

Appendix I: Transport Impact Assessment

Byford Rail Extension

Armadale Station, Transport Impact Assessment



MetCONNX June 2023



UrbSol

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Summary

Introduction

Urbsol was commissioned by MetCONNX on behalf of the Public Transport Authority (PTA) to prepare a Transport Impact Assessment in support of the Development Application for the redevelopment of Armadale Station. The redevelopment of the station includes a reconfiguration of the Park N Ride, Kiss N Ride, bus interchange facilities as well as the access arrangement and cyclist/pedestrian path network.

This report has been prepared in accordance with the *Transport Impact Assessment Guidelines, Volume 4 – Individual Developments* (WAPC, August 2016). Although the likely level of additional traffic is likely to be minimal, given the scale of redevelopment proposed, the requirements of a Transport Impact Assessment are addressed in this report. This has been done to ensure that all transport modes and their respective networks are considered in sufficient detail.

This report builds upon previous planning phase investigations for the BRE project, both undertaken by WSP, including the *Future Year Traffic Impact Analysis, Armadale* (WSP, March 2022) and the *Armadale Station Access Strategy* (WSP, January 2021).

Existing Situation

The development site's current use is the Armadale Station, which is currently the last station on the Armadale Line of Perth's metropolitan rail network. Land uses immediately surrounding the station includes various retail (including Armadale Shopping City and Armadale Central Shopping Centre), various office and commercial, restaurants, residential, recreational uses, educational (including TAFE and Armadale Senior High School), etc.

In terms of amenity and accessibility, pedestrians and cyclists to/from Armadale Station are serviced primarily via the presence of shared paths along both Green and Commerce Avenues (essentially around the entire perimeter of the station precinct). The paths have varying degrees of quality, as well as crossing opportunities (of Commerce Avenue and Green Avenue) either side of the main station building.

Armadale Station as it stands is a major public transport interchange between rail and buses, serving not only Armadale but also the surrounding suburbs. It is also a stopping point along the regional Australind Line (Perth-Bunbury, operated by Transwa). In all, there are 11 bus routes in total originating/terminating exclusively at Armadale Station today, with 2 via Forrest Road and 9 via Fourth Road, both converging onto Commerce Avenue where the bus station is currently located.

The key roads in the network surrounding Armadale Station include Green Avenue and Commerce Avenue, which are the north-south running roads on each side of the station precinct, and Forrest Road-Third Road and Church Avenue which are the east-west running roads at each end of the precinct. The intersections of these roads at each corner of the station precinct are roundabouts, which allow for safe and efficient operations. All access points to/from the station are serviced from Commerce Avenue and Green Avenue.

Based on current traffic data, the following peak hours for analysis were identified as the critical peak periods:

- AM peak: 8:15-9:15
- PM peak: 16:15-17:15

During those periods current site trip generation includes:

- 144 trips during the existing AM network peak, consisting of:
 - 60 trips in and 34 trips out for regular traffic
 - 25 trips in and 25 trips out for buses
- 216 trips during the existing PM network peak, consisting of:
 - 52 trips in and 102 trips out for regular traffic
 - 31 trips in and 31 trips out for buses

Prior to any works commencing on site, the park and ride (PnR) facilities on Armadale Station catered for approximately 300 at-grade parking bays for Transperth patrons, Transwa patrons and authorised personnel/staff.

Network Modifications

Road Network

The most significant change to the adjacent road network is the grade separation of the rail line that will remove level crossings at both Forrest Road-Third Road and Church Avenue. These grade separations are expected to provide significant benefits in terms of both safety and operational efficiency of the road network in the vicinity.

At the opening stage, the proposed station layout intends to rationalise the existing number of access points (7 in total) to 3, including:

- One full movement access point on Green Avenue, at the Fifth Avenue roundabout.
- One full movement access point on Commerce Avenue, located at approximately the same location as the existing Eastern Carpark and bus ingress access point.
- One full movement access point for the bus interchange at the northern end of that facility.

This reduction in the total number of access points is expected to reduce crash risks by reducing the number of potential conflict points, whilst still accommodating traffic in and out of the station at an appropriate level of service. It will also be simpler for patrons with access to a single parking area, completely separate from the bus interchange.

Pedestrian and Cyclist Networks

The elevated rail provides important opportunities to improve the pedestrian linkages in the centre of Armadale by grade separating the existing crossings at Forrest Road-Third Road and at Church Avenue. The limitations of existing rail crossings are removed and replaced by uninterrupted pedestrian connections. The east-west linkages at these locations and through through the station precinct better integrates the eastern and western parts of the precinct, and will directly service the projected increase in residential development to the west of the station.

The project also includes the continuation of the PSP to Byford.

Additional connections north of Forrest Road will further improve the pedestrian permeability around the City Centre. A new parkland around and underneath the elevated rail continues the green open space network north of the City Centre all the way to the train station.

Public Transport Network

The bus routes in place to service the locality are proposed to remain as is, modified slightly as a result of a relocation of the existing bus interchange facilities to the northern end of the station. It is anticipated that new/additional Transperth bus routes will be implemented as required to service the new growth areas surrounding Armadale Station, as outlined within Transperth's Service Development Plan.

Traffic Generation

Future trip generation at the station was based on surveyed existing site generation, factored up in accordance with patronage growth projections. The following statements outline the additional private vehicle traffic established for the traffic assessment:

- Compared to 2022, in the 2026 AM peak, an additional **1 PnR trip** is expected, along with an additional **1 inbound and 1 outbound KnR trip**
- Compared to 2022, in the 2026 PM peak, an additional **2 PnR trips** are expected, along with an additional **2 inbound and 2 outbound KnR trips**
- Compared to 2022, in the 2036 AM peak, an additional **17 PnR trips** are expected, along with an additional **22 inbound and 22 outbound KnR trips**
- Compared to 2022, in the 2036 PM peak, an additional **33 PnR trips** are expected, along with an additional **34 inbound and 34 outbound KnR trips**

Factoring up existing traffic entering and exiting the Armadale Station in alignment with the patronage growth projections assumes the same mode share in the future as existing situation. Considering target mode share targets, this approach to the traffic generation would represent a highly conservative approach to the traffic assessment as they would indicate that fewer patrons are expected to use private vehicles to access/leave the station in 2041 compared to 2022. There should therefore be a corresponding reduction in private vehicle trip generation at the station from current levels. Instead traffic has been forecast to grow for the traffic assessment.

In terms of traffic distribution, the traffic assessment undertaken accounted for:

- The rationalisation in total access points
- The relocation of the bus interchange access point
- The change in patterns as a result of the proposed KnR arrangement i.e. traffic that enters from Commerce Avenue is most likely to exit to Green Avenue, and vice versa.

Traffic Assessment

Operational assessments of the station access points were undertaken for the following scenarios:

- 2022 AM and PM peak, existing access arrangement
- 2022 AM and PM peak, project case access arrangement
- 2026 AM and PM peak, project case access arrangement - opening year assessment
- 2036 AM and PM peak, project case access arrangement - opening year + 10 year assessment.

For the 2022 assessment, the existing traffic generated at the station was redistributed in accordance with the likely patterns under the proposed access arrangement. The results of this assessment indicates that all access points are expected to operate satisfactorily using existing site traffic generation. This indicates that the rationalisation of the station access points and proposed arrangement is feasible and provide for suitable operational performance.

For the 2026 assessment, the traffic volumes used in the analysis account for the change in access arrangement, estimated growth in traffic generated at the station (albeit minimal compared to existing), and general traffic growth on the surrounding roads. The results of the assessment for 2026 indicates very similar operations to those reported for the 2022 analysis. All access points are expected to operate satisfactorily in the opening year with spare capacity.

Similarly to the 2026 assessment, the 2036 assessment accounted for the change in access arrangement, estimated growth in traffic generated at the station, and additional general traffic growth on the surrounding roads. The results of the assessment for 2036 indicates similar operations to those reported for the 2026 analysis. Even with the conservative assumptions around traffic growth for the station, all access points are expected to operate satisfactorily in this time horizon with spare capacity.

Conclusions

Key conclusions of the transport assessment are provided below:

- The grade separation of the rail line from the adjacent networks is expected to provide significant benefits in terms of both safety and operational efficiency of the road network in the vicinity of the station. In addition to the extension of the PSP to Byford, will create significant enhancements and opportunities for the pedestrian and cyclist networks.
- Consideration has been given to areas where potential difficulty in crossing roads or undesirable conflict has been identified, and appropriate treatments incorporated into the design.

- Public Transport access is largely unimpacted by the proposed redevelopment, apart from minor route alterations to the location of the proposed access point (to the bus interchange area) at the northern end of the site on Commerce Avenue
- The proposed station layout rationalises the number of existing access points (7) to 3. This reduction in the total number of access points is expected to reduce crash risks by reducing the number of potential conflict points, whilst still accommodating traffic in and out of the station at an appropriate level of service. It will also be simpler for patrons with access to a single parking area, completely separate from the bus interchange.
- Traffic generated at the station was estimated by factoring up existing traffic at the station in the same proportions as passenger growth projections. The result was minimal additional traffic generated at opening (2026), and approximately 60 trips (AM peak) and 100 trips (PM peak) additional trips in 2036 compared to 2022.
- The operational assessment undertaken indicated that the proposed access points are expected to operate well, with low degrees of saturation, minimal delays and minimal queueing. The 2026 and 2036 assessments indicated little change from the assessment that used 2022 traffic volumes. Due to the low traffic generated by the proposed redevelopment, it is not expected that the redevelopment will contribute to any operational issues at surrounding roads, nearby intersections, or neighbouring areas.

As a result of the assessment undertaken and with regard to the objectives of the TIA, it can be concluded that the proposed station redevelopment:

- and its associated proposals provides for safe and efficient access for all modes to the site
- is well-integrated with surrounding land uses
- does not adversely impact on the surrounding land uses
- does not adversely impact on the surrounding transport networks or its users

1 Introduction & Background

MetCONNX is responsible for the design, procurement, manufacture, construction, installation and commissioning of rail infrastructure and ancillary works to support an electrified operational passenger rail between Armadale and Byford, as part of the Byford Rail Extension (BRE) Design and Construction Project. A key component of these works is the delivery of two new train stations, namely the Armadale Station and the Byford Station.

Urbsol was commissioned by MetCONNX on behalf of the Public Transport Authority (PTA) to prepare Transport Impact Assessments (TIA's) in support of the Development Application (DA) for the each of the stations. The subject of this TIA is the redevelopment of the Armadale Station.

The redevelopment of the station includes a reconfiguration of the Park N Ride, Kiss N Ride, bus interchange facilities as well as the access arrangement and cyclist/pedestrian path network. The latest development plans are attached to this report in Appendix A.

This report has been prepared in accordance with the *Transport Impact Assessment Guidelines, Volume 4 – Individual Developments* (WAPC, August 2016). Although the likely level of additional traffic is likely to be minimal, given the scale of redevelopment proposed, the requirements of a Transport Impact Assessment are addressed in this report. This has been done to ensure that all transport modes and their respective networks are considered in sufficient detail. The TIA it has been structured in accordance with that reference document for ease of assessment. Accordingly, the objectives of this TIA are to demonstrate that the development will:

- Provide safe and efficient access for all modes to the individual site
- Be well-integrated with surrounding land uses
- Not adversely impact on the surrounding land uses
- Not adversely impact on the surrounding transport networks and the users of those networks

A copy of the Transport Impact Assessment Checklist has been included in Appendix B.

This report builds upon a previous planning phase investigations for the BRE project, both undertaken by WSP, including the *Future Year Traffic Impact Analysis, Armadale* (WSP, March 2022) and the *Armadale Station Access Strategy* (WSP, January 2021).

2 Existing Situation

2.1 Location

The City of Armadale, 28km south-east of Perth and covering an area of 560sqkm, is a multi-purpose centre that provides diverse economic and community services to the local population and those in the wider catchment area.

The area is known for its natural features – in particular its relationship to state forests, which rise into the Darling Scarp to the east, the City of Armadale is bordered by the City of Gosnells and Shire of Kalamunda to the north, the Shire of Beverley to the east, the Shires of Wandering and Serpentine-Jarrahdale to the south and the City of Cockburn to the west.

The City's population is approximately 91,000, with this number forecast to grow to 141,000 by 2036. This growing community will benefit from a station precinct that complements the existing Strategic Metropolitan Centre's activities and provides an attractive, safe and lively public transport hub as an integrated, welcoming heart of Armadale.



Figure 1 Location plan

2.2 Land Uses

The development site's current use is the Armadale Station, which is currently the last station on the Armadale Line of Perth's metropolitan rail network. Land uses immediately surrounding the station includes various retail (including Armadale Shopping City and Armadale Central Shopping Centre), various office and commercial, restaurants, residential, recreational uses, educational (including TAFE and Armadale Senior High School), etc.

The current zoning of land uses around the Armadale Station Precinct (refer Figure 2) indicates the potential to be a major urban centre with a range of land uses including residential, commercial, retail, community, cultural and civic. It serves a broad and diverse catchment and acts as a hub for the surrounding community.

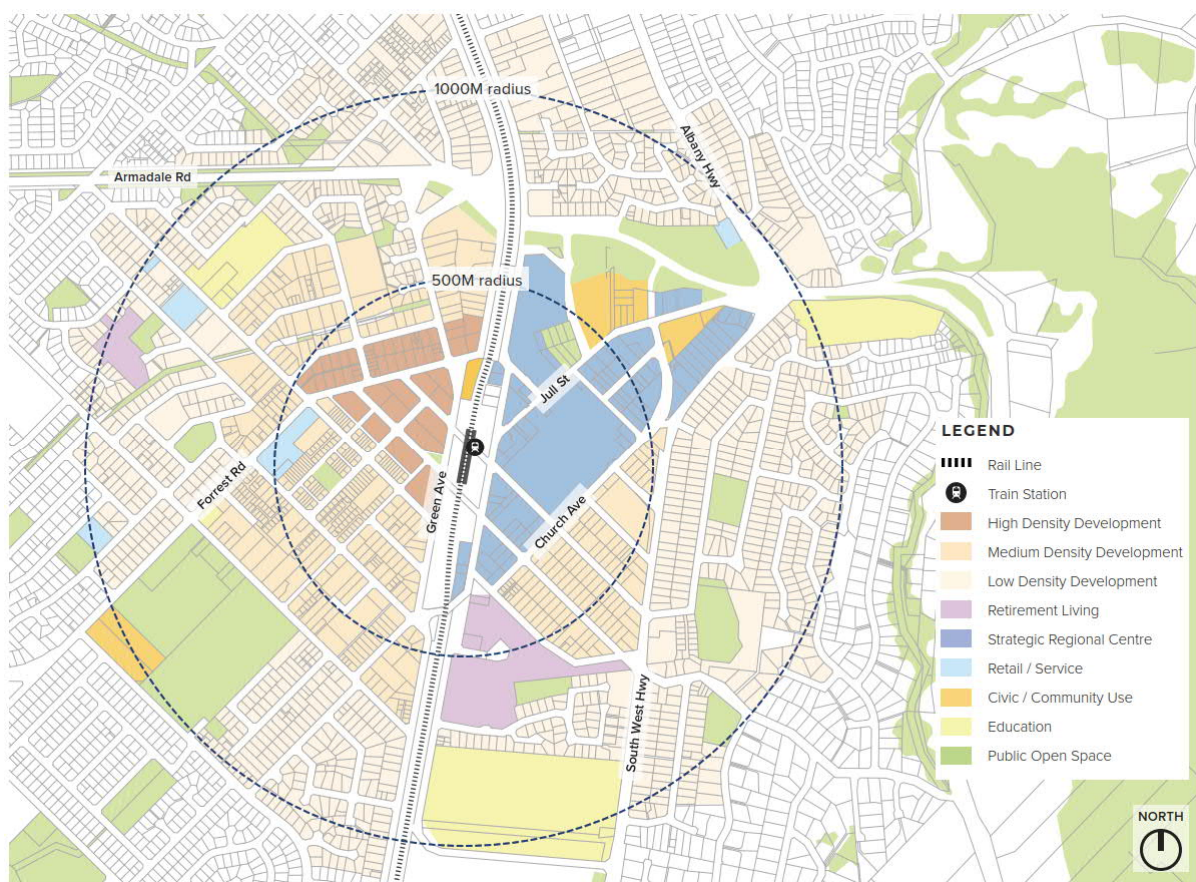


Figure 2 Land use

The medium to high density residential zoning around the station precinct promotes an increasing community of people living in the area.

The zoning also enables greater growth in non-residential floorspace and opportunities for employment, particularly at ground levels.

2.3 Road Network

Referring to Figure 3 and Figure 4, the key roads in the road network surrounding Armadale Station include the following:

- Green Avenue: aligned parallel and west of the railway line, single carriageway, 50 km/h posted speed limit and classified as a “Distributor B” within the MRWA Road Hierarchy. Transitions into Abbey Road north of the station complex, which also connects to Armadale Road as a four-way signalised intersection.
- Commerce Avenue: aligned parallel and east of the railway line, single carriageway, designated a 40 km/h area and classified as an “Access Road” within the MRWA Road Hierarchy.
- Forrest Road: an east-west link that intersects the two aforementioned roads as well as the existing Armadale railway line (at-grade boom gates), single carriageway, mainly 60 km/h posted speed limit and classified as both “Distributor B” and “Local Distributor” within the MRWA Road Hierarchy, depending on location.
- Church Avenue: a somewhat east-west link that also intersects the two aforementioned roads as well as the existing Armadale railway line (at-grade boom gates), single carriageway, 50 km/h posted speed limit and classified as a “Distributor B” within the MRWA Road Hierarchy. Also connects to Armadale Road a three-way priority intersection.



Figure 3 Key road links around Armadale Station, on aerial map view

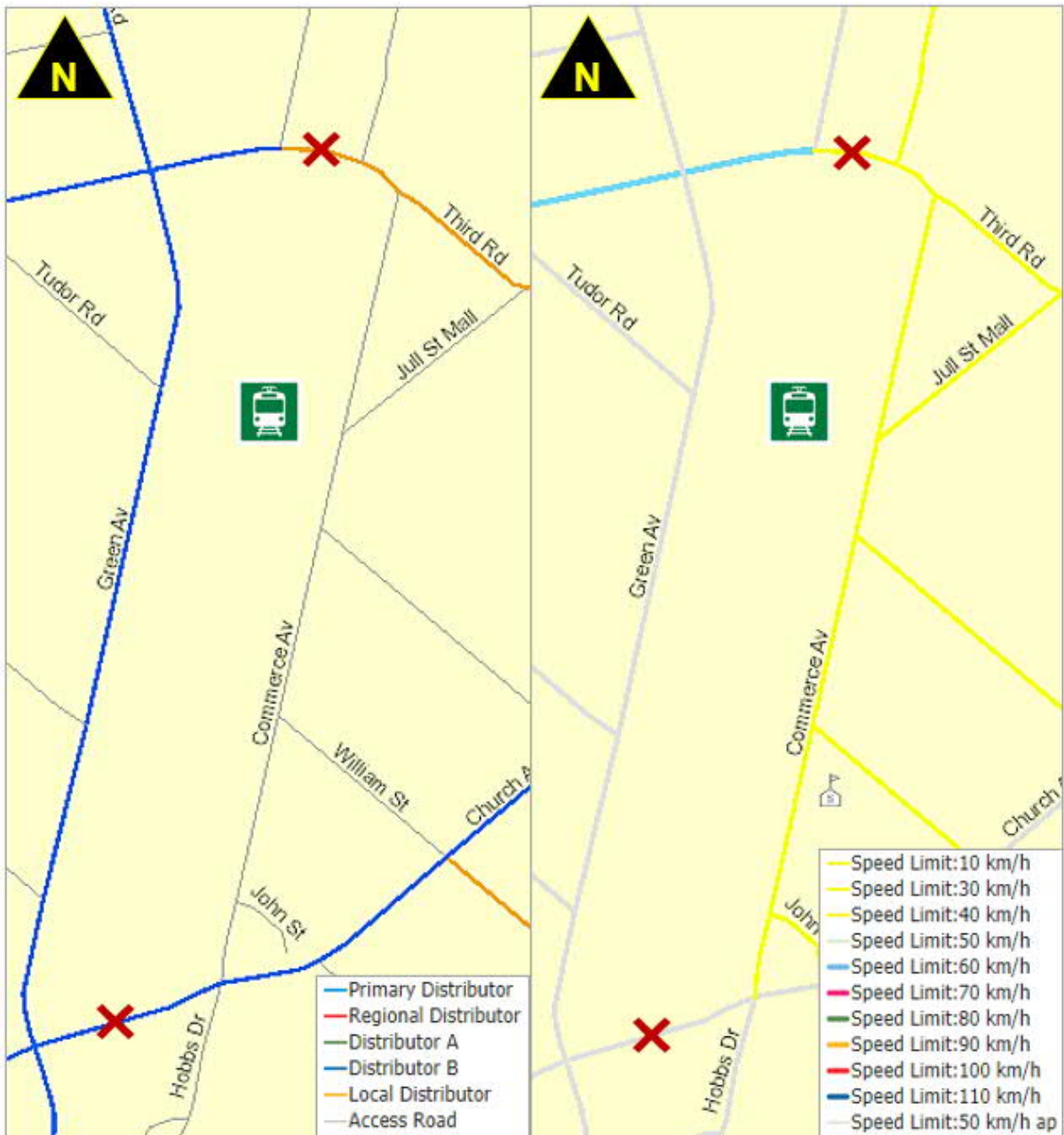


Figure 4 Road Hierarchy and posted speed limits (MRWA, Road Information Mapping)

In terms of the MRWA Road Hierarchy, “Distributor B” are locally governed roads with reduced capacity due to flow restrictions caused by frequent property accesses and roadside parking. “Local Distributors” have similar functions that also discourages through as well as heavy vehicle traffic. “Access Roads” are similar again but emphasising on higher priority for pedestrians and cyclists over vehicle movement function. It should be noted that the roads listed in this particular area are under the responsibility of both the Western Australian Planning Commission (WAPC) and City of Armadale.

2.4 Parking and Access

Prior to any works commencing on site, the park and ride (PnR) facilities on Armadale Station catered for approximately 300 at-grade parking bays for Transperth patrons, Transwa patrons and authorised personnel/staff. Included in that number are:

- 15 short term bays (including 1 short term ACROD bay)
- 7 other ACROD bays
- 15 motorcycle bays (approx.)
- 32 secure PTA bays
- 5 other PTA authorised personnel bays

Parking is split across three main areas:

- Western car park: accessible via 3 access points on Green Avenue between Fifth Road and Tudor Road
- Eastern car park: accessible via 1 access point on Commerce Avenue between William Street and Fourth Road
- Northern car park: accessible via 1 access point on Commerce Avenue between Jull Street mall and Third Road; informal/overflow car park. Based on site observations, significantly higher supply could be accommodated within this area.

Figure 5 visually shows the location of these PnR facilities. These are supported by station access maps available on the Transperth website, included in Figure 6 and Figure 7. These are the latest available station access maps, which show the closure of the northern carpark.

In terms of parking demand, this was checked regularly during the months of January and February 2023, where total parked vehicle counts were recorded at 10.00am and 3.00pm. Over a total of 25 days, the average parking demand was found to be approximately 88 vehicles, with a recorded maximum demand of 119 vehicles. This demand is low relative to the available supply.



