# CASTLE TOWERS – SITE B
# PLANNING PROPOSAL

## TRANSPORT IMPACT ASSESSMENT

PREPARED FOR QIC LIMITED |
31 AUGUST 2022
301403493

Stantec

# CASTLE TOWERS – SITE B PLANNING PROPOSAL

## Transport Impact Assessment

31 August 2022

Prepared for:
QIC Limited

Prepared by:
Stantec Australia Pty Ltd

Project Number:
301403493

| Revision | Date | Description | Author | Quality Check | Signature |
|---|---|---|---|---|---|
| A | 23/06/2022 | Final | Jordan Smith | Tim De Young | Tim De Young |
| B | 11/07/2022 | Amended | Jordan Smith | Tim De Young | Tim De Young |
| C | 31/08/2022 | Revision A | Will Finlay | Tim De Young | Tim De Young |

# TABLE OF CONTENTS

# 1 INTRODUCTION

## 1.1 BACKGROUND

A Planning Proposal has been prepared by Ethos Urban on behalf of QIC to initiate an amendment to The Hills Local Environmental Plan with respect to Site B at Castle Towers Shopping Centre in Castle Hill.

The primary objective of the Planning Proposal is to facilitate the site's development into a vibrant mixed-use neighbourhood that aligns with Council's vision for Castle Hill as a "vibrant and active centre with office, retail, community facilities, recreation, cultural facilities, education and increasing housing densities within walking distance of the Station" (p. 34 of the Hills LSPS).

To inform assessment of the Planning Proposal, a concept masterplan was prepared by Clarke Hopkins Clarke, in collaboration with Hatch Roberts Day, Aspect Studios and Stantec, for the proposed ultimate development of the site. The proposed site layout and indicative development yield are outlined and assessed later in this report.

## 1.2 RELEVANT DA HISTORY

On 27 September 2016, DA864/2015/JP was approved as a Deferred Commencement Consent by the then Joint Regional Planning Panel (now Sydney Central City Planning Panel) for the Stage 3 Expansion of Castle Towers Shopping Centre. The Deferred Commencement conditions have since been satisfied to activate the Consent. The Consent was subsequently modified by the Panel on 22 February 2022 (864/2015/B).

The approved works, which are able to be completed in stages, include:

- Significant demolition, reconstruction and expansion works of the Castle Towers Shopping Centre to significantly increase the Centre's retail gross floor area from 132,779sqm to 258,423sqm and gross lettable area from 113,197sqm to 193,457sqm.
- Construction of a vehicular tunnel beneath Pennant Street and via Site B to provide a new direct vehicular access/egress from the centre's car park to Showground Road via the signalised intersection at Kentwell Avenue.
- Closure of Castle Street between Pennant Street and Old Northern Road.
- Increase parking provision from 5,639 car spaces to 7,996 car spaces.

The development application was also endorsed by Transport for New South Wales (TfNSW) and a Voluntary Planning Agreement was entered into with TfNSW to provide $15m for significant upgrade works to Showground Road to increase the road capacity in Castle Hill. This payment was completed by QIC, and the road upgrade has been constructed.

Advice provided by Ethos Urban indicates the Development Consent 864/2015/B has been physically commenced by works carried out within Zone 2, including the Sydney Metro concourse connection, and is active and valid, will not lapse, and is open to QIC to complete the approved development and retail expansion should it wish to do so. Notwithstanding this, QIC is now looking towards a more diverse, mixed land use approach across its landholdings and is looking to obtain a range of planning approvals that would be pursued as an alternative to DA864/2015.

It is noted that a separate Development Application (DA) is to be submitted concurrently for a proposed indoor sports facility (Woodward) located at the southwest corner of the Site B Planning Proposal site. It is understood that this DA is approvable under the existing controls applicable to the site, noting that the DA is supported by its own transport impact assessment report.

## 1.3 PREVIOUS PRECINCT TRAFFIC MODELLING

The approved development described above was supported by AIMSUN traffic modelling completed by GTA (now Stantec).

The most recently submitted Transport Modelling Report was titled 'Castle Towers Shopping Centre, Section 96 and Stage 1 DA' (dated 28 September 2017) and indicated that the new road through Site B, connecting onto Showground Road at the Kentwell Avenue / Site Access signalised intersection, was expected to carry 1,000 and 1,200 vehicle movements (approx.) during the weekday PM and Saturday midday peak hours, respectively. The modelling report also indicated other traffic volume increases were expected spread across the precinct.

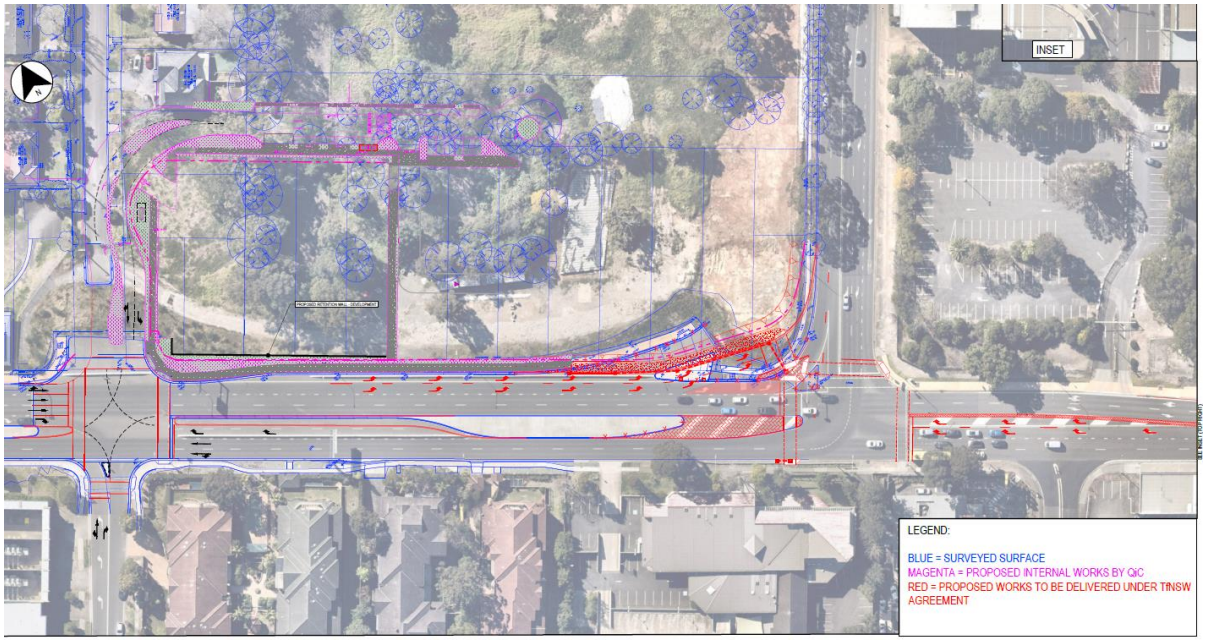
The development now proposed by QIC in the Castle Towers precinct, including to/from and through Site B, is expected to generate significantly less traffic than what was previously modelled and mitigated. (The new traffic generation estimate is outlined in Sections 4 and 7 of this report). In line with this significant traffic volume reduction, this Planning Proposal proposes to reduce the size of the Showground Road / Kentwell Avenue intersection from its previous five-lane cross-section to a new three-lane cross-section. The appropriateness of the vehicle access arrangements to the Site B Planning Proposal site is examined within this report.

## 1.4 AUTHORITY ENGAGEMENT

There has been extensive engagement with The Hills Shire Council (Council) and Transport for New South Wales (TfNSW) in relation to the Site B Planning Proposal and other Development Applications in the area, including:

- On 21 October 2021, the QIC project team met with Council representatives to present the new development vision for Site B.
- On 10 November 2021, a transport focussed meeting was held with Council (Mr Andrew King) to discuss the vehicle access arrangements for the development, including the reduced sizing for Showground Road / Kentwell Avenue intersection.
- On 4 April 2022, QIC met with TfNSW to present the revised road network proposed in the immediate vicinity of Site B, including the proposed reconfiguration of the Showground Road / Kentwell Avenue intersection and the configuration of the Showground Road / Pennant Street intersection on its existing alignment.
- On 4 May 2022, a meeting was held with TfNSW (which was also attended by Council (Mr Andrew King)) to present QIC's new vision for the Castle Towers precinct, including Site B, and outline the new configuration proposed for the Showground Road / Kentwell Avenue intersection. At this meeting, TfNSW requested that traffic modelling is submitted to confirm the appropriateness of the proposed road network changes, including consideration of the reduced traffic generation of the new development.
- On 20 June 2022, a subsequent meeting was attended by TfNSW and members of the QIC project team where the proposed approach to the traffic modelling requested at the previous meeting was discussed. Specifically, the QIC project team confirmed that it would provide SIDRA traffic modelling (as appropriate) for the Planning Proposal, noting that more detailed traffic modelling cannot be completed until such a time that the AISMUN model currently being prepared by Cardno now Stantec for TfNSW and Council was completed and made available. Following this meeting, TfNSW advised via email that it would assess each DA and Planning Proposal on its merits without the AIMSUN modelling subject to the provision of SIDRA modelling as appropriate.

Figure 1.1: Road Network Design presented to TfNSW on 4 April 2021




## 1.5 PURPOSE OF THIS REPORT

This report sets out an assessment of the transport impacts of the proposed ultimate development on the Site B Planning Proposal site. It considers:

- The existing transport conditions in the vicinity of the site – *refer to Section 2*
- The indicative development yield anticipated under the full development scenario – refer to Section 3
- The expected trip generation of the full development of the site – refer to Section 4
- The details of the transport response / impacts of the proposed development including:
    - The proposed transport design – refer to Section 5
    - The anticipated car parking provisions – refer to Section 6
    - The traffic impacts and potential mitigation measures – refer to Section 7

With respect to the assessment of traffic impacts of the development, the following is noted in response to the traffic modelling requested by Council and TfNSW (refer to Section 1.4):

- This report contains SIDRA analysis for key surrounding intersections, with the notable exception being the Showground Road / Pennant Street intersection. No SIDRA analysis is included for this latter intersection as there is no change proposed to the overall capacity of the intersection. Rather, the same sized intersection as previously proposed is simply to be constructed on the existing alignment of Pennant Street.
- This report does not contain traffic modelling for the Planning Proposal or the broader precinct as it is not considered to be necessary given:
    - The development of the Site B Planning Proposal site is expected to generate a relatively modest volume of traffic during peak hours given its predominantly residential nature. This report (Section 7) estimates a traffic generation of up to approximately 393 vehicle movements to and from the site during the weekday PM peak hour.

- In comparison to previously approved development within the Castle Towers precinct, the development of the Site B Planning Proposal site will generate significantly less traffic onto the adjacent roads. This is most clearly observable by comparing the expected total generation of the site (i.e., up to approximately 521 vehicle movements during the weekday PM peak hour) with the previously modelled traffic volume on the Site B access road alone (i.e., approximately 1,000 vehicle movements during the weekday PM peak hour). This traffic volume comparison is further discussed in Section 7.2.2.
- As the overall traffic generation of the precinct is comparatively lower, the new development will have a lesser overall impact on the surrounding road network. Despite this traffic volume reduction, QIC has also already contributed $15m to TfNSW for the completed duplication of Showground Road.
- As outlined in this report, the development of the Site B Planning Proposal site generally proposes to retain previously proposed intersection works, other than the reduction in the size of the Showground Road / Kentwell Avenue intersection as outlined above. (The provision of SIDRA analysis is considered sufficient to assess this layout change, noting that it has also been designed with flexibility to allow provision of a second right-turn lane into the site if deemed necessary in the future).
- The configuration of intersections in the vicinity of the Site B Planning Proposal site does not need to be determined prior to the approval of this Planning Proposal. Rather, these layouts can be determined for the subsequent Development Applications.

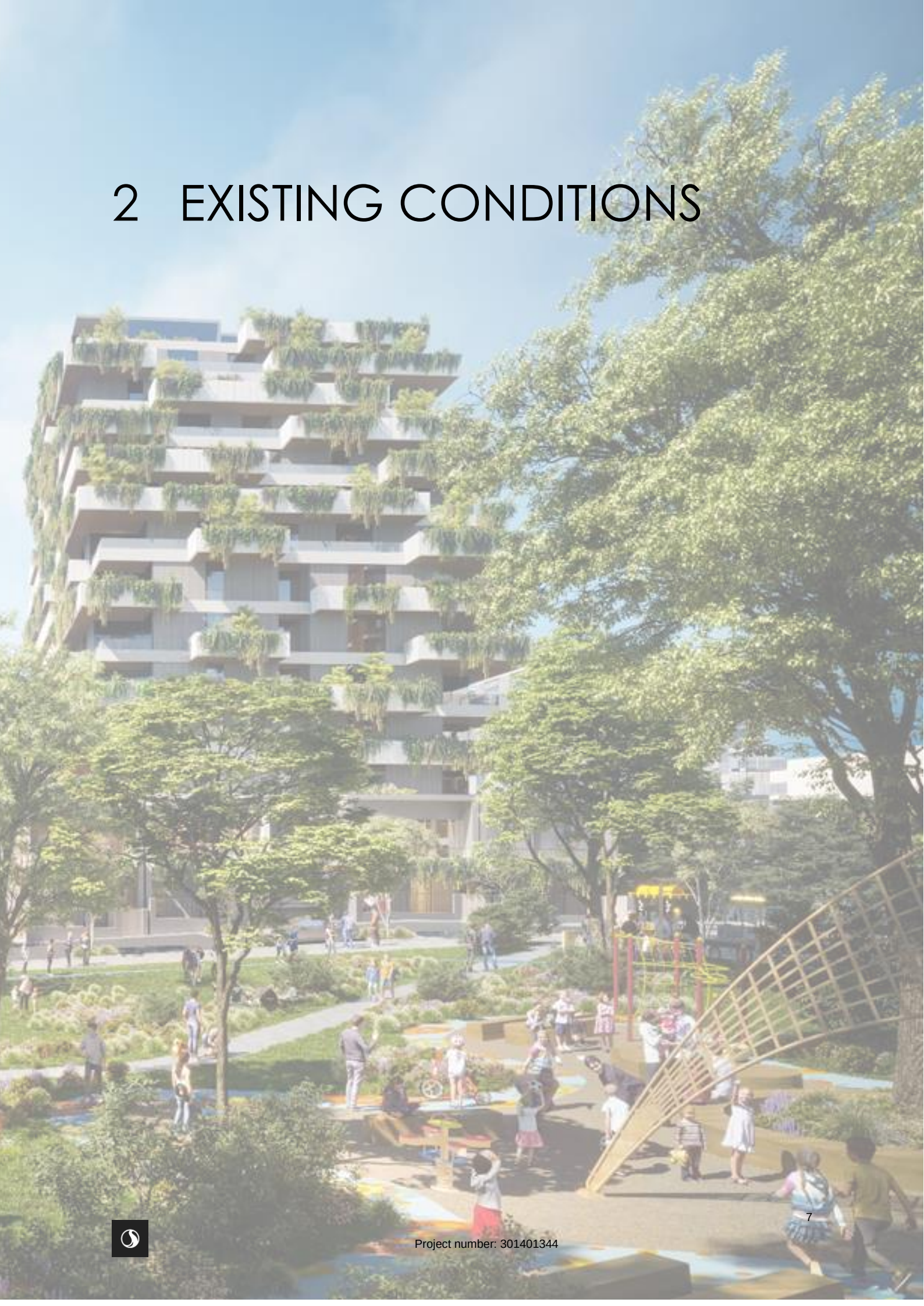
At the time of preparing this report, it is also noted that QIC had provided in-principle approval to engage Cardno now Stantec to complete traffic modelling for the precinct using the AIMSUN model currently being prepared for TfNSW and Council as part of its broader assessment of the precinct. The completion of this modelling is agreed by QIC to assist the orderly transport planning for the precinct by allowing the assessment of the cumulative traffic impacts of the new development now envisaged in the precinct. This modelling is likely to be completed later in 2022 once the AIMSUN model becomes available for use by QIC and is not considered necessary to support the Planning Proposal for the reasons outlined above.

## 1.6 REFERENCES

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

- an inspection of the site and its surrounds
- The Hills Development Control Plan (DCP), including the Castle Hill North DCP
- The Hills Local Environmental Plan 2019 (LEP 2019)
- TfNSW (RMS) Guide to Traffic Generating Developments (October 2002) and the subsequent Technical
- Plans and other documentation prepared by Clarke Hopkins Clarke, Hatch Roberts Day and Aspect Studios for the proposed master plan and indicative development on the Site B Planning Proposal site
- Relevant Australian Standard Standards for Parking Facilities (AS/NZS 2890.1:2004 and AS/NZS 2890.6:2009)
- other documents and data as referenced in this report.

# 2 EXISTING CONDITIONS



## 2.1 SITE LOCATION

The subject site, Castle Towers – Site B is located in Castle Hill which is 30km northwest of the Sydney CBD.

The site is currently mostly undeveloped, with some residential houses located along Kentwell Avenue. The site has a frontage of approximately 200m to Showground Rd, 150m to Pennant Street, 200m to Castle Street and 230m to Kentwell Avenue.

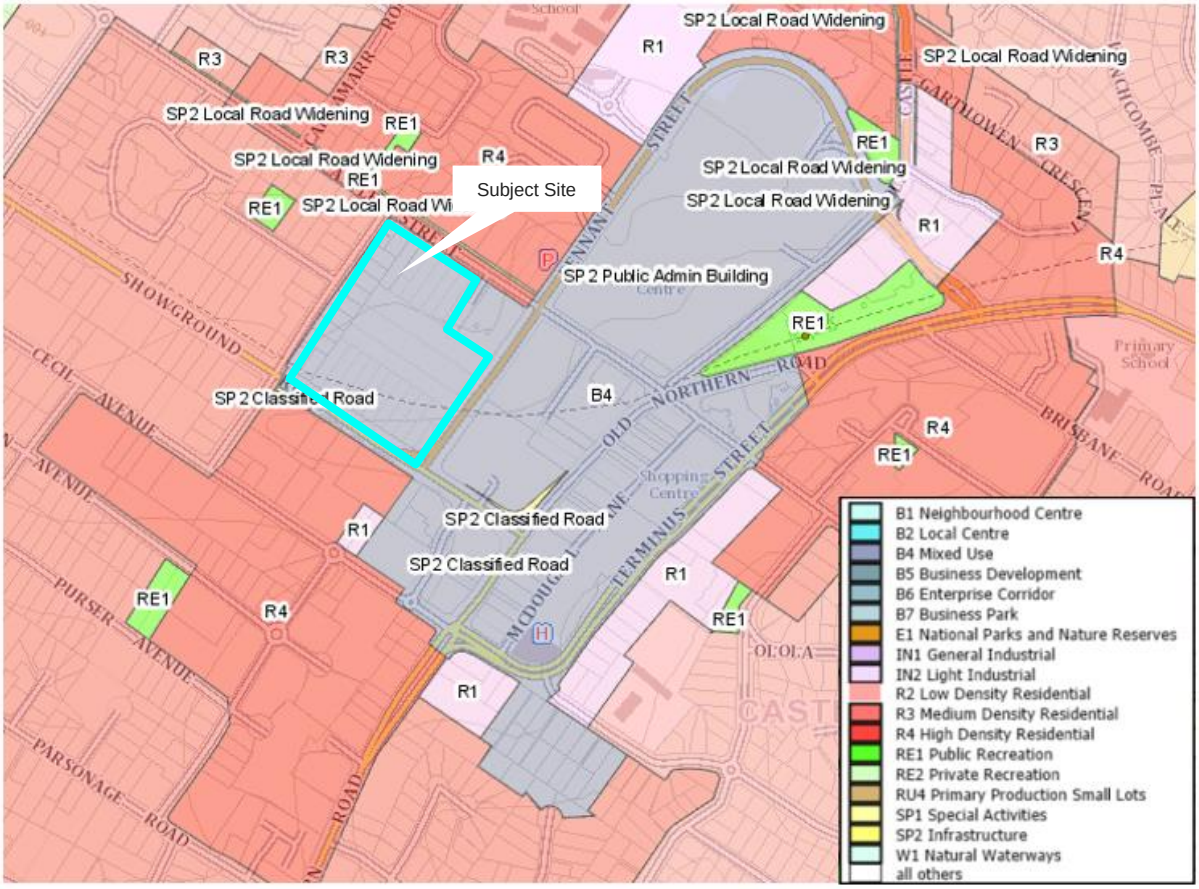
The surrounding properties predominately comprise of medium and low density residential and commercial uses. Castle Hill Library and Castle Hill Cultural Centre border the site to the northeast while the Castle Towers Shopping Centre is located east of Pennant Street.

The location of the site and the surroundings environs are shown in Figure 2.1 and the local zoning is shown in and Figure 2.2.

Figure 2.1: Subject Site and its Surrounds


Source: CHC

Figure 2.2: Land Zoning Map




# 2.2 SURROUNDING ROAD NETWORK

## 2.2.1 ABUTTING ROADS

The abutting roads include:

- Showground Road
- Pennant Street
- Castle Street
- Kentwell Avenue

These roads are described below.

### 2.2.1.1 Showground Road

Showground Road is a major east-west arterial road which connects Windsor Road to Old Northern Road. It is a two-way road configured with a 4-lane, 25m wide carriageway, set within a 30m road reserve (approx.). Showground Road is shown in Figure 2.3 and Figure 2.4.

Figure 2.3: Showground Rd (Looking East)

Figure 2.4: Showground Rd (Looking West)

### 2.2.1.2 Pennant Street

Pennant Street is located to the east of the site and effectively provides a western bypass of the Castle Hill Town Centre connecting Showground Road at its western end to Old Northern Road (via McMullen Avenue) at its eastern end. It is a two-way road configured with a 4-lane, 17m wide carriageway, set within a 25m road reserve (approx.) including turning lanes. Pennant Street is shown in Figure 2.5 and Figure 2.6.

Figure 2.5: Pennant St (Looking North)

Figure 2.6: Pennant St (Looking South)

### 2.2.1.3 Castle Street

Castle Street is an east–west collector road and provides direct access to Castle Hill Town Centre from the surrounding residential areas. It connects to Castle Hill bowling club and Castle Hill RSL at its westernmost point and Old Northern Road at its easternmost point. It is a two-way road configured with a 2-lane, 10m wide carriageway, set within a 19m road reserve (approx.), with bike lanes on both sides. Castle Street is shown in Figure 2.7 and Figure 2.8.

Figure 2.7: Castle Street (Looking East)

Figure 2.8: Castle Street (Looking West)

### 2.2.1.4 Kentwell Avenue

Kentwell Avenue is a local road and provides direct access to Castle Street (to the north) from surrounding residential areas. Kentwell Avenue terminates as its southern end and does not provide a direct road connection to Showground Road. It is a two-way road configured with a 2-lane, 7m wide carriageway, set within a 16m road reserve (approx.). Kentwell Avenue is shown in Figure 2.9 and Figure 2.10.

Figure 2.9: Kentwell Ave (Looking South)

Figure 2.10: Kentwell Ave (Looking North)

## 2.2.2 NEARBY INTERSECTIONS

Key intersections in the vicinity of the site include (but are not limited to) Showground Road / Cheriton Avenue (signalised), Showground Road / Pennant Street (signalised), Pennant Street / Castle Street (signalised) and Castle Street / Kentwell Avenue (unsignalised).

# 2.3 ACTIVE TRAVEL NETWORK

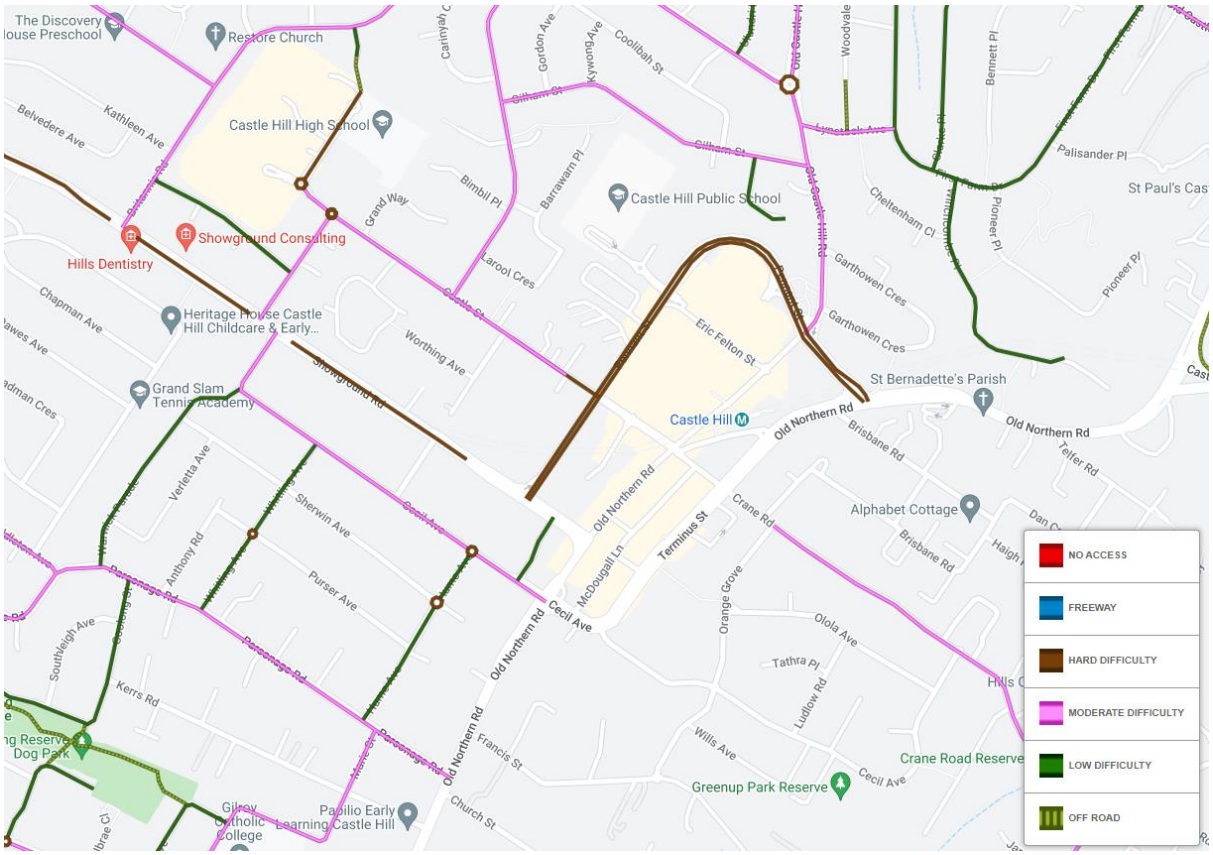
## 2.3.1 OVERVIEW

The site is well serviced by a pedestrian network that generally includes footpaths along all nearby roads. Signalised crossing opportunities are also provided across the main arterial roads at the nearby signalised intersections.

However, from a broader precinct perspective, there are constraints to pedestrian movement (including across the major arterial roads, despite the provision of signalised crossings) and footpath widths are narrow at some locations. Notwithstanding these constraints, the accessibility of the site via walking is generally good, noting that the "Walk Score" (www.walkscore.com) for the site[1] is 95. This score suggests that 'daily errands do not require a car'.

The site is also surrounded by a number of on-street cycling lanes, which provide varying levels of comfort and separation from traffic. These cycle lanes provide access to key destinations around the site, such as Castle Towers Shopping Centre, Castle Hill High School, and Castle Hill Metro Station. The cycle lanes are shown in Figure 2.11.

Figure 2.11 Surrounding Cycling Facilities




## 2.3.2 EXISTING CATCHMENTS

The available walking and cycling catchments within 30 minutes of the subject site at 5-minute intervals, is provided in Figure 2.12 and Figure 2.13, respectively.

[1] Based on 10 Pennant St, Castle Hill.

The figures indicate that major locations such as the Castle Towers and Castle Mall Shopping Centres and Castle Hill Metro Station are within comfortable walking distance, and that cycling permeability through the surrounding area is relatively good.

Importantly, the walking catchment includes the Metro train station is located within a 5 minute (approx.) walk from the site. The proximity of the metro station to the site is a significant benefit as it enhances the attractiveness of public transport for travel, particularly for residential land uses.

Figure 2.12: Pedestrian Walking Catchment Area

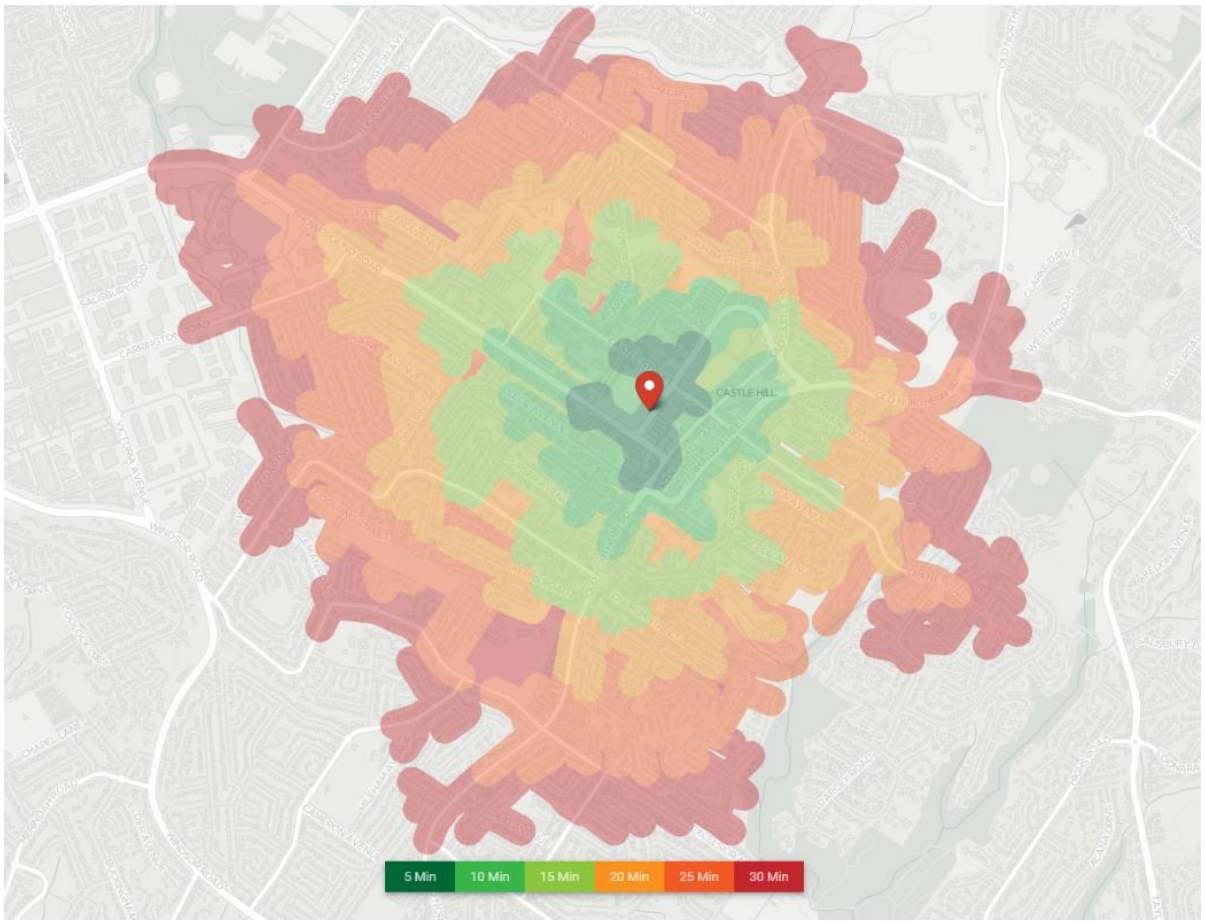
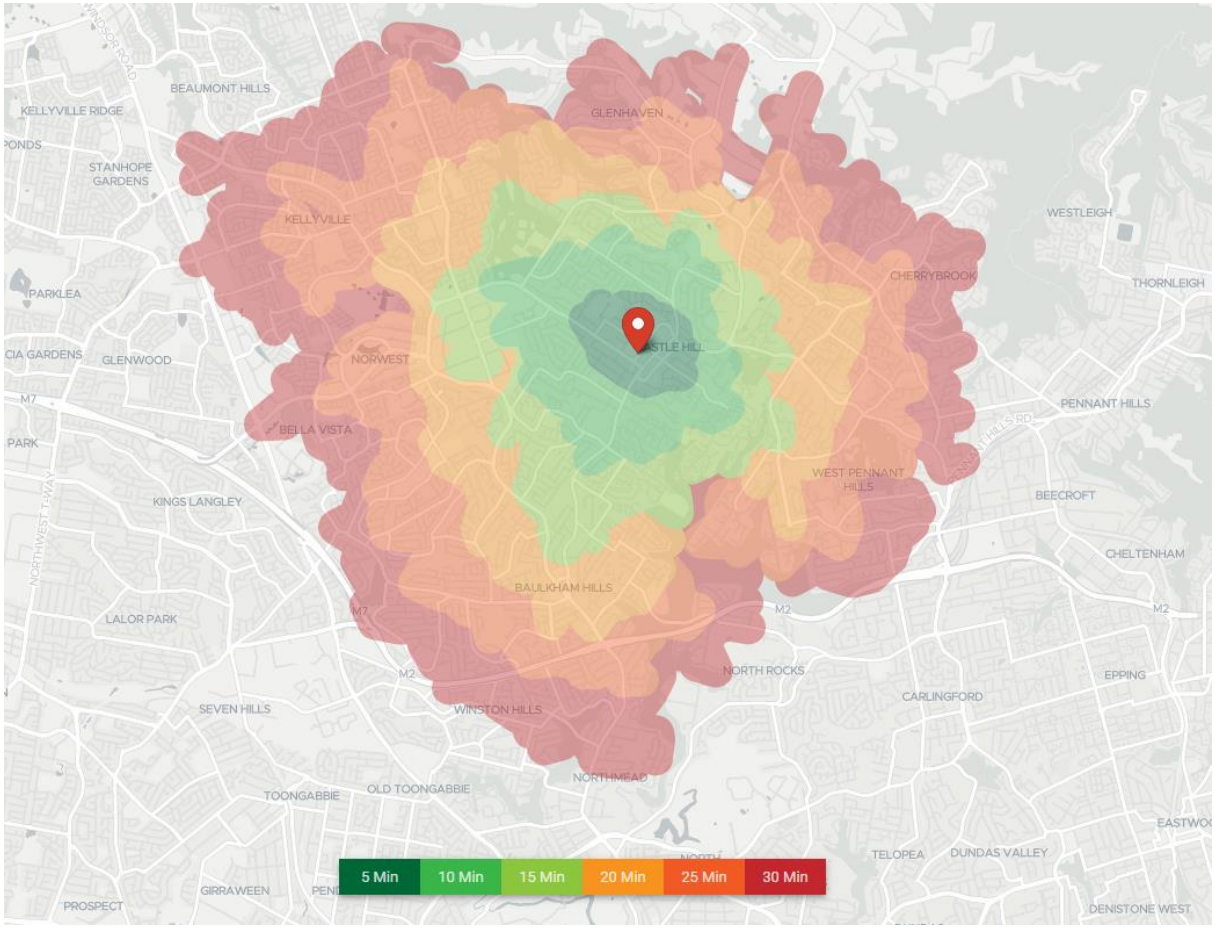


Figure 2.13: Bicycle Catchment Area




# 2.4 PUBLIC TRANSPORT

## 2.4.1 OVERVIEW

The site is serviced by a range of public transport services, including metro and numerous bus services operating in the immediate vicinity of the site, as shown in Figure 2.14.

The accessibility of the site via public transport can be measured by assessing the "Transit Score" of the suburb. The Transit Score measures how well a location is served by the public transit based on the distance and type of nearby transit lines. The applicable transit score (www.walkscore.com) for the subject site is 62 which suggests that "Good Transit' is provided in the area and that there are 'many nearby public transportation options.'

Further discussion regarding the key modes of public transport is presented below.

Figure 2.14: Castle Hill Local Area Bus Network (Weekday)


## 2.4.2 TRAIN SERVICES

Castle Hill Metro Station is located approximately 350m – about 7 mins of walking – to the east of the site. The station opened in May 2019 as part of the Sydney Metro Stage 1 project. The project provides a high frequency turn-up-and-go service between Rouse Hill and Chatswood. (Stage 2 of the project connects Chatswood and Bankstown and is expected to be completed in 2024).

During peak period, Metro services to Tallawong and Chatswood from Castle Hill Station are provided at four-minute frequencies (and 10 minutes during off peak periods). Travel times from the Centre of 14 minutes to Macquarie Park, 21 minutes to Chatswood, 34 minutes to North Sydney and 41 minutes to Wynyard are provided.

## 2.4.3 BUSES SERVICES

The site has good access to and is well serviced by public bus services, including five bus routes (604, 626, 651, 660, 730 and N92) running along Showground Road (see Figure 2.14) with a stop about 100m west of the site. Most bus routes / services within the area currently run through the recently completed (early 2019) Castle Hill Bus Interchange, with a summary bus operations provided below in Table 2.1.

