7 | 0.45 | 0.64 | 42.6 |
| West: New South Head Road (W leg) | | | | | | | | | | | | | |
| 10 | L2 | 41 | 2.6 | 41 | 2.6 | 0.307 | 5.6 | LOS A | 0.0 | 0.0 | 0.00 | 0.05 | 57.7 |
| 11 | T1 | 998 | 8.2 | 998 | 8.2 | 0.307 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.02 | 59.5 |
| Approach | | 1039 | 8.0 | 1039 | 8.0 | 0.307 | 0.3 | NA | 0.0 | 0.0 | 0.00 | 0.02 | 59.4 |
| All Vehicles | | 3280 | 5.6 | 3265 N1 | 5.6 | 0.380 | 0.2 | NA | 0.2 | 1.7 | 0.01 | 0.02 | 59.3 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 29.6 %
Number of Iterations: 10 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

# MOVEMENT SUMMARY

**Site: [NEW_BAY_17_AM_Proposed Option]**

**Network: N101 [AM_22_Proposed Option]**

NEW_BAY_17_AM_X
Giveway / Yield (Two-Way)

**Movement Performance - Vehicles**

| Mov ID | OD Mov | Demand Flows Total veh/h | HV % | Arrival Flows Total veh/h | HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | 95% Back of Queue Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East: New South Head Road (E leg) | | | | | | | | | | | | | |
| 5 | T1 | 2176 | 4.5 | 2161 | 4.5 | 0.380 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 59.9 |
| Approach | | 2176 | 4.5 | 2161 N1 | 4.5 | 0.380 | 0.0 | NA | 0.0 | 0.0 | 0.00 | 0.00 | 59.9 |
| North: Bay Street (N leg) | | | | | | | | | | | | | |
| 7 | L2 | 65 | 3.2 | 65 | 3.2 | 0.074 | 6.2 | LOS A | 0.2 | 1.7 | 0.44 | 0.63 | 42.7 |
| Approach | | 65 | 3.2 | 65 | 3.2 | 0.074 | 6.2 | LOS A | 0.2 | 1.7 | 0.44 | 0.63 | 42.7 |
| West: New South Head Road (W leg) | | | | | | | | | | | | | |
| 10 | L2 | 95 | 3.3 | 95 | 3.3 | 0.321 | 5.6 | LOS A | 0.0 | 0.0 | 0.00 | 0.11 | 57.2 |
| 11 | T1 | 998 | 8.2 | 998 | 8.2 | 0.321 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.05 | 59.1 |
| Approach | | 1093 | 7.8 | 1093 | 7.8 | 0.321 | 0.5 | NA | 0.0 | 0.0 | 0.00 | 0.05 | 58.8 |
| All Vehicles | | 3334 | 5.6 | 3319 N1 | 5.6 | 0.380 | 0.3 | NA | 0.2 | 1.7 | 0.01 | 0.03 | 59.1 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 9.9 %
Number of Iterations: 10 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

# MOVEMENT SUMMARY

## Site: [NEW_BAY_17_PM_Exisiting Condition]

## Network: N102 [PM_22_Existing Condition]

NEW_BAY_17_PM_X
Giveway / Yield (Two-Way)

**Movement Performance - Vehicles**

| Mov ID | OD Mov | Demand Flows Total veh/h | HV % | Arrival Flows Total veh/h | HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | 95% Back of Queue Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East: New South Head Road (E leg) | | | | | | | | | | | | | |
| 5 | T1 | 1413 | 2.0 | 1403 | 2.0 | 0.364 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 59.9 |
| Approach | | 1413 | 2.0 | 1403 N1 | 2.0 | 0.364 | 0.0 | NA | 0.0 | 0.0 | 0.00 | 0.00 | 59.9 |
| North: Bay Street (N leg) | | | | | | | | | | | | | |
| 7 | L2 | 79 | 0.0 | 79 | 0.0 | 0.237 | 9.2 | LOS A | 0.4 | 3.1 | 0.62 | 0.83 | 40.1 |
| Approach | | 79 | 0.0 | 79 | 0.0 | 0.237 | 9.2 | LOS A | 0.4 | 3.1 | 0.62 | 0.83 | 40.1 |
| West: New South Head Road (W leg) | | | | | | | | | | | | | |
| 10 | L2 | 56 | 0.0 | 56 | 0.0 | 0.441 | 5.6 | LOS A | 1.2 | 8.4 | 0.00 | 0.04 | 57.9 |
| 11 | T1 | 1651 | 1.4 | 1651 | 1.4 | 0.441 | 0.1 | LOS A | 2.0 | 14.0 | 0.00 | 0.02 | 59.5 |
| Approach | | 1706 | 1.4 | 1706 | 1.4 | 0.441 | 0.2 | NA | 2.0 | 14.0 | 0.00 | 0.02 | 59.4 |
| All Vehicles | | 3198 | 1.6 | 3188 N1 | 1.6 | 0.441 | 0.4 | NA | 2.0 | 14.0 | 0.02 | 0.03 | 59.0 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 3.8 %
Number of Iterations: 10 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

# MOVEMENT SUMMARY

## Site: [NEW_BAY_17_PM_Proposed Option]

## Network: N102 [PM_22_Proposed Option]

NEW_BAY_17_PM_X
Giveway / Yield (Two-Way)

**Movement Performance - Vehicles**

| Mov ID | OD Mov | Demand Flows Total veh/h | HV % | Arrival Flows Total veh/h | HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East: New South Head Road (E leg) | | | | | | | | | | | | | |
| 5 | T1 | 1413 | 2.0 | 1403 | 2.0 | 0.364 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.00 | 59.9 |
| Approach | | 1413 | 2.0 | 1403 N1 | 2.0 | 0.364 | 0.0 | NA | 0.0 | 0.0 | 0.00 | 0.00 | 59.9 |
| North: Bay Street (N leg) | | | | | | | | | | | | | |
| 7 | L2 | 79 | 0.0 | 79 | 0.0 | 0.224 | 8.6 | LOS A | 0.4 | 2.9 | 0.60 | 0.82 | 40.6 |
| Approach | | 79 | 0.0 | 79 | 0.0 | 0.224 | 8.6 | LOS A | 0.4 | 2.9 | 0.60 | 0.82 | 40.6 |
| West: New South Head Road (W leg) | | | | | | | | | | | | | |
| 10 | L2 | 126 | 0.0 | 126 | 0.0 | 0.460 | 5.6 | LOS A | 1.2 | 8.3 | 0.00 | 0.08 | 57.5 |
| 11 | T1 | 1651 | 1.4 | 1651 | 1.4 | 0.460 | 0.1 | LOS A | 2.0 | 14.0 | 0.00 | 0.04 | 59.2 |
| Approach | | 1777 | 1.3 | 1777 | 1.3 | 0.460 | 0.5 | NA | 2.0 | 14.0 | 0.00 | 0.04 | 58.9 |
| All Vehicles | | 3268 | 1.6 | 3258 N1 | 1.6 | 0.460 | 0.5 | NA | 2.0 | 14.0 | 0.01 | 0.04 | 58.8 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 3.8 %
Number of Iterations: 10 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

# MOVEMENT SUMMARY

## Site: TCS167 [NEW_CRO_22_AM_Exisiting Condition_SIDRA 7.0.9]

Network: N101 [AM]

NEW_CRO_17_AM_X
Signals - Fixed Time Coordinated  Cycle Time = 115 seconds (User-Given Phase Times)

**Movement Performance - Vehicles**

| Mov ID | OD Mov | Demand Flows Total veh/h | HV % | Arrival Flows Total veh/h | HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Bellevue Road (S leg) | | | | | | | | | | | | | |
| 1b | L3 | 19 | 5.3 | 19 | 5.3 | 0.638 | 50.9 | LOS D | 12.5 | 89.7 | 0.97 | 0.83 | 29.6 |
| 1 | L2 | 220 | 3.2 | 220 | 3.2 | 0.638 | 50.1 | LOS D | 12.5 | 89.7 | 0.97 | 0.83 | 21.3 |
| 2 | T1 | 82 | 0.0 | 82 | 0.0 | 0.316 | 45.5 | LOS D | 4.8 | 34.2 | 0.92 | 0.73 | 30.8 |
| 3 | R2 | 15 | 6.7 | 15 | 6.7 | 0.316 | 50.1 | LOS D | 4.8 | 34.2 | 0.92 | 0.73 | 22.6 |
| Approach | | 336 | 2.7 | 336 | 2.7 | 0.638 | 49.0 | LOS D | 12.5 | 89.7 | 0.95 | 0.80 | 24.8 |
| East: New South Head Road (E leg) | | | | | | | | | | | | | |
| 4 | L2 | 20 | 5.3 | 20 | 5.3 | 0.834 | 43.0 | LOS D | 27.2 | 194.7 | 0.94 | 0.90 | 34.2 |
| 4a | L1 | 202 | 1.0 | 202 | 1.0 | 0.834 | 41.7 | LOS C | 27.2 | 194.7 | 0.94 | 0.90 | 34.6 |
| 5 | T1 | 1483 | 4.5 | 1483 | 4.5 | 0.834 | 36.7 | LOS C | 36.4 | 264.6 | 0.96 | 0.91 | 27.5 |
| Approach | | 1705 | 4.1 | 1705 | 4.1 | 0.834 | 37.4 | LOS C | 36.4 | 264.6 | 0.96 | 0.91 | 28.9 |
| North: Cross Street (N leg) | | | | | | | | | | | | | |
| 7 | L2 | 35 | 5.7 | 35 | 5.7 | 0.172 | 47.7 | LOS D | 2.8 | 20.0 | 0.88 | 0.71 | 22.6 |
| 8 | T1 | 74 | 0.0 | 74 | 0.0 | 0.495 | 49.6 | LOS D | 4.7 | 33.3 | 0.95 | 0.76 | 29.5 |
| 9a | R1 | 13 | 0.0 | 13 | 0.0 | 0.495 | 55.1 | LOS D | 4.7 | 33.3 | 0.97 | 0.77 | 29.3 |
| 9 | R2 | 22 | 4.5 | 22 | 4.5 | 0.495 | 57.1 | LOS E | 4.7 | 33.3 | 0.97 | 0.77 | 20.7 |
| Approach | | 144 | 2.1 | 144 | 2.1 | 0.495 | 50.8 | LOS D | 4.7 | 33.3 | 0.94 | 0.75 | 27.1 |
| West: New South Head Road (W leg) | | | | | | | | | | | | | |
| 10 | L2 | 43 | 9.8 | 43 | 9.8 | 0.674 | 14.0 | LOS A | 13.9 | 104.6 | 0.45 | 0.43 | 41.6 |
| 11 | T1 | 1163 | 8.8 | 1163 | 8.8 | 0.674 | 8.8 | LOS A | 14.0 | 105.5 | 0.45 | 0.42 | 24.9 |
| 12 | R2 | 121 | 7.8 | 121 | 7.8 | 1.115 | 169.7 | LOS F | 16.4 | 124.6 | 1.00 | 1.34 | 10.0 |
| 12b | R3 | 26 | 20.0 | 26 | 20.0 | 1.115 | 170.6 | LOS F | 16.4 | 124.6 | 1.00 | 1.34 | 9.9 |
| Approach | | 1354 | 8.9 | 1354 | 8.9 | 1.115 | 26.5 | LOS B | 16.4 | 124.6 | 0.51 | 0.52 | 16.5 |
| SouthWest: Kiaora Road (SW leg) | | | | | | | | | | | | | |
| 30b | L3 | 68 | 12.3 | 68 | 12.3 | 0.308 | 54.1 | LOS D | 3.5 | 27.4 | 0.93 | 0.76 | 20.6 |
| 30a | L1 | 95 | 0.0 | 95 | 0.0 | 0.285 | 48.3 | LOS D | 4.7 | 32.8 | 0.91 | 0.75 | 30.2 |
| 32a | R1 | 159 | 4.0 | 159 | 4.0 | 0.511 | 50.5 | LOS D | 8.6 | 61.8 | 0.96 | 0.80 | 21.2 |
| 32b | R3 | 6 | 0.0 | 6 | 0.0 | 0.511 | 52.5 | LOS D | 8.6 | 61.8 | 0.96 | 0.80 | 29.3 |
| Approach | | 328 | 4.5 | 328 | 4.5 | 0.511 | 50.7 | LOS D | 8.6 | 61.8 | 0.94 | 0.78 | 24.5 |
| All Vehicles | | 3867 | 5.6 | 3867 | 5.6 | 1.115 | 36.2 | LOS C | 36.4 | 264.6 | 0.80 | 0.75 | 25.2 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 32.8 %
Number of Iterations: 10 (maximum specified: 10)

| Movement Performance - Pedestrians | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Mov ID | Description | Demand Flow ped/h | Average Delay sec | Level of Service | Average Back of Queue Pedestrian ped | Distance m | Prop. Queued | Effective Stop Rate per ped |
| P1 | South Full Crossing | 53 | 20.7 | LOS C | 0.1 | 0.1 | 0.60 | 0.60 |
| P2 | East Full Crossing | 53 | 49.0 | LOS E | 0.2 | 0.2 | 0.92 | 0.92 |
| P3 | North Full Crossing | 53 | 20.7 | LOS C | 0.1 | 0.1 | 0.60 | 0.60 |
| P4 | West Full Crossing | 53 | 51.8 | LOS E | 0.2 | 0.2 | 0.95 | 0.95 |
| P8 | SouthWest Full Crossing | 53 | 20.7 | LOS C | 0.1 | 0.1 | 0.60 | 0.60 |
| All Pedestrians | | 263 | 32.6 | LOS D | | | 0.74 | 0.74 |

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

# MOVEMENT SUMMARY

## Site: TCS167 [NEW_CRO_22_AM_Proposed Option]

## Network: N101 [AM_22_Proposed Option]

NEW_CRO_17_AM_X
Signals - Fixed Time Coordinated  Cycle Time = 115 seconds (User-Given Phase Times)