Figure 5 Park and ride (PnR) facilities on Armadale Station

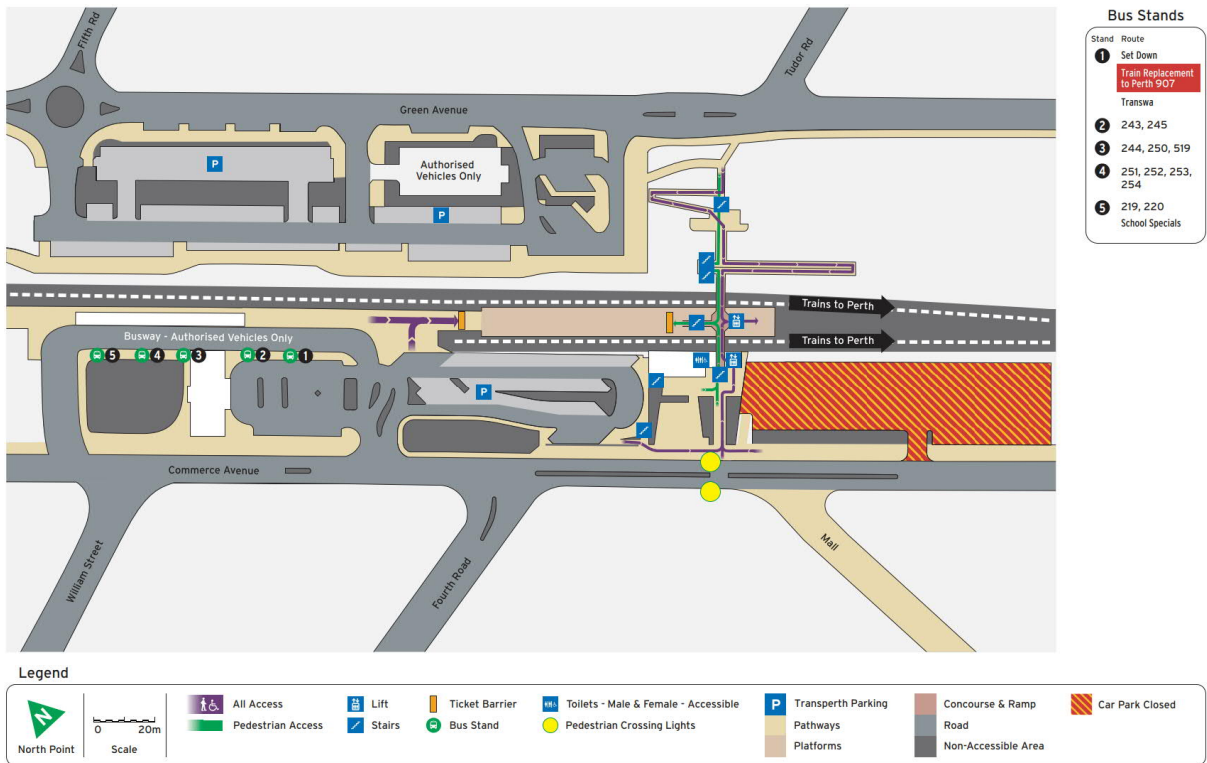


Figure 6 Armadale Station access map (PTA)

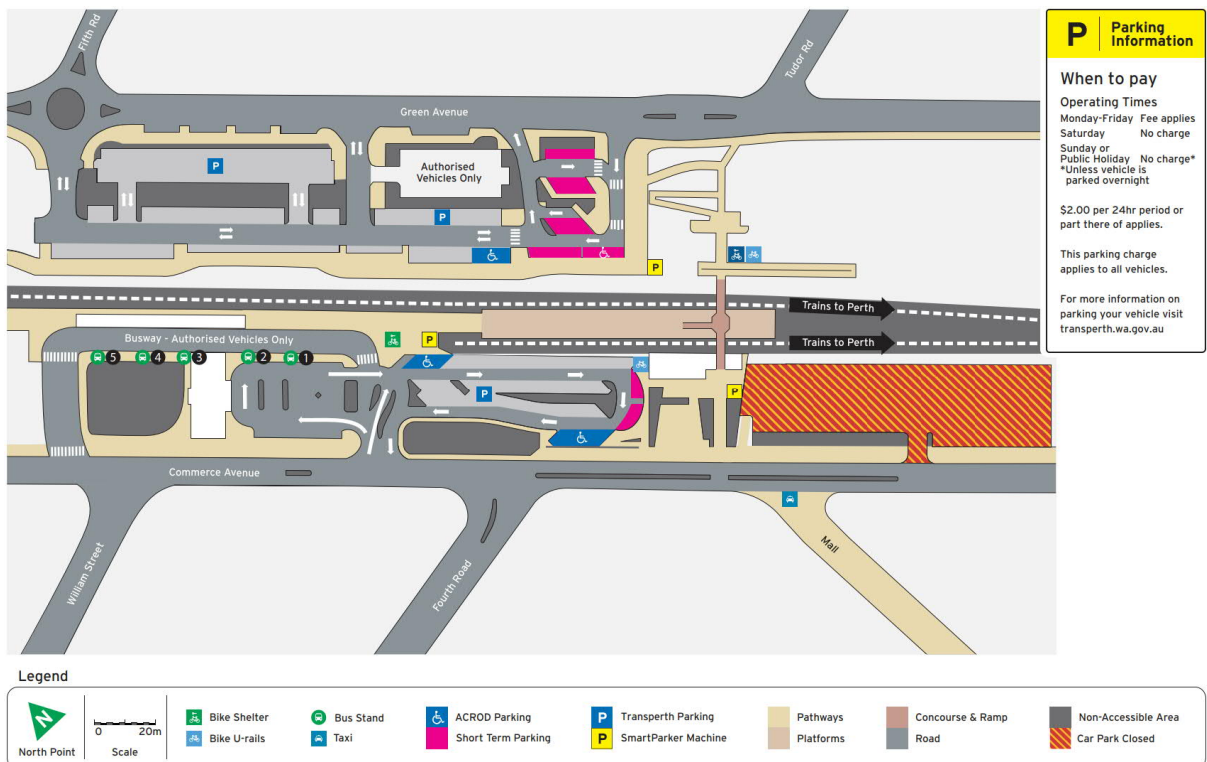


Figure 7 Armadale Station parking map (PTA)

2.5 Traffic Flows

In order to establish total trip generation for the existing station, as well as traffic volumes on key sections of the adjacent road network, traffic surveys were undertaken by Surveytech in June 2022. Figure 8 shows the locations at which traffic survey were undertaken. The surveys cover all station access points and relevant intersections so that total traffic can be established at the north and south ends of Commerce Avenue and Green Avenue, as well as total traffic in and out of the station.



Figure 8 Traffic survey locations (with ID numbers in red)

2.5.1 Site Generation

Table 1 summarises the traffic survey locations and their associated individual peak hour periods; Figure 9 shows the hourly volume profile for all the surveyed sites (with the sites along Green Avenue and Commerce Avenue coloured in blue and green, respectively; the dashed lines indicate those related to the car parks).

ID	Site Name	AM Peak Hour	PM Peak Hour
1	Green Avenue/Tudor Road	8:00-9:00	14:45-15:45
2	Green Avenue/Western Car Park North Entry	8:00-9:00	14:45-15:45
3	Green Avenue/Western Car Park North Exit	8:00-9:00	14:45-15:45
4	Green Avenue/Western Car Park Central Access	8:00-9:00	14:45-15:45
5	Green Avenue/Western Car Park South Access	8:00-9:00	14:45-15:45
6	Commerce Avenue/Northern Car Park Access	11:45-12:45	16:15-17:15
7	Commerce Avenue/Fourth Road	11:45-12:45	16:15-17:15
8	Commerce Avenue/Southern Car Park Access/Bus Entry	8:15-9:15	16:15-17:15
9	Commerce Avenue/William Street/Bus Exit	8:15-9:15	16:15-17:15

Table 1 Existing survey peak hour times for all individual sites

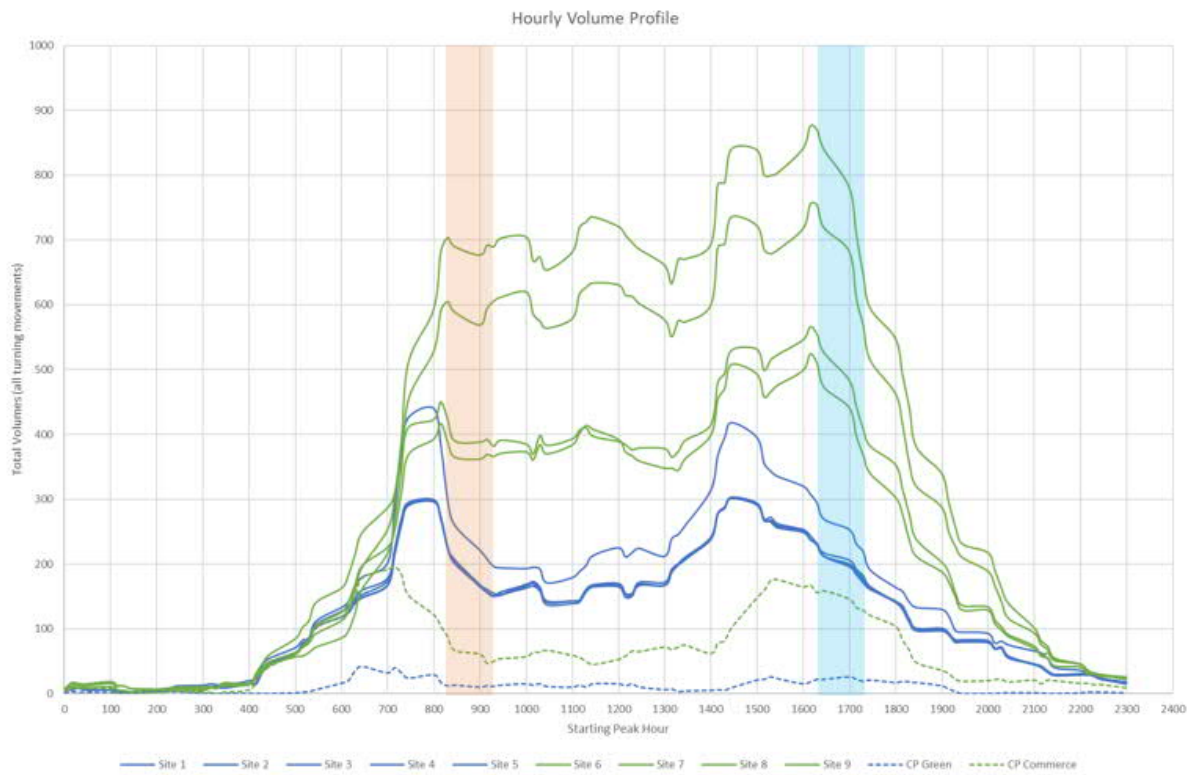


Figure 9 Hourly volume profile for all sites

It can be seen that there is some variability in the peak hour periods and is particularly distinguishable between the western (Green Avenue) and eastern (Commerce Avenue) sides of the railway. It should be emphasised, however, that these peak hours are typically determined by summing all turning movements in each site.

In comparison to WSP's *Armadaile Rail Extension, SIDRA Base Model Calibration and Validation Report* (WSP, December 2021), the peak hour periods observed in 2021 across a wider study area surrounding Armadale Station (covering several sites along Armadale Road, South Western Hwy, Church Avenue and Forrest Road) ranged from 8:00am to as late as 12:45 for the AM peak, and likewise 14:15 to 17:30 for the PM peak, are not that different to the recent 2022 surveys covered in this report.

The term 'peaking' can depend on the perspective of accounting every single movement, or the through movements along the main distributor, or the in- and outbound movements associated with the car parks. Thus, the objective of determining a pair of representative peak hour periods can be ambiguous depending on those aforementioned perspectives.

In the context for this TIA, it is most critical to assess the combined network/station peak rather than the station peak. As such the following representative peak hour periods were chosen (as shaded in orange and blue in the previous figure):

- AM peak: 8:15-9:15
- PM peak: 16:15-17:15

And were chosen based on the following points:

- The total traffic volumes accounting for all turning movements on the two sites with 11:45 as their individual AM peak hour on Commerce Avenue (sites 6 and 7) were found to be associated with commercial/through route demands more than the car parks themselves, which occur much earlier in the morning. Accounting for this and to ensure consistency with the other Commerce Avenue sites (8 and 9), 8:15 was chosen as the representative AM peak.
- Commerce Avenue generally consists of higher traffic volumes than Green Avenue and thus was weighted more in terms of the area's representation – thus 16:15 was chosen as the representative PM peak. It may be likely that other local factors contribute to an earlier peak on Green Avenue e.g. school activity.

WSP's *Byford Rail Extension Planning, Armadale Station Access Strategy* report (WSP, January 2021) showed the 2017 average hourly boarding demand profile for Transperth's Armadale Line (refer Figure 10) and was found to generally match the latest video surveys as far as the car park related traffic is concerned. The chosen peak hour periods for this TIA are shown in the orange and blue boxes are also superimposed, for context and comparison.

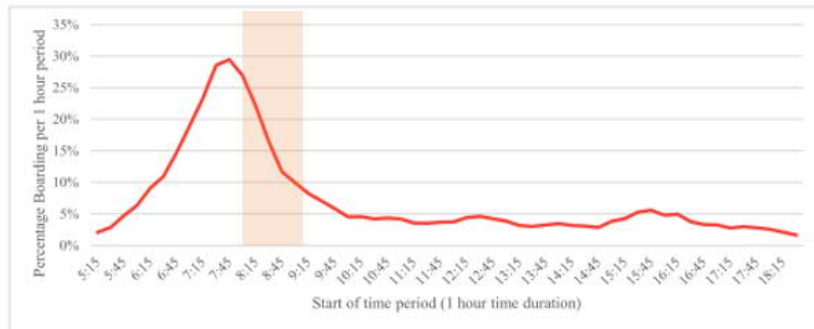


Figure 3.1 Boardings at Armadale Station (PTA March 2017)

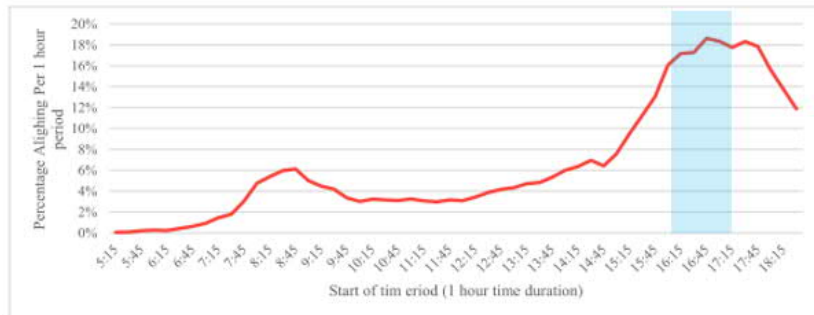


Figure 3.2 Alightings at Armadale Station (PTA March 2017)

Figure 10 2017 hourly boarding profile at Armadale Station (Credit: PTA/WSP)

Table 2 provides a summary of total trip generation for the station for the AM and PM peak network periods. For comparison and completeness, the AM and PM station peak trip generation is also provided.

For the purpose of this estimation it was assumed that any surveyed outbound trip in the AM peak was for Kiss N Ride (KnR) purposes and also entailed an inbound trip, with the balance relating to Park N Ride (PnR) purposes. Similarly for any inbound trip during the PM peak, it was assumed to be a KnR trip which also entailed an outbound trip.

It can be seen that most of the traffic to/from the station is via Commerce Avenue rather than Green Avenue. Interestingly this holds true for the KnR related traffic. Although most of the short term and KnR bays are located within the western carpark, over 80% of KnR traffic enters via Commerce Avenue, with the vast majority of those trips using the eastern carpark where there are only 2 short term/KnR bays located within the carpark.

Road	Car Park	AM Network Peak (8:15-9:15)								
		PnR			KnR			Bus		
		In	Out	Total	In	Out	Total	In	Out	Total
Green Ave	Western	3		3	6	6	12			
Commerce Ave	Northern	21		21	6	6	12			
	Eastern	2		2	22	22	44	25	25	50
Road	Car Park	AM Station Peak (7:15-8:15)								
		PnR			KnR			Bus		
		In	Out	Total	In	Out	Total	In	Out	Total
Green Ave	Western	18		18	11	11	22			
Commerce Ave	Northern	30		30	4	4	8			
	Eastern	4		4	61	61	122	32	32	64
Road	Car Park	PM Network Peak (16:15-17:15)								
		PnR			KnR			Bus		
		In	Out	Total	In	Out	Total	In	Out	Total
Green Ave	Western		5	5	6	6	12			
Commerce Ave	Northern		15	15	6	6	12			
	Eastern		30	30	40	40	80	31	31	62
Road	Car Park	PM Station Peak (15:30-16:30)								
		PnR			KnR			Bus		
		In	Out	Total	In	Out	Total	In	Out	Total
Green Ave	Western		2	2	12	12	24			
Commerce Ave	Northern		8	8	9	9	18			
	Eastern		24	24	47	47	94	31	31	62

Table 2 Station traffic generation for station and network peak periods

To summarise the existing trip generation:

- Traffic generated during the existing AM network peak is approximately 144 trips, consisting of:
 - 60 trips in and 34 trips out for regular traffic
 - 25 trips in and 25 trips out for buses
- Traffic generated during the existing PM network peak is approximately 216 trips, consisting of:
 - 52 trips in and 102 trips out for regular traffic
 - 31 trips in and 31 trips out for buses
- In addition to that data, traffic generated over an entire day is approximately 2,366 trips, consisting of:
 - 850 trips in and 850 trips out for regular traffic
 - 333 trips in and 333 trips out for buses

2.5.2 Network Traffic Flows

Figure 11 and Figure 12 summarise the peak hour period traffic volumes across the nine sites.

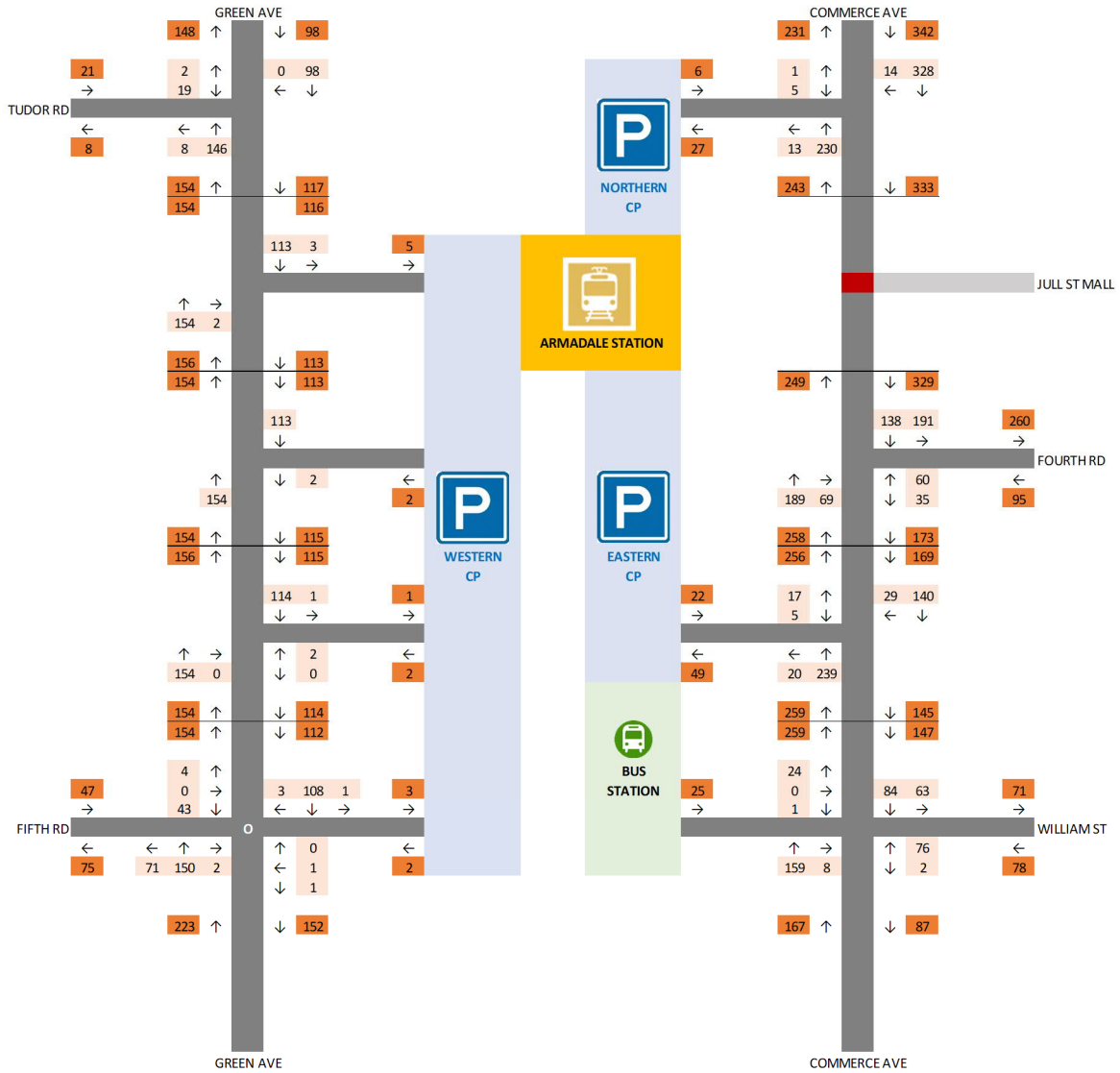


Figure 11 2022 AM peak hour network traffic flows (8.15-9.15am, June 2022)

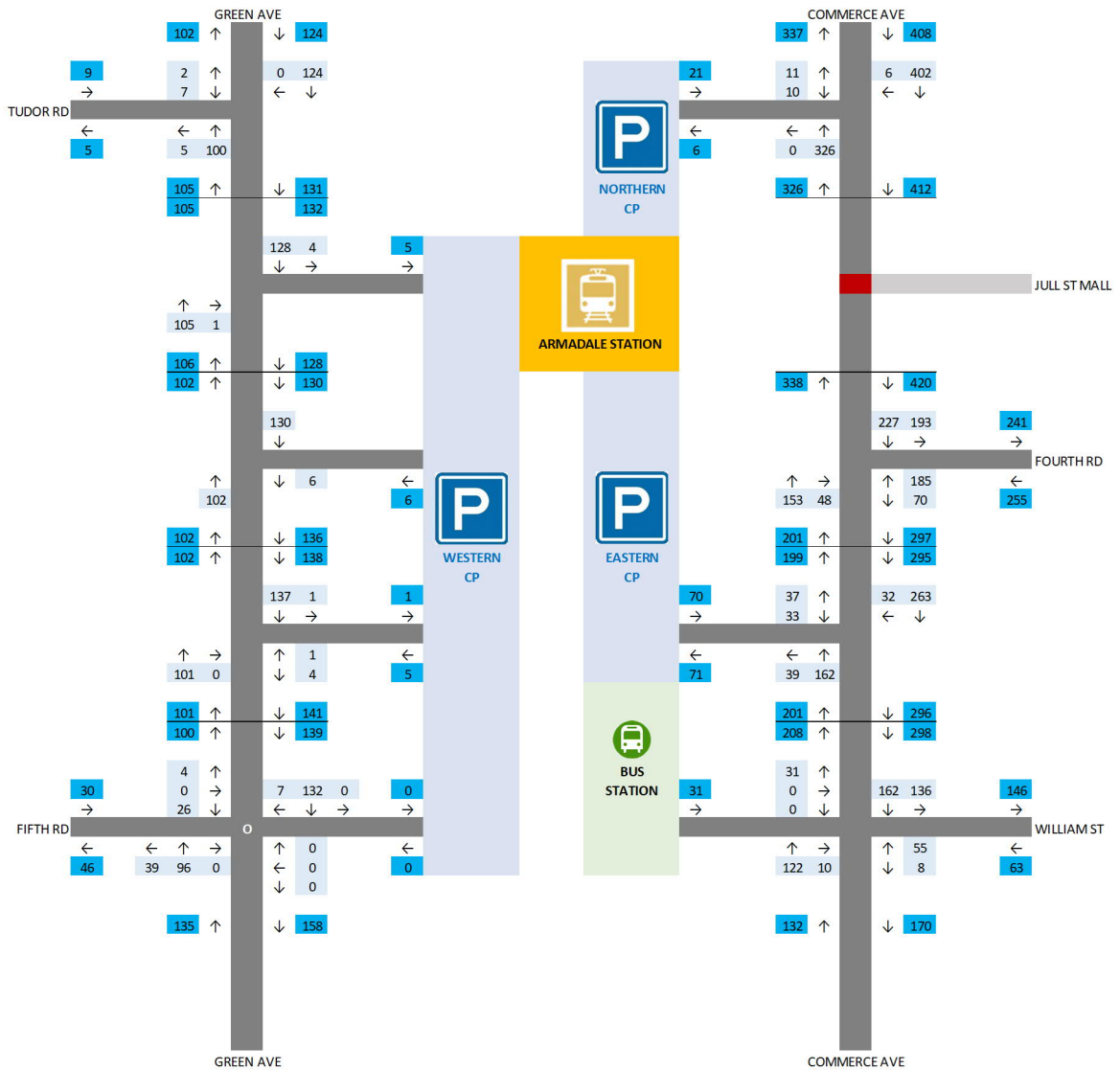


Figure 12 2022 PM peak hour network traffic flows (4.15-5.15pm, June 2022)

It should be noted that the inbound traffic volume on Commerce Avenue/Southern Car Park Access includes a fair percentage of buses as well, accounting for nearly 60% of the demand. This access also serves the eastern car park's KnR facility.

2.6 Pedestrian and Cyclist Access

In terms of amenity and accessibility, pedestrian and cyclists to/from Armadale Station are serviced primarily via the presence of shared paths along both Green and Commerce Avenues (essentially around the entire perimeter of the station precinct). The paths have varying degrees of quality, as well as crossing opportunities (of Commerce Avenue and Green Avenue) either side of the main station building. Figure 13 shows the general state of existing paths to and from Armadale Station, on Green and Commerce Avenues as well as one particular at-grade gated crossing just south of the station (near Fifth Road).



Figure 13 General pedestrian and cyclist accessibility along Green Ave (top), Commerce Ave (middle) and the gated crossing south of Armadale Station (bottom) (PTA)

Figure 14 shows the pelican (pedestrian light controlled) crossing intersecting Commerce Avenue and the Jull Street pedestrian mall, which provides direct access between Armadale Station and the adjacent town centre precinct. The traffic control signals and raised pavement type ensures safety as well as priority to pedestrians and cyclists between these two areas.



Figure 14 Commerce Avenue/Jull Street mall pelican crossing (Google Maps)

The Armadale Station itself consists of a grade-separated covered footbridge that forms as the station's mezzanine/unpaid area, which can be used by both Transperth patrons as well as the general public in order to cross from one side of the railway to the other. This station complex is also considered as DDA compliant, with elevators and ramps between the platforms, concourse and ground level on both Green and Commerce Avenues.

Figure 15 visually shows the extent of bike path provision surrounding Armadale Station – it can be seen that roads like Green and Commerce Avenue currently consist of a good overall cycling environment, with end-of-trip facilities at Armadale Station. Commerce Avenue currently also functions as the origin/terminus of the Perth Bicycle Network SW 18 route, which travels as far as Rowley Road.