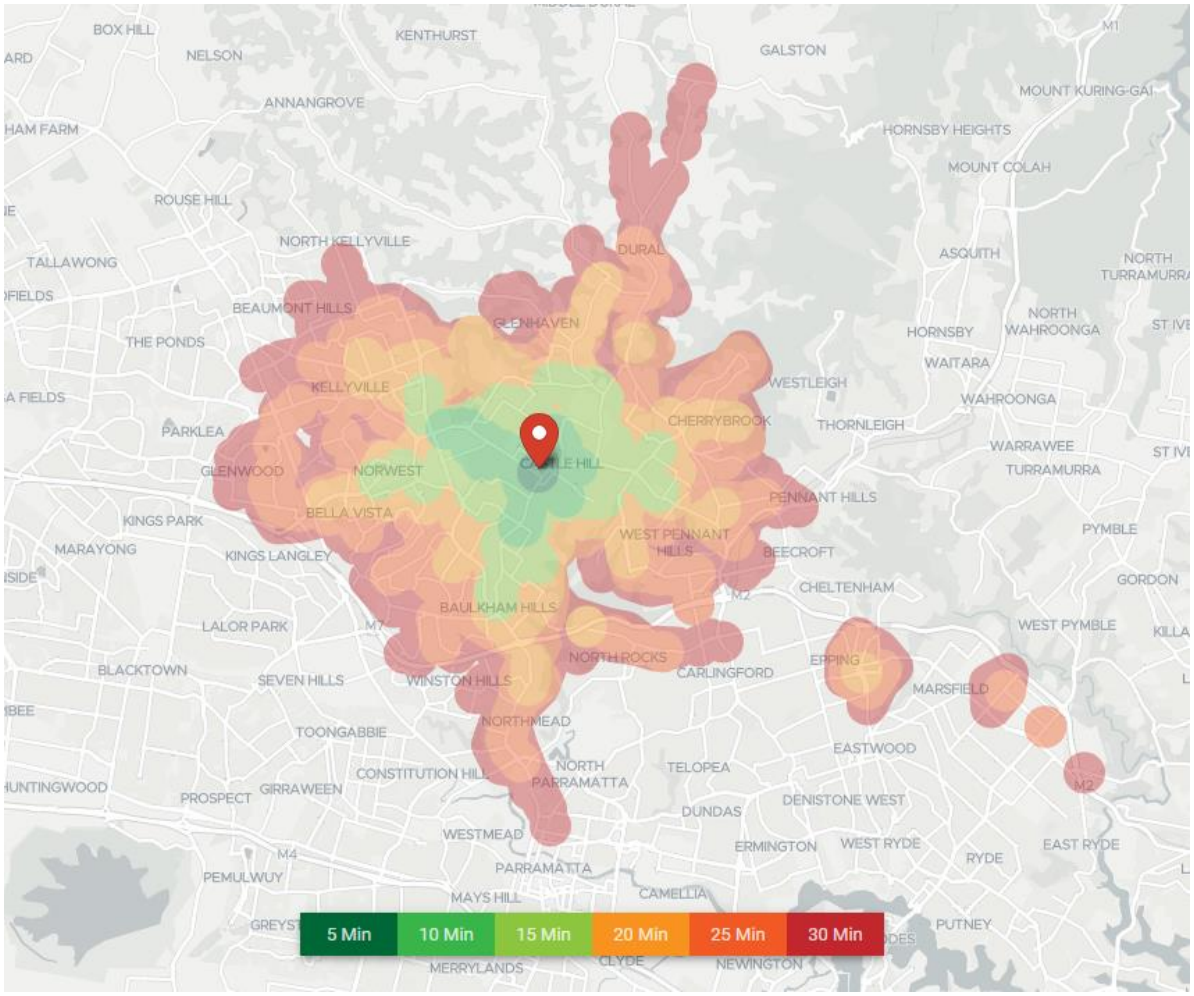
Table 2.1: Bus operations from Castle Hill Bus Interchange

| Route No. | Route Description | Frequency On / Off Peak |
|---|---|---|
| 600 | Hornsby to Parramatta | 10mins / 15mins |
| 603 | Rouse Hill Station to Parramatta via Glenhaven | 30mins / 60mins |
| 604 | Dural to Parramatta via Castle Hill | 30mins / 60mins |
| 610X | Kellyville to City QVB via Lane Cover Tunnel | 10-12mins / 30mins |
| 612X | Castle Hill to Milsons Point (Morning service) | 10mins / 20mins |
| 619 | Castle Hill to Macquarie Park via Baulkham Hills | 20mins / 30-40mins |
| 626 | Kellyville Station to Pennant Hills via Cherrybrook | 25mins / 40mins |
| 632 | Rouse Hill Station to Pennant Hills via Norwest & Castle Hill | 30mins / 30mins |
| 633 | Rouse Hill Station to Pennant Hills via Kellyville & Castle Hill | 30mins / 30mins |
| 635 | Castle Hill too Beecroft via West Pennant Hills | 30mins / 30mins |
| 637 | Glenorie to Castle Hill via Galston & Round Corner | 30mins / 60mins |
| 638 | Berowra Waters and Berrilee to Pennant Hills | 1 per day |
| 639 | Maraylya to Castle Hill | 1 per day |
| 651 | Rouse Hill Station to Epping via Castle Hill | 30mins / 30mins |
| 660 | Castlewood to Parramatta | 15-20mins / 60mins |
| 662 | Castle Hill to Parramatta via Bella Vista & North West Twy | 15-20mins / 60mins |
| 730 | Castle Hill to Blacktown via Norwest & Glenwood | 20mins / 60mins |
| NW1 | Tallong to Chatswood (Northwest Night Bus) | 10-30mins |
| NW2 | Tallawong to Chatswood (Northwest Night Bus – Limited Stops) | 10mins |

### 2.4.4 PUBLIC TRANSPORT CATCHMENT AREA

The available public transport catchment withing 30 minutes of the site (at 5-minute intervals) is presented in Figure 2.15, indicating that the site is well service by public transport, with a significant population residing within the catchment.

Figure 2.15: Public Transport Catchment Area




# 2.5 ACCIDENT HISTORY

A review of the reported casualty accident history for the roads and intersections adjoining the subject site has been sourced from TfNSW Crashes database.

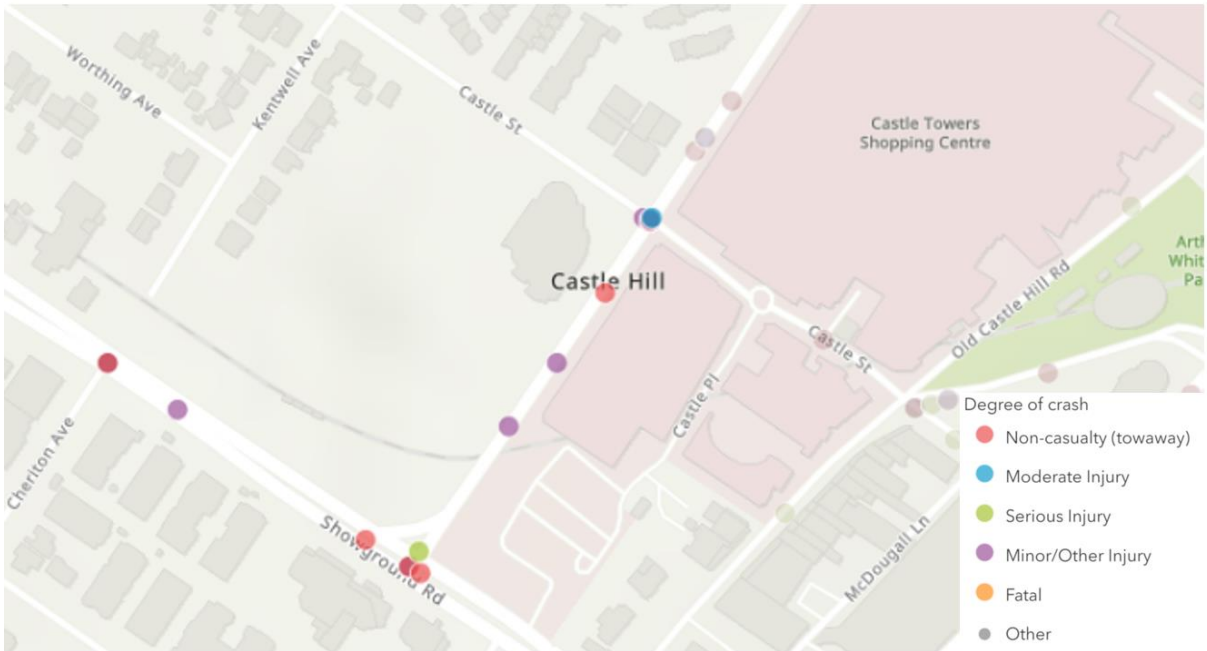
A summary of the accidents in the vicinity of the subject site for the last available five-year period (2016-2020) is presented in Table 2.2 and shown diagrammatically in Figure 2.16. The data indicates:

- One minor injury and one moderate injury accident has been recorded at the intersection of Pennant Street / Castle Street, with one serious injury accident recorded at the intersection of Showground Road / Pennant Street.
- A trend that has been identified is the common occurrence of rear end crashes on Pennant Street including the intersections with Showground Road and Castle Hill. There have been 5 of these crashes in the five-year period analysed.
- One crash that occurred at the Pennant Street / Castle Street intersection involved a pedestrian being hit resulting in moderate injury.

Table 2.2: Summary of Crashes in Vicinity of the Site in Past 5 years

| Location of Accident | Year | Type | Description |
|---|---|---|---|
| Showground Road / Cheriton Avenue | 2018 | Non-Casualty | Right Through |
| Showground Road | 2016 | Minor/Other Injury | Rear end |
| Showground Road / Pennant Street | 2016 | Non-Casualty | Other same direction |
| Showground Road / Pennant Street | 2016 | Non-Casualty | Right through |
| Showground Road / Pennant Street | 2018 | Non-Casualty | Off left/rt bnd=>obj |
| Showground Road / Pennant Street | 2017 | Serious Injury | Rear end |
| Pennant Street | 2018 | Minor/Other Injury | Rear end |
| Pennant Street | 2020 | Minor/Other Injury | Rear end |
| Pennant Street | 2020 | Non-Casualty | Object on road |
| Pennant Street | 2020 | Non-Casualty | Object on road |
| Pennant Street / Castle Street | 2017 | Non-Casualty | Right rear |
| Pennant Street / Castle Street | 2017 | Non-Casualty | Other straight |
| Pennant Street / Castle Street | 2017 | Non-Casualty | Right through |
| Pennant Street / Castle Street | 2019 | Non-Casualty | Rear end |
| Pennant Street / Castle Street | 2018 | Minor/Other Injury | Rear end |
| Pennant Street / Castle Street | 2018 | Moderate injury | Ped nearside |
| Castle Street | 2016 | Minor/Other injury | Right through |

Figure 2.16: Summary of Crashes in Vicinity of the Site in Past 5 years



## 2.6 CAR PARKING

In the vicinity of the site, there is on-street car parking provided along some abutting streets (but not Showground Road or Pennant Street), subject to time restrictions. This includes:

- Castle Street north of the site,
    - South side: 4P, 9am-3pm M-F
    - North side: No Stopping, 8:30am-6pm M-F & 8:30am-12:30pm Sat
- Kentwell Avenue west of the site:
    - East side: No Parking, 8:30am-6pm M-F
    - West side: 2P, 8:30am-6pm, M-F

Within the existing Castle Towers Shopping Centre (east of Pennant Street), there is presently a total of 4,759 car spaces, excluding the open-air car park at the southern end of Site A (148 car spaces) and the car park on Site C (514 car spaces). Surveys of this car parking in November 2021, including the Black Friday sales period, indicate the following rates of retail car parking demand:

- For weekdays: 3.3 car spaces per 100sqm GFA (85$^{th}$ percentile Friday)
- For Saturdays: 3.5 car spaces per 100sqm GFA (Saturday after Black Friday)

It is noted that the demands occur during daytime hours, with significant surplus car parking available during evening periods. These surpluses are equal to over 1,000 and 3,000 available car spaces on weekdays and weekends, respectively.

# 3 PROPOSED DEVELOPMENT

# 3.1 OVERVIEW

The Hatch Roberts Day Urban Design Report outlines:

**"The vision for Site B is to make a meaningful contribution to the vibrancy, connectivity, and long-term sustainability of the Castle Hill Strategic Centre"**

The proposed masterplan prepared by Clarke Hopkins Clarke is shown in Figure 3.1 and illustrates the intention to development the site with a number of buildings (accommodating predominantly residential apartments, plus ground level retail land uses) around a central park of approximately 4,000sqm.

Figure 3.1: Proposed Masterplan


Source: CHC

## 3.2 INDICATIVE DEVELOPMENT YIELD

Preliminary master planning for the site indicates that it will ultimately accommodate approximately 1,500 apartments, 4,700 sqm of commercial floor area, 6,100 sqm of showroom and retail floor area and a 120-place childcare centre across 7 lots. The indicative development is summarised in Table 3.1.

Table 3.1: Site Development Summary

| Land Use | Size |
|---|---|
| Lot A | |
| Residential | 146 dwellings |
| Commercial | 13,500sqm |
| Showroom | 1,500sqm |
| Lot B | |
| Residential | 184 dwellings |
| Lot C | |
| Residential | 195 dwellings |
| Lot D | |
| Residential | 414 dwellings |
| Commercial | 2,700sqm |
| Showroom | 1,200sqm |
| Minor Retail / Food & Beverage | 1,100sqm |
| Childcare | 120 children |
| Lot E | |
| Residential | 118 dwellings |
| Lot F | |
| Residential | 317 dwellings |
| Showroom | 700sqm |
| Supermarket | 1,600sqm |
| Lot G | |
| Residential | 36 dwellings |

| Land Use | Size |
|---|---|
| Residential | 1,410 dwellings |
| Commercial | 16,200sqm |
| Showroom | 3,400sqm |
| Minor Retail / Food & Beverage | 1,100sqm |
| Supermarket | 1,600sqm |
| Childcare | 120 children |

# 4 TRIP GENERATION

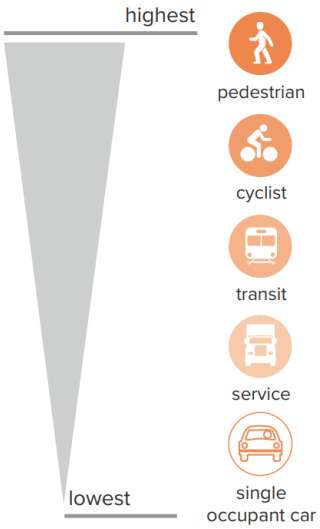
## 4.1 PREAMBLE

The development of the site and the broader Castle Hill precinct proposes a multi-modal transport approach which prioritises walking, cycling and public transport ahead of cars.

This is proposed with the objective of maximising the use of active and public transport modes and minimising car trips, particularly single occupant car trips, as far as practicable to reduce traffic impacts to both the environment and the adjacent road network operation.

This approach is reflected in the modal hierarchy that has been adopted for the planning of the site as shown in Figure 4.1.

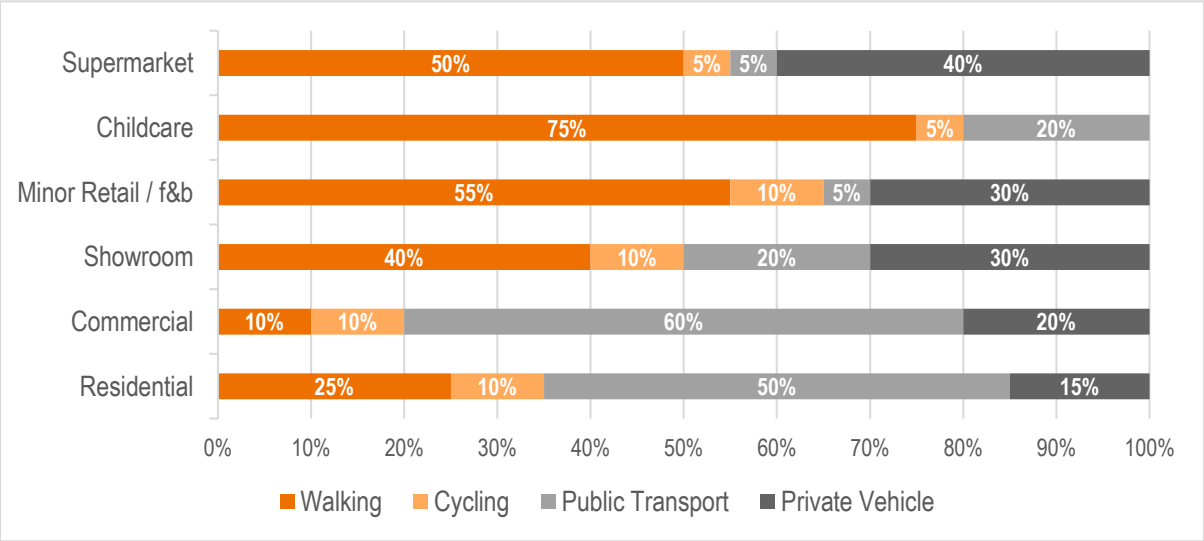
Figure 4.1: Proposed Modal Hierarchy




## 4.2 TARGET MODE SHARES

For the purposes of the assessment contained in this report, mode splits for additional trips to/from the proposed mixed-use site have been assumed. The assumed / target mode splits are shown in Figure 4.2.

Figure 4.2: Assumed Mode Splits




It is noted that the target mode splits have been assumed based on our experience on other projects but remain indicative only and for use only to estimate peak hour trips. For the traffic impact assessment presented later in this report, the vehicle trip generation estimate has also been sanity checked using a traditional 'traffic generation approach' (i.e., vehicle movements per car space by land use).

## 4.3 TRIP GENERATION

Table 4.1 presents a summary of the anticipated person trip generation to and from the site following its ultimate development.

The trip generation rates have been sourced from the data contained within the RMS Guide to Traffic Generating Development (Technical Direction 2013) and Stantec's extensive history of surveys and transport impact assessments.

It is noted that the trip generation estimate is presented only for the weekday PM peak hour, which will represent the most conservative period (given the retail land uses will generate considerably fewer trips than during the weekday PM peak hour).

Table 4.1: Total Site Trip Generation

| Land Use | Size / No | PM Peak Hour Trip Rate | PM Peak Hour Trip Generation |
|---|---|---|---|
| Residential | 1,410 dwellings | 0.65 trips per dwelling [1] | 917 trips |
| Commercial | 16,200sqm | 2.9 trips per 100 sqm [2] | 470 trips |
| Showroom | 3,400sqm | 4.9 trips per 100 sqm [3] | 167 trips |
| Minor Retail / Food & Drink | 1,100sqm | 7.5 trips per 100 sqm [4] | 83 trips |
| Supermarket | 1,600sqm | 1 person per 8 sqm [5] | 200 trips |
| Childcare | 120 children | 0.9 trips per child [6] | 108 trips |
| TOTAL | | | 1,945 trips |

[1] Sourced from the RMS Technical Direction (August 2013).
[2] Based on an employee density of 1 per 14sqm and assuming 50% arrive during the peak hour
[3] RMS Technical Direction (TDT 2013/04). Refer to Appendix C. Restricted retail adopted
[4] RMS Technical Direction (TDT 2013/04). Refer to Appendix C.
[5] Person per square meter from retail shopping centre rate. Increased to represent supermarket.
[6] Based on surveys conducted by Stantec of existing childcare centres.

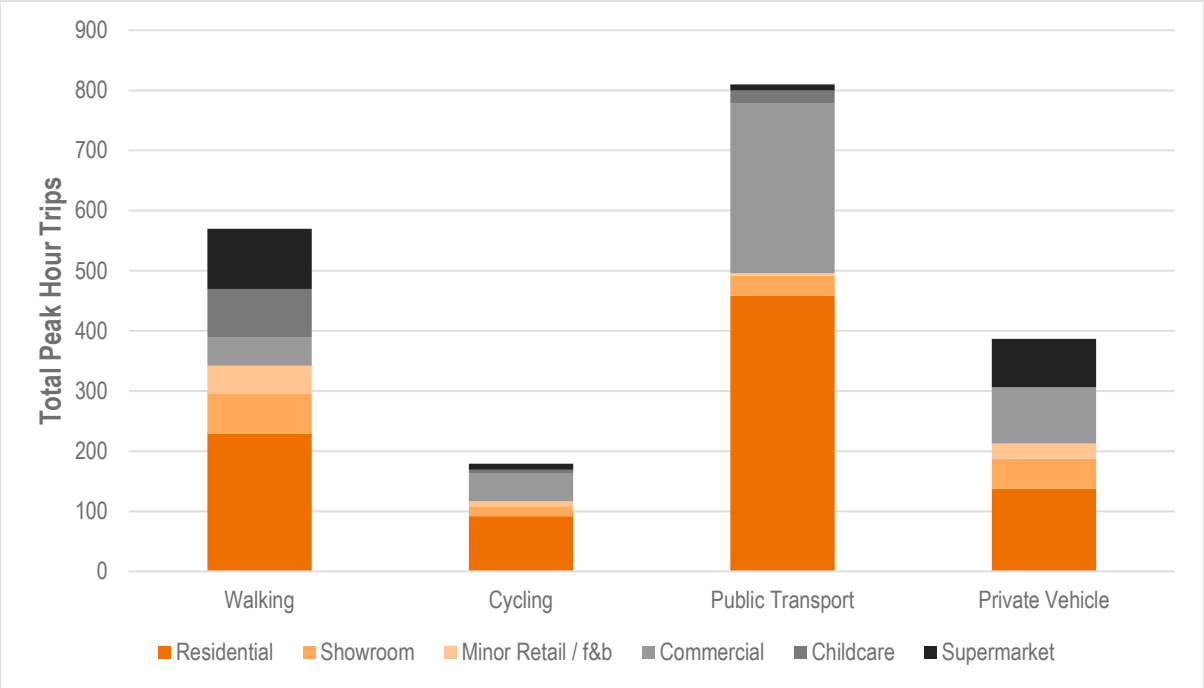
Table 4.1 indicates that the ultimate development of the site could potentially generate up to approximately 1,950 person trips (via all modes of transport) during the weekday PM peak hour. It is important to note that this trip generation estimate assumes all trips are external to the site, which is considered highly conservative given some of the trips will remain within the site (e.g., residential trips to retail, etc.).

Based on this total trip generation estimate and the target mode shares identified above, Table 4.2 presents an estimate of the trips by land use and transport mode, with the results graphically presented in Figure 5.3. The analysis indicates that the ultimate development could generate approximately 750 person trips by active travel modes, 810 person trips by public transport and 390 person trips (inclusive of passengers) by car to/from the surrounding transport network during the weekday PM road network peak hour.

Table 4.2: Trips Generated by Use

| Mode | Residential | Commercial | Showroom | Retail & F&B | Childcare | Supermarket | TOTAL |
|---|---|---|---|---|---|---|---|
| Walking | 229 | 47 | 67 | 46 | 81 | 100 | 570 |
| Cycling | 92 | 47 | 17 | 8 | 5 | 10 | 179 |
| Public Transport | 459 | 282 | 33 | 4 | 22 | 10 | 810 |
| Private Vehicle | 138 | 94 | 50 | 25 | 0 | 80 | 387 |
| TOTAL | 917 | 470 | 167 | 83 | 108 | 200 | 1945 |

Figure 4.3: Trip Generation by Mode

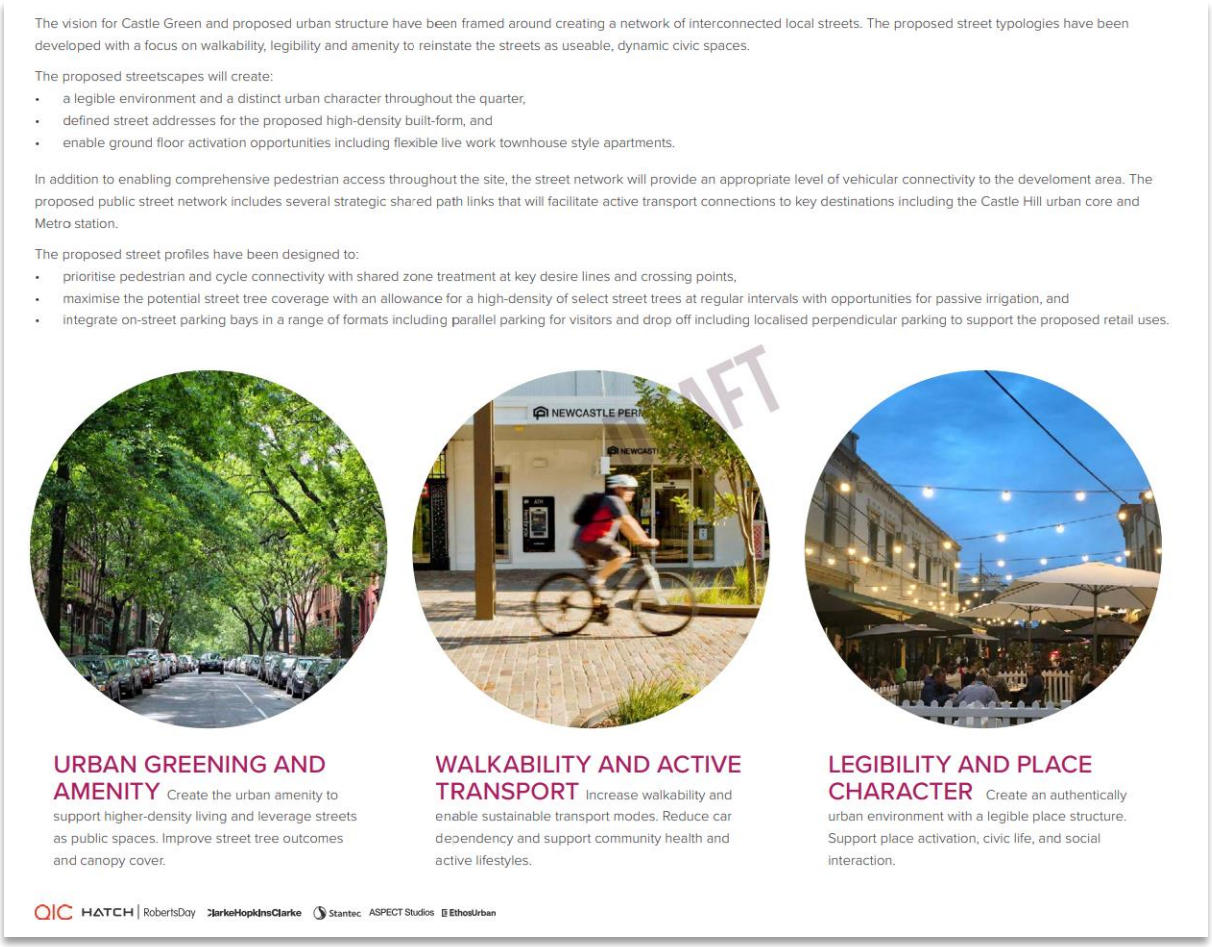


# 5 SITE LAYOUT

# 5.1 OVERVIEW

The master plan for the proposed Site B Planning Proposal development has been prepared with regard to the design vision and principles outlined in Figure 5.1 (as sourced from the Hatch Roberts Day Urban Design Report).

Figure 5.1: Design Vision & Principles




Source: Hatch Roberts Day

These design principles align with the recommended modal hierarchy outlined earlier in this report, and the overarching objective of maximising the use of active and public transport modes and minimising car trips to reduce traffic impacts associated with the development. Moreover, the design principles are also aligned with the objectives outlined in the Castle Hill North DCP, which are reproduced as follows:

- "To encourage residents to walk or cycle to shops, railway station, recreation areas, community and other facilities by providing for safe and direct pedestrian and cycle connections between key locations.
- A functional and attractive new street network is provided that facilitates access, safety and convenience for all street and road users and minimises the negative impact of traffic.
- Carriageways and verge widths are consistent with the identified street hierarchy and profiles to allow streets to perform their designated functions within the street network, enhance functionality and amenity for users and accommodate public utilities and drainage systems.
- Improve the capacity and function of the road network to support higher density development.

It is noted that the Castle Hill North DCP does not strictly apply to the development site, with the DCP southern boundary running along Castle Street. This has been referenced for comparative purposes only, and a site specific DCP will be developed for Site B in due course.

# 5.2 ACTIVE TRAVEL

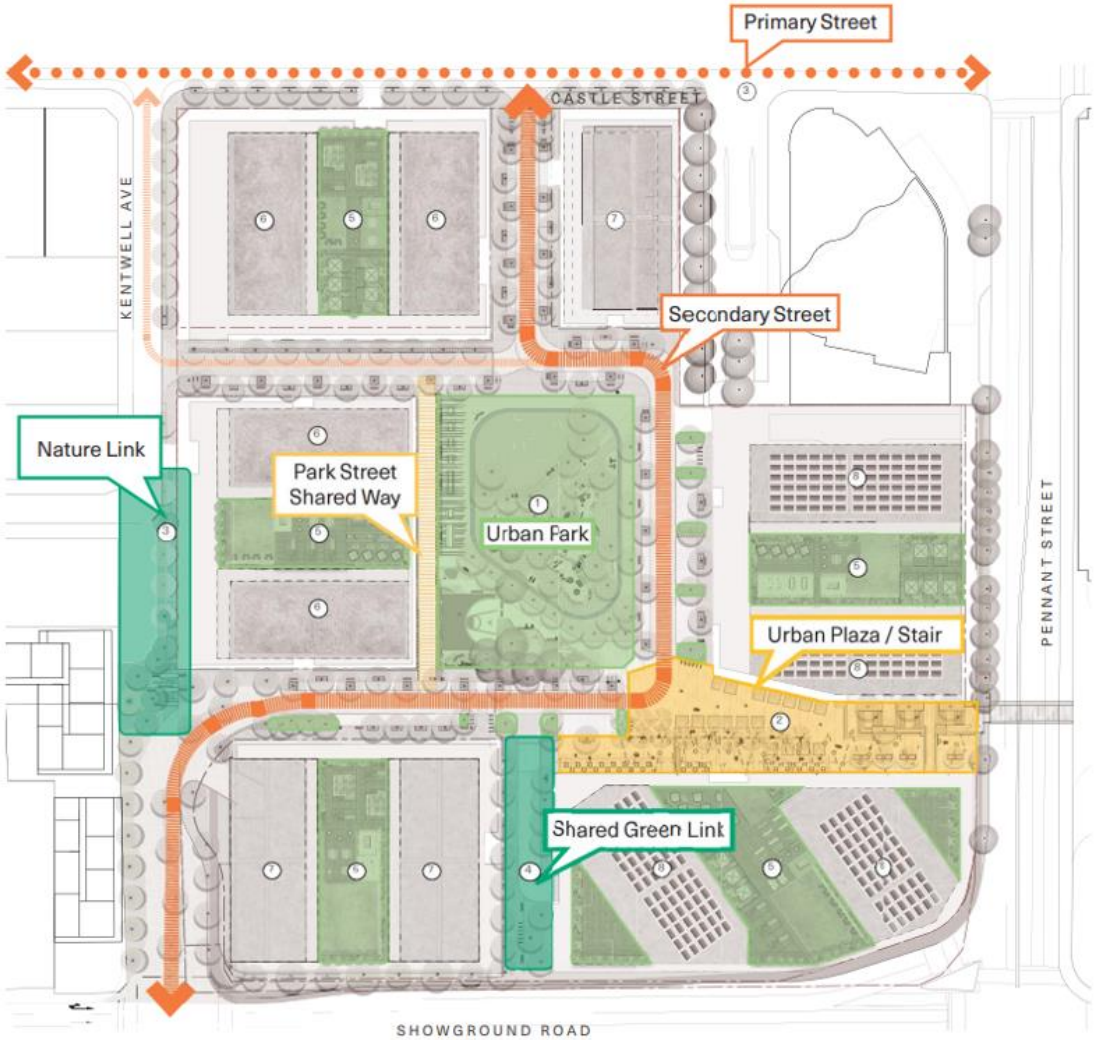
## 5.2.1 PEDESTRIAN NETWORK & CONNECTIONS

The internal layout of the site has been designed to accommodate a walkable and permeable mixed-use precinct that is integrated into the surrounding road network.

This will include a permeable internal pedestrian network, with access points to all road frontages, plus accommodation of a future bridge crossing over Pennant Street leading to Castle Towers Shopping Centre and Castle Hill Station. The proposed development will also include an internal street network, which is proposed to be vested as a public road, including connections to Showground Road, Castle Street and Kentwell Avenue.

Figure 5.2 outlines the proposed internal network of the site, including roads and walking paths as well as the new central urban park.

Figure 5.2: Site Layout




Source: Aspect Studios

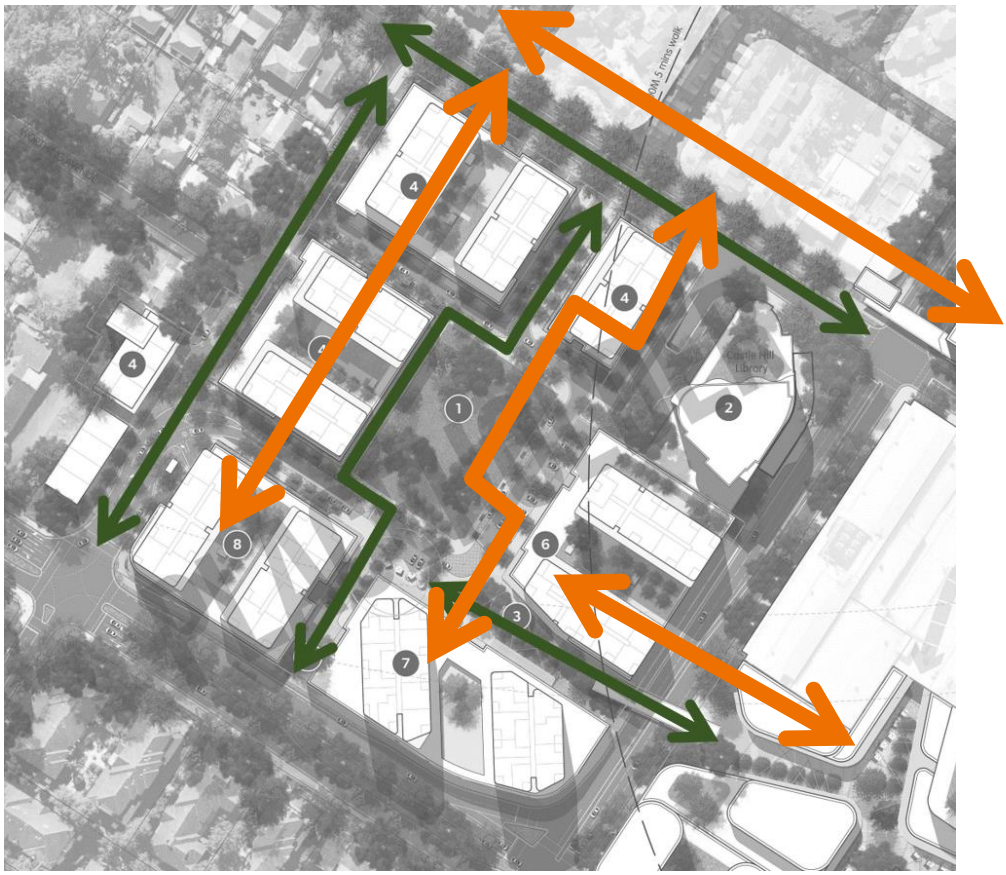
Figure 5.2 indicates that key features of the layout include:

- **Central Urban Park:** The development is proposed to be constructed with built form surrounding an internal "Urban Park". This park will provide internal permeability throughout the site, with access to all ground floor tenancies. This will encourage the use of the site as a walkable precinct, with residents having easy access to the retail and supermarket tenancies on-site. This will also provide an attractive environment for the surrounding area to permeate through the site as a walkable precinct.
- **Urban Plaza / Stairs over Pennant Street:** The "Urban Plaza / Stair" provided adjacent to Lots D & F will provide access to Pennant Street and over Pennant Street via a bridge to the future expansion to Castle Towers Shopping Centre. This crossing facility will ease in pedestrian access to Castle Towers and Metro Station.
- **Activated Internal Laneways:** Internal laneways provided between the various buildings within the development site will enhance permeability. This will enable walking to be used as a mode of transport by the nearby community to the retail land uses provided.
- **Pedestrian walkways throughout the site:** Generous pedestrian paths have been provided throughout the precinct, including the "Park Street Shared Way". This provides generous space for pedestrians to all locations through the Site B Planning Proposal.

### 5.2.2 CYCLING CONNECTIVITY

Shared paths and shared zones are to be provided through the precinct in a north-south and east-west direction. These connections are proposed to integrate the site into the cycling paths that surround the Site B Planning Proposal site and encourage cycling as a preferred mode of transport for residents and visitors. The proposed cycle paths within the site are outlined in Figure 5.3 and illustrate that an opportunity exists to link the site into the new cycling lanes proposed by Council (outlined within the Castle Hill North DCP) on the north side of Castle Street.

Figure 5.3: Key Proposed Pedestrian and Cycle Links



# 5.3 INTERNAL ROAD NETWORK

## 5.3.1 PREAMBLE

The internal road network has been designed with the overarching aim of providing a good level of vehicle access whilst also minimising the attractiveness of non-local rat-running traffic.

One key feature of the internal road network design that achieves this outcome is the provision of road cross-sections that are neither too narrow to accommodate expected traffic volumes nor too wide to encourage high vehicle speeds (that may make the internal roads attractive to drivers who do not have a destination in the precinct). These cross-sections are discussed further below.

In addition, the internal road network has purposefully been designed with somewhat road alignment, which wraps around the Central Park, and with 90-degree parking spaces off the roadway at one location as a proactive means to reduce non-local traffic. Similarly, Kentwell Avenue is to be retained as a truncated roadway so that it not able to be used as a rat-run between Castle Street and Showground Road. This truncation will also help minimise adverse traffic impacts on the adjacent residential streets to the west of the site.

## 5.3.2 CROSS-SECTIONS

The internal road cross-sections have been designed to meet or exceed the recommended dimensions outlined in the Castle Hill North DCP. Specifically, it is noted that the Castle Hill North DCP recommends a road reservation of 15-16m and 17.5m for Local Road 1 and 2 classifications respectively, noting that both road types include a recommended carriageway width of 6.0m and car space widths of 2.0m to 2.1m.