**Movement Performance - Vehicles**

| Mov ID | OD Mov | Demand Flows Total veh/h | HV % | Arrival Flows Total veh/h | HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Bellevue Road (S leg) | | | | | | | | | | | | | |
| 1b | L3 | 19 | 5.3 | 19 | 5.3 | 0.730 | 55.8 | LOS D | 13.3 | 95.5 | 1.00 | 0.87 | 28.5 |
| 1 | L2 | 220 | 3.2 | 220 | 3.2 | 0.730 | 54.9 | LOS D | 13.3 | 95.5 | 1.00 | 0.87 | 20.2 |
| 2 | T1 | 82 | 0.0 | 82 | 0.0 | 0.403 | 50.0 | LOS D | 5.1 | 36.1 | 0.96 | 0.76 | 29.7 |
| 3 | R2 | 15 | 6.7 | 15 | 6.7 | 0.403 | 54.6 | LOS D | 5.1 | 36.1 | 0.96 | 0.76 | 21.5 |
| Approach | | 336 | 2.7 | 336 | 2.7 | 0.730 | 53.8 | LOS D | 13.3 | 95.5 | 0.99 | 0.84 | 23.7 |
| East: New South Head Road (E leg) | | | | | | | | | | | | | |
| 4 | L2 | 20 | 5.3 | 20 | 5.3 | 0.650 | 26.8 | LOS B | 18.7 | 133.6 | 0.74 | 0.71 | 40.3 |
| 4a | L1 | 202 | 1.0 | 202 | 1.0 | 0.650 | 25.5 | LOS B | 18.7 | 133.6 | 0.74 | 0.71 | 40.8 |
| 5 | T1 | 1483 | 4.5 | 1483 | 4.5 | 0.650 | 21.8 | LOS B | 25.0 | 181.7 | 0.78 | 0.71 | 35.2 |
| Approach | | 1705 | 4.1 | 1705 | 4.1 | 0.650 | 22.3 | LOS B | 25.0 | 181.7 | 0.77 | 0.71 | 36.3 |
| North: Cross Street (N leg) | | | | | | | | | | | | | |
| 7 | L2 | 35 | 5.7 | 35 | 5.7 | 0.225 | 50.1 | LOS D | 3.3 | 23.5 | 0.91 | 0.73 | 22.0 |
| 8 | T1 | 74 | 0.0 | 74 | 0.0 | 0.647 | 53.2 | LOS D | 4.6 | 32.4 | 0.96 | 0.79 | 28.6 |
| 9a | R1 | 13 | 0.0 | 13 | 0.0 | 0.647 | 61.5 | LOS E | 4.6 | 32.4 | 1.00 | 0.83 | 27.8 |
| 9 | R2 | 22 | 4.5 | 22 | 4.5 | 0.647 | 63.4 | LOS E | 4.6 | 32.4 | 1.00 | 0.83 | 19.3 |
| Approach | | 144 | 2.1 | 144 | 2.1 | 0.647 | 54.8 | LOS D | 4.6 | 32.4 | 0.96 | 0.78 | 26.1 |
| West: New South Head Road (W leg) | | | | | | | | | | | | | |
| 10 | L2 | 43 | 9.8 | 43 | 9.8 | 0.581 | 7.5 | LOS A | 4.2 | 32.0 | 0.14 | 0.16 | 47.5 |
| 11 | T1 | 1163 | 8.8 | 1163 | 8.8 | 0.581 | 2.3 | LOS A | 4.3 | 32.2 | 0.14 | 0.14 | 43.3 |
| 12 | R2 | 121 | 7.8 | 121 | 7.8 | 0.974 | 75.8 | LOS F | 11.9 | 90.4 | 1.00 | 1.11 | 18.3 |
| 12b | R3 | 26 | 20.0 | 26 | 20.0 | 0.974 | 76.7 | LOS F | 11.9 | 90.4 | 1.00 | 1.11 | 18.2 |
| Approach | | 1354 | 8.9 | 1354 | 8.9 | 0.974 | 10.5 | LOS A | 11.9 | 90.4 | 0.23 | 0.25 | 28.9 |
| SouthWest: Kiaora Road (SW leg) | | | | | | | | | | | | | |
| 30b | L3 | 82 | 10.3 | 82 | 10.3 | 1.240 | 283.2 | LOS F | 11.9 | 90.7 | 1.00 | 1.52 | 5.7 |
| 30a | L1 | 95 | 0.0 | 95 | 0.0 | 0.380 | 53.8 | LOS D | 5.0 | 34.9 | 0.96 | 0.77 | 28.9 |
| 32a | R1 | 161 | 3.9 | 161 | 3.9 | 0.709 | 57.7 | LOS E | 9.5 | 68.2 | 1.00 | 0.86 | 19.6 |
| 32b | R3 | 6 | 0.0 | 6 | 0.0 | 0.709 | 59.8 | LOS E | 9.5 | 68.2 | 1.00 | 0.86 | 27.7 |
| Approach | | 344 | 4.3 | 344 | 4.3 | 1.240 | 110.5 | LOS F | 11.9 | 90.7 | 0.99 | 0.99 | 14.9 |
| All Vehicles | | 3883 | 5.6 | 3883 | 5.6 | 1.240 | 29.9 | LOS C | 25.0 | 181.7 | 0.63 | 0.59 | 27.8 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 9.9 %
Number of Iterations: 10 (maximum specified: 10)

| Movement Performance - Pedestrians | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Mov ID | Description | Demand Flow ped/h | Average Delay sec | Level of Service | Average Back of Queue Pedestrian ped | Distance m | Prop. Queued | Effective Stop Rate per ped |
| P1 | South Full Crossing | 53 | 15.7 | LOS B | 0.1 | 0.1 | 0.52 | 0.52 |
| P2 | East Full Crossing | 53 | 51.8 | LOS E | 0.2 | 0.2 | 0.95 | 0.95 |
| P3 | North Full Crossing | 53 | 15.7 | LOS B | 0.1 | 0.1 | 0.52 | 0.52 |
| P4 | West Full Crossing | 53 | 51.8 | LOS E | 0.2 | 0.2 | 0.95 | 0.95 |
| P8 | SouthWest Full Crossing | 53 | 15.7 | LOS B | 0.1 | 0.1 | 0.52 | 0.52 |
| All Pedestrians | | 263 | 30.1 | LOS D | | | 0.69 | 0.69 |

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

# MOVEMENT SUMMARY

## Site: TCS167 [NEW_CRO_22_PM_Existing Condition_SIDRA 7.0.9]

## Network: N102 [PM]

NEW_CRO_17_PM_X
Signals - Fixed Time Coordinated  Cycle Time = 110 seconds (User-Given Phase Times)

**Movement Performance - Vehicles**

| Mov ID | OD Mov | Demand Flows Total veh/h | HV % | Arrival Flows Total veh/h | HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Bellevue Road (S leg) | | | | | | | | | | | | | |
| 1b | L3 | 29 | 0.0 | 29 | 0.0 | 0.591 | 50.0 | LOS D | 10.0 | 72.1 | 0.96 | 0.82 | 29.8 |
| 1 | L2 | 171 | 4.1 | 171 | 4.1 | 0.591 | 49.2 | LOS D | 10.0 | 72.1 | 0.96 | 0.82 | 21.5 |
| 2 | T1 | 75 | 0.0 | 75 | 0.0 | 0.330 | 44.8 | LOS D | 4.5 | 31.6 | 0.93 | 0.74 | 30.9 |
| 3 | R2 | 18 | 0.0 | 18 | 0.0 | 0.330 | 49.4 | LOS D | 4.5 | 31.6 | 0.93 | 0.74 | 22.7 |
| Approach | | 293 | 2.4 | 293 | 2.4 | 0.591 | 48.2 | LOS D | 10.0 | 72.1 | 0.95 | 0.79 | 25.5 |
| East: New South Head Road (E leg) | | | | | | | | | | | | | |
| 4 | L2 | 40 | 0.0 | 40 | 0.0 | 0.302 | 30.2 | LOS C | 8.2 | 57.7 | 0.73 | 0.75 | 37.8 |
| 4a | L1 | 184 | 0.0 | 184 | 0.0 | 0.302 | 29.0 | LOS C | 8.2 | 57.7 | 0.73 | 0.75 | 38.2 |
| 5 | T1 | 1148 | 2.9 | 1148 | 2.9 | 0.738 | 28.1 | LOS B | 26.2 | 188.2 | 0.89 | 0.79 | 31.7 |
| Approach | | 1373 | 2.5 | 1373 | 2.5 | 0.738 | 28.3 | LOS B | 26.2 | 188.2 | 0.86 | 0.79 | 33.3 |
| North: Cross Street (N leg) | | | | | | | | | | | | | |
| 7 | L2 | 58 | 0.0 | 58 | 0.0 | 0.470 | 48.7 | LOS D | 7.9 | 55.3 | 0.94 | 0.78 | 22.6 |
| 8 | T1 | 121 | 0.8 | 121 | 0.8 | 0.571 | 45.5 | LOS D | 7.9 | 55.3 | 0.95 | 0.78 | 30.5 |
| 9a | R1 | 27 | 0.0 | 27 | 0.0 | 0.571 | 56.1 | LOS D | 4.5 | 31.7 | 0.99 | 0.79 | 28.7 |
| 9 | R2 | 38 | 0.0 | 38 | 0.0 | 0.571 | 58.0 | LOS E | 4.5 | 31.7 | 0.99 | 0.79 | 20.1 |
| Approach | | 244 | 0.4 | 244 | 0.4 | 0.571 | 49.4 | LOS D | 7.9 | 55.3 | 0.96 | 0.78 | 27.4 |
| West: New South Head Road (W leg) | | | | | | | | | | | | | |
| 10 | L2 | 35 | 0.0 | 35 | 0.0 | 0.550 | 11.3 | LOS A | 8.1 | 57.3 | 0.31 | 0.30 | 44.1 |
| 11 | T1 | 1040 | 1.8 | 1040 | 1.8 | 0.550 | 6.0 | LOS A | 8.1 | 57.7 | 0.31 | 0.29 | 30.5 |
| 12 | R2 | 130 | 1.5 | 130 | 1.5 | 0.761 | 41.4 | LOS C | 7.8 | 54.9 | 0.90 | 0.86 | 25.8 |
| 12b | R3 | 24 | 0.0 | 24 | 0.0 | 0.761 | 42.3 | LOS C | 7.8 | 54.9 | 0.90 | 0.86 | 25.9 |
| Approach | | 1229 | 1.7 | 1229 | 1.7 | 0.761 | 10.6 | LOS A | 8.1 | 57.7 | 0.38 | 0.36 | 29.1 |
| SouthWest: Kiaora Road (SW leg) | | | | | | | | | | | | | |
| 30b | L3 | 67 | 4.5 | 67 | 4.5 | 0.275 | 50.9 | LOS D | 3.3 | 23.7 | 0.92 | 0.76 | 21.3 |
| 30a | L1 | 84 | 0.0 | 84 | 0.0 | 0.242 | 45.2 | LOS D | 3.9 | 27.3 | 0.90 | 0.74 | 31.0 |
| 32a | R1 | 220 | 0.0 | 220 | 0.0 | 0.748 | 51.6 | LOS D | 12.5 | 87.4 | 0.99 | 0.89 | 21.0 |
| 32b | R3 | 15 | 0.0 | 15 | 0.0 | 0.748 | 53.7 | LOS D | 12.5 | 87.4 | 0.99 | 0.89 | 29.0 |
| Approach | | 386 | 0.8 | 386 | 0.8 | 0.748 | 50.2 | LOS D | 12.5 | 87.4 | 0.96 | 0.83 | 24.1 |
| All Vehicles | | 3525 | 1.9 | 3525 | 1.9 | 0.761 | 27.6 | LOS B | 26.2 | 188.2 | 0.72 | 0.64 | 29.3 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 3.8 %
Number of Iterations: 10 (maximum specified: 10)

| Movement Performance - Pedestrians | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Mov ID | Description | Demand Flow ped/h | Average Delay sec | Level of Service | Average Back of Queue Pedestrian ped | Distance m | Prop. Queued | Effective Stop Rate per ped |
| P1 | South Full Crossing | 53 | 20.4 | LOS C | 0.1 | 0.1 | 0.61 | 0.61 |
| P2 | East Full Crossing | 53 | 49.3 | LOS E | 0.2 | 0.2 | 0.95 | 0.95 |
| P3 | North Full Crossing | 53 | 20.4 | LOS C | 0.1 | 0.1 | 0.61 | 0.61 |
| P4 | West Full Crossing | 53 | 49.3 | LOS E | 0.2 | 0.2 | 0.95 | 0.95 |
| P8 | SouthWest Full Crossing | 53 | 20.4 | LOS C | 0.1 | 0.1 | 0.61 | 0.61 |
| All Pedestrians | | 263 | 32.0 | LOS D | | | 0.75 | 0.75 |

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

# MOVEMENT SUMMARY

## Site: TCS167 [NEW_CRO_22_PM_Proposed Option]

## Network: N102 [PM_22_Proposed Option]

NEW_CRO_17_PM_X
Signals - Fixed Time Coordinated  Cycle Time = 110 seconds (User-Given Phase Times)

**Movement Performance - Vehicles**

| Mov ID | OD Mov | Demand Flows Total veh/h | HV % | Arrival Flows Total veh/h | HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Bellevue Road (S leg) | | | | | | | | | | | | | |
| 1b | L3 | 29 | 0.0 | 29 | 0.0 | 0.864 | 65.3 | LOS E | 12.0 | 86.4 | 1.00 | 0.98 | 26.5 |
| 1 | L2 | 171 | 4.1 | 171 | 4.1 | 0.864 | 64.5 | LOS E | 12.0 | 86.4 | 1.00 | 0.98 | 18.3 |
| 2 | T1 | 75 | 0.0 | 75 | 0.0 | 0.562 | 53.5 | LOS D | 5.0 | 35.1 | 1.00 | 0.78 | 28.8 |
| 3 | R2 | 18 | 0.0 | 18 | 0.0 | 0.562 | 58.1 | LOS E | 5.0 | 35.1 | 1.00 | 0.78 | 20.6 |
| Approach | | 293 | 2.4 | 293 | 2.4 | 0.864 | 61.4 | LOS E | 12.0 | 86.4 | 1.00 | 0.92 | 22.5 |
| East: New South Head Road (E leg) | | | | | | | | | | | | | |
| 4 | L2 | 40 | 0.0 | 40 | 0.0 | 0.254 | 24.4 | LOS B | 7.2 | 50.1 | 0.64 | 0.72 | 40.2 |
| 4a | L1 | 184 | 0.0 | 184 | 0.0 | 0.254 | 23.1 | LOS B | 7.2 | 50.1 | 0.64 | 0.72 | 40.7 |
| 5 | T1 | 1148 | 2.9 | 1148 | 2.9 | 0.613 | 21.6 | LOS B | 22.0 | 157.9 | 0.77 | 0.69 | 35.6 |
| Approach | | 1373 | 2.5 | 1373 | 2.5 | 0.613 | 21.9 | LOS B | 22.0 | 157.9 | 0.75 | 0.69 | 36.8 |
| North: Cross Street (N leg) | | | | | | | | | | | | | |
| 7 | L2 | 58 | 0.0 | 58 | 0.0 | 0.744 | 58.2 | LOS E | 9.9 | 69.6 | 1.00 | 0.89 | 20.4 |
| 8 | T1 | 121 | 0.8 | 121 | 0.8 | 0.744 | 53.7 | LOS D | 9.9 | 69.6 | 1.00 | 0.89 | 28.6 |
| 9a | R1 | 30 | 0.0 | 30 | 0.0 | 1.120 | 180.2 | LOS F | 7.7 | 53.8 | 1.00 | 1.31 | 14.2 |
| 9 | R2 | 40 | 0.0 | 40 | 0.0 | 1.120 | 182.1 | LOS F | 7.7 | 53.8 | 1.00 | 1.31 | 8.4 |
| Approach | | 249 | 0.4 | 249 | 0.4 | 1.120 | 90.6 | LOS F | 9.9 | 69.6 | 1.00 | 1.01 | 19.6 |
| West: New South Head Road (W leg) | | | | | | | | | | | | | |
| 10 | L2 | 35 | 0.0 | 35 | 0.0 | 0.481 | 6.3 | LOS A | 1.6 | 11.4 | 0.06 | 0.09 | 49.1 |
| 11 | T1 | 1040 | 1.8 | 1040 | 1.8 | 0.481 | 1.0 | LOS A | 1.6 | 11.4 | 0.06 | 0.07 | 50.6 |
| 12 | R2 | 130 | 1.5 | 130 | 1.5 | 0.648 | 25.3 | LOS B | 5.6 | 39.6 | 0.67 | 0.78 | 31.8 |
| 12b | R3 | 24 | 0.0 | 24 | 0.0 | 0.648 | 26.3 | LOS B | 5.6 | 39.6 | 0.67 | 0.78 | 32.0 |
| Approach | | 1229 | 1.7 | 1229 | 1.7 | 0.648 | 4.2 | LOS A | 5.6 | 39.6 | 0.14 | 0.16 | 40.6 |
| SouthWest: Kiaora Road (SW leg) | | | | | | | | | | | | | |
| 30b | L3 | 82 | 3.7 | 82 | 3.7 | 1.137 | 195.1 | LOS F | 9.3 | 67.4 | 1.00 | 1.37 | 7.8 |
| 30a | L1 | 84 | 0.0 | 84 | 0.0 | 0.242 | 45.2 | LOS D | 3.9 | 27.3 | 0.90 | 0.74 | 31.0 |
| 32a | R1 | 220 | 0.0 | 220 | 0.0 | 0.748 | 51.6 | LOS D | 12.5 | 87.4 | 0.99 | 0.89 | 21.0 |
| 32b | R3 | 15 | 0.0 | 15 | 0.0 | 0.748 | 53.7 | LOS D | 12.5 | 87.4 | 0.99 | 0.89 | 29.0 |
| Approach | | 401 | 0.7 | 401 | 0.7 | 1.137 | 79.7 | LOS F | 12.5 | 87.4 | 0.97 | 0.96 | 18.2 |
| All Vehicles | | 3545 | 1.9 | 3545 | 1.9 | 1.137 | 30.4 | LOS C | 22.0 | 157.9 | 0.60 | 0.58 | 27.9 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 3.8 %
Number of Iterations: 10 (maximum specified: 10)