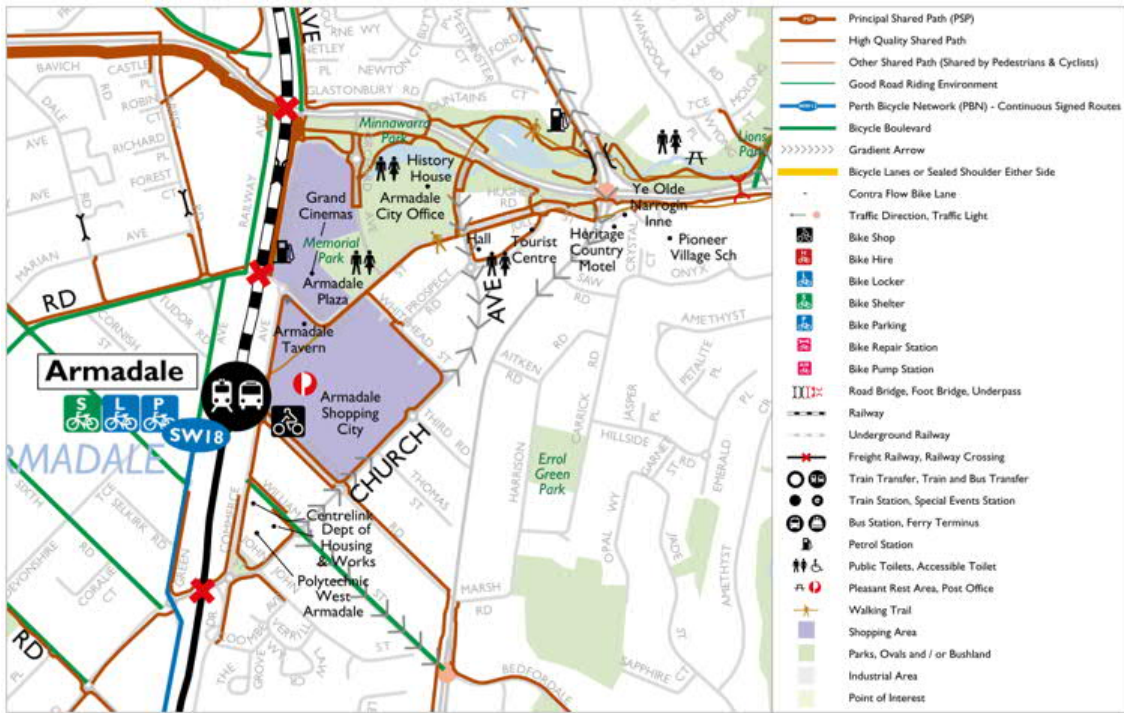


Figure 15 Comprehensive bike map surrounding Armadale Station (DoT)

2.7 Public Transport Provisions

Figure 16 shows the location of Armadale Station in relation to the Armadale railway line, located within Transperth's Zone 4 fare system as well as approximately being 35 kilometres from Perth Station. In terms of average weekday day-/night-time travel time, it is approximately between 35 to 40 minutes of travel respectively, to and from Perth Station, based on the C stopping pattern (express service between Cannington and Claisebrook, stopping at Oats Street). Trains currently run as low as five-minute headways during peak periods (approximately 10 trains per hour).



Figure 16 Armadale Station location in relation to Armadale and Australind Lines (PTA/Transwa)

Armadale Station as it stands is a major public transport interchange between rail and buses, serving not only Armadale but also the surrounding suburbs. It is also a stopping point along the regional Australind Line (Perth-Bunbury, operated by Transwa).

Figure 17 shows the current Transperth bus routes operating to and from Armadale Station. Note that the 519 bus route along Armadale Road currently travels to and from Murdoch Station/Fiona Stanley Hospital, via Nicholson Road and South Street. In all, there are 11 bus routes in total originating/terminating exclusively at Armadale Station today, with 2 via Forrest Road and 9 via Fourth Road, both converging onto Commerce Avenue where the bus station is currently located.

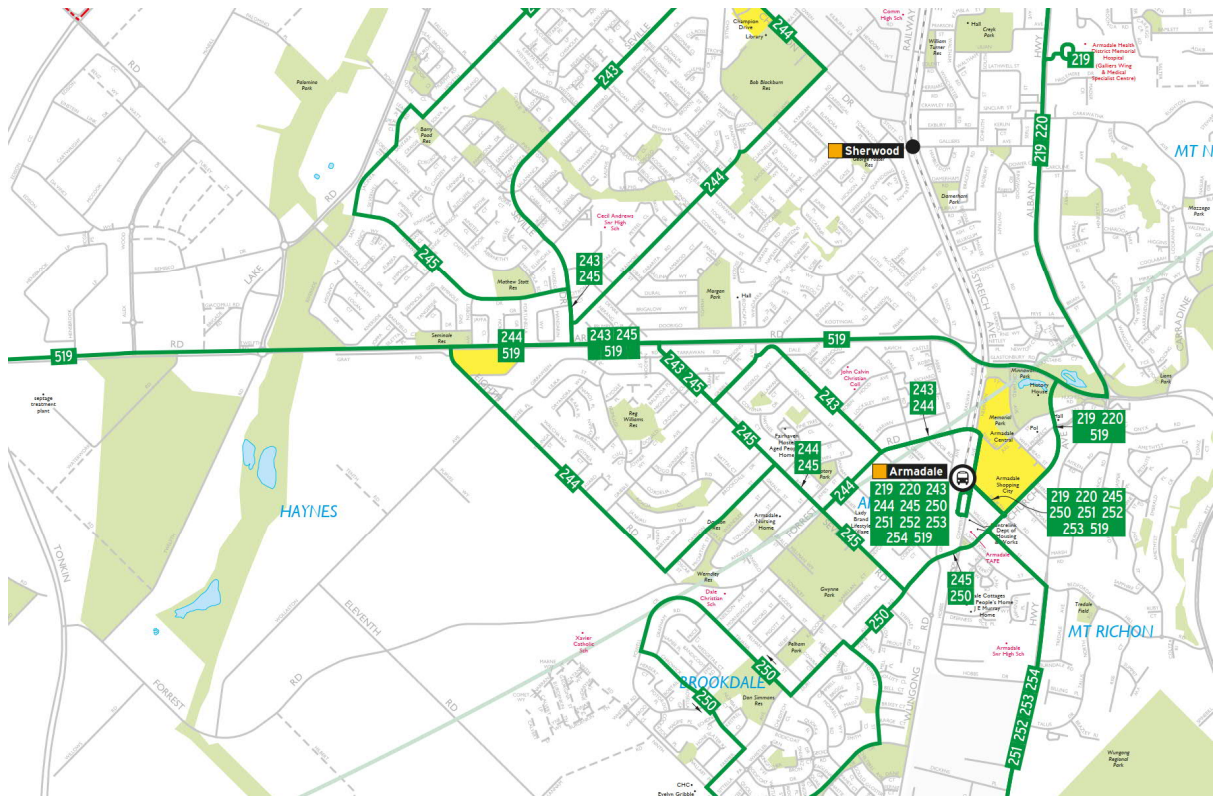


Figure 17 Bus routes to and from Armadale Station

2.8 Crash Data

Figure 18 shows the crash data summary obtained from Main Roads' Reporting Centre, focusing on Green and Commerce Avenues sections directly surrounding Armadale Station. This crash data covers a period of five years, between the start of 2017 and end of 2021.

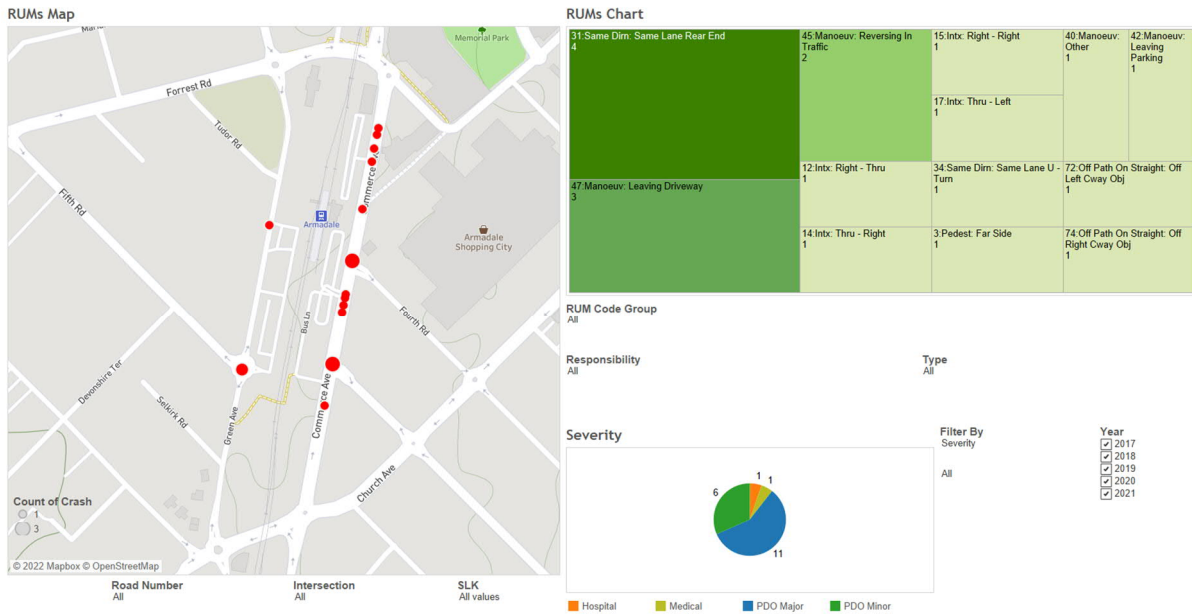


Figure 18 Crash data summary

There have been about 19 crashes for these defined road links, with 3 on Green Avenue and 16 on Commerce Avenue. Out of the total amount and in terms of Severity, 11 was classified as “PDO Major”, 6 as “PDO Minor”, 1 as “Medical” and 1 as “Hospital”. None of these crashes were classified as fatal.

The figure also shows a RUMs chart that indicates the type of crash: the majority of them was related to rear ends, with others relating to driveway-related accidents and reversing in traffic manoeuvres.

3 Development Proposal

MetCONNX is responsible for the design, procurement, manufacture, construction, installation and commissioning of rail infrastructure and ancillary works to support an electrified operational passenger rail between Armadale and Byford, as part of the Byford Rail Extension (BRE) Design and Construction Project. A key component of these works is the delivery of two new train stations, namely the Armadale Station and the Byford Station.

The redevelopment of Armadale station includes grade separating the rail line from the adjacent road network, a reconfiguration of the Park N Ride, Kiss N Ride, bus interchange facilities as well as the access arrangement and cyclist/pedestrian path network. The latest development plans are attached to this report in Appendix A. An overall schematic is also shown in Figure 19.

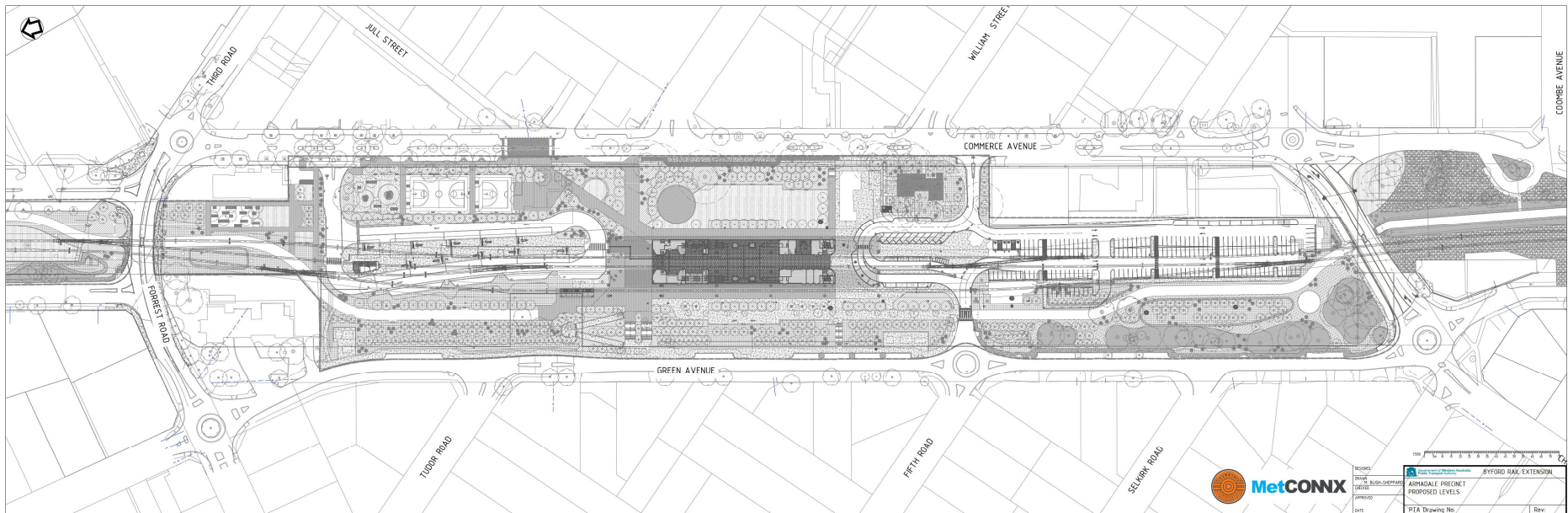


Figure 19 Proposed station layout

4 Changes to Surrounding Transport Networks

This section of the report discusses proposed modifications to the various transport networks and draws upon MetCONNx's *Armadale Station (Elevated) Final Place Plan* (MetCONNx, February 2023).

4.1 Road Network

The key road access routes to/from Armadale Station for private vehicles are outlined in Figure 20, which are the same as per the existing situation. In the vicinity of the Armadale Station however, the most significant change to the adjacent road network is the grade separation of the rail line that will remove level crossings at both Forrest Road and Church Avenue. These grade separations are expected to provide significant benefits in terms of both safety and operational efficiency of the road network in the vicinity.



Figure 20 Armadale Station – road network (MetCONNx)

From a safety perspective, the grade separation removes any potential conflict between trains and motorists. It also results in more consistent flow of traffic through the area i.e. less stop-start and potential for other crash types e.g. rear end.

From an operational perspective, the improved traffic flow along Forrest Road and Third Road reduces delay to motorists. It is acknowledged that during the design development phase, there was a concern raised relating to the potential for increased delays to side road traffic. However the through traffic volumes along Forrest Road and Church Avenue are not particularly high, and with the efficient flow along these roads, sufficient gaps in the traffic streams are expected that would allow side road traffic to manoeuvre safely and efficiently.

An assessment of the routes along both Forrest Road/Third Road and Church Avenue was undertaken by WSP and documented in the report *Byford Rail Extension, Future Year Traffic Impact Analysis, Armadale* (WSP, March 2022). The assessments were undertaken for the year 2036 and the results indicated that with the grade separation of the rail line, and with no changes to the existing layout of nearby intersections, the networks performed satisfactorily with all intersections operating with reasonable delays and queuing.

4.2 Intersection Layouts/Controls

As previously discussed (and refer Figure 5), the existing station is currently serviced by:

- 4 access/egress points on Green Avenue which service the Western Carpark, including:
 - one inbound only entry which predominantly services the short term area of the western carpark, but from which access to other areas of the carpark can be gained.
 - one outbound only exit which predominantly services the short term area of the western carpark, but can also be used by other areas of the carpark.
 - one full movement access point located centrally along the western carpark
 - one full movement access point (the eastern leg) at the Green Avenue/Fifth Avenue roundabout.
- 3 access/egress points on Commerce Avenue, which service the Eastern and Northern Carparks, including:
 - one full movement access point servicing the Northern Carpark
 - one full movement access point servicing the Eastern Carpark, which also provides inbound access for buses to the bus interchange area.
 - one outbound only exit which provides egress for buses from the bus interchange area.

At the opening stage, the proposed station layout intends to rationalise the number of access points to include:

- One full movement access point on Green Avenue, using the exiting eastern leg of the roundabout at Fifth Avenue. This access point would provide access to both the PnR and KnR areas.

- One full movement access point on Commerce Avenue, located at approximately the same location as the existing Eastern Carpark and bus ingress access point. This access point would provide access to both the PnR and KnR areas.
- One full movement access point for the bus interchange area located at the northern end of that facility.

The operations of the proposed access arrangement have been documented in Sections 9 and 10 of this report.

This reduction in the total number of access points is expected to reduce crash risks by reducing the number of potential conflict points, whilst still accommodating traffic in and out of the station at an appropriate level of service. It will also be simpler for patrons with access to a single parking area, completely separate from the bus interchange.

Other sections of roadway and intersections proposed to be modified as part of the station redevelopment includes:

- On Forrest Road/Third Road – remove the short turn pockets into Neerigan Street. This reduces the span required for the rail overpass.
- Reducing Church Avenue underneath the rail overpass from two lanes each way to a single lane each way. Similarly to above this reduces the span required for the rail overpass.

The potential impacts of these modifications were assessed by Urbsol during the design development phase and documented in a technical note *Byford Rail Extension, Armadale Station, Lane Configurations Under Rail Crossings* (Urbsol, November 2022). A copy of this technical note is included in Appendix C.

4.3 Pedestrian and Cyclist Networks

The elevated rail provides important opportunities to improve the pedestrian linkages in the centre of Armadale by grade separating the existing crossings at Forrest Road-Third Road and at Church Avenue. The limitations of existing rail crossings are removed and replaced by uninterrupted pedestrian connections. The east-west linkages at these locations and through the station precinct better integrates the eastern and western parts of the precinct, and will directly service the projected increase in residential development to the west of the station.

Additional connections north of Forrest Road will further improve the pedestrian permeability around the City Centre. A new parkland around and underneath the elevated rail continues the green open space network north of the City Centre all the way to the train station.

Enhancing the Principal Shared Path (PSP) and cycling linkages between the station and key local destinations and future higher density urban development is the basis for the future precinct strategy.

The project includes the continuation of the PSP to Byford and the provision of secure bike parking.

These represent enhancements to the existing pedestrian network and are consistent with the station access strategy. Refer to Figure 21 for a schematic of the pedestrian network.



Figure 21 Armadale Station – pedestrian network (MetCONNX)

Additionally, future development of the precinct should include the provision of a network of secondary routes that link to key destinations and provide safe, high-amenity cycling environments will assist in increasing patronage from the immediate catchment and a means of raising the priority of active transport to access the station.

The purpose is to ensure that the future path infrastructure provides a well-connected, accessible and enjoyable walking environment through the Armadale Strategic Centre, consistent with the station access strategy and long term cycle network. Refer to Figure 22 for a schematic of the cyclist network.



Figure 22 Armadale Station – cyclist network (MetCONNX)

4.4 Public Transport Networks

Primarily, the bus routes in place to service the locality are proposed to remain as is, modified slightly as a result of a relocation of the existing bus interchange facilities to the northern end of the station. It is anticipated there will be implementation of new/additional Transperth bus routes as required to service the new growth areas surrounding Armadale Station, as outlined within Transperth's Service Development Plan. Refer to Figure 23 for a schematic of the public transport network.

It is important to note that confirmation of future bus routes is still subject to future Transperth/PTA planning.



Figure 23 Armadale Station – public transport network (MetCONNx)

5 Integration with Surrounding Area

As stated in the *Transport Impact Assessment Guidelines, Volume 4 – Individual Developments* (WAPC, August 2016), the intent of this section is to identify how well the proposed development integrates with the surrounding land uses with respect to transport links and accessibility.

5.1 Surrounding Attractors/Generators

5.1.1 District Level Destinations

Figure 24 shows an overview of the existing destinations and activities on a district level around the Armadale station precinct's surrounding context at the district level. In the large part, these consist of major shopping centres, recreation areas, cultural centres and educational facilities.

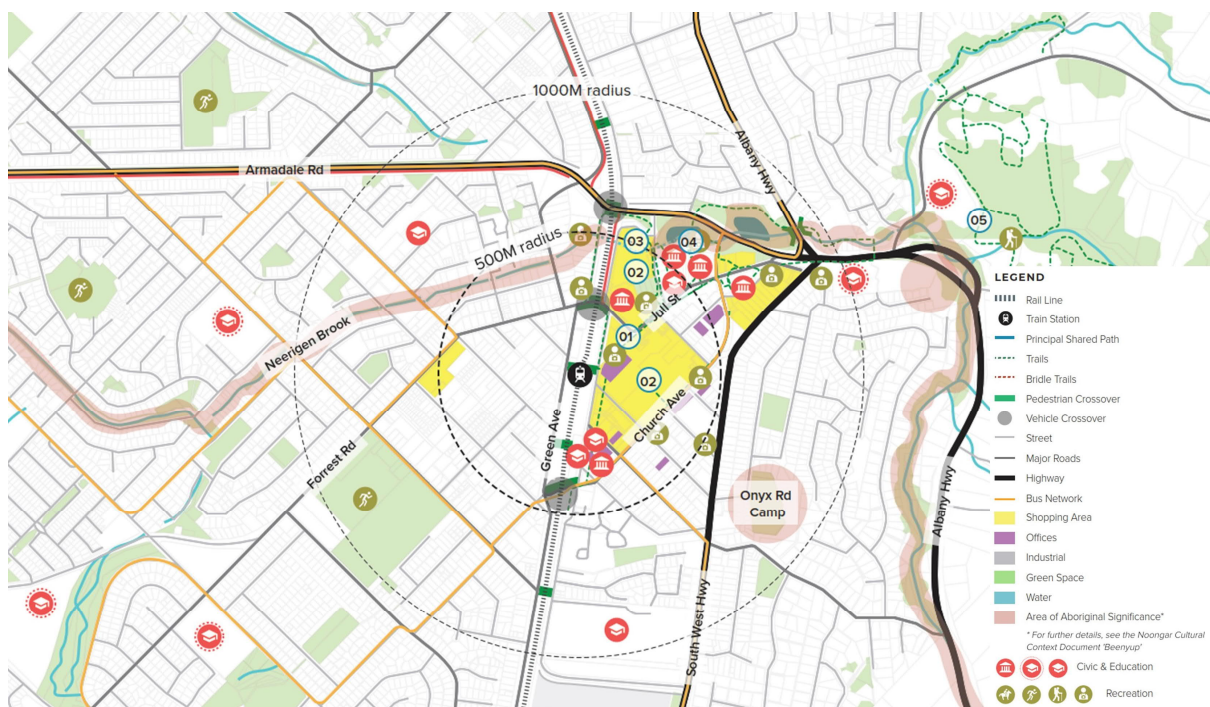


Figure 24 Armadale Station – district level destinations (MetCONNx)

5.1.2 Local Activities

Figure 25 shows an overview of the local activities layered across the Armadale city centre. Civic, commercial, hospitality and commercial activities are clustered on the eastern side of the railway line (around Jull Street Mall), with further concentration of commercial uses south (between Fourth Road and Jull Street). These activities are serviced by car parking that is usually concealed behind buildings.

Stronger connections across the rail line, through the introduction of a new station environment, will help to encourage activity west.

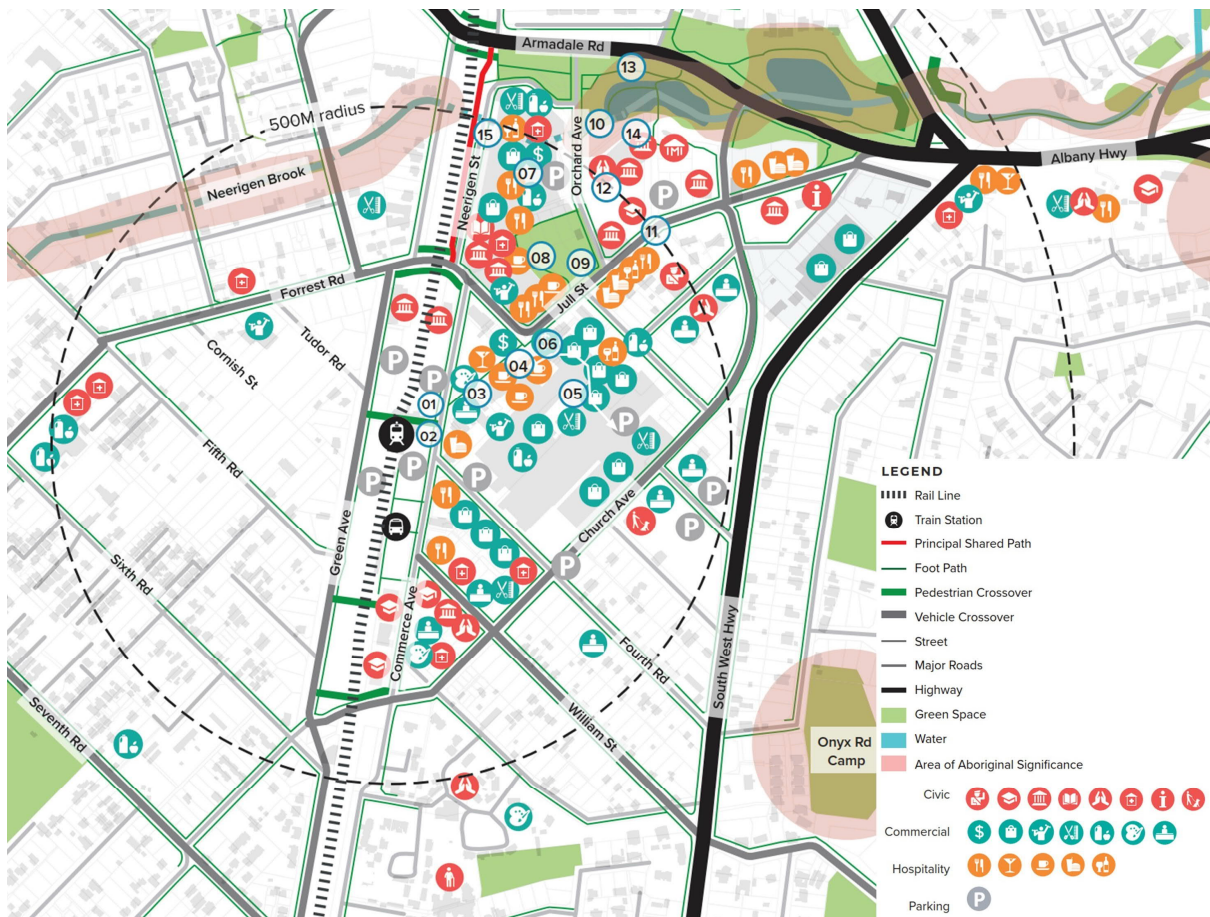


Figure 25 Armadale Station – local level destinations (MetCONNX)

5.2 Proposed Changes to Surrounding Land Uses

Currently, Armadale Town Centre's land uses are focused on retail activities. It is a known challenge that Armadale lacks a diverse employment offering. There is very little employment mix, particularly in professional service industries, which may be seen as a logical maturation of town centre land use activity. Therefore, to fulfil Armadale's role as a strategic metropolitan centre, the precinct must deliver greater opportunities for commercial development.