For reference, the proposed internal road cross-sections within the Site B Planning Proposal development are presented in Figure 5.5 to Figure 5.8, with a reference map shown in Figure 5.4. These figures indicate the following:

- Cross-section Location A ("Castle Street Link") – This street features a road reservation width of 18m, which exceeds the DCP requirement, and a carriageway width of 6.0m, which meets the DCP requirement. It also includes generous verge widths which will include indented car parking spaces at 2.3m width, which exceed the DCP requirement.
- Cross-section Location B ("Internal Link Street") – This street features a road reservation width of 18m, which exceeds the DCP requirement, and a carriageway width of 6.0m, which meets the DCP requirement. It also includes generous verge widths which will include indented car parking spaces on the northern side of the road at 2.3m width and truck / bus parking on the southern side of the road at 3.0m width. The proposed parking space dimensions exceed the DCP requirement.
- Cross-section Location C ("Local Street") – This street features a road reservation width of 14.7m, which is slightly narrower than the DCP Local Road 1 recommendation. However, the proposed cross-section is considered acceptable given it maintains a 6.0m wide carriageway, 2.3m wide car parking spaces and verge widths of 3.2m.
- Cross-section Location D ("Urban Green Street") – This street features a road reservation width of 20.3m, including a 6.4m carriageway width, 5.4m long 90-degree car spaces on the eastern side of the road, 2.3m wide parallel car spaces on western side of the road and generous verge widths. The dimensions are generally consistent with the DCP requirements, except for the 90-degree car space dimensions. The 90-degree car space dimensions are considered to be acceptable given the road will be subject to low speed and traffic volumes, and therefore are generally compliant with recommendations of AS2890.5:2020 (Table A.3).

Figure 5.4: Internal Street Cross-Sections – Reference Map


Figure 5.5: Cross-Section for Location A (“Castle Street Link”)

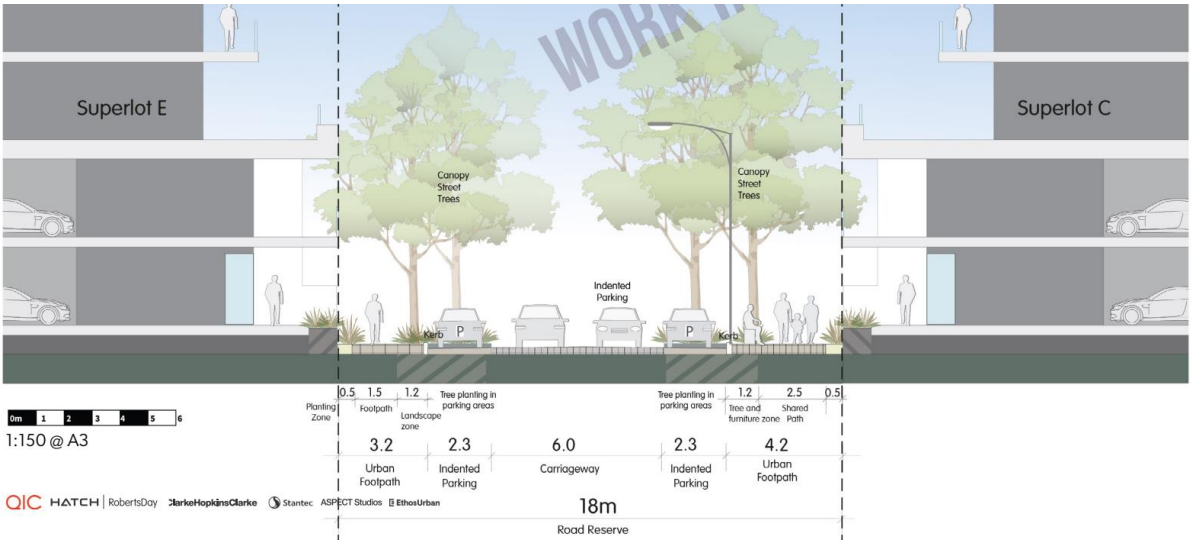


Figure 5.6: Cross-Section for Location B (“Internal Link Street”)

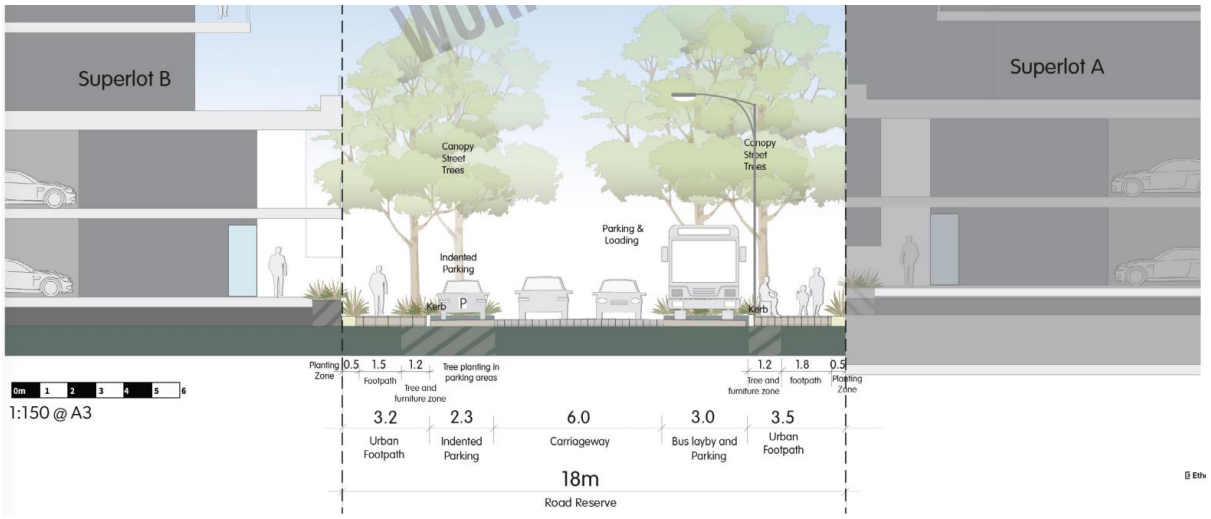
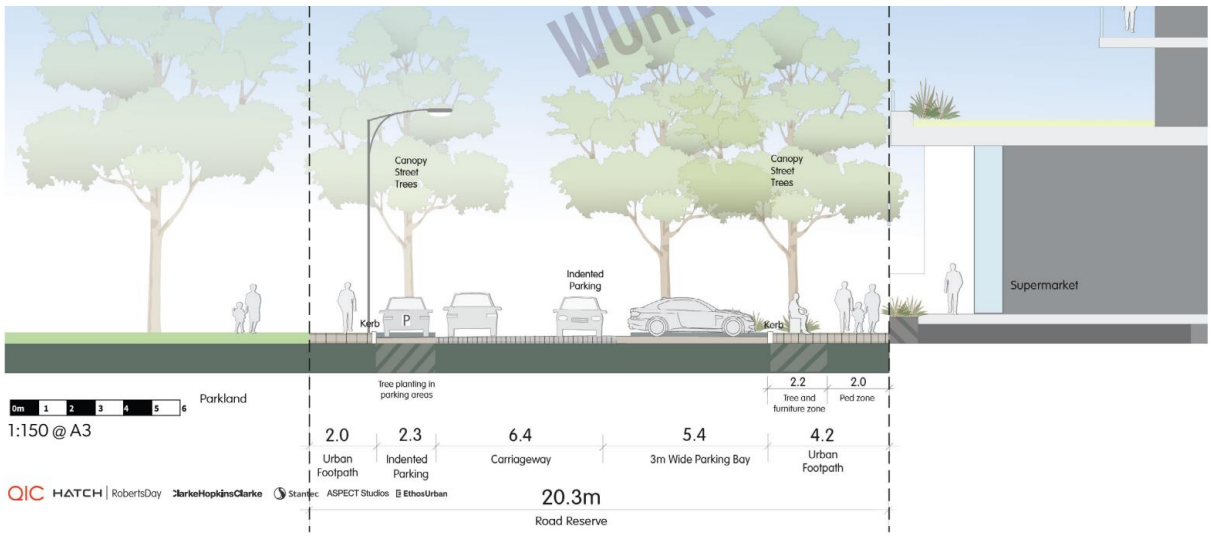



Figure 5.7: Cross-Section for Location C (“Local Street”)


Figure 5.8: Cross-Section for Location D (“Urban Green Street”)



### 5.3.3 SWEPT PATH ASSESSMENT

The adequacy of the internal road network to accommodate expected vehicle movement swept paths has been tested with AutoTURN. The swept path assessments are included at Appendix X of this report and indicate that appropriate vehicle movements can be accommodated through the site (including at the bends in the internal road network), subject to minor design revisions that will be addressed in subsequent design stages.

## 5.4 EXTERNAL VEHICLE ACCESS ARRANGEMENTS

### 5.4.1 OVERVIEW

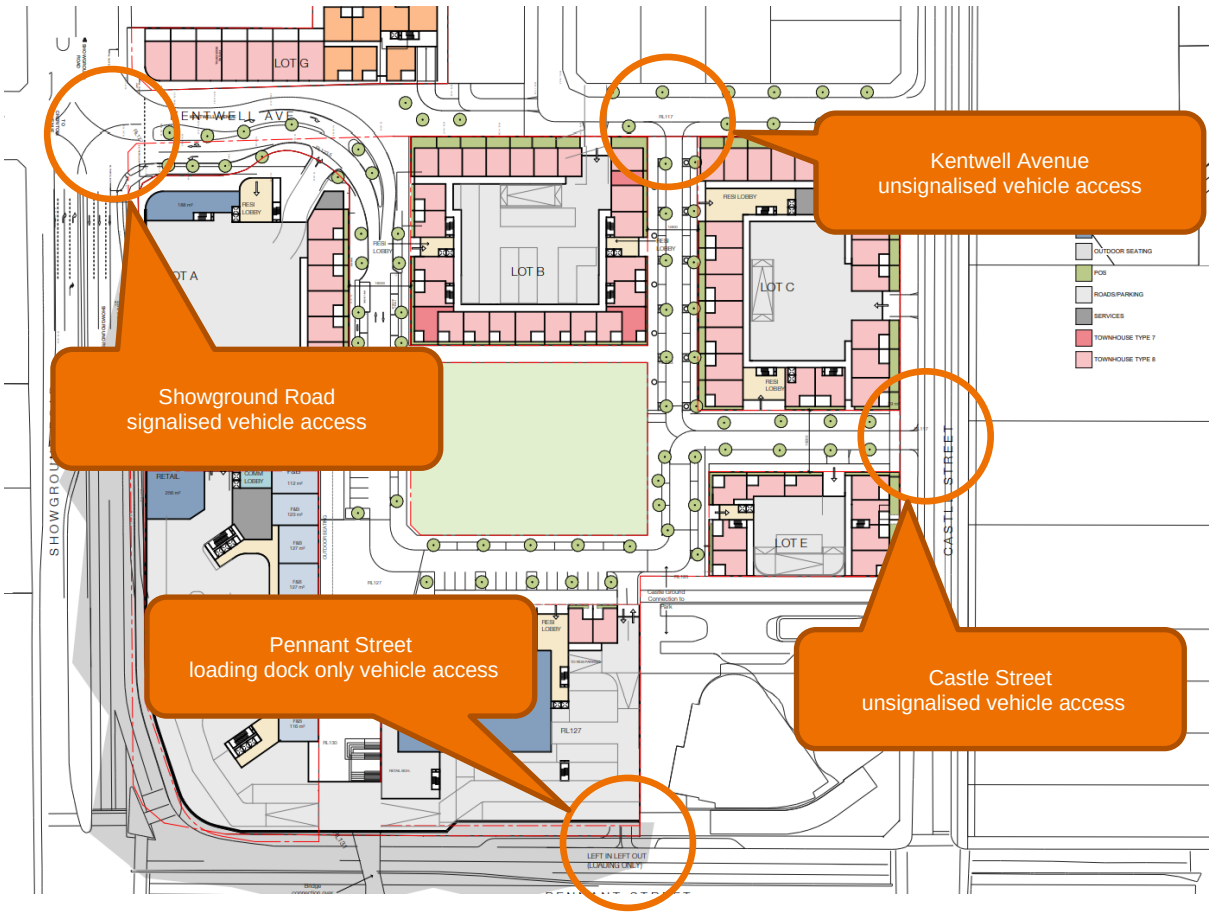
Vehicle access to the Site B Planning Proposal development is proposed as follows:

- Showground Road via a signalised intersection at Kentwell Avenue,
- Pennant Street via a unsignalised left-in / left-out intersection for loading vehicles only, and
- Castle Street and Kentwell Avenue via unsignalised T-intersections.

As outlined above, the internal road network has purposefully been designed to minimise non-local rat-running traffic via the provision of appropriate road cross-section, a somewhat circuitous road alignment and the retention of the truncation of Kentwell Avenue.

The proposed vehicle access locations are shown in Figure 5.5 and are discussed further below.

Figure 5.5: Proposed Vehicle Access Locations



### 5.4.2 SHOWGROUND ROAD / KENTWELL AVENUE INTERSECTION

At the Showground Road signalised intersection, the new internal road will have a three-lane cross-section (one entry lane and two exit lanes).

This layout has been designed having regard to the SIDRA analysis presented in this report which indicates that a larger intersection is no longer required given the very significant reduction in the traffic generation to/from and through Site B (compared to the previous DA approval which required a wider cross-section).

Notwithstanding this, whilst the provision of a double right-turn lane from Showground Road into the new access road is not proposed for the above reasons, it is noted that the Planning Proposal does not preclude a second right-turn lane from being provided if it is deemed necessary by TfNSW in the future. Specifically, it is noted that a second right turn lane could be provided by widening the intersection to the west, noting that this widening would more closely match the new access road to the existing width of the existing stub constructed at the intersection.

### 5.4.3 PENNANT STREET LOADING DOCK VEHICLE ACCESS

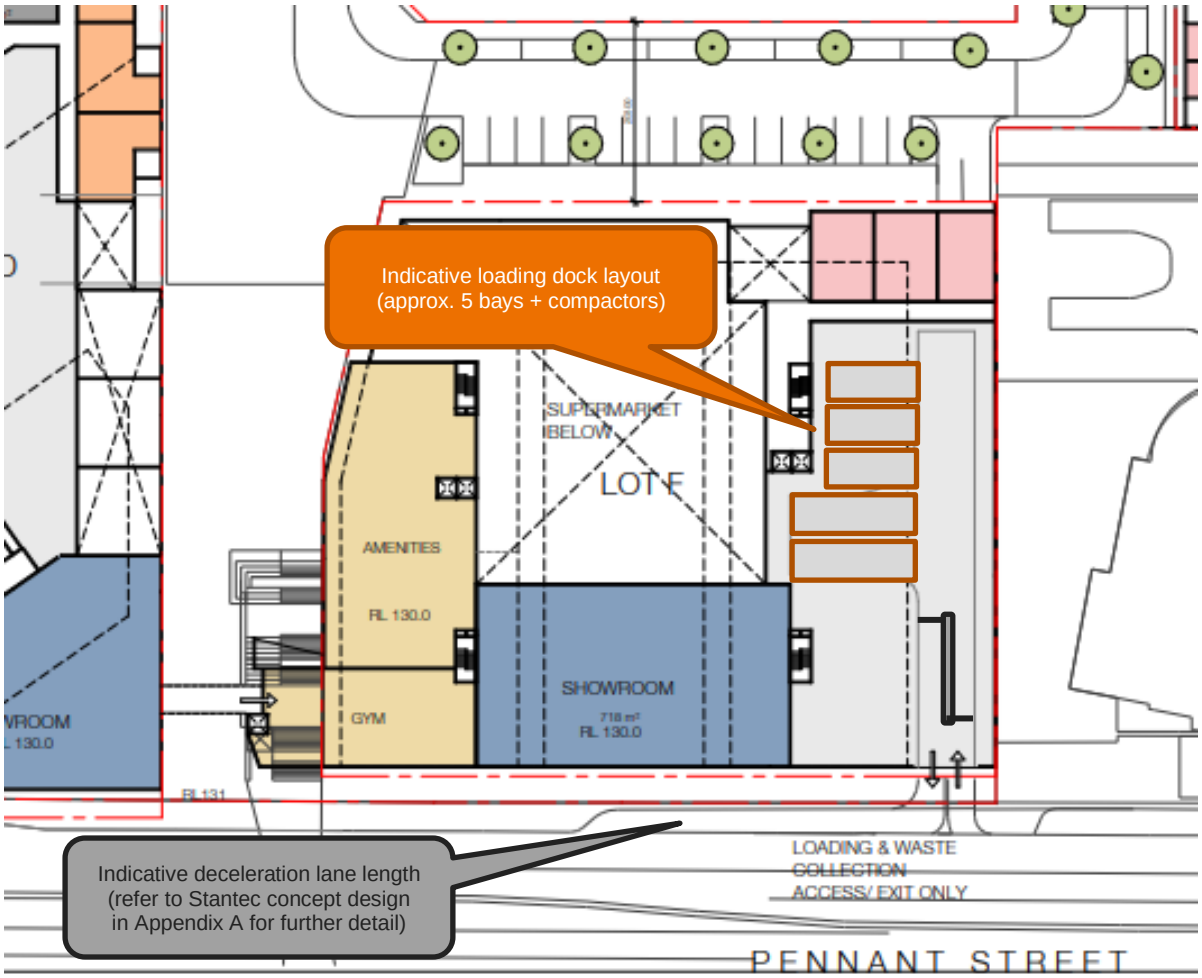
The Site B Planning Proposal development proposes a left-in / left-out vehicle access to a basement loading dock only off Pennant Street. This is subject to further detailed design and assessment as part of future relevant DAs and is detailed for high-level consideration only at this stage.

This loading dock vehicle access is critical to achieve the design principles and objectives outlined above, as it minimises loading movements on the internal road network and therefore allows the streets to be designed better for pedestrians (e.g., relatively narrower road widths). In addition, it also allows for greater ground level activation to the streets, as vehicle crossover widths (and ramping impacts) can be minimised.

It is appreciated that preliminary feedback provided by TfNSW suggests that this vehicle access is not supported. Notwithstanding this, the vehicle access is retained in the proposed design given it has significant benefits and is considered to be acceptable for the following reasons:

- The vehicle access is able to be designed with a fully compliant deceleration lane, even allowing for the downgrade of Pennant Street, as shown in the plans at Appendix X. In this context, the vehicle access will be more compliant that the other existing loading dock accesses off this road which have no deceleration lanes.
- The vehicle access is to be restricted to loading and waste collection vehicle movements only. This restriction will mean that the vehicle access carries low level of traffic each day. These vehicle movements may also be able to be further managed to occur outside of road network peak hours via a loading dock management plan that can be enforced by TfNSW.
- The internal design of the loading dock will be subject to subsequent Development Applications but is proposed to be designed to reduce the potential for vehicle queuing to extend onto Pennant Street. The indicative layout of this loading dock is shown in Figure 5.6 and indicates that the loading bays will be located some distance into the site. It is further noted that it is not proposed to control the loading dock vehicle access near the property boundary.
- The vehicle access is positioned at a location which was previously approved by TfNSW (RMS) for a previous development on the site.

Figure 5.6: Indicative Loading Dock Layout




### 5.4.4 CASTLE STREET AND KENTWELL AVENUE INTERSECTIONS

These intersections are proposed to be unsignalised T-intersections without the provision of separate right-turn lanes or left-turn deceleration lanes into the internal road network. Concept designs for the intersections are shown in Appendix A.

It is noted that the concept design for the Castle Street vehicle access shows the anticipated layout with the proposed widening of Castle Street. The cross-section presented for the Castle Street widening is generally consistent with the design presented in the Castle Hill North DCP.

## 5.5 SUMMARY

The site layout has been designed with the overarching objective of maximising the use of active and public transport modes and minimising car trips to reduce traffic impacts associated with the development.

The design also aligns with the objectives outlined in the Castle Hill North DCP and will provide safe and direct pedestrian and cycling connections between key locations, a functional and attractive street network that facilitates safe and convenient access for all road users, appropriate carriageway and verge widths, and sufficient vehicle access arrangements to support the density of the development

The vehicle access arrangements proposed for the development, including the proposed loading dock vehicle access onto Pennant Street, are also considered appropriate for the development.

# 6 PARKING PROVISION

# 6.1 PREAMBLE

The Planning Proposal does not propose the introduction of site-specific car or bicycle parking rates and therefore the assessment contained below is principally included to simply outline the adequacy of the anticipated provisions. It is acknowledged that further analysis of these provisions will be required for each subsequent Development Application on the Site B Planning Proposal site.

# 6.2 CAR PARKING

## 6.2.1 DCP REQUIREMENT

The car parking requirements for land use in Castle Hill is set out in Table 1: Required Minimum Car Parking Provisions of The Hills Shire Development Control Plan 2012.

Using these rates, an assessment of the DCP car parking requirement for the indicative development yield is summarised in Table 6.1. This table indicates that the indicative development yield would generate a DCP requirement of 3,941 car spaces.

Table 6.1: The Hills Shire DCP Car Parking Rates

| Description | Land Use | | No. / Size | DCP Parking Rate | DCP Parking Requirement |
|---|---|---|---|---|---|
| **Residential** | Residential Flat Buildings | 1-bedroom | 353 | 1 space per 1 bedroom unit | 353 spaces |
| | | 2-bedroom | 775 | 2 spaces per 2+ bedroom unit | 1,550 spaces |
| | | 3-bedroom | 282 | | 564 spaces |
| | Residential Visitor | | 1,410 | 2 visitor spaces per 5 units | 564 spaces |
| **Commercial** | Commercial premises | | 16,200sqm | 1 space per 25sqm GFA | 648 spaces |
| **Showroom** | Bulky Goods Premises [1] | | 3,400sqm | 1 space per 40sqm GFA | 85 spaces |
| **Retail / F&B** | Shop | | 1,100sqm | 1 space per 18.5sqm GLFA | 59 spaces |
| **Supermarket** | | | 1,600sqm | | 86 spaces |
| **Childcare Centre** | Childcare | | 120 children (12 staff [2]) | 1 space per employee plus 1 space per 6 children enrolled for visitors and/or parent parking | 32 spaces |
| **Total** | | | | | **3,941 spaces** |

[1] Indicative land Use for Car Parking assessment purposes
[2] Assume ratio of 10 staff to children

This DCP requirement is considered to be excessive and inappropriate for the future development of the Site B Planning Proposal site for a variety of reasons, including:

- The DCP rates do not have sufficient regard to the site's location adjacent to Castle Hill metro station (which commenced operations after the DCP rates were formulated), which has improved public transport accessibility to the precinct and reduced car reliance.
- The DCP rates do not have regard to the extent to which car parking at the Centre, and increasingly in the surrounding area, is controlled and managed. The extent of this control and management acts to constrain the available car parking supply, particularly long-term car parking, and thus reduce car parking demand.

- The DCP rates align with the 'predict and provide' approach to car parking. The Austroads Guide to Parking Management Part 11 describes this approach as a technique which readily interprets a 'parking problem' as an issue of 'inadequate supply'. Over the past decade, the 'predict and provide' approach has been steadily replaced by a range of travel demand management techniques which challenge historical travel behaviours and encourage mode change away (reversing the trend) from private motor vehicle travel, particularly during road network peak hours. For the future development in Castle Hill, it is considered appropriate, if not necessary to curtail rising traffic congestion, to adopt a reduced car parking rate approach to encourage travel by sustainable transport modes (walking, cycling and public transport) and minimise, as far as practical, travel by private motor vehicle. This alternative approach is adopted for Castle Hill North, which lies immediately north of the site, as described further below.

- The DCP rates do not have regard to the changing nature of transport and the extent to which mobility as a service technology is resulting in reductions to long-term car parking demands. As the full development of the site is not expected to occur for circa 20 years, it is considered reasonable to expect car parking reliance to reduce as other modes of transport become more prevalent and accessible.

The combination of the above factors will result in the post-development car parking demands being considerably lower than the DCP requirement, as outlined below.

### 6.2.2 RECOMMENDED CAR PARKING RATES

Residential

Guidance on car parking rates for the proposed residential apartments has been sought from the TfNSW (RMS) Guide to Traffic Generating Developments and the Castle Hill North DCP. The rates outlined in these documents are summarised in Table 6.2.

Table 6.2: Residential Car Parking Rates (car spaces per dwelling)

| Size | TfNSW (RMS) Guide | | | Castle Hill North DCP (Maximum) [1] |
|---|---|---|---|---|
| | CBD | Sub-Regional | Midpoint | |
| 1-bedroom apartment | 0.4 | 0.6 | 0.5 | 0.5 |
| 2-bedroom apartment | 0.7 | 0.9 | 0.8 | 0.8 |
| 3-bedroom apartment | 1.2 | 1.4 | 1.3 | 1.3 |

[1] Rates align with Bonus FSR rates under LEP.

Table 6.2 highlights that the maximum car parking rates outlined in the Castle Hill North DCP match the midpoint of the rates recommended in the TfNSW (RMS) Guide.

In this context and given the need for car ownership is expected to decline over the coming decades as other transport modes become more prevalent and accessible, the adoption of the maximum Castle Hill North DCP rates for the proposed development is considered reasonable (if not conservative on the high side).

Office

As outlined above, it is evident there is opportunity to provide less car parking for the office land use in particular to actively encourage the use of the sustainable transport modes (particularly public transport) and discourage the (over) use of cars.

This approach is consistent with the approach recommended in Castle Hill North DCP, which specifies a maximum car parking rate of 0.5 car spaces per 100sqm GFA (i.e., 1 car spaces per 200sqm GFA), and other comparable precincts in metropolitan Sydney.

For comparison, a summary of office car parking rates for a range of similar precincts with broadly similar levels of public transport accessibility is presented in Table 6.3. This table indicates the Castle Hill North DCP rate aligns with the rate recommended for the Chatswood CBD and is lower than the rates recommended in Ryde and Paramatta (and the rate proposed in Bankstown).

Table 6.3: Benchmarking of office car parking rates

| Location | Office car parking rate |
|---|---|
| Bankstown (proposed) | 1.25 car spaces per 100sqm (max.) |
| Parramatta | 1 car space per 100sqm (max.) |
| Ryde (Macquarie Park Corridor) | 1 car space per 100sqm (max.) |
| Chatswood CBD | 0.5 car spaces per 100sqm (max.) |
| St Leonards (Zone B3 and B4) | 0.25 car spaces per 100sqm (max.) |
| North Sydney CBD | 0.25 car spaces per 100sqm (max.) |

For the purposes of presenting a conservative assessment of car parking provision and thus traffic generation, an office car parking rate of **2 car space per 100sqm GFA** has been adopted in this report.

Shop / Food & Beverage / Supermarket

As outlined earlier in this report, the existing Castle Towers Shopping Centre generates a car parking demand at a rate of **3.5 car spaces per 100sqm GFA** (on weekends). The adoption of this rate is considered reasonable for shop, food and drink, and supermarket land uses and is potentially conservative on the high side given its likely that the retail offering with the Site B Planning Proposal site will principally service people living in the immediate area who are more likely to walk or cycle to the site.

Showroom

For the purposes of this assessment, a car parking rate of **2.0 car spaces per 100sqm GFA** has been adopted for the showroom. This rate is generally consistent with empirical data and is only slightly lower than the standard DCP rate of 2.5 car spaces per 100sqm.

Childcare Centre

It is expected that the proposed childcare centre will principally service people living or working in the development or the immediate precinct. For this assessment, guidance for this land use has been sought from empirical evidence which suggests that a rate of approximately 0.2 car spaces per child is likely to be more than sufficient.

### 6.2.3 RECOMMENDED MAXIMUM CAR PARKING PROVISION

Based on the rates recommended above, an assessment of the recommended maximum car parking provision for the ultimate development is presented in Table 6.4.

This table indicates that the maximum car parking provision for the ultimate development of the site should be approximately 1,486 car spaces (excluding allowances for visitors, which would typically be predominantly accommodated on-street).

Table 6.4: Recommended Maximum Car Parking Provision

| Description | Land Use | | No. / Size | Maximum Parking Rate | Maximum Parking Provision |
|---|---|---|---|---|---|
| **Residential** | Residential Flat Buildings | 1-bedroom | 353 | 0.5 spaces per 1 bedroom unit | 177 spaces |
| | | 2-bedroom | 775 | 0.8 spaces per 2 bedroom unit | 620 spaces |
| | | 3-bedroom | 282 | 1.3 spaces per 3 bedroom unit | 367 spaces |
| **Commercial** | Commercial premises | | 16,200sqm | 2 space per 100sqm GFA | 324 spaces |
| **Showroom** | Bulky Goods Premises [1] | | 3,400sqm | 2 spaces per 100sqm GFA | 68 spaces |
| **Retail / F&B** | Shop | | 1,100sqm | 3.5 spaces per 100sqm GFA | 39 spaces |
| **Supermarket** | | | 1,600sqm | 3.5 spaces per 100sqm GFA | 56 spaces |
| **Childcare Centre** | Childcare | | 120 children (12 staff [2]) | 0.2 spaces per child | 24 spaces |
| **Total** | | | | | **1,675 spaces** |

[1] Indicative land Use for Car Parking assessment purposes
[2] Assume ratio of 10 staff to children

### 6.2.4 ADEQUACY OF PROPOSED PROVISION

The development summary shown in the architectural plans prepared by Clarke Hopkins Clarke indicate that a total of 1,644 car spaces (excluding on-street spaces) are envisaged in the ultimate development of the Site B Planning Proposal site. This provision generally aligns with the assessment outlined above and indicates that the proposed car parking provision is appropriate for the site.

## 6.3 BICYCLE PARKING

It is proposed that the level of bicycle parking provision will be generally at a high rate to encourage the use of cycling as a mode of transport and achieve a mode shift away from the use of private vehicles.

At a minimum, it is expected that bicycle parking facilities should be provide for a 5%-10% target mode share for each land use and the subsequent bicycle trip generation rates as specified in Section 3.3. This approach is likely to entail the provision of long-tern (resident and staff) bicycle parking at the following rates:

- Residential: 0.33 bicycle spaces / dwelling (minimum) to 1 bicycle space / dwelling (aspiration)
- Office: 0.33 bicycle spaces / 100sqm (minimum) to 1 bicycle space / 100sqm (aspiration)
- Retail: 0.20 bicycle spaces / 100sqm (minimum) to 0.33 bicycle spaces / 100sqm (aspiration)

The on-site bicycle parking facilities would be designed in accordance with AS2890.3: Bicycle Parking. End of Trip facilities and be provided to align with the recommendations of the NSW Government's Planning Guidelines for Waking and Cycling.

## 6.4 OTHER VEHICLE PARKING

The ultimate development of the site will also include the provision of a range of different car parking types, including (from) electric vehicle parking, motorcycle and scooter parking, emergency vehicle parking, and shared vehicle parking. Further detail regarding this parking will be provided within subsequent Development Applications.

## 6.5 SUMMARY

The proposed development will provide car parking appropriate for the site having regard to its proximity to surrounding land uses and public transport services which can be expected to encourage the use of walking and cycling and public transport, respectively.

The proposed provision generally accords with the rates recommended in the Castle Hill North DCP which acknowledges the importance of reducing car parking provisions to proactively lessen adverse traffic impacts.

The proposed development will also provide suitable bicycle parking and other forms of car parking as appropriate

# 7 TRAFFIC IMPACTS

# 7.1 OVERVIEW

As outlined earlier in this report, SIDRA intersection modelling has been completed to test traffic impacts of the proposed Site B Planning Proposal development at key surrounding intersections.

This form of analysis is considered appropriate for the Planning Proposal and no AIMSUN traffic modelling has been completed for the following reasons:

- The development of the Site B Planning Proposal site is expected to generate a relatively modest volume of traffic during peak hours given its predominantly residential nature. The expected traffic generation of the Site B Planning Proposal site is up to approximately 393 vehicle movements during the weekday PM peak hour, as outlined below.
- In comparison to previously approved development within the Castle Towers precinct, the development of the Site B Planning Proposal site will generate significantly less traffic onto the adjacent roads. This is most clearly observable by comparing the expected total generation of the site (i.e., up to approximately 393 vehicle movements during the weekday PM peak hour) with the previously modelled traffic volume on the Site B access road alone (i.e., approximately 1,000 vehicle movements during the weekday PM peak hour). This traffic volume comparison is further discussed below.
- As the overall traffic generation of the precinct is comparatively lower, the new development will have a lesser overall impact on the surrounding road network. Despite this traffic volume reduction, QIC has also already contributed $15m to TfNSW for the completed duplication of Showground Road.
- As outlined earlier in this report, the development of the Site B Planning Proposal site generally proposes to retain previously proposed intersection works, other than the reduction in the size of the Showground Road / Kentwell Avenue intersection as outlined above. (The provision of SIDRA analysis is considered sufficient to assess this layout change, noting that it has also been designed with flexibility to allow provision of a second right-turn lane into the site if deemed necessary in the future).
- The configuration of intersections in the vicinity of the Site B Planning Proposal site does not need to be determined prior to the approval of this Planning Proposal. Rather, these layouts can be determined for the subsequent Development Applications.

Notwithstanding this, at the time of preparing this report, it is noted that QIC had provided in-principle approval to engage Cardno now Stantec to complete traffic modelling for the precinct using the AIMSUN model currently being prepared for TfNSW and Council as part of its broader assessment of the precinct. The completion of this modelling is agreed by QIC to assist the orderly transport planning for the precinct by allowing the assessment of the cumulative traffic impacts of the new development now envisaged in the precinct. This modelling is likely to be completed later in 2022 (once the AIMSUN model becomes available for use by QIC) and is not considered necessary to support the Planning Proposal for the reasons outlined above.

# 7.2 TRAFFIC GENERATION

## 7.2.1 DEVELOPMENT GENERATED TRAFFIC

The trip generation estimate outlined earlier in this report indicates that the proposed development is expected to generate approximately 370 person trips by car during the weekday PM peak hour.

For comparative purposes, a supplementary estimate of the anticipated traffic generation has also been undertaken using a traditional 'vehicle movements per car space' approach. This assessment is summarised in Table 7.1 and assumes the following:

- The **residential** traffic generation rates are sourced from the RMS Technical Note (TDT 2013/04), which advises rates per car parking space for high density residential developments of 0.15 and 0.12 vehicle movements per car space during the AM and PM peak hours, respectively.
- For the **commercial** office rate, a traffic engineering rule of thumb rate of 0.5 vehicle movements per car space has been applied. This rate is informed by the variability in the rates found in the RMS technical note, as well as other traffic survey data.
- A combined rate has been applied for the minor **retail** tenancies as well as the **showrooms**. Data was sourced from the RMS guide, generally applicable to mixed-use shopping centres and retail land uses. Given the nature of the mixed-use development, with various retail offerings throughout the precinct, it is expected that there will be a large degree of sharing of traffic demands generated by these uses.
- Traffic generation rates for the **supermarket** were sourced from a report commissioned by RMS, for retail supermarkets (Roads and Maritime Trip Generation Surveys, NSW Small Suburban Shopping Centres, Bitzios Consulting for RMS (2018)). These found rates of 1.9 trips per car parking space and 2.4 trips per car parking space. The rates contained within these traffic surveys are generally considered to be conservative as they often include traffic generated by retail offerings in the immediate surrounds of the main anchor supermarket. Given the mixed-use nature of the precinct, it is expected that a sharing of traffic will occur with other uses contained on the site. Additionally, the Bitzios report presents rates for the supermarket AM and PM Peak hours, not the road network peak hours. Given the above, a traffic generation rate of 1 movement per space in the AM Peak and 2 movements per space in the PM Peak were deemed to be appropriate.
- In the below assessment, it has been assumed that the **childcare centre** will not generate an additional traffic demand, as it will primarily consist of residents of the site and in the immediate surrounds. It has been assumed that additional movements will occur outside of peak periods, or be contained within the above traffic volumes.

Using this approach, Table 7.1 indicates that the Site B Planning Proposal development could be expected to generate up to approximately 447 and 521 vehicle movements during the weekday AM and PM road network peak hours, respectively. (This estimate is broadly consistent with the earlier trip generation estimate).

Table 7.1: Forecast Development Traffic Generation

| Land Use | No of Car Spaces | Peak Hour Generation Rate | | Peak Hour Traffic Generation | |
|---|---|---|---|---|---|
| | | AM Peak | PM Peak | AM Peak | PM Peak |
| **Residential** | 1,164 | 0.15 vph per parking space | 0.12 vph per parking space | 175 vph | 140 vph |
| **Commercial** | 324 | 0.5 vph per car parking space | 0.5 vph per car parking space | 162 vph | 162 vph |
| **Showroom** | 68 | 0.5 vph per car parking space | 1 trip per car parking space | 34 vph | 68 vph |
| **Shop / F&B** | 39 | 0.5 vph per car parking space | 1 trip per car parking space | 20 vph | 39 vph |
| **Supermarket** | 56 | 1 trip per car parking space | 2 vph per car parking space | 56 vph | 112 vph |
| **Total** | | | | **447 vph** | **521 vph** |

### 7.2.2 COMPARISON TO EXISTING DA APPROVAL

In November 2017, GTA (now Stantec) prepared a Transport Impact Assessment report (GTA Ref: N105870 dated 28/09/17) for the approved expansion of the Castle Towers Shopping Centre which increased the retail floor area from circa 113,000sqm to 193,000sqm GLFA.

The report contained detailed AIMSUN traffic modelling based on an analysis of the anticipated traffic generation of that development. The estimated traffic generation increase during the weekday PM peak hour and Saturday midday peak hour was +1,051 and +1,260 vehicle movements, respectively[2]. The majority of this traffic generation increase was expected to pass through the Site B site to/from the Showground Road / Kentwell Avenue / Site Access signalised intersection.

In this context and noting that the abovementioned expansion of the shopping centre is no longer proposed by QIC (or indeed possible in its approved format given that the Site B Planning Proposal development alters its approved vehicle access arrangement through Site B), it is evident that the new Site B Planning Proposal development will generate significantly less traffic than the previously approved expansion.

## 7.3 TRAFFIC DISTRIBUTION & ASSIGNMENT

The estimated traffic generation of the proposed development has been split between entering and exiting volumes in accordance with the assumptions outlined in Table 7.2. These assumptions align with empirical evidence for the land use and are commonly adopted for transport impact assessments.

