TRAFFIC IMPACT ASSESSMENT

Station Street Pedestrian Bridge, Menangle

PREPARED FOR:
Mirvac Homes (NSW) Pty Limited

REFERENCE:
0371r01v06

DATE:
12/09/2022

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ABN: 22 006 922 998

Reference: 0371r01v06

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Revision History

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1. Introduction

1.1. Overview

PDC Consultants has been commissioned by Mirvac Homes (NSW) Pty Limited to undertake a Traffic Impact Assessment (TIA) of proposed pedestrian bridge at Station Street, Menangle. The bridge will be free standing and adjacent to an existing narrow vehicle bridge over the Main Southern Rail Line, which makes no provision for pedestrians or cyclists, serving a proposed masterplan development of around 380 residential lots spread across either side of the bridge.

The land to the east of the bridge is currently rural, generating very little demand for pedestrian or vehicular traffic. Upon completion of the masterplan development, some 280 residential lots will be provided to the east of the bridge, along with a neighbourhood centre and recreational outdoor areas, which in turn will increase pedestrian and cyclist demand for the bridge.

A pedestrian bridge is therefore proposed to separate pedestrian and cyclist movements from vehicular movements on the existing bridge, thus removing potential conflict and ensuring safe passage across the rail line.

Approval for the pedestrian bridge and its associated works is sought under Part 5 of the Environmental Planning and Assessment Act 1979, and as such this TIA will inform the broader Review of Environmental Factors (REF) for the subject development.

1.2. Structure of this Report

This report documents the findings of our investigations in relation to the anticipated traffic impacts of the proposed development and should be read in the context of the REF, prepared separately by Calibre Group. The remainder of this report is structured as follows:

- Section 2: Describes the site and existing vehicular and pedestrian traffic conditions in the locality.
- Section 3: Describes the proposed development.
- Section 4: Assesses the pedestrian traffic impacts of the development.
- Section 5: Discusses the construction impacts of the proposed development.
- Section 6: Presents the overall study conclusions.

1.3. References

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

- Environmental Planning and Assessment Act 1979 (EPA 1979).
- State Environmental Planning Policy (Transport and Infrastructure) 2021 (SEPP Transport and Infrastructure 2021).
- Wollondilly Shire Council Development Control Plan 2016 (WDCP 2016).
- Australian Bureau of Statistics Quick Stats Census Data 2016 (ABS Quick Stats).
- Sydney's Cycling Future: Cycling for Everyday Transport 2013 (Sydney's Cycling Future 2013).
- Austroads Guide to Traffic Management Part 3: Transport Study and Analysis Methods (AGTM03-20).
- Austroads Guide to Road Design Part 6A: Paths for Walking and Cycling (AGRD06A-17).
- Highway Capacity Manual 2010 (HCM 2010).
- RMS Guide to Traffic Generating Development 2002 (RMS Guide).
- RMS Technical Direction TDT 2013/04a - Guide to Traffic Generating Developments, Updated Traffic Surveys (RMS Guide Update).
- Australian Standard AS 1428.1 – 2001, Part 1: Design for Access and Mobility (AS 1428.1).
- Australian Standard AS 1428.4.1 – 2019, Part 4.1: Means to Assist the Orientation of People with Vision Impairment – Tactile Ground Surface Indicators (AS 1428.4).
- Household Travel Survey (HTS) – Data by LGA, Transport for NSW (HTS Data).

2. Existing Conditions

2.1. Location and Site

2.1.1. Pedestrian Bridge

The subject bridge is located at Station Street, Menangle, being situated approximately 250 metres south of Menangle Railway Station and 50 kilometres south-west of the Sydney CBD. More specifically, it is located over the Main Southern Rail Line between Station Street intersections with Stevens Road to the west and Moreton Park Road to the east.

The existing bridge is approximately 32 metres in length and allows for two-lane, two-way traffic movements along Station Street within a 6.6-metre-wide carriageway. Armco guardrails and pedestrian fencing are provided on both sides of the bridge; however, no pedestrian footpath or other segregation is provided, with the bridge carriageway effectively operating as a shared facility between all modes of transport.

2.1.2. Masterplan Development

The proposed masterplan development of around 380 residential lots and ancillary commercial and open space will be delivered in four stages, with details and progression of each summarised as follows:

- Stage 1: Subdivision by Torrens title to create 97 residential lots in 2 stages, earthworks, construction of roads, retaining walls and bioretention basin, tree removal, decommissioning and filling of an existing dam, street tree planting and associated works at 15 Menangle Road, Menangle, formally identified as Lot 201 DP 590247. The Development Application (DA) 2019 / 93 / 1 was determined and approved by Council 19/06/20.

- Stage 2: Subdivision by Torrens title to create 117 residential lots and residues in 2 stages, earthworks, construction of roads, retaining walls, bio-retention basin, temporary basin, street tree planting and associated works at 1370 Moreton Park Road, Menangle, formally identified as Lot 202 DP 590247.

- Stage 3: Subdivision by Torrens title to create approximately 69 residential lots and residues, earthworks, construction of roads, retaining walls, bio-retention basin, street tree planting, a local park and associated works at 1370 Moreton Park Road, Menangle, formally identified as Lot 202 DP 590247.

- Stage 4: Subdivision by Torrens title to create approximately 96 residential lots and residues, a neighbourhood centre, earthworks, construction of roads, retaining walls, bio-retention basin, street tree planting and associated works at 1370 Moreton Park Road, Menangle, formally identified as Lot 202 DP 590247.

Furthermore, a separate DA (2019 / 296 / 1) has been lodged for a concept masterplan for progressive redevelopment of the heritage listed Camden Park Estate Central Creamery buildings to allow for their adaptive future re-use to include an event precinct, function precinct, an eating precinct, and a stay precinct. This development, known as 'The Creamery', will form a neighbourhood centre to the north of Stage 1 of the masterplan and is located within 45 Stevens Road, Menangle, and 15 Menangle Road, Menangle.

Stage 1 and The Creamery developments are located west of the Main Southern Rail Line, to the north of Station Street between its intersections with Menangle Road and Stevens Road. All other Stages are located to the east of the Main Southern Rail Line. Travel for all modes between Stage 1 and The Creamery and all other Stages will therefore require use of the subject Station Street bridge, as will travel from Stages 2 – 4 to and from Menangle Railway Station.

Subdivision works within Stage 1 (97 Lots) are complete and the lots have now settled. A sales office and display home have been completed within Stage 1 and there are multiple dwellings currently under construction. Bulk earthworks have commenced across Stages 2 – 4. There is one occupied cottage within Stage 4, and an unoccupied heritage listed cottage within Stage 2 (no. 1370 Moreton Park Road). The Camden Park Estate Central Creamery and Rotolactor buildings are derelict and currently unoccupied.

The proposed masterplan development layout is provided in Figure 1 below and as Appendix A.

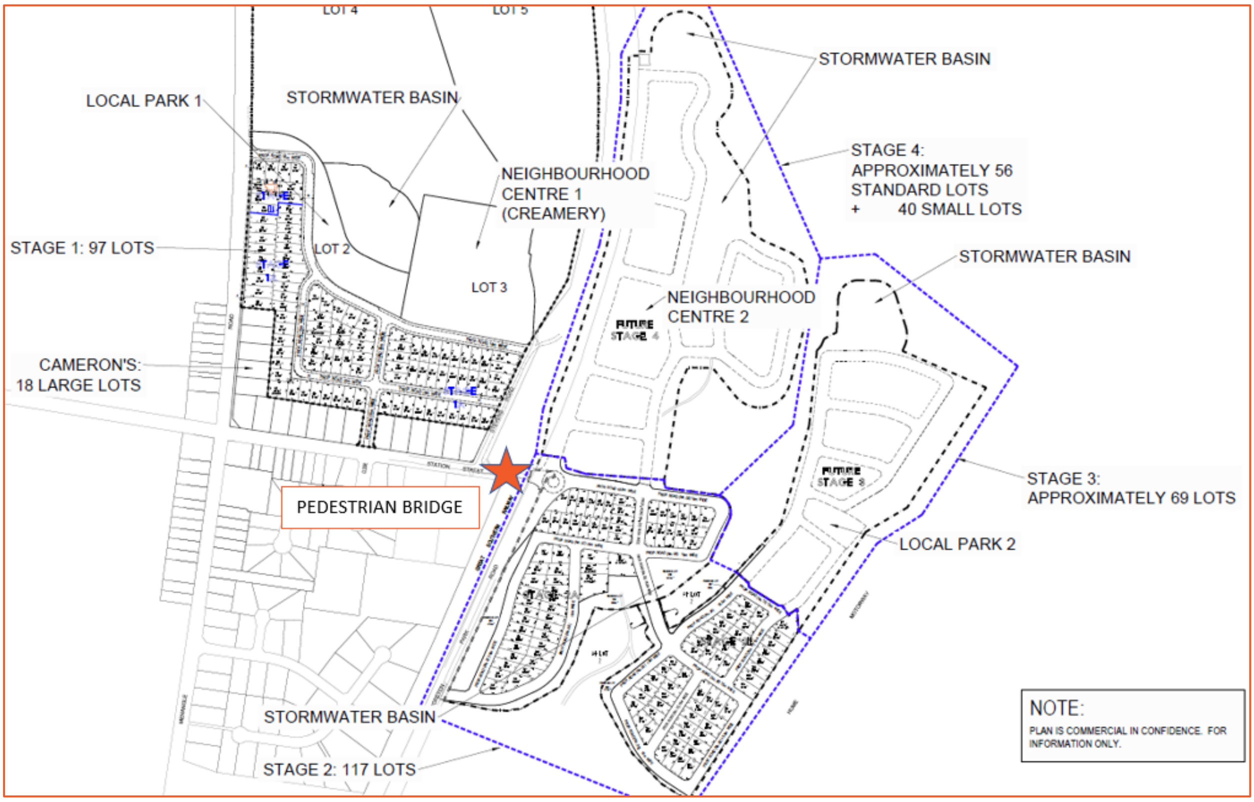


Figure 1: Proposed Masterplan Development and Pedestrian Bridge Location

Figure 2 and Figure 3 provide an appreciation of the subject bridge's location in a broad and local context, respectively.

2.2. Road Network

The road hierarchy in the vicinity of the site is shown by **Figure 2**, with the following roads considered noteworthy:

- Hume Motorway: a state arterial highway (HW 2) that generally runs in a north-south alignment between Parramatta Road and the Victorian State Border. Near the site it provides two lanes in each direction within a divided carriageway and is subject to 110 km/h speed zoning restrictions. Whilst it borders the proposed masterplan development and is near the bridge, the nearest interchange accesses to Hume Motorway are at Bingara Gorge to the south (14 km) or at Campbelltown to the north (8 km).

- Menangle Road: a regional road in the vicinity of the site which follows a north-east to south-south alignment between Maldon in the south and Macarthur Square in the north. Menangle Road becomes a Main Road (MR 179) approximately 1.0 kilometre north of Station Street at its crossing of the Nepean River. Near the site it carries a single lane in each direction and is subject to 50 km/h speed zoning restrictions. Unrestricted on-street parallel parking is generally provided along its length in the vicinity of the site.

- Station Street: a local road which runs in an east-west alignment between its intersections with Menangle Road to the west and Moreton Park Road to the east. It carries a single lane of traffic in each direction and is subject to 50 km/h speed zoning restrictions. Unrestricted parallel parking is provided along its length.

- Moreton Park Road: a local road which runs in a north-south alignment between Douglas Park in the south and Station Street, Menangle in the north. It carries a single lane of traffic in each direction and is subject to 50 km/h speed zoning restrictions. Unrestricted parallel parking is provided along its length, though the road is generally rural in nature with little to no on-street parking generators in its vicinity.

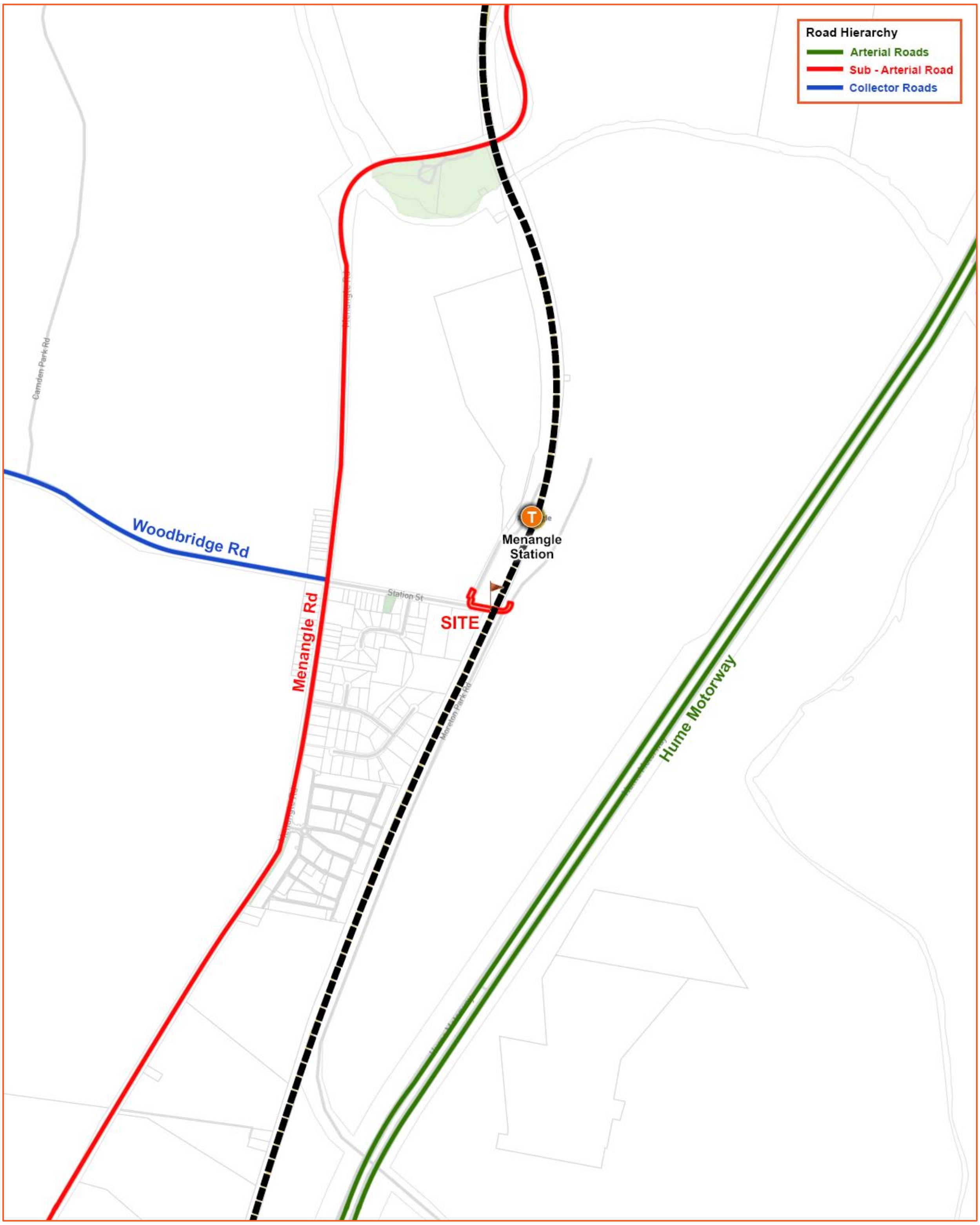


Figure 2: Location and Road Hierarchy Plan

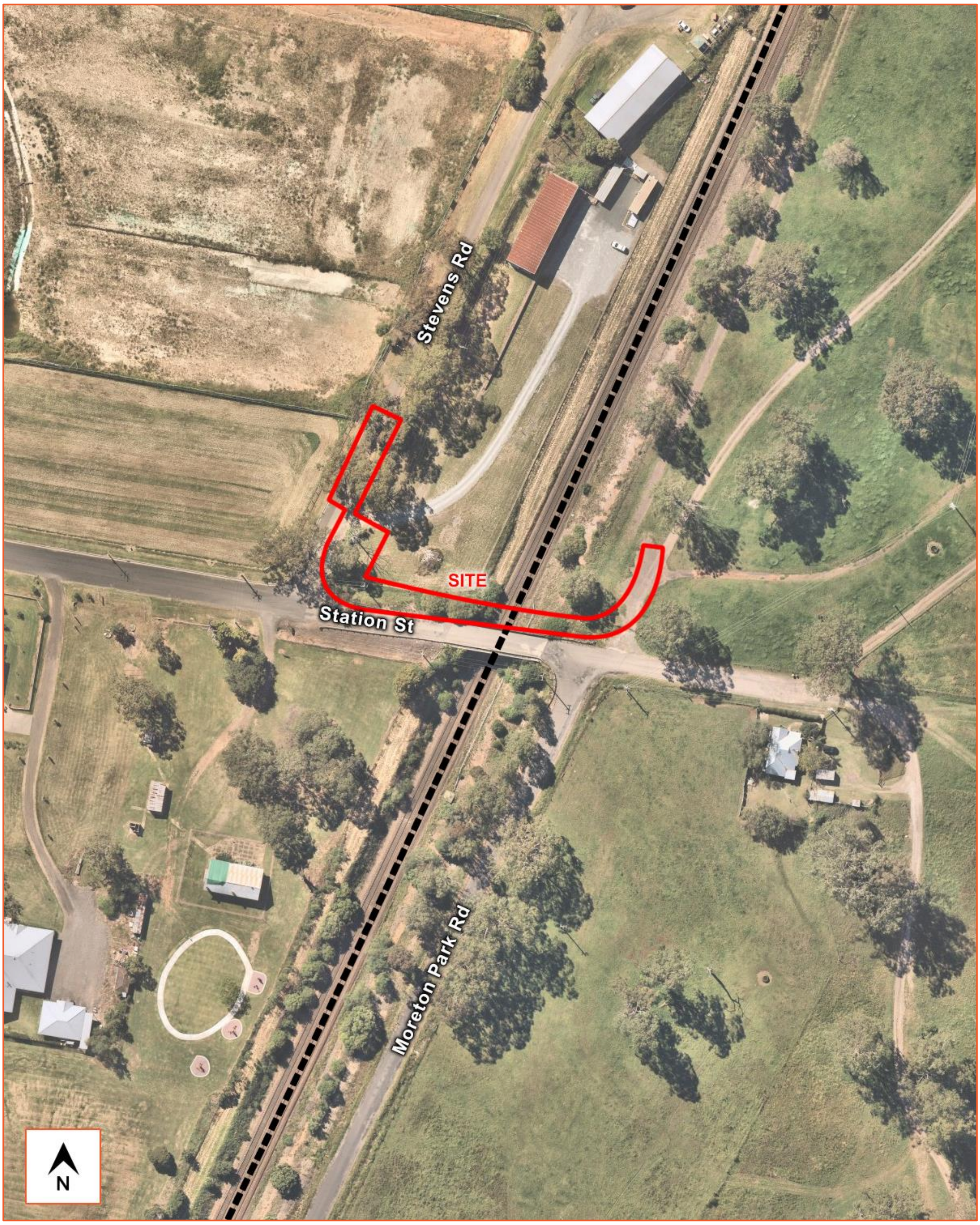


Figure 3: Pedestrian Bridge and Accesses Location Plan

2.3. Public and Active Transport

2.3.1. Rail Services

The Integrated Public Transport Service Planning Guidelines, Sydney Metropolitan Area, states that the walking catchment for metropolitan railway stations includes all areas within an 800-metre radius of a station. It can be seen from **Figure 6** that Menangle Railway Station is located within 250 metres of the bridge and within an 800-metre radius of the proposed masterplan development, and hence falls within the typical walking catchment area. Accordingly, it is anticipated that residents of existing and proposed developments within the vicinity of the pedestrian bridge would use the bridge for access to and from the broader Sydney Trains network.