The current zoning of land uses around the Armadale Station Precinct indicates the potential to be a major urban centre with a range of land uses including residential, commercial, retail, community, cultural and civic. It serves a broad and diverse catchment and acts as a hub for the surrounding community.

The medium to high density residential zoning around the station precinct promotes an increasing community of people living in the area.

The zoning also enables greater growth in non-residential floorspace and opportunities for employment, particularly at ground levels.

The integration of the eastern and western parts of the precinct, afforded by the upgraded station, will promote the opportunity for business agglomeration, therefore, a greater quantum of commercial floor space could be reasonably expected.

5.3 Desire Lines between Station and Surrounds

For a summary of key journey routes and accessibility through and around the station for the various travel modes, please refer to Figure 26 and the following sections which cover the various travel modes.

5.3.1 Vehicular Traffic

Key road access routes to/from Armadale Station for private vehicles were discussed in Section 4.1, and are generally the same as per the existing situation. In the vicinity of the Armadale Station, the most significant change to the adjacent road network is the grade separation of the rail line that will remove level crossings at both Forrest Road-Third Road and Church Avenue. These grade separations are expected to provide significant benefits in terms of both safety and operational efficiency of the road network in the vicinity.

5.3.2 Pedestrians and Cyclists

Key pedestrian and cyclist access routes to/from Armadale Station were discussed in Section 4.3, and are significantly improved through the extension of the PSP to Byford, and the grade separation of the rail line at Forrest Road-Third Road and at Church Avenue.

The grade separations will also provide important opportunities to improve the pedestrian linkages in the centre of Armadale, particularly in the east-west direction through the station precinct. These east-west linkages through the station better integrates the eastern and western parts of the precinct, and will directly service the projected increase in residential development to the west of the station. The station is layout such that the main entrance on the western side carries through to the Jull Street signalised crossing and the broader district and local activity areas previously documented in this section of the TIA.

For pedestrian and cyclist traffic on Commerce Avenue and Green Avenue, there is a significant enhancement in safety expected as a result of the rationalisation of vehicular access points, along with appropriate priority for the non-motorised traffic via the zebra/wombat crossings at the access points.

The redevelopment and associated upgrades will provide significant enhancements for accessibility to the station for pedestrians and cyclists, and also improve permeability through the precinct and better connections between residents and the town centre and its attractions.

5.3.3 Public Transport

For bus traffic key road access routes to/from Armadale Station were discussed in Section 4.4, and are generally the same as per the existing situation. Bus traffic will also benefit from the grade separation of the rail line at Forrest Road and Church Avenue. Public transport users will benefit from the relocation of the bus interchange area to the northern end of the station precinct as it will be closer to the heart of the town centre and its attractions.

The expected demand on the various transport networks and desire lines for their respective modes are expected to be accommodated by the existing and planned upgrades to the facilities as part of the station redevelopment.

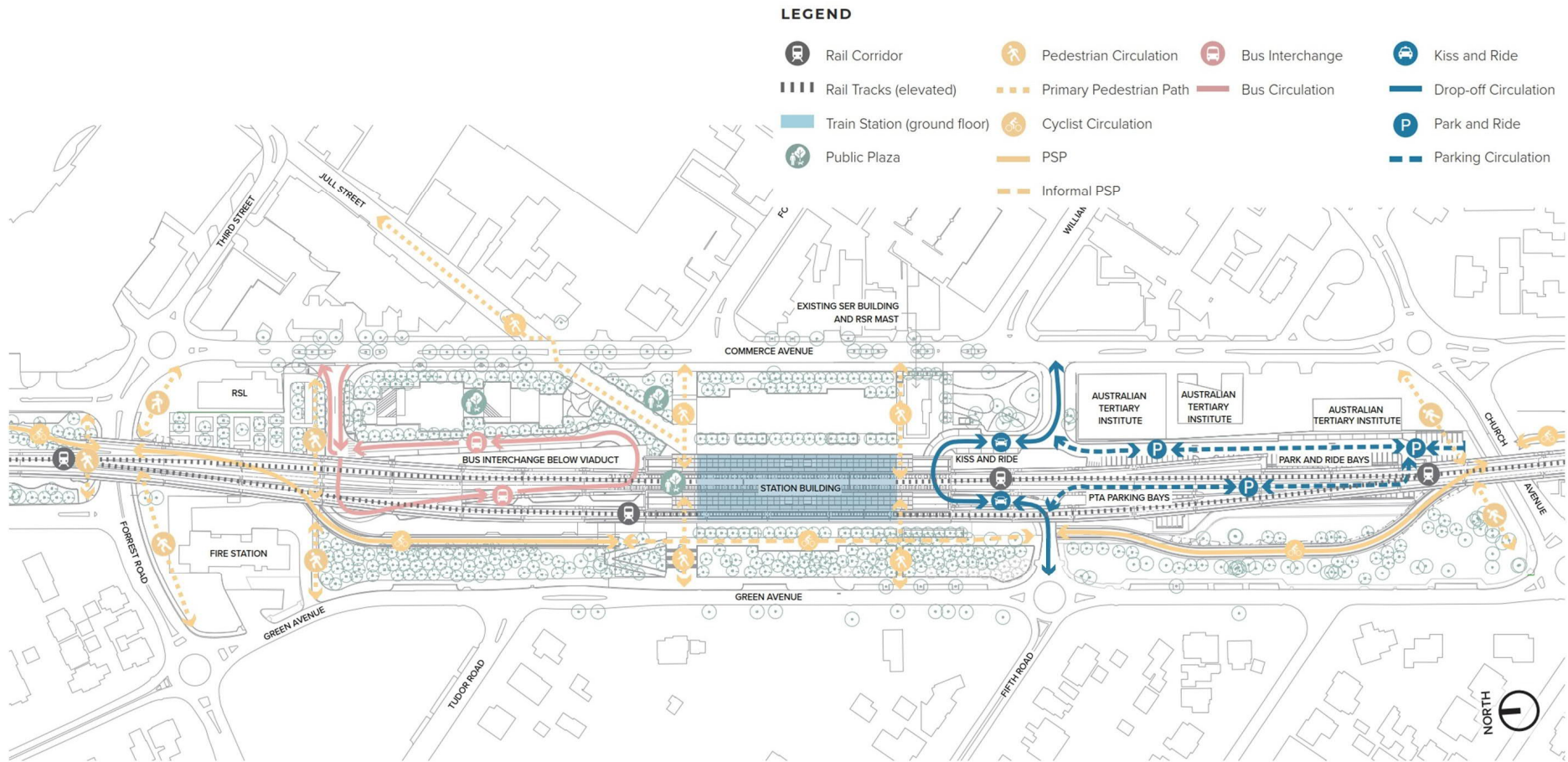


Figure 26 Armadale Station – transport journey and accessibility plan (MetCONNx)

6 Committed Developments and Other Transport Proposals

As previously mentioned, the BRE Project includes provision of an electrified operational passenger rail between Armadale and Byford. Whilst this includes redevelopment of the existing Armadale Station, the most significant other transport project/proposal that will impact operations at the Armadale Station is the provision of a new station at Byford.

Figure 27 illustrates the origins of passengers who accesses Armadale Station via PNR and KNR. In addition, the results of a PNR License Plate Survey undertaken by the PTA in 2019 are provided in Figure 28. These figures indicates that the majority of station users access Armadale Station from Armadale, Brookdale, Mount Richon and Byford.

This information is important as it demonstrates that it may be possible that existing patronage at Armadale Station may divert to the new Byford Station, and hence impact the patronage at Armadale Station.

WSP's *Armadale Station Access Strategy (January 2021)* described its use of the Department of Transport's Strategic Transport Evaluation Model (STEM) in determining the total patronage for the future scenarios. The forecasted patronage growth at Armadale Station compared to 2017 daily boarding's at Opening of the BRE (2026), 2031 and 2041 is shown below in Table 3.

	2026	2031	2041
Change in Boardings (from 2017)	8.0%	37.6%	108.9%

Table 3 Forecasted Daily Passenger Growth from 2017 (WSP)

Further to this, and in reference to the project opening year of 2026, the STEM estimates that associated with the BRE, passenger demand at Armadale Station will grow by 27% between 2026 and 2031, and 93% between 2026 and 2041. It is probably important to note that the STEM modelling assumed a total PNR bays provision of 370 bays. The actual amount to be provided is more likely to be around 170 bays.

Based on the above, it is clear that patronage at the Armadale Station is expected to grow in the medium to long term. However until such time that growth is realised, there may actually be a reduction in patronage as some existing users of Armadale Station utilise the Byford Station instead. This may also result in a decrease in traffic generation at Armadale Station compared to the existing situation.

Regardless of that, trip generation for the assessment of traffic impacts has been based on proportioning of existing station related traffic in accordance with growth in station patronage. This is detailed in the following sections.

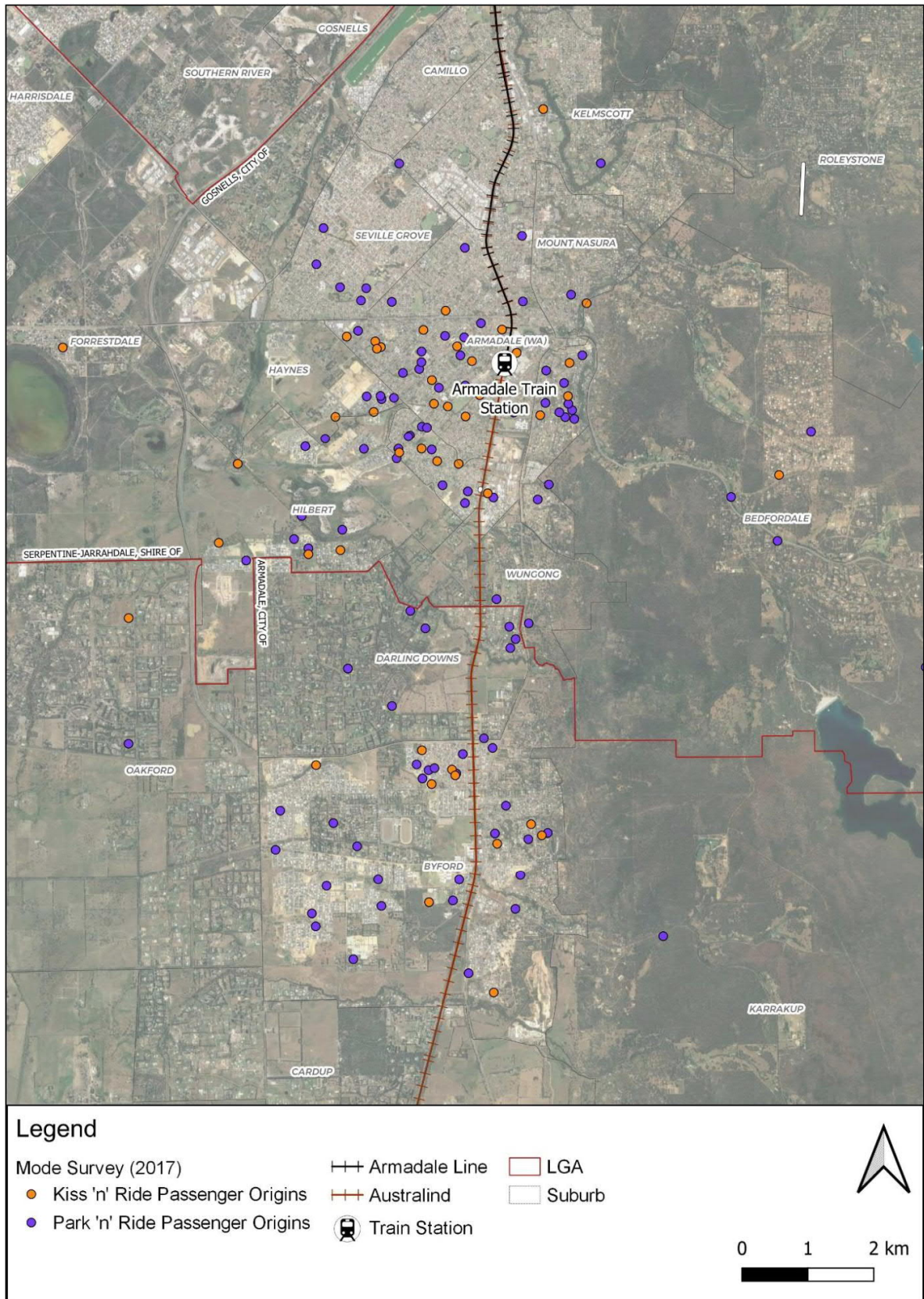


Figure 27 Park 'n' Ride & Kiss 'n' Ride survey origin map (WSP)

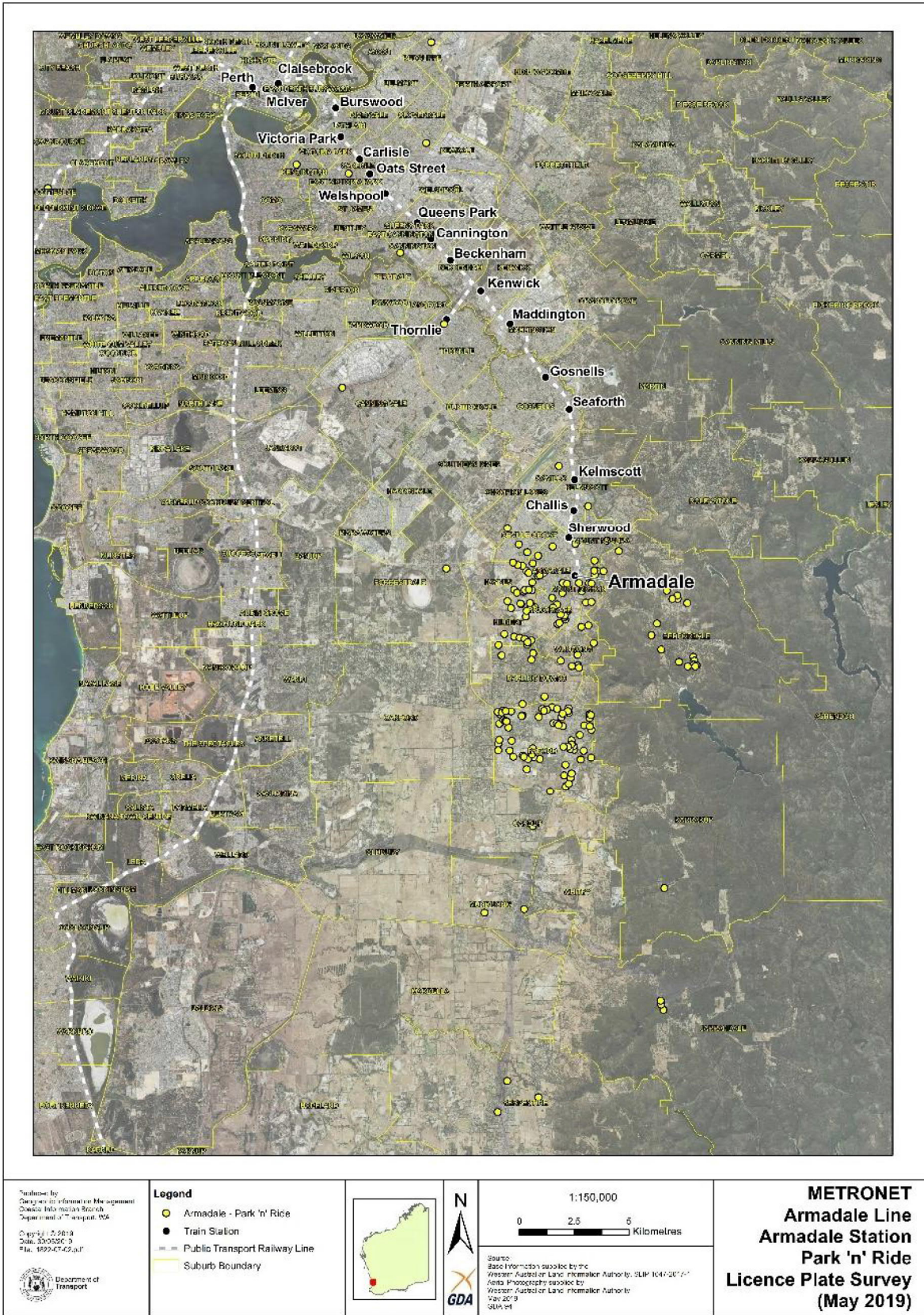


Figure 28 Park 'n' Ride License Plate Survey 2019 (WSP)

In terms of the likely sources of growth in patronage, Armadale’s City centre has undergone important strategic planning exercises to encourage coordinated growth. The planning framework in this area cascades from state-based documents to local strategies and plans. The Perth and Peel @3.5 million frameworks classifies the City of Armadale as a strategic metropolitan centre, meaning it is a multi-purpose centre that provides diverse economic and community services for the local community and catchment.

Locally, the Armadale City Centre Structure Plan and Car Parking Strategy identifies the station precinct as central to the regeneration of the city centre and subsequently is required to be a high-quality civic place which integrates into the surrounding urban context. The Plan stipulates all surrounding developments must reinforce the station precincts status as a place for public life with an active ground plane of retail, food and beverage; and hospitality land uses while office and residential use are located on the upper floors.

Consistent with this, the *Armadale Station Access Strategy* (WSP, January 2021) indicates that the City of Armadale is likely to experience significant growth over the next two decades. It states that the number of jobs in the Armadale City Centre is forecasted to grow from 2,900 to over 15,000 (as specified within the Armadale City Centre Structure Plan. Growth and diversification of the town centre has already started. As recently in mid-2020 the government announced an inner-city TAFE which is anticipated to help revitalise the Armadale City Centre. The TAFE will cater for over 200 full-time equivalent students per day, generating over 50 direct ongoing jobs and many more indirect jobs through related services and industries.

In addition, it mentions that the land surrounding Armadale Station (particularly on the west) will be subject to high density residential growth over the next decade, and that the Armadale City Centre West of Rail Precinct Structure Plan and the Armadale Activity Centre Structure Plan will guide the forecasted growth in population, employment and land use development and intensification for Armadale.

Some key projections for the Armadale City Centre are included in Table 4.

Item	2017	Future
Total area covered by the Activity Centre Structure Plan	85 hectares	85 hectares
Estimated number of dwellings	236	1,250-2,300
Estimated population	456	5,000-7,000
Estimated non-residential floor space	54,900	80,000
Estimated area and percentage of public open space given over to: <ul style="list-style-type: none"> Regional open space (Parks and Recreation Reserve) Local open space 	7%	7.5%
Estimated employment (number of jobs) in the activity centre area	3,046	18,000

Table 4 Armadale City Centre Projections (MetCONNX)

7 Analysis of Transport Networks – General Advice

7.1 Assessment Years

For ease of understanding against existing conditions, and to allow a comparison of 'before' and 'after' station redevelopment, the 2022 surveyed traffic counts will be used as a base for the assessment.

A 2022 assessment has been undertaken, primarily to account for and demonstrate the operations of access points under the proposed access arrangement. Then an opening year i.e. 2026, assessment has been undertaken. These are based on network traffic volumes projected out to 2026, that WSP used in its future year network assessment, modified to reflect the network peak period that is being assessed as part of this TIA. The 2026 assessment also accounts for the modifications to the access arrangement.

A 2036 assessment has also been undertaken to address the longer term considerations required in the Transport Assessment Guidelines for Development, also using available and approved traffic volumes that WSP used in its future year network assessment (modified to reflect the network peak period that is being assessed as part of this TIA).

7.2 Time Periods for Assessment

In the context for this TIA, it is most critical to consider the combined network/station peak rather than the station peak. As such the following representative peak hour periods were chosen:

- AM peak: 8:15-9:15
- PM peak: 16:15-17:15

The logic behind each of those time periods was discussed in detail in Section 2.5.1.

8 Development Generation & Distribution

8.1 Traffic Generation

8.1.1 Private Vehicles

Section 2.5.1 detailed the traffic generation of the existing Armadale Station. To summarise, the existing traffic generation:

- Traffic generated during the existing AM network peak is approximately 144vph, consisting of:
 - 60 trips in and 34 trips out for regular traffic
 - 25 trips in and 25 trips out for buses
- Traffic generated during the existing PM network peak is approximately 216vph, consisting of:
 - 52 trips in and 102 trips out for regular traffic
 - 31 trips in and 31 trips out for buses
- In addition to that data, traffic generated over an entire day is approximately 2,366vpd, consisting of:
 - 850 trips in and 850 trips out for regular traffic
 - 333 trips in and 333 trips out for buses

Estimation of traffic generation for stations in order to conduct a future year assessment, is sometimes based on an assumed rate of turnover on a 'per parking bay' basis, or by assuming that the total number of supplied parking bays is filled by an assumed proportion during the peak periods being assessed. That may be suitable for PnR traffic. Additionally, for KnR traffic, an arbitrary number or an estimate of traffic is sometimes used. However in the case of Armadale Station, these methods are not considered suitable as:

1. Current parking demand is significantly lower than the existing supply, so would result in a significant overestimation of traffic demand.
2. The construction of the new Byford Station may have a significant impact on future patronage at Armadale Station.
3. Detailed data on existing site trip generation has already been collected. Using these as a base to predict future trip generation is likely to give a more accurate picture of demand and the resulting operation of the road network.

As a result, it is considered that the most accurate method of estimating future trip generation at the station is to use the detailed survey information that establishes existing site generation, and factor up that traffic in accordance with the patronage growth projections.

The *Armadale Station Access Strategy* (WSP, January 2021) established future target mode share based on stakeholder feedback provided for a number of scenarios that were considered for Armadale Station. Mode share for the 2017 baseline and the targets for the preferred scenario (for 2041) are shown in Figure 29.

It is understood that the future target mode share scenario responds to the planned densification of Armadale Town Centre, development of vacant land adjacent to the Station and Armadale’s Strategic Metropolitan Activity Centre role for the south-east region of Perth. This scenario supports the existing planning framework and responds to proposed high density development stated in the *Armadale City Centre West of Rail Precinct Structure Plan* (MRA, June 2016).

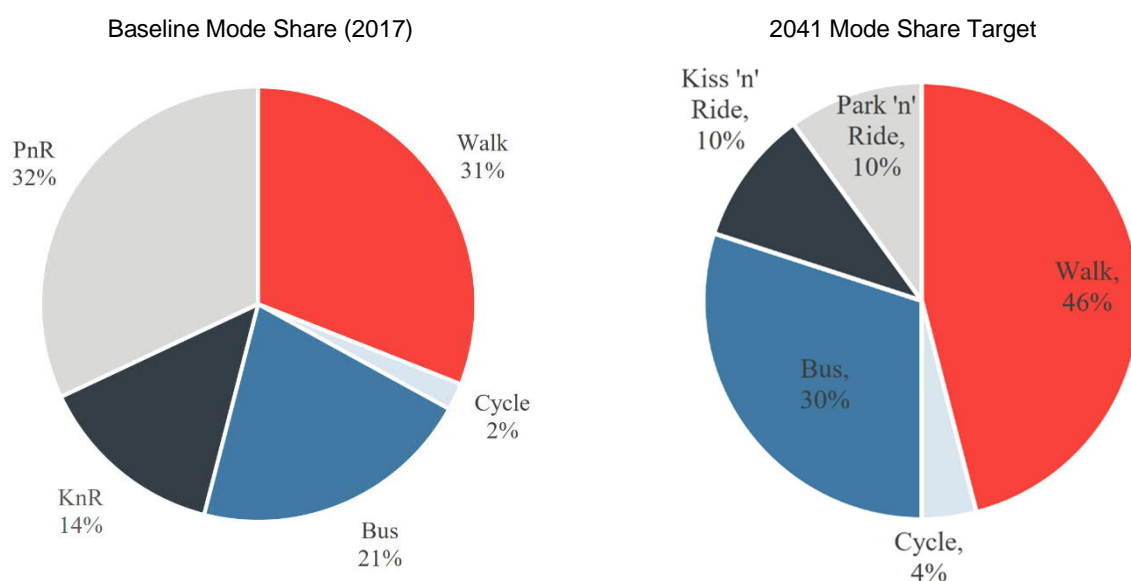


Figure 29 Mode Share Target (WSP)

Factoring up existing traffic entering and exiting the Armadale Station in alignment with the patronage growth projections assumes the same mode share in the future as existing situation. Considering the mode share targets discussed, this approach to the traffic generation would represent a highly conservative approach to the traffic assessment.

Table 5 documents the estimated trip generation for PnR and KnR traffic using the agreed forecast patronage growth, interpolated where required to establish trip generation for the required years of assessment.

	2022	2026	2031	2036	2041
Boardings Growth (from 2022)	N/A	3.4%	31.7%	65.9%	100.1%
AM Peak PnR Trips	26 in: 0 out	27 in: 0 out	34 in: 0 out	43 in: 0 out	52 in: 0 out
AM Peak KnR Trips	34 in: 34 out	35 in: 35 out	45 in: 45 out	56 in: 56 out	68 in: 68 out
PM Peak PnR Trips	0 in: 50 out	0 in: 52 out	0 in: 66 out	0 in: 83 out	0 in: 100 out
PM Peak KnR Trips	52 in: 52 out	54 in: 54 out	68 in: 68 out	86 in: 86 out	104 in: 104 out

Table 5 Existing & Forecasted Trip Generation

These figures indicate that on opening (2026), station related private vehicle use is expected to increase approximately 3.4% from existing levels, and approximately 66% in 2036 compared to existing levels.

To demonstrate how conservative the method of traffic generation is in comparison to the mode share targets:

- In 2022, 46% of existing patrons use private vehicles to access/leave the station (32% PnR and 14% KnR). Of the total daily boardings, approximately 782 use private vehicles.
- In 2041, 20% of estimated patrons are targeted to use private vehicles to access/leave the station (10% PnR and 10% KnR). Of the total daily boardings, approximately 680 are expected to use private vehicles.
- This indicates that fewer patrons are expected to use private vehicles to access/leave the station in 2041 compared to 2022. There should therefore be a corresponding reduction in private vehicle trip generation at the station from current levels.
- Instead traffic has been forecast to grow for the traffic assessment.