Table 7.2: Splits for Site Generated Traffic

| Land Use | AM Peak Hour | | PM Peak Hour | |
|---|---|---|---|---|
| | In | Out | In | Out |
| Residential | 20% | 80% | 60% | 40% |
| Commercial | 90% | 10% | 10% | 90% |
| Showroom | 90% | 10% | 50% | 50% |
| Minor Retail / F&B | 50% | 50% | 50% | 50% |
| Supermarket | 50% | 50% | 50% | 50% |

For the purposes of this assessment, the following traffic distribution has been assumed onto the surrounding road network:

Table 7.3: Distribution onto Surrounding Road Network

| Distribution Direction (To/From) | Percentage of Traffic Generation |
|---|---|
| West along Showground Road | 30% |
| East Along Showground Road | 20% |
| West Along Castle Street | 10% |
| East Along Castle Street | 10% |
| North Along Pennant Street | 30% |

The site contains a number of different development lots and site access points to the surrounding road network. Further detail of the movement distribution of each lot, onto the surrounding road network is outlined in Appendix B, alongside the total site generated traffic volumes found in Appendix C.

[2] It is noted that a GTA report prepared in November 2015 (GTA Ref: 12S1268902 dated 25/11/15 and titled 'CASTLE TOWERS SHOPPING CENTRE EAST MALL ADDENDUM DA – TRAFFIC AND PARKING REVIEW') for an earlier approval of the retail expansion (of the same magnitude) estimated the increase in traffic generation as +2,016 and +2,244 vehicle movements during the weekday PM peak hour and Saturday midday peak hour, respectively. It is understood that this earlier report was used as the basis of the assessment of the traffic generation from the Centre that was ultimately used to determine QIC's financial contribution of $15m to TfNSW for the now completed duplication of Showground Road.

# 7.4 TRAFFIC IMPACTS

## 7.4.1 ASSUMPTIONS & LIMITATIONS

Key assumptions that have informed this SIDRA analysis include:

- The SIDRA analysis focuses solely on the Thursday PM peak hour as traffic congestion on the adjacent road network is typically highest during this period as commuter and retail peak vehicle activity occurs at the same time.
- During the weekday morning periods, the proposed development is also expected to generate lower levels of traffic activity, as demonstrated in the traffic generation analysis. This is principally the case as retail land uses generally generate little traffic during these peak hours.
- The traffic volumes used in the SIDRA analysis were collected by Stantec on Thursday 4th March 2021, which was a period not materially impacted by COVID restrictions. These traffic volumes and estimated future scenario volumes are shown in Appendix B.

It is acknowledged that SIDRA is not the perfect tool for the analysis of intersection performance in congested road networks or where closely spaced intersections may impact the operation of other nearby intersections.

In this context, it is noted that the analysis presented below should not necessarily be seen as providing an exact representation of existing intersection performance. Rather, it is principally included to assess the general change in intersection performance by comparing scenarios modelled.

## 7.4.2 INTERSECTION ANALYSIS

### 7.4.2.1 SHOWGROUND ROAD / KENTWELL AVENUE INTERSECTION

Modelling Scenarios

The following scenarios have been analysed:

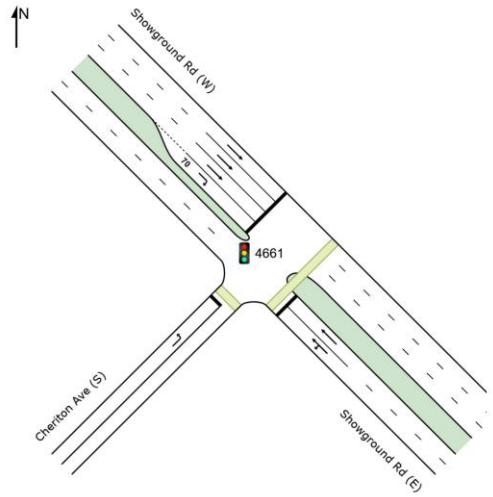
- Existing Conditions – The existing intersection arrangement with traffic volumes from surveys undertaken.
- Future Base Conditions – Existing intersection arrangement with 20% growth on through volumes.
- Post Development Conditions with Proposed Layout – Revised intersection arrangement with the proposed intersection layout. Additional site generated traffic volumes, based on traffic distribution outlined above.
- Post Development Sensitivity Test Scenario with Proposed Layout – Sensitivity test assuming 100% of the site traffic volumes accesses the site via the intersection.

Intersection Layout

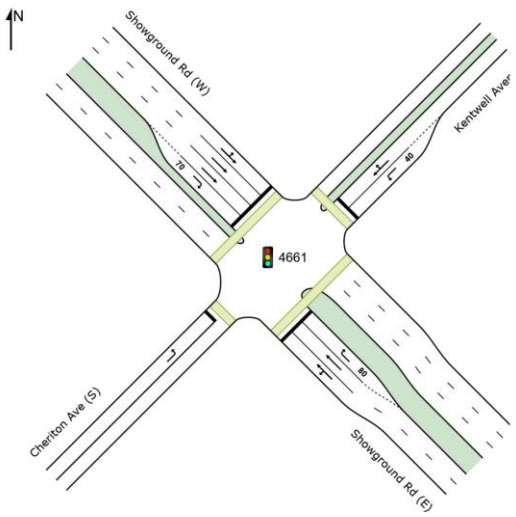
The Showground Road / Kentwell Avenue signalised intersection will be the primary vehicle access to the proposed development and is to be configured with two exit lanes and a one entry lane (including a single right-turn lane from Showground Road). The existing and proposed layout of the intersection are shown in Figure 7.1.

Figure 7.1: Showground Road / Kentwell Avenue Intersection Configurations

Existing Layout




Anticipated Future Layout




## Existing Conditions

The results of the SIDRA analysis for existing conditions are shown in Table 7.4 and indicates that the intersection currently operates well with a Level of Service of A and with a DOS of 0.50. Full results are shown in Appendix C.

Table 7.4: Showground Rd / Cheriton Ave – Existing Conditions SIDRA Results

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] veh/h | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] m | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SouthEast: Showground Rd (E) | | | | | | | | | | | | | | |
| 4 | L2 | 111 | 0 | 117 | 0.0 | *0.497 | 11.9 | LOS B | 15.1 | 108.1 | 0.45 | 0.47 | 0.45 | 52.2 |
| 5 | T1 | 1206 | 42 | 1269 | 3.5 | 0.497 | 6.4 | LOS A | 15.3 | 110.0 | 0.45 | 0.44 | 0.45 | 54.0 |
| Approach | | 1317 | 42 | 1386 | 3.2 | 0.497 | 6.8 | LOS A | 15.3 | 110.0 | 0.45 | 0.44 | 0.45 | 53.8 |
| NorthWest: Showground Rd (W) | | | | | | | | | | | | | | |
| 11 | T1 | 1082 | 38 | 1139 | 3.5 | 0.270 | 5.0 | LOS A | 6.6 | 47.3 | 0.35 | 0.31 | 0.35 | 55.4 |
| 12 | R2 | 129 | 1 | 136 | 0.8 | *0.476 | 52.4 | LOS D | 6.8 | 48.1 | 0.96 | 0.79 | 0.96 | 31.7 |
| Approach | | 1211 | 39 | 1275 | 3.2 | 0.476 | 10.1 | LOS B | 6.8 | 48.1 | 0.42 | 0.36 | 0.42 | 51.3 |
| SouthWest: Cheriton Ave (S) | | | | | | | | | | | | | | |
| 1 | L2 | 17 | 0 | 18 | 0.0 | 0.062 | 48.6 | LOS D | 0.8 | 5.8 | 0.88 | 0.70 | 0.88 | 32.9 |
| Approach | | 17 | 0 | 18 | 0.0 | 0.062 | 48.6 | LOS D | 0.8 | 5.8 | 0.88 | 0.70 | 0.88 | 32.9 |
| All Vehicles | | 2545 | 81 | 2679 | 3.2 | 0.497 | 8.6 | LOS A | 15.3 | 110.0 | 0.44 | 0.40 | 0.44 | 52.4 |

## Future Base Conditions

To allow for the impact of traffic volume growth on abutting road network, the through movements on Showground Road have been factored up by 20% to represent a 'future base condition'. This growth has been assumed to proxy general traffic volume growth that is expected to occur in the precinct from approved developments.

The results of this analysis are shown in Table 7.5 (noting that the same intersection configuration as the existing conditions has been adopted) and indicates that the intersection is expected to continue to operate very well with a Level of Service of A and a DOS of 0.59. Full results are shown in Appendix C. This analysis highlights that the overall intersection performance is not overly sensitive to growth in traffic volumes along Showground Road.

Table 7.5: Showground Rd / Cheriton Ave – Future Base SIDRA Results

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] veh/h | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] m | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SouthEast: Showground Rd (E) | | | | | | | | | | | | | | |
| 4 | L2 | 111 | 0 | 117 | 0.0 | *0.587 | 12.7 | LOS B | 20.0 | 143.2 | 0.50 | 0.51 | 0.50 | 51.8 |
| 5 | T1 | 1447 | 50 | 1523 | 3.5 | 0.587 | 7.1 | LOS A | 20.2 | 145.3 | 0.50 | 0.48 | 0.50 | 53.4 |
| Approach | | 1558 | 50 | 1640 | 3.2 | 0.587 | 7.5 | LOS A | 20.2 | 145.3 | 0.50 | 0.49 | 0.50 | 53.3 |
| NorthWest: Showground Rd (W) | | | | | | | | | | | | | | |
| 11 | T1 | 1299 | 46 | 1367 | 3.5 | 0.325 | 5.3 | LOS A | 8.3 | 59.8 | 0.37 | 0.33 | 0.37 | 55.2 |
| 12 | R2 | 129 | 1 | 136 | 0.8 | *0.476 | 52.4 | LOS D | 6.8 | 48.1 | 0.96 | 0.79 | 0.96 | 31.7 |
| Approach | | 1428 | 47 | 1503 | 3.3 | 0.476 | 9.5 | LOS A | 8.3 | 59.8 | 0.43 | 0.37 | 0.43 | 51.7 |
| SouthWest: Cheriton Ave (S) | | | | | | | | | | | | | | |
| 1 | L2 | 17 | 0 | 18 | 0.0 | 0.062 | 48.6 | LOS D | 0.8 | 5.8 | 0.88 | 0.70 | 0.88 | 32.9 |
| Approach | | 17 | 0 | 18 | 0.0 | 0.062 | 48.6 | LOS D | 0.8 | 5.8 | 0.88 | 0.70 | 0.88 | 32.9 |
| All Vehicles | | 3003 | 97 | 3161 | 3.2 | 0.587 | 8.7 | LOS A | 20.2 | 145.3 | 0.47 | 0.43 | 0.47 | 52.3 |

## Future Post Development Conditions

The operation of the intersection with the additional traffic generated by the proposed development (as estimated above) has also been assessed.

For this scenario, the modified layout that includes the Kentwell Avenue approach has been adopted as shown in the architectural plans presented earlier in this report. This layout includes:

- A three-lane cross-section on Kentwell Avenue, including one through and right turn lane and one short left-turn only lane.
- A reduction in the number of right turn lanes from the Showground Road east approach into Kentwell Avenue from two lanes to a single lane.

The results of the SIDRA analysis for the future post development scenarios are shown in Table 7.6 and indicate that the intersection can be expected to continue to operate with an acceptable level of service (i.e., Level of Service C) and with manageable queues and delays on all approaches. Full results are shown in Appendix C.

Key findings from this analysis include:

- There is modest vehicle queuing on the Kentwell Avenue approach, with a 95th percentile queue of 30m.
- There is modest vehicle queuing on the Showground Road east approach in the right turn lane, with a 95th percentile queue of 12m. This queue is less than the available storage in the lane and indicates that a single lane is sufficient to accommodate the expected traffic volume. That is, the previously proposed double right turn is not required for this scenario.
- The queueing for through movements on Showground Road increases to 107m and 250m, with an increase in vehicle delays. Notwithstanding these increases, the post-development queues and delays are well within acceptable limits and are considerably less than those previously anticipated at the intersection under post-development conditions with the expansion of the shopping centre (which is no longer proposed).

Overall, the analysis indicates that acceptable intersection performance is expected at the intersection with the proposed reconfigured layout. Including a single right turn lane into the Site B Planning Proposal site.

Table 7.6: Showground Rd / Cheriton Ave / Kentwell Ave – Post Development SIDRA Results

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] veh/h | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] m | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SouthEast: Showground Rd (E) | | | | | | | | | | | | | | |
| 4 | L2 | 111 | 0 | 117 | 0.0 | *0.791 | 26.2 | LOS C | 34.8 | 249.9 | 0.86 | 0.80 | 0.86 | 43.4 |
| 5 | T1 | 1447 | 50 | 1523 | 3.5 | 0.791 | 20.5 | LOS C | 34.8 | 249.9 | 0.85 | 0.79 | 0.85 | 44.7 |
| 23 | R2 | 32 | 0 | 34 | 0.0 | 0.181 | 56.0 | LOS E | 1.7 | 12.0 | 0.95 | 0.72 | 0.95 | 23.3 |
| Approach | | 1590 | 50 | 1674 | 3.1 | 0.791 | 21.6 | LOS C | 34.8 | 249.9 | 0.85 | 0.79 | 0.85 | 44.1 |
| NorthEast: Kentwell Avenue | | | | | | | | | | | | | | |
| 24 | L2 | 65 | 0 | 68 | 0.0 | 0.110 | 32.3 | LOS C | 2.5 | 17.5 | 0.72 | 0.73 | 0.72 | 31.2 |
| 25 | T1 | 1 | 0 | 1 | 0.0 | *0.307 | 44.6 | LOS D | 4.3 | 29.9 | 0.92 | 0.77 | 0.92 | 25.6 |
| 26 | R2 | 83 | 0 | 87 | 0.0 | 0.307 | 50.1 | LOS D | 4.3 | 29.9 | 0.92 | 0.77 | 0.92 | 25.2 |
| Approach | | 149 | 0 | 157 | 0.0 | 0.307 | 42.3 | LOS D | 4.3 | 29.9 | 0.84 | 0.75 | 0.84 | 27.5 |
| NorthWest: Showground Rd (W) | | | | | | | | | | | | | | |
| 27 | L2 | 51 | 0 | 54 | 0.0 | 0.448 | 20.8 | LOS C | 14.7 | 105.6 | 0.63 | 0.59 | 0.63 | 25.9 |
| 11 | T1 | 1298 | 46 | 1366 | 3.5 | 0.448 | 15.4 | LOS B | 14.9 | 107.2 | 0.64 | 0.57 | 0.64 | 47.8 |
| 12 | R2 | 129 | 1 | 136 | 0.8 | *0.735 | 61.7 | LOS E | 7.6 | 53.8 | 1.00 | 0.85 | 1.15 | 29.3 |
| Approach | | 1478 | 47 | 1556 | 3.2 | 0.735 | 19.6 | LOS B | 14.9 | 107.2 | 0.67 | 0.60 | 0.68 | 44.5 |
| SouthWest: Cheriton Ave (S) | | | | | | | | | | | | | | |
| 1 | L2 | 17 | 0 | 18 | 0.0 | 0.096 | 55.3 | LOS E | 0.9 | 6.3 | 0.94 | 0.70 | 0.94 | 31.0 |
| Approach | | 17 | 0 | 18 | 0.0 | 0.096 | 55.3 | LOS E | 0.9 | 6.3 | 0.94 | 0.70 | 0.94 | 31.0 |
| All Vehicles | | 3234 | 97 | 3404 | 3.0 | 0.791 | 21.8 | LOS C | 34.8 | 249.9 | 0.77 | 0.70 | 0.77 | 43.4 |

## Future Post Development Conditions – Sensitivity Assessment

As outlined above, the traffic volumes generated by the proposed development are expected to be distributed to the surrounding road network.

However, as an additional sensitivity test, the traffic generated by the proposed development was assessed as 100% accessing the site via the Kentwell Avenue intersection in the two traffic growth scenarios. In this sensitivity test, the following traffic distribution assumptions were made:

- For entering traffic:
    - 70% enters from Showground Road from the east
    - 30% enters from Showground Road from the west.
- For exiting traffic:
    - 60% exits to Showground Road to the east
    - 30% exits to Showground Road to the west
    - 10% exits to Cheriton Avenue to the south.

The results of the final sensitivity test scenario can be found in Table 7.7 and indicates broadly comparable results to those found in the post development scenario. That is, the intersection can be expected to continue to operate with an acceptable level of service (i.e., Level of Service C) and with manageable queues and delays on all approaches.

The above analysis highlights that the Showground Road / Kentwell Avenue signalised intersection expected to operate with an acceptable level of service (up to Level of Service C) under post-development conditions with the proposed intersection configuration which includes a single right-turn lane into the Site B Planning Proposal site.

Table 7.7: Showground Rd / Cheriton Ave / Kentwell Ave – Sensitivity SIDRA Results

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] veh/h | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] m | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SouthEast: Showground Rd (E) | | | | | | | | | | | | | | |
| 4 | L2 | 111 | 0 | 117 | 0.0 | *0.806 | 26.2 | LOS C | 36.6 | 262.6 | 0.87 | 0.81 | 0.87 | 43.5 |
| 5 | T1 | 1447 | 50 | 1523 | 3.5 | 0.806 | 20.3 | LOS C | 36.6 | 262.6 | 0.83 | 0.78 | 0.84 | 44.8 |
| 23 | R2 | 123 | 0 | 129 | 0.0 | 0.767 | 63.5 | LOS E | 7.4 | 51.8 | 1.00 | 0.88 | 1.20 | 21.6 |
| Approach | | 1681 | 50 | 1769 | 3.0 | 0.806 | 23.9 | LOS C | 36.6 | 262.6 | 0.85 | 0.79 | 0.87 | 42.6 |
| NorthEast: Kentwell Avenue | | | | | | | | | | | | | | |
| 24 | L2 | 115 | 0 | 121 | 0.0 | 0.199 | 34.0 | LOS C | 4.7 | 32.6 | 0.76 | 0.75 | 0.76 | 30.5 |
| 25 | T1 | 17 | 0 | 18 | 0.0 | *0.762 | 51.1 | LOS D | 11.5 | 80.6 | 1.00 | 0.89 | 1.13 | 23.9 |
| 26 | R2 | 183 | 0 | 193 | 0.0 | 0.762 | 56.7 | LOS E | 11.5 | 80.6 | 1.00 | 0.89 | 1.13 | 23.6 |
| Approach | | 315 | 0 | 332 | 0.0 | 0.762 | 48.1 | LOS D | 11.5 | 80.6 | 0.91 | 0.84 | 1.00 | 25.7 |
| NorthWest: Showground Rd (W) | | | | | | | | | | | | | | |
| 27 | L2 | 90 | 0 | 95 | 0.0 | 0.454 | 20.3 | LOS C | 14.9 | 107.0 | 0.62 | 0.60 | 0.62 | 25.9 |
| 11 | T1 | 1299 | 46 | 1367 | 3.5 | 0.454 | 14.9 | LOS B | 15.2 | 109.3 | 0.63 | 0.57 | 0.63 | 48.0 |
| 12 | R2 | 129 | 1 | 136 | 0.8 | *0.809 | 65.1 | LOS E | 7.9 | 55.8 | 1.00 | 0.90 | 1.27 | 28.5 |
| Approach | | 1518 | 47 | 1598 | 3.1 | 0.809 | 19.5 | LOS B | 15.2 | 109.3 | 0.66 | 0.60 | 0.68 | 44.0 |
| SouthWest: Cheriton Ave (S) | | | | | | | | | | | | | | |
| 1 | L2 | 17 | 0 | 18 | 0.0 | 0.106 | 56.5 | LOS E | 0.9 | 6.4 | 0.95 | 0.70 | 0.95 | 30.7 |
| Approach | | 17 | 0 | 18 | 0.0 | 0.106 | 56.5 | LOS E | 0.9 | 6.4 | 0.95 | 0.70 | 0.95 | 30.7 |
| All Vehicles | | 3531 | 97 | 3717 | 2.7 | 0.809 | 24.3 | LOS C | 36.6 | 262.6 | 0.77 | 0.71 | 0.80 | 41.5 |

### 7.4.2.2 PENNANT STREET / CASTLE STREET INTERSECTION

Modelling Scenarios

The following scenarios have been analysed:

- Existing Conditions – The existing intersection arrangement with traffic volumes from surveys undertaken.
- Future Base Conditions – Existing intersection arrangement with an allowance for 20% growth on arterial through volumes. It is noted that the 20% increase to through movements has been arbitrarily adopted as a proxy of development generated volumes in the precinct.
- Post Development Without Road Works – Future Base conditions with site generated traffic volumes on the existing intersection arrangement.

It is understood that Council and TfNSW are currently considering the completion of works at this intersection to improve its safety and operation. The works proposed are to enable 'double diamond' traffic signal phasing at the intersection and thus remove filtered right turns. This phasing requires separate right-turn lanes on the Castle Street approaches.

In this regard, the following additional future conditions scenarios have been tested with double diamond phasing and a reconfigured intersection layout as described above.

- Future Base Conditions (Revised Layout and Double Diamond Phasing) – Proposed intersection works and double diamond phasing assessing 20% growth on arterial through volumes.
- Post Development (Revised Layout and Double Diamond Phasing) - Proposed intersection works and double diamond phasing assessing post development traffic volumes

Intersection Layout

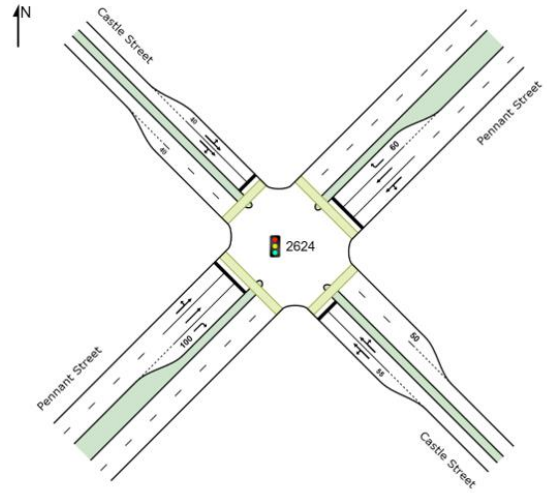
The existing and anticipated future layout of the intersection (to allow for the double diamond phasing) are shown in Figure 7. 2.

It is noted that the future layout assumes three approach lanes on the Castle Street approaches (as has previously been sought by Council via Consent condition), with a single departure lane on these approaches. The provision of a single departure lane is considered necessary and appropriate for the following reasons:

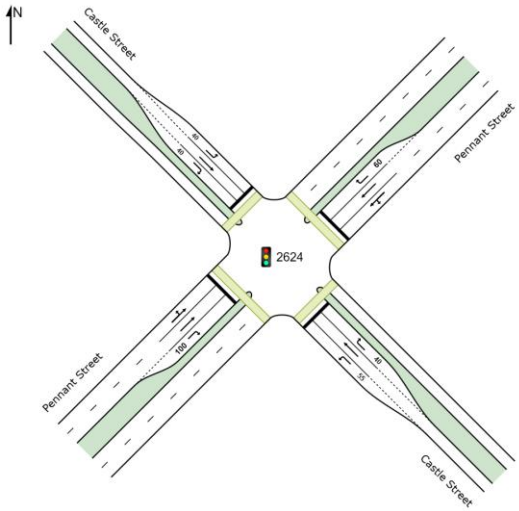
- There is a need to accommodate on-road bicycle lanes or a shared use path on the northern side of Castle Street through this intersection. Due to the constraints of existing built form, which is no longer proposed to be demolished and rebuilt by QIC, the provision of a five-lane cross-section would inhibit the ability to provide this active travel connection.
- The provision of two departure lanes is also likely to have very little traffic capacity benefit, even if the lanes were able to be provided, given
    - There is no scope to provide double right-turn lanes from the Pennant Street approaches, and
    - The provision of two through lanes on the Castle Street approaches (e.g., a through lane and a shared left and through lane) would have little benefit given the heavy left turn movements would mean the shared lane would rarely be used by through traffic.

Figure 7.2: Pennant Street / Castle Street Intersection Configurations

Existing Layout




Anticipated Future Layout




## Existing Conditions

The results of the analysis for existing conditions are shown in Table 7.8 and indicate the intersection currently operates satisfactorily with Level of Service of D and with a DOS of 0.70, albeit with a queue length for the right turn movement from the Pennant Street southern leg (106m) that exceeds the capacity of the turning lane. Full results are shown in Appendix C.

Table 7.8: Pennant St / Castle St – Existing Conditions SIDRA Results

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] veh/h | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] m | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SouthEast: Castle Street | | | | | | | | | | | | | | |
| 4 | L2 | 343 | 9 | 361 | 2.6 | *0.450 | 26.6 | LOS C | 14.4 | 103.4 | 0.73 | 0.78 | 0.73 | 30.5 |
| 5 | T1 | 34 | 0 | 36 | 0.0 | 0.213 | 48.1 | LOS D | 3.4 | 23.9 | 0.88 | 0.72 | 0.88 | 8.0 |
| 6 | R2 | 26 | 0 | 27 | 0.0 | 0.213 | 52.5 | LOS D | 3.4 | 23.9 | 0.88 | 0.72 | 0.88 | 22.9 |
| Approach | | 403 | 9 | 424 | 2.2 | 0.450 | 30.1 | LOS C | 14.4 | 103.4 | 0.75 | 0.77 | 0.75 | 28.3 |
| NorthEast: Pennant Street | | | | | | | | | | | | | | |
| 7 | L2 | 147 | 1 | 155 | 0.7 | *0.704 | 41.9 | LOS D | 26.9 | 190.9 | 0.91 | 0.82 | 0.91 | 25.5 |
| 8 | T1 | 751 | 16 | 791 | 2.1 | 0.704 | 35.3 | LOS D | 26.9 | 190.9 | 0.88 | 0.78 | 0.88 | 33.5 |
| 9 | R2 | 134 | 0 | 141 | 0.0 | 0.395 | 54.4 | LOS D | 7.9 | 55.2 | 0.92 | 0.79 | 0.92 | 21.0 |
| Approach | | 1032 | 17 | 1086 | 1.6 | 0.704 | 38.7 | LOS D | 26.9 | 190.9 | 0.89 | 0.79 | 0.89 | 31.1 |
| NorthWest: Castle Street | | | | | | | | | | | | | | |
| 10 | L2 | 218 | 0 | 229 | 0.0 | 0.283 | 24.2 | LOS C | 8.4 | 58.6 | 0.66 | 0.74 | 0.66 | 31.4 |
| 11 | T1 | 64 | 0 | 67 | 0.0 | 0.563 | 54.0 | LOS D | 8.5 | 59.2 | 0.96 | 0.80 | 0.96 | 7.2 |
| 12 | R2 | 71 | 0 | 75 | 0.0 | 0.563 | 58.0 | LOS E | 8.5 | 59.2 | 0.96 | 0.80 | 0.96 | 21.1 |
| Approach | | 353 | 0 | 372 | 0.0 | 0.563 | 36.4 | LOS D | 8.5 | 59.2 | 0.78 | 0.77 | 0.78 | 24.7 |
| SouthWest: Pennant Street | | | | | | | | | | | | | | |
| 1 | L2 | 113 | 4 | 119 | 3.5 | 0.597 | 39.7 | LOS D | 21.4 | 154.2 | 0.86 | 0.78 | 0.86 | 17.8 |
| 2 | T1 | 707 | 21 | 744 | 3.0 | 0.597 | 34.4 | LOS C | 22.1 | 158.4 | 0.86 | 0.76 | 0.86 | 33.8 |
| 3 | R2 | 234 | 5 | 246 | 2.1 | *0.700 | 58.7 | LOS E | 14.9 | 106.4 | 0.99 | 0.85 | 1.01 | 20.3 |
| Approach | | 1054 | 30 | 1109 | 2.8 | 0.700 | 40.3 | LOS D | 22.1 | 158.4 | 0.89 | 0.78 | 0.89 | 29.2 |
| All Vehicles | | 2842 | 56 | 2992 | 2.0 | 0.704 | 37.8 | LOS D | 26.9 | 190.9 | 0.86 | 0.78 | 0.86 | 29.4 |

## Future Base Conditions

As outlined above, a future base assessment has been undertaken, assuming a 20% growth in traffic volumes along the arterial road network, with the existing intersection layout. These results are shown in Table 7.9 and indicate that the intersection is expected to continue to operate with Level of Service of D with a marginal increase in the DOS from 0.70 to 0.76.

Table 7.9: Pennant St / Castle St – Future Base SIDRA Results

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] veh/h | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] m | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SouthEast: Castle Street | | | | | | | | | | | | | | |
| 4 | L2 | 343 | 9 | 361 | 2.6 | *0.488 | 29.5 | LOS C | 15.4 | 110.1 | 0.77 | 0.79 | 0.77 | 29.3 |
| 5 | T1 | 34 | 0 | 36 | 0.0 | 0.251 | 52.2 | LOS D | 3.6 | 25.0 | 0.91 | 0.73 | 0.91 | 7.5 |
| 6 | R2 | 26 | 0 | 27 | 0.0 | 0.251 | 56.6 | LOS E | 3.6 | 25.0 | 0.91 | 0.73 | 0.91 | 21.9 |
| Approach | | 403 | 9 | 424 | 2.2 | 0.488 | 33.1 | LOS C | 15.4 | 110.1 | 0.79 | 0.78 | 0.79 | 27.0 |
| NorthEast: Pennant Street | | | | | | | | | | | | | | |
| 7 | L2 | 147 | 1 | 155 | 0.7 | *0.759 | 39.8 | LOS D | 31.7 | 225.0 | 0.92 | 0.84 | 0.92 | 26.2 |
| 8 | T1 | 901 | 16 | 948 | 1.8 | 0.759 | 33.4 | LOS C | 31.7 | 225.0 | 0.89 | 0.80 | 0.89 | 34.2 |
| 9 | R2 | 134 | 0 | 141 | 0.0 | 0.549 | 62.1 | LOS E | 8.5 | 59.8 | 0.98 | 0.80 | 0.98 | 19.4 |
| Approach | | 1182 | 17 | 1244 | 1.4 | 0.759 | 37.4 | LOS D | 31.7 | 225.0 | 0.90 | 0.80 | 0.90 | 31.7 |
| NorthWest: Castle Street | | | | | | | | | | | | | | |
| 10 | L2 | 218 | 0 | 229 | 0.0 | 0.340 | 31.0 | LOS C | 9.7 | 67.8 | 0.76 | 0.77 | 0.76 | 28.4 |
| 11 | T1 | 64 | 0 | 67 | 0.0 | 0.663 | 59.2 | LOS E | 8.9 | 62.4 | 1.00 | 0.84 | 1.04 | 6.7 |
| 12 | R2 | 71 | 0 | 75 | 0.0 | 0.663 | 63.1 | LOS E | 8.9 | 62.4 | 1.00 | 0.84 | 1.04 | 20.1 |
| Approach | | 353 | 0 | 372 | 0.0 | 0.663 | 42.6 | LOS D | 9.7 | 67.8 | 0.85 | 0.80 | 0.87 | 22.7 |
| SouthWest: Pennant Street | | | | | | | | | | | | | | |
| 1 | L2 | 113 | 4 | 119 | 3.5 | 0.579 | 32.2 | LOS C | 23.0 | 164.4 | 0.79 | 0.73 | 0.79 | 19.0 |
| 2 | T1 | 848 | 21 | 893 | 2.5 | 0.579 | 27.3 | LOS C | 23.6 | 168.7 | 0.79 | 0.72 | 0.79 | 36.2 |
| 3 | R2 | 234 | 5 | 246 | 2.1 | *0.729 | 60.5 | LOS E | 15.3 | 108.7 | 1.00 | 0.86 | 1.05 | 19.9 |
| Approach | | 1195 | 30 | 1258 | 2.5 | 0.729 | 34.3 | LOS C | 23.6 | 168.7 | 0.83 | 0.75 | 0.84 | 31.3 |
| All Vehicles | | 3133 | 56 | 3298 | 1.8 | 0.759 | 36.3 | LOS D | 31.7 | 225.0 | 0.85 | 0.78 | 0.86 | 30.3 |

## Post Development Conditions without Road Works

The operation of the existing intersection layout with final post development traffic volumes has been assessed to test the need for changes to the layout as a result of the development.

The results of this assessment are shown in Table 7.10 and indicate that the intersection is expected to continue to perform acceptably and with Level of Service D, with only a marginal increase in the DOS from 0.76 to 0.82. This analysis suggests that the impact of the proposed development traffic on the operation of this intersection is minor.

Table 7.10: Pennant St / Castle St – Post Development SIDRA Results

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] veh/h | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] m | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SouthEast: Castle Street | | | | | | | | | | | | | | |
| 4 | L2 | 343 | 9 | 361 | 2.6 | 0.462 | 28.0 | LOS C | 14.8 | 106.0 | 0.70 | 0.78 | 0.70 | 29.9 |
| 5 | T1 | 64 | 0 | 67 | 0.0 | 0.306 | 49.1 | LOS D | 5.2 | 36.6 | 0.90 | 0.73 | 0.90 | 8.0 |
| 6 | R2 | 26 | 0 | 27 | 0.0 | 0.306 | 53.5 | LOS D | 5.2 | 36.6 | 0.90 | 0.73 | 0.90 | 22.8 |
| Approach | | 433 | 9 | 456 | 2.1 | 0.462 | 32.6 | LOS C | 14.8 | 106.0 | 0.74 | 0.77 | 0.74 | 26.6 |
| NorthEast: Pennant Street | | | | | | | | | | | | | | |
| 7 | L2 | 147 | 1 | 155 | 0.7 | *0.797 | 42.3 | LOS D | 34.2 | 242.2 | 0.95 | 0.87 | 0.96 | 25.4 |
| 8 | T1 | 901 | 16 | 948 | 1.8 | 0.797 | 36.2 | LOS D | 34.2 | 242.2 | 0.90 | 0.83 | 0.93 | 33.3 |
| 9 | R2 | 193 | 0 | 203 | 0.0 | 0.646 | 60.1 | LOS E | 12.2 | 85.6 | 0.99 | 0.82 | 0.99 | 20.2 |
| Approach | | 1241 | 17 | 1306 | 1.4 | 0.797 | 40.6 | LOS D | 34.2 | 242.2 | 0.92 | 0.83 | 0.94 | 30.6 |
| NorthWest: Castle Street | | | | | | | | | | | | | | |
| 10 | L2 | 286 | 0 | 301 | 0.0 | 0.467 | 26.6 | LOS C | 11.8 | 82.8 | 0.67 | 0.76 | 0.67 | 31.1 |
| 11 | T1 | 94 | 0 | 99 | 0.0 | *0.818 | 62.4 | LOS E | 11.6 | 81.4 | 0.99 | 0.94 | 1.22 | 6.4 |
| 12 | R2 | 73 | 0 | 77 | 0.0 | 0.818 | 66.3 | LOS E | 11.6 | 81.4 | 0.99 | 0.94 | 1.22 | 19.6 |
| Approach | | 453 | 0 | 477 | 0.0 | 0.818 | 40.4 | LOS D | 11.8 | 82.8 | 0.79 | 0.83 | 0.87 | 23.4 |
| SouthWest: Pennant Street | | | | | | | | | | | | | | |
| 1 | L2 | 116 | 4 | 122 | 3.4 | 0.682 | 38.8 | LOS D | 26.7 | 191.4 | 0.88 | 0.80 | 0.88 | 18.0 |
| 2 | T1 | 848 | 21 | 893 | 2.5 | 0.682 | 33.2 | LOS C | 26.7 | 191.4 | 0.87 | 0.78 | 0.87 | 34.2 |
| 3 | R2 | 234 | 5 | 246 | 2.1 | *0.796 | 65.2 | LOS E | 16.0 | 114.4 | 1.00 | 0.90 | 1.13 | 19.1 |
| Approach | | 1198 | 30 | 1261 | 2.5 | 0.796 | 40.0 | LOS D | 26.7 | 191.4 | 0.90 | 0.80 | 0.92 | 29.6 |
| All Vehicles | | 3325 | 56 | 3500 | 1.7 | 0.818 | 39.3 | LOS D | 34.2 | 242.2 | 0.87 | 0.81 | 0.90 | 29.1 |

Future Base & Post-Development Conditions – Revised Layout and Double Diamond Phasing

For completeness, the intersection has also been assessed for the revised layout and double diamond phasing as we understand is preferred by TfNSW and Council for both the future base and post-development conditions. The results of this analysis are shown in Table 7.11 and Table 7.12 for the two scenarios, and indicate:

- For the base case conditions, the revised layout and phasing results in an increase in the intersection DOS from 0.76 in the base case scenario (refer to Table 7.9) to 0.91 (refer to Table 7.11). This DOS increase occurs at the number of phases also increases, which reduces the time available for other movements. Notwithstanding this, the overall intersection Level of Service is expected to remain at D.
- The impact of the development generated traffic on this revised layout is also minor, which is similar to the SIDRA results presented earlier in this report for the existing intersection layout. This can be observed by comparing Table 7.12 (post-development conditions with revised layout and phasing) and Table 7,11 (base case conditions with revised layout and phasing). This comparison shows that the DOS increase from 0.91 to 0.93 is minor.

Overall, the analysis indicates the impact of the development generated traffic on the operation of this intersection is expected to be minor irrespective of the layout and phasing adopted. Moreover, the analysis indicates that the intersection can be expected to operate acceptability (LOS D) under post-development arrangements with the revised layout and phasing.