| Movement Performance - Pedestrians | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Mov ID | Description | Demand Flow ped/h | Average Delay sec | Level of Service | Average Back of Queue Pedestrian ped | Distance m | Prop. Queued | Effective Stop Rate per ped |
| P1 | South Full Crossing | 53 | 15.9 | LOS B | 0.1 | 0.1 | 0.54 | 0.54 |
| P2 | East Full Crossing | 53 | 49.3 | LOS E | 0.2 | 0.2 | 0.95 | 0.95 |
| P3 | North Full Crossing | 53 | 15.9 | LOS B | 0.1 | 0.1 | 0.54 | 0.54 |
| P4 | West Full Crossing | 53 | 49.3 | LOS E | 0.2 | 0.2 | 0.95 | 0.95 |
| P8 | SouthWest Full Crossing | 53 | 15.9 | LOS B | 0.1 | 0.1 | 0.54 | 0.54 |
| All Pedestrians | | 263 | 29.2 | LOS C | | | 0.70 | 0.70 |

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

# MOVEMENT SUMMARY

## Site: TCS711 [NEW_KNO_22_AM_Exisiting Condition]

## Network: N101 [AM_22_Existing Condition]

NEW_KNO_17_AM_X
Signals - Fixed Time Coordinated  Cycle Time = 115 seconds (User-Given Phase Times)

**Movement Performance - Vehicles**

| Mov ID | OD Mov | Demand Flows Total veh/h | Demand Flows HV % | Arrival Flows Total veh/h | Arrival Flows HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | 95% Back of Queue Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East: New South Head Road (E leg) | | | | | | | | | | | | | |
| 5 | T1 | 1775 | 4.4 | 1759 | 4.4 | 0.894 | 14.6 | LOS B | 11.5 | 83.1 | 0.18 | 0.43 | 16.8 |
| 6 | R2 | 17 | 6.3 | 17 | 6.1 | 0.894 | 20.7 | LOS B | 10.4 | 75.5 | 0.18 | 0.45 | 36.3 |
| Approach | | 1792 | 4.5 | 1776 N1 | 4.4 | 0.894 | 14.7 | LOS B | 11.5 | 83.2 | 0.18 | 0.43 | 17.4 |
| North: Knox Street (N leg) | | | | | | | | | | | | | |
| 7 | L2 | 21 | 0.0 | 21 | 0.0 | 0.091 | 51.8 | LOS D | 1.0 | 7.3 | 0.90 | 0.70 | 20.9 |
| 9 | R2 | 62 | 3.4 | 62 | 3.4 | 0.547 | 58.4 | LOS E | 3.5 | 25.4 | 0.98 | 0.80 | 19.5 |
| Approach | | 83 | 2.5 | 83 | 2.5 | 0.547 | 56.8 | LOS E | 3.5 | 25.4 | 0.96 | 0.77 | 19.8 |
| West: New South Head Road (W leg) | | | | | | | | | | | | | |
| 10 | L2 | 54 | 3.9 | 54 | 3.9 | 0.046 | 5.9 | LOS A | 0.1 | 0.4 | 0.02 | 0.58 | 45.3 |
| 11 | T1 | 1339 | 9.0 | 1339 | 9.0 | 0.587 | 0.6 | LOS A | 1.9 | 14.1 | 0.05 | 0.05 | 56.5 |
| Approach | | 1393 | 8.8 | 1393 | 8.8 | 0.587 | 0.8 | LOS A | 1.9 | 14.1 | 0.05 | 0.07 | 54.6 |
| All Vehicles | | 3267 | 6.3 | 3252 N1 | 6.3 | 0.894 | 9.8 | LOS A | 11.5 | 83.2 | 0.14 | 0.28 | 27.4 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 29.6 %
Number of Iterations: 10 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

**Movement Performance - Pedestrians**

| Mov ID | Description | Demand Flow ped/h | Average Delay sec | Level of Service | Average Back of Queue Pedestrian ped | Average Back of Queue Distance m | Prop. Queued | Effective Stop Rate per ped |
|---|---|---|---|---|---|---|---|---|
| P2 | East Full Crossing | 53 | 51.8 | LOS E | 0.2 | 0.2 | 0.95 | 0.95 |
| P3 | North Full Crossing | 53 | 6.3 | LOS A | 0.1 | 0.1 | 0.33 | 0.33 |
| P4 | West Full Crossing | 53 | 51.8 | LOS E | 0.2 | 0.2 | 0.95 | 0.95 |
| All Pedestrians | | 158 | 36.6 | LOS D | | | 0.74 | 0.74 |

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

# MOVEMENT SUMMARY

## Site: TCS711 [NEW_KNO_22_AM_Proposed Option]

## Network: N101 [AM_22_Proposed Option]

NEW_KNO_17_AM_X
Signals - Fixed Time Coordinated  Cycle Time = 115 seconds (User-Given Phase Times)

**Movement Performance - Vehicles**

| Mov ID | OD Mov | Demand Flows Total veh/h | HV % | Arrival Flows Total veh/h | HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East: New South Head Road (E leg) | | | | | | | | | | | | | |
| 5 | T1 | 1775 | 4.4 | 1759 | 4.4 | 0.845 | 7.6 | LOS A | 6.7 | 48.5 | 0.13 | 0.34 | 25.8 |
| 6 | R2 | 1 | 100.0 | 1 | 100.0 | 0.845 | 12.0 | LOS A | 6.6 | 48.1 | 0.13 | 0.34 | 42.0 |
| Approach | | 1776 | 4.5 | 1760 N1 | 4.5 | 0.845 | 7.6 | LOS A | 6.7 | 48.6 | 0.13 | 0.34 | 25.9 |
| North: Knox Street (N leg) | | | | | | | | | | | | | |
| 7 | L2 | 21 | 0.0 | 21 | 0.0 | 0.091 | 51.8 | LOS D | 1.0 | 7.3 | 0.90 | 0.70 | 20.9 |
| 9 | R2 | 62 | 3.4 | 62 | 3.4 | 0.547 | 58.4 | LOS E | 3.5 | 25.4 | 0.98 | 0.80 | 19.5 |
| Approach | | 83 | 2.5 | 83 | 2.5 | 0.547 | 56.8 | LOS E | 3.5 | 25.4 | 0.96 | 0.77 | 19.8 |
| West: New South Head Road (W leg) | | | | | | | | | | | | | |
| 10 | L2 | 1 | 100.0 | 1 | 100.0 | 0.002 | 6.5 | LOS A | 0.0 | 0.0 | 0.02 | 0.57 | 44.4 |
| 11 | T1 | 1339 | 9.0 | 1339 | 9.0 | 0.587 | 0.6 | LOS A | 1.9 | 14.1 | 0.05 | 0.05 | 56.5 |
| Approach | | 1340 | 9.1 | 1340 | 9.1 | 0.587 | 0.6 | LOS A | 1.9 | 14.1 | 0.05 | 0.05 | 56.5 |
| All Vehicles | | 3199 | 6.4 | 3183 N1 | 6.4 | 0.845 | 5.9 | LOS A | 6.7 | 48.6 | 0.12 | 0.23 | 33.9 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 9.9 %
Number of Iterations: 10 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

**Movement Performance - Pedestrians**

| Mov ID | Description | Demand Flow ped/h | Average Delay sec | Level of Service | Average Back of Queue Pedestrian ped | Distance m | Prop. Queued | Effective Stop Rate per ped |
|---|---|---|---|---|---|---|---|---|
| P2 | East Full Crossing | 53 | 51.8 | LOS E | 0.2 | 0.2 | 0.95 | 0.95 |
| P3 | North Full Crossing | 53 | 6.3 | LOS A | 0.1 | 0.1 | 0.33 | 0.33 |
| P4 | West Full Crossing | 53 | 51.8 | LOS E | 0.2 | 0.2 | 0.95 | 0.95 |
| All Pedestrians | | 158 | 36.6 | LOS D | | | 0.74 | 0.74 |

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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# MOVEMENT SUMMARY

## Site: TCS711 [NEW_KNO_22_PM_Exisiting Condition]

## Network: N102 [PM_22_Existing Condition]

NEW_KNO_17_PM_X
Signals - Fixed Time Coordinated  Cycle Time = 110 seconds (User-Given Phase Times)

**Movement Performance - Vehicles**

| Mov ID | OD Mov | Demand Flows Total veh/h | Demand Flows HV % | Arrival Flows Total veh/h | Arrival Flows HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | 95% Back of Queue Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East: New South Head Road (E leg) | | | | | | | | | | | | | |
| 5 | T1 | 1431 | 3.1 | 1417 | 3.1 | 0.629 | 0.6 | LOS A | 2.1 | 15.2 | 0.06 | 0.06 | 53.2 |
| 6 | R2 | 31 | 0.0 | 30 | 0.0 | 0.629 | 5.9 | LOS A | 1.9 | 13.5 | 0.06 | 0.08 | 49.5 |
| Approach | | 1461 | 3.0 | 1447 N1 | 3.0 | 0.629 | 0.7 | LOS A | 2.1 | 15.2 | 0.06 | 0.06 | 52.7 |
| North: Knox Street (N leg) | | | | | | | | | | | | | |
| 7 | L2 | 52 | 2.0 | 52 | 2.0 | 0.203 | 49.3 | LOS D | 2.5 | 17.6 | 0.91 | 0.74 | 21.5 |
| 9 | R2 | 165 | 0.0 | 165 | 0.0 | 0.660 | 53.8 | LOS D | 8.7 | 60.9 | 0.99 | 0.83 | 20.4 |
| Approach | | 217 | 0.5 | 217 | 0.5 | 0.660 | 52.7 | LOS D | 8.7 | 60.9 | 0.97 | 0.81 | 20.7 |
| West: New South Head Road (W leg) | | | | | | | | | | | | | |
| 10 | L2 | 71 | 0.0 | 71 | 0.0 | 0.062 | 5.9 | LOS A | 0.1 | 0.6 | 0.02 | 0.58 | 45.4 |
| 11 | T1 | 1258 | 1.7 | 1258 | 1.7 | 0.701 | 1.9 | LOS A | 4.6 | 32.6 | 0.15 | 0.13 | 49.7 |
| Approach | | 1328 | 1.6 | 1328 | 1.6 | 0.701 | 2.1 | LOS A | 4.6 | 32.6 | 0.14 | 0.16 | 48.8 |
| All Vehicles | | 3006 | 2.2 | 2992 N1 | 2.2 | 0.701 | 5.1 | LOS A | 8.7 | 60.9 | 0.16 | 0.16 | 38.1 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 3.8 %
Number of Iterations: 10 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

**Movement Performance - Pedestrians**

| Mov ID | Description | Demand Flow ped/h | Average Delay sec | Level of Service | Average Back of Queue Pedestrian ped | Average Back of Queue Distance m | Prop. Queued | Effective Stop Rate per ped |
|---|---|---|---|---|---|---|---|---|
| P2 | East Full Crossing | 53 | 45.6 | LOS E | 0.1 | 0.1 | 0.91 | 0.91 |
| P3 | North Full Crossing | 53 | 7.3 | LOS A | 0.1 | 0.1 | 0.36 | 0.36 |
| P4 | West Full Crossing | 53 | 48.3 | LOS E | 0.2 | 0.2 | 0.94 | 0.94 |
| All Pedestrians | | 158 | 33.7 | LOS D | | | 0.74 | 0.74 |

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

# MOVEMENT SUMMARY

## Site: TCS711 [NEW_KNO_22_PM_Proposed Option]

## Network: N102 [PM_22_Proposed Option]

NEW_KNO_17_PM_X
Signals - Fixed Time Coordinated  Cycle Time = 110 seconds (User-Given Phase Times)