To summarise, the following statements outline the additional private vehicle traffic assumed in the traffic assessment:

- Compared to 2022, in the 2026 AM peak, an additional **1 PnR trip** is expected, along with an additional **1 inbound and 1 outbound KnR trip**
- Compared to 2022, in the 2026 PM peak, an additional **2 PnR trips** are expected, along with an additional **2 inbound and 2 outbound KnR trips**
- Compared to 2022, in the 2036 AM peak, an additional **17 PnR trips** are expected, along with an additional **22 inbound and 22 outbound KnR trips**
- Compared to 2022, in the 2036 PM peak, an additional **33 PnR trips** are expected, along with an additional **34 inbound and 34 outbound KnR trips**

8.1.2 Buses

Future planned bus routes and frequencies servicing Armadale Station were provided by PTA. These are summarised in Table 6. It has been assumed that these services are applicable to the 2036 assessment. For the 2022 and 2026 (opening) year assessments, existing services have been assumed.

Existing scheduled bus services are approximately 16 in:13 out during the AM peak and 19 in:20 out during the PM peak. These services generate slightly higher traffic volumes on the road network (25 in:25 out during the AM peak and 31 in:31 out during the PM Peak) most likely due to operational factors and recirculation. In the future, buses will not need to recirculate using the adjacent road network as a loop facility is proposed within the bus interchange area of the station.

Route		AM Peak - 8:15 to 9:15am		PM Peak - 16:15 to 17:15	
		In	Out	In	Out
219	Kelmscott Station	1	1	1	1
220	Perth Busport	3	6	6	3
235	Gosnells Station	2	3	3	2
243	Kelmscott Station	2	3	3	2
244	Kelmscott Station	2	3	3	2
245	Kelmscott Station	3	6	6	3
246	Byford Station	6	3	3	6
247	Hilbert	3	2	2	3
248	Hilbert	6	3	3	6
249	Hilbert	3	2	2	3
250	Byford Station	3	2	2	3
251	Byford Station	3	2	2	3
260	Murdoch Station	3	6	6	3
519	Murdoch Station	3	6	6	3
529	Cockburn Central Station	3	6	6	3
Total		46	54	46	54

Table 6 Future planned bus services

Note: It is important to note that confirmation of future bus routes and numbers is still subject to future Transperth/PTA planning.

8.2 Traffic Distribution

As previously mentioned, a 2022 assessment has been undertaken, primarily to account for and demonstrate the operations of access points under the proposed access arrangement. This required the 2022 traffic in and out of the station to be redistributed in accordance with the likely patterns under the proposed access arrangement. This process had to account for:

- The rationalisation in total access points
- The relocation of the bus interchange access point
- The change in patterns as a result of the proposed KnR arrangement i.e. traffic that enters from Commerce Avenue is most likely to exit to Green Avenue, and vice versa.

With respect to the estimated additional traffic, it was generally assumed that entering traffic would be 50% from each of the Commerce Avenue and Green Avenue sides of the station, with approximately the same split as existing from the north or south approaches on both Commerce Avenue and Green Avenue. For 2026, the additional traffic is very low. For 2036, the same distribution was assumed. Whilst this may not be in accordance with existing distribution (a higher proportion currently enters via Commerce Avenue), with the growth expected to the west, it was considered a feasible distribution for the longer term assessment. Again, the additional traffic (which is considered to be conservatively high), is not expected to have a significant impact on the operations of the adjacent road network or its intersections.

9 Base and With Development Traffic Flows

In a meeting at the project outset (held on 14 July 2022), the approach to the traffic assessment was outlined and agreed, which included focussing any operational assessment on the access points, and not intersections on the adjacent road network. Such an assessment on the nearby intersections was undertaken in some detail by WSP. In that assessment, traffic projections were prepared and approved by Main Roads, and the assessment of access points in this TIA have attempted to remain consistent with those approved projections.

The future traffic projections documented in this section therefore focus on the station access points, rather than nearby intersections.

9.1 Base Flows

Existing 2022 traffic volumes were provided in Section 2.5.2, for both AM and PM peak traffic periods to be assessed. As discussed, the existing traffic had to be redistributed to take account of the modifications in the access arrangement to/from the station. The estimated redistributed traffic is shown in Figure 30 and Figure 31.

The key differences are the rationalisation of access points, relocation of the bus access, and the likely travel between Commerce Avenue and Green Avenue for KNR traffic i.e. KNR traffic entering from Commerce Avenue is likely to exit via Green Avenue, and vice versa. Because more traffic currently enters the site from the Commerce Avenue side (of which the KNR is likely to exit to Green Avenue), this may result in a minor increase in traffic on Green Avenue of around 20vph in the worst case PM peak traffic period. Such minor increases would be well within the function and capacity of Green Avenue and its intersections.

Conversely, some sections of Commerce Avenue may experience a reduction in traffic to a similar scale.

Should KNR patrons prefer to circulate through the carpark to exit at the same point as their entry, any change will be less significant than reported.

9.2 “With Development” Flows

9.2.1 2022 Flows

2022 AM peak traffic generation for the Armadale Station is approximately 94vph, whilst in the PM peak traffic generation is approximately 154vph. These were included in the base flows as shown in Figure 30 and Figure 31.

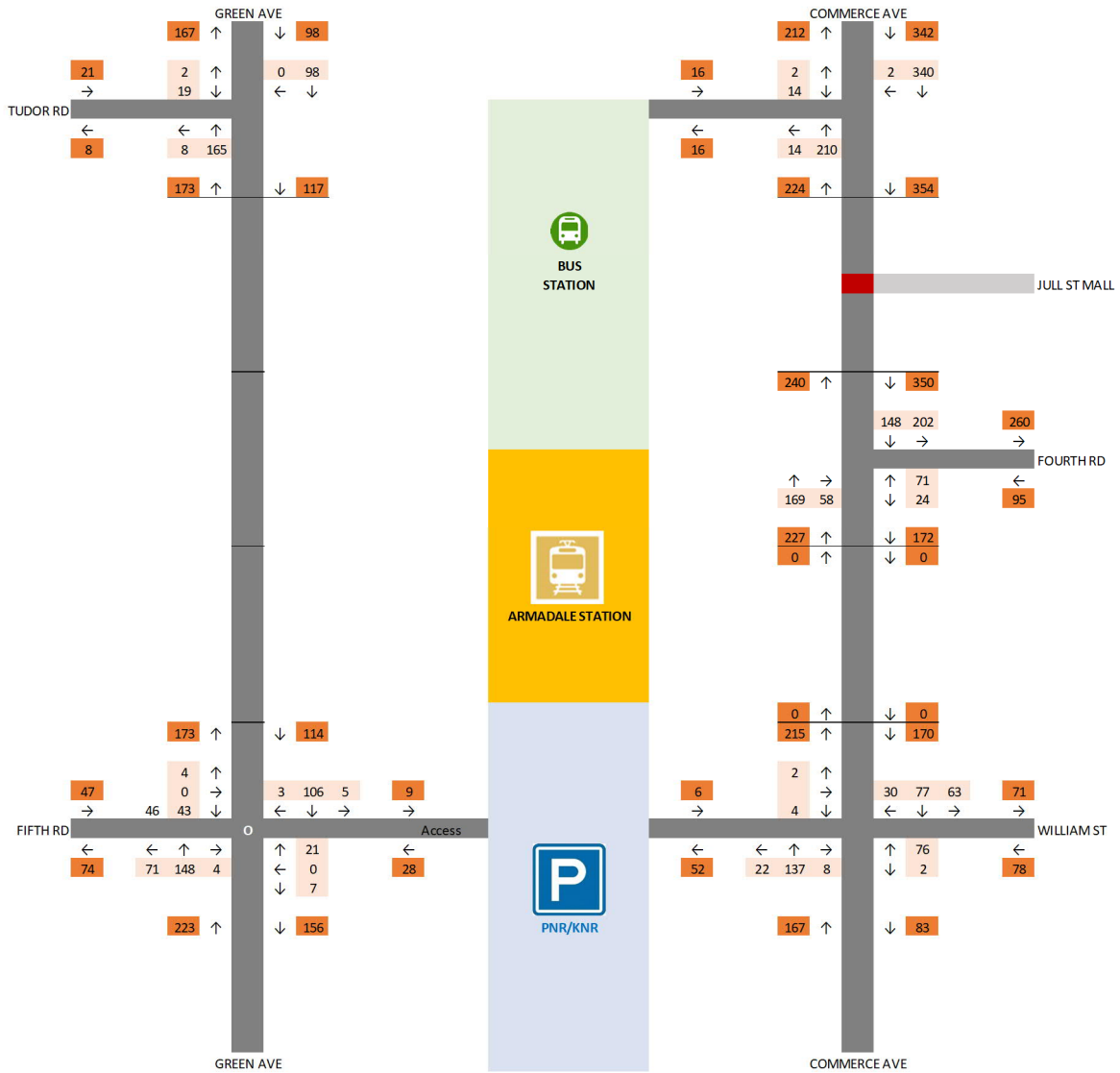


Figure 30 2022 AM peak hour network traffic flows on proposed access

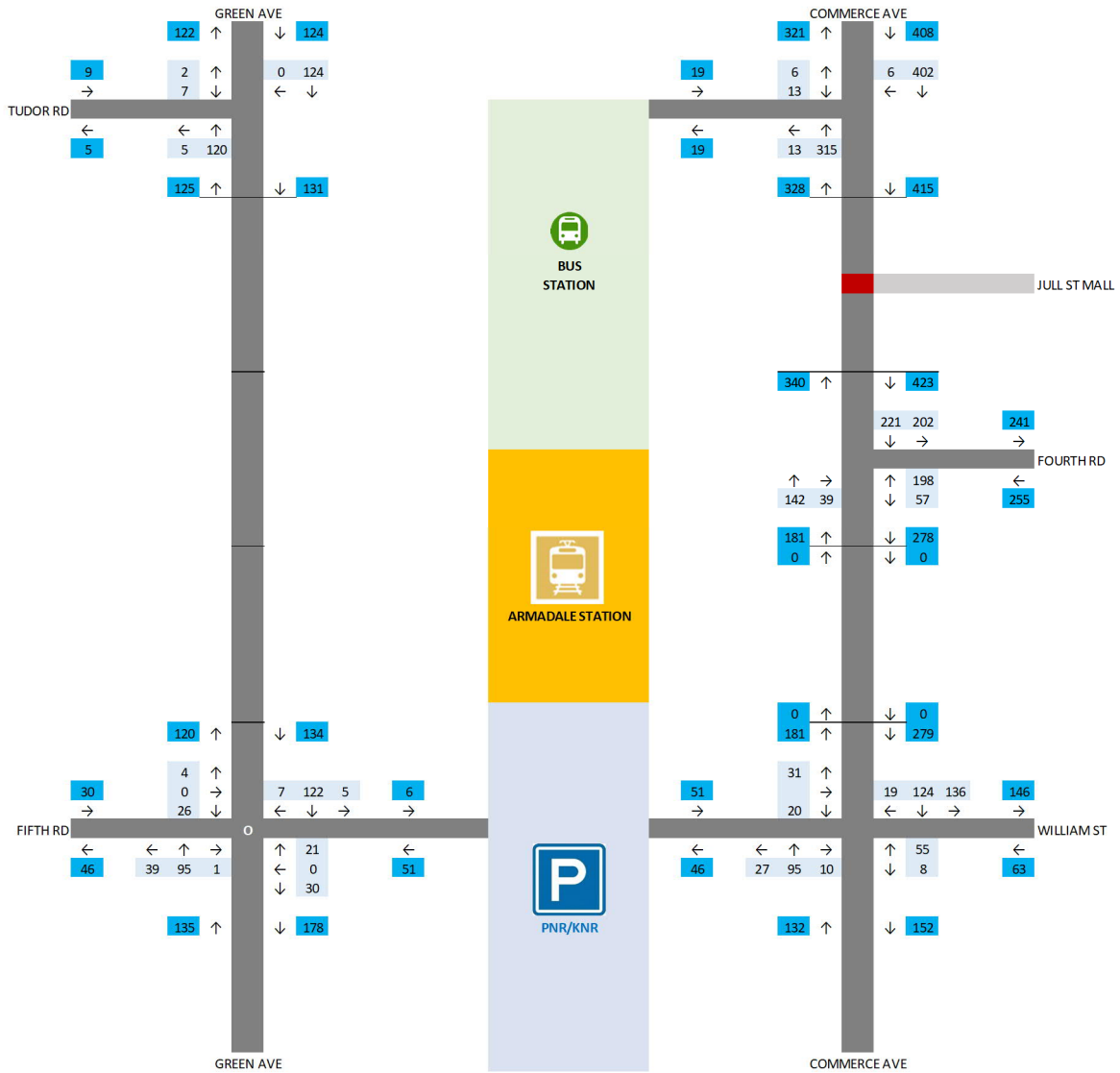


Figure 31 2022 PM peak hour network traffic flows on proposed access

9.2.2 2026 Flows

Using the traffic generation and projections documented in Section 8.1, traffic generated by the station in 2026 is expected to be approximately 3 trips during the AM peak and 6 trips in the PM peak, compared to 2022 trips.

- The additional 3 AM peak trips include 1 inbound PnR trip and 2 inbound/outbound KnR trips.
- The additional 6 PM peak trips include 2 outbound PnR trips and 2 inbound/outbound KnR trips.

Baseline 2026 traffic flows were estimated at the following locations in order to account for background traffic growth, so that a future assessment of access points could be undertaken:

- Commerce Avenue south of Third Road
- Green Avenue north of Church Avenue
- Commerce Avenue north of Church Avenue

These were estimated using the same methodology as WSP in their future network assessment, and entailed the following steps for the first two of those locations:

- Establish daily traffic growth in each direction between 2021 and 2031 from Main Roads ROM24 (Regional Operations Traffic Model).
- Apply peak hour factors to the daily growth in accordance with existing peak hour factors obtained from the traffic surveys.
- Half the estimated traffic growth between 2021 and 2031, to obtain growth estimates to 2026.
- Add the estimated peak hour traffic growth (between 2021 and 2026) to the 2022 traffic volumes.

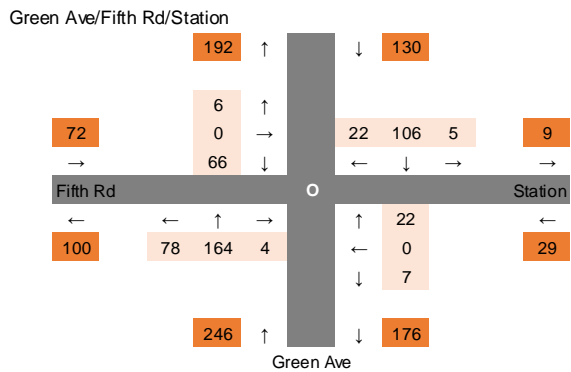
This process allowed peak period turning volumes to be established at the bus interchange access point on Commerce Avenue.

At the Green Avenue/Fifth Road/Access Point roundabout, an additional step had to be undertaken to estimate growth on Fifth Avenue, which was similar to the process outlined above. This then allowed peak period turning volumes to be established at the roundabout.

For the Commerce Avenue PnR/KnR access point, the same method was not possible as the available detail in the coded network in ROM was not sufficient to provide growth estimates. Instead, and in the same way WSP estimated future traffic, a 15% increase was applied to traffic on Commerce Avenue. Note that this means existing station related traffic at this location also gets factored up by 15%, so adds a degree of conservatism.

The resultant 2026 AM and PM peak traffic projections at the station access points are shown in Figure 32.

2026 AM Peak



2026 PM Peak

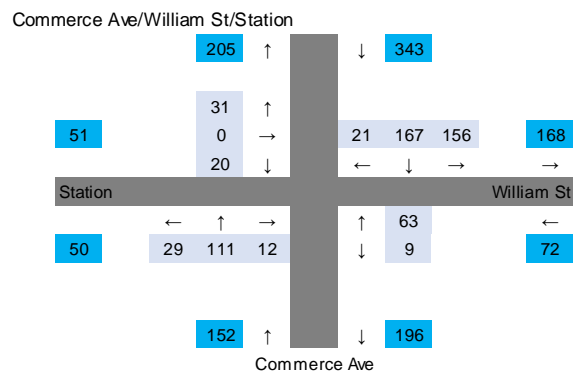
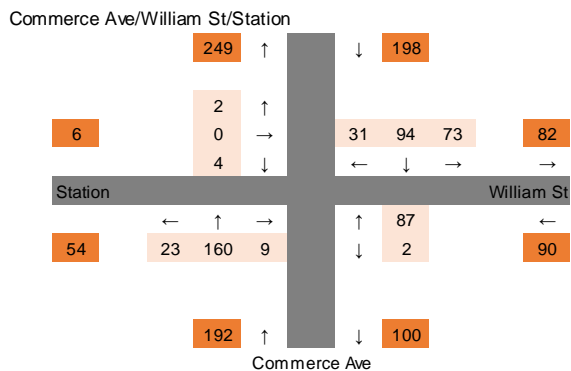
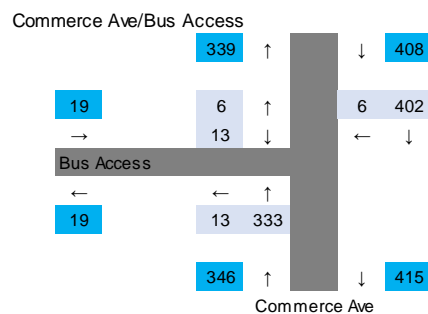
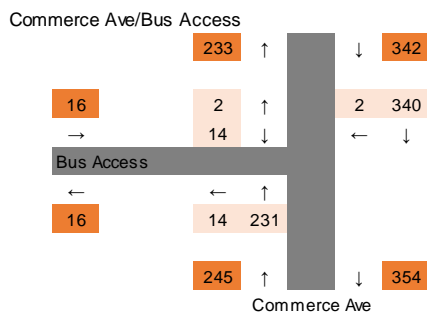
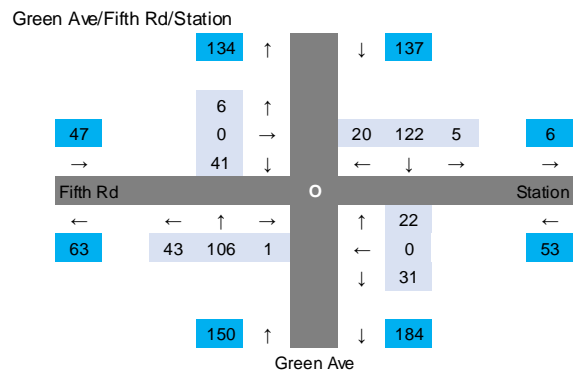


Figure 32 2026 AM and PM peak hour traffic flows at access points

9.2.3 2036 Flows

Using the traffic generation and projections documented in Section 8.1, traffic generated by the station in 2026 is expected to be approximately 61 trips during the AM peak and 101 trips in the PM peak, compared to 2022 trips.

- The additional 17 AM peak trips include 22 inbound PnR trip and 22 inbound/outbound KnR trips.
- The additional 33 PM peak trips include 34 outbound PnR trips and 34 inbound/outbound KnR trips.

Baseline 2036 traffic flows were estimated at the same locations as the 2026 assessment in order to account for background traffic growth, so that a 2036 assessment of access points could be undertaken. The process for Commerce Avenue (south of Third Road) and Green Avenue (north of Church Avenue) was identical to that documented for 2026, except that daily traffic growth estimates were established from ROM24's 2021 and 2036 scenarios. The process for Commerce Avenue (north of Church Avenue) was identical to that documented for 2026, except that daily traffic growth estimates were factored by 45% (same as WSP assumption). Note that this means existing station related traffic at this location also gets factored up by 45%, so adds a degree of conservatism.

The resultant 2036 AM and PM peak traffic projections at the station access points are shown in Figure 33.

2036 AM Peak

2036 PM Peak

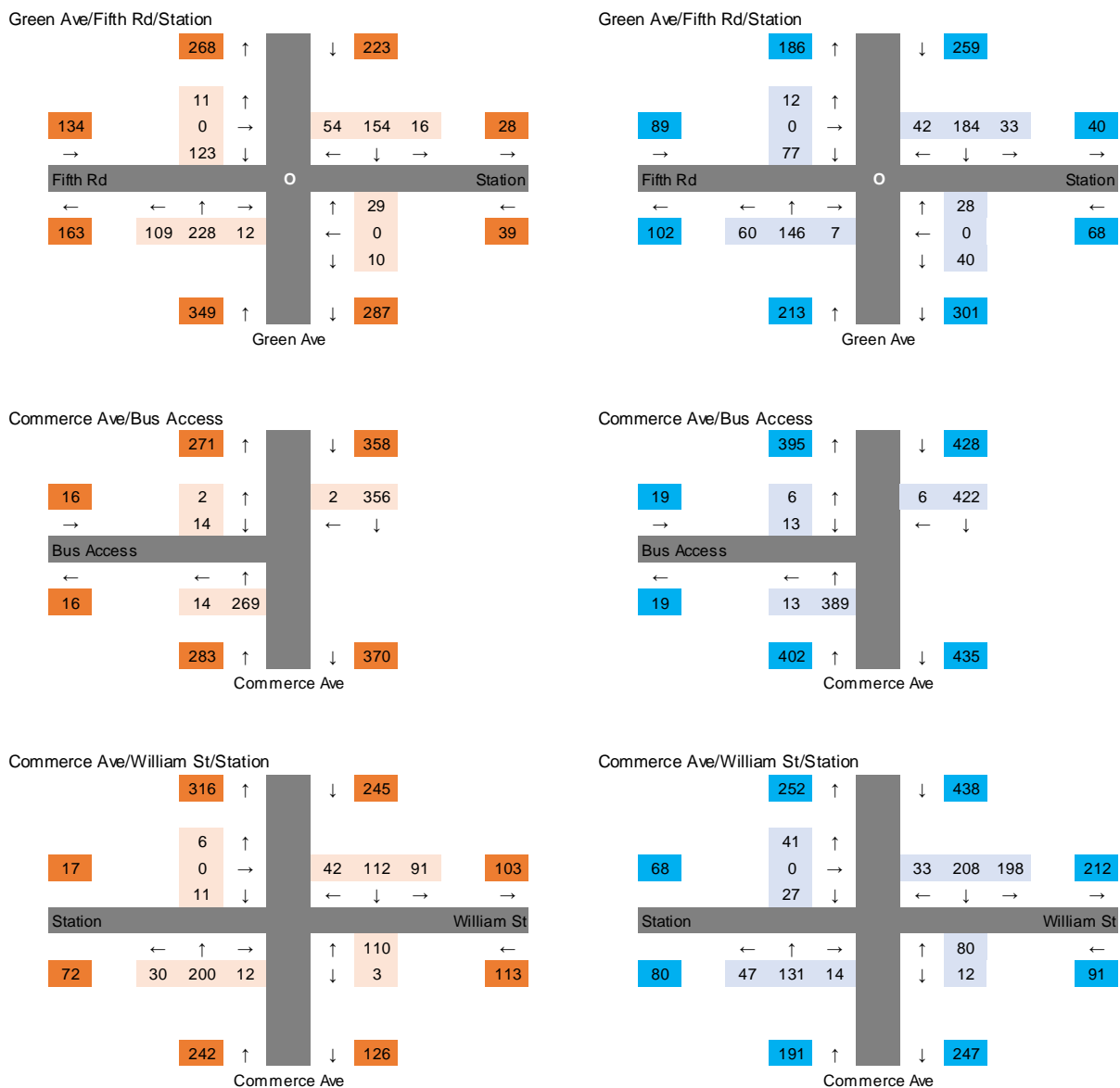


Figure 33 2036 AM and PM peak hour traffic flows at access points

10 Analysis of Development Accesses

The operational assessment of the Armadale Station access points was undertaken using SIDRA. For the existing case, these included the 7 access/egress points that currently service the existing station. This assessment was undertaken purely to gain an appreciation of base case operations as a basis of comparison for the project case scenario, albeit there can't be a direct comparison because of the modified access arrangement.

For the project case scenario the access points assessed included:

- The Green Avenue/Fifth Road/Station Access point roundabout
- The Commerce Avenue/Bus Interchange Access point
- The Commerce Avenue/PnR-KnR/William Street intersection

It should be noted that the PnR-KnR access point on Commerce Avenue is located in relatively close proximity to the William Street intersection. Although it is expected that the two intersections will likely operate independently of each other, they were assessed as a single intersection to consider a worst case scenario in terms of operations. Further discussion on these intersections is documented in Section 12.

Operational assessments of the station access points were undertaken for the following scenarios:

- 2022 AM and PM peak, existing access arrangement
- 2022 AM and PM peak, project case access arrangement
- 2026 AM and PM peak, project case access arrangement, representing an opening year assessment
- 2036 AM and PM peak, project case access arrangement, representing an opening year + 10 year assessment.

10.1 Existing Access Assessment (2022)

The results of the SIDRA analysis for the existing operations are summarised in Table 7. This assessment indicates that all existing access points and intersections assessed operate well during the AM and PM peak traffic periods. No particular access points or movements indicate any operational concern, as was observed on site.

10.2 Project Case (Proposed) Access Assessment

The project case access arrangement was assessed for the years 2022, 2026 (opening) and 2036 (opening year +10 years). The results of the SIDRA analysis for all access points and all future years are summarised in Table 8 (AM peak) and Table 9 (PM Peak).

10.2.1 2022 Assessment

For the 2022 assessment, the existing traffic generated at the station was redistributed in accordance with the likely patterns under the proposed access arrangement. The results of this assessment indicate that all access points are expected to operate satisfactorily using existing site traffic generation. This indicates that the rationalisation of the station access points and proposed arrangement is feasible and provide for suitable operational performance.