Table 7.11: Pennant St / Castle St – Future Base Double Diamond SIDRA Results

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] veh/h | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] m | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SouthEast: Castle Street | | | | | | | | | | | | | | |
| 4 | L2 | 343 | 9 | 361 | 2.6 | *0.542 | 34.0 | LOS C | 16.8 | 120.0 | 0.83 | 0.81 | 0.83 | 29.0 |
| 5 | T1 | 34 | 0 | 36 | 0.0 | 0.076 | 40.1 | LOS D | 1.7 | 12.1 | 0.80 | 0.60 | 0.80 | 9.5 |
| 6 | R2 | 26 | 0 | 27 | 0.0 | 0.326 | 73.4 | LOS E | 1.8 | 12.6 | 1.00 | 0.72 | 1.00 | 18.8 |
| Approach | | 403 | 9 | 424 | 2.2 | 0.542 | 37.1 | LOS D | 16.8 | 120.0 | 0.84 | 0.78 | 0.84 | 26.9 |
| NorthEast: Pennant Street | | | | | | | | | | | | | | |
| 7 | L2 | 147 | 1 | 155 | 0.7 | 0.845 | 49.4 | LOS D | 36.2 | 256.5 | 0.99 | 0.94 | 1.06 | 25.1 |
| 8 | T1 | 901 | 16 | 948 | 1.8 | *0.845 | 44.1 | LOS D | 36.2 | 256.5 | 0.95 | 0.92 | 1.04 | 34.6 |
| 9 | R2 | 134 | 0 | 141 | 0.0 | 0.658 | 67.2 | LOS E | 8.9 | 62.4 | 1.00 | 0.82 | 1.04 | 19.7 |
| Approach | | 1182 | 17 | 1244 | 1.4 | 0.845 | 47.4 | LOS D | 36.2 | 256.5 | 0.96 | 0.91 | 1.04 | 31.9 |
| NorthWest: Castle Street | | | | | | | | | | | | | | |
| 10 | L2 | 218 | 0 | 229 | 0.0 | 0.381 | 34.7 | LOS C | 10.4 | 72.6 | 0.80 | 0.78 | 0.80 | 28.6 |
| 11 | T1 | 64 | 0 | 67 | 0.0 | 0.146 | 41.0 | LOS D | 3.3 | 23.3 | 0.82 | 0.64 | 0.82 | 9.3 |
| 12 | R2 | 71 | 0 | 75 | 0.0 | *0.905 | 84.8 | LOS F | 5.5 | 38.5 | 1.00 | 0.99 | 1.55 | 16.8 |
| Approach | | 353 | 0 | 372 | 0.0 | 0.905 | 45.9 | LOS D | 10.4 | 72.6 | 0.85 | 0.79 | 0.96 | 22.6 |
| SouthWest: Pennant Street | | | | | | | | | | | | | | |
| 1 | L2 | 113 | 4 | 119 | 3.5 | 0.676 | 37.7 | LOS D | 26.1 | 186.8 | 0.88 | 0.80 | 0.88 | 20.4 |
| 2 | T1 | 848 | 21 | 893 | 2.5 | 0.676 | 32.4 | LOS C | 26.1 | 186.8 | 0.87 | 0.78 | 0.87 | 38.9 |
| 3 | R2 | 234 | 5 | 246 | 2.1 | *0.875 | 74.4 | LOS E | 17.3 | 123.5 | 1.00 | 0.95 | 1.27 | 18.6 |
| Approach | | 1195 | 30 | 1258 | 2.5 | 0.875 | 41.2 | LOS D | 26.1 | 186.8 | 0.89 | 0.81 | 0.95 | 32.6 |
| All Vehicles | | 3133 | 56 | 3298 | 1.8 | 0.905 | 43.5 | LOS D | 36.2 | 256.5 | 0.91 | 0.84 | 0.97 | 30.8 |

Table 7.12: Pennant St / Castle St – Post Development Double Diamond SIDRA Results

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] veh/h | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] m | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SouthEast: Castle Street | | | | | | | | | | | | | | |
| 4 | L2 | 343 | 9 | 361 | 2.6 | *0.559 | 34.9 | LOS C | 17.0 | 121.8 | 0.84 | 0.81 | 0.84 | 28.7 |
| 5 | T1 | 64 | 0 | 67 | 0.0 | 0.148 | 41.8 | LOS D | 3.4 | 23.5 | 0.83 | 0.64 | 0.83 | 9.1 |
| 6 | R2 | 26 | 0 | 27 | 0.0 | 0.326 | 73.4 | LOS E | 1.8 | 12.6 | 1.00 | 0.72 | 1.00 | 18.8 |
| Approach | | 433 | 9 | 456 | 2.1 | 0.559 | 38.2 | LOS D | 17.0 | 121.8 | 0.85 | 0.78 | 0.85 | 25.7 |
| NorthEast: Pennant Street | | | | | | | | | | | | | | |
| 7 | L2 | 147 | 1 | 155 | 0.7 | 0.853 | 49.7 | LOS D | 37.7 | 267.0 | 0.99 | 0.95 | 1.07 | 25.0 |
| 8 | T1 | 901 | 16 | 948 | 1.8 | *0.853 | 44.3 | LOS D | 37.7 | 267.0 | 0.94 | 0.92 | 1.04 | 34.5 |
| 9 | R2 | 193 | 0 | 203 | 0.0 | 0.748 | 66.2 | LOS E | 13.0 | 91.0 | 1.00 | 0.86 | 1.09 | 19.9 |
| Approach | | 1241 | 17 | 1306 | 1.4 | 0.853 | 48.3 | LOS D | 37.7 | 267.0 | 0.96 | 0.91 | 1.06 | 31.3 |
| NorthWest: Castle Street | | | | | | | | | | | | | | |
| 10 | L2 | 323 | 0 | 340 | 0.0 | 0.560 | 34.8 | LOS C | 16.0 | 111.9 | 0.84 | 0.80 | 0.84 | 28.6 |
| 11 | T1 | 101 | 0 | 106 | 0.0 | 0.237 | 42.9 | LOS D | 5.4 | 38.0 | 0.85 | 0.68 | 0.85 | 8.9 |
| 12 | R2 | 73 | 0 | 77 | 0.0 | *0.930 | 88.3 | LOS F | 5.8 | 40.6 | 1.00 | 1.03 | 1.62 | 16.3 |
| Approach | | 497 | 0 | 523 | 0.0 | 0.930 | 44.3 | LOS D | 16.0 | 111.9 | 0.87 | 0.81 | 0.96 | 22.8 |
| SouthWest: Pennant Street | | | | | | | | | | | | | | |
| 1 | L2 | 116 | 4 | 122 | 3.4 | 0.727 | 40.6 | LOS D | 27.8 | 198.8 | 0.92 | 0.83 | 0.92 | 19.8 |
| 2 | T1 | 848 | 21 | 893 | 2.5 | 0.727 | 35.2 | LOS D | 27.8 | 198.8 | 0.90 | 0.80 | 0.90 | 37.8 |
| 3 | R2 | 234 | 5 | 246 | 2.1 | *0.875 | 74.4 | LOS E | 17.3 | 123.5 | 1.00 | 0.95 | 1.27 | 18.6 |
| Approach | | 1198 | 30 | 1261 | 2.5 | 0.875 | 43.4 | LOS D | 27.8 | 198.8 | 0.92 | 0.84 | 0.97 | 31.8 |
| All Vehicles | | 3369 | 56 | 3546 | 1.7 | 0.930 | 44.7 | LOS D | 37.7 | 267.0 | 0.92 | 0.85 | 0.99 | 30.0 |

## 7.4.3 CASTLE STREET & KENTWELL AVENUE VEHICLE ACCESSES

The proposed vehicle accesses onto Castle Street and Kentwell Avenue have also been assessed with SIDRA to ensure that they will operate satisfactorily. The intersections are to be designed as simple unsignalised, give-way controlled T-intersection, with a single lane in each direction.

The results for each intersection shown in Table 7.13 and Table 7.14 and indicate that both intersections will operate with minimal queuing and delay. This analysis confirms that intersection upgrades at these intersections are not expected to be required.

Table 7.13: Castle St / Proposed Site Access Point – Post Development SIDRA Results

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] veh/h | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] m | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Site Access | | | | | | | | | | | | | | |
| 1 | L2 | 17 | 0 | 18 | 0.0 | 0.138 | 6.0 | LOS A | 0.5 | 3.4 | 0.49 | 0.76 | 0.49 | 46.8 |
| 3 | R2 | 75 | 0 | 79 | 0.0 | 0.138 | 8.7 | LOS A | 0.5 | 3.4 | 0.49 | 0.76 | 0.49 | 30.0 |
| Approach | | 92 | 0 | 97 | 0.0 | 0.138 | 8.2 | LOS A | 0.5 | 3.4 | 0.49 | 0.76 | 0.49 | 35.2 |
| East: Castle Street | | | | | | | | | | | | | | |
| 4 | L2 | 77 | 0 | 81 | 0.0 | 0.202 | 4.8 | LOS A | 0.0 | 0.0 | 0.00 | 0.15 | 0.00 | 41.9 |
| 5 | T1 | 290 | 4 | 305 | 1.4 | 0.202 | 0.2 | LOS A | 0.0 | 0.0 | 0.00 | 0.15 | 0.00 | 51.5 |
| Approach | | 367 | 4 | 386 | 1.1 | 0.202 | 1.1 | NA | 0.0 | 0.0 | 0.00 | 0.15 | 0.00 | 50.6 |
| West: Castle Street | | | | | | | | | | | | | | |
| 11 | T1 | 369 | 0 | 388 | 0.0 | 0.214 | 0.1 | LOS A | 0.2 | 1.6 | 0.06 | 0.03 | 0.06 | 50.0 |
| 12 | R2 | 18 | 0 | 19 | 0.0 | 0.214 | 7.2 | LOS A | 0.2 | 1.6 | 0.06 | 0.03 | 0.06 | 47.6 |
| Approach | | 387 | 0 | 407 | 0.0 | 0.214 | 0.5 | NA | 0.2 | 1.6 | 0.06 | 0.03 | 0.06 | 49.9 |
| All Vehicles | | 846 | 4 | 891 | 0.5 | 0.214 | 1.6 | NA | 0.5 | 3.4 | 0.08 | 0.16 | 0.08 | 49.1 |

Table 7.14: Castle St / Kentwell Avenue – Post Development SIDRA Results

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] veh/h | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] m | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Kentwell Ave | | | | | | | | | | | | | | |
| 1 | L2 | 26 | 0 | 27 | 0.0 | 0.055 | 5.5 | LOS A | 0.2 | 1.4 | 0.40 | 0.61 | 0.40 | 44.9 |
| 3 | R2 | 21 | 0 | 22 | 0.0 | 0.055 | 7.4 | LOS A | 0.2 | 1.4 | 0.40 | 0.61 | 0.40 | 31.3 |
| Approach | | 47 | 0 | 49 | 0.0 | 0.055 | 6.3 | LOS A | 0.2 | 1.4 | 0.40 | 0.61 | 0.40 | 41.2 |
| East: Castle Street | | | | | | | | | | | | | | |
| 4 | L2 | 21 | 0 | 22 | 0.0 | 0.164 | 4.6 | LOS A | 0.0 | 0.0 | 0.00 | 0.04 | 0.00 | 43.4 |
| 5 | T1 | 280 | 4 | 295 | 1.4 | 0.164 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.04 | 0.00 | 50.3 |
| Approach | | 301 | 4 | 317 | 1.3 | 0.164 | 0.3 | NA | 0.0 | 0.0 | 0.00 | 0.04 | 0.00 | 50.1 |
| West: Castle Street | | | | | | | | | | | | | | |
| 11 | T1 | 370 | 0 | 389 | 0.0 | 0.210 | 0.1 | LOS A | 0.1 | 1.0 | 0.04 | 0.02 | 0.04 | 50.4 |
| 12 | R2 | 13 | 0 | 14 | 0.0 | 0.210 | 6.8 | LOS A | 0.1 | 1.0 | 0.04 | 0.02 | 0.04 | 47.9 |
| Approach | | 383 | 0 | 403 | 0.0 | 0.210 | 0.3 | NA | 0.1 | 1.0 | 0.04 | 0.02 | 0.04 | 50.3 |
| All Vehicles | | 731 | 4 | 769 | 0.5 | 0.210 | 0.7 | NA | 0.2 | 1.4 | 0.05 | 0.07 | 0.05 | 49.7 |

## 7.5 SUMMARY

The analysis presented above indicates that the key intersections in the vicinity of the Site B Planning Proposal site can be expected to operate acceptability under post-development conditions with the intersection configuration presented. This includes:

- At the **Showground Road / Kentwell Avenue signalised intersection** – The intersection can be expected to operate acceptably under post-development conditions, with the proposed intersection layout that includes a single right-turn lane into the site and two exit lanes out of the site.
- At the **Pennant Street / Castle Street signalised intersection** – The intersection can be expected to operate acceptably under post-development conditions, with either the existing layout or the revised layout with double diamond signal phasing as we understand is preferred by TfNSW and Council.

With respect to the Showground Road / Kentwell Avenue signalised intersection, it is noted that whilst the provision of a double right-turn lane from Showground Road into the new access road is not considered necessary, this Planning Proposal does not preclude a second right-turn lane from being provided if it is deemed necessary by TfNSW in the future. That is, a second right turn lane could be provided by widening the intersection to the west, noting that this widening would more closely match the new access road to the existing width of the existing stub constructed at the intersection. Accordingly, the determination of the final intersection layout at this intersection is not required for this Planning Proposal.

More broadly, the discussion presented earlier in this section also indicates that the full development of the Site B Planning Proposal site can be expected to generate significantly less traffic than that which was predicted to be generated by the Castle Towers expansion (which is no longer proposed by QIC). In this context and noting that QIC previously contributed $15m to TfNSW for the duplication of Showground Road, it is considered reasonable that additional traffic mitigation works for the Planning Proposal (above and beyond the financial contribution previously made by QIC) should not be required.

# 8 CONCLUSIONS

Key conclusions outlined in this report include:

Trip Generation (Section 4)

- The ultimate development of the site could potentially generate up to approximately 1,950 person trips (via all modes of transport) during the weekday PM peak hour.
- Assuming target mode shares identified in this report, it is estimated that this trip generation could include approximately 750 person trips by active travel modes, 810 person trips by public transport and 390 person trips (inclusive of passengers) by car to/from the surrounding transport network during the weekday PM road network peak hour.

Site Layout (Section 5)

- The site layout has been designed with the overarching objective of maximising the use of active and public transport modes and minimising car trips to reduce traffic impacts associated with the development.
- The design also aligns with the objectives outlined in the Castle Hill North DCP and will provide safe and direct pedestrian and cycling connections between key locations, a functional and attractive street network that facilitates safe and convenient access for all road users, appropriate carriageway and verge widths, and sufficient vehicle access arrangements to support the density of the development
- The vehicle access arrangements proposed for the development, including the proposed loading dock vehicle access onto Pennant Street, are also considered appropriate for the development.

Parking Provision (Section 6)

- The proposed development will provide car parking appropriate for the site having regard to its proximity to surrounding land uses and public transport services which can be expected to encourage the use of walking and cycling and public transport, respectively.
- The proposed provision generally accords with the rates recommended in the Castle Hill North DCP which acknowledges the importance of reducing car parking provisions to proactively lessen adverse traffic impacts.
- The proposed development will also provide suitable bicycle parking and other forms of car parking as appropriate

Traffic Impacts (Section 7)

- The key intersections in the vicinity of the Site B Planning Proposal site can be expected to operate acceptability under post-development conditions with the intersection configuration presented. This includes:
    - At the **Showground Road / Kentwell Avenue signalised intersection** – The intersection can be expected to operate acceptably under post-development conditions, with the proposed intersection layout that includes a single right-turn lane into the site and two exit lanes out of the site.
    - At the **Pennant Street / Castle Street signalised intersection** – The intersection can be expected to operate acceptably under post-development conditions, with either the existing layout or the revised layout with double diamond signal phasing as we understand is preferred by TfNSW and Council.
- Whilst the provision of a double right-turn lane from Showground Road into the new access road at the Kentwell Avenue signalised intersection is not considered necessary, this Planning Proposal does not preclude a second right-turn lane from being provided if it is deemed necessary by TfNSW in the future. That is, a second right turn lane could be provided by widening the intersection to the west, noting that this widening would more closely match the new access road to the existing width of the existing stub constructed at the intersection. Accordingly, the determination of the final intersection layout at this intersection is not required for this Planning Proposal.

- The discussion presented in this report indicates that the full development of the Site B Planning Proposal site can be expected to generate significantly less traffic than that which was predicted to be generated by the Castle Towers expansion (which is no longer proposed by QIC). In this context and noting that QIC previously contributed $15m to TfNSW for the duplication of Showground Road, it is considered reasonable that additional traffic mitigation works for the Planning Proposal (above and beyond the financial contribution previously made by QIC) should not be required.

# APPENDICES

# Appendix A
# Road Network & Swept Path Assessments

CASTLE

STREET

STREET

AVE

02

04

WOODWARD

KENTWELL

PENNANT

SHOWGROUND

ROAD

03

05

SHOWGROUND ROAD AND PENNANT STREET
INTERSECTION - REFER TO BG&E DESIGN

N

ON 06/09/22 AT 14:55:04

PLOTTED BY : asedigh

Stantec

nearmap.com

**PRELIMINARY PLAN**
FOR DISCUSSION PURPOSES
ONLY SUBJECT TO CHANGE
WITHOUT NOTIFICATION

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

DESIGNED A. SEDIGH
DESIGN CHECK T.DE YOUNG
APPROVED BY T. DE YOUNG
DATE ISSUED 9 JUNE 2022

SCALE A3 0 20 40 1:1000
CAD FILE NO. 301401401-19-P1.dgn

CASTLE TOWERS SITE B
CASTLE STREET, CASTLE HILL

INTERNAL/EXTERNAL CONCEPT LAYOUT

DRAWING NO. 300303493-19-01 SHEET 01 OF 09 ISSUE P1

CASTLE

STREET

AVENUE

KENTWELL

INDICATIVE FUTURE CASTLE STREET CROSS-SCETION (GENERALLY AS PER CASTLE HILL NORTH DCP REQUIREMENTS)

3.5 3.5

3.4 3.0 1.0 2.1 3.5 3.5 2.1 5.3 23.9

POTENTIAL CROSSOVER

PROPOSED UNSIGNALISED ACCESS

3.3 1.5 3.5

PROPOSED DEVELOPMENT
(INDICATIVE DESIGN ONLY)

7.0

PROPOSED UNSIGNALISED ACCESS

1.0 3.0 3.3 3.0 3.0

N

ON 06/09/22 AT 14:55:06

PLOTTED BY : dsedigh

Stantec

nearmap.com

**PRELIMINARY PLAN**
FOR DISCUSSION PURPOSES ONLY SUBJECT TO CHANGE WITHOUT NOTIFICATION

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

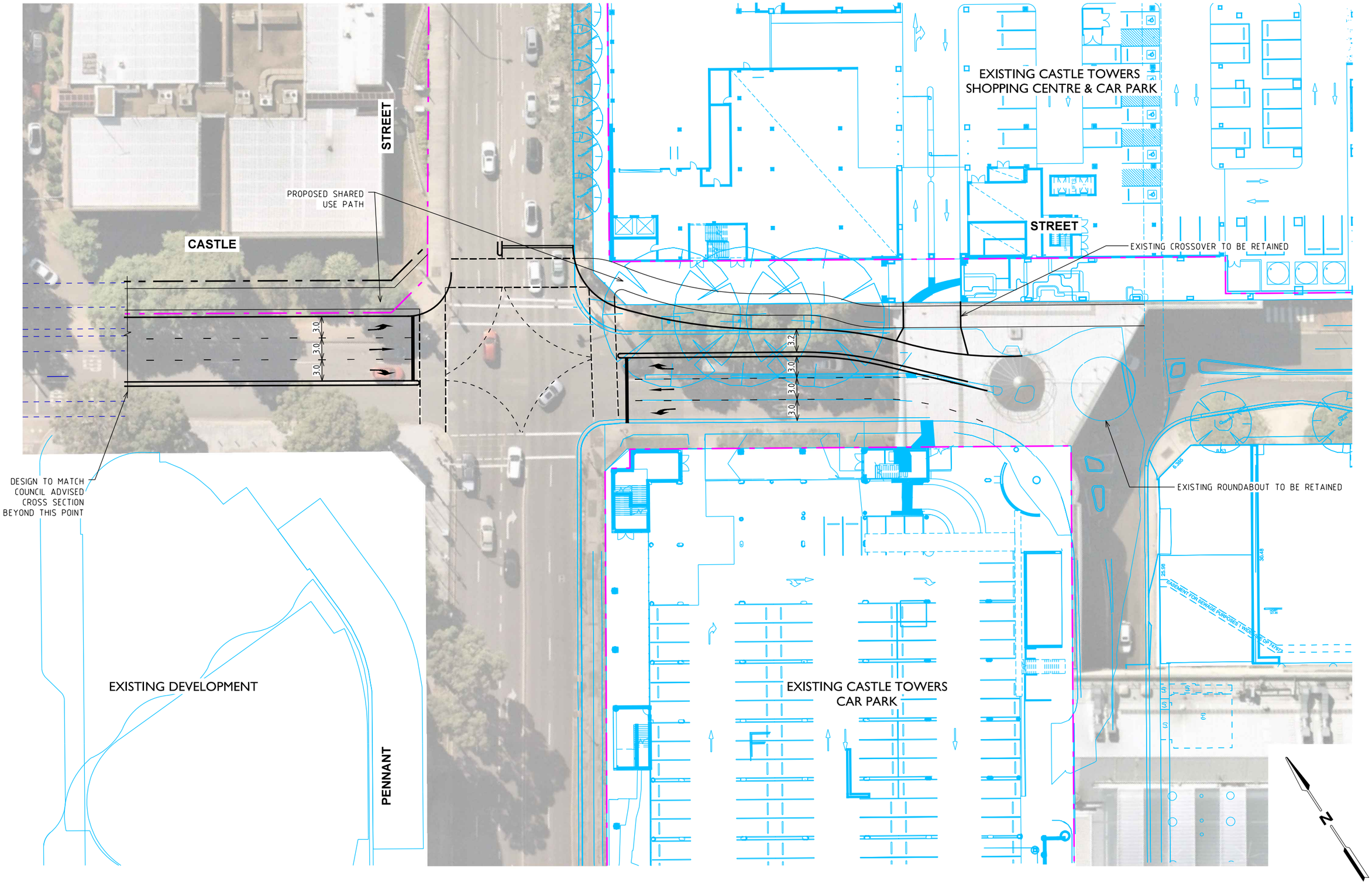
| | |
|---|---|
| DESIGNED A. SEDIGH | DESIGN CHECK H. STEVENSON |
| APPROVED BY T. DE YOUNG | DATE ISSUED 9 JUNE 2022 |

SCALE A3 0 5 10 1:500

CAD FILE NO. 301401401-19-P1.dgn

CASTLE TOWERS SITE B
CASTLE STREET & KENTWELL AVENUE
CASTLE HILL
CONCEPT LAYOUT

DRAWING NO. 300303493-19-02 SHEET 02 OF 09 ISSUE P1




ON 06/09/22 AT 14:55:07

PLOTTED BY : asedigh

Stantec

nearmap.com

**PRELIMINARY PLAN**
FOR DISCUSSION PURPOSES ONLY SUBJECT TO CHANGE WITHOUT NOTIFICATION

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

| | |
|---|---|
| DESIGNED A. SEDIGH | DESIGN CHECK H. STEVENSON |
| APPROVED BY T. DE YOUNG | DATE ISSUED 9 JUNE 2022 |

SCALE A3 0 5 10 1:500

CAD FILE NO. 301401401-19-P1.dgn

CASTLE TOWERS SITE B
CASTLE STREET & PENNANT STREET
CASTLE HILL
CONCEPT LAYOUT

DRAWING NO. 300303493-19-03 SHEET 03 OF 09 ISSUE P1

AVENUE

KENTWELL

KEEP CLEAR

POTENTIAL FOR SECOND RIGHT TURN LANE IF REQUIRED

PROPOSED DEVELOPMENT (WOODWARD)

SHOWGROUND

PROPOSED DEVELOPMENT (INDICATIVE DESIGN ONLY)

REFER TO BG&E DESIGN

ROAD

PROPOSED SINGLE RIGHT TURN LANE (WITH FLEXIBILITY FOR SECOND LANE IF REQUIRED)

N

PLOTTED BY : asedigh ON 06/09/22 AT 14:55:09

Stantec

nearmap.com

**PRELIMINARY PLAN**

FOR DISCUSSION PURPOSES ONLY SUBJECT TO CHANGE WITHOUT NOTIFICATION

**WARNING**

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

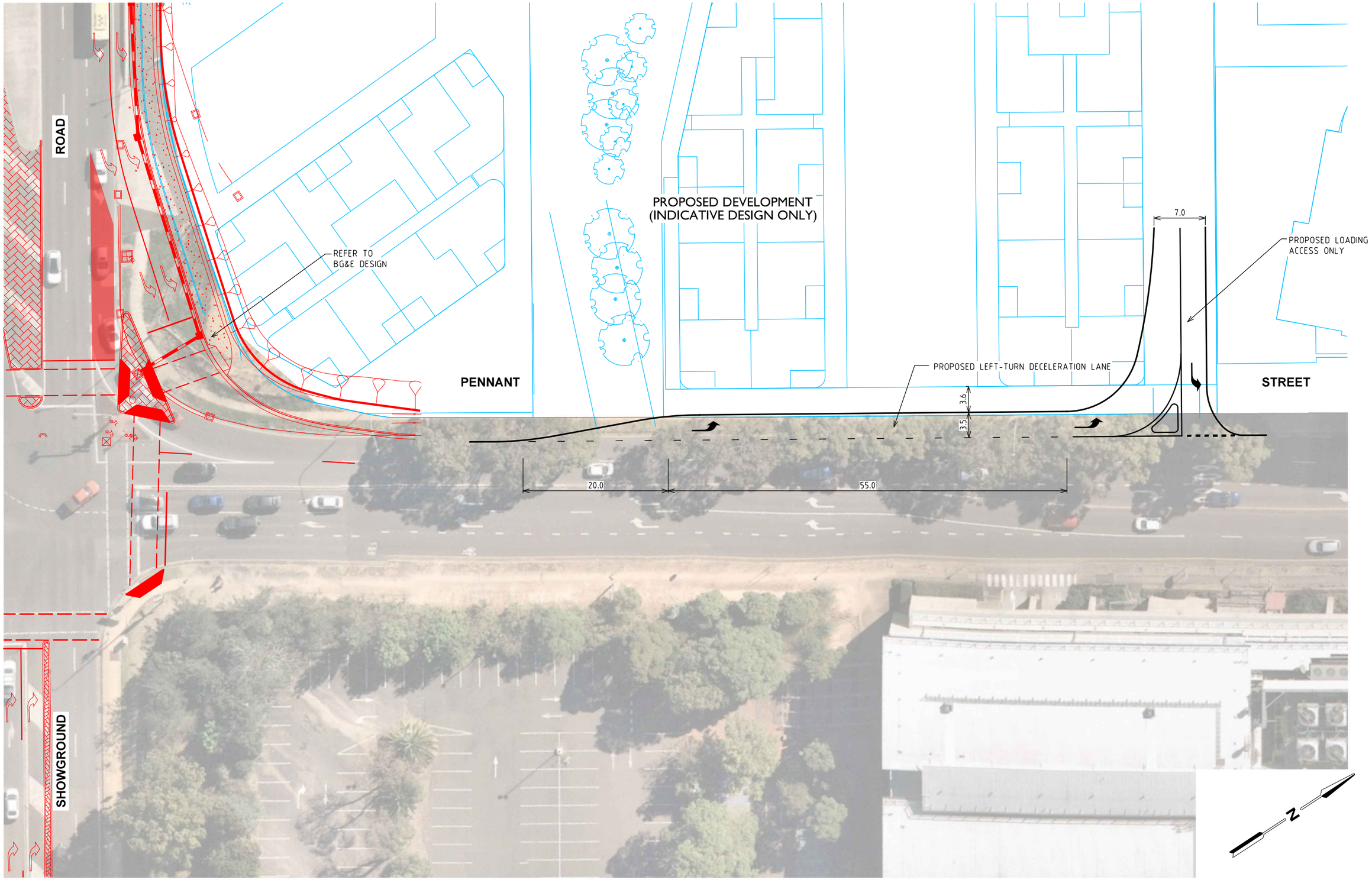
| | |
|---|---|
| DESIGNED A. SEDIGH | DESIGN CHECK H. STEVENSON |
| APPROVED BY T. DE YOUNG | DATE ISSUED 9 JUNE 2022 |

SCALE A3 0 5 10 1:500

CAD FILE NO. 301401401-19-P1.dgn

CASTLE TOWERS SITE B
SHOWGROUND ROAD & KENTWELL AVENUE
CASTLE HILL
CONCEPT LAYOUT

DRAWING NO. 300303493-19-04 SHEET 04 OF 09 ISSUE P1




ON 06/09/22 AT 14:55:10

PLOTTED BY : asedigh

Stantec

nearmap.com

**PRELIMINARY PLAN**

FOR DISCUSSION PURPOSES
ONLY SUBJECT TO CHANGE
WITHOUT NOTIFICATION

**WARNING**

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

| | |
|---|---|
| DESIGNED<br>A. SEDIGH | DESIGN CHECK<br>H. STEVENSON |
| APPROVED BY<br>T. DE YOUNG | DATE ISSUED<br>9 JUNE 2022 |

SCALE A3 — 0 5 10 — 1:500

CAD FILE NO.
301401401-19-P1.dgn

CASTLE TOWERS SITE B
SHOWGROUND ROAD & PENNANT STREET
CASTLE HILL
CONCEPT LAYOUT

DRAWING NO. 300303493-19-05 SHEET 05 OF 09 ISSUE P1

CASTLE STREET

AVENUE

KENTWELL

PROPOSED DEVELOPMENT
(INDICATIVE DESIGN ONLY)

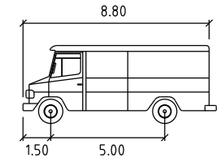
MRV STANDARDS 2018 (AU)

B99 STANDARDS 2018 (AU)

## SWEPT PATH KEY

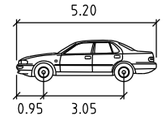
- VEHICLE CENTRE LINE
- VEHICLE TYRE PATH
- VEHICLE BODY PATH
- 500mm CLEARANCE FROM VEHICLE BODY

ASSUMED SPEED 5km/h




MRV AS2890.2 metres

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




B99 6.3mR metres

| | |
|---|---|
| Width | : 1.94 |
| Track | : 1.77 |
| Lock to Lock Time | : 6.0 |
| Steering Angle | : 34.0 |

N

ON 06/09/22 AT 14:55:12

PLOTTED BY : asedigh

Stantec

nearmap.com

**PRELIMINARY PLAN**
FOR DISCUSSION PURPOSES ONLY SUBJECT TO CHANGE WITHOUT NOTIFICATION

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

| | |
|---|---|
| DESIGNED A. SEDIGH | DESIGN CHECK H. STEVENSON |
| APPROVED BY T. DE YOUNG | DATE ISSUED 9 JUNE 2022 |

SCALE A3 0 5 10 1:500

CAD FILE NO. 301401401-19-P1.dgn

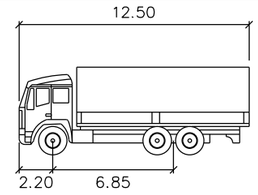
CASTLE TOWERS SITE B
CASTLE STREET & KENTWELL AVENUE
CASTLE HILL
SWEPT PATH ASSESSMENT

DRAWING NO. 300303493-19-06 SHEET 06 OF 09 ISSUE P1

## SWEPT PATH KEY

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

ASSUMED SPEED 5km/h




SU TRUCK

| | meters |
|---|---|
| Width | : 2.50 |
| Track | : 2.50 |
| Lock to Lock Time | : 6.0 |
| Steering Angle | : 36.6 |

CASTLE

STREET

EXISTING CASTLE TOWERS SHOPPING CENTRE & CAR PARK

STREET

SU TRUCK AUSTROADS 2006 (AU)

SU TRUCK AUSTROADS 2013 (AU)

EXISTING DEVELOPMENT

PENNANT

EXISTING CASTLE TOWERS CAR PARK

EASEMENT FOR SEWERAGE PURPOSES TWENTY-FIVE (25) WIDE

N

ON 06/09/22 AT 14:55:13

PLOTTED BY : asedigh

Stantec

nearmap.com

**PRELIMINARY PLAN**
FOR DISCUSSION PURPOSES ONLY SUBJECT TO CHANGE WITHOUT NOTIFICATION

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

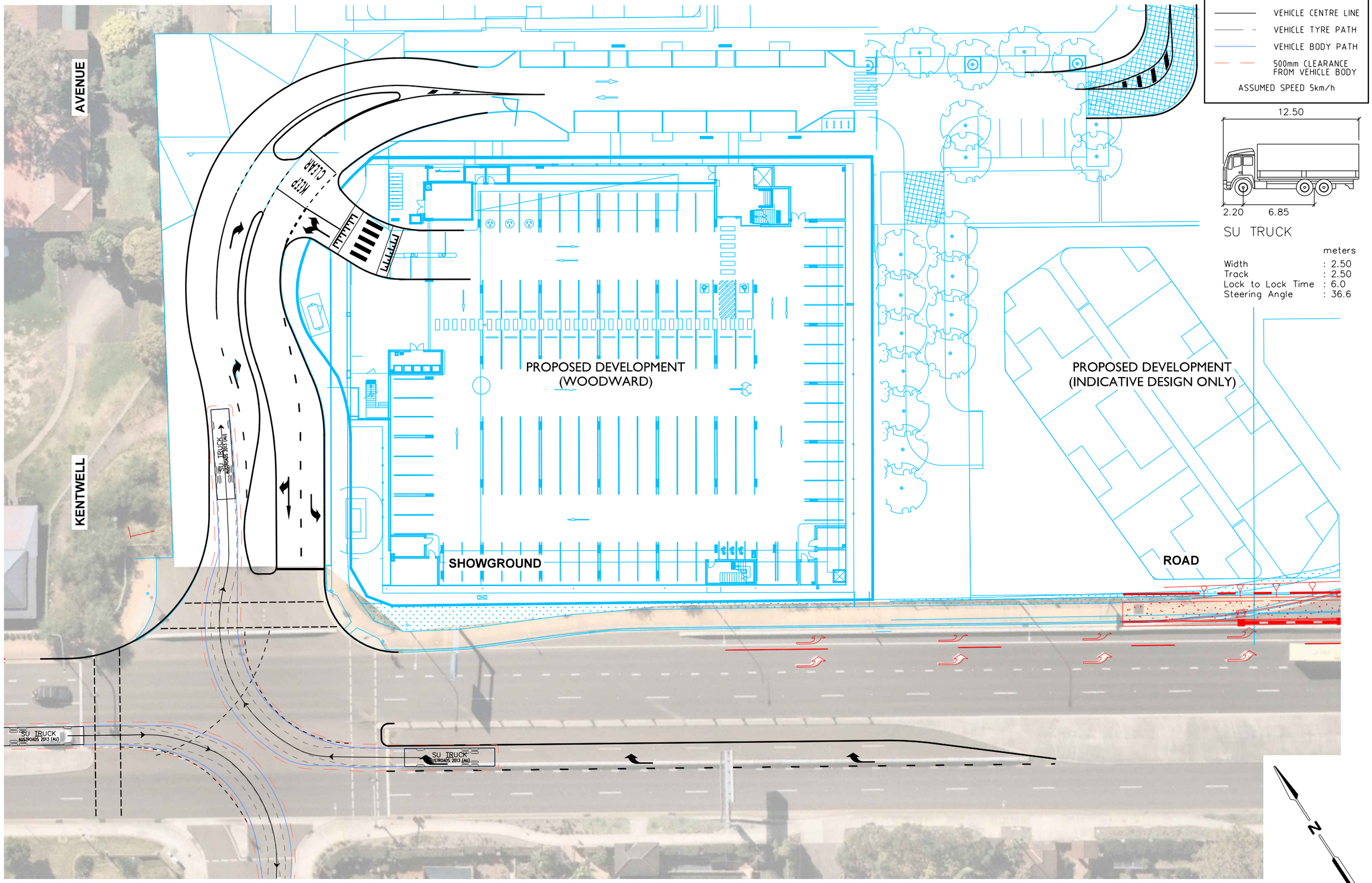
| | |
|---|---|
| DESIGNED A. SEDIGH | DESIGN CHECK H. STEVENSON |
| APPROVED BY T. DE YOUNG | DATE ISSUED 9 JUNE 2022 |

SCALE A3 0 5 10 1:500

CAD FILE NO. 301401401-19-P1.dgn

CASTLE TOWERS SITE B
CASTLE STREET & PENNANT STREET
CASTLE HILL
SWEPT PATH ASSESSMENT

DRAWING NO. 300303493-19-07 SHEET 07 OF 09 ISSUE P1




## SWEPT PATH KEY

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

ASSUMED SPEED 5km/h




SU TRUCK

| | meters |
|---|---|
| Width | : 2.50 |
| Track | : 2.50 |
| Lock to Lock Time | : 6.0 |
| Steering Angle | : 36.6 |

PLOTTED BY : asedigh ON 06/09/22 AT 14:55:15

Stantec

nearmap.com

**PRELIMINARY PLAN**
FOR DISCUSSION PURPOSES ONLY SUBJECT TO CHANGE WITHOUT NOTIFICATION

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

| | |
|---|---|
| DESIGNED A. SEDIGH | DESIGN CHECK H. STEVENSON |
| APPROVED BY T. DE YOUNG | DATE ISSUED 9 JUNE 2022 |

SCALE A3 — 0 5 10 — 1:500

CAD FILE NO. 301401401-19-P1.dgn

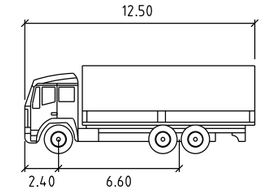
CASTLE TOWERS SITE B
SHOWGROUND ROAD & KENTWELL AVENUE
CASTLE HILL
SWEPT PATH ASSESSMENT

DRAWING NO. 300303493-19-08 SHEET 08 OF 09 ISSUE P1

## SWEPT PATH KEY

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

ASSUMED SPEED 5km/h




HRV AS2890.2 meters

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

ROAD

PENNANT

PROPOSED DEVELOPMENT
(INDICATIVE DESIGN ONLY)

HRV STANDARDS 2018 (AU)

STREET

SHOWGROUND

N

ON 06/09/22 AT 14:55:17

PLOTTED BY : asedigh

Stantec

nearmap.com

**PRELIMINARY PLAN**
FOR DISCUSSION PURPOSES ONLY SUBJECT TO CHANGE WITHOUT NOTIFICATION

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

| | |
|---|---|
| DESIGNED | A. SEDIGH |
| DESIGN CHECK | H. STEVENSON |
| APPROVED BY | T. DE YOUNG |
| DATE ISSUED | 9 JUNE 2022 |