Menangle Railway Station is serviced by the Southern Highlands Line (SHL). **Table 1** below shows the notable town centres that are accessible along the SHL and the average service headways during peak and off-peak periods.

Table 1: Rail Services

RAILWAY LINE	NOTABLE TOWN CENTRES ALONG LINE	AVERAGE HEADWAY
SHL	Sydney CBD, Glenfield, Campbelltown, Menangle, Picton, Mittagong, Bowral, Moss Vale, Bundanoon & Goulburn	Weekdays: 60 minutes Weekends: 60 - 90 minutes

2.3.2. Bus Services

The Integrated Public Transport Service Planning Guidelines, Sydney Metropolitan Area, states that the walking catchment for metropolitan bus services includes all areas within a 400-metre radius of a bus stop. As can be seen from **Figure 6**, the bridge and Stage 1 of the proposed masterplan development is situated within 400 metres of bus stops located along Station Street. Whilst Stages 2 – 4 fall outside of the typical walking catchment for buses, a portion of residents and visitors are expected to use the bridge for access to and from the broader bus network.

Figure 6 also shows that additional bus stops are accessible within 800 metres of the site. **Table 2** shows the notable town centres that are accessible via the bus services within 800 metres of the proposed masterplan development and bridge, and the average service headways during peak and off-peak periods.

Table 2: Bus Services

ROUTE NO.	TO / FROM	ROUTE DESCRIPTION	AVERAGE HEADWAY
49	Camden to Menangle & Razorback	Via Cawdor & Menangle	Weekdays: 2 services only Weekends: No services
889	Menangle to Campbelltown	Via USW Campbelltown, Englorie Park & Menangle Park	Weekdays: 6 services only Weekends: 2 services on Saturdays / No services on Sundays

2.3.3. Cycle Network

Figure 6 shows that the existing cycle network in the vicinity of the bridge and proposed masterplan development is scarce, with nothing in the way of designated on or off-road cycle routes provided within approximately 1.0 kilometre of the bridge.

The proposed masterplan development is expected to enhance and promote cycling facilities in the area, which the subject bridge will form a key part of. This in turn will support objectives and controls set out in Section 3.14, Volume 3 of WDCP 2016 to encourage walking and cycling and reduce vehicle reliance through the provision of pedestrian and cycle paths illustrated by Figure 3 of Section 3.14, Volume 3, WDCP 2016, provided as **Figure 4** for reference.

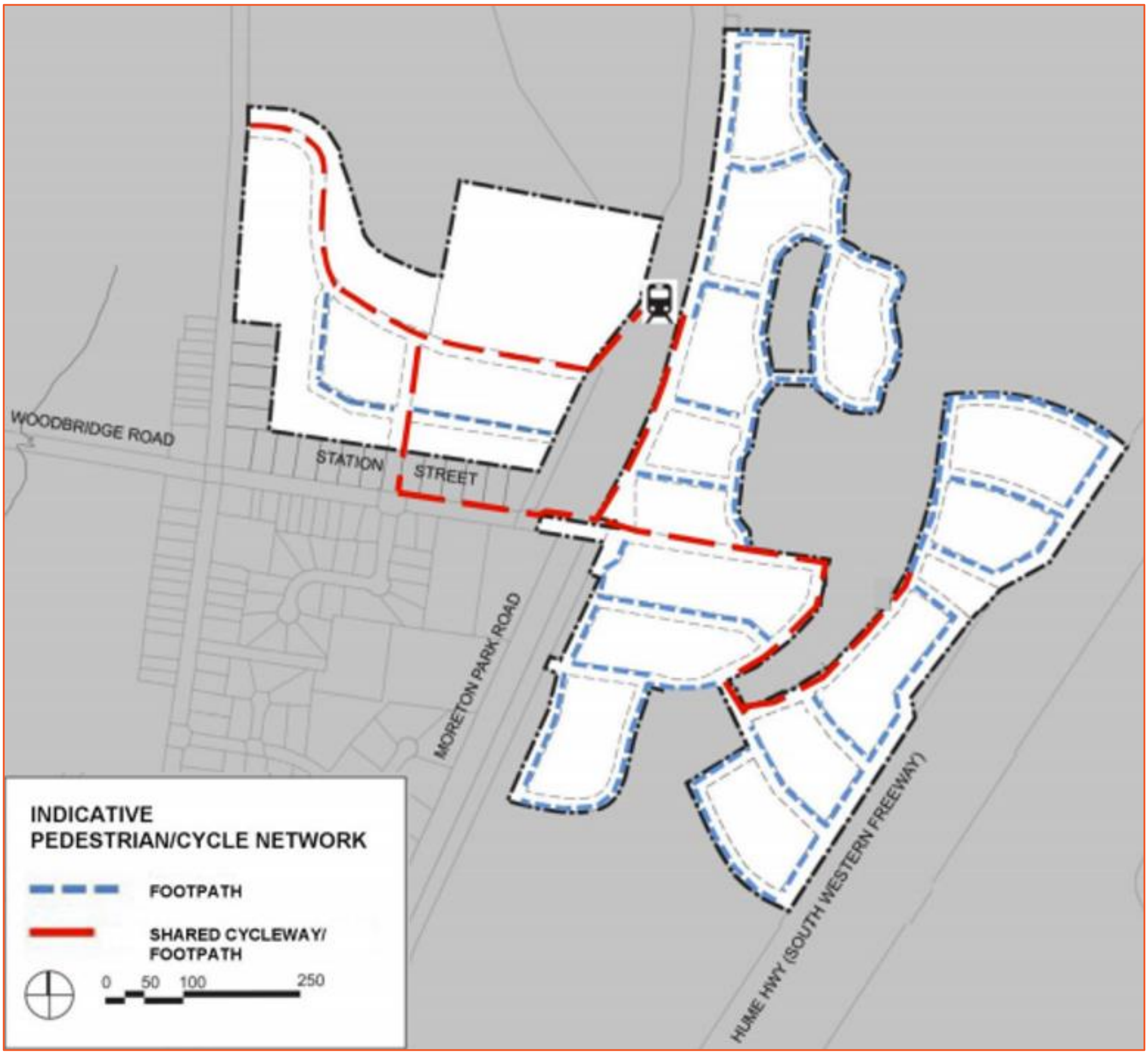


Figure 4: Proposed Pedestrian and Cycle Network

2.4. Existing Traffic Conditions

2.4.1. Pedestrian Bridge

To gain an understanding of the existing vehicular and pedestrian traffic conditions on the subject Station Street bridge, traffic surveys were undertaken on 21/04/21 between 6:00am – 8:00pm. Findings of these surveys are illustrated in **Figure 5** below.

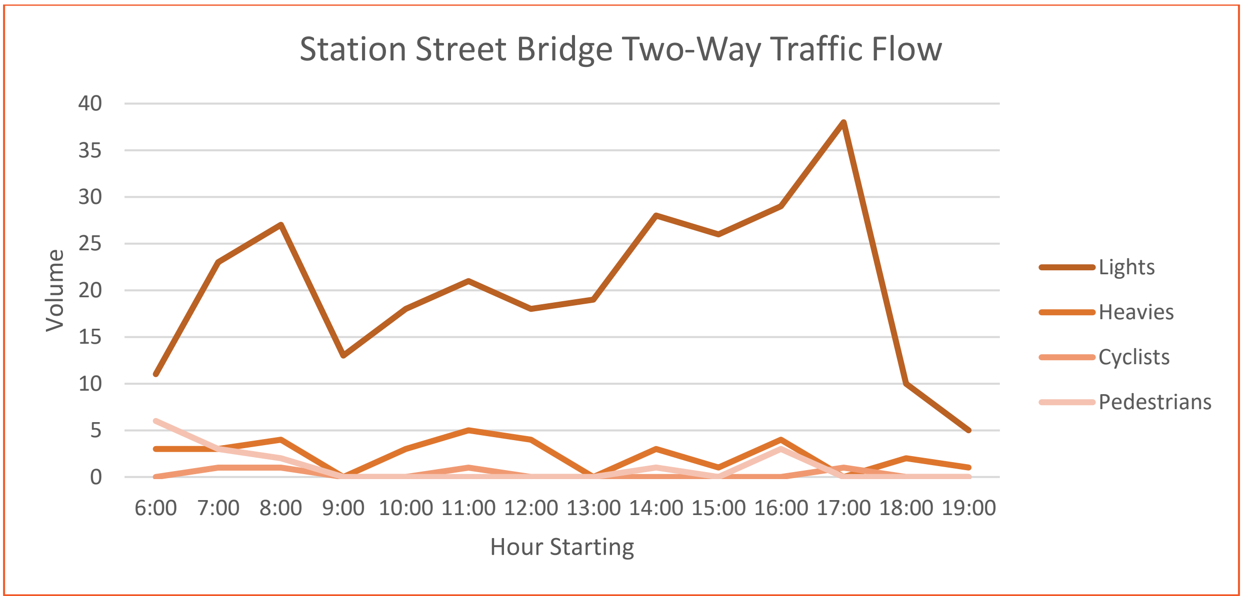


Figure 5: Existing Station Street Volumes

Figure 5 demonstrates that traffic, pedestrian, and cyclist volumes on the existing Station Street bridge are very low. The peak, two-way traffic demand for the bridge occurs between 5 – 6pm, during which a total of 38 light vehicles use the bridge, 22 vehicles eastbound and 16 westbound. During this hour, nil (0) heavy vehicles used the bridge; however up to five (5) heavy vehicles were recorded using the bridge within the hour of 11am – 12pm.

Active transport mode volumes are also very low. Cyclist demands are very infrequent, with a maximum of one (1) per hour and a total of only four (4) cyclists recorded throughout the 6am – 8pm survey period. A total of 15 pedestrians used the bridge throughout the survey period, with the peak occurring between 6 – 7am at six (6) pedestrians. A PM peak of three (3) pedestrians occurred 4 – 5pm; however, nil (0) was recorded using the bridge during the vehicular PM peak.

The traffic, pedestrian, and cyclist survey raw data are provided as **Appendix B**.

2.4.2. Masterplan Development

As discussed in Section 2.1 of this report, the land upon which the masterplan development is proposed is currently under development and is unoccupied, other than one occupied cottage on the eastern side of the rail line, and thus does not generate any notable pedestrian or vehicular trips.

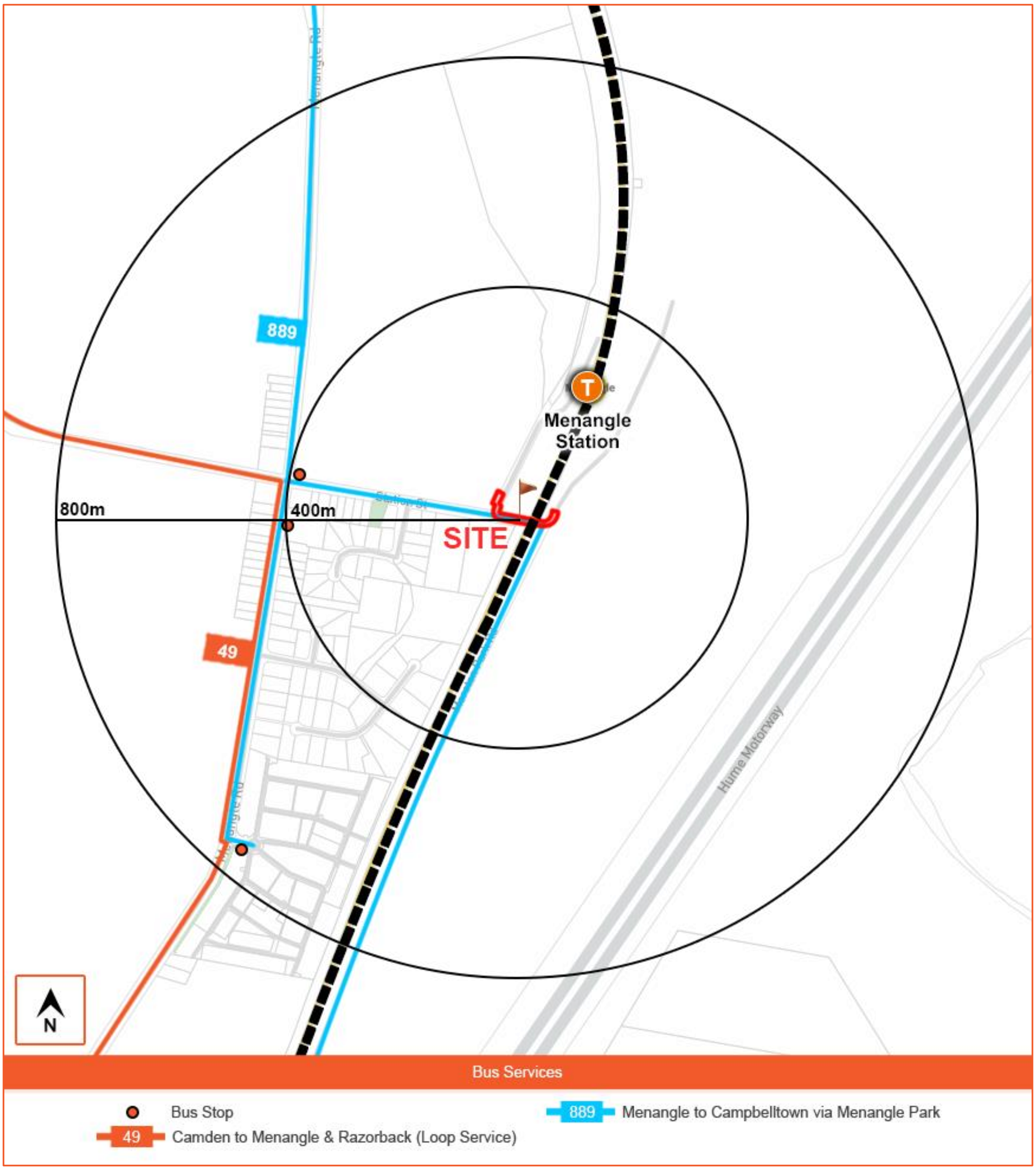


Figure 6: Public & Active Transport Services

3. Proposed Development

A detailed description of the proposed development for which approval is now sought, is outlined in the REF prepared separately by Calibre Group. In summary, the project proposes the provision of a free standing bridge adjacent to the existing 32-metre-long vehicular bridge to provide a segregated 2.5-metre-wide pedestrian and cycle path to the northern side of the existing bridge structure.

AGRD06A-17 Section 5.1.4 recommends minimum shared path width of 2.0 metres for 'local access paths', with higher order connections requiring larger widths. The proposed bridge exceeds this width and is therefore considered acceptable.

The general arrangement drawings of the proposed bridge, prepared by Bridge Design, is included in **Appendix C**.