The proposed access points are expected to operate with low degrees of saturation, minimal delays and minimal queueing. With respect to bus operations, compared to the existing situation, the results indicate slightly higher delays for exiting buses (on average 14s in the AM peak and 16s in the PM peak, compared to around 7s at the moment). This is a result of the bus access point being located in the section of Commerce Avenue where traffic demands are slightly higher. Regardless, the degree of saturation is 0.05 (AM peak) and 0.06 (PM peak) and minimal queueing is expected, which indicates significant spare capacity.

There is also some level of delay expected for buses turning right into the interchange area (19s during the critical PM peak). This is not considered unusual, and does not cause any significant impacts to following through traffic because the bus volumes are low.

10.2.2 2026 (Opening Year) Assessment

For the 2026 assessment, the traffic volumes used in the SIDRA analysis account for the change in access arrangement, estimated growth in traffic generated at the station (albeit minimal compared to existing), and general traffic growth on the surrounding roads.

The results of the assessment for 2026 indicates very similar operations to those reported for the 2022 analysis. All access points are expected to operate satisfactorily in the opening year with spare capacity. The results indicate insignificant changes to degrees of saturation and average delays, and barely any change to expected 95th percentile queue lengths. The expected change in operations between the 2022 and 2026 scenarios would likely be unnoticeable.

10.2.3 2036 Assessment

For the 2036 assessment, the traffic volumes used in the SIDRA analysis account for the change in access arrangement, estimated growth in traffic generated at the station, and general traffic growth on the surrounding roads.

The results of the assessment for 2036 indicates similar operations to those reported for the 2026 analysis. Even with the conservative assumptions around traffic growth for the station, all access points are expected to operate satisfactorily in this time horizon with spare capacity. The results indicate insignificant changes to degrees of saturation and average delays, and barely any change to expected 95th percentile queue lengths.

Intersection	Approach	Movement	2022 AM Peak - Existing				2022 PM Peak - Existing			
			DOS	Ave Delay (s)	LOS	95%ile Queue (veh)	DOS	Ave Delay (s)	LOS	95%ile Queue (veh)
Green Ave - Northern Carpark Entry	Green Ave - south	T	0.09	0.0	A	0	0.06	0.0	A	0
		R	0.09	3.6	A	0	0.06	3.6	A	0
	Green Ave - north	L	0.07	5.6	A	0	0.07	5.6	A	0
		T	0.07	0.0	A	0	0.07	0.0	A	0
	Intersection		0.09	0.1	NA	0	0.07	0.1	NA	0
Green Ave - Northern Carpark Exit	Green Ave - south	T	0.09	0.0	A	0	0.06	0.0	A	0
	Station Exit - east	L	0.00	5.9	A	0	0.00	5.9	A	0
	Green Ave - north	T	0.06	0.0	A	0	0.07	0.0	A	0
	Intersection		0.09	0.0	NA	0	0.07	0.2	NA	0
Green Ave - Western Carpark Access	Green Ave - south	T	0.09	0.0	A	0	0.06	0.0	A	0
		R	0.09	5.8	A	0	0.06	5.9	A	0
	Carpark Access - east	L	0.00	5.9	A	0	0.00	5.9	A	0
		R	0.00	6.4	A	0	0.00	6.3	A	0
	Green Ave - north	L	0.06	4.1	A	0	0.08	4.1	A	0
		T	0.06	0.0	A	0	0.08	0.0	A	0
	Intersection		0.09	0.1	NA	0	0.08	0.2	NA	0
Green Ave - Fifth Rd	Green Ave - south	L	0.15	4.2	A	1	0.10	4.2	A	0
		T	0.15	4.3	A	1	0.10	4.3	A	0
		R	0.15	8.3	A	1	0.10	8.3	A	0
	Carpark Access - east	L	0.00	5.0	A	0	0.00	5.0	A	0
		T	0.00	5.0	A	0	0.00	5.1	A	0
		R	0.00	9.0	A	0	0.00	9.1	A	0
	Green Ave - north	L	0.10	4.4	A	1	0.11	4.3	A	1
		T	0.10	4.5	A	1	0.11	4.4	A	1
		R	0.10	8.5	A	1	0.11	8.5	A	1
	Fifth Rd - west	L	0.05	5.1	A	0	0.03	4.8	A	0
		T	0.05	5.2	A	0	0.03	4.8	A	0
		R	0.05	9.2	A	0	0.03	8.8	A	0
	Intersection		0.15	5.0	A	1	0.11	4.8	A	1
Commerce Ave - Northern Carpark Access	Commerce Ave - south	L	0.13	5.5	A	0	0.18	5.5	A	0
		T	0.13	0.0	A	0	0.18	0.0	A	0
	Commerce Ave - north	T	0.19	0.1	A	0	0.22	0.0	A	0
		R	0.19	6.5	A	0	0.22	7.0	A	0
	Carpark Access - west	L	0.01	6.3	A	0	0.03	6.7	A	0
		R	0.01	8.1	A	0	0.03	9.5	A	0
Intersection		0.19	0.4	NA	0	0.22	0.3	NA	0	
Commerce Ave - Eastern Carpark Access	Commerce Ave - south	L	0.15	5.7	A	0	0.13	5.7	A	0
		T	0.15	0.0	A	0	0.13	0.0	A	0
	Commerce Ave - north	T	0.12	0.6	A	0	0.18	0.3	A	0
		R	0.12	5.2	A	0	0.18	4.9	A	0
	Carpark Access - west	L	0.01	6.3	A	0	0.03	6.1	A	0
		R	0.01	7.2	A	0	0.04	7.7	A	0
Intersection		0.15	1.1	NA	0	0.18	1.7	NA	0	
Commerce Ave - William St - Bus Exit	Commerce Ave - south	T	0.09	0.0	A	0	0.07	0.0	A	0
		R	0.09	6.4	A	0	0.07	8.2	A	0
	William St - east	L	0.00	5.8	A	0	0.01	6.0	A	0
		R	0.10	7.4	A	0	0.08	8.0	A	0
	Commerce Ave - north	L	0.08	5.6	A	0	0.16	5.5	A	0
		T	0.08	0.0	A	0	0.16	0.0	A	0
	Bus Exit - west	L	0.03	8.2	A	0	0.04	7.9	A	0
Intersection		0.10	2.8	NA	0	0.16	3.0	NA	0	

Table 7 2022 (existing) summary of access points operational performance

Intersection	Approach	Movement	2022 AM Peak - Project Case				2026 AM Peak - Project Case				2036 AM Peak - Project Case			
			DOS	Ave Delay (s)	LOS	95%ile Queue (veh)	DOS	Ave Delay (s)	LOS	95%ile Queue (veh)	DOS	Ave Delay (s)	LOS	95%ile Queue (veh)
Green Ave - Fifth Rd	Green Ave - south	L	0.17	4.3	A	1	0.19	4.5	A	1	0.29	4.8	A	2
		T	0.17	4.4	A	1	0.19	4.5	A	1	0.29	4.8	A	2
		R	0.17	8.4	A	1	0.19	8.5	A	1	0.29	8.7	A	2
		Approach	0.17	4.4	A	1	0.19	4.6	A	1	0.29	4.9	A	2
	Carpark Access - east	L	0.03	5.0	A	0	0.03	5.3	A	0	0.05	6.1	A	0
		T	0.03	5.1	A	0	0.03	5.3	A	0	0.05	6.2	A	0
		R	0.03	9.1	A	0	0.03	9.3	A	0	0.05	10.2	B	0
		Approach	0.03	8.0	A	0	0.03	8.2	A	0	0.05	9.1	A	0
	Green Ave - north	L	0.10	4.4	A	1	0.12	4.6	A	1	0.22	5.1	A	1
		T	0.10	4.6	A	1	0.12	4.7	A	1	0.22	5.3	A	1
		R	0.10	8.5	A	1	0.12	8.6	A	1	0.22	9.2	A	1
		Approach	0.10	4.7	A	1	0.12	5.4	A	1	0.22	6.2	A	1
	Fifth Rd - west	L	0.05	5.3	A	0	0.08	5.4	A	0	0.17	6.1	A	1
		T	0.05	5.3	A	0	0.08	5.5	A	0	0.17	6.2	A	1
		R	0.05	9.3	A	0	0.08	9.5	A	0	0.17	10.2	B	1
		Approach	0.05	8.9	A	0	0.08	9.1	A	0	0.17	9.6	A	1
Intersection			0.17	5.3	A	1	0.19	5.7	A	1	0.29	6.4	A	2
Commerce Ave – Bus Access	Commerce Ave - south	L	0.13	7.1	A	0	0.14	7.1	A	0	0.16	7.1	A	0
		T	0.13	0.0	A	0	0.14	0.0	A	0	0.16	0.0	A	0
		Approach	0.13	0.5	NA	0	0.14	0.4	NA	0	0.16	0.4	NA	0
	Commerce Ave - north	T	0.19	0.0	A	0	0.19	0.0	A	0	0.20	0.0	A	0
		R	0.19	8.9	A	0	0.19	9.3	A	0	0.20	10.1	B	0
		Approach	0.19	0.1	NA	0	0.19	0.1	NA	0	0.20	0.1	NA	0
	Bus Access - west	L	0.05	8.7	A	0	0.05	8.9	A	0	0.05	9.3	A	0
		R	0.05	14.3	B	0	0.05	14.8	B	0	0.05	16.0	C	0
		Approach	0.05	13.6	B	0	0.05	14.0	B	0	0.05	15.2	C	0
	Intersection			0.19	0.6	NA	0	0.19	0.6	NA	0	0.20	0.6	NA
Commerce Ave - William St – Carpark	Commerce Ave - south	L	0.09	5.5	A	0	0.11	5.5	A	0	0.13	5.5	A	0
		T	0.09	0.0	A	0	0.11	0.0	A	0	0.13	0.0	A	0
		R	0.09	6.8	A	0	0.11	7.3	A	0	0.13	7.9	A	0
		Approach	0.09	1.1	NA	0	0.11	1.0	NA	0	0.13	1.1	NA	0
	William St - east	L	0.00	5.7	A	0	0.00	5.8	A	0	0.00	5.9	A	0
		T	0.10	5.8	A	0	0.12	6.1	A	0	0.17	6.8	A	1
		R	0.10	7.2	A	0	0.12	7.5	A	0	0.17	8.3	A	1
		Approach	0.10	7.1	A	0	0.12	7.5	A	0	0.17	8.2	A	1
	Commerce Ave - north	L	0.10	5.5	A	0	0.11	5.5	A	0	0.14	5.5	A	0
		T	0.10	0.0	A	0	0.11	0.0	A	0	0.14	0.0	A	0
		R	0.10	7.0	A	0	0.11	7.4	A	0	0.14	8.0	A	0
		Approach	0.10	3.3	NA	0	0.11	3.2	NA	0	0.14	3.4	NA	0
	Carpark Access - west	L	0.01	5.9	A	0	0.01	6.0	A	0	0.02	6.2	A	0
		T	0.01	5.8	A	0	0.01	6.1	A	0	0.02	6.7	A	0
		R	0.01	6.8	A	0	0.01	7.1	A	0	0.02	7.7	A	0
		Approach	0.01	6.4	A	0	0.01	6.6	A	0	0.02	7.1	A	0
Intersection			0.10	3.2	NA	0	0.12	3.2	NA	0	0.17	3.5	NA	1

Table 8 2022, 2026 and 2036 AM peak summary of project case access points operational performance

Intersection	Approach	Movement	2022 AM Peak - Project Case				2026 AM Peak - Project Case				2036 AM Peak - Project Case				
			DOS	Ave Delay (s)	LOS	95%ile Queue (veh)	DOS	Ave Delay (s)	LOS	95%ile Queue (veh)	DOS	Ave Delay (s)	LOS	95%ile Queue (veh)	
Green Ave - Fifth Rd	Green Ave - south	L	0.10	4.3	A	1	0.12	4.4	A	1	0.17	4.6	A	1	
		T	0.10	4.4	A	1	0.12	4.5	A	1	0.17	4.6	A	1	
		R	0.10	8.4	A	1	0.12	8.5	A	1	0.17	8.6	A	1	
		Approach	0.10	4.4	A	1	0.12	4.5	A	1	0.17	4.7	A	1	
	Carpark Access - east	L	0.05	5.1	A	0	0.06	5.2	A	0	0.07	5.4	A	0	
		T	0.05	5.1	A	0	0.06	5.3	A	0	0.07	5.4	A	0	
		R	0.05	9.1	A	0	0.06	9.3	A	0	0.07	9.4	A	0	
		Approach	0.05	6.7	A	0	0.06	6.9	A	0	0.07	7.0	A	0	
	Green Ave - north	L	0.11	4.3	A	1	0.12	4.4	A	1	0.15	4.7	A	1	
		T	0.11	4.4	A	1	0.12	4.5	A	1	0.15	4.8	A	1	
		R	0.11	8.6	A	1	0.12	8.7	A	1	0.15	9.1	A	1	
		Approach	0.11	4.6	A	1	0.12	5.1	A	1	0.15	5.9	A	1	
	Fifth Rd - west	L	0.03	4.9	A	0	0.05	5.0	A	0	0.10	5.4	A	0	
		T	0.03	4.9	A	0	0.05	5.0	A	0	0.10	5.4	A	0	
		R	0.03	8.9	A	0	0.05	9.0	A	0	0.10	9.4	A	0	
		Approach	0.03	8.3	A	0	0.05	8.4	A	0	0.10	8.8	A	0	
Intersection			0.11	5.2	A	1	0.12	5.5	A	1	0.17	6.1	A	1	
Commerce Ave – Bus Access	Commerce Ave - south	L	0.19	7.1	A	0	0.20	7.1	A	0	0.23	7.1	A	0	
		T	0.19	0.0	A	0	0.20	0.1	A	0	0.23	0.1	A	0	
		Approach	0.19	0.3	NA	0	0.20	0.3	NA	0	0.23	0.3	NA	0	
	Commerce Ave - north	T	0.23	0.0	A	0	0.23	0.0	A	0	0.24	0.0	A	0	
		R	0.23	18.9	C	0	0.23	20.1	C	0	0.24	24.0	C	0	
		Approach	0.23	0.3	NA	0	0.23	0.3	NA	0	0.24	0.3	NA	0	
	Bus Access - west	L	0.06	9.8	A	0	0.07	10.0	B	0	0.08	10.8	B	0	
		R	0.06	18.9	C	0	0.07	19.4	C	0	0.08	22.0	C	0	
		Approach	0.06	16.0	C	0	0.07	16.4	C	0	0.08	18.5	C	0	
	Intersection			0.23	0.7	NA	0	0.23	0.7	NA	0	0.24	0.7	NA	0
Commerce Ave - William St - Carpark	Commerce Ave - south	L	0.07	5.5	A	0	0.09	5.5	A	0	0.11	5.5	A	0	
		T	0.07	0	A	0	0.09	0.0	A	0	0.11	0.0	A	0	
		R	0.07	8.5	A	0	0.09	9.5	A	0	0.11	11.3	B	0	
		Approach	0.07	1.8	NA	0	0.09	1.8	NA	0	0.11	2.2	NA	0	
	William St - east	L	0.01	5.9	A	0	0.01	6.0	A	0	0.01	6.2	A	0	
		T	0.08	6	A	0	0.10	6.5	A	0	0.14	7.4	A	0	
		R	0.08	7.6	A	0	0.10	8.2	A	0	0.14	9.3	A	0	
	Approach	Approach	0.08	7.3	A	0	0.10	7.9	A	0	0.14	8.8	A	0	
		L	0.16	5.6	A	0	0.19	5.6	A	0	0.25	5.6	A	0	
		T	0.16	0	A	0	0.19	0.0	A	0	0.25	0.0	A	0	
	Commerce Ave - north	R	0.16	6.9	A	0	0.19	7.2	A	0	0.25	7.8	A	0	
		Approach	0.16	3.2	NA	0	0.19	3.0	NA	0	0.25	3.1	NA	0	
		L	0.05	5.8	A	0	0.05	5.9	A	0	0.07	6.0	A	0	
	Carpark Access - west	T	0.05	6.3	A	0	0.05	6.9	A	0	0.07	8.1	A	0	
		R	0.05	7	A	0	0.05	7.4	A	0	0.07	8.2	A	0	
		Approach	0.05	6.3	A	0	0.05	6.5	A	0	0.07	6.9	A	0	
	Intersection			0.16	3.6	NA	0	0.19	3.6	NA	0	0.25	3.9	NA	0

Table 9 2022, 2026 and 2036 PM peak summary of project case access points operational performance

11 Impact on Surrounding Roads

It has been demonstrated that very little change in traffic generated by the station is expected between 2022 and the opening year of 2026. As a result, it is not expected that the redevelopment of the station will contribute to any issues on the road network. It is more likely that the removal of the at-grade crossings at Forrest Road and Church Avenue will result in an improvement in the operation of the surrounding roads, and this was confirmed in the 2036 SIDRA assessment undertaken by WSP and documented in their “Byford Rail Extension, Future Year Traffic Impact Analysis, Armadale” report.

The biggest change to traffic volumes on the surrounding roads is due to the rationalisation of access points, relocation of the bus access, and the likely travel between Commerce Avenue and Green Avenue for KNR traffic i.e. KNR traffic entering from Commerce Avenue is likely to exit via Green Avenue, and vice versa. The expected changes can be estimated by comparing the data from Figure 11 and Figure 30 (for the AM peak) and Figure 12 and Figure 31 (for the PM peak). The most significant impact is a minor increase in traffic on Green Avenue of around 20vph, both southbound, south of Fifth Road (an increase from around 160vph to 180vph) and northbound, north of Fifth Road (an increase from around 100vph to 120vph) in the worst case PM peak traffic period. Such minor increases are well within the function and capacity of Green Avenue and its intersections.

Conversely, some sections of Commerce Avenue may experience a reduction in traffic to a similar scale.

Should KNR patrons prefer to circulate through the carpark to exit at the same point as their entry, any change will be less significant than reported.

Into the longer term, mode share targets indicate that fewer patrons (compared to 2026) are expected to use private vehicles to access/leave the station. There should therefore be a corresponding reduction in private vehicle trip generation at the station from current levels. Regardless, existing mode share at the station has been assumed for the future year assessment which indicates that the additional traffic can be accommodated at the access points, and therefore not expected to present any issues in the broader road network.

12 Impact on Intersections

As previously mentioned, in a meeting at the project outset (held on 14 July 2022), the approach to the traffic assessment was outlined and agreed, which included focussing any operational assessment on the access points, and not intersections on the adjacent road network. Such an assessment on the nearby intersections was undertaken in some detail by WSP. In that assessment, traffic projections were prepared and approved by Main Roads, and the assessment of access points in this TIA have attempted to remain consistent with those approved projections.

Consistent with Section 11, it has been demonstrated that very little change in traffic generated by the station is expected between 2022 and the opening year of 2026. As a result, it is not expected that the redevelopment of the station will contribute to any operational issues at nearby intersections. It is more likely that the removal of the at-grade crossings at Forrest Road and Church Avenue will result in an improvement in the operation of the surrounding roads and intersections, and this was confirmed in the 2036 SIDRA assessment undertaken by WSP and documented in their “Byford Rail Extension, Future Year Traffic Impact Analysis, Armadale” report.

There has been some consideration of the proximity of the proposed PnR and KnR access point on Commerce Avenue to the intersection of Commerce Avenue/William Street. Whilst it is recognised that greater separation would be more desirable, the proposed access point location is as far south as possible, and any change to this further north (to perhaps align with William Street) would remove any possibility of creating an intended ‘urban lounge’ in this area.

Consideration of potential undesirable interaction between the two intersections has been considered, by looking at the existing turning volumes in/out of William Street. From the traffic surveys undertaken, it is evident that most of the traffic to/from William Street is travelling to/from Commerce Avenue to the north i.e. most of the traffic is turning left into William Street and right out of William Street. Surveys undertaken at this location indicate that only 2 vehicles and 8 vehicles in the AM and PM peak hours respectively turn left from William Street into Commerce Avenue, and 8 vehicles and 10 vehicles in the AM and PM peak hours respectively turn right into William Street. These figures demonstrate that there is very little interaction likely to occur between the William Street intersection and the proposed access point.

In addition, the proposed access point is in the location of the exiting bus exit, and the volume of traffic likely to exit (compared to existing bus numbers), are not dissimilar in magnitude. There are no known existing issues relating to the current situation. Considering this, and the fact that the location is in a slow moving town centre environment with relatively low traffic volumes, the proximity between the proposed Commerce Avenue access point and the William Street intersection is considered a low risk and manageable situation.

13 Impact on Neighbouring Areas

It has been demonstrated that very little change in traffic generated by the station is expected between 2022 and the opening year of 2026 and beyond. As a result, it is not expected that the redevelopment of the station will contribute to any issues in neighbouring areas.

Furthermore the station redevelopment is not likely to have any significant traffic noise or vibration impacts to residential areas. It will only generate the same class of vehicles that are currently utilising the station. As a result no specific traffic noise and vibration analysis is considered necessary and has been undertaken as part of this transport assessment. However there is a noise and vibration report that is part of the overall package of technical documents that will be submitted as part of the DA.

14 Road Safety

It is worth noting that no clear crash patterns were evident in the recorded crashes in the past five years. It has also been demonstrated that very little change in traffic generated by the station is expected between 2022 and the opening year of 2026. As a result, it is not expected that changes in traffic volumes due to the redevelopment of the station will contribute to any safety issues.

Rather the rationalisation of access points is expected to reduce crash risks by reducing the number of potential conflict points, whilst still accommodating traffic in and out of the station at an appropriate level of service. It will also be simpler for patrons with access to a single parking area, completely separate from the bus interchange. In addition, for pedestrian and cyclist traffic on Commerce Avenue and Green Avenue, there is a significant enhancement in safety expected as a result of the rationalisation of vehicular access points, along with appropriate priority for the non-motorised traffic via the zebra/wombat crossings at the access points.

The grade separation of the rail line will remove level crossings at both Forrest Road and Church Avenue. These grade separations are expected to provide significant benefits in terms of both safety and operational efficiency of the road network in the vicinity. It will also provide significant benefits to pedestrians and cyclists in the area.

15 Public Transport Access

Current public transport provisions have been covered in detail in the previous sections.

With respect to a development or redevelopment, the usual aim for this section of the TIA is to assess whether access from the development to the nearest bus stops and/or station is direct, safe and convenient. This TIA is solely focused on the redevelopment of the Armadale Station. The public transport access is proposed via a single access point at the northern end of the site, providing access to/from the new bus interchange area, and circulation within the site. This represents a reduction of crossovers compared to the existing situation, hence reducing potential points of conflict. The access point is expected to operate efficiently as detailed in the previous sections, and with circulation occurring within the site, this minimises any impact or conflict with other road users and pedestrians and cyclists.

16 Pedestrian and Cyclist Access/Amenity

Current pedestrian and cyclist provisions and proposed changes to the pedestrian and cyclist networks have been discussed in sections 2.6, 4.3 and 5.3.2. This section represents a consolidation of information contained in the previous sections, as required in the WAPC TIA Guidelines. For ease of reference, pedestrian and cyclist discussions have been combined.

16.1 Existing Facilities

Pedestrian and cyclists to/from Armadale Station are serviced in terms amenity and accessibility primarily via the presence of shared paths along both Green and Commerce Avenues (essentially around the entire perimeter of the station precinct). The paths have varying degrees of quality, as well as crossing opportunities (of Commerce Avenue and Green Avenue) either side of the main station building. These include a signalised pedestrian crossing between the Jull Street Mall and the station, and a raised crossing on Green Avenue.

16.2 Enhancement of Facilities

Pedestrian and cyclist access routes to/from Armadale Station will be significantly improved through the extension of the PSP to Byford, and the grade separation of the rail line at Forrest Road-Third Road and at Church Avenue. The elevated rail over Forrest Road-Third Road and Church Avenue provides important opportunities to improve the pedestrian linkages in the centre of Armadale. The limitations of existing rail crossings are removed and replaced by uninterrupted pedestrian connections.

In addition to the improved linkages achieved from the grade separations, there will be additional opportunities for pedestrian linkages in the east-west direction through the station precinct. These east-west linkages through the station better integrates the eastern and western parts of the precinct, and will directly service the projected increase in residential development to the west of the station. The station is layout such that the main entrance on the western side carries through to the Jull Street signalised crossing and the broader district and local activity areas previously documented in this TIA.

Additional connections north of Forrest Road will further improve the pedestrian permeability around the City Centre. A new parkland around and underneath the elevated rail continues the green open space network north of the City Centre all the way to the train station.

On Commerce Avenue, the existing signalised pedestrian crossing will continue to provide access between the Jull Street Mall, major commercial areas and the station. There is also consideration of a scheme to widen the existing crossing, to improve pedestrian amenity and safety. On Green Avenue side, the existing raised crossing facility is expected to continue to service pedestrian and cyclist crossing demand safely and conveniently.

For pedestrian and cyclist traffic on Commerce Avenue and Green Avenue, there is a significant enhancement in safety expected as a result of the rationalisation of vehicular access points, along with appropriate priority for the non-motorised traffic via the zebra/wombat crossings at the access points.

These represent enhancements to the existing pedestrian and cyclist networks that will provide significant enhancements for accessibility to the station, and also improve permeability through the precinct and better connections between residents and the town centre and its attractions. Refer to Figure 34 and Figure 35 for schematics of the existing and future pedestrian and cyclist networks.

Whilst the project includes the continuation of the PSP to Byford, future development of the precinct should include the provision of a network of secondary routes that link to key destinations and provide

safe, high-amenity cycling environments will assist in increasing patronage from the immediate catchment and a means of raising the priority of active transport to access the station.



Figure 34 Armadale Station – pedestrian network (MetCONNx)



Figure 35 Armadale Station – cyclist network (MetCONNX)

17 Analysis of Pedestrian/Cycle Networks

Whilst there are some significant enhancements and opportunities created with respect to the pedestrian and cyclist networks, consideration has been given to areas where potential difficulty in crossing roads or undesirable conflict has been identified.