SCALE A3 — 0 5 10 — 1:500

CAD FILE NO. 301401401-19-P1.dgn

# CASTLE TOWERS SITE B
## SHOWGROUND ROAD & PENNANT STREET
## CASTLE HILL
## SWEPT PATH ASSESSMENT

DRAWING NO. 300303493-19-09 SHEET 09 OF 09 ISSUE P1

# Appendix B
# Traffic Volumes

Figure B.1: PM Peak Hour Traffic Survey Volumes

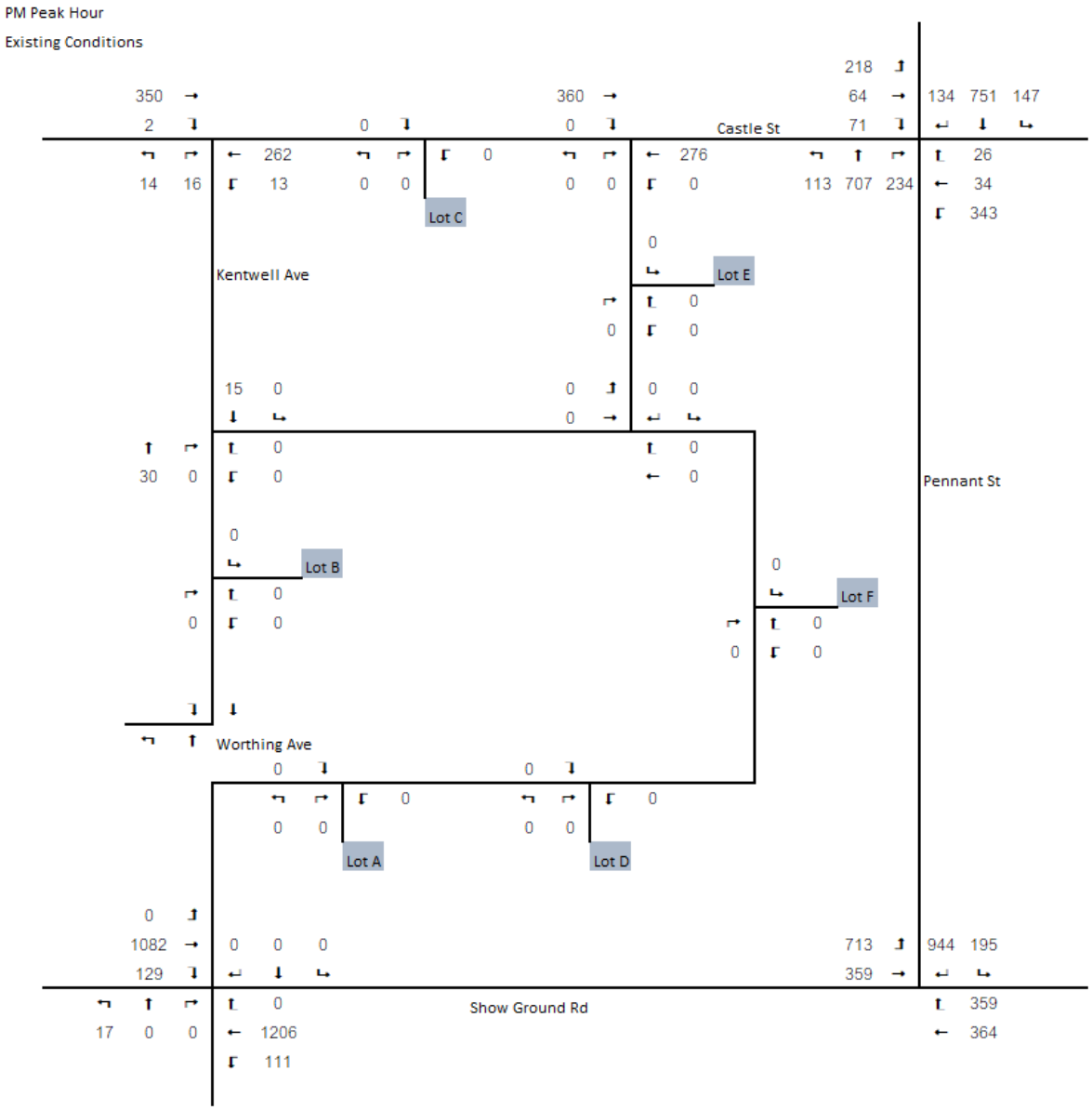


Figure B.2: PM Peak Hour Site Traffic Generation

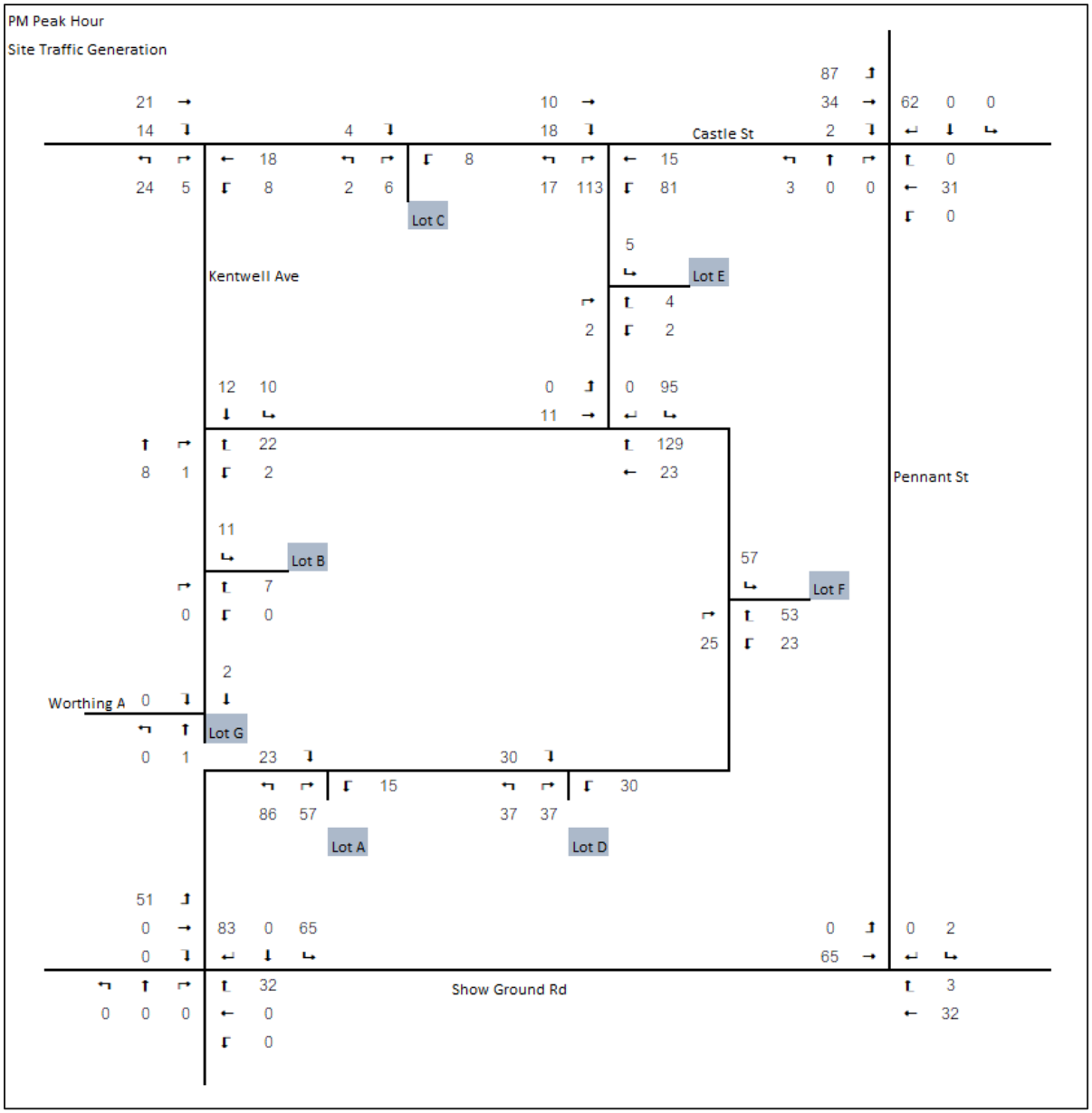
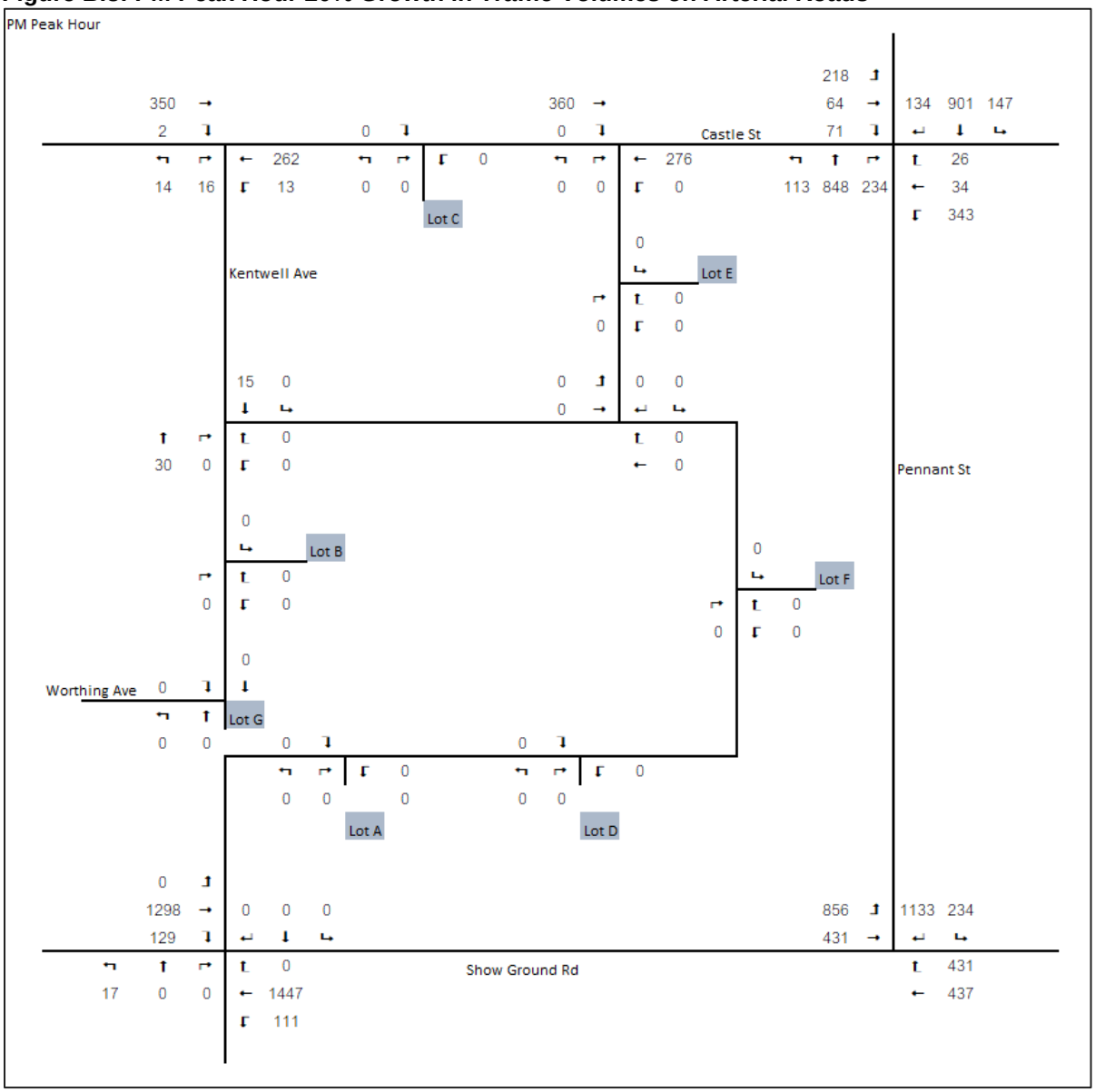
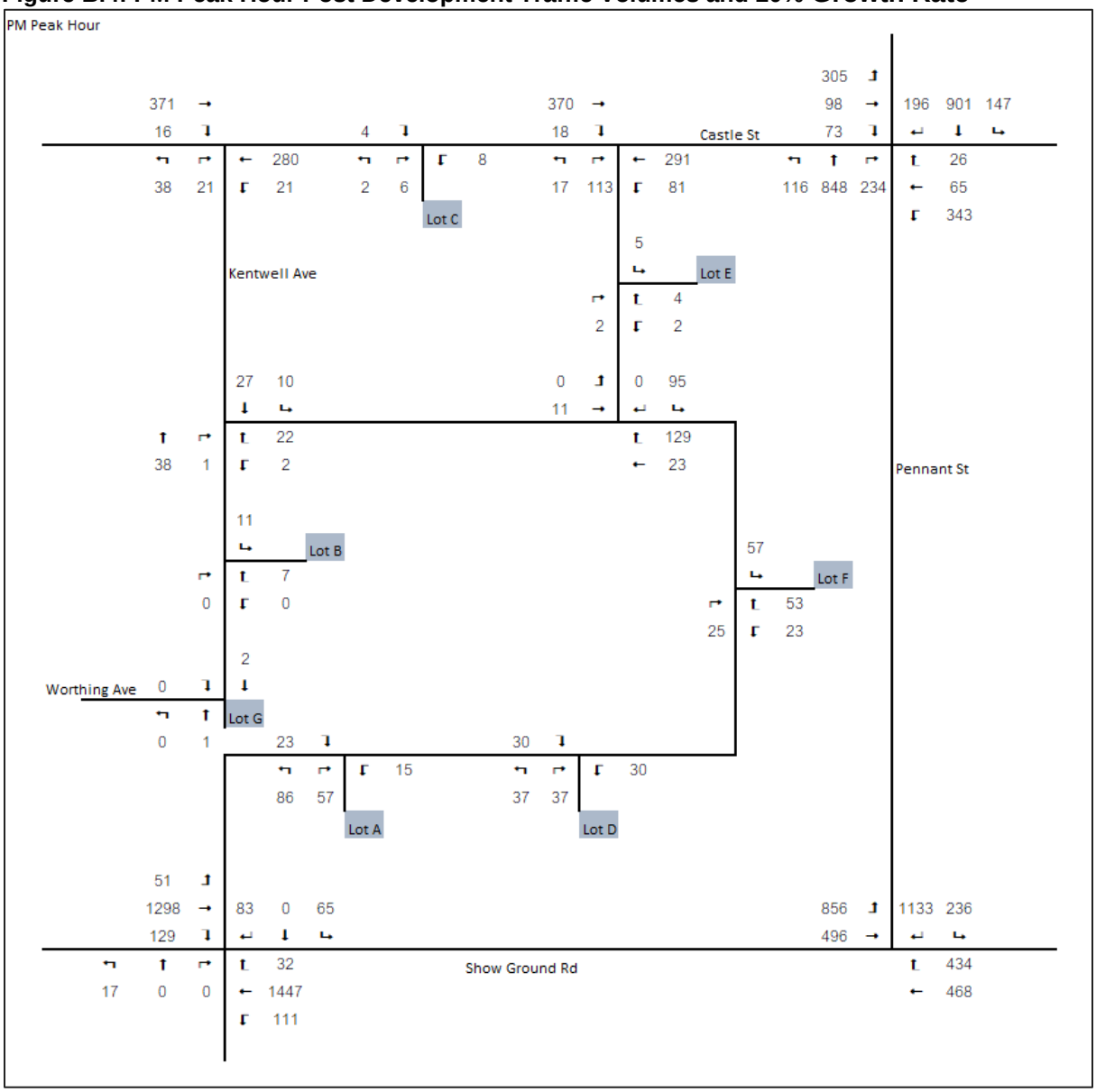


**Figure B.3: PM Peak Hour 20% Growth in Traffic Volumes on Arterial Roads**



## Figure B.4: PM Peak Hour Post Development Traffic Volumes and 20% Growth Rate



# Appendix C
# SIDRA Results

# USER REPORT FOR SITE

## All Movement Classes

**Project: 220826_3493_castle_towers_sidra** **Template: Stantec Site (2)**

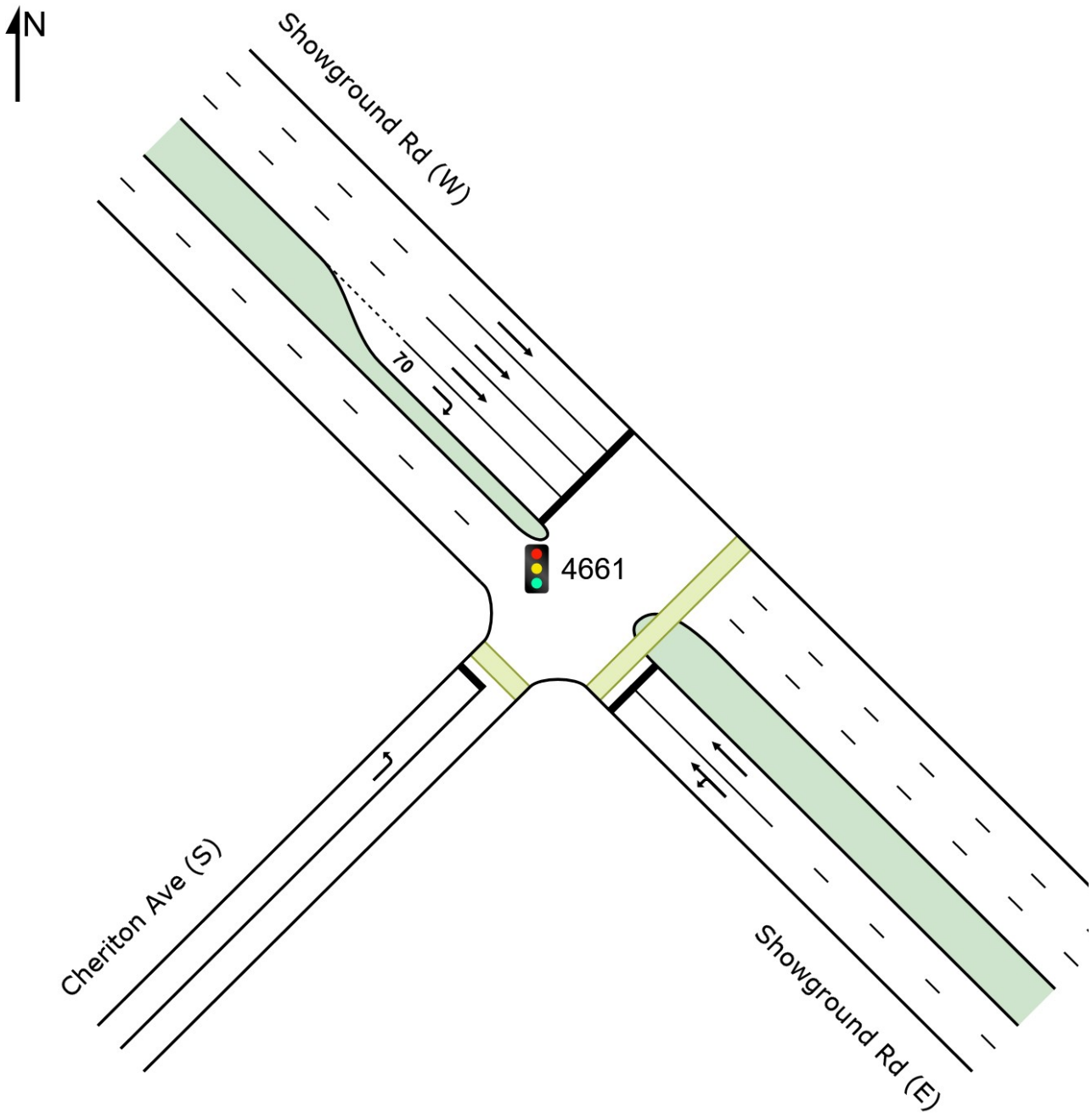
## Site: 4661 [Showground Rd & Kentwell Ave - PM Peak (5pm-6pm) - Base (Site Folder: Base)]

ShowgroundRd Tunnel Access (Kentwell)
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated  Cycle Time = 110 seconds (Site User-Given Cycle Time)

**Timings based on settings in the Site Phasing & Timing dialog**
**Phase Times determined by the program**
**Green Split Priority has been specified**
**Phase Sequence: Variable Phasing (phase reduction applied)**
**Reference Phase: Phase A**
**Input Phase Sequence: A, B, C**
**Output Phase Sequence: A, C**

## Site Layout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.

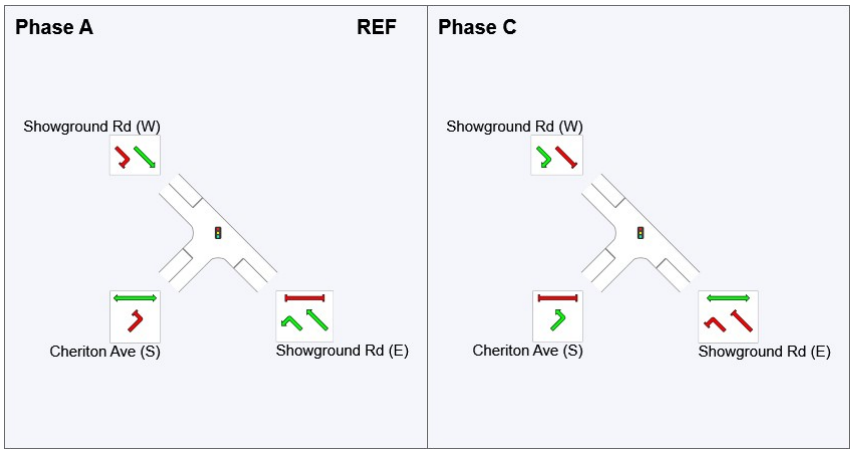


| Vehicle Movement Performance | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] veh/h | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] m | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed km/h |
| SouthEast: Showground Rd (E) | | | | | | | | | | | | | | |
| 4 | L2 | 111 | 0 | 117 | 0.0 | * 0.497 | 11.9 | LOS B | 15.1 | 108.1 | 0.45 | 0.47 | 0.45 | 52.2 |
| 5 | T1 | 1206 | 42 | 1269 | 3.5 | 0.497 | 6.4 | LOS A | 15.3 | 110.0 | 0.45 | 0.44 | 0.45 | 54.0 |
| Approach | | 1317 | 42 | 1386 | 3.2 | 0.497 | 6.8 | LOS A | 15.3 | 110.0 | 0.45 | 0.44 | 0.45 | 53.8 |
| NorthWest: Showground Rd (W) | | | | | | | | | | | | | | |
| 11 | T1 | 1082 | 38 | 1139 | 3.5 | 0.270 | 5.0 | LOS A | 6.6 | 47.3 | 0.35 | 0.31 | 0.35 | 55.4 |
| 12 | R2 | 129 | 1 | 136 | 0.8 | * 0.476 | 52.4 | LOS D | 6.8 | 48.1 | 0.96 | 0.79 | 0.96 | 31.7 |
| Approach | | 1211 | 39 | 1275 | 3.2 | 0.476 | 10.1 | LOS B | 6.8 | 48.1 | 0.42 | 0.36 | 0.42 | 51.3 |
| SouthWest: Cheriton Ave (S) | | | | | | | | | | | | | | |
| 1 | L2 | 17 | 0 | 18 | 0.0 | 0.062 | 48.6 | LOS D | 0.8 | 5.8 | 0.88 | 0.70 | 0.88 | 32.9 |
| Approach | | 17 | 0 | 18 | 0.0 | 0.062 | 48.6 | LOS D | 0.8 | 5.8 | 0.88 | 0.70 | 0.88 | 32.9 |
| All Vehicles | | 2545 | 81 | 2679 | 3.2 | 0.497 | 8.6 | LOS A | 15.3 | 110.0 | 0.44 | 0.40 | 0.44 | 52.4 |

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site 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.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

## Output Phase Sequence




REF: Reference Phase
VAR: Variable Phase

| | |
|---|---|
| Normal Movement | Permitted/Opposed |
| Slip/Bypass-Lane Movement | Opposed Slip/Bypass-Lane |
| Stopped Movement | Turn On Red |
| Other Movement Class (MC) Running | Undetected Movement |
| Mixed Running & Stopped MCs | Continuous Movement |
| Other Movement Class (MC) Stopped | Phase Transition Applied |

## Phase Timing Summary

| Phase | A | C |
|---|---|---|
| Phase Change Time (sec) | 0 | 87 |
| Green Time (sec) | 81 | 17 |
| Phase Time (sec) | 87 | 23 |
| Phase Split | 79% | 21% |

See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

# USER REPORT FOR SITE

## All Movement Classes

**Project: 220826_3493_castle_towers_sidra** **Template: Stantec Site (2)**

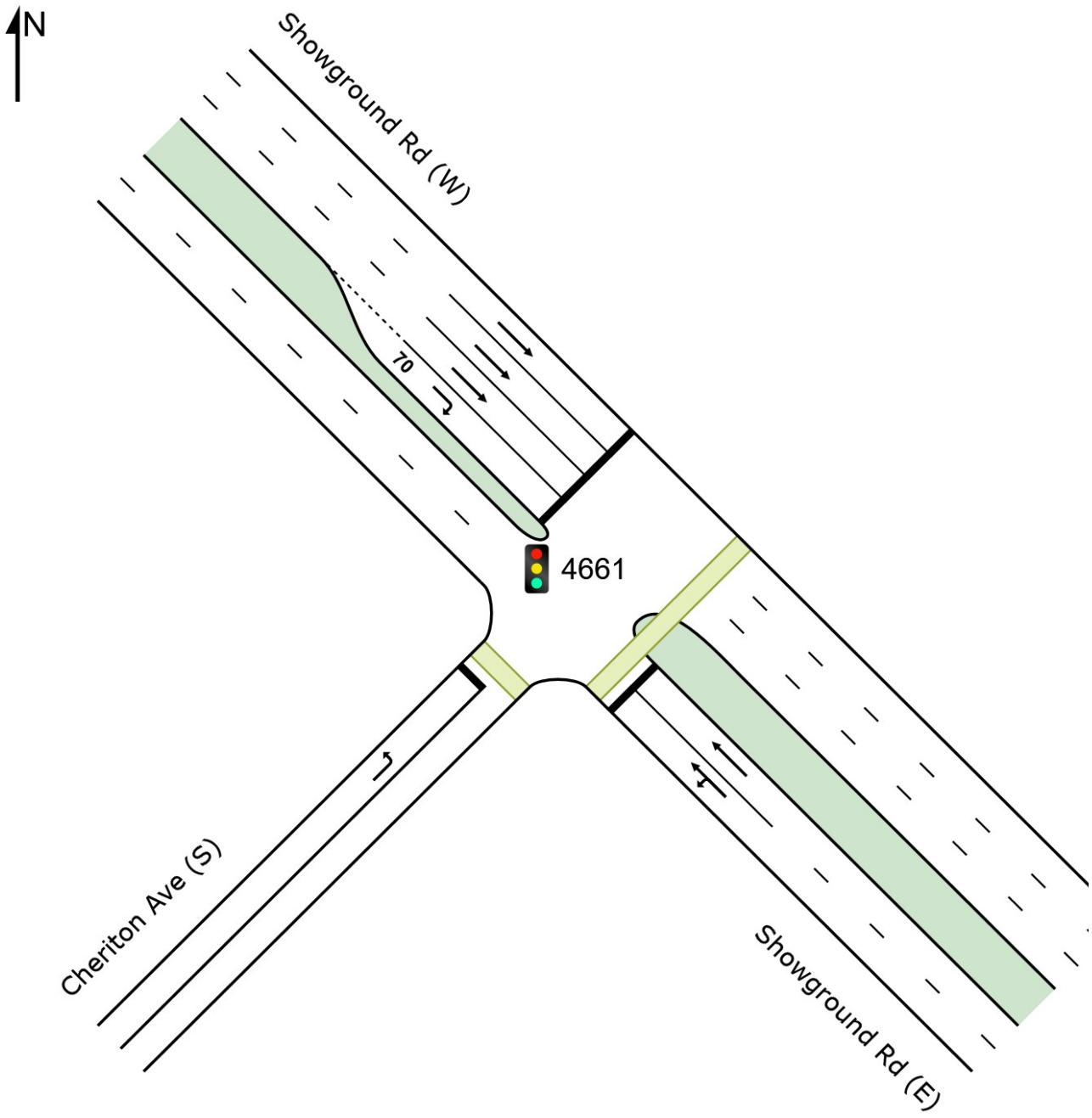
## Site: 4661 [Showground Rd & Kentwell Ave - PM Peak (5pm-6pm) - Future Base - 20% (Site Folder: Future Base)]

ShowgroundRd Tunnel Access (Kentwell)
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 110 seconds (Site User-Given Cycle Time)

**Timings based on settings in the Site Phasing & Timing dialog**
**Phase Times determined by the program**
**Green Split Priority has been specified**
**Phase Sequence: Variable Phasing (phase reduction applied)**
**Reference Phase: Phase A**
**Input Phase Sequence: A, B, C**
**Output Phase Sequence: A, C**

## Site Layout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.

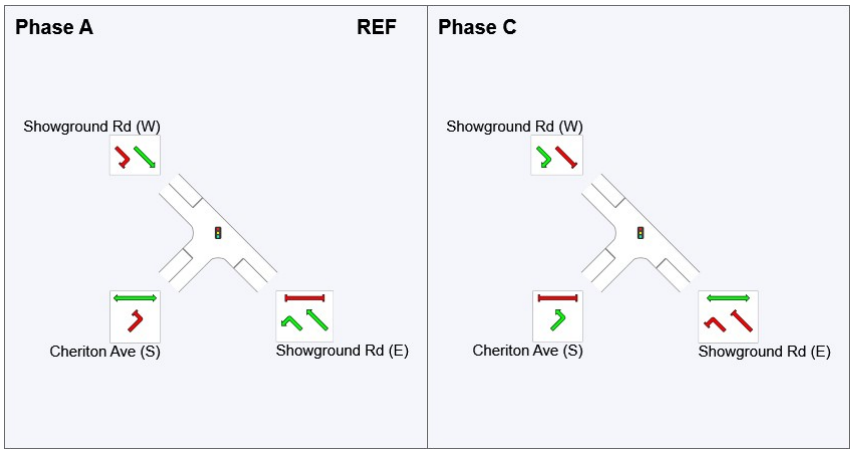


| Vehicle Movement Performance | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] % | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] m | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed km/h |
| SouthEast: Showground Rd (E) | | | | | | | | | | | | | | |
| 4 | L2 | 111 | 0.0 | 117 | 0.0 | * 0.587 | 12.7 | LOS B | 20.0 | 143.2 | 0.50 | 0.51 | 0.50 | 51.8 |
| 5 | T1 | 1447 | 3.5 | 1523 | 3.5 | 0.587 | 7.1 | LOS A | 20.2 | 145.3 | 0.50 | 0.48 | 0.50 | 53.4 |
| Approach | | 1558 | 3.2 | 1640 | 3.2 | 0.587 | 7.5 | LOS A | 20.2 | 145.3 | 0.50 | 0.49 | 0.50 | 53.3 |
| NorthWest: Showground Rd (W) | | | | | | | | | | | | | | |
| 11 | T1 | 1298 | 3.5 | 1366 | 3.5 | 0.324 | 5.3 | LOS A | 8.3 | 59.7 | 0.37 | 0.33 | 0.37 | 55.2 |
| 12 | R2 | 129 | 0.8 | 136 | 0.8 | * 0.476 | 52.4 | LOS D | 6.8 | 48.1 | 0.96 | 0.79 | 0.96 | 31.7 |
| Approach | | 1427 | 3.3 | 1502 | 3.3 | 0.476 | 9.5 | LOS A | 8.3 | 59.7 | 0.43 | 0.37 | 0.43 | 51.7 |
| SouthWest: Cheriton Ave (S) | | | | | | | | | | | | | | |
| 1 | L2 | 17 | 0.0 | 18 | 0.0 | 0.062 | 48.6 | LOS D | 0.8 | 5.8 | 0.88 | 0.70 | 0.88 | 32.9 |
| Approach | | 17 | 0.0 | 18 | 0.0 | 0.062 | 48.6 | LOS D | 0.8 | 5.8 | 0.88 | 0.70 | 0.88 | 32.9 |
| All Vehicles | | 3002 | 3.2 | 3160 | 3.2 | 0.587 | 8.7 | LOS A | 20.2 | 145.3 | 0.47 | 0.43 | 0.47 | 52.3 |

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site 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.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

## Output Phase Sequence




REF: Reference Phase
VAR: Variable Phase

| | |
|---|---|
| Normal Movement | Permitted/Opposed |
| Slip/Bypass-Lane Movement | Opposed Slip/Bypass-Lane |
| Stopped Movement | Turn On Red |
| Other Movement Class (MC) Running | Undetected Movement |
| Mixed Running & Stopped MCs | Continuous Movement |
| Other Movement Class (MC) Stopped | Phase Transition Applied |

## Phase Timing Summary

| Phase | A | C |
|---|---|---|
| Phase Change Time (sec) | 0 | 87 |
| Green Time (sec) | 81 | 17 |
| Phase Time (sec) | 87 | 23 |
| Phase Split | 79% | 21% |

See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

# USER REPORT FOR SITE

## All Movement Classes

**Project: 220826_3493_castle_towers_sidra** **Template: Stantec Site (2)**

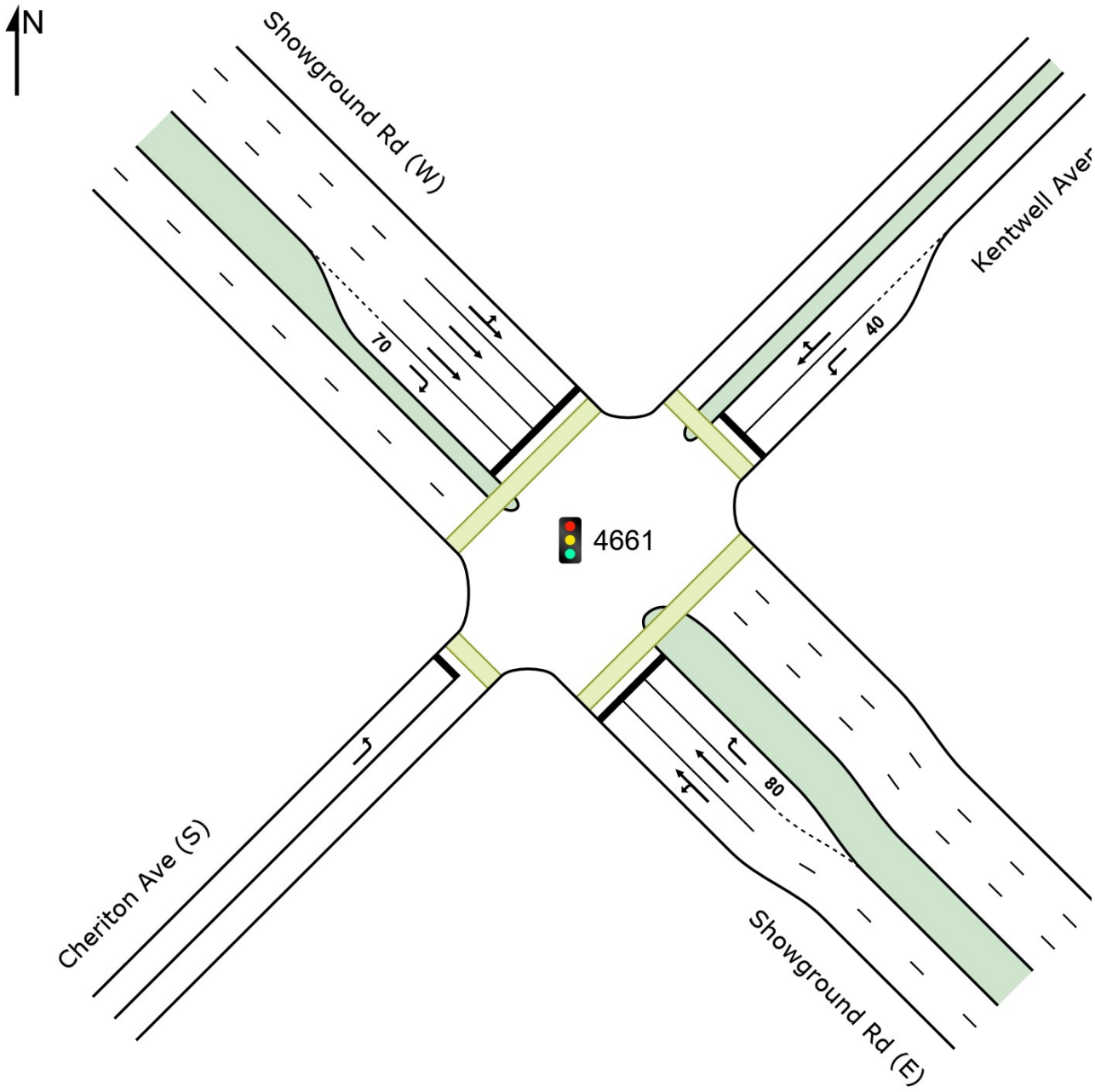
## Site: 4661 [Showground Rd & Kentwell Ave - PM Peak (5pm-6pm) - General Distribution - 20% (Site Folder: Option Testing)]

ShowgroundRd Tunnel Access (Kentwell)
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated  Cycle Time = 110 seconds (Site User-Given Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

**Timings based on settings in the Site Phasing & Timing dialog**
**Phase Times determined by the program**
**Green Split Priority has been specified**
**Phase Sequence: Variable Phasing**
**Reference Phase: Phase A**
**Input Phase Sequence: A, B, B1*, C**
**Output Phase Sequence: A, B, C**
(* Variable Phase)