The bridge will connect the segregated pedestrian path to the existing network on the western side, by Stevens Road, via accessible ramp and stairs. This connection will be facilitated by road improvement works proposed along Stevens Road in the vicinity of the bridge as part of Stage 1 (DA 2019 / 93 / 1) of the masterplan development.

On the eastern side, the pedestrian path will connect to the north-western corner of a proposed roundabout to be located at the existing intersection of Station Street with Moreton Park Road via an accessible ramp. This proposed roundabout is currently being delivered as part of Stage 2 of the masterplan development.

Engineering plans of the proposed pedestrian path connections to the broader active transport network, prepared by Calibre Group, are provided as **Appendix D**.

4. Pedestrian Traffic Impacts

4.1. Pedestrian Trip Generation

Key to determining the suitability of the proposed pedestrian bridge is identification of the estimated pedestrian demand set to use it once the entire masterplan development is complete. TfNSW commissioned comprehensive traffic surveys of several types of development to inform the RMS Guide Update, which remains the industry standard document for determining trip generation rates of different types of development.

The proposed masterplan development comprises two key types of development which were surveyed by the RMS Guide Update, being low density residential dwelling developments and neighbourhood centre developments. The following sections discuss pedestrian trip generation of each.

4.1.1. Residential Dwellings

Within the RMS Guide Update, weekday surveys were undertaken at 11 residential developments in total, ranging from 509 to 1,495 low density dwellings, across New South Wales. Six (6) of the sites were within the Sydney Metropolitan Area and five (5) outside, in Regional New South Wales. Given the subject masterplan development's proximity in Regional New South Wales, only data from the five (5) Regional sites has been considered within this assessment.

Person trip observations, that is trips by all persons via all travel modes, were made in the surveys and are summarised below:

- Peak hour person-trips per dwelling: 1.27.
- Total daily person-trips per dwelling: 9.42.

Peak hour person-trips varied between AM and PM commuter peaks across the five (5) sites. The peak-hour rate is therefore considered an appropriate proxy for both AM and PM commuter peak hour pedestrian trip generation.

HTS Data was used to identify the split of these person trips between travel modes, with data from the latest available period of 2018/19 for the Wollondilly local government area (LGA) adopted. The modes considered as generating walking trips which would potentially require travel across the pedestrian bridge, from any component of the masterplan development, are train (4.3% mode share), bus (2.4%) and walk-only (6.4%), totalling 13.1% of overall mode share. Train and bus modes are termed 'linked' trips hereon, as they comprise a linked trip of both walking and the respective public transport mode.

Applying these person-trip rates and the linked or walk-only travel mode share to the dwelling yields of each development Stage, discussed in Section 2.1.2, results in peak hour and daily residential pedestrian trip generation as in Table 3.

Table 3: Residential Pedestrian Trip Generation

STAGE	DWELLINGS	PEAK HOUR TRIP RATE	DAILY TRIP RATE	PEAK HOUR TRIP GENERATION	DAILY TRIP GENERATION
Stage 1	97	0.17	1.23	16	120
Stage 2	117			19	144
Stage 3	69			11	85
Stage 4	96			16	119
			TOTAL	***62***	***468***

Table 3 demonstrates that the weekday peak hour linked or walk-only pedestrian trip generation of the entire masterplan development is estimated at 62 person trips, with 468 pedestrian trips estimated for the entire day.

4.1.2. Neighbourhood Centres

As discussed in Section 2.1.2, two neighbourhood centres are proposed as part of the broader masterplan development. One, The Creamery, does not form part of the masterplan but will serve residents of it, and is located immediately north of Stage 1. The second is located in Stage 4.

The Creamery is expected to contain several independent premises including food and drink, function centre, conference room, hotel, and children's play area. Given surveys undertaken in the RMS Guide Update do not detail each of these land uses, they have all been broadly categorised as shopping centre land use within this assessment.

The total gross floor area (GFA) of The Creamery is approximately 4,940 m^2, with the RMS Guide suggesting that *"As a general guide, 100 m^2 gross floor area equals 75 m^2 gross leasable floor area."* As such, The Creamery is estimated to provide 3,705 m^2 gross leasable floor area (GLFA).

The total gross floor area of the Stage 4 neighbourhood centre is yet to be confirmed, given this element of the proposed masterplan development has not yet entered its early design stages. Following advice from the project team, it is estimated the maximum developable GFA will be approximately 8,500 m^2, equating to approximately 6,375 m^2 GLFA.

Weekday and weekend surveys were undertaken at 10 shopping centre developments in total for the RMS Guide Update, ranging from 15,552 m^2 GLFA to 100,134 m^2 GLFA. Seven (7) of the sites were within the Sydney Metropolitan Area and three (3) outside, in Regional New South Wales. Given the subject masterplan development's proximity in Regional New South Wales, only data from the three (3) Regional sites has been considered within this assessment.

The same two key observations of peak hour and daily person trips discussed in Section 4.1.1 were made for shopping centres; however, these were done for each of Thursday, Friday, Saturday, and Sunday.

HTS Data is not applicable to trips generated by shopping centre land uses. However, the RMS Guide Update surveys identify travel modes of shopping centre person trips, with 'on foot' or 'pedestrian' trips identified as constituting 2.7 – 4.3% of all person trips across the four (4) surveys days at the three (3) Regional sites.

The resultant pedestrian trip generation of the two neighbourhood centres proposed is set out in **Table 4**.

Table 4: Shopping Centre Pedestrian Trip Generation

CENTRE	GLFA	PEAK HOUR TRIP RATE (TRIPS / 100 m^2 GLFA)	DAILY TRIP RATE (TRIPS / 100 m^2 GLFA)	PEAK HOUR TRIP GENERATION	DAILY TRIP GENERATION
THURSDAY					
Creamery	3,705 m^2	0.32	3.23	12	120
Stage 4	6,375 m^2			20	206
FRIDAY					
Creamery	3,705 m^2	0.33	2.66	12	99
Stage 4	6,375 m^2			21	170
SATURDAY					
Creamery	3,705 m^2	0.49	3.38	18	125
Stage 4	6,375 m^2			31	215
SUNDAY					
Creamery	3,705 m^2	0.24	1.49	9	55
Stage 4	6,375 m^2			16	95

Table 4 demonstrates that the busiest single peak hour for neighbourhood centre pedestrian trip generation is Saturday lunchtime, during which an estimated 49 pedestrian trips will be generated by the two centres. Total daily trips are also highest on a Saturday, followed closely by a Thursday on which 326 estimated trips are generated by the two centres.

4.1.3. Combined Pedestrian Trip Generation

Given residential pedestrian trip generation surveys are only available for weekdays, the combined pedestrian trip generation of residential and neighbourhood centre developments can only be assessed for a weekday.

It is evident from the assessment provided in Sections 4.1.1 and 4.1.2 that the combined daily peak for pedestrian trip generation of the residential and neighbourhood centre land uses proposed within the vicinity of the pedestrian bridge would occur on a Thursday, with the peak hour occurring during the PM commuter peak.

The combined external pedestrian trip generation of all land uses assessed is provided in **Table 5**.

Table 5: Combined Thursday External Pedestrian Trip Generation

STAGE	DWELLINGS / GLFA	EXTERNAL PEAK HOUR TRIP GENERATION	EXTERNAL DAILY TRIP GENERATION
Stage 1	97	16	120
Stage 2	117	19	144

STAGE	DWELLINGS / GLFA	EXTERNAL PEAK HOUR TRIP GENERATION	EXTERNAL DAILY TRIP GENERATION
Stage 3	69	11	85
Stage 4	96	16	119
Creamery	3,705 m^2	12	120
Stage 4 SC	6,375 m^2	20	206
	TOTAL	*94*	*794*

The total number of pedestrian trips generated that would be expected to travel external to the respective land uses is 94 trips during the Thursday evening peak hour, and 794 trips throughout the entire day of Thursday.

4.2. Bicycle Trip Generation

Neither the RMS Guide nor RMS Guide Update provide bicycle trip generation rates for any type of development. Furthermore, no documentation prepared for DAs for The Creamery, Stage 1, or Stage 2 of the proposed masterplan development comments on bicycle parking provision or anticipated modal share.

Analysis of ABS Quick Stats data suggests limited current use of bicycles across the Menangle State Suburb, with the lowest reported mode of transport being 'Truck' at 2.9% of all responses. Across the Greater Sydney Statistical Area, the number of journeys to work involving a bicycle was observed at 1.0% in 2016 census data, the lowest of all State capitals in Australia.

Bicycle trip generation for the proposed residential masterplan development and associated neighbourhood centres is therefore expected to be low, particularly given the subject site's location in Regional New South Wales. Sydney's Cycling Future 2013 states *"Cycling is ideal for short distances of about five kilometres or 20 minutes."* However, there is little in the way of employment centres or major trip generators within a five-kilometre radius of the proposed masterplan development, with urban centres of Campbelltown approximately 10 kilometres cycle and Camden Park approximately seven kilometres.

As such, any cycle demand for the proposed pedestrian bridge is expected to be low, with a proportion of this low demand likely to use the Station Street vehicular carriageway in any event. Bicycle trip generation is therefore not quantified within this assessment for the sake of determining suitability of the proposed pedestrian bridge.

4.3. Pedestrian Trip Distribution

4.3.1. Residential Pedestrian Trips

As discussed in Section 4.1.3, the day of the week during which the peaks of residential and neighbourhood centre pedestrian trip peaks coincide is most likely to be Thursday, with the peak hour occurring during the PM commuter peak period.

Typical residential trip distribution assumes the following proportions:

- PM Peak hour person-trips distribution: 80% inbound / 20% outbound.
- Daily person-trips distribution: 50% inbound / 50% outbound.

These are assumed noting that residents of the development would typically leave for work in the weekday morning, and vice versa for the weekday evening. When considering daily traffic, the origin and destination of pedestrian trips are both considered to be a person's place of residence.

All trips generated by the residential developments on a Thursday are considered in terms of their likely purpose and destination. Given neighbourhood centre trips are considered separately, the only remaining key trip generators within the study area are public transport options discussed in Section 2.3, that is bus stops and Menangle Railway Station.

Stage 1 is located west of the proposed pedestrian bridge and so pedestrians are not required to use the bridge to access public transport. As there are no other public transport options east of the bridge and trips to the Stage 4 neighbourhood centre are considered separately, it is assumed no pedestrian trips generated by Stage 1 use the bridge.

As Stages 2 – 4 are located east of the proposed bridge, all pedestrian trips generated by these Stages are assumed as using the bridge to access public transport options. Adopting the abovementioned inbound / outbound splits result in estimated bidirectional residential pedestrian traffic on the bridge as shown in Table 6.

Table 6: Residential Pedestrian Trip Distribution – Bridge Volumes

STAGE	DWELLINGS	EASTBOUND		WESTBOUND	
		PEAK	DAILY	PEAK	DAILY
Stage 1	97	0	0	0	0
Stage 2	117	16	72	4	72
Stage 3	69	9	43	2	43
Stage 4	96	13	59	3	59
	TOTAL	***37***	***174***	***9***	***174***

A total of 46 pedestrians trips generated by the residential component of the masterplan development would be expected to use the bridge during the PM peak hour, with 348 daily trips expected.

4.3.2. Neighbourhood Centre Pedestrian Trips

Trips generated by the two neighbourhood centres are expected to be largely generated by the respective residential development Stage they are located near, that is trips generated by The Creamery will largely be generated by Stage 1 and trips generated by the Stage 4 neighbourhood centre would largely be generated by Stages 2 – 4.

As such, it is expected there would be limited occurrence of pedestrian trips generated by the neighbourhood centres being required to walk across the pedestrian bridge. Furthermore, the residential trip generation discussed in Section 4.3.1 contains a portion of trips which would be between residential dwellings and nearby neighbourhood centres, and so by considering the two trip generators as separate entities, the study runs the risk of double-counting pedestrian trips.

Nevertheless, to ensure a conservative assessment, 50% of all pedestrian trips generated by each of the neighbourhood centres is assumed as having been generated by residents of other pre-existing dwellings in the area, such as the existing Menangle town centre. Given all existing dwellings are located to the west of the pedestrian bridge, trips to The Creamery would not require use of the pedestrian bridge, and thus only trips to the Stage 4 neighbourhood centre are considered.

Trip distribution assumes the following proportions:

- PM Peak hour person-trips distribution: 50% inbound / 50% outbound.
- Daily person-trips distribution: 50% inbound / 50% outbound.

PM peak hour proportions for shopping centres differ from those of residential developments, as retail developments akin to the neighbourhood centres generate bidirectional trips throughout the course of the afternoon and evening peak, with visitors coming and going throughout the peak hour. When considering daily traffic, the origin and destination of pedestrian trips are both considered to be a person's place of residence.

Adopting the abovementioned inbound / outbound splits result in estimated bidirectional residential pedestrian traffic on the bridge as shown in **Table 7**.

Table 7: Neighbourhood centre Pedestrian Trip Distribution – Bridge Volumes

STAGE	GLFA	EASTBOUND		WESTBOUND	
		PEAK	DAILY	PEAK	DAILY
Creamery	3,705 m^2	0	0	0	0
Stage 4	6,375 m^2	5	52	5	52
	TOTAL	*5*	*52*	*5*	*52*

4.3.3. Combined Pedestrian Trip Distribution

Totalling residential and neighbourhood centre east and westbound bridge volumes identified in **Table 6** and **Table 7** results in total anticipated pedestrian bridge volumes upon completion of the masterplan development as provided in **Table 8**.

Table 8: Estimated Total Bridge Volumes

STAGE	EASTBOUND		WESTBOUND	
	PEAK	DAILY	PEAK	DAILY
Residential	37	174	9	174
Shopping Centre	5	52	5	52
TOTAL	***42***	***226***	***14***	***226***

Total peak hourly pedestrian volumes using the bridge upon completion of the masterplan development and neighbourhood centres are estimated at 56 persons, with daily volumes of 552 persons.

4.4. Pedestrian Bridge Capacity Analysis

AGTM20-03 states that reference should be made to the *Highway Capacity Manual 2010 (HCM 2010)* for guidance on undertaking capacity analysis for pedestrian movements on footpaths/walkways. The relevant extracts from the HCM 2010 are provided as **Appendix E** and detail the methodology that is required to be adopted to determine the Level of Service (LOS) of a pedestrian footpath within the urban street environment.

It is noted that the HCM 2010 utilises the imperial measurement system and accordingly, for the purposes of consistency, the pedestrian capacity assessment has been undertaken using imperial measurements.

The HCM 2010 states the LOS criteria for pedestrians on pedestrian facilities are determined by consideration of both the LOS score and the average pedestrian space on the footpath. The applicable LOS for a given segment of footpath is determined from Exhibit 17-3 of HCM 2010 (provided as **Figure 7** below) by finding the intersection of the row corresponding to the computed score value and the column corresponding to the computed space value.

Pedestrian LOS Score	LOS by Average Pedestrian Space (ft^2/p)					
	>60	>40–60	>24–40	>15–24	>8.0–15[a]	≤ 8.0[a]
≤2.00	A	B	C	D	E	F
>2.00–2.75	B	B	C	D	E	F
>2.75–3.50	C	C	C	D	E	F
>3.50–4.25	D	D	D	D	E	F
>4.25–5.00	E	E	E	E	E	F
>5.00	F	F	F	F	F	F

Note: [a] In cross-flow situations, the LOS E/F threshold is 13 ft^2/p.

Figure 7: Exhibit 17-3 of HCM 2010

The calculations associated with determination of the LOS score and average pedestrian space are provided as **Appendix F**. Assessment identified a pedestrian LOS score of 2.49 and average pedestrian space of 1,447.5 ft^2 per person, resulting in an overall Pedestrian LOS of B for the proposed footpath. Given LOS A considers the “best” quality of service and LOS F the “worst” quality of service, operation at LOS B is considered a good performance outcome for the proposal.

5. Preliminary Construction Traffic Management Plan

5.1. Overview

A Construction Traffic Management Plan (CTMP) is a document that details the proposed traffic management arrangements to be implemented for the construction of a development and seeks to minimise the impact of the construction activities on the surrounding community, in terms of both vehicle and pedestrian access and amenity. A CTMP typically addresses the following:

- Construction program.
- Hours of work.
- Traffic management including the proposed vehicular access arrangements, truck routes, Works Zone or loading arrangements, traffic control plans, and pedestrian access and protection measures.
- Construction impacts including traffic generation and contractor parking demands.
- Discussion on any public transport services impacted and how, and potential mitigation.
- Pedestrian and emergency vehicle access.

As discussed in Section 1.1, this TIA has been prepared to inform the REF of the proposed development. As such, a builder had not been appointed at the time of writing and accordingly, there was insufficient information available to allow for the preparation of a comprehensive CTMP.

Notwithstanding, to provide preliminary input to the REF, an assessment has been undertaken of the expected truck routes to and from the site and further requirements for construction of the development.

It is emphasised that the information provided below is indicative only, would need to be reassessed once a builder has been appointed on the project and is therefore subject to change. The consent authority is invited to impose a suitable condition of consent requiring a detailed CTMP to be submitted to and approved by Council prior to the issue of commencement. The condition should also include any site-specific requirements that Council would like addressed.

5.2. Truck Routes

The proposed truck routes to and from the site are illustrated by **Figure 8.** All trucks will arrive and depart the site via Station Street, which provides direct access to Menangle Road approximately 400 metres west of the site. Trucks will use Menangle Road to access the arterial road network to the north, by using Tindall Street and Kellicar Road to access Narellan Road (MR 178) and Hume Highway (HW 2).