As previously mentioned, the elevated rail provides important opportunities to improve the pedestrian linkages in the centre of Armadale. Along with the PSP through the station precinct, this allows convenient north-south movement and ability to cross the rail line at the northern and southern ends of the precinct. There was some initial concern that there may be difficulties in crossing Forrest Road-Third Road and Church Avenue and that some control intervention may be necessary. To address this, gap acceptance assessments were undertaken at these locations in accordance with Main Roads requirements.

These assessments demonstrated that signalised crossings were not warranted. Regardless, investigations to reduce the crossing distance and provision of central refuges has been undertaken and incorporated into the designs.

The potential impacts of these modifications were assessed by Urbsol during the design development phase (November 2022) and documented in a technical note “Byford Rail Extension, Armadale Station, Lane Configurations Under Rail Crossings” (Urbsol 2022). A copy of this technical note is included in Appendix C.

A number of potential points of conflict on the pedestrian/cycle network within the station precinct were identified as part of the expected pedestrian/cyclist desire lines, and appropriate treatments incorporated. Figure 36 shows the area around the bus interchange. As patrons will embark and disembark in the central island, zebra crossings have been incorporated at the northern and southern ends to ensure safe and efficient connectivity to the shared path and supporting path network to/from the north, and between the bus interchange area and the main station building to the south.

Similarly at the KnR facility on the southern side of the station building, a zebra crossing has been incorporated to allow safe and efficient movement between the building and KnR/short term parking area and beyond. Please refer to Figure 37. Also on this figure, the PSP crosses the entrance to the KnR facility just north of the roundabout at Green Avenue/Fifth Avenue. At this location a zebra crossing has also been provided, along with a raised platform i.e. wombat crossing. This treatment will reduce vehicle speeds and maximise safety with the different surface treatment, appropriate signage and pavement markings, and the raised platform.

For pedestrians/cyclists using the path along Commerce Avenue, consideration was given to priority treatments at the bus station access point and the KnR/PnR access point. By undertaking a gap acceptance assessment, with the key criteria being volumes entering/exiting the access points and the crossing distance, it was established that there are sufficient gaps for pedestrians/cyclists to navigate the crossings, and therefore priority facilities were not considered necessary for operational purposes.

To reduce any crossing risk at the PnR/KnR and bus interchange access points, median islands on the internal approaches, with refuges, will be incorporated into the design at both locations. These will allow pedestrian/cyclist crossings to occur in two stages.

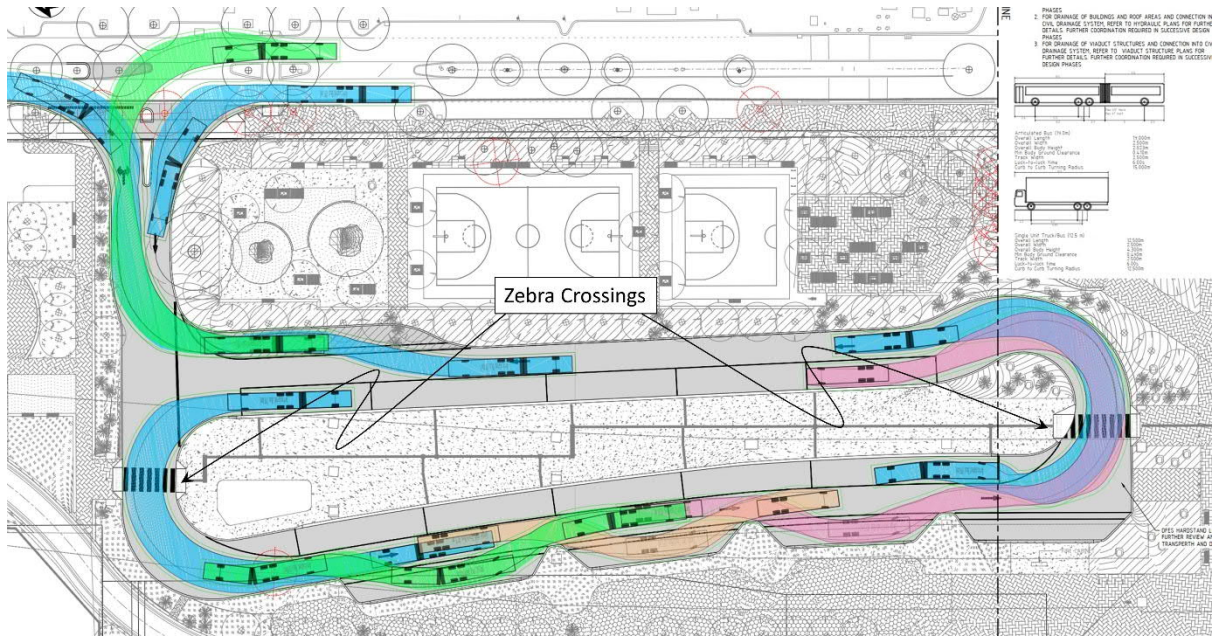


Figure 36 Bus station crossings

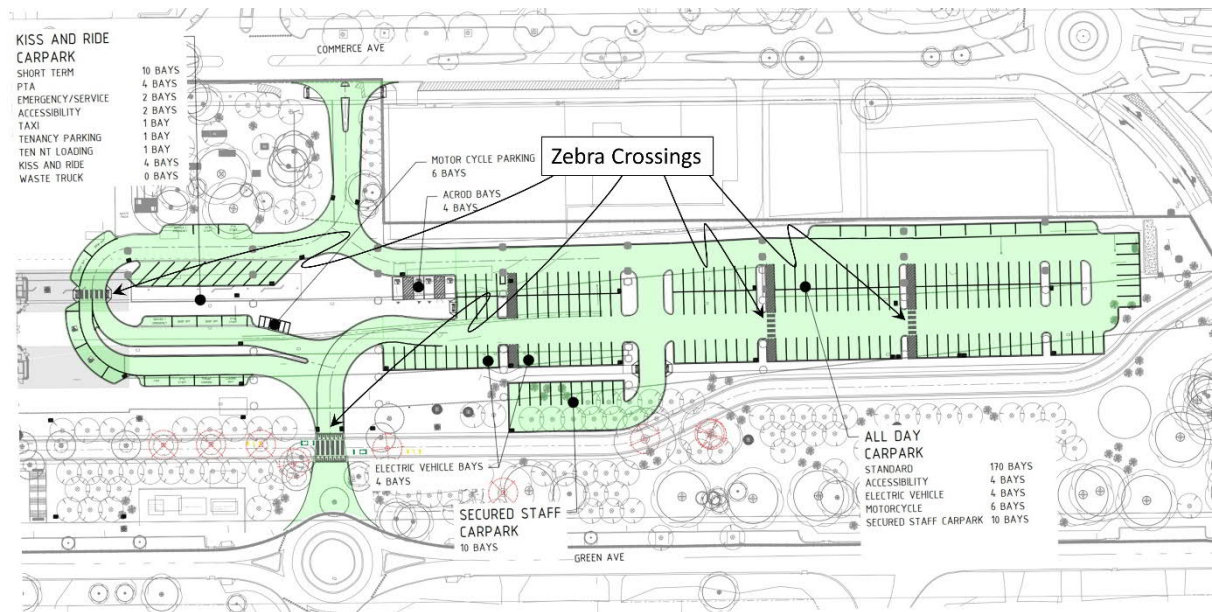


Figure 37 Parking area crossings

18 Safe Walk/Cycle to School

A safe walk/cycle to school assessment is required for residential developments or school developments to assess routes between residential areas and schools in an 800m vicinity, and to identify potential deficiencies to address. As a result, and because the station redevelopment is only likely to enhance facilities between nearby residential areas and schools, it is not considered necessary or applicable to undertake such an assessment for the station redevelopment.

19 Parking

In terms of parking demand, actual demand was checked regularly during the months of January and February 2023, where total parked vehicle counts were recorded at 10.00am and 3.00pm. Over a total of 25 days, the average parking demand was found to be approximately 88 vehicles, with a recorded maximum demand of 119 vehicles. This demand is low relative to the available supply of approximately 240 PnR bays for patrons (approximately 300 bays total).

Considering the relatively low patronage increase expected in the short to medium term, the proposed supply of approximately 170 PnR bays (excluding PTA staff parking) is expected to comfortably accommodate the demand.

In the longer term, mode share targets indicate significantly increased proportions of arrivals via non private vehicle modes, enough to potentially reduce traffic generation to the station.

20 Provision for Service Vehicles

On site loading, emergency access and rubbish collection will be provided for within the KnR area. Dedicated loading and service/emergency bays have been provided within the area, and bulk rubbish collection is proposed to occur in a separate driveway accessed via the KNR roadway as shown in Figure 38. It is understood that both front in entry and reverse entry into the bulk rubbish collection area is required for operational purposes. As such, turning paths in/out of the rubbish collection area for the required design vehicle, for both front in entry and reverse entry, are shown in Figure 39 and Figure 40. It is anticipated that rubbish collection can occur in a safe an efficient manor and the separate driveway will minimise potential conflict and interruption with patrons.

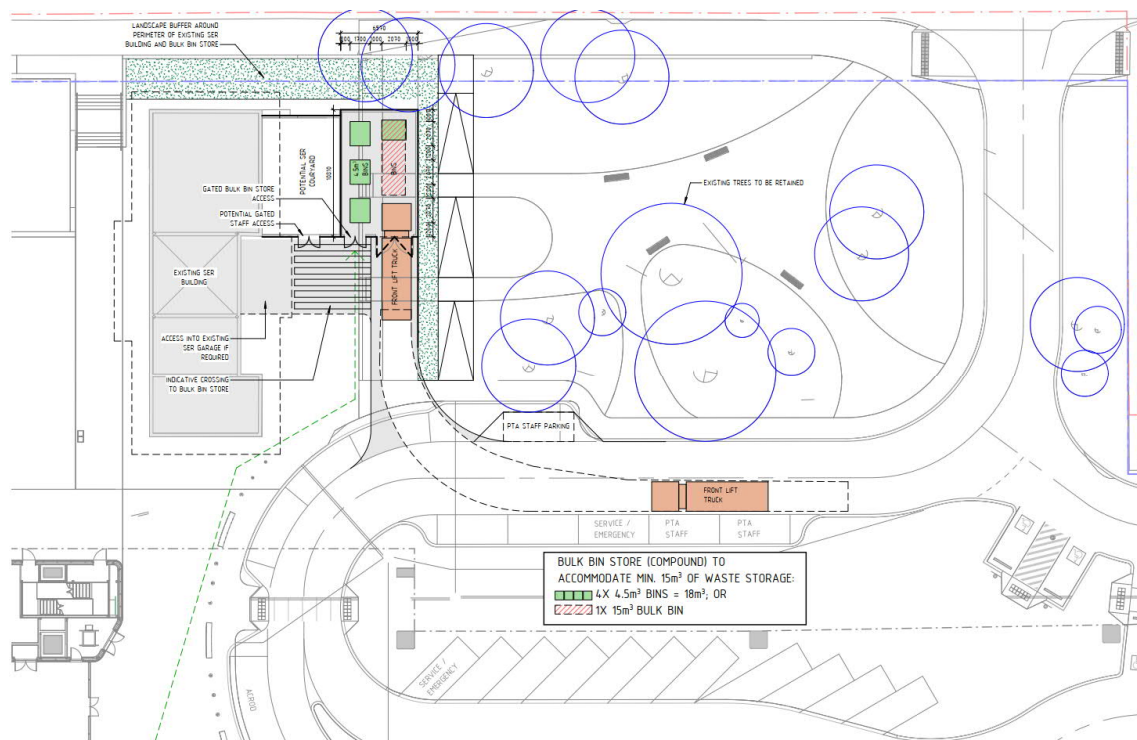


Figure 38 Bulk rubbish collection arrangement

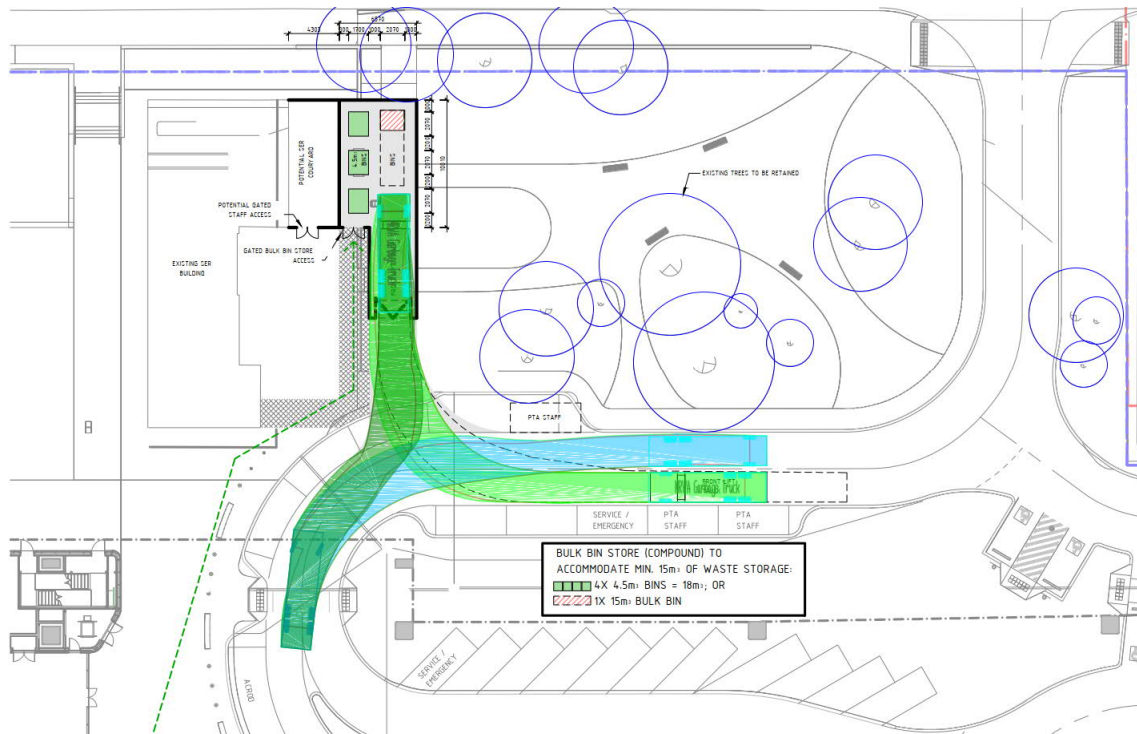


Figure 39 Bulk rubbish collection turning paths (front entry)

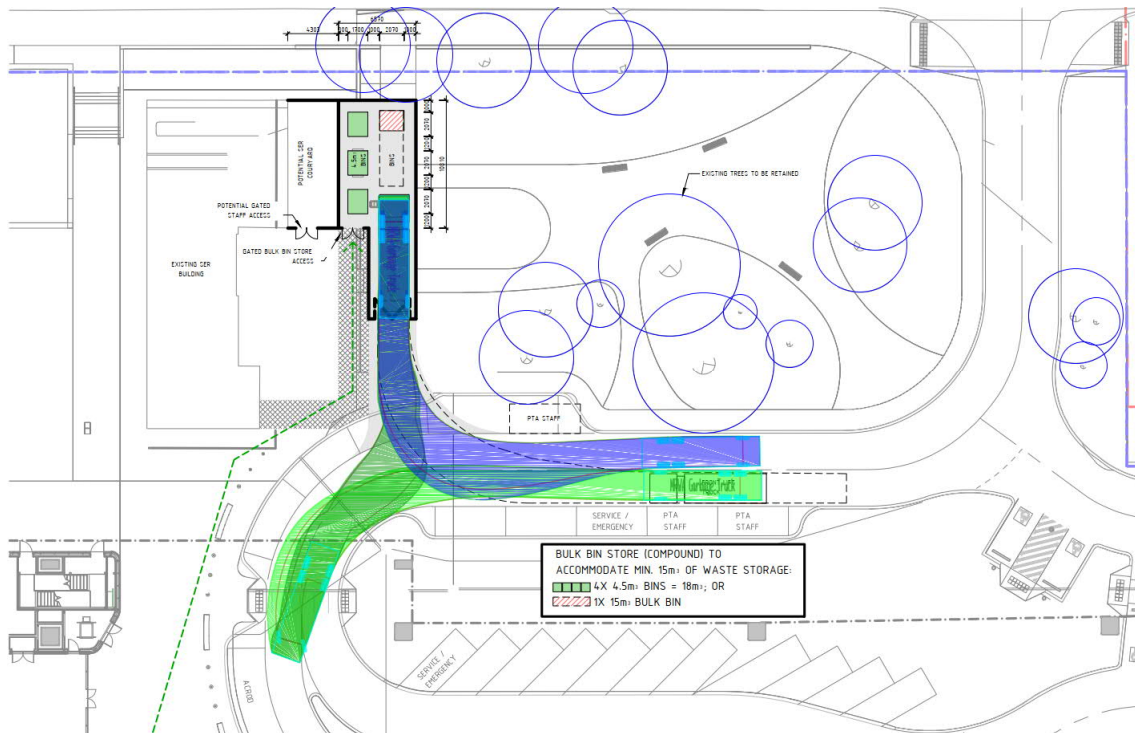


Figure 40 Bulk rubbish collection turning paths (reverse entry)

21 Traffic Management Plan

A management plan is usually required at school sites, and other developments that generate significant activity on the frontage roads. In this instance, most of the activity is planned and facilitated for on site. This includes parking, KnR activity, taxi activity, bus activity, etc. As a result, any assessment of on-street activity of frontage roads is not considered necessary.

Pedestrian and cyclist activity networks including on adjacent roads has already been discussed, as well as the enhancements to those facilities. Also as previously discussed, the rationalisation of station access points will reduce potential for conflict between pedestrians/cyclists and other modes on frontage roads.

22 Conclusions

Urbsol was commissioned by MetCONNx on behalf of the Public Transport Authority (PTA) to prepare a TIA in support of the Development Application (DA) for the redevelopment of the Armadale Station, as part of the Byford Rail Extension (BRE) Design and Construction Project. This report was prepared in accordance with the *Transport Impact Assessment Guidelines, Volume 4 – Individual Developments* (WAPC, August 2016) and builds upon previous planning phase investigations for the BRE project.

The redevelopment of Armadale station includes grade separating the rail line from the adjacent road network, a reconfiguration of the Park N Ride, Kiss N Ride, bus interchange facilities as well as the access arrangement and cyclist/pedestrian path network.

The grade separation of the existing level crossings at both Forrest Road-Third Road and Church Avenue is expected to provide significant benefits in terms of both safety and operational efficiency of the road network in the vicinity.

In terms of station access, the proposed station layout intends to rationalise the number of existing access points (7 in total) to 3. This reduction in the total number of access points is expected to reduce crash risks by reducing the number of potential conflict points, whilst still accommodating traffic in and out of the station at an appropriate level of service. It will also be simpler for patrons with access to a single parking area, completely separate from the bus interchange.

In the context for this TIA, the operational assessment of the access points was undertaken for the critical combined network/station peak. Traffic generated at the station was estimated by factoring up existing traffic at the station in the same proportions as passenger growth projections. The result was minimal additional traffic generated at opening (2026), and approximately 60 trips (AM peak) and 100 trips (PM peak) additional trips in 2036 compared to 2022.

The operational assessment undertaken indicated that the proposed access points are expected to operate well, with low degrees of saturation, minimal delays and minimal queueing. The 2026 and 2036 assessments indicated little change from the assessment that used 2022 traffic volumes. Due to the low traffic generated by the proposed redevelopment, it is not expected that the redevelopment will contribute to any operational issues at surrounding roads, nearby intersections, or neighbouring areas.

With respect to pedestrian/cyclist amenity, there are some significant enhancements and opportunities created with the redevelopment, including the extension of the PSP to Byford and grade separation of the rail operations, resulting in significant enhancements to accessibility and permeability. Consideration has been given to areas where potential difficulty in crossing roads or undesirable conflict has been identified, and appropriate treatments incorporated into the design.

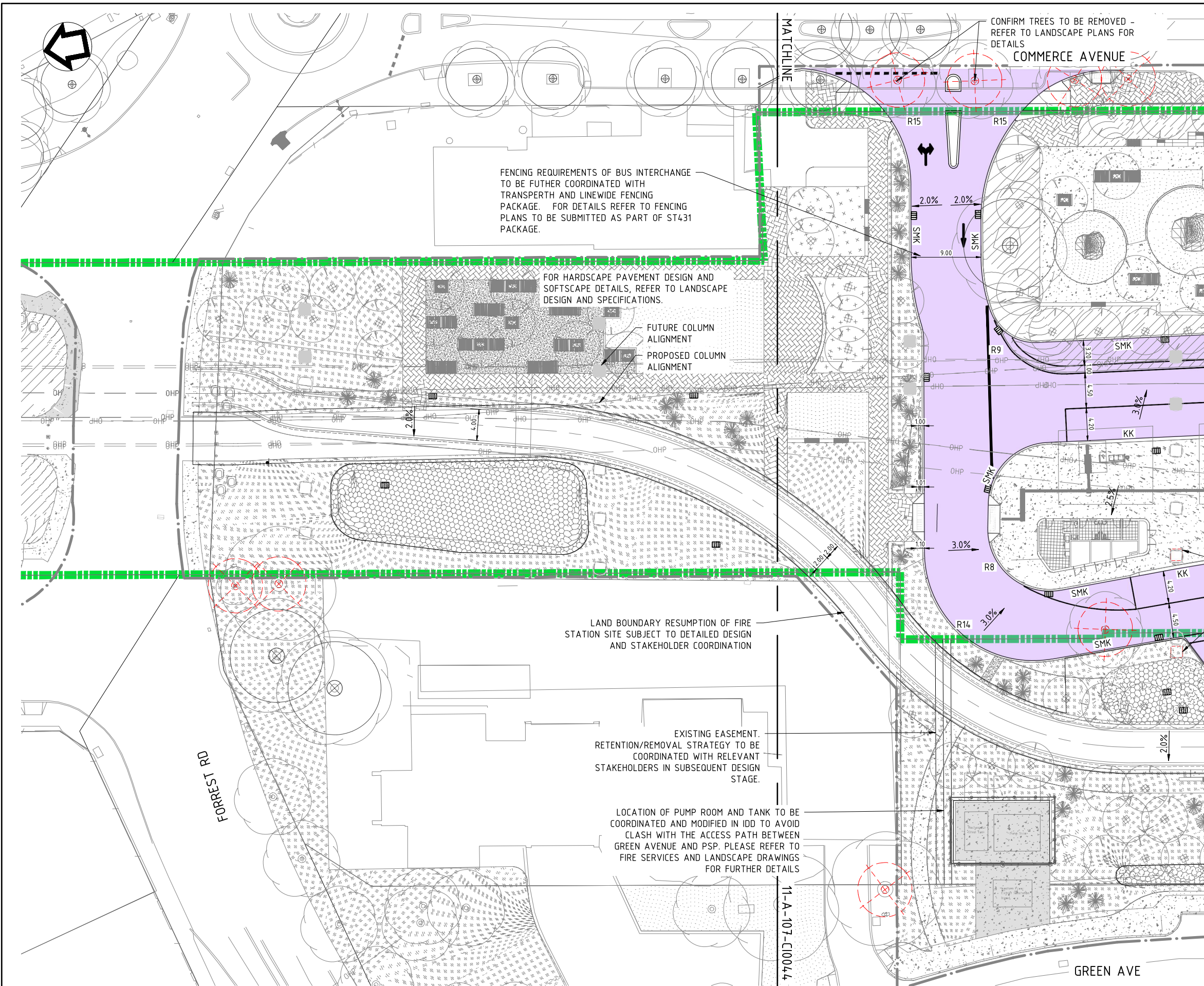
Public Transport access is largely unimpacted by the proposed redevelopment, apart from minor route alterations to the location of the proposed access point (to the bus interchange area) at the northern end of the site on Commerce Avenue.

As a result of the assessment undertaken and with regard to the objectives of the TA, it can be concluded that the proposed station redevelopment:

- and its associated proposals provides for safe and efficient access for all modes to the site
- is well-integrated with surrounding land uses
- does not adversely impact on the surrounding land uses
- does not adversely impact on the surrounding transport networks or its users

Appendix A

Armadale Station Redevelopment Plans



- NOTES**
- BUS STOP LAYOUT DRAWINGS TO BE DEVELOPED IN THE SUBSEQUENT DESIGN STAGE
 - REFER TO LANDSCAPE DRAWINGS FOR HARDSCAPE AND SOFTSCAPE PAVEMENT DETAILS AND SPECIFICATIONS INCLUDING PSHP/DUP
 - FOR DRIVER CRIB FACILITIES AND PUBLIC AMENITIES REFER TO ARCHITECTURAL DRAWINGS
 - REFER TO BUILDING SERVICES DRAWINGS FOR SERVICING REQUIREMENTS AND CONNECTIONS TO CRIB FACILITY AND PUBLIC AMENITIES
 - FOR PLATFORM AND STATION BUILDING DESIGN, DETAILS AND SPECIFICATIONS REFER TO ARCHITECTURAL DRAWINGS PACKAGE AR225
 - FOR TRACKS, VIADUCT AND COLUMN ALIGNMENTS REFER TO LINEWIDE VIADUCT STRUCTURAL DRAWING PACKAGE ST170
 - GRADIENTS ACROSS PEDESTRIAN WALKWAYS ARE DESIGNED TO BE DDA COMPLIANT. IN INSTANCES WHERE GRADIENTS ARE HIGHER THAN 1 IN 40 (1 IN 20 MAXIMUM) LANDINGS ARE PROVIDED EVERY 20.0M IN ACCORDANCE WITH SWTC AND PTA SPECIFICATIONS
 - SOME PEDESTRIAN AREAS DO ACCOUNT FOR GRADIENTS HIGHER THAN 1 IN 20. THESE AREAS ARE BEING COORDINATED BETWEEN LANDSCAPE AND CIVIL DURING IDC AND WILL BE RESOLVED AND A COMPLIANT GRADIENT WILL BE ADOPTED PRIOR TO RD SUBMISSION TO PTA
 - THE MAIN CAR PARK PROVIDES 183 ALL-DAY CAR PARKING BAYS (INCLUDING 4 ACROD AND 4 ELECTRICAL VEHICLE BAYS), 6 x MOTORCYCLE BAYS, 14 x STAFF CARPARKING BAYS (SECURED)
 - THE SHORT TERM CARPARK AREA ACCOUNTS FOR 10 x SHORT-TERM CAR BAYS, 4 x PTA BAYS, 2 x EMERGENCY/SERVICE VEHICLE BAYS, 2 x ACROD BAYS, 1 x TAXI RANK, 1 x TENANCY PARKING, 1 x TENANCY LOADING, 4 x KISS AND RIDE BAYS AND 1 x WASTE TRUCK BAY
 - FUTURE PROOFING ASSESSMENT FOR ADDITIONAL 73 CAR BAYS HAS BEEN UNDERTAKEN AND IS INTENDED TO BE LANDSCAPED INITIALLY. CONSTRUCTION OF THE FUTURE CAR PARK TO BE UNDERTAKEN BY OTHERS
 - FOR FENCING LAYOUT AND DETAILS REFER TO DESIGN PACKAGE ST-431 EXTENT DETAILS SUBJECT TO FURTHER COORDINATION AND APPROVAL WITH PTA

PROPOSED COLUMN RELOCATIONS ACCEPTED IN PRINCIPLE BY VIADUCT STRUCTURES DESIGN. TO BE DEVELOPED AND VERIFIED BY VIADUCT STRUCTURAL PACKAGE. DETAILS TO BE CONFIRMED IN SUBSEQUENT DESIGN

CAUTION: HIGH PRESSURE GAS IN VICINITY.
CONTRACTOR TO LOCATE AND DETERMINE DEPTH PRIOR TO COMMENCEMENT OF WORKS. ALL WORK UNDERTAKEN WITHIN PROXIMITY OF THE PIPELINE SHALL BE IN ACCORDANCE WITH THE RELEVANT AUTHORITY REQUIREMENTS.