**Movement Performance - Vehicles**

| Mov ID | OD Mov | Demand Flows Total veh/h | Demand Flows HV % | Arrival Flows Total veh/h | Arrival Flows HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | 95% Back of Queue Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East: New South Head Road (E leg) | | | | | | | | | | | | | |
| 5 | T1 | 1431 | 3.1 | 1417 | 3.1 | 0.582 | 0.6 | LOS A | 1.7 | 12.5 | 0.05 | 0.05 | 54.5 |
| 6 | R2 | 1 | 0.0 | 1 | 0.0 | 0.582 | 5.8 | LOS A | 1.7 | 12.5 | 0.05 | 0.05 | 49.8 |
| Approach | | 1432 | 3.1 | 1418 N1 | 3.1 | 0.582 | 0.6 | LOS A | 1.7 | 12.5 | 0.05 | 0.05 | 54.4 |
| North: Knox Street (N leg) | | | | | | | | | | | | | |
| 7 | L2 | 52 | 2.0 | 52 | 2.0 | 0.203 | 49.3 | LOS D | 2.5 | 17.6 | 0.91 | 0.74 | 21.5 |
| 9 | R2 | 165 | 0.0 | 165 | 0.0 | 0.660 | 53.8 | LOS D | 8.7 | 60.9 | 0.99 | 0.83 | 20.4 |
| Approach | | 217 | 0.5 | 217 | 0.5 | 0.660 | 52.7 | LOS D | 8.7 | 60.9 | 0.97 | 0.81 | 20.7 |
| West: New South Head Road (W leg) | | | | | | | | | | | | | |
| 10 | L2 | 1 | 0.0 | 1 | 0.0 | 0.001 | 5.9 | LOS A | 0.0 | 0.0 | 0.02 | 0.58 | 45.4 |
| 11 | T1 | 1258 | 1.7 | 1258 | 1.7 | 0.701 | 1.9 | LOS A | 4.6 | 32.6 | 0.15 | 0.13 | 49.7 |
| Approach | | 1259 | 1.7 | 1259 | 1.7 | 0.701 | 1.9 | LOS A | 4.6 | 32.6 | 0.15 | 0.14 | 49.7 |
| All Vehicles | | 2907 | 2.3 | 2893 N1 | 2.3 | 0.701 | 5.1 | LOS A | 8.7 | 60.9 | 0.16 | 0.14 | 37.4 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 3.8 %
Number of Iterations: 10 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

**Movement Performance - Pedestrians**

| Mov ID | Description | Demand Flow ped/h | Average Delay sec | Level of Service | Average Back of Queue Pedestrian ped | Average Back of Queue Distance m | Prop. Queued | Effective Stop Rate per ped |
|---|---|---|---|---|---|---|---|---|
| P2 | East Full Crossing | 53 | 45.6 | LOS E | 0.1 | 0.1 | 0.91 | 0.91 |
| P3 | North Full Crossing | 53 | 7.3 | LOS A | 0.1 | 0.1 | 0.36 | 0.36 |
| P4 | West Full Crossing | 53 | 48.3 | LOS E | 0.2 | 0.2 | 0.94 | 0.94 |
| All Pedestrians | | 158 | 33.7 | LOS D | | | 0.74 | 0.74 |

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

# MOVEMENT SUMMARY

## Site: TCS223 [NEW_MAN_17_AM_Exisiting Condition]

## Network: N101 [AM_22_Existing Condition]

NEW_MAN_17_AM_X
Signals - Fixed Time Coordinated  Cycle Time = 115 seconds (User-Given Phase Times)

**Movement Performance - Vehicles**

| Mov ID | OD Mov | Demand Flows Total veh/h | HV % | Arrival Flows Total veh/h | HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Manning Road (S leg) | | | | | | | | | | | | | |
| 1 | L2 | 337 | 1.3 | 337 | 1.3 | 0.728 | 46.5 | LOS D | 17.6 | 124.1 | 0.97 | 0.87 | 22.2 |
| 3 | R2 | 89 | 0.0 | 89 | 0.0 | 0.440 | 56.9 | LOS E | 4.8 | 33.8 | 0.97 | 0.78 | 19.8 |
| Approach | | 426 | 1.0 | 426 | 1.0 | 0.728 | 48.7 | LOS D | 17.6 | 124.1 | 0.97 | 0.85 | 21.6 |
| East: New South Head Road (E leg) | | | | | | | | | | | | | |
| 4 | L2 | 68 | 0.0 | 68 | 0.0 | 0.970 | 46.8 | LOS D | 31.5 | 228.5 | 1.00 | 1.12 | 26.8 |
| 5 | T1 | 1852 | 5.0 | 1837 | 5.0 | 0.970 | 42.1 | LOS C | 31.5 | 228.5 | 1.00 | 1.13 | 10.7 |
| Approach | | 1920 | 4.8 | 1904 N1 | 4.8 | 0.970 | 42.3 | LOS C | 31.5 | 228.5 | 1.00 | 1.12 | 11.7 |
| West: New South Head Road (W leg) | | | | | | | | | | | | | |
| 11 | T1 | 841 | 9.4 | 841 | 9.4 | 0.410 | 4.9 | LOS A | 9.8 | 75.3 | 0.36 | 0.32 | 29.3 |
| 12 | R2 | 196 | 2.7 | 196 | 2.7 | 0.581 | 35.6 | LOS C | 8.6 | 61.7 | 0.86 | 0.79 | 27.3 |
| Approach | | 1037 | 8.1 | 1037 | 8.1 | 0.581 | 10.7 | LOS A | 9.8 | 75.3 | 0.45 | 0.41 | 28.0 |
| All Vehicles | | 3383 | 5.4 | 3368 N1 | 5.4 | 0.970 | 33.4 | LOS C | 31.5 | 228.5 | 0.83 | 0.87 | 16.3 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 29.6 %
Number of Iterations: 10 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

**Movement Performance - Pedestrians**

| Mov ID | Description | Demand Flow ped/h | Average Delay sec | Level of Service | Average Back of Queue Pedestrian ped | Distance m | Prop. Queued | Effective Stop Rate per ped |
|---|---|---|---|---|---|---|---|---|
| P1 | South Full Crossing | 53 | 12.2 | LOS B | 0.1 | 0.1 | 0.46 | 0.46 |
| P2 | East Full Crossing | 53 | 51.8 | LOS E | 0.2 | 0.2 | 0.95 | 0.95 |
| P4 | West Full Crossing | 53 | 51.8 | LOS E | 0.2 | 0.2 | 0.95 | 0.95 |
| All Pedestrians | | 158 | 38.6 | LOS D | | | 0.79 | 0.79 |

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

# MOVEMENT SUMMARY

## Site: TCS223 [NEW_MAN_17_AM_Proposed Option]

## Network: N101 [AM_22_Proposed Option]

NEW_MAN_17_AM_X
Signals - Fixed Time Coordinated  Cycle Time = 115 seconds (User-Given Phase Times)

**Movement Performance - Vehicles**

| Mov ID | OD Mov | Demand Flows Total veh/h | HV % | Arrival Flows Total veh/h | HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Manning Road (S leg) | | | | | | | | | | | | | |
| 1 | L2 | 337 | 1.3 | 337 | 1.3 | 0.728 | 46.5 | LOS D | 17.6 | 124.1 | 0.97 | 0.87 | 22.2 |
| 3 | R2 | 89 | 0.0 | 89 | 0.0 | 0.440 | 56.9 | LOS E | 4.8 | 33.8 | 0.97 | 0.78 | 19.8 |
| Approach | | 426 | 1.0 | 426 | 1.0 | 0.728 | 48.7 | LOS D | 17.6 | 124.1 | 0.97 | 0.85 | 21.6 |
| East: New South Head Road (E leg) | | | | | | | | | | | | | |
| 4 | L2 | 68 | 0.0 | 68 | 0.0 | 0.970 | 46.8 | LOS D | 31.5 | 228.5 | 1.00 | 1.12 | 26.8 |
| 5 | T1 | 1852 | 5.0 | 1837 | 5.0 | 0.970 | 42.1 | LOS C | 31.5 | 228.5 | 1.00 | 1.13 | 10.7 |
| Approach | | 1920 | 4.8 | 1904 N1 | 4.8 | 0.970 | 42.3 | LOS C | 31.5 | 228.5 | 1.00 | 1.12 | 11.7 |
| West: New South Head Road (W leg) | | | | | | | | | | | | | |
| 11 | T1 | 841 | 9.4 | 841 | 9.4 | 0.410 | 4.9 | LOS A | 9.8 | 75.3 | 0.36 | 0.32 | 29.3 |
| 12 | R2 | 196 | 2.7 | 196 | 2.7 | 0.581 | 35.6 | LOS C | 8.6 | 61.7 | 0.86 | 0.79 | 27.3 |
| Approach | | 1037 | 8.1 | 1037 | 8.1 | 0.581 | 10.7 | LOS A | 9.8 | 75.3 | 0.45 | 0.41 | 28.0 |
| All Vehicles | | 3383 | 5.4 | 3368 N1 | 5.4 | 0.970 | 33.4 | LOS C | 31.5 | 228.5 | 0.83 | 0.87 | 16.3 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 9.9 %
Number of Iterations: 10 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

**Movement Performance - Pedestrians**

| Mov ID | Description | Demand Flow ped/h | Average Delay sec | Level of Service | Average Back of Queue Pedestrian ped | Distance m | Prop. Queued | Effective Stop Rate per ped |
|---|---|---|---|---|---|---|---|---|
| P1 | South Full Crossing | 53 | 12.2 | LOS B | 0.1 | 0.1 | 0.46 | 0.46 |
| P2 | East Full Crossing | 53 | 51.8 | LOS E | 0.2 | 0.2 | 0.95 | 0.95 |
| P4 | West Full Crossing | 53 | 51.8 | LOS E | 0.2 | 0.2 | 0.95 | 0.95 |
| All Pedestrians | | 158 | 38.6 | LOS D | | | 0.79 | 0.79 |

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

# MOVEMENT SUMMARY

## Site: TCS223 [NEW_MAN_17_PM_Exisiting Condition]

## Network: N102 [PM_22_Existing Condition]

NEW_MAN_17_PM_X
Signals - Fixed Time Coordinated  Cycle Time = 110 seconds (User-Given Phase Times)

**Movement Performance - Vehicles**

| Mov ID | OD Mov | Demand Flows Total veh/h | HV % | Arrival Flows Total veh/h | HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Manning Road (S leg) | | | | | | | | | | | | | |
| 1 | L2 | 258 | 1.6 | 258 | 1.6 | 0.449 | 34.7 | LOS C | 10.8 | 76.0 | 0.82 | 0.80 | 25.9 |
| 3 | R2 | 105 | 0.0 | 105 | 0.0 | 0.459 | 53.3 | LOS D | 5.4 | 37.5 | 0.97 | 0.78 | 20.5 |
| Approach | | 363 | 1.2 | 363 | 1.2 | 0.459 | 40.1 | LOS C | 10.8 | 76.0 | 0.87 | 0.79 | 24.1 |
| East: New South Head Road (E leg) | | | | | | | | | | | | | |
| 4 | L2 | 96 | 0.0 | 95 | 0.0 | 0.193 | 8.2 | LOS A | 1.0 | 7.3 | 0.12 | 0.38 | 45.6 |
| 5 | T1 | 1164 | 2.1 | 1154 | 2.1 | 0.558 | 2.8 | LOS A | 4.5 | 31.7 | 0.16 | 0.17 | 45.0 |
| Approach | | 1260 | 1.9 | 1249 N1 | 1.9 | 0.558 | 3.3 | LOS A | 4.5 | 31.7 | 0.16 | 0.18 | 45.2 |
| West: New South Head Road (W leg) | | | | | | | | | | | | | |
| 11 | T1 | 1401 | 1.4 | 1401 | 1.4 | 0.546 | 6.8 | LOS A | 15.0 | 106.1 | 0.48 | 0.44 | 24.6 |
| 12 | R2 | 292 | 1.1 | 292 | 1.1 | 0.802 | 47.0 | LOS D | 15.0 | 106.1 | 1.00 | 1.09 | 23.8 |
| Approach | | 1693 | 1.4 | 1693 | 1.4 | 0.802 | 13.7 | LOS A | 15.0 | 106.1 | 0.57 | 0.55 | 24.1 |
| All Vehicles | | 3316 | 1.6 | 3305 N1 | 1.6 | 0.802 | 12.7 | LOS A | 15.0 | 106.1 | 0.45 | 0.44 | 28.6 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 3.8 %
Number of Iterations: 10 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

**Movement Performance - Pedestrians**

| Mov ID | Description | Demand Flow ped/h | Average Delay sec | Level of Service | Average Back of Queue Pedestrian ped | Distance m | Prop. Queued | Effective Stop Rate per ped |
|---|---|---|---|---|---|---|---|---|
| P1 | South Full Crossing | 53 | 14.3 | LOS B | 0.1 | 0.1 | 0.51 | 0.51 |
| P2 | East Full Crossing | 53 | 49.3 | LOS E | 0.2 | 0.2 | 0.95 | 0.95 |
| P4 | West Full Crossing | 53 | 49.3 | LOS E | 0.2 | 0.2 | 0.95 | 0.95 |
| All Pedestrians | | 158 | 37.6 | LOS D | | | 0.80 | 0.80 |

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

# MOVEMENT SUMMARY

## Site: TCS223 [NEW_MAN_17_PM_Proposed Option]

## Network: N102 [PM_22_Proposed Option]

NEW_MAN_17_PM_X
Signals - Fixed Time Coordinated  Cycle Time = 110 seconds (User-Given Phase Times)

**Movement Performance - Vehicles**

| Mov ID | OD Mov | Demand Flows Total veh/h | HV % | Arrival Flows Total veh/h | HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Manning Road (S leg) | | | | | | | | | | | | | |
| 1 | L2 | 258 | 1.6 | 258 | 1.6 | 0.449 | 34.7 | LOS C | 10.8 | 76.0 | 0.82 | 0.80 | 25.9 |
| 3 | R2 | 105 | 0.0 | 105 | 0.0 | 0.459 | 53.3 | LOS D | 5.4 | 37.5 | 0.97 | 0.78 | 20.5 |
| Approach | | 363 | 1.2 | 363 | 1.2 | 0.459 | 40.1 | LOS C | 10.8 | 76.0 | 0.87 | 0.79 | 24.1 |
| East: New South Head Road (E leg) | | | | | | | | | | | | | |
| 4 | L2 | 96 | 0.0 | 95 | 0.0 | 0.193 | 8.2 | LOS A | 1.0 | 7.3 | 0.12 | 0.38 | 45.6 |
| 5 | T1 | 1164 | 2.1 | 1154 | 2.1 | 0.558 | 2.8 | LOS A | 4.5 | 31.7 | 0.16 | 0.17 | 45.0 |
| Approach | | 1260 | 1.9 | 1249 N1 | 1.9 | 0.558 | 3.3 | LOS A | 4.5 | 31.7 | 0.16 | 0.18 | 45.2 |
| West: New South Head Road (W leg) | | | | | | | | | | | | | |
| 11 | T1 | 1401 | 1.4 | 1401 | 1.4 | 0.546 | 6.8 | LOS A | 15.0 | 106.1 | 0.48 | 0.44 | 24.6 |
| 12 | R2 | 292 | 1.1 | 292 | 1.1 | 0.802 | 47.0 | LOS D | 15.0 | 106.1 | 1.00 | 1.09 | 23.8 |
| Approach | | 1693 | 1.4 | 1693 | 1.4 | 0.802 | 13.7 | LOS A | 15.0 | 106.1 | 0.57 | 0.55 | 24.1 |
| All Vehicles | | 3316 | 1.6 | 3305 N1 | 1.6 | 0.802 | 12.7 | LOS A | 15.0 | 106.1 | 0.45 | 0.44 | 28.6 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 3.8 %
Number of Iterations: 10 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