Despite the construction site's close physical proximity to the Hume Motorway, direct access is not possible at a point closer than the intersection with Narellan Road, approximately 8.5 kilometres to the north. Nevertheless, it is evident that the site benefits from convenient access to the arterial road network via Menangle Road and hence trucks would not be required to circulate through local streets to access the site, except for the short section of Station Street. Accordingly, the proposed truck routes would have a limited impact on neighbouring residents and businesses.

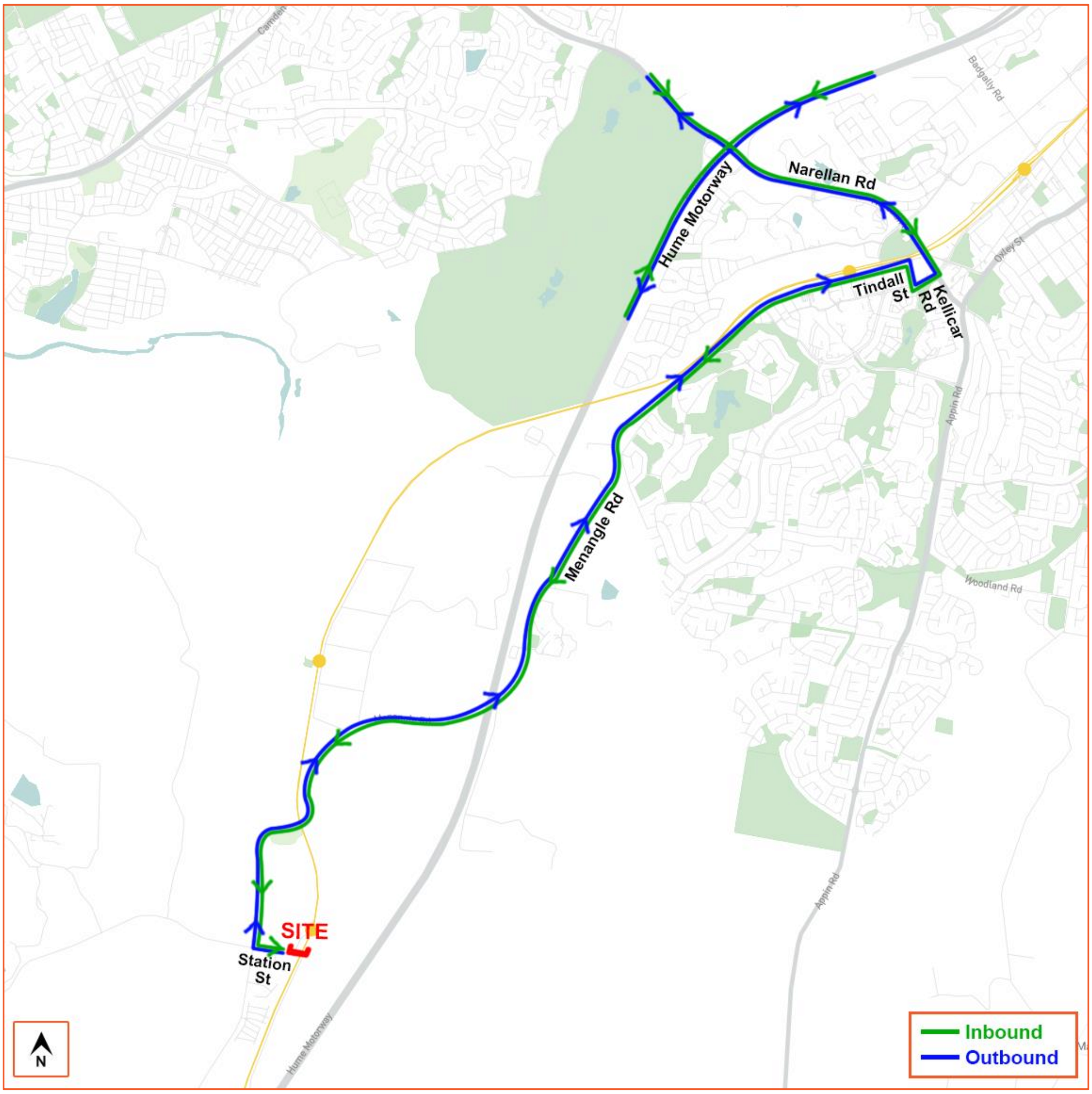


Figure 8: Truck Routes

5.3. Loading Zone

Figure 9 illustrates the indicative proposed loading zone location for the construction works. The loading zone is sited wholly within Lot 202 DP 590247 in land comprising part of Stage 4 of the proposed masterplan development. The loading zone is accessible directly via the existing unformed private driveway to the Lot via Station Street, directly east of the proposed bridge development.

Figure 9: Indicative Loading Zone Location (source: Six Maps)

Trucks using the proposed loading zone will be able to turn within Lot 202 of DP 590247 and therefore enter and exit the loading zone from and to Station Street in a forward direction.

It is noted that this loading zone location is indicative only and may change upon more refined development of the construction methodology by the contractor, prior to commencement.

5.4. Construction Programme and Duration

Limited information is available regarding construction methodology as a contractor has not been appointed, and as such detailed programming and an accurate estimate of duration of construction is not possible. Nevertheless, works are generally anticipated to include:

- Pre-assembly of product off site.
- Set out of reinforced concrete footings (piers).
- Excavation for footings / slab.
- Disposal of excavated material.

- Placement of formwork (above ground), reinforcement and concrete for footings / slab.
- Transport to site of product parts (in part or pre-assembled).
- Installation of product including craneage, hoisting and scaffolding (steel support columns, bearers, joists, balustrade, anti-throw screens, etc) – refer to **Appendix C**.
- Installation of associated civil works (kerb and gutter, stormwater pit and pipe, road pavement strip, concrete landings/pram ramp, signage, etc) – Refer to **Appendix D**.
- Provision of site amenities.
- Reinstatement works to surrounding areas.
- Removal and disposal of rubbish from site.

Night works may be required for several of the above activities; however, this will be identified and confirmed upon more refined development of the construction methodology by the contractor, prior to commencement.

Construction of the pedestrian bridge is expected to occur over a period of approximately 24 weeks; however, this is subject to change pending the contractor's proposed construction methodology. Furthermore, works within the rail corridor, Lot 11 DP 1262205, may require ARTC track possessions, the programming of which may in turn impact the construction programme and methodology.

Works within the rail corridor, such as bridge structure, abutments, and connections to the approach ramps, will likely occur during times of day coinciding with ARTC track possessions, which in turn are scheduled to achieve maximum track access time without severely impacting planned train movements. Works within the Council road reserve will adopt relatively standard construction hours, as follows:

- Monday – Friday: 7:00am – 5:00pm.
- Saturday: 8:00am – 5:00pm.
- No construction work on Sundays and public holidays.

5.5. Traffic Guidance Scheme

Based on the anticipated loading zone illustrated by **Figure 9**, a preliminary Traffic Guidance Scheme (TGS, formerly Traffic Control Plan) has been prepared to demonstrate the example traffic management arrangements that may be necessary to facilitate the safe and efficient operation of the work site. This TSG has been designed in accordance with the *RMS Traffic Control at Work Sites Manual* and *Australian Standard AS 1742.3-2009, Part 3: Traffic Control for Works on Roads*, and is provided as **Appendix G**.

It is noted however that this TGS is for illustrative purposes only, is not for construction, and would be subject to review upon appointment of a contractor and more refined construction methodology.

6. Conclusions

In summary:

- PDC Consultants has been commissioned by Mirvac Homes (NSW) Pty Limited to undertake a traffic impact assessment to support a REF relating to a proposed pedestrian bridge at Station Street, Menangle.

- The bridge will be free standing adjacent to an existing narrow vehicle bridge over the Main Southern Rail Line, which makes no provision for pedestrians or cyclists, serving a proposed masterplan development of around 380 residential lots sited on either side of the bridge. A pedestrian bridge is therefore proposed to separate pedestrian and cyclist movements from vehicular movements on the existing bridge, thus removing potential conflict and ensuring safe passage across the rail line.

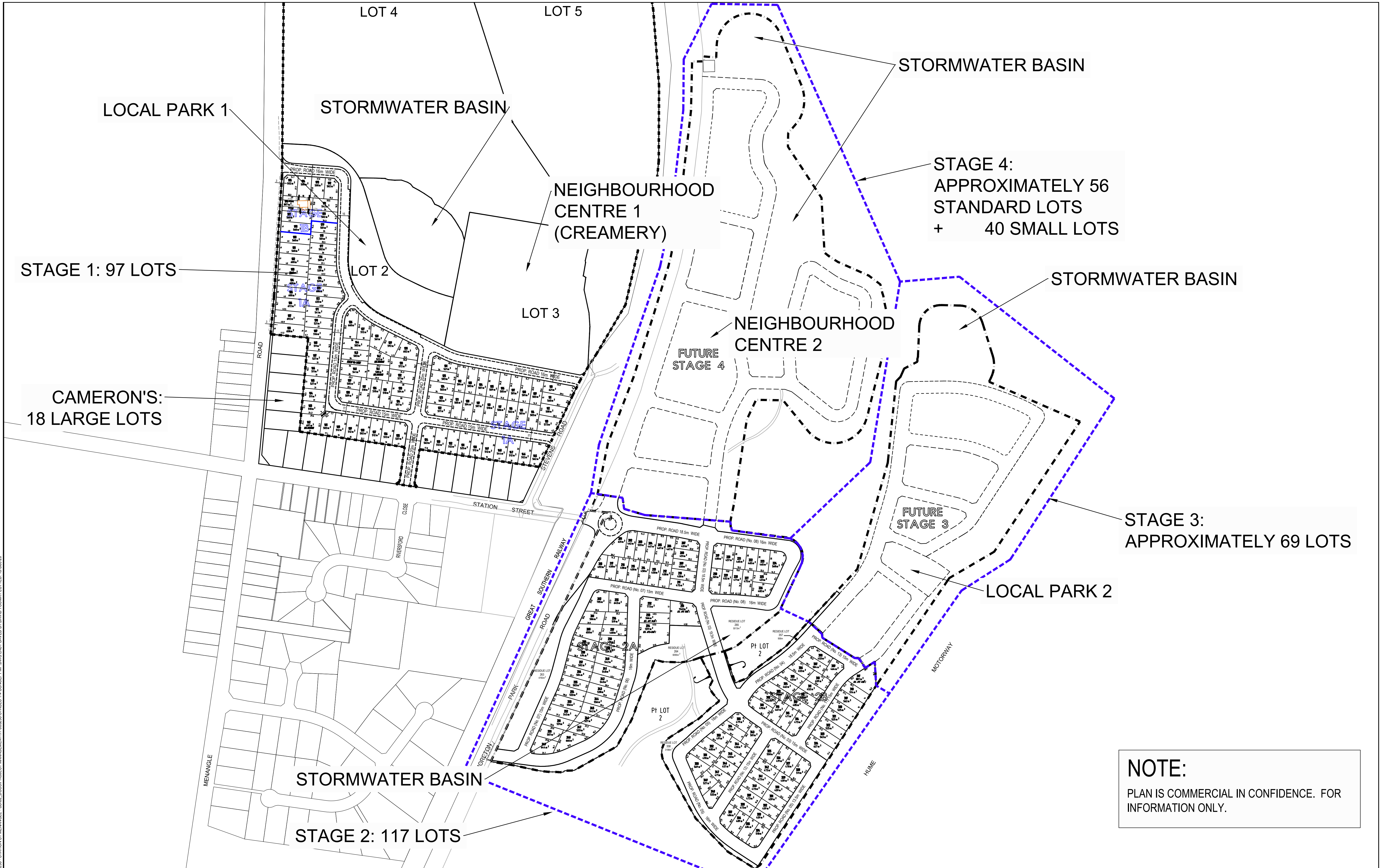
- Assessment into the capacity of the proposed 2.5-metre-wide bridge to accommodate the anticipated pedestrian demand upon completion of the entire Station Street masterplan development identifies pedestrian trip generation of up to 56 persons during a typical Thursday PM peak and 552 across the entire day, resulting in a Level of Service B, which is considered good performance.

- A preliminary assessment of construction methodology has been undertaken, identifying appropriate truck routes between the proposed bridge and arterial road network, the potential loading zone location, and indicative construction programme and duration, all of which are subject to change and refinement upon appointment of a contractor. It is also likely out of hours works will be required.

It is therefore concluded that the proposed development is supportable on traffic planning grounds.

Appendix A

Appendix A



STATUS: FOR INFORMATION	Disclaimer and Copyright: ALL DIMENSIONS TO BE CHECKED ON SITE BY CONTRACTOR PRIOR TO CONSTRUCTION. USE WRITTEN DIMENSIONS ONLY. DO NOT SCALE. NOT FOR CONSTRUCTION UNLESS STAMPED BY CERTIFYING AUTHORITY UNLESS NOTED OTHERWISE.	calibre ©2019 calibregroup.com	TITLE: CONCEPTUAL PRECINCT 1 MASTERPLAN
AUTHORISED FOR ISSUE: BY: CLAIRE KOLLARAS, SENIOR PROJECT MANAGER SIGN: DATE:			DRAWING: 17-003293-STAGES 1-4 CONCEPT MP · DATE: 15/12/2020 · REV: 0

Appendix B

R.O.A.R. DATA
Reliable, Original & Authentic Results
Ph. Mob.0418-239019

Client : pdc Consultants
Job No/Name : 7517 MENANGLE Station St Bridge
Day/Date : Wednesday 21st April 2021

Mobility scooter

Cyclists	STATION ST Over Bridge		
Time Per	EB	WB	Total
0600 - 0615	0	0	**0**
0615 - 0630	0	0	**0**
0630 - 0645	0	0	**0**
0645 - 0700	0	0	**0**
0700 - 0715	0	0	**0**
0715 - 0730	1	0	**1**
0730 - 0745	0	0	**0**
0745 - 0800	0	0	**0**
0800 - 0815	0	1	**1**
0815 - 0830	0	0	**0**
0830 - 0845	0	0	**0**
0845 - 0900	0	0	**0**
0900 - 0915	0	0	**0**
0915 - 0930	0	0	**0**
0930 - 0945	0	0	**0**
0945 - 1000	0	0	**0**
1000 - 1015	0	0	**0**
1015 - 1030	0	0	**0**
1030 - 1045	0	0	**0**
1045 - 1100	0	0	**0**
1100 - 1115	0	0	**0**
1115 - 1130	0	0	**0**
1130 - 1145	1	0	**1**
1145 - 1200	0	0	**0**
1200 - 1215	0	0	**0**
1215 - 1230	0	0	**0**
1230 - 1245	0	0	**0**
1245 - 1300	0	0	**0**
1300 - 1315	0	0	**0**
1315 - 1330	0	0	**0**
1330 - 1345	0	0	**0**
1345 - 1400	0	0	**0**
1400 - 1415	0	0	**0**
1415 - 1430	0	0	**0**
1430 - 1445	0	0	**0**
1445 - 1500	0	0	**0**
1500 - 1515	0	0	**0**
1515 - 1530	0	0	**0**
1530 - 1545	0	0	**0**
1545 - 1600	0	0	**0**
1600 - 1615	0	0	**0**
1615 - 1630	0	0	**0**
1630 - 1645	0	0	**0**
1645 - 1700	0	0	**0**
1700 - 1715	0	1	**1**
1715 - 1730	0	0	**0**
1730 - 1745	0	0	**0**
1745 - 1800	0	0	**0**
1800 - 1815	0	0	**0**
1815 - 1830	0	0	**0**
1830 - 1845	0	0	**0**
1845 - 1900	0	0	**0**
1900 - 1915	0	0	**0**
1915 - 1930	0	0	**0**
1930 - 1945	0	0	**0**
1945 - 2000	0	0	**0**
Period End	**2**	**2**	**4**

Pedestrians	STATION ST Over Bridge		
Time Per	EB	WB	Total
0600 - 0615	1	0	**1**
0615 - 0630	1	0	**1**
0630 - 0645	2	2	**4**
0645 - 0700	0	0	**0**
0700 - 0715	1	2	**3**
0715 - 0730	0	0	**0**
0730 - 0745	0	0	**0**
0745 - 0800	0	0	**0**
0800 - 0815	0	0	**0**
0815 - 0830	1	0	**1**
0830 - 0845	0	0	**0**
0845 - 0900	1	0	**1**
0900 - 0915	0	0	**0**
0915 - 0930	0	0	**0**
0930 - 0945	0	0	**0**
0945 - 1000	0	0	**0**
1000 - 1015	0	0	**0**
1015 - 1030	0	0	**0**
1030 - 1045	0	0	**0**
1045 - 1100	0	0	**0**
1100 - 1115	0	0	**0**
1115 - 1130	0	0	**0**
1130 - 1145	0	0	**0**
1145 - 1200	0	0	**0**
1200 - 1215	0	0	**0**
1215 - 1230	0	0	**0**
1230 - 1245	0	0	**0**
1245 - 1300	0	0	**0**
1300 - 1315	0	0	**0**
1315 - 1330	0	0	**0**
1330 - 1345	0	0	**0**
1345 - 1400	0	0	**0**
1400 - 1415	0	0	**0**
1415 - 1430	0	1	**1**
1430 - 1445	0	0	**0**
1445 - 1500	0	0	**0**
1500 - 1515	0	0	**0**
1515 - 1530	0	0	**0**
1530 - 1545	0	0	**0**
1545 - 1600	0	0	**0**
1600 - 1615	0	0	**0**
1615 - 1630	2	0	**2**
1630 - 1645	0	0	**0**
1645 - 1700	1	0	**1**
1700 - 1715	0	0	**0**
1715 - 1730	0	0	**0**
1730 - 1745	0	0	**0**
1745 - 1800	0	0	**0**
1800 - 1815	0	0	**0**
1815 - 1830	0	0	**0**
1830 - 1845	0	0	**0**
1845 - 1900	0	0	**0**
1900 - 1915	0	0	**0**
1915 - 1930	0	0	**0**
1930 - 1945	0	0	**0**
1945 - 2000	0	0	**0**
Period End	**10**	**5**	**15**