## Site Layout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.

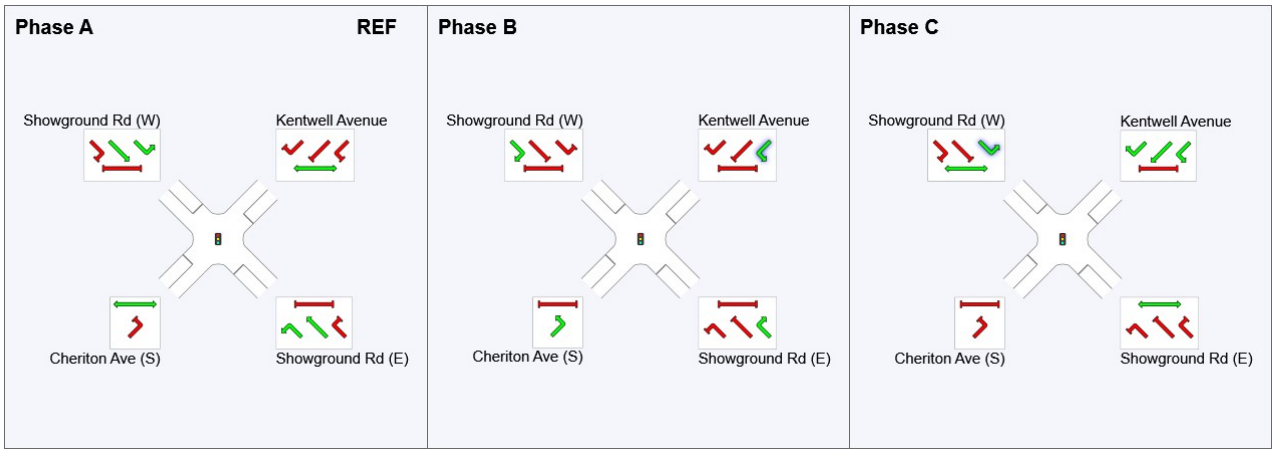


| Vehicle Movement Performance | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] veh/h | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] m | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed km/h |
| SouthEast: Showground Rd (E) | | | | | | | | | | | | | | |
| 4 | L2 | 111 | 0 | 117 | 0.0 | * 0.791 | 26.2 | LOS C | 34.8 | 249.9 | 0.86 | 0.80 | 0.86 | 43.4 |
| 5 | T1 | 1447 | 50 | 1523 | 3.5 | 0.791 | 20.5 | LOS C | 34.8 | 249.9 | 0.85 | 0.79 | 0.85 | 44.7 |
| 23 | R2 | 32 | 0 | 34 | 0.0 | 0.181 | 56.0 | LOS E | 1.7 | 12.0 | 0.95 | 0.72 | 0.95 | 23.3 |
| Approach | | 1590 | 50 | 1674 | 3.1 | 0.791 | 21.6 | LOS C | 34.8 | 249.9 | 0.85 | 0.79 | 0.85 | 44.1 |
| NorthEast: Kentwell Avenue | | | | | | | | | | | | | | |
| 24 | L2 | 65 | 0 | 68 | 0.0 | 0.110 | 32.3 | LOS C | 2.5 | 17.5 | 0.72 | 0.73 | 0.72 | 31.2 |
| 25 | T1 | 1 | 0 | 1 | 0.0 | * 0.307 | 44.6 | LOS D | 4.3 | 29.9 | 0.92 | 0.77 | 0.92 | 25.6 |
| 26 | R2 | 83 | 0 | 87 | 0.0 | 0.307 | 50.1 | LOS D | 4.3 | 29.9 | 0.92 | 0.77 | 0.92 | 25.2 |
| Approach | | 149 | 0 | 157 | 0.0 | 0.307 | 42.3 | LOS D | 4.3 | 29.9 | 0.84 | 0.75 | 0.84 | 27.5 |
| NorthWest: Showground Rd (W) | | | | | | | | | | | | | | |
| 27 | L2 | 51 | 0 | 54 | 0.0 | 0.448 | 20.8 | LOS C | 14.7 | 105.6 | 0.63 | 0.59 | 0.63 | 25.9 |
| 11 | T1 | 1298 | 46 | 1366 | 3.5 | 0.448 | 15.4 | LOS B | 14.9 | 107.2 | 0.64 | 0.57 | 0.64 | 47.8 |
| 12 | R2 | 129 | 1 | 136 | 0.8 | * 0.735 | 61.7 | LOS E | 7.6 | 53.8 | 1.00 | 0.85 | 1.15 | 29.3 |
| Approach | | 1478 | 47 | 1556 | 3.2 | 0.735 | 19.6 | LOS B | 14.9 | 107.2 | 0.67 | 0.60 | 0.68 | 44.5 |
| SouthWest: Cheriton Ave (S) | | | | | | | | | | | | | | |
| 1 | L2 | 17 | 0 | 18 | 0.0 | 0.096 | 55.3 | LOS E | 0.9 | 6.3 | 0.94 | 0.70 | 0.94 | 31.0 |
| Approach | | 17 | 0 | 18 | 0.0 | 0.096 | 55.3 | LOS E | 0.9 | 6.3 | 0.94 | 0.70 | 0.94 | 31.0 |
| All Vehicles | | 3234 | 97 | 3404 | 3.0 | 0.791 | 21.8 | LOS C | 34.8 | 249.9 | 0.77 | 0.70 | 0.77 | 43.4 |

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site 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.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

## Output Phase Sequence




REF: Reference Phase
VAR: Variable Phase

| | |
|---|---|
| Normal Movement | Permitted/Opposed |
| Slip/Bypass-Lane Movement | Opposed Slip/Bypass-Lane |
| Stopped Movement | Turn On Red |
| Other Movement Class (MC) Running | Undetected Movement |
| Mixed Running & Stopped MCs | Continuous Movement |
| Other Movement Class (MC) Stopped | Phase Transition Applied |

## Phase Timing Summary

| Phase | A | B | C |
|---|---|---|---|
| Phase Change Time (sec) | 0 | 67 | 84 |
| Green Time (sec) | 61 | 11 | 20 |
| Phase Time (sec) | 67 | 17 | 26 |
| Phase Split | 61% | 15% | 24% |

See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

# USER REPORT FOR SITE

## All Movement Classes

**Project: 220826_3493_castle_towers_sidra** **Template: Stantec Site (2)**

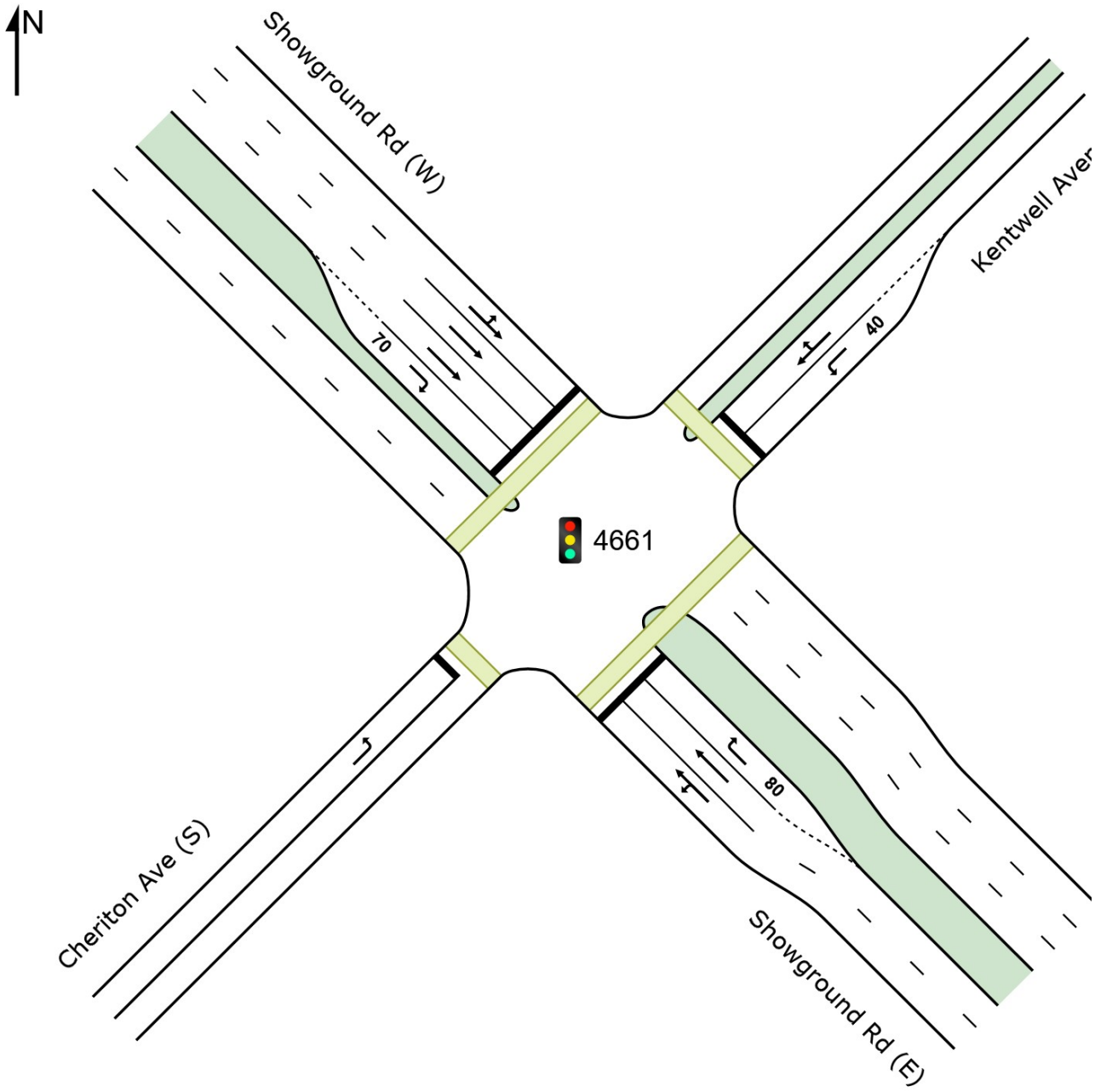
## Site: 4661 [Showground Rd & Kentwell Ave - PM Peak (5pm-6pm) - 100% Site - 20% (Site Folder: Option Testing)]

ShowgroundRd Tunnel Access (Kentwell)
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 110 seconds (Site User-Given Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

**Timings based on settings in the Site Phasing & Timing dialog**
**Phase Times determined by the program**
**Green Split Priority has been specified**
**Phase Sequence: Variable Phasing**
**Reference Phase: Phase A**
**Input Phase Sequence: A, B, B1*, C**
**Output Phase Sequence: A, B, C**
(* Variable Phase)

## Site Layout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



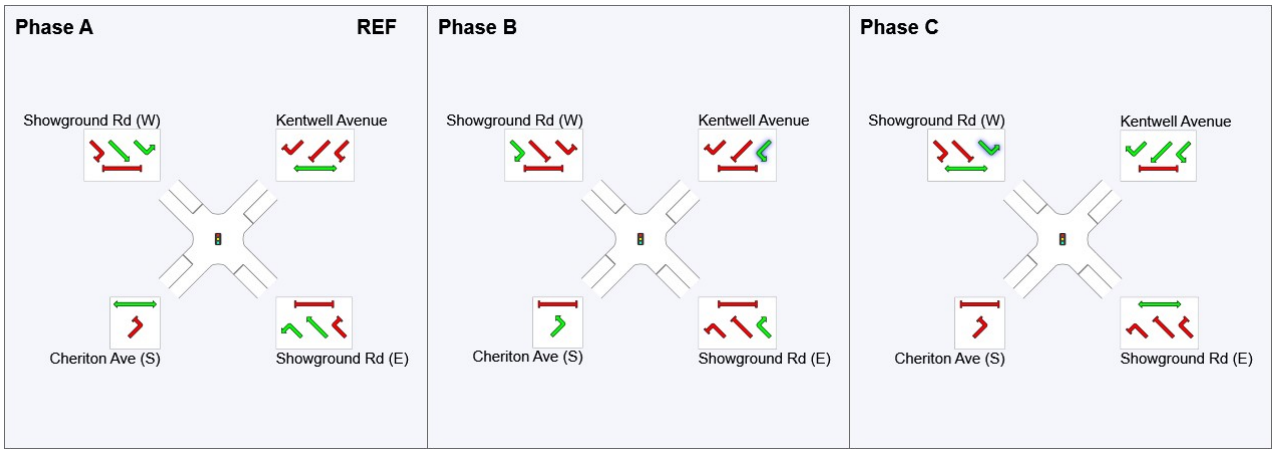
## Vehicle Movement Performance

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] veh/h | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] m | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SouthEast: Showground Rd (E) | | | | | | | | | | | | | | |
| 4 | L2 | 111 | 0 | 117 | 0.0 | * 0.806 | 26.2 | LOS C | 36.6 | 262.6 | 0.87 | 0.81 | 0.87 | 43.5 |
| 5 | T1 | 1447 | 50 | 1523 | 3.5 | 0.806 | 20.3 | LOS C | 36.6 | 262.6 | 0.83 | 0.78 | 0.84 | 44.8 |
| 23 | R2 | 123 | 0 | 129 | 0.0 | 0.767 | 63.5 | LOS E | 7.4 | 51.8 | 1.00 | 0.88 | 1.20 | 21.6 |
| Approach | | 1681 | 50 | 1769 | 3.0 | 0.806 | 23.9 | LOS C | 36.6 | 262.6 | 0.85 | 0.79 | 0.87 | 42.6 |
| NorthEast: Kentwell Avenue | | | | | | | | | | | | | | |
| 24 | L2 | 115 | 0 | 121 | 0.0 | 0.199 | 34.0 | LOS C | 4.7 | 32.6 | 0.76 | 0.75 | 0.76 | 30.5 |
| 25 | T1 | 17 | 0 | 18 | 0.0 | * 0.762 | 51.1 | LOS D | 11.5 | 80.6 | 1.00 | 0.89 | 1.13 | 23.9 |
| 26 | R2 | 183 | 0 | 193 | 0.0 | 0.762 | 56.7 | LOS E | 11.5 | 80.6 | 1.00 | 0.89 | 1.13 | 23.6 |
| Approach | | 315 | 0 | 332 | 0.0 | 0.762 | 48.1 | LOS D | 11.5 | 80.6 | 0.91 | 0.84 | 1.00 | 25.7 |
| NorthWest: Showground Rd (W) | | | | | | | | | | | | | | |
| 27 | L2 | 90 | 0 | 95 | 0.0 | 0.454 | 20.3 | LOS C | 14.9 | 107.0 | 0.62 | 0.60 | 0.62 | 25.9 |
| 11 | T1 | 1299 | 46 | 1367 | 3.5 | 0.454 | 14.9 | LOS B | 15.2 | 109.3 | 0.63 | 0.57 | 0.63 | 48.0 |
| 12 | R2 | 129 | 1 | 136 | 0.8 | * 0.809 | 65.1 | LOS E | 7.9 | 55.8 | 1.00 | 0.90 | 1.27 | 28.5 |
| Approach | | 1518 | 47 | 1598 | 3.1 | 0.809 | 19.5 | LOS B | 15.2 | 109.3 | 0.66 | 0.60 | 0.68 | 44.0 |
| SouthWest: Cheriton Ave (S) | | | | | | | | | | | | | | |
| 1 | L2 | 17 | 0 | 18 | 0.0 | 0.106 | 56.5 | LOS E | 0.9 | 6.4 | 0.95 | 0.70 | 0.95 | 30.7 |
| Approach | | 17 | 0 | 18 | 0.0 | 0.106 | 56.5 | LOS E | 0.9 | 6.4 | 0.95 | 0.70 | 0.95 | 30.7 |
| All Vehicles | | 3531 | 97 | 3717 | 2.7 | 0.809 | 24.3 | LOS C | 36.6 | 262.6 | 0.77 | 0.71 | 0.80 | 41.5 |

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site 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.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

## Output Phase Sequence




REF: Reference Phase
VAR: Variable Phase

| | |
|---|---|
| Normal Movement | Permitted/Opposed |
| Slip/Bypass-Lane Movement | Opposed Slip/Bypass-Lane |
| Stopped Movement | Turn On Red |
| Other Movement Class (MC) Running | Undetected Movement |
| Mixed Running & Stopped MCs | Continuous Movement |
| Other Movement Class (MC) Stopped | Phase Transition Applied |

## Phase Timing Summary

| Phase | A | B | C |
|---|---|---|---|
| Phase Change Time (sec) | 0 | 68 | 84 |
| Green Time (sec) | 62 | 10 | 20 |
| Phase Time (sec) | 68 | 16 | 26 |
| Phase Split | 62% | 15% | 24% |

See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

# USER REPORT FOR SITE

## All Movement Classes

**Project: 220826_3493_castle_towers_sidra** **Template: Stantec Site (2)**

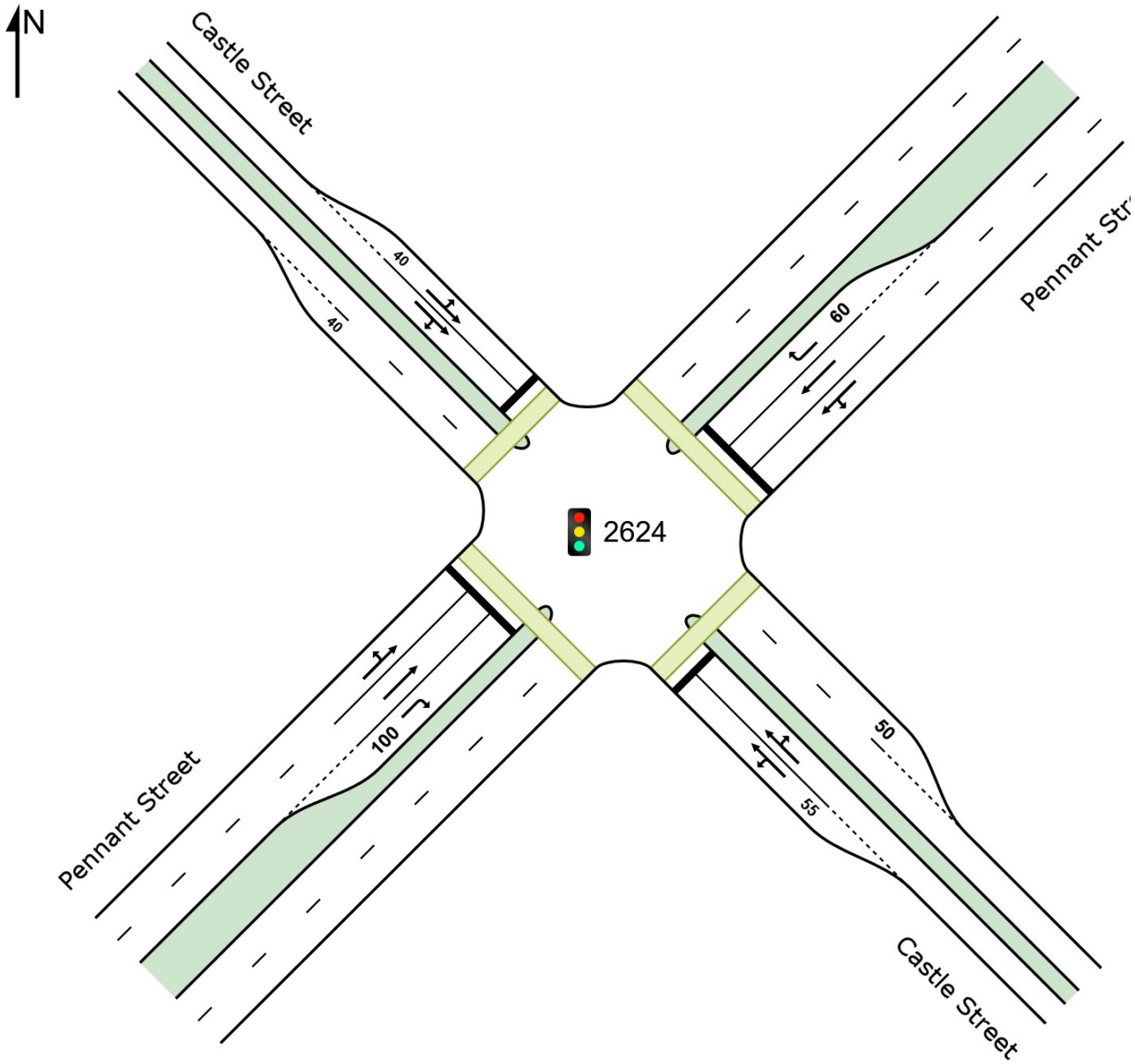
## Site: 2624 [Castle St & Pennant St - PM Peak (5pm-6pm) - Option 1 - Existing Vols (Site Folder: Existing Layout)]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated  Cycle Time = 130 seconds (Site User-Given Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

**Timings based on settings in the Site Phasing & Timing dialog**
**Phase Times determined by the program**
**Phase Sequence: Variable Phasing**
**Reference Phase: Phase A**
**Input Phase Sequence: A, D, E, E1*, E2***
**Output Phase Sequence: A, D, E**
(* Variable Phase)

## Site Layout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



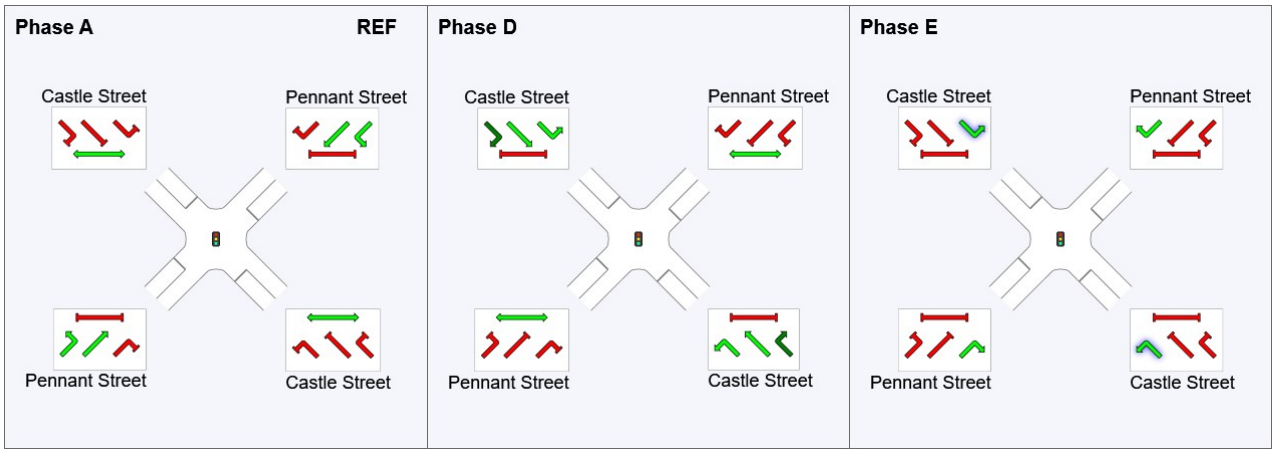
## Vehicle Movement Performance

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] veh/h | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] m | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SouthEast: Castle Street | | | | | | | | | | | | | | |
| 4 | L2 | 343 | 9 | 361 | 2.6 | 0.447 | 27.3 | LOS C | 14.6 | 104.4 | 0.69 | 0.78 | 0.69 | 30.2 |
| 5 | T1 | 34 | 0 | 36 | 0.0 | 0.242 | 51.2 | LOS D | 3.5 | 24.7 | 0.91 | 0.73 | 0.91 | 7.6 |
| 6 | R2 | 26 | 0 | 27 | 0.0 | 0.242 | 55.5 | LOS E | 3.5 | 24.7 | 0.91 | 0.73 | 0.91 | 22.1 |
| Approach | | 403 | 9 | 424 | 2.2 | 0.447 | 31.1 | LOS C | 14.6 | 104.4 | 0.72 | 0.77 | 0.72 | 27.8 |
| NorthEast: Pennant Street | | | | | | | | | | | | | | |
| 7 | L2 | 147 | 1 | 155 | 0.7 | * 0.676 | 40.0 | LOS D | 26.1 | 185.7 | 0.89 | 0.81 | 0.89 | 26.1 |
| 8 | T1 | 751 | 16 | 791 | 2.1 | 0.676 | 33.5 | LOS C | 26.1 | 185.7 | 0.86 | 0.77 | 0.86 | 34.1 |
| 9 | R2 | 134 | 0 | 141 | 0.0 | 0.380 | 53.4 | LOS D | 7.8 | 54.6 | 0.91 | 0.79 | 0.91 | 21.2 |
| Approach | | 1032 | 17 | 1086 | 1.6 | 0.676 | 37.0 | LOS D | 26.1 | 185.7 | 0.87 | 0.77 | 0.87 | 31.6 |
| NorthWest: Castle Street | | | | | | | | | | | | | | |
| 10 | L2 | 216 | 0 | 227 | 0.0 | 0.262 | 24.8 | LOS C | 8.4 | 58.6 | 0.63 | 0.74 | 0.63 | 31.1 |
| 11 | T1 | 64 | 0 | 67 | 0.0 | * 0.643 | 57.9 | LOS E | 8.8 | 61.6 | 0.99 | 0.83 | 1.02 | 6.8 |
| 12 | R2 | 71 | 0 | 75 | 0.0 | 0.643 | 61.8 | LOS E | 8.8 | 61.6 | 0.99 | 0.83 | 1.02 | 20.3 |
| Approach | | 351 | 0 | 369 | 0.0 | 0.643 | 38.3 | LOS D | 8.8 | 61.6 | 0.77 | 0.77 | 0.78 | 24.0 |
| SouthWest: Pennant Street | | | | | | | | | | | | | | |
| 1 | L2 | 113 | 4 | 119 | 3.5 | 0.574 | 37.9 | LOS D | 20.9 | 150.3 | 0.84 | 0.76 | 0.84 | 18.0 |
| 2 | T1 | 707 | 21 | 744 | 3.0 | 0.574 | 32.6 | LOS C | 21.5 | 154.2 | 0.84 | 0.75 | 0.84 | 34.4 |
| 3 | R2 | 234 | 5 | 246 | 2.1 | * 0.673 | 57.0 | LOS E | 14.6 | 104.4 | 0.98 | 0.84 | 0.98 | 20.6 |
| Approach | | 1054 | 30 | 1109 | 2.8 | 0.673 | 38.6 | LOS D | 21.5 | 154.2 | 0.87 | 0.77 | 0.87 | 29.6 |
| All Vehicles | | 2840 | 56 | 2989 | 2.0 | 0.676 | 36.9 | LOS D | 26.1 | 185.7 | 0.84 | 0.77 | 0.84 | 29.7 |

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site 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.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

## Output Phase Sequence




REF: Reference Phase
VAR: Variable Phase

| | |
|---|---|
| Normal Movement | Permitted/Opposed |
| Slip/Bypass-Lane Movement | Opposed Slip/Bypass-Lane |
| Stopped Movement | Turn On Red |
| Other Movement Class (MC) Running | Undetected Movement |
| Mixed Running & Stopped MCs | Continuous Movement |
| Other Movement Class (MC) Stopped | Phase Transition Applied |

## Phase Timing Summary

| Phase | A | D | E |
|---|---|---|---|
| Phase Change Time (sec) | 0 | 58 | 98 |
| Green Time (sec) | 52 | 34 | 26 |
| Phase Time (sec) | 58 | 40 | 32 |
| Phase Split | 45% | 31% | 25% |

See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

# USER REPORT FOR SITE

## All Movement Classes

**Project: 220826_3493_castle_towers_sidra** **Template: Stantec Site (2)**

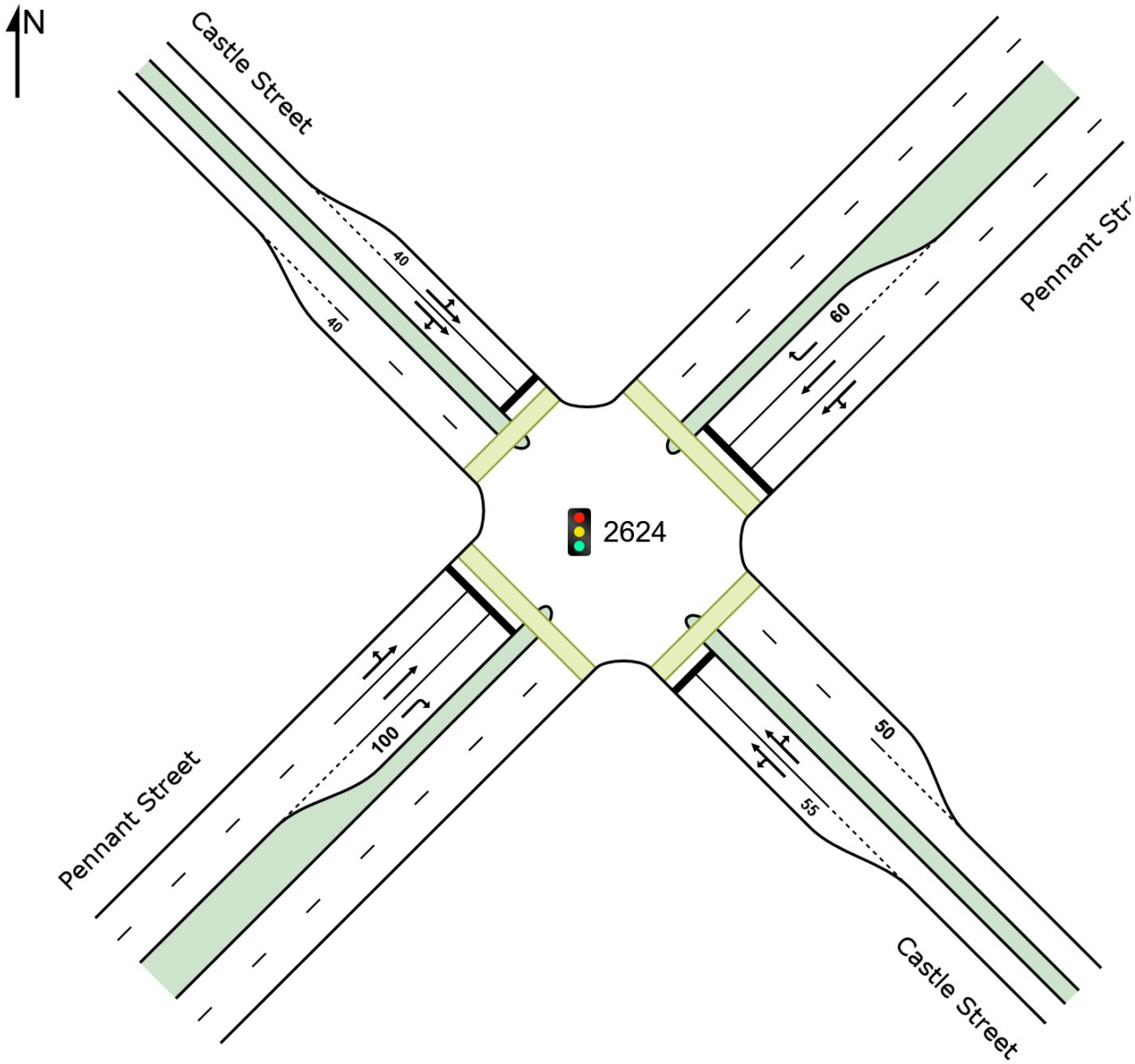
## Site: 2624 [Castle St & Pennant St - PM Peak (5pm-6pm) - Option 1 - 20% Growth (Site Folder: For Report)]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated  Cycle Time = 130 seconds (Site User-Given Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

**Timings based on settings in the Site Phasing & Timing dialog**
**Phase Times determined by the program**
**Phase Sequence: Variable Phasing**
**Reference Phase: Phase A**
**Input Phase Sequence: A, D, E, E1*, E2***
**Output Phase Sequence: A, D, E, E1***
(* Variable Phase)

## Site Layout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



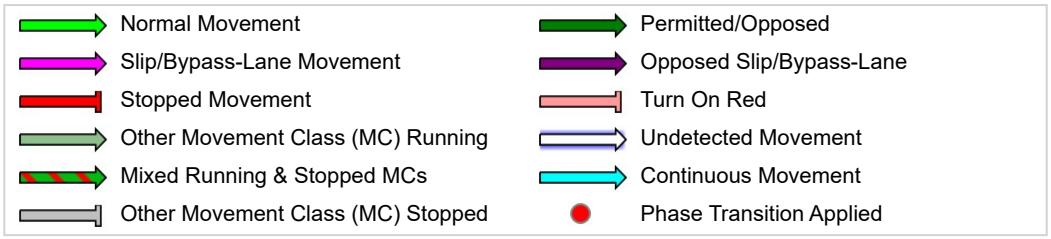
| Vehicle Movement Performance | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] veh/h | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] m | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed km/h |
| SouthEast: Castle Street | | | | | | | | | | | | | | |
| 4 | L2 | 343 | 9 | 361 | 2.6 | 0.480 | 29.4 | LOS C | 15.3 | 109.2 | 0.72 | 0.79 | 0.72 | 29.3 |
| 5 | T1 | 34 | 0 | 36 | 0.0 | 0.263 | 53.3 | LOS D | 3.6 | 25.2 | 0.92 | 0.73 | 0.92 | 7.4 |
| 6 | R2 | 26 | 0 | 27 | 0.0 | 0.263 | 57.6 | LOS E | 3.6 | 25.2 | 0.92 | 0.73 | 0.92 | 21.6 |
| Approach | | 403 | 9 | 424 | 2.2 | 0.480 | 33.3 | LOS C | 15.3 | 109.2 | 0.75 | 0.78 | 0.75 | 27.0 |
| NorthEast: Pennant Street | | | | | | | | | | | | | | |
| 7 | L2 | 147 | 1 | 155 | 0.7 | * 0.746 | 38.9 | LOS D | 31.3 | 222.1 | 0.91 | 0.83 | 0.91 | 26.5 |
| 8 | T1 | 901 | 16 | 948 | 1.8 | 0.746 | 32.4 | LOS C | 31.3 | 222.1 | 0.87 | 0.79 | 0.87 | 34.5 |
| 9 | R2 | 134 | 0 | 141 | 0.0 | 0.581 | 63.3 | LOS E | 8.6 | 60.4 | 0.99 | 0.80 | 0.99 | 19.2 |
| Approach | | 1182 | 17 | 1244 | 1.4 | 0.746 | 36.7 | LOS D | 31.3 | 222.1 | 0.89 | 0.79 | 0.89 | 31.9 |
| NorthWest: Castle Street | | | | | | | | | | | | | | |
| 10 | L2 | 218 | 0 | 229 | 0.0 | 0.315 | 31.7 | LOS C | 9.8 | 68.4 | 0.72 | 0.77 | 0.72 | 28.1 |
| 11 | T1 | 64 | 0 | 67 | 0.0 | * 0.699 | 61.1 | LOS E | 9.1 | 63.7 | 1.00 | 0.86 | 1.08 | 6.5 |
| 12 | R2 | 71 | 0 | 75 | 0.0 | 0.699 | 65.1 | LOS E | 9.1 | 63.7 | 1.00 | 0.86 | 1.08 | 19.7 |
| Approach | | 353 | 0 | 372 | 0.0 | 0.699 | 43.8 | LOS D | 9.8 | 68.4 | 0.83 | 0.80 | 0.86 | 22.3 |
| SouthWest: Pennant Street | | | | | | | | | | | | | | |
| 1 | L2 | 113 | 4 | 119 | 3.5 | 0.560 | 30.7 | LOS C | 22.3 | 159.6 | 0.77 | 0.71 | 0.77 | 19.3 |
| 2 | T1 | 848 | 21 | 893 | 2.5 | 0.560 | 25.8 | LOS C | 22.9 | 163.6 | 0.77 | 0.70 | 0.77 | 36.8 |
| 3 | R2 | 234 | 5 | 246 | 2.1 | * 0.729 | 60.5 | LOS E | 15.3 | 108.7 | 1.00 | 0.86 | 1.05 | 19.9 |
| Approach | | 1195 | 30 | 1258 | 2.5 | 0.729 | 33.0 | LOS C | 22.9 | 163.6 | 0.81 | 0.73 | 0.82 | 31.7 |
| All Vehicles | | 3133 | 56 | 3298 | 1.8 | 0.746 | 35.7 | LOS D | 31.3 | 222.1 | 0.84 | 0.77 | 0.84 | 30.5 |

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site 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.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

## Output Phase Sequence


REF: Reference Phase
VAR: Variable Phase




## Phase Timing Summary

| Phase | A | D | E | E1 |
|---|---|---|---|---|
| Phase Change Time (sec) | 0 | 61 | 100 | 123 |
| Green Time (sec) | 55 | 33 | 17 | 1 |
| Phase Time (sec) | 61 | 39 | 23 | 7 |
| Phase Split | 47% | 30% | 18% | 5% |