**Movement Performance - Pedestrians**

| Mov ID | Description | Demand Flow ped/h | Average Delay sec | Level of Service | Average Back of Queue Pedestrian ped | Distance m | Prop. Queued | Effective Stop Rate per ped |
|---|---|---|---|---|---|---|---|---|
| P1 | South Full Crossing | 53 | 14.3 | LOS B | 0.1 | 0.1 | 0.51 | 0.51 |
| P2 | East Full Crossing | 53 | 49.3 | LOS E | 0.2 | 0.2 | 0.95 | 0.95 |
| P4 | West Full Crossing | 53 | 49.3 | LOS E | 0.2 | 0.2 | 0.95 | 0.95 |
| All Pedestrians | | 158 | 37.6 | LOS D | | | 0.80 | 0.80 |

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

# MOVEMENT SUMMARY

## Site: 1AM_BY [NEW_WIL_22_AM_Exisiting Condition]

## Network: N101 [AM_22_Existing Condition]

TCS 1430
Signals - Fixed Time Coordinated  Cycle Time = 115 seconds (Network Cycle Time - User-Given)

**Movement Performance - Vehicles**

| Mov ID | OD Mov | Demand Flows Total veh/h | HV % | Arrival Flows Total veh/h | HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: New South Head Road (S) | | | | | | | | | | | | | |
| 1 | L2 | 39 | 2.7 | 39 | 2.7 | 0.044 | 18.5 | LOS B | 0.8 | 5.7 | 0.39 | 0.65 | 30.4 |
| 2 | T1 | 1358 | 8.2 | 1358 | 8.2 | 0.729 | 18.3 | LOS B | 24.7 | 185.1 | 0.70 | 0.63 | 39.3 |
| Approach | | 1397 | 8.1 | 1397 | 8.1 | 0.729 | 18.3 | LOS B | 24.7 | 185.1 | 0.69 | 0.63 | 39.1 |
| North: New South Head Road (N) | | | | | | | | | | | | | |
| 8 | T1 | 1676 | 4.1 | 1676 | 4.1 | 0.592 | 6.5 | LOS A | 20.3 | 147.3 | 0.48 | 0.44 | 45.3 |
| 9 | R2 | 249 | 0.4 | 249 | 0.4 | 0.545 | 39.0 | LOS C | 11.8 | 83.1 | 0.93 | 0.96 | 23.2 |
| Approach | | 1925 | 3.6 | 1925 | 3.6 | 0.592 | 10.7 | LOS A | 20.3 | 147.3 | 0.54 | 0.51 | 39.3 |
| West: William Street | | | | | | | | | | | | | |
| 10 | L2 | 301 | 1.7 | 301 | 1.7 | 0.186 | 4.8 | LOS A | 1.1 | 7.8 | 0.13 | 0.51 | 47.9 |
| 12 | R2 | 27 | 11.5 | 27 | 11.5 | 0.143 | 55.6 | LOS D | 1.4 | 11.0 | 0.93 | 0.72 | 6.1 |
| Approach | | 328 | 2.6 | 328 | 2.6 | 0.186 | 9.0 | LOS A | 1.4 | 11.0 | 0.20 | 0.53 | 41.8 |
| All Vehicles | | 3651 | 5.2 | 3651 | 5.2 | 0.729 | 13.5 | LOS A | 24.7 | 185.1 | 0.56 | 0.56 | 39.4 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 29.6 %
Number of Iterations: 10 (maximum specified: 10)

**Movement Performance - Pedestrians**

| Mov ID | Description | Demand Flow ped/h | Average Delay sec | Level of Service | Average Back of Queue Pedestrian ped | Distance m | Prop. Queued | Effective Stop Rate per ped |
|---|---|---|---|---|---|---|---|---|
| P1 | South Full Crossing | 53 | 51.8 | LOS E | 0.2 | 0.2 | 0.95 | 0.95 |
| P3 | North Full Crossing | 53 | 51.8 | LOS E | 0.2 | 0.2 | 0.95 | 0.95 |
| P4 | West Full Crossing | 53 | 16.7 | LOS B | 0.1 | 0.1 | 0.54 | 0.54 |
| P4S | West Slip/Bypass Lane Crossing | 53 | 14.2 | LOS B | 0.1 | 0.1 | 0.50 | 0.50 |
| All Pedestrians | | 211 | 33.6 | LOS D | | | 0.73 | 0.73 |

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

# MOVEMENT SUMMARY

## Site: 1AM_BY [NEW_WIL_22_AM_Proposed Option]

## Network: N101 [AM_22_Proposed Option]

TCS 1430
Signals - Fixed Time Coordinated  Cycle Time = 115 seconds (Network Cycle Time - User-Given)

**Movement Performance - Vehicles**

| Mov ID | OD Mov | Demand Flows Total veh/h | HV % | Arrival Flows Total veh/h | HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: New South Head Road (S) | | | | | | | | | | | | | |
| 1 | L2 | 39 | 2.7 | 39 | 2.7 | 0.045 | 19.4 | LOS B | 0.8 | 5.9 | 0.40 | 0.65 | 29.8 |
| 2 | T1 | 1358 | 8.2 | 1358 | 8.2 | 0.755 | 20.0 | LOS B | 26.6 | 199.5 | 0.74 | 0.67 | 38.1 |
| Approach | | 1397 | 8.1 | 1397 | 8.1 | 0.755 | 20.0 | LOS B | 26.6 | 199.5 | 0.73 | 0.67 | 37.9 |
| North: New South Head Road (N) | | | | | | | | | | | | | |
| 8 | T1 | 1676 | 4.1 | 1676 | 4.1 | 0.592 | 6.5 | LOS A | 20.3 | 147.3 | 0.48 | 0.44 | 45.3 |
| 9 | R2 | 266 | 0.8 | 266 | 0.8 | 0.555 | 40.4 | LOS C | 12.4 | 87.5 | 0.92 | 0.97 | 22.7 |
| Approach | | 1942 | 3.6 | 1942 | 3.6 | 0.592 | 11.2 | LOS A | 20.3 | 147.3 | 0.54 | 0.52 | 38.8 |
| West: William Street | | | | | | | | | | | | | |
| 10 | L2 | 301 | 1.7 | 301 | 1.7 | 0.186 | 4.8 | LOS A | 1.1 | 7.8 | 0.13 | 0.51 | 47.9 |
| 12 | R2 | 27 | 11.5 | 27 | 11.5 | 0.143 | 55.6 | LOS D | 1.4 | 11.0 | 0.93 | 0.72 | 6.1 |
| Approach | | 328 | 2.6 | 328 | 2.6 | 0.186 | 9.0 | LOS A | 1.4 | 11.0 | 0.20 | 0.53 | 41.8 |
| All Vehicles | | 3667 | 5.2 | 3667 | 5.2 | 0.755 | 14.3 | LOS A | 26.6 | 199.5 | 0.58 | 0.58 | 38.6 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 9.9 %
Number of Iterations: 10 (maximum specified: 10)

**Movement Performance - Pedestrians**

| Mov ID | Description | Demand Flow ped/h | Average Delay sec | Level of Service | Average Back of Queue Pedestrian ped | Distance m | Prop. Queued | Effective Stop Rate per ped |
|---|---|---|---|---|---|---|---|---|
| P1 | South Full Crossing | 53 | 51.8 | LOS E | 0.2 | 0.2 | 0.95 | 0.95 |
| P3 | North Full Crossing | 53 | 51.8 | LOS E | 0.2 | 0.2 | 0.95 | 0.95 |
| P4 | West Full Crossing | 53 | 17.8 | LOS B | 0.1 | 0.1 | 0.56 | 0.56 |
| P4S | West Slip/Bypass Lane Crossing | 53 | 15.2 | LOS B | 0.1 | 0.1 | 0.51 | 0.51 |
| All Pedestrians | | 211 | 34.1 | LOS D | | | 0.74 | 0.74 |

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

# MOVEMENT SUMMARY

## Site: 1PM_BY [NEW_WIL_22_PM_Exisiting Condition]

## Network: N102 [PM_22_Existing Condition]

TCS 1430
Signals - Fixed Time Coordinated  Cycle Time = 110 seconds (Network Cycle Time - User-Given)

**Movement Performance - Vehicles**

| Mov ID | OD Mov | Demand Flows Total veh/h | HV % | Arrival Flows Total veh/h | HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: New South Head Road (S) | | | | | | | | | | | | | |
| 1 | L2 | 36 | 0.0 | 36 | 0.0 | 0.040 | 20.8 | LOS B | 0.9 | 6.3 | 0.50 | 0.67 | 28.9 |
| 2 | T1 | 1375 | 1.5 | 1375 | 1.5 | 0.712 | 20.6 | LOS B | 28.0 | 198.8 | 0.80 | 0.73 | 37.7 |
| Approach | | 1411 | 1.5 | 1411 | 1.5 | 0.712 | 20.6 | LOS B | 28.0 | 198.8 | 0.79 | 0.73 | 37.5 |
| North: New South Head Road (N) | | | | | | | | | | | | | |
| 8 | T1 | 1331 | 2.8 | 1331 | 2.8 | 0.479 | 6.2 | LOS A | 14.3 | 102.2 | 0.44 | 0.40 | 45.8 |
| 9 | R2 | 212 | 0.5 | 212 | 0.5 | 0.504 | 38.4 | LOS C | 9.8 | 69.0 | 0.93 | 0.92 | 23.4 |
| Approach | | 1542 | 2.5 | 1542 | 2.5 | 0.504 | 10.6 | LOS A | 14.3 | 102.2 | 0.51 | 0.47 | 39.4 |
| West: William Street | | | | | | | | | | | | | |
| 10 | L2 | 397 | 0.0 | 397 | 0.0 | 0.244 | 4.8 | LOS A | 1.5 | 10.8 | 0.15 | 0.52 | 47.9 |
| 12 | R2 | 45 | 0.0 | 45 | 0.0 | 0.195 | 52.0 | LOS D | 2.2 | 15.6 | 0.93 | 0.73 | 6.4 |
| Approach | | 442 | 0.0 | 442 | 0.0 | 0.244 | 9.7 | LOS A | 2.2 | 15.6 | 0.23 | 0.54 | 40.9 |
| All Vehicles | | 3395 | 1.7 | 3395 | 1.7 | 0.712 | 14.7 | LOS B | 28.0 | 198.8 | 0.59 | 0.59 | 38.6 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 3.8 %
Number of Iterations: 10 (maximum specified: 10)

**Movement Performance - Pedestrians**

| Mov ID | Description | Demand Flow ped/h | Average Delay sec | Level of Service | Average Back of Queue Pedestrian ped | Distance m | Prop. Queued | Effective Stop Rate per ped |
|---|---|---|---|---|---|---|---|---|
| P1 | South Full Crossing | 53 | 49.3 | LOS E | 0.2 | 0.2 | 0.95 | 0.95 |
| P3 | North Full Crossing | 53 | 49.3 | LOS E | 0.2 | 0.2 | 0.95 | 0.95 |
| P4 | West Full Crossing | 53 | 16.4 | LOS B | 0.1 | 0.1 | 0.55 | 0.55 |
| P4S | West Slip/Bypass Lane Crossing | 53 | 13.8 | LOS B | 0.1 | 0.1 | 0.50 | 0.50 |
| All Pedestrians | | 211 | 32.2 | LOS D | | | 0.74 | 0.74 |

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

# MOVEMENT SUMMARY

## Site: 1PM_BY [NEW_WIL_22_PM_Proposed Option]

## Network: N102 [PM_22_Proposed Option]

TCS 1430
Signals - Fixed Time Coordinated  Cycle Time = 110 seconds (Network Cycle Time - User-Given)

**Movement Performance - Vehicles**

| Mov ID | OD Mov | Demand Flows Total veh/h | HV % | Arrival Flows Total veh/h | HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: New South Head Road (S) | | | | | | | | | | | | | |
| 1 | L2 | 36 | 0.0 | 36 | 0.0 | 0.041 | 21.4 | LOS B | 0.9 | 6.5 | 0.52 | 0.67 | 28.5 |
| 2 | T1 | 1375 | 1.5 | 1375 | 1.5 | 0.724 | 21.6 | LOS B | 28.7 | 203.8 | 0.82 | 0.74 | 37.0 |
| Approach | | 1411 | 1.5 | 1411 | 1.5 | 0.724 | 21.6 | LOS B | 28.7 | 203.8 | 0.81 | 0.74 | 36.8 |
| North: New South Head Road (N) | | | | | | | | | | | | | |
| 8 | T1 | 1331 | 2.8 | 1331 | 2.8 | 0.473 | 5.8 | LOS A | 13.8 | 98.6 | 0.43 | 0.39 | 46.6 |
| 9 | R2 | 242 | 0.4 | 242 | 0.4 | 0.539 | 39.6 | LOS C | 11.0 | 77.4 | 0.92 | 0.95 | 23.0 |
| Approach | | 1573 | 2.4 | 1573 | 2.4 | 0.539 | 11.0 | LOS A | 13.8 | 98.6 | 0.50 | 0.47 | 39.0 |
| West: William Street | | | | | | | | | | | | | |
| 10 | L2 | 397 | 0.0 | 397 | 0.0 | 0.244 | 4.8 | LOS A | 1.5 | 10.8 | 0.15 | 0.52 | 47.9 |
| 12 | R2 | 45 | 0.0 | 45 | 0.0 | 0.209 | 53.1 | LOS D | 2.3 | 15.8 | 0.94 | 0.74 | 6.3 |
| Approach | | 442 | 0.0 | 442 | 0.0 | 0.244 | 9.8 | LOS A | 2.3 | 15.8 | 0.23 | 0.54 | 40.7 |
| All Vehicles | | 3425 | 1.7 | 3425 | 1.7 | 0.724 | 15.2 | LOS B | 28.7 | 203.8 | 0.60 | 0.59 | 38.0 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 3.8 %
Number of Iterations: 10 (maximum specified: 10)