Combined	STATION ST Over Bridge		
Time Per	EB	WB	Total
0600 - 0615	1	0	**1**
0615 - 0630	1	0	**1**
0630 - 0645	2	2	**4**
0645 - 0700	0	0	**0**
0700 - 0715	1	2	**3**
0715 - 0730	1	0	**1**
0730 - 0745	0	0	**0**
0745 - 0800	0	0	**0**
0800 - 0815	0	1	**1**
0815 - 0830	1	0	**1**
0830 - 0845	0	0	**0**
0845 - 0900	1	0	**1**
0900 - 0915	0	0	**0**
0915 - 0930	0	0	**0**
0930 - 0945	0	0	**0**
0945 - 1000	0	0	**0**
1000 - 1015	0	0	**0**
1015 - 1030	0	0	**0**
1030 - 1045	0	0	**0**
1045 - 1100	0	0	**0**
1100 - 1115	0	0	**0**
1115 - 1130	0	0	**0**
1130 - 1145	1	0	**1**
1145 - 1200	0	0	**0**
1200 - 1215	0	0	**0**
1215 - 1230	0	0	**0**
1230 - 1245	0	0	**0**
1245 - 1300	0	0	**0**
1300 - 1315	0	0	**0**
1315 - 1330	0	0	**0**
1330 - 1345	0	0	**0**
1345 - 1400	0	0	**0**
1400 - 1415	0	0	**0**
1415 - 1430	0	1	**1**
1430 - 1445	0	0	**0**
1445 - 1500	0	0	**0**
1500 - 1515	0	0	**0**
1515 - 1530	0	0	**0**
1530 - 1545	0	0	**0**
1545 - 1600	0	0	**0**
1600 - 1615	0	0	**0**
1615 - 1630	2	0	**2**
1630 - 1645	0	0	**0**
1645 - 1700	1	0	**1**
1700 - 1715	0	1	**1**
1715 - 1730	0	0	**0**
1730 - 1745	0	0	**0**
1745 - 1800	0	0	**0**
1800 - 1815	0	0	**0**
1815 - 1830	0	0	**0**
1830 - 1845	0	0	**0**
1845 - 1900	0	0	**0**
1900 - 1915	0	0	**0**
1915 - 1930	0	0	**0**
1930 - 1945	0	0	**0**
1945 - 2000	0	0	**0**
Period End	**12**	**7**	**19**

R.O.A.R. DATA
Reliable, Original & Authentic Results
Ph. Mob.0418-239019

Client : pdc Consultants
Job No/Name : 7517 MENANGLE Station St Bridge
Day/Date : Wednesday 21st April 2021

Lights

	STATION ST Over Bridge		
Time Per	EB	WB	Total
0600 - 0615	1	3	**4**
0615 - 0630	1	1	**2**
0630 - 0645	0	2	**2**
0645 - 0700	2	1	**3**
0700 - 0715	1	3	**4**
0715 - 0730	3	1	**4**
0730 - 0745	2	5	**7**
0745 - 0800	4	4	**8**
0800 - 0815	2	4	**6**
0815 - 0830	2	4	**6**
0830 - 0845	2	6	**8**
0845 - 0900	5	2	**7**
0900 - 0915	2	1	**3**
0915 - 0930	1	3	**4**
0930 - 0945	1	2	**3**
0945 - 1000	1	2	**3**
1000 - 1015	3	3	**6**
1015 - 1030	1	1	**2**
1030 - 1045	2	6	**8**
1045 - 1100	0	2	**2**
1100 - 1115	3	3	**6**
1115 - 1130	3	1	**4**
1130 - 1145	4	5	**9**
1145 - 1200	1	1	**2**
1200 - 1215	1	3	**4**
1215 - 1230	3	3	**6**
1230 - 1245	0	4	**4**
1245 - 1300	0	4	**4**
1300 - 1315	3	3	**6**
1315 - 1330	2	3	**5**
1330 - 1345	2	2	**4**
1345 - 1400	2	2	**4**
1400 - 1415	2	3	**5**
1415 - 1430	1	1	**2**
1430 - 1445	11	3	**14**
1445 - 1500	4	3	**7**
1500 - 1515	3	4	**7**
1515 - 1530	3	3	**6**
1530 - 1545	1	4	**5**
1545 - 1600	4	4	**8**
1600 - 1615	6	1	**7**
1615 - 1630	5	3	**8**
1630 - 1645	6	3	**9**
1645 - 1700	3	2	**5**
1700 - 1715	7	5	**12**
1715 - 1730	5	4	**9**
1730 - 1745	6	4	**10**
1745 - 1800	4	3	**7**
1800 - 1815	1	2	**3**
1815 - 1830	2	0	**2**
1830 - 1845	3	1	**4**
1845 - 1900	1	0	**1**
1900 - 1915	1	1	**2**
1915 - 1930	1	0	**1**
1930 - 1945	0	1	**1**
1945 - 2000	1	0	**1**
Period End	**141**	**145**	**286**

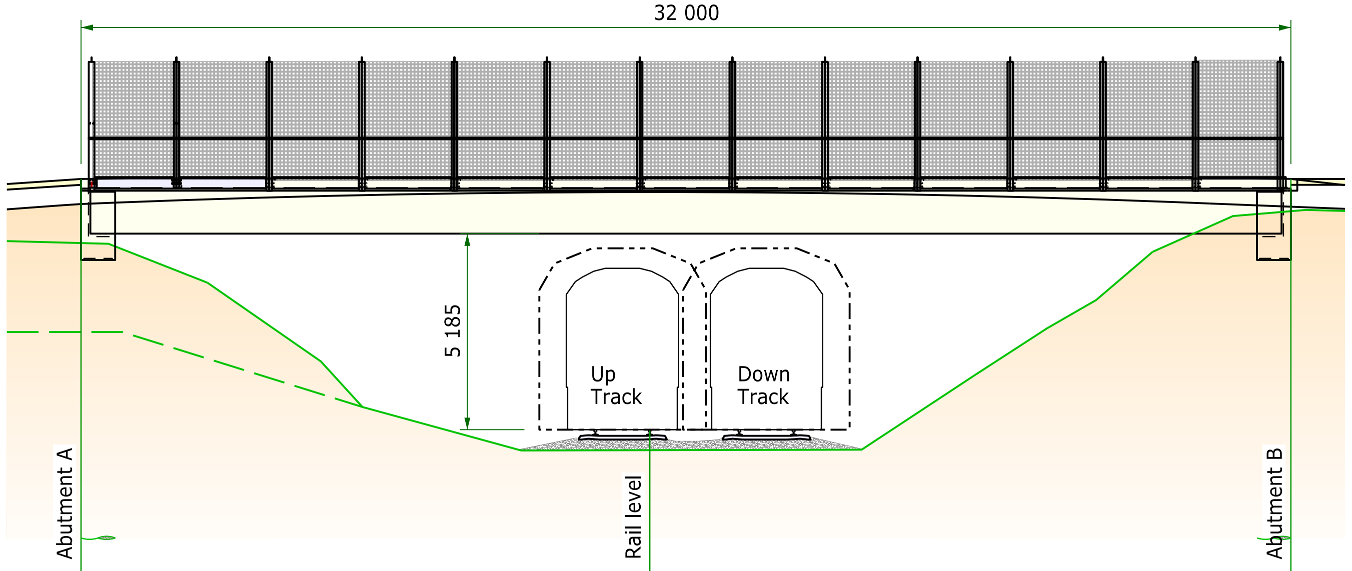
Heavies

	STATION ST Over Bridge		
Time Per	EB	WB	Total
0600 - 0615	0	0	**0**
0615 - 0630	0	1	**1**
0630 - 0645	0	1	**1**
0645 - 0700	1	0	**1**
0700 - 0715	0	0	**0**
0715 - 0730	1	0	**1**
0730 - 0745	0	0	**0**
0745 - 0800	1	1	**2**
0800 - 0815	0	1	**1**
0815 - 0830	1	0	**1**
0830 - 0845	0	1	**1**
0845 - 0900	0	1	**1**
0900 - 0915	0	0	**0**
0915 - 0930	0	0	**0**
0930 - 0945	0	0	**0**
0945 - 1000	0	0	**0**
1000 - 1015	0	1	**1**
1015 - 1030	0	0	**0**
1030 - 1045	1	0	**1**
1045 - 1100	1	0	**1**
1100 - 1115	1	3	**4**
1115 - 1130	0	0	**0**
1130 - 1145	0	1	**1**
1145 - 1200	0	0	**0**
1200 - 1215	1	1	**2**
1215 - 1230	0	1	**1**
1230 - 1245	1	0	**1**
1245 - 1300	0	0	**0**
1300 - 1315	0	0	**0**
1315 - 1330	0	0	**0**
1330 - 1345	0	0	**0**
1345 - 1400	0	0	**0**
1400 - 1415	1	0	**1**
1415 - 1430	0	0	**0**
1430 - 1445	0	1	**1**
1445 - 1500	1	0	**1**
1500 - 1515	0	0	**0**
1515 - 1530	0	0	**0**
1530 - 1545	0	0	**0**
1545 - 1600	1	0	**1**
1600 - 1615	0	0	**0**
1615 - 1630	1	1	**2**
1630 - 1645	1	1	**2**
1645 - 1700	0	0	**0**
1700 - 1715	0	0	**0**
1715 - 1730	0	0	**0**
1730 - 1745	0	0	**0**
1745 - 1800	0	0	**0**
1800 - 1815	1	0	**1**
1815 - 1830	0	1	**1**
1830 - 1845	0	0	**0**
1845 - 1900	0	0	**0**
1900 - 1915	1	0	**1**
1915 - 1930	0	0	**0**
1930 - 1945	0	0	**0**
1945 - 2000	0	0	**0**
Period End	**16**	**17**	**33**

Combined

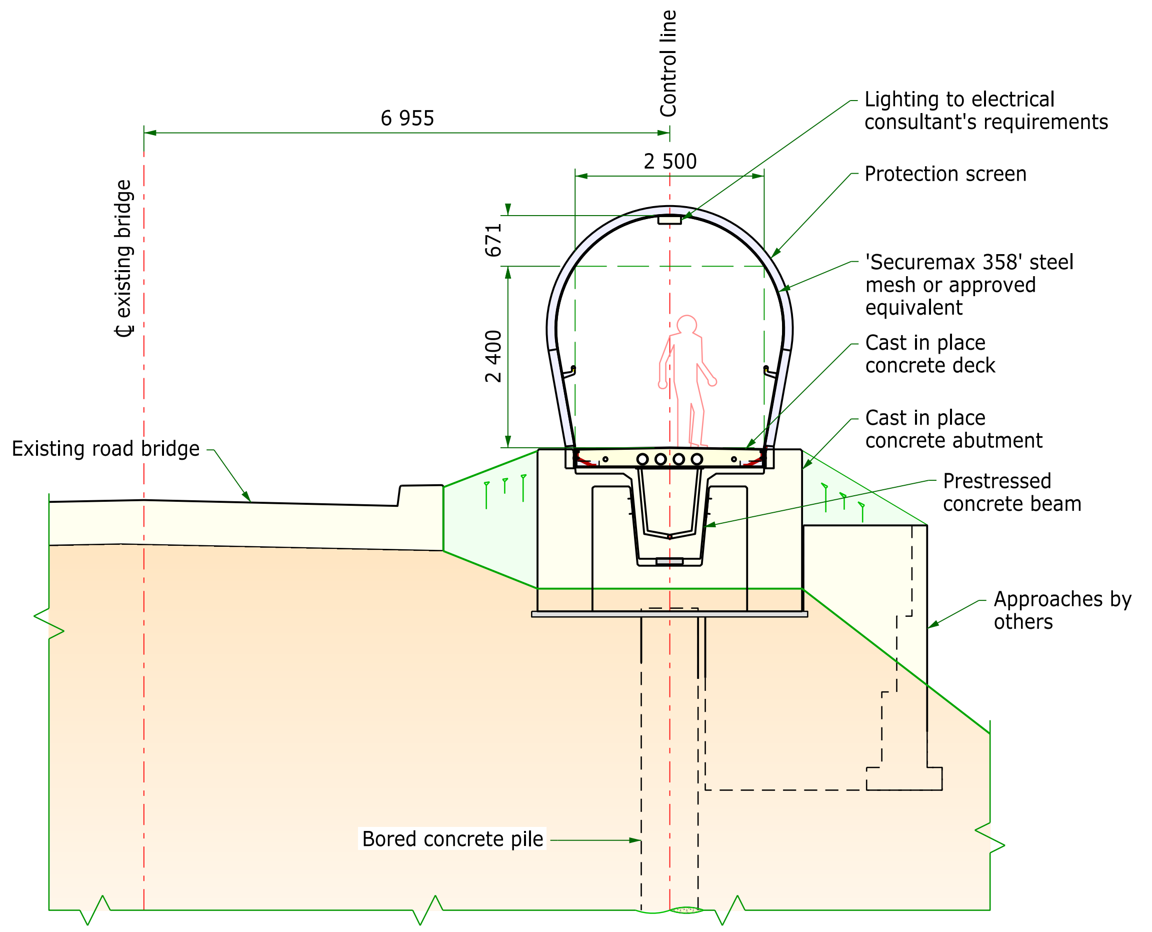
	STATION ST Over Bridge		
Time Per	EB	WB	Total
0600 - 0615	1	3	**4**
0615 - 0630	1	2	**3**
0630 - 0645	0	3	**3**
0645 - 0700	3	1	**4**
0700 - 0715	1	3	**4**
0715 - 0730	4	1	**5**
0730 - 0745	2	5	**7**
0745 - 0800	5	5	**10**
0800 - 0815	2	5	**7**
0815 - 0830	3	4	**7**
0830 - 0845	2	7	**9**
0845 - 0900	5	3	**8**
0900 - 0915	2	1	**3**
0915 - 0930	1	3	**4**
0930 - 0945	1	2	**3**
0945 - 1000	1	2	**3**
1000 - 1015	3	4	**7**
1015 - 1030	1	1	**2**
1030 - 1045	3	6	**9**
1045 - 1100	1	2	**3**
1100 - 1115	4	6	**10**
1115 - 1130	3	1	**4**
1130 - 1145	4	6	**10**
1145 - 1200	1	1	**2**
1200 - 1215	2	4	**6**
1215 - 1230	3	4	**7**
1230 - 1245	1	4	**5**
1245 - 1300	0	4	**4**
1300 - 1315	3	3	**6**
1315 - 1330	2	3	**5**
1330 - 1345	2	2	**4**
1345 - 1400	2	2	**4**
1400 - 1415	3	3	**6**
1415 - 1430	1	1	**2**
1430 - 1445	11	4	**15**
1445 - 1500	5	3	**8**
1500 - 1515	3	4	**7**
1515 - 1530	3	3	**6**
1530 - 1545	1	4	**5**
1545 - 1600	5	4	**9**
1600 - 1615	6	1	**7**
1615 - 1630	6	4	**10**
1630 - 1645	7	4	**11**
1645 - 1700	3	2	**5**
1700 - 1715	7	5	**12**
1715 - 1730	5	4	**9**
1730 - 1745	6	4	**10**
1745 - 1800	4	3	**7**
1800 - 1815	2	2	**4**
1815 - 1830	2	1	**3**
1830 - 1845	3	1	**4**
1845 - 1900	1	0	**1**
1900 - 1915	2	1	**3**
1915 - 1930	1	0	**1**
1930 - 1945	0	1	**1**
1945 - 2000	1	0	**1**
Period End	**157**	**162**	**319**