See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

# USER REPORT FOR SITE

## All Movement Classes

**Project: 220826_3493_castle_towers_sidra** **Template: Stantec Site (2)**

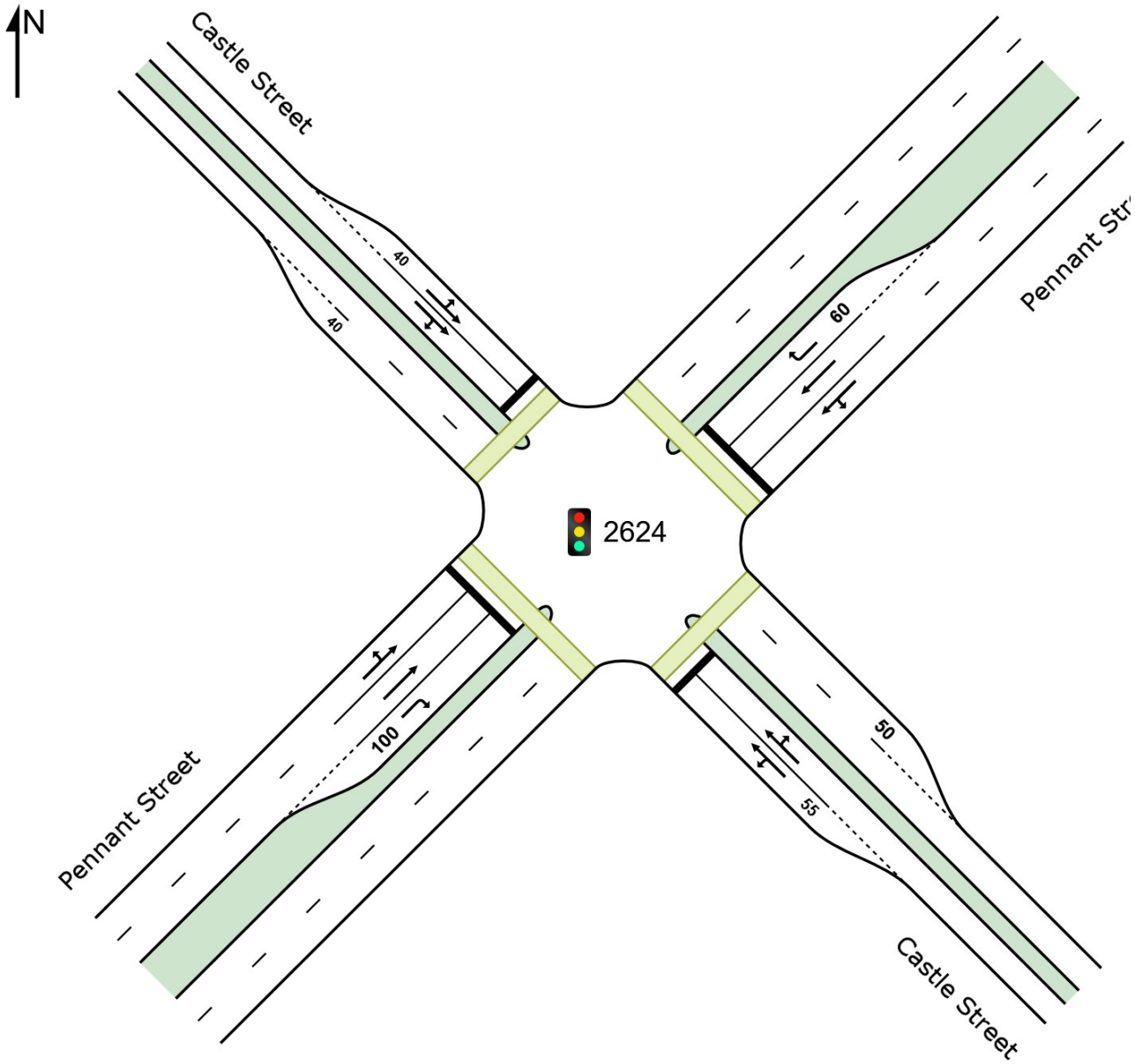
## Site: 2624 [Castle St & Pennant St - PM Peak (5pm-6pm) - Option 1 - 20% Growth + Site Vols (Site Folder: For Report)]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated  Cycle Time = 130 seconds (Site User-Given Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

**Timings based on settings in the Site Phasing & Timing dialog**
**Phase Times determined by the program**
**Phase Sequence: Variable Phasing**
**Reference Phase: Phase A**
**Input Phase Sequence: A, D, E, E1*, E2***
**Output Phase Sequence: A, D, E**
(* Variable Phase)

## Site Layout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



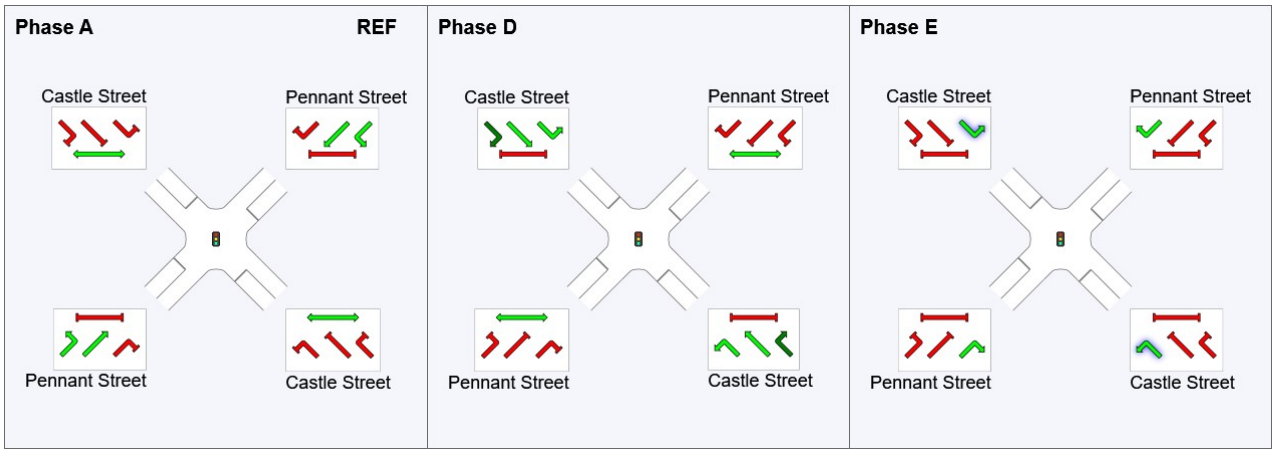
## Vehicle Movement Performance

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] veh/h | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] m | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SouthEast: Castle Street | | | | | | | | | | | | | | |
| 4 | L2 | 343 | 9 | 361 | 2.6 | 0.462 | 28.0 | LOS C | 14.8 | 106.0 | 0.70 | 0.78 | 0.70 | 29.9 |
| 5 | T1 | 64 | 0 | 67 | 0.0 | 0.306 | 49.1 | LOS D | 5.2 | 36.6 | 0.90 | 0.73 | 0.90 | 8.0 |
| 6 | R2 | 26 | 0 | 27 | 0.0 | 0.306 | 53.5 | LOS D | 5.2 | 36.6 | 0.90 | 0.73 | 0.90 | 22.8 |
| Approach | | 433 | 9 | 456 | 2.1 | 0.462 | 32.6 | LOS C | 14.8 | 106.0 | 0.74 | 0.77 | 0.74 | 26.6 |
| NorthEast: Pennant Street | | | | | | | | | | | | | | |
| 7 | L2 | 147 | 1 | 155 | 0.7 | *0.797 | 42.3 | LOS D | 34.2 | 242.2 | 0.95 | 0.87 | 0.96 | 25.4 |
| 8 | T1 | 901 | 16 | 948 | 1.8 | 0.797 | 36.2 | LOS D | 34.2 | 242.2 | 0.90 | 0.83 | 0.93 | 33.3 |
| 9 | R2 | 193 | 0 | 203 | 0.0 | 0.646 | 60.1 | LOS E | 12.2 | 85.6 | 0.99 | 0.82 | 0.99 | 20.2 |
| Approach | | 1241 | 17 | 1306 | 1.4 | 0.797 | 40.6 | LOS D | 34.2 | 242.2 | 0.92 | 0.83 | 0.94 | 30.6 |
| NorthWest: Castle Street | | | | | | | | | | | | | | |
| 10 | L2 | 286 | 0 | 301 | 0.0 | 0.467 | 26.6 | LOS C | 11.8 | 82.8 | 0.67 | 0.76 | 0.67 | 31.1 |
| 11 | T1 | 94 | 0 | 99 | 0.0 | *0.818 | 62.4 | LOS E | 11.6 | 81.4 | 0.99 | 0.94 | 1.22 | 6.4 |
| 12 | R2 | 73 | 0 | 77 | 0.0 | 0.818 | 66.3 | LOS E | 11.6 | 81.4 | 0.99 | 0.94 | 1.22 | 19.6 |
| Approach | | 453 | 0 | 477 | 0.0 | 0.818 | 40.4 | LOS D | 11.8 | 82.8 | 0.79 | 0.83 | 0.87 | 23.4 |
| SouthWest: Pennant Street | | | | | | | | | | | | | | |
| 1 | L2 | 116 | 4 | 122 | 3.4 | 0.682 | 38.8 | LOS D | 26.7 | 191.4 | 0.88 | 0.80 | 0.88 | 18.0 |
| 2 | T1 | 848 | 21 | 893 | 2.5 | 0.682 | 33.2 | LOS C | 26.7 | 191.4 | 0.87 | 0.78 | 0.87 | 34.2 |
| 3 | R2 | 234 | 5 | 246 | 2.1 | *0.796 | 65.2 | LOS E | 16.0 | 114.4 | 1.00 | 0.90 | 1.13 | 19.1 |
| Approach | | 1198 | 30 | 1261 | 2.5 | 0.796 | 40.0 | LOS D | 26.7 | 191.4 | 0.90 | 0.80 | 0.92 | 29.6 |
| All Vehicles | | 3325 | 56 | 3500 | 1.7 | 0.818 | 39.3 | LOS D | 34.2 | 242.2 | 0.87 | 0.81 | 0.90 | 29.1 |

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site 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.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

## Output Phase Sequence




REF: Reference Phase
VAR: Variable Phase

| | |
|---|---|
| Normal Movement | Permitted/Opposed |
| Slip/Bypass-Lane Movement | Opposed Slip/Bypass-Lane |
| Stopped Movement | Turn On Red |
| Other Movement Class (MC) Running | Undetected Movement |
| Mixed Running & Stopped MCs | Continuous Movement |
| Other Movement Class (MC) Stopped | Phase Transition Applied |

## Phase Timing Summary

| Phase | A | D | E |
|---|---|---|---|
| Phase Change Time (sec) | 0 | 59 | 102 |
| Green Time (sec) | 53 | 37 | 22 |
| Phase Time (sec) | 59 | 43 | 28 |
| Phase Split | 45% | 33% | 22% |

See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

# USER REPORT FOR SITE

## All Movement Classes

**Project:** 220826_3493_castle_towers_sidra_double_diamond

**Template: Stantec Site (2)**

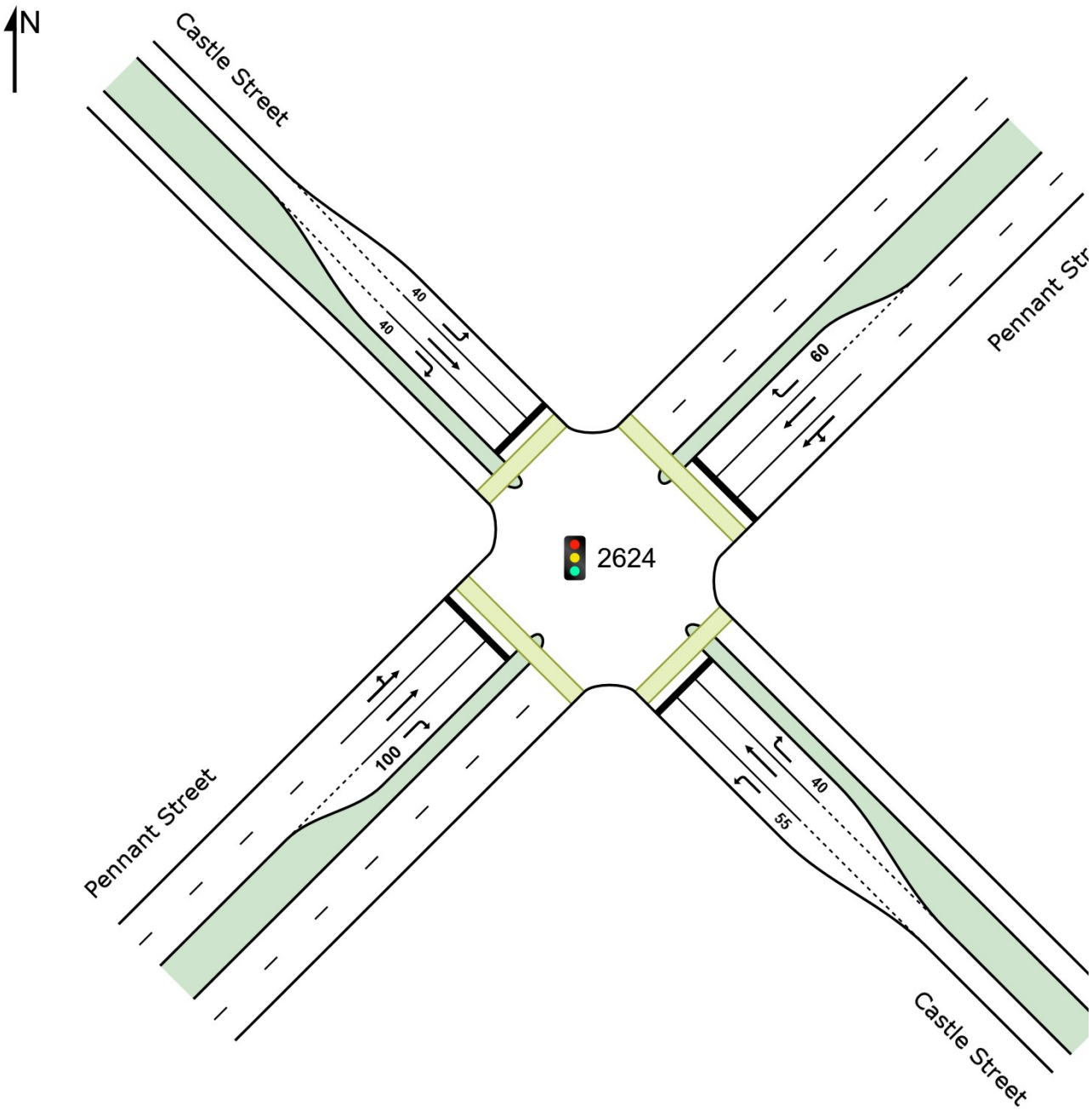
## Site: 2624 [Castle St & Pennant St - PM Peak (5pm-6pm) - Option 3B - 20% Growth - Double Diamond (Site Folder: For Report)]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated  Cycle Time = 130 seconds (Site User-Given Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

**Timings based on settings in the Site Phasing & Timing dialog**
**Phase Times determined by the program**
**Phase Sequence: Variable Phasing**
**Reference Phase: Phase A**
**Input Phase Sequence: A, B, B1*, B2*, C, E, E1*, E2***
**Output Phase Sequence: A, B, C, E, E1***
(* Variable Phase)

## Site Layout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



| Vehicle Movement Performance | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] veh/h | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] m | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed km/h |
| SouthEast: Castle Street | | | | | | | | | | | | | | |
| 4 | L2 | 343 | 9 | 361 | 2.6 | * 0.542 | 34.0 | LOS C | 16.8 | 120.0 | 0.83 | 0.81 | 0.83 | 29.0 |
| 5 | T1 | 34 | 0 | 36 | 0.0 | 0.076 | 40.1 | LOS D | 1.7 | 12.1 | 0.80 | 0.60 | 0.80 | 9.5 |
| 6 | R2 | 26 | 0 | 27 | 0.0 | 0.326 | 73.4 | LOS E | 1.8 | 12.6 | 1.00 | 0.72 | 1.00 | 18.8 |
| Approach | | 403 | 9 | 424 | 2.2 | 0.542 | 37.1 | LOS D | 16.8 | 120.0 | 0.84 | 0.78 | 0.84 | 26.9 |
| NorthEast: Pennant Street | | | | | | | | | | | | | | |
| 7 | L2 | 147 | 1 | 155 | 0.7 | 0.845 | 49.4 | LOS D | 36.2 | 256.5 | 0.99 | 0.94 | 1.06 | 25.1 |
| 8 | T1 | 901 | 16 | 948 | 1.8 | * 0.845 | 44.1 | LOS D | 36.2 | 256.5 | 0.95 | 0.92 | 1.04 | 34.6 |
| 9 | R2 | 134 | 0 | 141 | 0.0 | 0.658 | 67.2 | LOS E | 8.9 | 62.4 | 1.00 | 0.82 | 1.04 | 19.7 |
| Approach | | 1182 | 17 | 1244 | 1.4 | 0.845 | 47.4 | LOS D | 36.2 | 256.5 | 0.96 | 0.91 | 1.04 | 31.9 |
| NorthWest: Castle Street | | | | | | | | | | | | | | |
| 10 | L2 | 218 | 0 | 229 | 0.0 | 0.381 | 34.7 | LOS C | 10.4 | 72.6 | 0.80 | 0.78 | 0.80 | 28.6 |
| 11 | T1 | 64 | 0 | 67 | 0.0 | 0.146 | 41.0 | LOS D | 3.3 | 23.3 | 0.82 | 0.64 | 0.82 | 9.3 |
| 12 | R2 | 71 | 0 | 75 | 0.0 | * 0.905 | 84.8 | LOS F | 5.5 | 38.5 | 1.00 | 0.99 | 1.55 | 16.8 |
| Approach | | 353 | 0 | 372 | 0.0 | 0.905 | 45.9 | LOS D | 10.4 | 72.6 | 0.85 | 0.79 | 0.96 | 22.6 |
| SouthWest: Pennant Street | | | | | | | | | | | | | | |
| 1 | L2 | 113 | 4 | 119 | 3.5 | 0.676 | 37.7 | LOS D | 26.1 | 186.8 | 0.88 | 0.80 | 0.88 | 20.4 |
| 2 | T1 | 848 | 21 | 893 | 2.5 | 0.676 | 32.4 | LOS C | 26.1 | 186.8 | 0.87 | 0.78 | 0.87 | 38.9 |
| 3 | R2 | 234 | 5 | 246 | 2.1 | * 0.875 | 74.4 | LOS E | 17.3 | 123.5 | 1.00 | 0.95 | 1.27 | 18.6 |
| Approach | | 1195 | 30 | 1258 | 2.5 | 0.875 | 41.2 | LOS D | 26.1 | 186.8 | 0.89 | 0.81 | 0.95 | 32.6 |
| All Vehicles | | 3133 | 56 | 3298 | 1.8 | 0.905 | 43.5 | LOS D | 36.2 | 256.5 | 0.91 | 0.84 | 0.97 | 30.8 |

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site 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.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

## Output Phase Sequence


REF: Reference Phase
VAR: Variable Phase


## Phase Timing Summary

| Phase | A | B | C | E | E1 |
|---|---|---|---|---|---|
| Phase Change Time (sec) | 0 | 54 | 66 | 104 | 125 |
| Green Time (sec) | 48 | 6 | 32 | 15 | *** |
| Phase Time (sec) | 54 | 12 | 38 | 21 | 5 |
| Phase Split | 42% | 9% | 29% | 16% | 4% |

See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

*** No green time has been calculated for this phase because the next phase starts during its intergreen time. This occurs with overlap phasing where there is no single movement connecting this phase to the next, or where the only such movement is a dummy movement with zero minimum green time specified. If a green time is required for this phase, specify a dummy movement with a non-zero minimum green time.

# USER REPORT FOR SITE

## All Movement Classes

**Project:** 220826_3493_castle_towers_sidra_double_diamond

**Template: Stantec Site (2)**

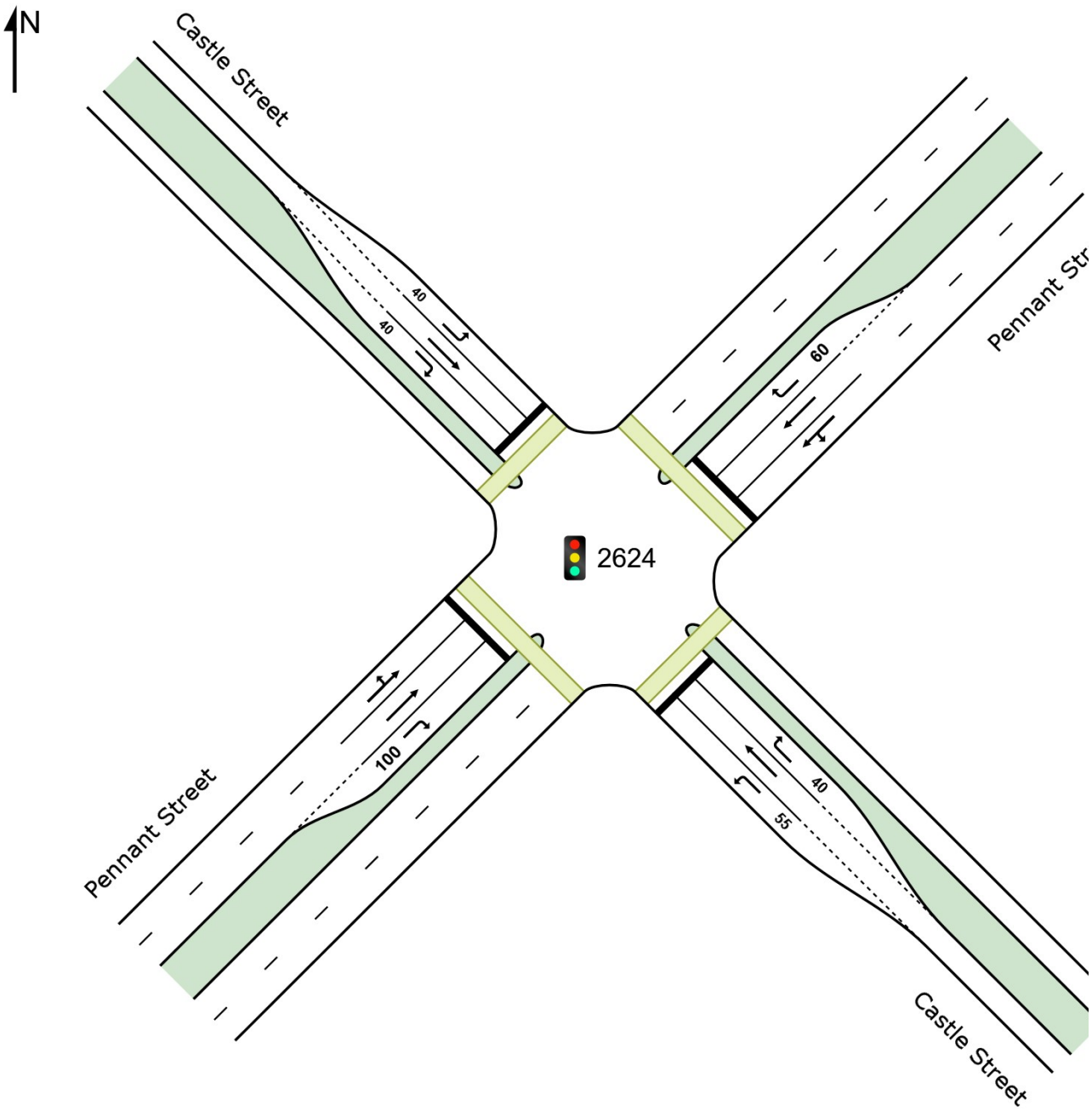
## Site: 2624 [Castle St & Pennant St - PM Peak (5pm-6pm) - Option 3B - 20% Growth + Site Vols - Double Diamond (Site Folder: For Report)]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated  Cycle Time = 130 seconds (Site User-Given Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

**Timings based on settings in the Site Phasing & Timing dialog**
**Phase Times determined by the program**
**Phase Sequence: Variable Phasing**
**Reference Phase: Phase A**
**Input Phase Sequence: A, B, B1*, B2*, C, E, E1*, E2***
**Output Phase Sequence: A, B, C, E, E1***
(* Variable Phase)

## Site Layout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



| Vehicle Movement Performance | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] veh/h | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] m | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed km/h |
| SouthEast: Castle Street | | | | | | | | | | | | | | |
| 4 | L2 | 343 | 9 | 361 | 2.6 | * 0.559 | 34.9 | LOS C | 17.0 | 121.8 | 0.84 | 0.81 | 0.84 | 28.7 |
| 5 | T1 | 64 | 0 | 67 | 0.0 | 0.148 | 41.8 | LOS D | 3.4 | 23.5 | 0.83 | 0.64 | 0.83 | 9.1 |
| 6 | R2 | 26 | 0 | 27 | 0.0 | 0.326 | 73.4 | LOS E | 1.8 | 12.6 | 1.00 | 0.72 | 1.00 | 18.8 |
| Approach | | 433 | 9 | 456 | 2.1 | 0.559 | 38.2 | LOS D | 17.0 | 121.8 | 0.85 | 0.78 | 0.85 | 25.7 |
| NorthEast: Pennant Street | | | | | | | | | | | | | | |
| 7 | L2 | 147 | 1 | 155 | 0.7 | 0.853 | 49.7 | LOS D | 37.7 | 267.0 | 0.99 | 0.95 | 1.07 | 25.0 |
| 8 | T1 | 901 | 16 | 948 | 1.8 | * 0.853 | 44.3 | LOS D | 37.7 | 267.0 | 0.94 | 0.92 | 1.04 | 34.5 |
| 9 | R2 | 193 | 0 | 203 | 0.0 | 0.748 | 66.2 | LOS E | 13.0 | 91.0 | 1.00 | 0.86 | 1.09 | 19.9 |
| Approach | | 1241 | 17 | 1306 | 1.4 | 0.853 | 48.3 | LOS D | 37.7 | 267.0 | 0.96 | 0.91 | 1.06 | 31.3 |
| NorthWest: Castle Street | | | | | | | | | | | | | | |
| 10 | L2 | 323 | 0 | 340 | 0.0 | 0.560 | 34.8 | LOS C | 16.0 | 111.9 | 0.84 | 0.80 | 0.84 | 28.6 |
| 11 | T1 | 101 | 0 | 106 | 0.0 | 0.237 | 42.9 | LOS D | 5.4 | 38.0 | 0.85 | 0.68 | 0.85 | 8.9 |
| 12 | R2 | 73 | 0 | 77 | 0.0 | * 0.930 | 88.3 | LOS F | 5.8 | 40.6 | 1.00 | 1.03 | 1.62 | 16.3 |
| Approach | | 497 | 0 | 523 | 0.0 | 0.930 | 44.3 | LOS D | 16.0 | 111.9 | 0.87 | 0.81 | 0.96 | 22.8 |
| SouthWest: Pennant Street | | | | | | | | | | | | | | |
| 1 | L2 | 116 | 4 | 122 | 3.4 | 0.727 | 40.6 | LOS D | 27.8 | 198.8 | 0.92 | 0.83 | 0.92 | 19.8 |
| 2 | T1 | 848 | 21 | 893 | 2.5 | 0.727 | 35.2 | LOS D | 27.8 | 198.8 | 0.90 | 0.80 | 0.90 | 37.8 |
| 3 | R2 | 234 | 5 | 246 | 2.1 | * 0.875 | 74.4 | LOS E | 17.3 | 123.5 | 1.00 | 0.95 | 1.27 | 18.6 |
| Approach | | 1198 | 30 | 1261 | 2.5 | 0.875 | 43.4 | LOS D | 27.8 | 198.8 | 0.92 | 0.84 | 0.97 | 31.8 |
| All Vehicles | | 3369 | 56 | 3546 | 1.7 | 0.930 | 44.7 | LOS D | 37.7 | 267.0 | 0.92 | 0.85 | 0.99 | 30.0 |

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site 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.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

## Output Phase Sequence


REF: Reference Phase
VAR: Variable Phase


## Phase Timing Summary

| Phase | A | B | C | E | E1 |
|---|---|---|---|---|---|
| Phase Change Time (sec) | 0 | 55 | 67 | 104 | 129 |
| Green Time (sec) | 49 | 6 | 31 | 19 | *** |
| Phase Time (sec) | 55 | 12 | 37 | 25 | 1 |
| Phase Split | 42% | 9% | 28% | 19% | 1% |

See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

*** No green time has been calculated for this phase because the next phase starts during its intergreen time. This occurs with overlap phasing where there is no single movement connecting this phase to the next, or where the only such movement is a dummy movement with zero minimum green time specified. If a green time is required for this phase, specify a dummy movement with a non-zero minimum green time.

# USER REPORT FOR SITE

## All Movement Classes

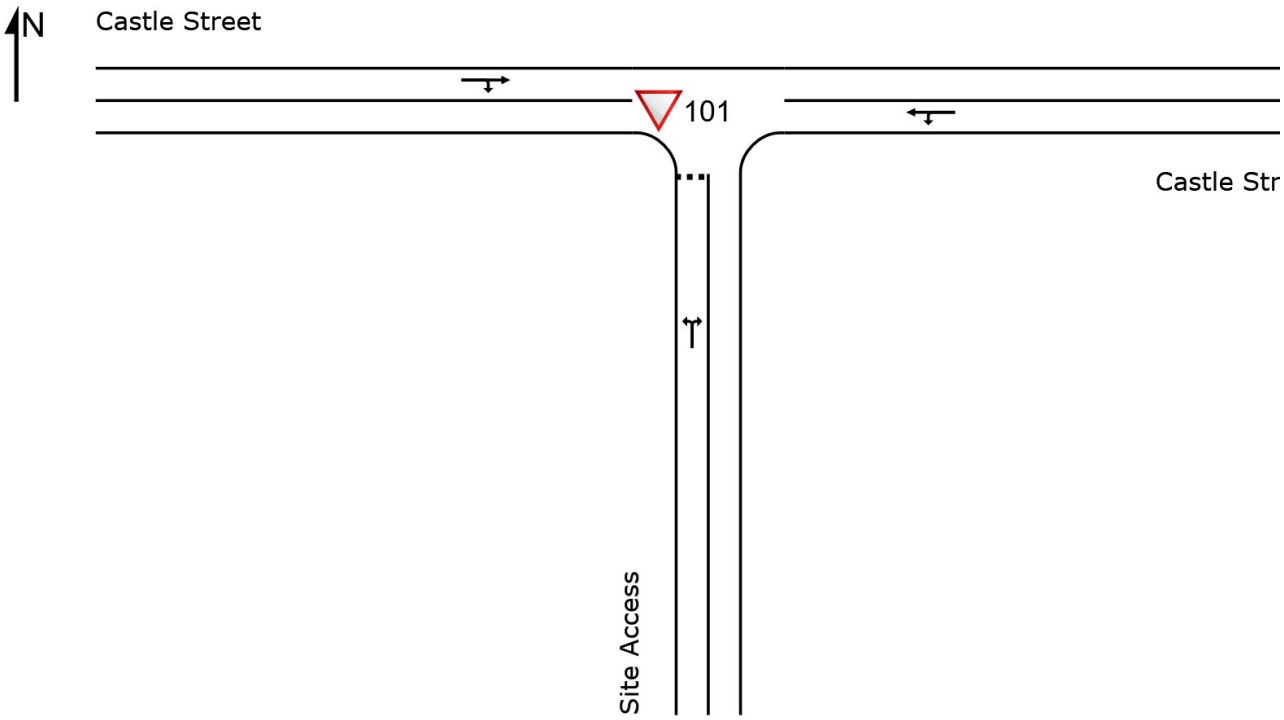
**Project: 220826_3493_castle_towers_sidra** **Template: Stantec Site (2)**

### Site: 101 [Castle Street / Site Access (Site Folder: Minor Intersections)]

New Site
Site Category: (None)
Give-Way (Two-Way)

## Site Layout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] veh/h | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] m | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| rojec | \\Co | gtadata | | sMelb\300 | | echn | odell ng\22031 | | DRA\220826_34 | | castle | owers_si | sip9 | |
| South: Site Access | | | | | | | | | | | | | | |
| 1 | L2 | 17 | 0 | 18 | 0.0 | 0.200 | 6.1 | LOS A | 0.7 | 5.0 | 0.52 | 0.78 | 0.52 | 46.5 |
| 3 | R2 | 112 | 0 | 118 | 0.0 | 0.200 | 8.9 | LOS A | 0.7 | 5.0 | 0.52 | 0.78 | 0.52 | 29.5 |
| Approach | | 129 | 0 | 136 | 0.0 | 0.200 | 8.5 | LOS A | 0.7 | 5.0 | 0.52 | 0.78 | 0.52 | 33.5 |
| East: Castle Street | | | | | | | | | | | | | | |
| 4 | L2 | 79 | 0 | 83 | 0.0 | 0.203 | 4.8 | LOS A | 0.0 | 0.0 | 0.00 | 0.15 | 0.00 | 41.8 |
| 5 | T1 | 290 | 4 | 305 | 1.4 | 0.203 | 0.2 | LOS A | 0.0 | 0.0 | 0.00 | 0.15 | 0.00 | 51.5 |
| Approach | | 369 | 4 | 388 | 1.1 | 0.203 | 1.2 | NA | 0.0 | 0.0 | 0.00 | 0.15 | 0.00 | 50.6 |
| West: Castle Street | | | | | | | | | | | | | | |
| 11 | T1 | 369 | 0 | 388 | 0.0 | 0.215 | 0.1 | LOS A | 0.2 | 1.6 | 0.06 | 0.03 | 0.06 | 50.0 |
| 12 | R2 | 18 | 0 | 19 | 0.0 | 0.215 | 7.2 | LOS A | 0.2 | 1.6 | 0.06 | 0.03 | 0.06 | 47.6 |
| Approach | | 387 | 0 | 407 | 0.0 | 0.215 | 0.5 | NA | 0.2 | 1.6 | 0.06 | 0.03 | 0.06 | 49.9 |
| All Vehicles | | 885 | 4 | 932 | 0.5 | 0.215 | 1.9 | NA | 0.7 | 5.0 | 0.10 | 0.19 | 0.10 | 48.6 |

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site 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.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# USER REPORT FOR SITE

## All Movement Classes

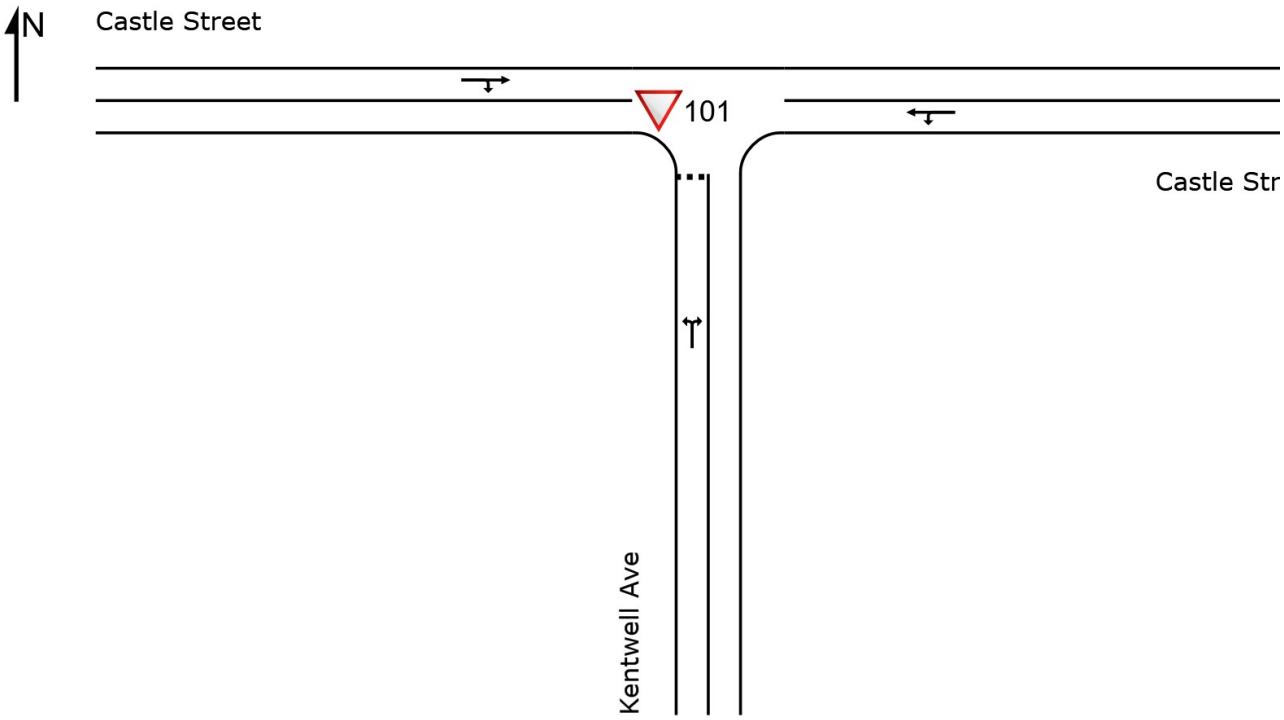
**Project: 220826_3493_castle_towers_sidra** **Template: Stantec Site (2)**

### Site: 101 [Castle Street / Kentwell Ave (Site Folder: Minor Intersections)]

New Site
Site Category: (None)
Give-Way (Two-Way)

## Site Layout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



## Vehicle Movement Performance

| Mov ID | Turn | INPUT VOLUMES [ Total veh/h | HV ] veh/h | DEMAND FLOWS [ Total veh/h | HV ] % | Deg. Satn v/c | Aver. Delay sec | Level of Service | 95% BACK OF QUEUE [ Veh. veh | Dist ] m | Prop. Que | Effective Stop Rate | Aver. No. Cycles | Aver. Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Kentwell Ave | | | | | | | | | | | | | | |
| 1 | L2 | 38 | 0 | 40 | 0.0 | 0.065 | 5.8 | LOS A | 0.2 | 1.7 | 0.39 | 0.61 | 0.39 | 45.9 |
| 3 | R2 | 21 | 0 | 22 | 0.0 | 0.065 | 7.5 | LOS A | 0.2 | 1.7 | 0.39 | 0.61 | 0.39 | 31.8 |
| Approach | | 59 | 0 | 62 | 0.0 | 0.065 | 6.4 | LOS A | 0.2 | 1.7 | 0.39 | 0.61 | 0.39 | 43.0 |
| East: Castle Street | | | | | | | | | | | | | | |
| 4 | L2 | 21 | 0 | 22 | 0.0 | 0.164 | 4.6 | LOS A | 0.0 | 0.0 | 0.00 | 0.04 | 0.00 | 43.4 |
| 5 | T1 | 280 | 4 | 295 | 1.4 | 0.164 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.04 | 0.00 | 50.3 |
| Approach | | 301 | 4 | 317 | 1.3 | 0.164 | 0.3 | NA | 0.0 | 0.0 | 0.00 | 0.04 | 0.00 | 50.1 |
| West: Castle Street | | | | | | | | | | | | | | |
| 11 | T1 | 370 | 0 | 389 | 0.0 | 0.212 | 0.1 | LOS A | 0.2 | 1.2 | 0.05 | 0.02 | 0.05 | 50.3 |
| 12 | R2 | 15 | 0 | 16 | 0.0 | 0.212 | 6.7 | LOS A | 0.2 | 1.2 | 0.05 | 0.02 | 0.05 | 47.8 |
| Approach | | 385 | 0 | 405 | 0.0 | 0.212 | 0.3 | NA | 0.2 | 1.2 | 0.05 | 0.02 | 0.05 | 50.2 |
| All Vehicles | | 745 | 4 | 784 | 0.5 | 0.212 | 0.8 | NA | 0.2 | 1.7 | 0.05 | 0.08 | 0.05 | 49.7 |

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site 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.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.