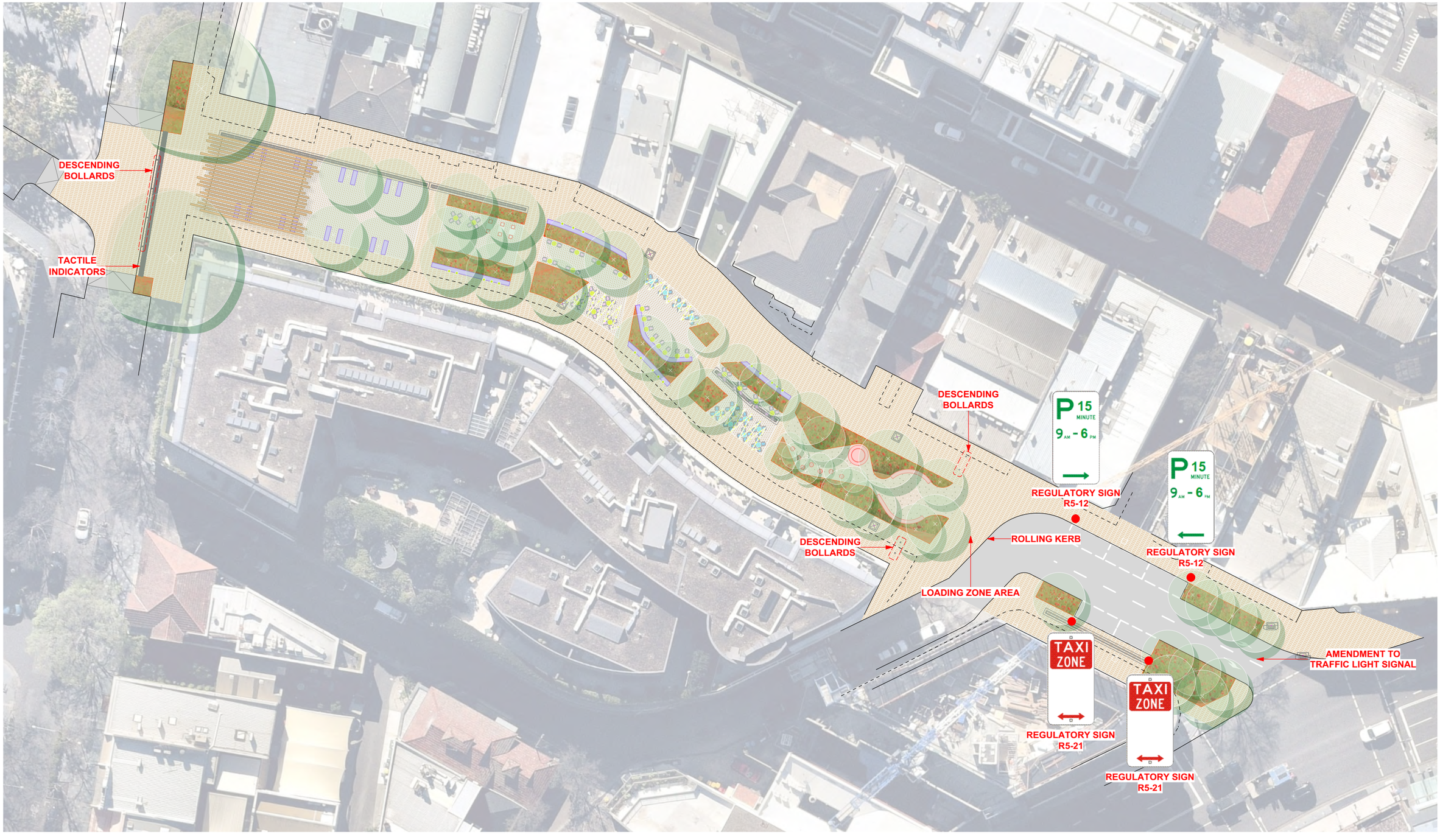
**Movement Performance - Pedestrians**

| Mov ID | Description | Demand Flow ped/h | Average Delay sec | Level of Service | Average Back of Queue Pedestrian ped | Distance m | Prop. Queued | Effective Stop Rate per ped |
|---|---|---|---|---|---|---|---|---|
| P1 | South Full Crossing | 53 | 49.3 | LOS E | 0.2 | 0.2 | 0.95 | 0.95 |
| P3 | North Full Crossing | 53 | 49.3 | LOS E | 0.2 | 0.2 | 0.95 | 0.95 |
| P4 | West Full Crossing | 53 | 17.0 | LOS B | 0.1 | 0.1 | 0.56 | 0.56 |
| P4S | West Slip/Bypass Lane Crossing | 53 | 14.3 | LOS B | 0.1 | 0.1 | 0.51 | 0.51 |
| All Pedestrians | | 211 | 32.4 | LOS D | | | 0.74 | 0.74 |

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.


SCT
Consulting

# Knox Street Plaza Traffic Plan



## Appendix D – Geotechnical Assessment

REPORT TO

**ASPECT STUDIOS**

ON

**GEOTECHNICAL ASSESSMENT**

FOR

**PROPOSED KNOX STREET PLAZA**

AT

**KNOX STREET, DOUBLE BAY, NSW**

Date: 10 September 2021
Ref: 34387BFrpt


JKGeotechnics
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Report prepared by:

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Associate | Geotechnical Engineer

Report reviewed by:

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Principal | Geotechnical Engineer

For and on behalf of
JK GEOTECHNICS
PO BOX 976
NORTH RYDE BC NSW 1670

## DOCUMENT REVISION RECORD

| Report Reference | Report Status | Report Date |
|---|---|---|
| 34387BFrpt | Final Report | 10 September 2021 |
| | | |
| | | |

# Table of Contents



**ATTACHMENTS**

# 1 INTRODUCTION

This report presents the results of a geotechnical assessment for the proposed Knox Street Plaza at Knox Street, Double Bay, NSW. The location of the site is shown in Figure 1. The assessment was commissioned by Mr Matthew Shaw of ??? by email dated 12 August 2021 and was carried out in accordance with our fee proposal, Ref: P54491BF, dated 1 July 2021.

We understand from the supplied documents that it is proposed to redevelop Knox Street into a pedestrian plaza between Bay Street and Goldman Lane with the remainder of Knox Street to New South Head Road to be a one lane street . We understand that the road pavement will be replaced with pavers and new and/or upgrade poles and other streetscape features, such as seating and planters, will be installed. From a geotechnical perspective, we expect relatively minor subsurface work as the redevelopment will essentially be constructed at existing grade.

The purpose of the assessment was to review available information from previous investigations carried out in the vicinity of the site to assess the likely subsurface conditions as a basis for comments and recommendations on excavation conditions, excavation support, footings and subgrade preparation.

# 2 ASSESSMENT PROCEDURE

The assessment comprised:

- A site walkover by our Associate Geotechnical Engineer on 7 September 2021.
- A search of the JK Geotechnics project database to identify relevant geotechnical investigations completed nearby.
- A review of aerial photography and digital street view (NearMap and Google Earth).
- A review of the regional geology maps.

No subsurface investigations were carried out as part of this assessment.

# 3 RESULTS OF ASSESSMENT

## 3.1 Site Description

The site is located in relatively low lying topography associated with the foreshore of Sydney Harbour to the north. The site initially has a gentle slope down from its eastern end and then flattens for the majority of the remainder of the site. The site is bound by New South Head Road to the east and Bay Street to the west.

The street is typically lined by one to five storey buildings that generally appear to be in good condition based on a cursory inspection from the street frontage. The roadway comprises an asphaltic concrete (AC) pavement that appears in moderate condition with occasional minor cracking observed. At some locations median gardens are present containing hedges and medium sized trees, particularly at each end of the road.

The footpath either side of the road comprise concrete pavers, with light poles, planters and other street furniture.

### 3.2 Inferred Subsurface Conditions

The Geological Map of Sydney (Geological Series Sheet 9130, Scale 1:100,000, 1983), published by the Department of Mineral Resources indicates that the site is mapped to be underlain by man-made fill overlying Quarternary age alluvial and estuarine soils consisting of medium to fine grained "marine" sand with podsols.

We have carried out geotechnical investigations within various sites to the east, west and south of Knox Street. Based on the results of those investigations , we expect that the subsurface profile would comprise sandy fill possibly to depths of about 1.5m covering natural silty sand and then sandstone bedrock at considerable depth. Fill would also be present associated with the buried services that run below the road and footpath. Within our previous investigations, the natural sands were generally initially of very loose to loose relative density but improved to be of medium dense relative density around 2m to 2.5m depth. We expect the groundwater table to be relatively high at around RL1.0m.

## 4 COMMENTS AND RECOMMENDATIONS

The comments and recommendations provided below are based on an assumed subsurface profile as detailed above. The subsurface profile must be confirmed at the very least by inspection and testing of the conditions encountered during construction.

### 4.1 Excavation Conditions

Prior to any excavation commencing we recommend that reference be made to the latest version (currently January 2020 at the time of this report) of NSW Government "Code of Practice Excavation Work".

Based on the supplied information, we anticipate that relatively minor excavations will be required, say typically less than 1m depth, primarily for the installation of buried services and construction of high level footings. Based on the results of the assessment, we expect that the excavations will encounter sandy soils, predominantly fill but some natural sands may be encountered. Excavation of these soils will be possible using the bucket of a small hydraulic excavator.

If any demolition occurs that may require the removal of concrete, then percussive techniques may be required, such as the use of a hydraulic hammer. Where percussive excavation techniques are adopted there is the risk that transmitted vibrations may damage the existing buildings either side of the road or other nearby movement sensitive structures.

Consequently, care must be taken when using rock breakers during demolition so that ground vibrations do not adversely affect nearby neighbouring structures. Due to the close proximity of the adjoining buildings our preference for this site would be not to use rock breakers and use low vibration emitting equipment,

such as saw cutting the concrete and then lifting with a bucket or ripping hook. If hammers are to be used, we recommend that vibrations transmitted to the adjoining buildings be monitored at all times while the rock breakers are being used to confirm that peak particle velocities fall within acceptable limits. We recommend that a peak particle velocity limit of 5mm/sec be adopted. We note that this vibration limit will reduce the risk of vibration damage to the neighbouring buildings, but these vibrations may still result in discomfort to occupants of the neighbouring buildings. If excessive vibrations are occurring, it will be necessary to use lower energy equipment such as smaller rock breakers or rock saws on hydraulic excavators. Reference should be made to the attached Vibration Emission Design Goals for further information.

### 4.2 Excavation Batters

Where sandy soils are present and space allows, we recommend temporary batters formed through the soils be no steeper than 1 Vertical (V) to 1.5 Horizontal (H). If the excavation depths are less than 1m and no structures are present behind the excavation, then steeper excavation sides may be possible, but some slumping of the sides may occur.

Due to the presence of collapsible sandy soils, care must be taken to not undermine any nearby footings and if excavations are proposed close to existing structures additional geotechnical advice should be obtained.

For the excavation of service trenches the use of shoring boxes could be used to avoid the use of batters.

### 4.3 Footings

We expect that only lightly loaded footings will be required for the proposed plaza, such as for landscape walls and light/smart poles. For lightly loaded footings where the required Allowable Bearing Pressure (ABP) is less than 50kPa, then it would likely be feasible to adopt high level pad or strip footings founded on the existing fill provided the base of the footing is moistened and recompacted following excavation using a 'wacker-packer' or similar. However, Council will need to accept the risk that some settlement of the fill may occur under the footings requiring future repairs to the structures. This risk can be reduced by adopted a low bearing pressure and compacting the base of the excavation as recommended above. In addition, we recommend that the excavations be inspected by a geotechnical engineer and Dynamic Cone Penetration (DCP) tests carried out to assess the fill compaction. If particularly low results are measured during such testing those particular locations may require treatment, such as deepening of the footing excavation or excavation and recompaction of the fill.

Where higher bearing pressures are required or the risk of settlement is to be further reduced, then we consider that piled footings will likely be required founded below the fill and within the natural sands. If the piles are relatively short, say no more than 2m deep, then bored piles may be feasible. Otherwise, the piles may need to be drilled using Continuous Flight Auger (CFA) techniques. If bored piles are being considered, then we recommend a trial pier be drilled to confirm feasibility.

Where such piles are required, a geotechnical investigation should be carried out to determine the depth to the natural sand and the relative density to assess the appropriate bearing pressure. We note that the bearing capacity of sand is dependent not only on the sand density, but also on the footing geometry, i.e. pile diameter and embedment depth. As a guide, piles which are installed to a depth of 2m or four times the pile diameter (whichever is the deepest) into sands of at least loose to medium dense relative density an allowable bearing pressure of 150kPa would be appropriate.

Once footing loads are known, then further advice can be provided on the most appropriate footing type and design parameters.

### 4.4 Subgrade Preparation

We expect that pavements will be constructed, both pavers within pedestrian areas and possibly a new road pavement at the eastern end. The following subgrade preparation works would be expected, but must be confirmed once exact details are known.

Earthworks recommendations presented below should be complemented by reference to AS3798.

Within soil subgrade areas where paved areas are to be constructed and in any areas of proposed fill, subgrade preparation should consist of the following:

- Remove any existing grass cover, topsoil and root affected material. This is likely to be limited to within the median garden beds.
- Proof roll the subgrade with a smooth drum vibratory roller to achieve a minimum density index ($I_D$) of 70% for the sandy soils. The size of the roller that can be used will depend on site access but preferably should be a minimum 6 tonnes. The main objective of the proof rolling is to assist in detection of any soft or heaving areas and to improve the state of compaction of the near surface fill materials.
- Proof rolling should be closely monitored by the site supervisor to detect soft or unstable areas, with the final pass inspected by a geotechnical engineer to identify such weak areas.
- Any weak areas detected should be locally excavated to a sound base and the material replaced with engineered fill, or as directed by the geotechnical engineer during the inspection.
- Care should also be taken when using vibrating equipment not to cause damage to adjacent existing structures. If there is any cause for concern then proof rolling should cease and further geotechnical advice sought. Alternatively, where appropriate, the static (non-vibration) mode may be used.

Where engineered fill is required, it should be free from organic materials, other contaminants and deleterious substances, and have a maximum particle size not exceeding 40mm. From a geotechnical perspective, we expect the excavated soils may be re-used as engineered fill, but this should be confirmed by inspection of the excavated material by a geotechnical engineer. Engineered fill should be placed in layers of maximum 200mm loose thickness, but should be reduced to 100mm if lightweight equipment is used. The fill should be compacted with the above mentioned roller to achieve a minimum $I_D$ of 70% for the sandy soils.

Where other granular fill is used, such as crushed sandstone, it should be compacted to a density of at least 98% of Standard Maximum Dry Density (SMDD).

To confirm the above specification has been achieved, density tests should be carried out at a frequency of one test per layer per 200m$^2$ or three tests per visit, whichever requires the most tests, for general fill and one test per 2 layers per 50m$^2$ for retaining wall backfill and backfill to soft or heaving areas. At least Level 2 testing of earthworks should be carried out in accordance with AS3798. Any areas of insufficient compaction will require reworking.

If new pavements are required, then we recommend that a geotechnical investigation be carried out and bulk samples of the soils obtained to undertake CBR tests to confirm the pavement design parameters. Given the inferred sandy soils, we envisage that a CBR value of at least 5% should be achievable but must be confirmed by CBR testing.

### 4.5 Further Geotechnical Input

The following is a summary of the further geotechnical input which is required and which has been detailed in the preceding sections of this report:

- Geotechnical investigation once details of the proposed structures are known, including CBR testing to assess pavement design parameters.
- Quantitative vibration monitoring if percussive equipment used.
- Testing and inspection of footing excavations.
- Inspection of proof rolling of soil subgrade.
- Density testing to confirm fill compaction.