Appendix C

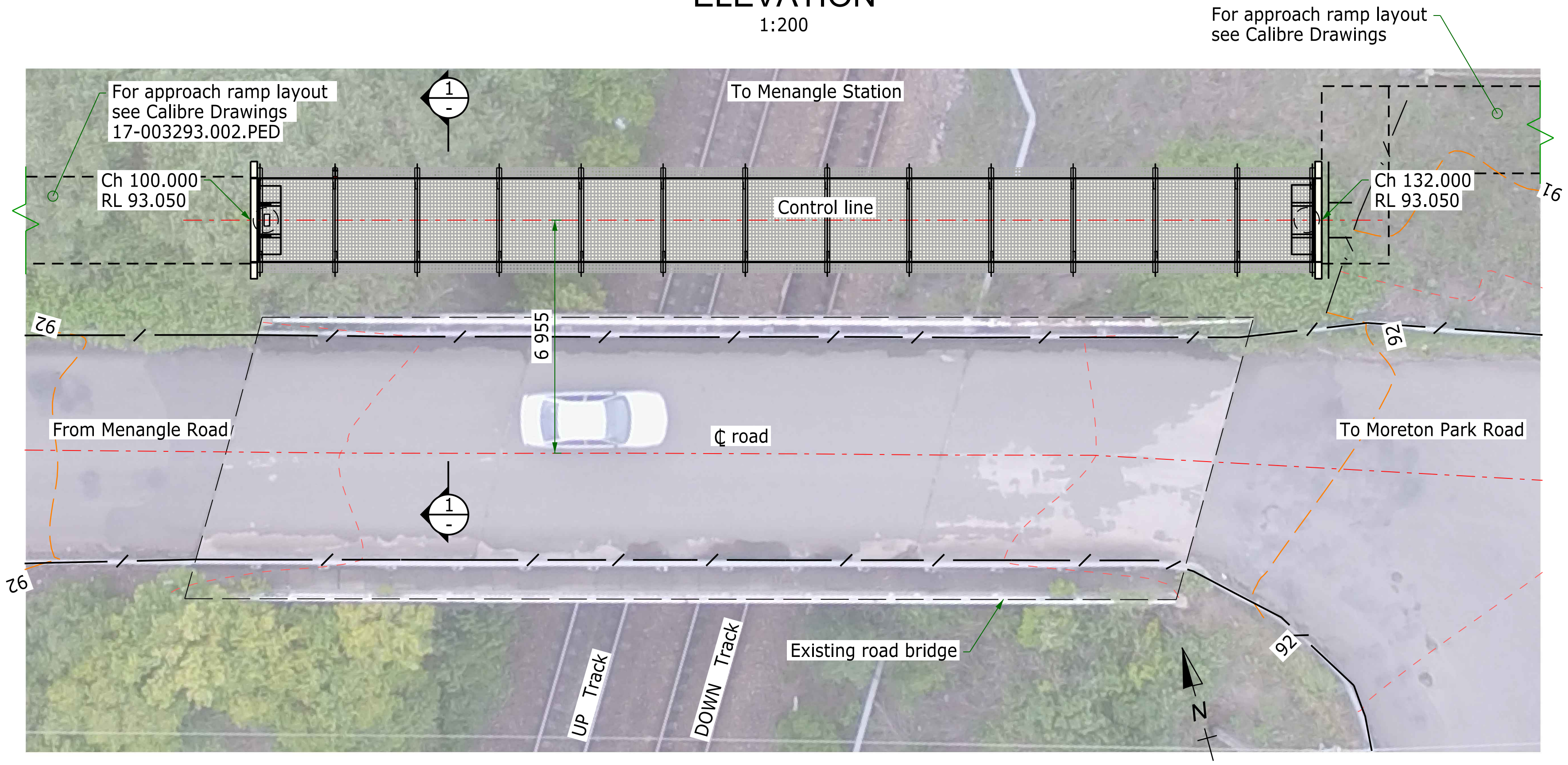


RL 82.000	Abutment A	Rail level	Abutment B
Design Level on Pedestrian Bridge Control line	93.050		93.050
Level on Existing Bridge Centreline	92.36	86.40	92.22
Chainage on Pedestrian Bridge Control Line	100.000	115.040	132.000

ELEVATION
1:200



SECTION 1/-
1:100



PLAN
1:200

General Notes
Dimensions in millimetres.
Chainages and levels are in metres.
Reduced levels are to AHD.

1:100 0 500 1000 1500 2000 2500
1:200 0 1m 2m 3m 4m 5m

DRAWING SCALES TRUE AT A3

PRELIMINARY DRAWING
NOT FOR CONSTRUCTION

Bridge Design Pty Ltd ABN 63 145 429 063

ISO 9001:2008 REGISTERED FIRM — CONSULT AUSTRALIA Member Firm

DESIGN:	JRA
VERIFIED:	L1
DRAWING:	WJS
CHECKED:	JRA

MANAGER, BRIDGE DESIGN PTY LTD

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Station Street — Wollondilly Shire Council

FOOTBRIDGE OVER RAILWAY LINE
at 0.45km east of Menangle Road

GENERAL ARRANGEMENT

JOB NUMBER B1849
DOCUMENT NUMBER D102
SHEET 2 OF 13
REVISION P1

100mm on original
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Jim 11:36:21 AM 21/07/2022

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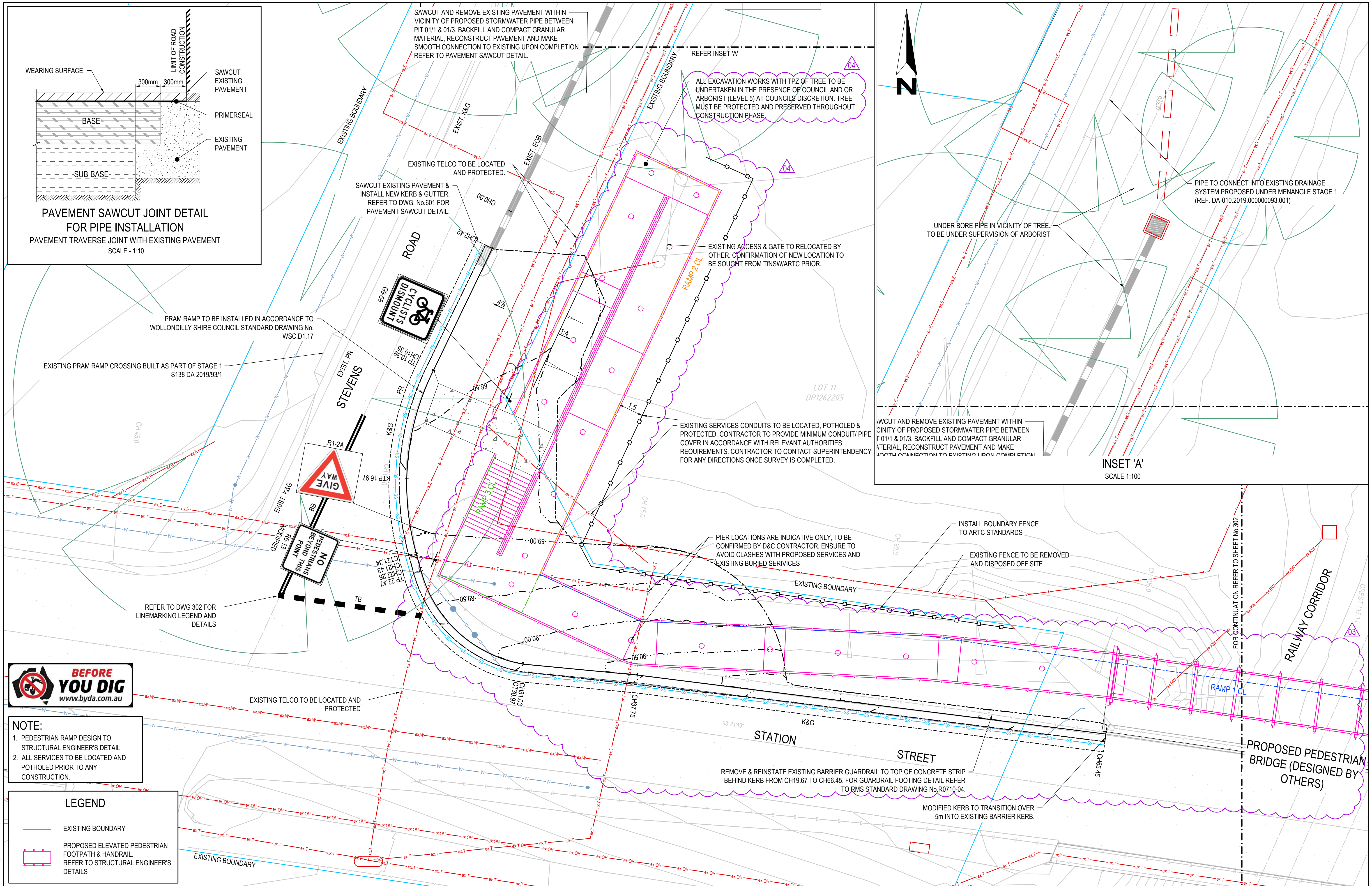
Appendix D



NOTE:

1. PEDESTRIAN RAMP DESIGN TO STRUCTURAL ENGINEER'S DETAIL
2. ALL SERVICES TO BE LOCATED AND POTHOLED PRIOR TO ANY CONSTRUCTION.

LEGEND

EXISTING BOUNDARY

PROPOSED ELEVATED PEDESTRIAN FOOTPATH & HANDRAIL. REFER TO STRUCTURAL ENGINEER'S DETAILS

FILE: H:\17\17-003293 - STATION ST MENANGLE - UD\06_MODEL\AUTOCAD\CIVIL\PEDESTRIAN BRIDGE\SWC17-003293-02-PED_LD_SWC-301.DWG LAST SAVED BY PAMA SENDURAN

		DESIGN	DRAWN	CHECK	APPD.	DATE	AMENDMENT DETAILS
FIRST ISSUE		AV	AB/JS	CK	EF	25/02/2021	
AMENDMENTS	01	AV	LH	CK	EF	10/06/2021	ISSUED FOR CONSTRUCTION CERTIFICATE
	02	AV	AB	CK	EF	01/07/2021	ISSUED FOR CONSTRUCTION CERTIFICATE
	03	AV	AV	CK	EF	18/08/2022	ISSUED FOR CONSTRUCTION CERTIFICATE
	04	RT	SS	CK	EF	26/09/2022	ISSUED FOR CONSTRUCTION CERTIFICATE

STATUS
FOR REVIEW OF ENVIRONMENTAL FACTORS (PART 5)

AUTHORISED FOR ISSUE:
BY: ENRIQUE FRANCO SIGN:
BE(Hons) MIEAust. CPEng NER DATE: 26/9/22

SCALE
0 1 2 3 4 5 6 7 8
SCALE 1:100 (A1) SCALE 1:200 (A3)

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PROJECT
STATION ST MENANGLE PEDESTRIAN BRIDGE CROSSING

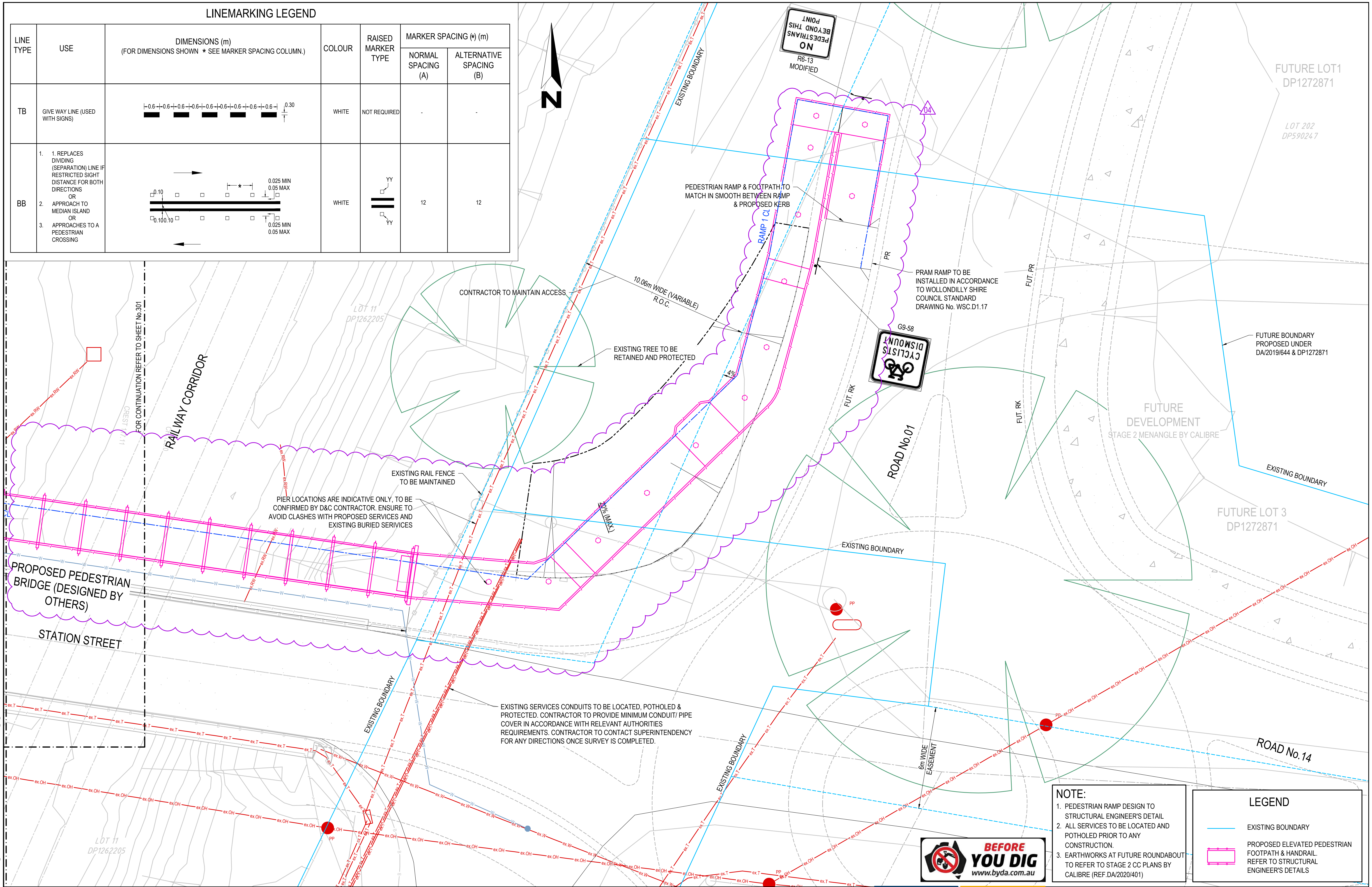
DISCLAIMER
ALL DIMENSIONS TO BE CHECKED ON SITE BY CONTRACTOR PRIOR TO CONSTRUCTION. USE WRITTEN DIMENSIONS ONLY, DO NOT SCALE. NOT FOR CONSTRUCTION UNLESS STAMPED BY CERTIFYING AUTHORITY

DRAWING TITLE
ENGINEERING PLAN SHEET 01 OF 02

PROJECT No.	DRAWING No.	MILESTONE	REVISION
17-003293.002.PED	301	REF	04

LINEMARKING LEGEND

LINE TYPE	USE	DIMENSIONS (m) (FOR DIMENSIONS SHOWN * SEE MARKER SPACING COLUMN.)	COLOUR	RAISED MARKER TYPE	MARKER SPACING (*) (m) NORMAL SPACING (A)	ALTERNATIVE SPACING (B)
TB	GIVE WAY LINE (USED WITH SIGNS)	0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.6 0.30	WHITE	NOT REQUIRED	-	-
BB	1. REPLACES DIVIDING (SEPARATION) LINE IF RESTRICTED SIGHT DISTANCE FOR BOTH DIRECTIONS OR 2. APPROACH TO MEDIAN ISLAND OR 3. APPROACHES TO A PEDESTRIAN CROSSING	0.10 * 0.025 MIN 0.05 MAX 0.10 0.10 0.025 MIN 0.05 MAX	WHITE	YY YY	12	12



NOTE:
1. PEDESTRIAN RAMP DESIGN TO STRUCTURAL ENGINEER'S DETAIL
2. ALL SERVICES TO BE LOCATED AND POTHOLED PRIOR TO ANY CONSTRUCTION.
3. EARTHWORKS AT FUTURE ROUNDABOUT TO REFER TO STAGE 2 CC PLANS BY CALIBRE (REF.DA/2020/401)

LEGEND

EXISTING BOUNDARY

PROPOSED ELEVATED PEDESTRIAN FOOTPATH & HANDRAIL. REFER TO STRUCTURAL ENGINEER'S DETAILS

	DESIGN	DRAWN	CHECK	APPD.	DATE	AMENDMENT DETAILS
FIRST ISSUE	AV	AB/JS	CK	EF	25/02/2021	
01	AV	LH	CK	EF	10/06/2021	ISSUED FOR CONSTRUCTION CERTIFICATE
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03	AV	AV	CK	EF	18/08/2022	ISSUED FOR CONSTRUCTION CERTIFICATE
04	RT	SS	CK	EF	26/09/2022	ISSUED FOR CONSTRUCTION CERTIFICATE

AMENDMENTS

STATUS
FOR REVIEW OF ENVIRONMENTAL FACTORS (PART 5)

AUTHORISED FOR ISSUE:
BY: ENRIQUE FRANCO
BE(Hons) MIEAust. CPEng NER
SIGN:
DATE: 28/9/22

SCALE
0 1 2 3 4 5 6 7 8
SCALE 1:100 (A1) SCALE 1:200 (A3)

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PROJECT
STATION ST MENANGLE PEDESTRIAN BRIDGE CROSSING

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DRAWING TITLE
ENGINEERING PLAN SHEET 02 OF 02

PROJECT No.	DRAWING No.	MILESTONE	REVISION
17-003293.002.PED	302	REF	04

FILE: H:\17\17-003293 - STATION ST MENANGLE - UD\06_MODEL\AUTOCAD\CIVIL\PEDESTRIAN BRIDGE\SWC\17-003293-02-PED_LD_SWC-302.DWG LAST SAVED BY PAMA SENDURAN

Appendix E

~~boundary intersection is not significant. The travel speed is between 67% and 85% of the base free-flow speed, and the volume-to-capacity ratio is no greater than 1.0.~~

~~LOS C describes stable operation. The ability to maneuver and change lanes at midsegment locations may be more restricted than at LOS B. Longer queues at the boundary intersection may contribute to lower travel speeds. The travel speed is between 50% and 67% of the base free-flow speed, and the volume-to-capacity ratio is no greater than 1.0.~~

~~LOS D indicates a less stable condition in which small increases in flow may cause substantial increases in delay and decreases in travel speed. This operation may be due to adverse signal progression, high volume, or inappropriate signal timing at the boundary intersection. The travel speed is between 40% and 50% of the base free-flow speed, and the volume-to-capacity ratio is no greater than 1.0.~~

~~LOS E is characterized by unstable operation and significant delay. Such operations may be due to some combination of adverse progression, high volume, and inappropriate signal timing at the boundary intersection. The travel speed is between 30% and 40% of the base free-flow speed, and the volume-to-capacity ratio is no greater than 1.0.~~

~~LOS F is characterized by flow at extremely low speed. Congestion is likely occurring at the boundary intersection, as indicated by high delay and extensive queuing. The travel speed is 30% or less of the base free-flow speed, or the volume-to-capacity ratio is greater than 1.0.~~

~~Exhibit 17-2 lists the LOS thresholds established for the automobile mode on urban streets.~~

~~**Exhibit 17-2**~~
~~LOS Criteria: Automobile Mode~~

Travel Speed as a ~~Percentage of Base Free-Flow Speed (%)~~	~~**LOS by Volume-to-Capacity Ratio[a]**~~	
	~~**≤1.0**~~	~~**> 1.0**~~
~~>85~~	~~A~~	~~F~~
~~>67–85~~	~~B~~	~~F~~
~~>50–67~~	~~C~~	~~F~~
~~>40–50~~	~~D~~	~~F~~
~~>30–40~~	~~E~~	~~F~~
~~≤30~~	~~F~~	~~F~~

~~Note: [a] Volume-to-capacity ratio of through movement at downstream boundary intersection.~~

Nonautomobile Modes

Historically, this manual has used a single performance measure as the basis for defining LOS. However, research documented in Chapter 5, Quality and Level-of-Service Concepts, indicates that travelers consider a wide variety of factors when they assess the quality of service provided to them. Some of these factors can be described as performance measures (e.g., speed), and others can be described as basic descriptors of the urban street character (e.g., sidewalk width). The methodology for evaluating each mode provides a procedure for mathematically combining these factors into a score. This score is then used to determine the LOS that is provided for a given direction of travel along a segment.

Exhibit 17-3 lists the scores associated with each LOS for the pedestrian travel mode. The LOS for this particular mode is determined by consideration of both the LOS score and the average pedestrian space on the sidewalk. The applicable LOS for an evaluation is determined from the table by finding the intersection of the row corresponding to the computed score value and the column corresponding to the computed space value.

Exhibit 17-3
LOS Criteria: Pedestrian Mode

Pedestrian LOS Score	LOS by Average Pedestrian Space (ft^2/p) >60	>40–60	>24–40	>15–24	>8.0–15[a]	≤ 8.0[a]
≤2.00	A	B	C	D	E	F
>2.00–2.75	B	B	C	D	E	F
>2.75–3.50	C	C	C	D	E	F
>3.50–4.25	D	D	D	D	E	F
>4.25–5.00	E	E	E	E	E	F
>5.00	F	F	F	F	F	F

Note: [a] In cross-flow situations, the LOS E/F threshold is 13 ft^2/p.

The association between LOS score and LOS is based on traveler perception research. Travelers were asked to rate the quality of service associated with a specific trip along an urban street. The letter "A" was used to represent the "best" quality of service, and the letter "F" was used to represent the "worst" quality of service. "Best" and "worst" were left undefined, allowing the respondents to identify the best and worst conditions on the basis of their traveling experience and perception of service quality.

Exhibit 17-4 lists the range of scores that are associated with each LOS for the bicycle and transit modes. This exhibit is also applicable for determining pedestrian LOS when a sidewalk is not available.

Exhibit 17-4
LOS Criteria: Bicycle and Transit Modes

LOS	LOS Score
A	≤2.00
B	>2.00–2.75
C	>2.75–3.50
D	>3.50–4.25
E	>4.25–5.00
F	>5.00

REQUIRED INPUT DATA

This subsection describes the required input data for the automobile, pedestrian, bicycle, and transit methodologies. Default values for some of these data are described in Section 3, Applications.

Automobile Mode

This part describes the input data needed for the automobile methodology. The data are listed in Exhibit 17-5 and are identified as "input data elements." They must be separately specified for each direction of travel on the segment and for each boundary intersection.

The last column in Exhibit 17-5 indicates whether the input data are needed for a movement group at a boundary intersection, the overall intersection, or the segment. The input data needed to evaluate the boundary intersections are identified in the appropriate chapter (i.e., Chapters 18 to 22).

Equation 17-21

$$P_F = \left(1 + e^{3.8044 - 0.253\, H_{seg} + 0.3434\, P_{LTL,seg}}\right)^{-1}$$

where

$I_{a,seg}$ = automobile traveler perception score for segment;

P_{BCDEF} = probability that an individual will respond with a rating of B, C, D, E, or F;

P_{CDEF} = probability that an individual will respond with a rating of C, D, E, or F;

P_{DEF} = probability that an individual will respond with a rating of D, E, or F;

P_{EF} = probability that an individual will respond with a rating of E or F;

P_F = probability that an individual will respond with a rating of F; and

$P_{LTL,seg}$ = proportion of intersections with a left-turn lane (or bay) on the segment (decimal).

Other variables are as previously defined. The derivation of Equation 17-16 is based on the assignment of scores to each letter rating, in which a score of "1" is assigned to the rating of A (denoting "best"), "2" is assigned to B, and so on. The survey results were used to calibrate a set of models that collectively predicts the probability that a traveler will assign various rating combinations for a specified spatial stop rate and proportion of intersections with left-turn lanes. The score obtained from Equation 17-16 represents the expected (or long-run average) score for the population of travelers.

The proportion of intersections with left-turn lanes equals the number of left-turn lanes (or bays) encountered while driving along the segment divided by the number of intersections encountered. The signalized boundary intersection is counted (if it exists). All unsignalized intersections of public roads are counted. Private driveway intersections are not counted, unless they are signal controlled.

The score obtained from Equation 17-16 provides a useful indication of performance from the perspective of the traveler. Scores of 2.0 or less indicate the best perceived service, and values in excess of 5.0 indicate the worst perceived service. Although this score is closely tied to the concept of service quality, it is *not* used to determine LOS for the urban street segment.

PEDESTRIAN MODE

This subsection describes the methodology for evaluating the performance of an urban street segment in terms of its service to pedestrians.

Urban street segment performance from a pedestrian perspective is separately evaluated for each side of the street. *Unless otherwise stated, all variables identified in this section are specific to the subject side of the street.* If a sidewalk is not available for the subject side of the street, then it is assumed that pedestrians will walk in the street on that side (even if there is a sidewalk on the other side).

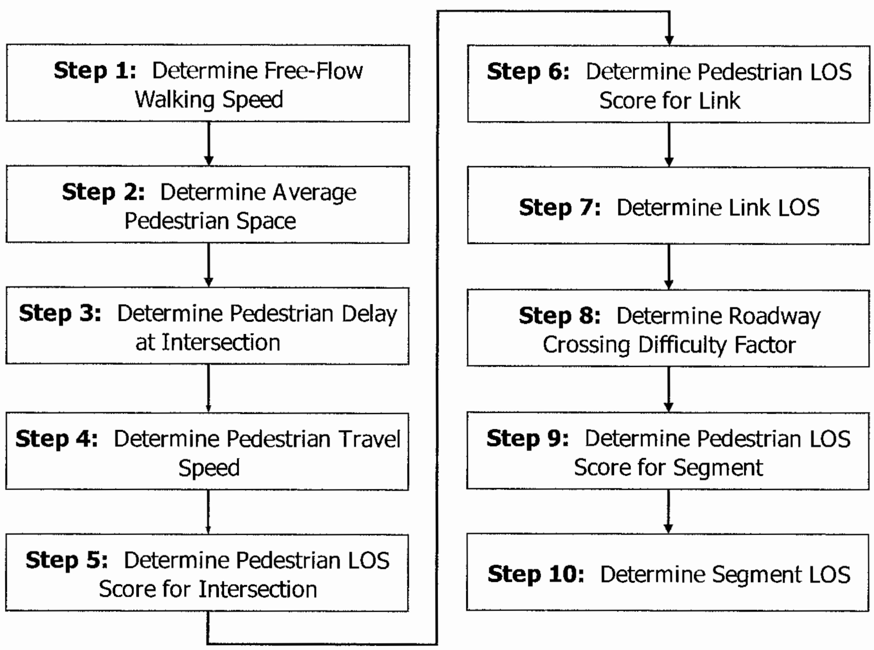
The methodology is focused on the analysis of a segment with either signal-controlled or two-way STOP-controlled boundary intersections. Chapter 18 describes a methodology for evaluating signalized intersection performance from a pedestrian perspective. No methodology exists for evaluating two-way STOP-controlled intersection performance (with the cross street STOP controlled). However, it is reasoned that this type of control has negligible influence on pedestrian service along the segment. This edition of the HCM does not include a procedure for evaluating a segment's performance when the boundary intersection is an all-way STOP-controlled intersection, a roundabout, or a signalized interchange ramp terminal.

The pedestrian methodology is applied through a series of nine steps that culminate in the determination of the segment LOS. These steps are illustrated in Exhibit 17-15. Performance measures that are estimated include

- Pedestrian travel speed,
- Average pedestrian space, and
- Pedestrian LOS scores for the link and segment.

A methodology for evaluating off-street pedestrian facilities is provided in Chapter 23, Off-Street Pedestrian and Bicycle Facilities.

Exhibit 17-15
Pedestrian Methodology for Urban Street Segments



Link-Based Evaluation

Steps 6 and 7 of the pedestrian methodology can be used as a stand-alone procedure for link-based evaluation of pedestrian service. This approach is regularly used by local, regional, and state transportation agencies. It offers the advantage of being less data-intensive than the full, 10-step methodology and produces results that are generally reflective of pedestrian perceptions of service along the roadway. It can be especially attractive when agencies are performing a networkwide evaluation for a large number of roadway links.

The analyst should recognize that the resulting link LOS does not consider some aspects of pedestrian travel along a segment (e.g., crossing difficulty or intersection service). For this reason, the LOS score for the link should not be aggregated for the purpose of characterizing facility performance. The analyst should also be aware that this approach precludes an integrated multimodal evaluation because it does not fully reflect segment performance.

Concepts

The methodology provides a variety of measures for evaluating segment performance in terms of its service to pedestrians. Each measure describes a different aspect of the pedestrian trip along the segment. One measure is the LOS score. This score is an indication of the typical pedestrian's perception of the overall segment travel experience. A second measure is the average speed of pedestrians traveling along the segment.

A third measure is based on the concept of "circulation area." It represents the average amount of sidewalk area available to each pedestrian walking along the segment. A larger area is more desirable from the pedestrian perspective. Exhibit 17-16 provides a qualitative description of pedestrian space that can be used to evaluate sidewalk performance from a circulation-area perspective.

Exhibit 17-16 Qualitative Description of Pedestrian Space

Pedestrian Space (ft^2/p)		
Random Flow	**Platoon Flow**	**Description**
>60	>530	Ability to move in desired path, no need to alter movements
>40–60	>90–530	Occasional need to adjust path to avoid conflicts
>24–40	>40–90	Frequent need to adjust path to avoid conflicts
>15–24	>23–40	Speed and ability to pass slower pedestrians restricted
>8–15	>11–23	Speed restricted, very limited ability to pass slower pedestrians
≤8	≤11	Speed severely restricted, frequent contact with other users

The first two columns in Exhibit 17-16 indicate a sensitivity to flow condition. Random pedestrian flow is typical of most segments. Platoon flow is appropriate for shorter segments (e.g., in downtown areas) with signalized boundary intersections.

Step 1: Determine Free-Flow Walking Speed

The *average* free-flow pedestrian walking speed S_{pf} is needed for the evaluation of urban street segment performance from a pedestrian perspective. This speed should reflect conditions in which there are negligible pedestrian-to-pedestrian conflicts and negligible adjustments in a pedestrian's desired walking path to avoid other pedestrians.

Research indicates that walking speed is influenced by pedestrian age and sidewalk grade (*6*). If 0% to 20% of pedestrians traveling along the subject segment are elderly (i.e., 65 years of age or older), an average free-flow walking speed of 4.4 ft/s is recommended for segment evaluation. If more than 20% of pedestrians are elderly, an average free-flow walking speed of 3.3 ft/s is recommended. In addition, an upgrade of 10% or greater reduces walking speed by 0.3 ft/s.

Step 2: Determine Average Pedestrian Space

Pedestrians are sensitive to the amount of space separating them from other pedestrians and obstacles as they walk along a sidewalk. Average pedestrian space is an indicator of segment performance for travel in a sidewalk. It depends on the effective sidewalk width, pedestrian flow rate, and walking speed. This step is not applicable when the sidewalk does not exist.

A. Compute Effective Sidewalk Width

The effective sidewalk width equals the total walkway width less the effective width of fixed objects located on the sidewalk and less any shy distance associated with the adjacent street or a vertical obstruction. Fixed objects can be continuous (e.g., a fence or a building face) or discontinuous (e.g., trees, poles, or benches).

The effective sidewalk width is an average value for the length of the link. It is computed by using Equation 17-22 to Equation 17-26.

$$W_E = W_T - W_{O,i} - W_{O,o} - W_{s,i} - W_{s,o} \quad \geq 0.0$$

Equation 17-22

with

$$W_{s,i} = \max(W_{buf}, 1.5)$$

Equation 17-23

$$W_{s,o} = 3.0 p_{\text{window}} + 2.0\, p_{\text{building}} + 1.5\, p_{\text{fence}}$$

Equation 17-24

$$W_{O,i} = w_{O,i} - W_{s,i} \quad \geq 0.0$$

Equation 17-25

$$W_{O,o} = w_{O,o} - W_{s,o} \quad \geq 0.0$$

Equation 17-26

where

W_E = effective sidewalk width (ft),

W_T = total walkway width (ft),

$W_{O,i}$ = adjusted fixed-object effective width on inside of sidewalk (ft),

$W_{O,o}$ = adjusted fixed-object effective width on outside of sidewalk (ft),

$W_{s,i}$ = shy distance on inside (curb side) of sidewalk (ft),

$W_{s,o}$ = shy distance on outside of sidewalk (ft),

W_{buf} = buffer width between roadway and sidewalk (ft),

p_{window} = proportion of sidewalk length adjacent to a window display (decimal),

p_{building} = proportion of sidewalk length adjacent to a building face (decimal),

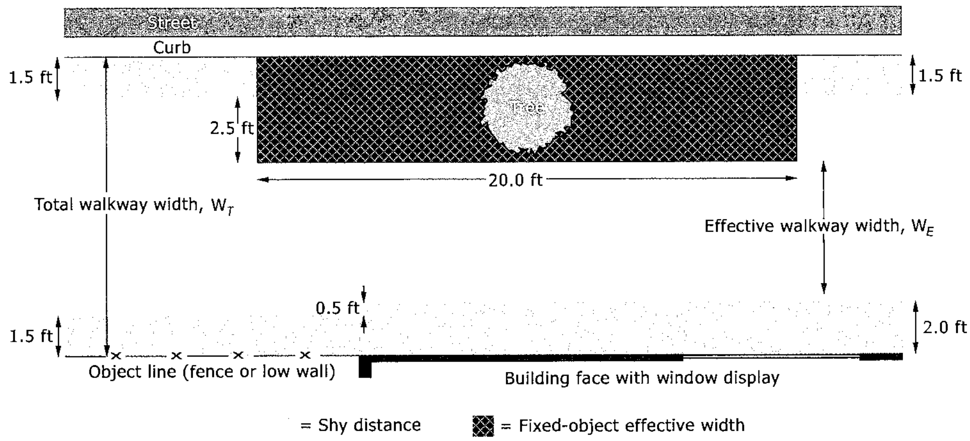
p_{fence} = proportion of sidewalk length adjacent to a fence or low wall (decimal),

$w_{O,i}$ = effective width of fixed objects on inside of sidewalk (ft), and

$w_{O,o}$ = effective width of fixed objects on outside of sidewalk (ft).

The relationship between the variables in these equations is illustrated in Exhibit 17-17.

Exhibit 17-17
Width Adjustments for Fixed Objects



The variables W_T, W_{buf}, p_{window}, p_{building}, p_{fence}, $w_{O,i}$, and $w_{O,o}$ are input variables. They represent average, or typical, values for the length of the sidewalk. Chapter 23, Off-Street Pedestrian and Bicycle Facilities, provides guidance for estimating the effective width of many common fixed objects.

Typical shy distances are shown in Exhibit 17-17. Shy distance on the inside (curb side) of the sidewalk is measured from the outside edge of the paved roadway (or face of curb, if present). It is generally considered to equal 1.5 ft. Shy distance on the outside of the sidewalk is 1.5 ft if a fence or a low wall is present, 2.0 ft if a building is present, 3.0 ft if window display is present, and 0.0 ft otherwise.