## 5 GENERAL COMMENTS

The recommendations presented in this report include specific issues to be addressed during the detailed design and construction phases of the project. In the event that any of the detailed design or construction phase recommendations presented in this report are not implemented, the general recommendations may become inapplicable and JK Geotechnics accept no responsibility whatsoever for the performance of the structure where recommendations are not implemented in full and properly tested, inspected and documented.

The long term successful performance of floor slabs and pavements is dependent on the satisfactory completion of the earthworks. In order to achieve this, the quality assurance program should not be limited to routine compaction density testing only. Other critical factors associated with the earthworks may include subgrade preparation, selection of fill materials, control of moisture content and drainage, etc. The satisfactory control and assessment of these items may require judgment from an experienced engineer. Such judgment often cannot be made by a technician who may not have formal engineering qualifications

and experience. In order to identify potential problems, we recommend that a pre-construction meeting be held so that all parties involved understand the earthworks requirements and potential difficulties. This meeting should clearly define the lines of communication and responsibility.

This report provides advice on geotechnical aspects for the proposed civil and structural design. As part of the documentation stage of this project, Contract Documents and Specifications may be prepared based on our report. However, there may be design features we are not aware of or have not commented on for a variety of reasons. The designers should satisfy themselves that all the necessary advice has been obtained. If required, we could be commissioned to review the geotechnical aspects of contract documents to confirm the intent of our recommendations has been correctly implemented.

A waste classification is required for any soil and/or bedrock excavated from the site prior to offsite disposal. Subject to the appropriate testing, material can be classified as Virgin Excavated Natural Material (VENM), Excavated Natural Material (ENM), General Solid, Restricted Solid or Hazardous Waste. Analysis can take up to seven to ten working days to complete, therefore, an adequate allowance should be included in the construction program unless testing is completed prior to construction. If contamination is encountered, then substantial further testing (and associated delays) could be expected. We strongly recommend that this requirement is addressed prior to the commencement of excavation on site.


AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

This plan should be read in conjunction with the JK Geotechnics report.

Title: **SITE LOCATION PLAN**

Location: KNOX STREET, DOUBLE BAY, NSW

Report No: 34387BF

Figure No: 1

JKGeotechnics

PLOT DATE: 9/09/2021 3:09:35 PM DWG FILE: Y:\34000'S\34387BF DOUBLE BAY\CAD\34387BF DWG

# VIBRATION EMISSION DESIGN GOALS

German Standard DIN 4150 – Part 3: 1999 provides guideline levels of vibration velocity for evaluating the effects of vibration in structures. The limits presented in this standard are generally recognised to be conservative.

The DIN 4150 values (maximum levels measured in any direction at the foundation, OR, maximum levels measured in (x) or (y) horizontal directions, in the plane of the uppermost floor), are summarised in Table 1 below.

It should be noted that peak vibration velocities higher than the minimum figures in Table 1 for low frequencies may be quite 'safe', depending on the frequency content of the vibration and the actual condition of the structure.

It should also be noted that these levels are 'safe limits', up to which no damage due to vibration effects has been observed for the particular class of building. 'Damage' is defined by DIN 4150 to include even minor non-structural effects such as superficial cracking in cement render, the enlargement of cracks already present, and the separation of partitions or intermediate walls from load bearing walls. Should damage be observed at vibration levels lower than the 'safe limits', then it may be attributed to other causes. DIN 4150 also states that when vibration levels higher than the 'safe limits' are present, it does not necessarily follow that damage will occur. Values given are only a broad guide.

**Table 1: DIN 4150 – Structural Damage – Safe Limits for Building Vibration**

| Group | Type of Structure | Peak Vibration Velocity in mm/s | | | |
|---|---|---|---|---|---|
| | | At Foundation Level at a Frequency of: | | | Plane of Floor of Uppermost Storey |
| | | Less than 10Hz | 10Hz to 50Hz | 50Hz to 100Hz | All Frequencies |
| 1 | Buildings used for commercial purposes, industrial buildings and buildings of similar design. | 20 | 20 to 40 | 40 to 50 | 40 |
| 2 | Dwellings and buildings of similar design and/or use. | 5 | 5 to 15 | 15 to 20 | 15 |
| 3 | Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Group 1 and 2 and have intrinsic value (eg. buildings that are under a preservation order). | 3 | 3 to 8 | 8 to 10 | 8 |

**Note:** For frequencies above 100Hz, the higher values in the 50Hz to 100Hz column should be used.

# Appendix E – Flood Assessment

Catchment Simulation Solutions

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Suite 1, Level 10
70 Phillip Street
SYDNEY NSW 2000

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(02) 8355 5505
admin@csse.com.au

Caitlin Moffat
**Woollahra Municipal Council**
536 New South Head Road
Double Bay, NSW 2028

17th January, 2022

Dear Caitlin,

**Knox Street, Double Bay**
**Flood Assessment for Knox St Pedestrian Plaza**

Further to recent discussions, I am pleased to advise that we have completed a flood investigation for the proposed pedestrian plaza works across part sections of Knox St and Bay St at Double Bay. The following report summarises the outcomes of the assessment.

## Background

Woollahra Municipal Council is planning to carry out works on Knox St and Bay St, Double Bay to create a pedestrian plaza with limited vehicular access. These works will include raising portions of Knox St, additional landscaping and plantings, and the construction of a raised pedestrian zone on Bay St between Knox St and Guilfoyle Park.

Part sections of Knox Street and Bay Street are known to be impacted by flooding. Therefore, a flood assessment was requested by Council to assess the impact that the proposed land use and topographic changes may have on existing flood behaviour.

## Existing Flood Behaviour

Existing design flood behaviour within the local catchment was most recently defined as part of the '*Double Bay Floodplain Risk Management Study and Plan*' (Bewsher Consulting, 2011). The study employed a DRAINS model to define hydrology across the catchment, and a 2D TUFLOW hydraulic model to define flood behaviour across the lower portion of the catchment.

The models used as part of the '*Double Bay Floodplain Risk Management Study and Plan*' (Bewsher Consulting, 2011) were also used as part of the current study. However, updates to the TUFLOW hydraulic model were first undertaken to provide an improved representation of existing conditions in the vicinity of the proposed works. This involved incorporating detailed survey of the full length of Knox St collected by Veris (survey dated 23/09/2021). Survey of the intersection of Knox St/Bay St/Guilfoyle Ave was also provided by Woollahra Municipal Council to ensure existing flood behaviour at the intersection was reliably defined.

The updated TUFLOW model was then used to simulate the design 5% and 1% AEP floods to define the base-case (existing conditions) flood behaviour. The 5% AEP and 1%AEP flood depths and levels across the study area are presented in **Plate 1** and **Plate 2** respectively.

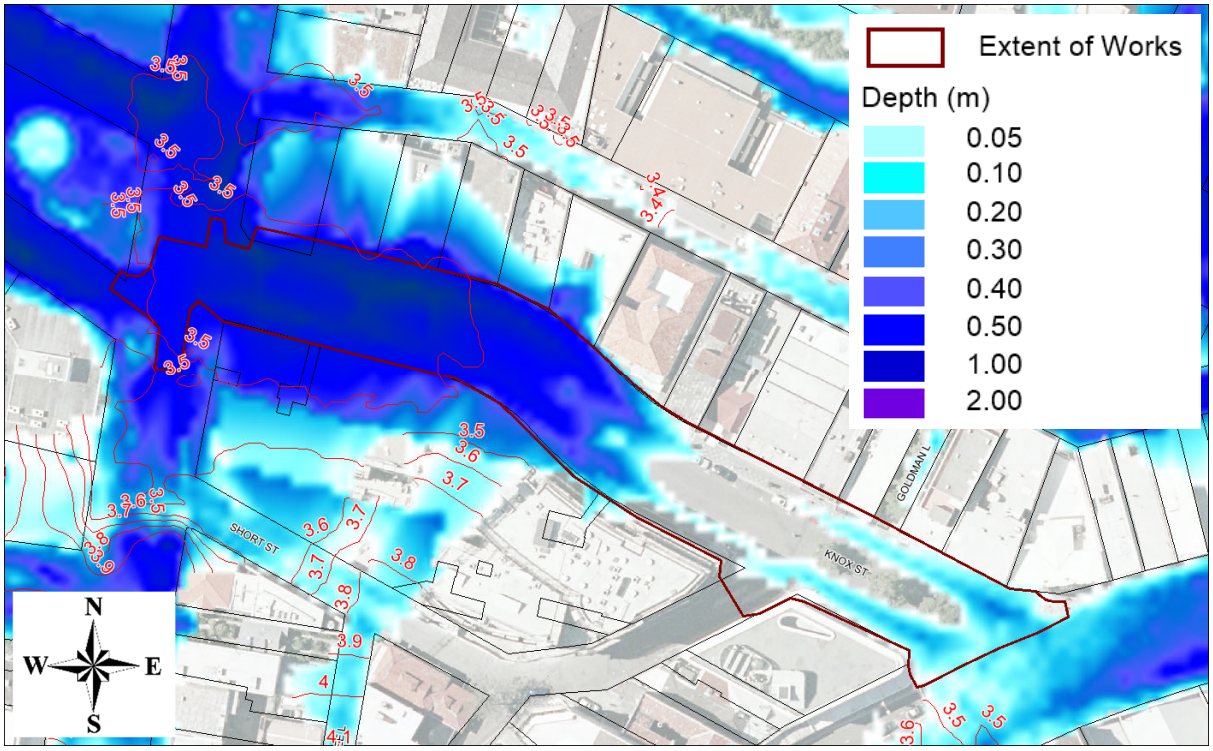


*Plate 1: 5% AEP flood depths and levels for existing conditions*

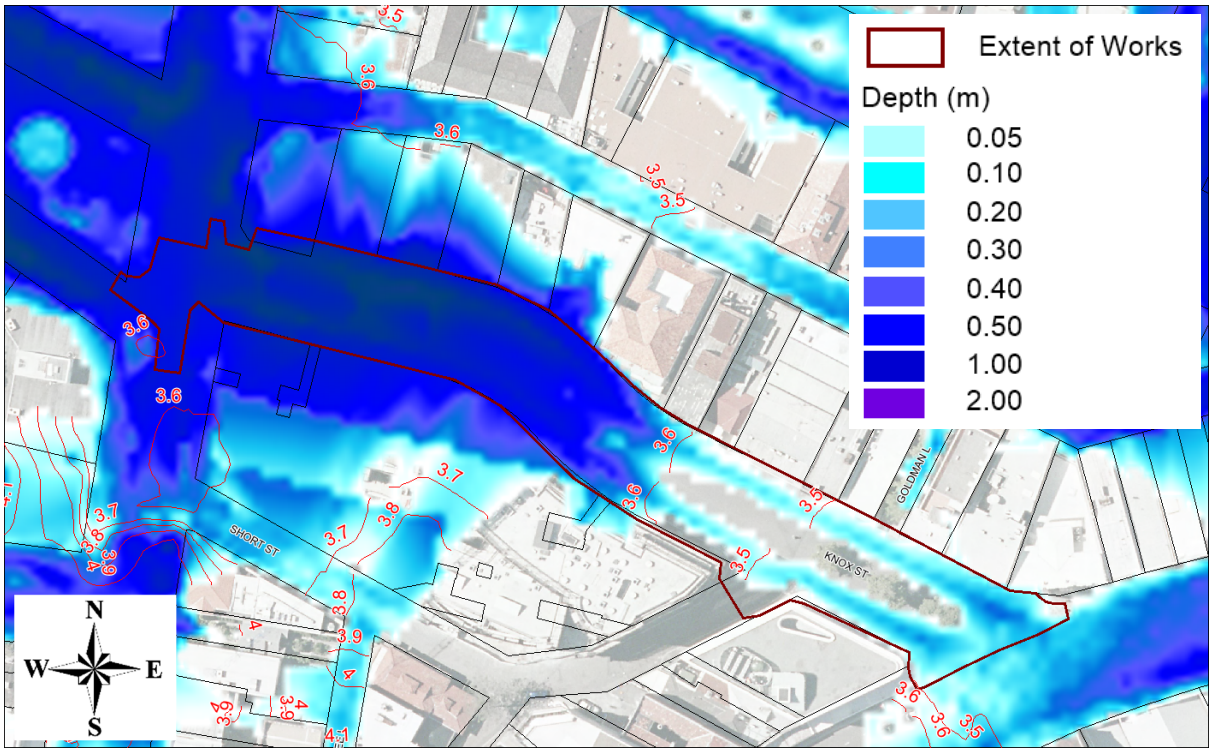


*Plate 2: 1% AEP flood depths and levels for existing conditions*

As shown on **Plate 1**, inundation on Knox St in the 5% AEP is concentrated at the western end of the street, with depths generally greater than 0.5 metres. Water depths of more than 0.9 metres are predicted near the intersection with Bay St. Depths along the eastern portion of Knox St are generally between 0.15 and 0.3 metres and generally contained to the gutter. Depths on Bay St are predicted to be between 0.4 and 0.6 metres. Peak flood levels vary very little across the study area, with a peak level of around 3.5m AHD extending across most of Knox St and Bay St in the vicinity of the proposed works.

**Plate 2** indicates that in the 1% AEP event, floodwater depths across the western end of Knox St are predicted to vary between 0.6 metres and 1 metre. Peak water depths of over 0.6 metres are common on Bay St. Depths of up to 0.3 metres are predicted across the eastern section of Knox St, however, floodwater again is generally contained to the gutter. A peak flood level of ~3.6m AHD extends across Knox St/Bay St in the vicinity of the proposed works.

## Assessment of Proposed Works

The updated TUFLOW model that was used to define existing conditions was then updated further to include design ground surface contours across Knox St as provided by Woollahra Municipal Council on 15/12/2021. A landscaping plan was also provided and used to modify the hydraulic roughness within the TUFLOW model to 0.05 (increased from 0.02) to reflect the additional landscaping proposed throughout the plaza.

Although no design topography was provided for the works proposed on Bay St, it was advised that the pedestrian zone between Knox St and Guilfoyle Park would be raised to top of kerb level. As a result, this modification was also included within the model with the aid of the existing survey.

The updated model was then re-run for the 5% AEP and 1% AEP floods for “proposed” conditions. The peak flood depths and levels from the proposed conditions simulations are presented on **Plate 3** and **Plate 4** respectively for the 5% AEP and 1% AEP events.

**Plate 3** indicates that in the 5%AEP event, floodwater depths appear similar to those presented on **Plate 1** for existing conditions. However, interrogation of water depths near Bay St indicate that the terrain modifications associated with the pedestrian plaza works have generally reduced peak depths to around 0.75 metres (as opposed to 0.9 metres under existing conditions). Peak depths within the eastern portion of Knox St are predicted to both increase and decrease relative to existing conditions in a commensurate manner (associated with a redistribution of flow within the road reserve due to the altered topography). Peak flood levels across the study area are predicted to remain at ~3.5m AHD.