B. Compute Pedestrian Flow Rate per Unit Width

The pedestrian flow per unit width of sidewalk is computed by using Equation 17-27 for the subject sidewalk. The variable v_{ped} is an input variable.

Equation 17-27

$$v_p = \frac{v_{ped}}{60\ W_E}$$

where

v_p = pedestrian flow per unit width (p/ft/min),

v_{ped} = pedestrian flow rate in the subject sidewalk (walking in both directions) (p/h), and

W_E = effective sidewalk width (ft).

C. Compute Average Walking Speed

The average walking speed S_p is computed by using Equation 17-28. This equation is derived from the relationship between flow rate and average walking speed described in Exhibit 23-1 of Chapter 23.

Equation 17-28

$$S_p = (1 - 0.00078\ v_p^2)\ S_{pf} \quad \geq 0.5\ S_{pf}$$

where S_p = pedestrian walking speed (ft/s), S_{pf} = free-flow pedestrian walking speed (ft/s), and v_p = pedestrian flow per unit width (p/ft/min).

D. Compute Pedestrian Space

Finally, Equation 17-29 is used to compute average pedestrian space.

$$A_p = 60\,\frac{S_p}{v_p}$$

Equation 17-29

where A_p is the pedestrian space (ft^2/p) and other variables are as previously defined.

The pedestrian space obtained from Equation 17-29 can be compared with the ranges provided in Exhibit 17-16 to make some judgments about the performance of the subject intersection corner.

Step 3: Determine Pedestrian Delay at Intersection

Pedestrian delay at three locations along the segment is determined in this step. Each of these delays represents an input variable for the methodology and is described in Section 1, Required Input Data.

The first delay variable represents the delay incurred by pedestrians who travel through the boundary intersection along a path that is parallel to the segment centerline d_{pp}. The second delay variable represents the delay incurred by pedestrians who cross the segment at the nearest signal-controlled crossing d_{pc}. The third delay variable represents the delay incurred by pedestrians waiting for a gap to cross the segment at an uncontrolled location d_{pw}.

Step 4: Determine Pedestrian Travel Speed

Pedestrian travel speed represents an aggregate measure of speed along the segment. It combines the delay incurred at the downstream boundary intersection plus the time required to walk the length of the segment. As such, it is typically slower than the average walking speed. The pedestrian travel speed is computed by using Equation 17-30.

$$S_{Tp,seg} = \frac{L}{\dfrac{L}{S_p} + d_{pp}}$$

Equation 17-30

where

$S_{Tp,seg}$ = travel speed of through pedestrians for the segment (ft/s),

L = segment length (ft),

S_p = pedestrian walking speed (ft/s), and

d_{pp} = pedestrian delay when walking parallel to the segment (s/p).

In general, a travel speed of 4.0 ft/s or more is considered desirable and a speed of 2.0 ft/s or less is considered undesirable.

Step 5: Determine Pedestrian LOS Score for Intersection

The pedestrian LOS score for the boundary intersection $I_{p,int}$ is determined in this step. If the boundary intersection is signalized, then the pedestrian methodology described in Chapter 18 is used for this determination. If the boundary intersection is two-way STOP controlled, then the score is equal to 0.0.

Step 6: Determine Pedestrian LOS Score for Link

The pedestrian LOS score for the link $I_{p,link}$ is calculated by using Equation 17-31.

Equation 17-31

$$I_{p,link} = 6.0468 + F_w + F_v + F_S$$

with

Equation 17-32

$$F_w = -1.2276\ \ln(W_v + 0.5\ W_1 + 50\ p_{pk} + W_{buf}\ f_b + W_{aA}\ f_{sw})$$

Equation 17-33

$$F_v = 0.0091\ \frac{v_m}{4\ N_{th}}$$

Equation 17-34

$$F_s = 4\left(\frac{S_R}{100}\right)^2$$

where

$I_{p,link}$ = pedestrian LOS score for link;

F_w = cross-section adjustment factor;

F_v = motorized vehicle volume adjustment factor;

F_S = motorized vehicle speed adjustment factor;

$\ln(x)$ = natural log of x;

W_v = effective total width of outside through lane, bicycle lane, and shoulder as a function of traffic volume (see Exhibit 17-18) (ft);

W_1 = effective width of combined bicycle lane and shoulder (see Exhibit 17-18) (ft);

p_{pk} = proportion of on-street parking occupied (decimal);

W_{buf} = buffer width between roadway and available sidewalk (= 0.0 if sidewalk does not exist) (ft);

f_b = buffer area coefficient = 5.37 for any continuous barrier at least 3 ft high that is located between the sidewalk and the outside edge of roadway; otherwise use 1.0;

W_A = available sidewalk width = 0.0 if sidewalk does not exist or $W_T - W_{buf}$ if sidewalk exists (ft);

W_{aA} = adjusted available sidewalk width = min(W_A, 10) (ft);

f_{sw} = sidewalk width coefficient = 6.0 – 0.3 W_{aA};

v_m = midsegment demand flow rate (direction nearest to the subject sidewalk) (veh/h);

N_{th} = number of through lanes on the segment in the subject direction of travel (ln); and

S_R = motorized vehicle running speed = (3,600 L)/(5,280 t_R) (mi/h).

The value used for several of the variables in Equation 17-32 to Equation 17-34 is dependent on various conditions. These conditions are identified in Column 1 of Exhibit 17-18. If the condition is satisfied, then the equation in Column 2 is used to compute the variable value. If it is not satisfied, then the equation in Column 3 is used. The equations in the first two rows are considered in sequence to determine the effective width of the outside lane and shoulder W_v.

Exhibit 17-18
Variables for Pedestrian LOS Score for Link

Condition	Variable When Condition Is Satisfied	Variable When Condition Is Not Satisfied
$p_{pk} = 0.0$	$W_t = W_{ol} + W_{bl} + W_{os}^*$	$W_t = W_{ol} + W_{bl}$
$v_m > 160$ veh/h or street is divided	$W_v = W_t$	$W_v = W_t(2 - 0.005\ v_m)$
$p_{pk} < 0.25$ or parking is striped	$W_1 = W_{bl} + W_{os}^*$	$W_1 = 10$

Notes: W_t = total width of the outside through lane, bicycle lane, and paved shoulder (ft);
W_{ol} = width of the outside through lane (ft);
W_{os}^* = adjusted width of paved outside shoulder; if curb is present $W_{os}^* = W_{os} - 1.5 \geq 0.0$, otherwise $W_{os}^* = W_{os}$ (ft);
W_{os} = width of paved outside shoulder (ft); and
W_{bl} = width of the bicycle lane = 0.0 if bicycle lane not provided (ft).

The buffer width coefficient determination is based on the presence of a continuous barrier in the buffer. In making this determination, repetitive vertical objects (e.g., trees or bollards) are considered to represent a continuous barrier if they are at least 3 ft high and have an average spacing of 20 ft or less. For example, the sidewalk shown in Exhibit 17-17 does not have a continuous buffer because the street trees adjacent to the curb are spaced at more than 20 ft.

The pedestrian LOS score is sensitive to the separation between pedestrians and moving vehicles; it is also sensitive to the speed and volume of these vehicles. Physical barriers and parked cars between moving vehicles and pedestrians effectively increase the separation distance and the perceived quality of service. Higher vehicle speeds or volumes lower the perceived quality of service.

If the sidewalk is not continuous for the length of the segment, then the segment should be subdivided into subsegments and each subsegment separately evaluated. For this application, a subsegment is defined to begin or end at each break in the sidewalk. Each subsegment is then separately evaluated by using Equation 17-31. Each equation variable is uniquely quantified to represent the subsegment to which it applies. The buffer width and the effective sidewalk width are each set to 0.0 ft for any subsegment without a sidewalk. The pedestrian LOS score $I_{p,link}$ is then computed as a weighted average of the subsegment scores, where the weight assigned to each score equals the portion of the segment length represented by the corresponding subsegment.

The motorized vehicle running speed is computed by using the automobile methodology, as described in a previous subsection.

Step 7: Determine Link LOS

The pedestrian LOS for the link is determined by using the pedestrian LOS score from Step 6 and the average pedestrian space from Step 2. These two performance measures are compared with their respective thresholds in Exhibit

17-3 to determine the LOS for the specified direction of travel along the subject link. If a sidewalk does not exist and pedestrians are relegated to walking in the street, then LOS is determined by using Exhibit 17-4 because the pedestrian space concept does not apply.

~~Step 8: Determine Roadway Crossing Difficulty Factor~~

~~The pedestrian roadway crossing difficulty factor measures the difficulty of crossing the street between boundary intersections. Segment performance from a pedestrian perspective is reduced if the crossing is perceived to be difficult.~~

~~The roadway crossing difficulty factor is based on the delay incurred by a pedestrian who crosses the subject segment. One crossing option the pedestrian may consider is to alter his or her travel path by diverting to the nearest signal-controlled crossing. This crossing location may be a midsegment signalized crosswalk or it may be a signalized intersection.~~

~~A second crossing option is to continue on the original travel path by completing a midsegment crossing at an uncontrolled location. If this type of crossing is legal along the subject segment, then the pedestrian crosses when there is an acceptable gap in the motorized vehicle stream.~~

~~Each of these two crossing options is considered in this step, with that option requiring the least delay used as the basis for computing the pedestrian roadway crossing difficulty factor. The time to walk across the segment is common to both options and therefore is not included in the delay estimate for either option.~~

~~*A. Compute Diversion Delay*~~

~~The delay incurred as a consequence of diverting to the nearest signal-controlled crossing is computed first. It includes the delay involved in walking to and from the midsegment crossing point to the nearest signal-controlled crossing and the delay waiting to cross at the signal. Hence, calculation of this delay requires knowledge of the distance to the nearest signalized crossing and its signal timing.~~

~~The distance to the nearest crossing location~~ $\cancel{D_c}$ ~~is based on one of two approaches. The first approach is used if there is an identifiable pedestrian path (*a*) that intersects the segment and continues on beyond the segment and (*b*) on which most crossing pedestrians travel. The location of this path is shown for two cases in Exhibit 17-19. Exhibit 17-19(a) illustrates the distance~~ $\cancel{D_c}$ ~~when the pedestrian diverts to the nearest signalized intersection. This distance is measured from the crossing location to the signalized intersection.~~

Appendix F

Undertaking the steps which begin on Page 17-46 of HCM 2010 Vol 3

Step 1 - Determine free-flow walking speed

4.4 ft / s (recommended by HCM 2010)

Step 2 - Determine average pedestrian space

1.0 metre equals: 3.2808 foot

Step 2a - Compute effective sidewalk width

We = 5.202 ft

Wt	8.202	ft
Wsi	1.5	ft
Wso	1.5	ft
Woi	0	ft
Woo	0	ft

Step 2b - Compute pedestrian flow rate per unit width

Vp = 0.182377

Vped 57 peds / hour combined in both directions

Step 2c - Compute average walking speed

Sp = 4.399886

Step 2d - Compute pedestrian space

Ap = 1447.515

Step 3 - Determine pedestrian delay at intersection

0

Step 4 - Determine pedestrian travel speed

Stp,seg = 4.399886

L 105 ft (32 metre bridge length)

Step 5 - Determine pedestrian LOS score for intersection

0

Step 6 - Determine pedestrian LOS score for link

Ip,link = 2.488739

Wt	10.82664	ft	total width of outside through lane
Vm	300	veh/h	midsegment demand flow rate (direcection of sidewalk, i.e. eastbound). Taken from p. 47/52 of Stage 1 TIA (Stantec, 21/02/2019)
Wv	5.41332	ft	
W1	0	ft	
Ppk	0	%	
Wbuf	1.5	ft	
Fb	5.37		
Wa	9.32664	ft	
Waa	9.32664	ft	
Fsw	3.202008		
Fw	-4.626699		
Nth	1	lane	
Fv	0.6825		
Sr	31.07	mi/h	(posted speed limit of 50 km/h converted to mi/h)
Fs	0.386138		

Step 7 - Determine link LOS

Pedestrian LOS Score for Link: 2.488739

Average pedestrian space: 1447.515

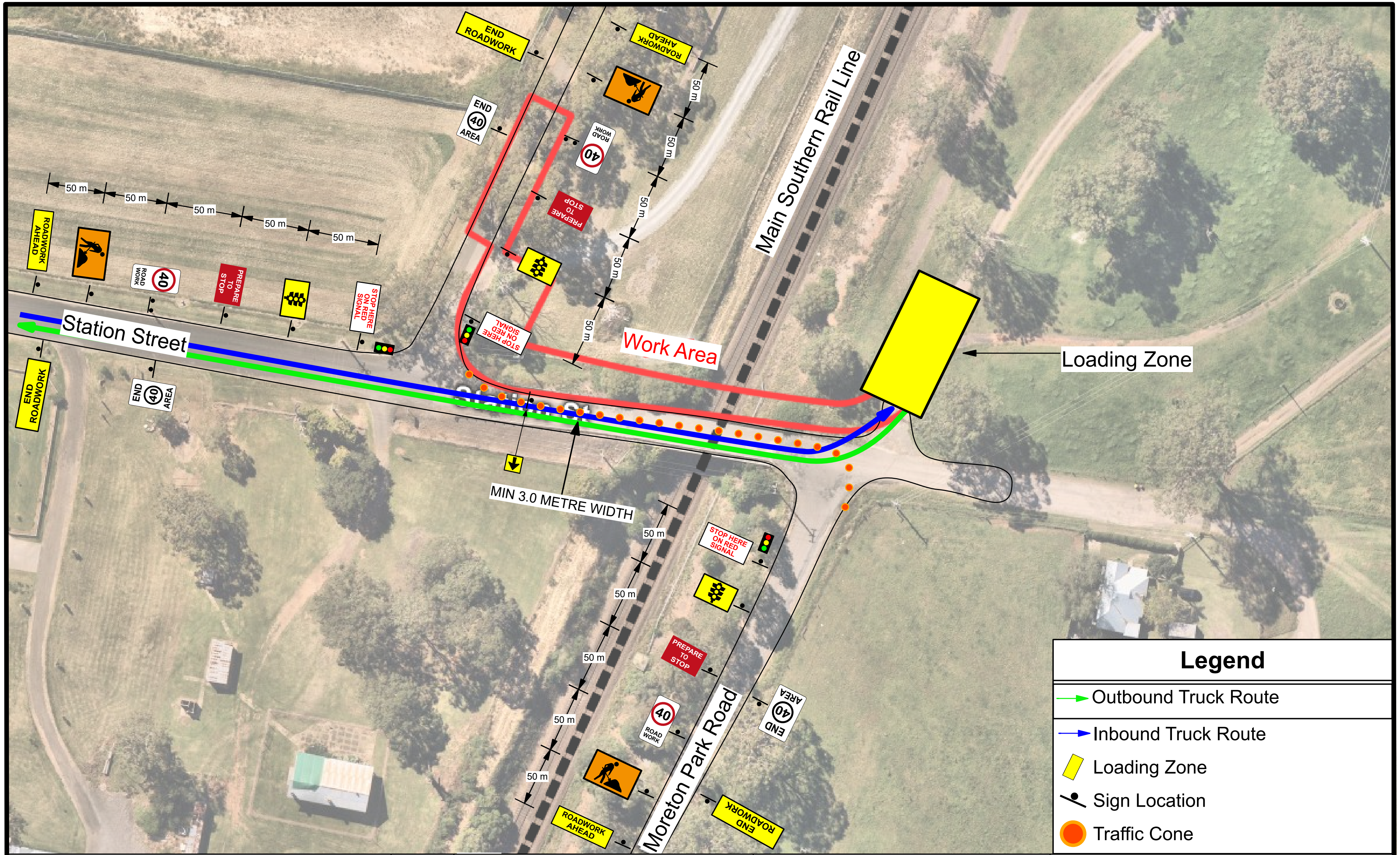
Pedestrian LOS: **B**

Pedestrian LOS Score	LOS by Average Pedestrian Space (ft^2/p) >60	>40–60	>24–40	>15–24	>8.0–15[a]	≤ 8.0[a]
≤2.00	A	B	C	D	E	F
>2.00–2.75	B	B	C	D	E	F
>2.75–3.50	C	C	C	D	E	F
>3.50–4.25	D	D	D	D	E	F
>4.25–5.00	E	E	E	E	E	F
>5.00	F	F	F	F	F	F

Note: [a] In cross-flow situations, the LOS E–F threshold is 13 ft^2/p.

Exhibit 16-5
LOS Criteria: Pedestrian Mode

Appendix G



Notes:

1. Designed in accordance with AS 1742.3 (2009) and Technical Manual - Traffic Control at Works Sites (Issue No. 6, 2020).
2. Dimension D provided in accordance with Section 7.3 of Technical Manual - Traffic Control at Works Sites (Issue No. 6, 2020).
3. This TGS is an indicative illustration of what measures may be implemented, and is subject to refinement upon appointment of a contractor. It should not be considered as final or for construction.

North

Title Traffic Guidance Scheme for Bridge Construction (For Illustration Only - Not for Construction)	Project Station Street Pedestrian Bridge, Menangle
Client Mirvac Homes (NSW) Pty Limited	Job Number 0371
SafeWork NSW Certification: Prepare a Work Zone Traffic Management Plan - TCT0038351	Date 29/04/2021

PDC Consultants

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