**Plate 4** indicates that similar changes to the magnitude and location of flood water depths are predicted during the 1 % AEP flood. That is, peak depths across the western sections of the proposed works are predicted to reduce to around 0.85 metres as opposed to 1 metre under existing conditions and peak flood levels across the study area remain at ~3.6m AHD.

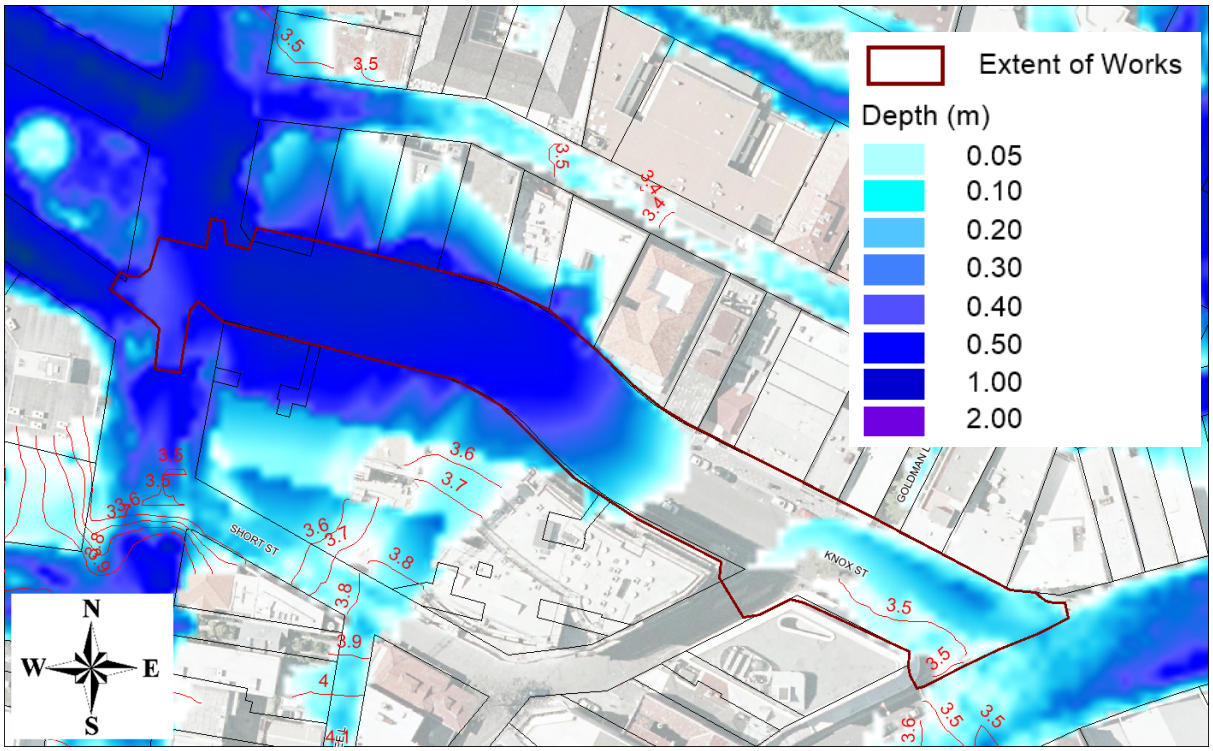


*Plate 3: 5% AEP flood depths and levels with Knox St pedestrian plaza*

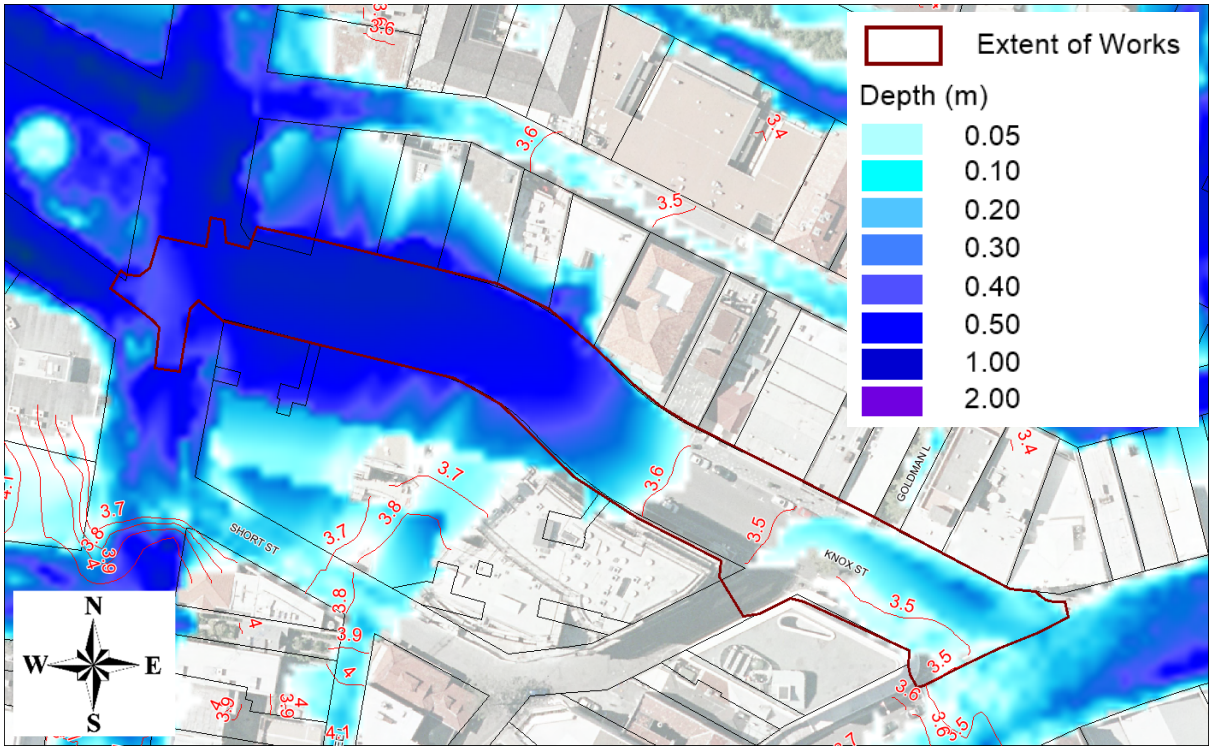


*Plate 4: 1% AEP flood depths and levels with Knox St pedestrian plaza*

Flood level difference mapping was then prepared by subtracting the modified existing conditions peak flood levels from flood levels with the proposed works included. The difference mapping shows the location and magnitude of changes in flood levels and extents associated with the proposed works and are presented on **Plate 5** and **Plate 6** respectively for the 5% and 1% AEP events.

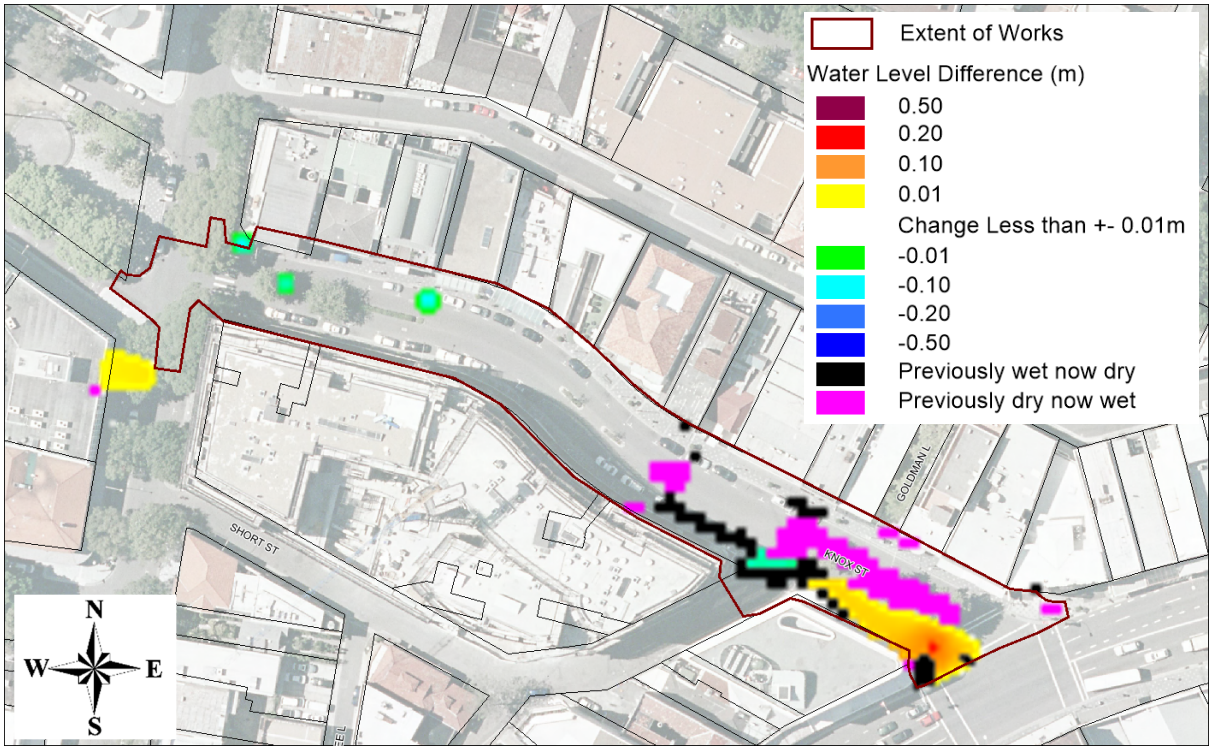


*Plate 5: 5% AEP flood level differences with Knox St pedestrian plaza*

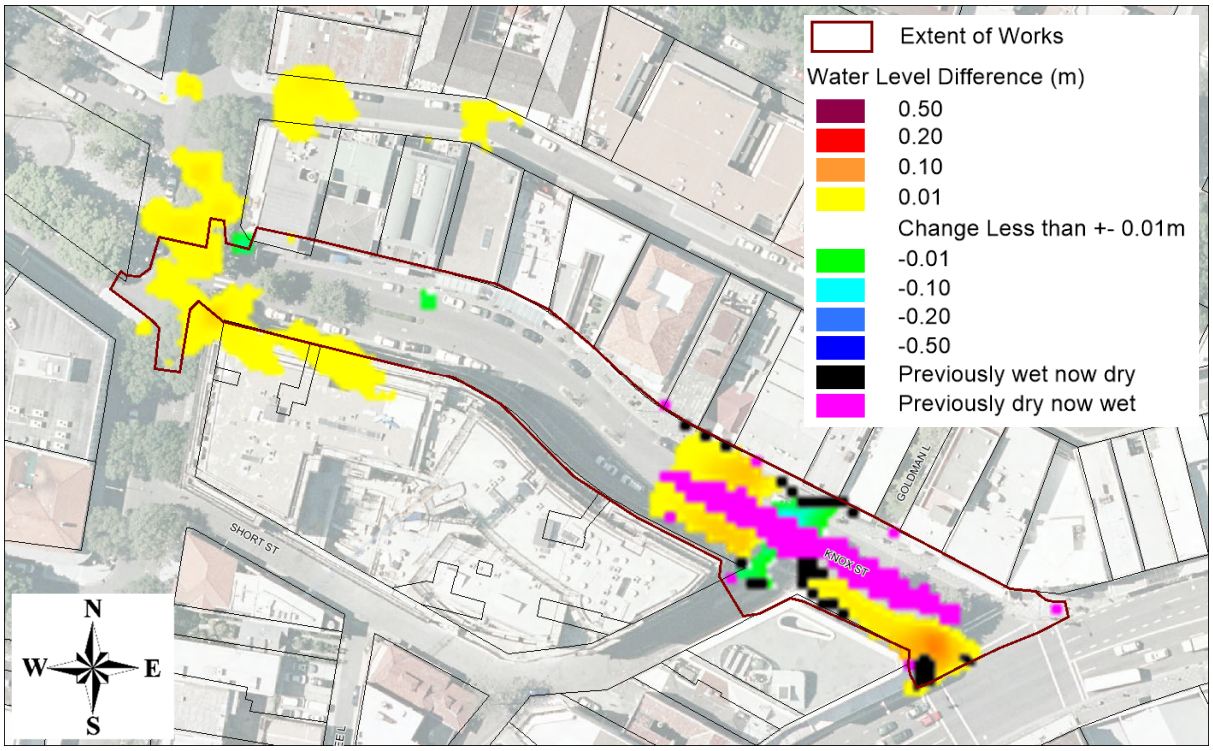


*Plate 6: 1% AEP flood level differences with Knox St pedestrian plaza*

The flood level differences on **Plate 5** indicate that flood levels are predicted to both increase and decrease on Knox St near the intersection of Goldman Ln as a result of the altered topography. However, these changes are limited to the road reserve. Increases in inundation extent through the centre of Knox St is also predicted. Flood level increase of up to 0.03 metres are also predicted on Bay St, primarily concentrated around the southern edge of the raised section of roadway.

**Plate 6** shows that similar increases and decreases in flood level are predicted during the 1%AEP event around the intersection of Goldman Ln (albeit with a slightly larger extent). More extensive increases in flood level of 0.01 metres are predicted on Bay St around the raised section of roadway, and some isolated areas of flood level increase of 0.01 metres are predicted on Knox Ln. These increases are considered minor and isolated and do not represent a significant flood impact due to the proposed works.

The outcomes of the flood level difference mapping indicates that the proposed works are not predicted to produce any significant change in flood level across the study area. This is primarily driven by this area of Double Bay acting as a large flood storage area with generally slow-moving water. The loss of flood storage by the changes in roadway level/profile are considered insignificant in the scale of the wider Double Bay catchment, and therefore produce only small and localised changes in flood level, which appear to be generally limited to within road reserves. Furthermore, the predicted reduction in water depths (due to the raised pedestrian plaza) is likely to afford improvements to flood hazard for any pedestrians who happen to be in the area during future floods.

## Conclusion

This investigation has assessed the potential impact that construction of a pedestrian plaza on Knox St and Bay St, Double Bay may have on existing flood behaviour. The assessment was completed using an updated TUFLOW hydraulic model that was previously developed for the '*Double Bay Floodplain Risk Management Study and Plan'* (Bewsher Consulting, 2011). The outcomes of the flood modelling indicates that the proposed works will generate small, localised increases and decreases in existing flood levels. However, widespread flood level increases are not predicted to exceed 0.03 metres and are generally contained to the road reserves.

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I trust this letter suitably summarises the outcomes of the flood investigation that we have completed. However, if you have any questions or require anything further on this matter, please do not hesitate to contact Daniel Fedczyna (*ph: 8355 5503 email: daniel.fedczyna@csse.com.au*).

Kind Regards,

Daniel Fedczyna
**Catchment Simulation Solutions**