CAUTION: FIBRE OPTIC CABLE IN VICINITY.
CONTRACTOR TO LOCATE AND DETERMINE DEPTH PRIOR TO COMMENCEMENT OF WORKS. ALL WORK UNDERTAKEN WITHIN PROXIMITY OF THE CABLE SHALL BE IN ACCORDANCE WITH THE RELEVANT AUTHORITY REQUIREMENTS.



REFERENCE DESIGN

BYFORD RAIL EXTENSION

ARMADALE PRECINCT
CIVIL WORKS
ROAD LAYOUT PLAN - SHEET 1 OF 5
PTA Drawing No: 11-A-107-C10043

REV	DATE	AMENDMENT	DSN	DRN	CHK	APP
C.01.01	17/05/23	ISSUED FOR IDD - IDC	R.T.	M.B.	R.T.	A.E.
B	08/02/23	RE-ISSUED FOR RD	R.T.	M.B.	F.O.	A.E.
A	05/08/22	ISSUED FOR RD - PTA REVIEW	R.T.	M.B.	Y.K.	A.E.

ORIG SIZE: **A1**

AT ORIGINAL PLOT SIZE

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REFERENCES

XR01GN_CADAstral_BDY_PCG2020
R30-MET-XRF-CI-200-00001
R30-MET-XRF-CI-200-00002
R30-MET-XRF-CI-200-00003
XR01GN_SURVEY_PCG2020
R30-UOL-XRF-LA-230-00001
LOGO_METCONNX
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R30-WWH-XRF-AR-225-00001
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XR01UT_UTILITIES_PCG2020
R30-MET-XRF-ST-431-00001
XR01GN_ENVIRONMENTAL_SITES_PCG2020

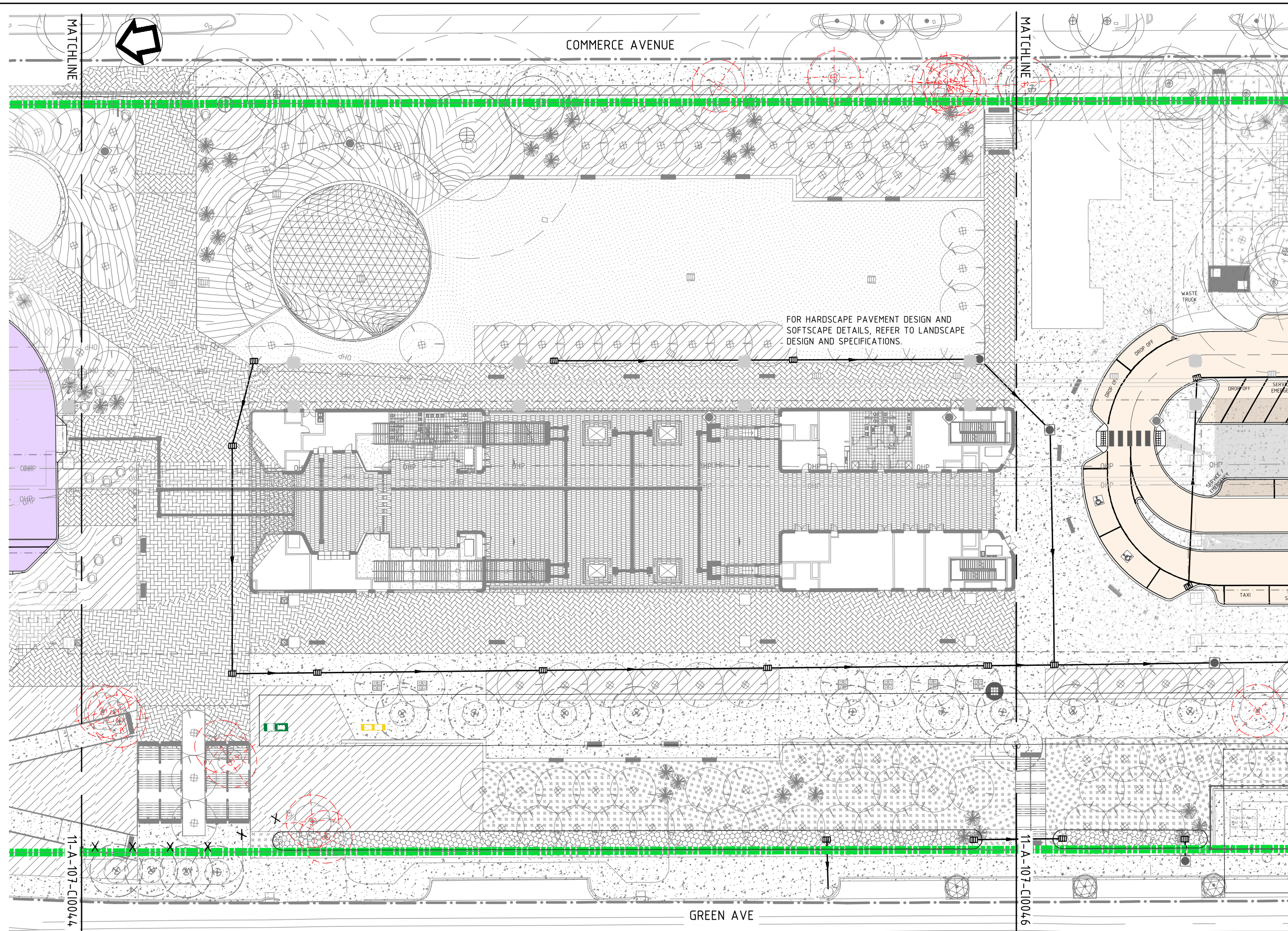
SCALE

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DATUM

HORIZONTAL: PCG2020
VERTICAL: AHD71

DESIGNED R. THOMPSON
DRAWN M. BIGH-SHEPPARD
CHECKED R. THOMPSON
APPROVED A. EYRES
DATE 17/05/23



FOR HARDSCAPE PAVEMENT DESIGN AND SOFTSCAPE DETAILS, REFER TO LANDSCAPE DESIGN AND SPECIFICATIONS.

- NOTES**
- BUS STOP LAYOUT DRAWINGS TO BE DEVELOPED IN THE SUBSEQUENT DESIGN STAGE
 - REFER TO LANDSCAPE DRAWINGS FOR HARDSCAPE AND SOFTSCAPE PAVEMENT DETAILS AND SPECIFICATIONS
 - FOR DRIVER CRIB FACILITIES AND PUBLIC AMENITIES REFER TO ARCHITECTURAL DRAWINGS
 - REFER TO BUILDING SERVICES DRAWINGS FOR SERVING REQUIREMENTS AND CONNECTIONS TO CRIB FACILITY AND PUBLIC AMENITIES
 - FOR PLATFORM AND STATION BUILDING DESIGN, DETAILS AND SPECIFICATIONS REFER TO ARCHITECTURAL DRAWINGS PACKAGE AR225
 - FOR TRACKS, VIADUCT AND COLUMN ALIGNMENTS REFER TO LINEWIDE VIADUCT STRUCTURAL DRAWING PACKAGE ST170
 - GRADIENTS ACROSS PEDESTRIAN WALKWAYS ARE DESIGNED TO BE DDA COMPLIANT. IN INSTANCES WHERE GRADIENTS ARE HIGHER THAN 1 IN 40 (1 IN 20 MAXIMUM) LANDINGS ARE PROVIDED EVERY 20.0M IIN ACCORDANCE WITH SWTC AND PTA SPECIFICATIONS
 - SOME PEDESTRIAN AREAS DO ACCOUNT FOR GRADIENTS HIGHER THAN 1 IN 20. THESE AREAS ARE BEING COORDINATED BETWEEN LANDSCAPE AND CIVIL DURING IDC AND WILL BE RESOLVED AND A COMPLIANT GRADIENT WILL BE ADOPTED PRIOR TO RD SUBMISSION TO PTA
 - THE MAIN CAR PARK PROVIDES 183 ALL-DAY CAR PARKING BAYS (INCLUDING 4 ACROD AND 4 ELECTRICAL VEHICLE BAYS), 6 x MOTORCYCLE BAYS, 14 x STAFF CARPARKING BAYS (SECURED)
 - THE SHORT TERM CARPARK AREA ACCOUNTS FOR 10 x SHORT-TERM CAR BAYS, 4 x PTA BAYS, 2 x EMERGENCY/SERVICE VEHICLE BAYS, 2 x ACROD BAYS, 1 x TAXI RANK, 1 x TENANCY PARKING, 1 x TENANCY LOADING, 4 x KISS AND RIDE BAYS AND 1 x WASTE TRUCK BAY
 - FUTURE PROOFING ASSESSMENT FOR ADDITIONAL 73 CAR BAYS HAS BEEN UNDERTAKEN AND IS INTENDED TO BE LANDSCAPED INITIALLY. CONSTRUCTION OF THE FUTURE CAR PARK TO BE UNDERTAKEN BY OTHERS
 - FOR FENCING LAYOUT AND DETAILS REFER TO DESIGN PACKAGE ST-431 EXTENT DETAILS SUBJECT TO FURTHER COORDINATION AND APPROVAL WITH PTA



CAUTION: HIGH PRESSURE GAS IN VICINITY.
CONTRACTOR TO LOCATE AND DETERMINE DEPTH PRIOR TO COMMENCEMENT OF WORKS. ALL WORK UNDERTAKEN WITHIN PROXIMITY OF THE PIPELINE SHALL BE IN ACCORDANCE WITH THE RELEVANT AUTHORITY REQUIREMENTS.

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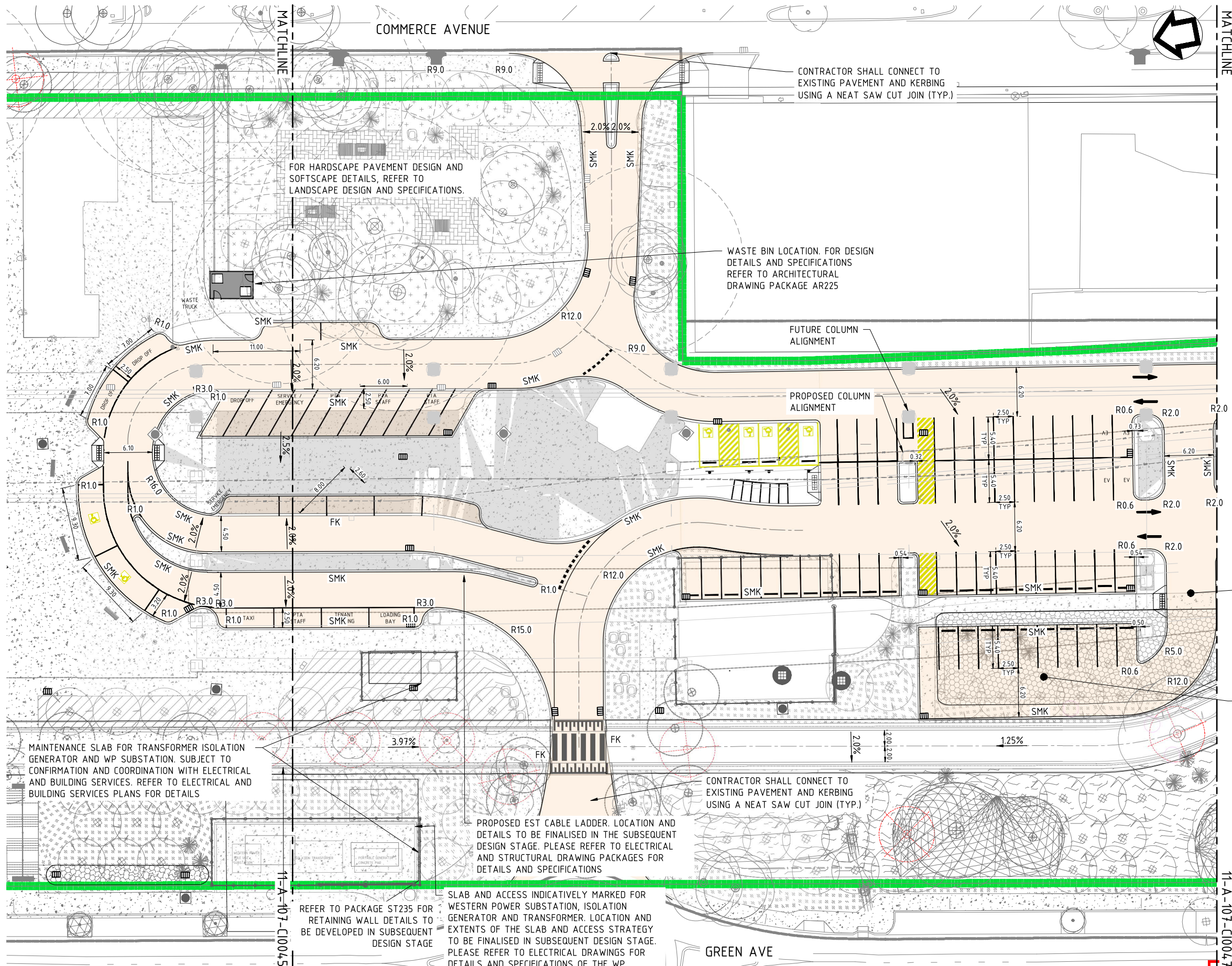
REFERENCE DESIGN	
DESIGNED	R. THOMPSON
DRAWN	M. BLIGH-SHEPPARD
CHECKED	R. THOMPSON
APPROVED	A. EYRES
DATE	17/05/23
BYFORD RAIL EXTENSION	
ARMADALE PRECINCT	
CIVIL WORKS	
ROAD LAYOUT PLAN - SHEET 3 OF 5	
PTA Drawing No:	11-A-107-C10045
Rev:	B

C.0101	17/05/23	ISSUED FOR IDD - IDC	R.T.	M.B.	R.T.	A.E.
B	08/02/23	RE-ISSUED FOR RD	R.T.	M.B.	F.O.	A.E.
A	05/08/22	ISSUED FOR RD - PTA REVIEW	R.T.	M.B.	Y.K.	A.E.
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ORIG SIZE	0 10 20 30 40 50 100mm		This document must not be copied without PTA's written permission, and the contents thereof must not be imparted to a third party nor be used for any unauthorised purpose.			
A1	AT ORIGINAL PLOT SIZE		Contractor No: R30-MET-DWG-CI-200-05002 Rev: C.0101			



REFERENCES	
XR01GN_CADAstral_BDY_PCG2020	
R30-MET-XRF-CI-200-00001	
R30-MET-XRF-CI-200-00002	
R30-MET-XRF-CI-200-00003	
R30-WWH-XRF-AR-225-00001	
R30-UDL-DWG-LA-230-00001	
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LOGO_METCONNX	
XR01UT_UTILITIES_PCG2020	
R30-MET-XRF-ST-431-00001	

SCALE	
1:250	
DATUM	
HORIZONTAL:	PCG2020
VERTICAL:	AHD71



- NOTES**
- BUS STOP LAYOUT DRAWINGS TO BE DEVELOPED IN THE SUBSEQUENT DESIGN STAGE
 - REFER TO LANDSCAPE DRAWINGS FOR HARDSCAPE AND SOFTSCAPE PAVEMENT DETAILS AND SPECIFICATIONS
 - FOR DRIVER CRIB FACILITIES AND PUBLIC AMENITIES REFER TO ARCHITECTURAL DRAWINGS
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 - FOR TRACKS, VIADUCT AND COLUMN ALIGNMENTS REFER TO LINEWIDE VIADUCT STRUCTURAL DRAWING PACKAGE ST170
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 - FOR FENCING LAYOUT AND DETAILS REFER TO DESIGN PACKAGE ST-431. EXTENT DETAILS SUBJECT TO FURTHER COORDINATION AND APPROVAL WITH PTA



CAUTION: HIGH PRESSURE GAS IN VICINITY.
 CONTRACTOR TO LOCATE AND DETERMINE DEPTH PRIOR TO COMMENCEMENT OF WORKS. ALL WORK UNDERTAKEN WITHIN PROXIMITY OF THE PIPELINE SHALL BE IN ACCORDANCE WITH THE RELEVANT AUTHORITY REQUIREMENTS.

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 R30-MET-XRF-ST-431-00001
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SCALE

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DATUM

HORIZONTAL: PCG2020
 VERTICAL: AHD71

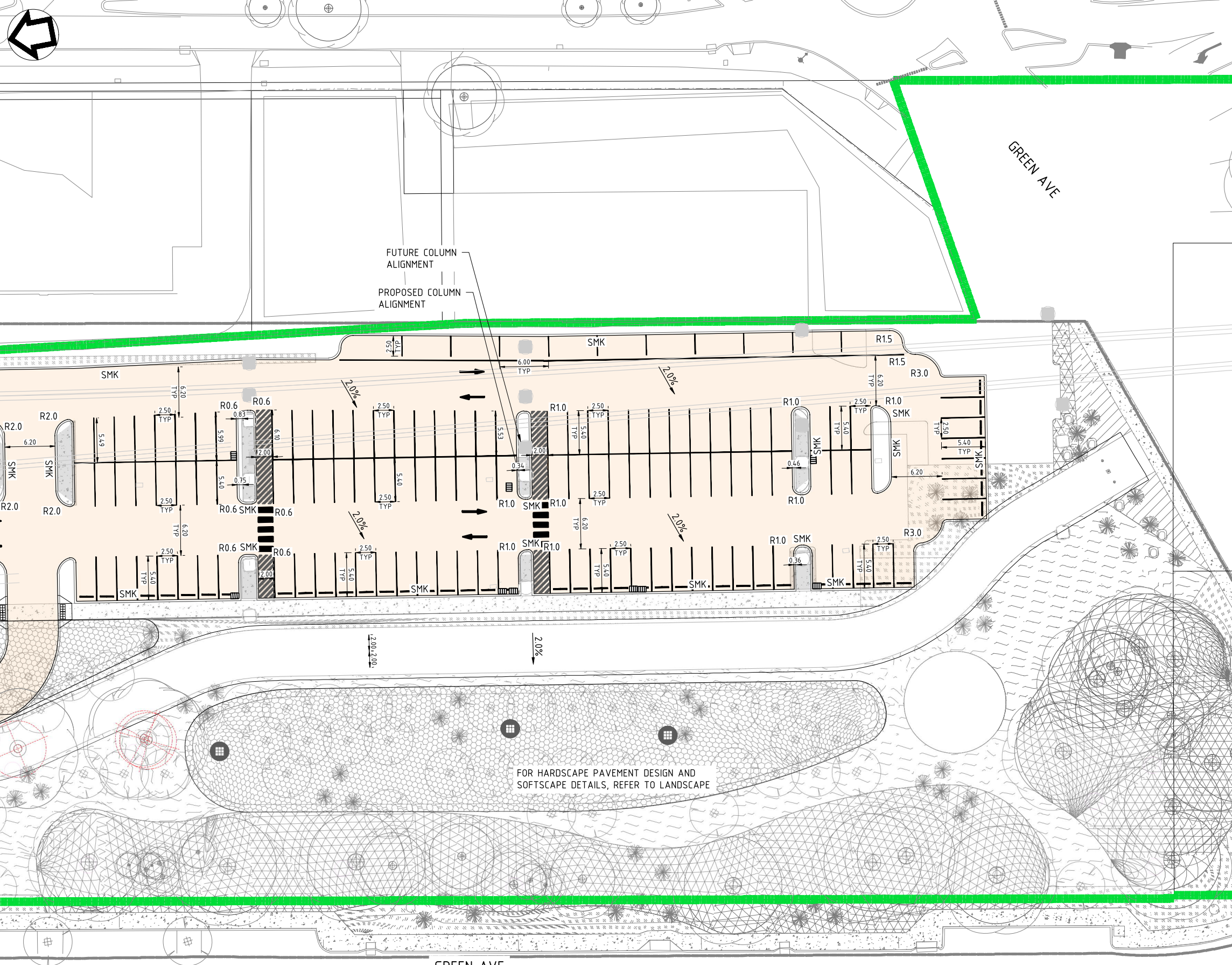
DESIGNED R. THOMPSON
DRAWN M. BLIGH-SHEPPARD
CHECKED R. THOMPSON
APPROVED A. EYRES
DATE 17/05/23

Government of Western Australia
Public Transport Authority

BYFORD RAIL EXTENSION

ARMADALE PRECINCT
 CIVIL WORKS
 ROAD LAYOUT PLAN - SHEET 4 OF 5
 PTA Drawing No: 11-A-107-CI0046 Rev: B

MATCHLINE



- NOTES
- BUS STOP LAYOUT DRAWINGS TO BE DEVELOPED IN THE SUBSEQUENT DESIGN STAGE
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11-A-107-C10046

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XR01GN_ENVIRONMENTAL_SITES_PCG2020

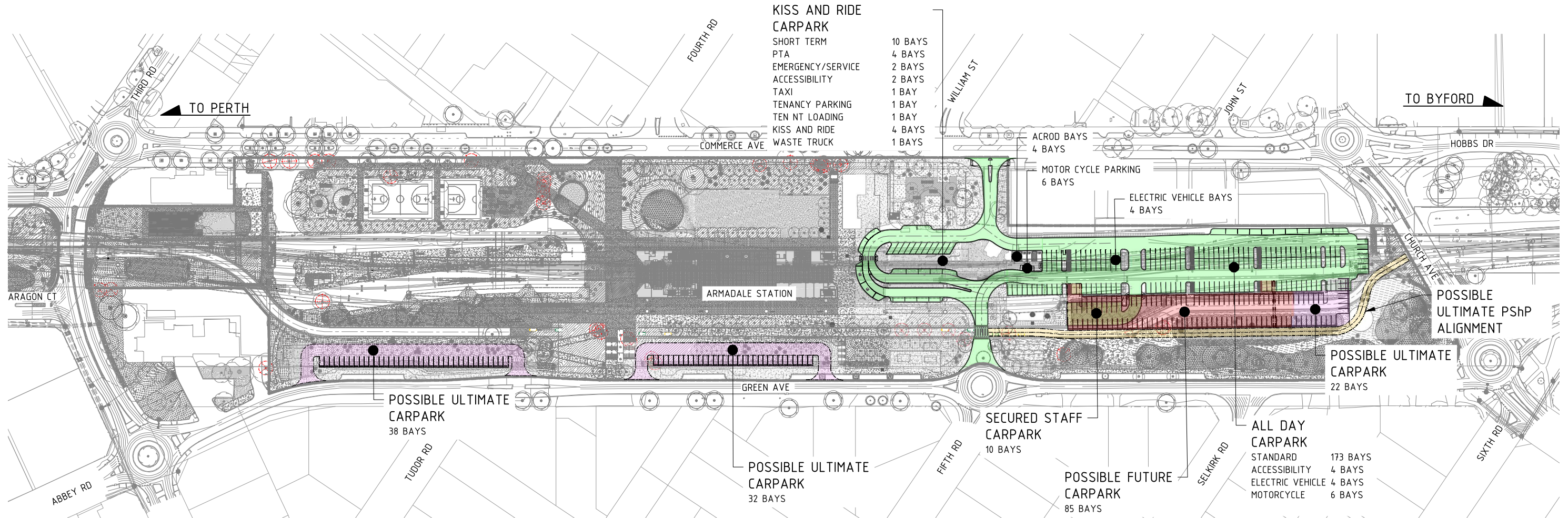
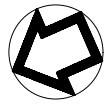
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DATUM	CHECKED	R. THOMPSON
HORIZONTAL: PCG2020	APPROVED	A. EYRES
VERTICAL: AHD71	DATE	17/05/23

REFERENCE DESIGN

Government of Western Australia
Public Transport Authority

BYFORD RAIL EXTENSION

ARMADALE PRECINCT
CIVIL WORKS
ROAD LAYOUT PLAN - SHEET 5 OF 5
PTA Drawing No: 11-A-107-C10047 Rev: B



SITE PLAN
1:1000

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LEGEND

	PROPOSED CARPARKING 181 ALL DAY CARBAY 26 SHORT TERM CAR BAYS 207 TOTAL CAR BAYS 6 MOTORCYCLE BAYS
	POSSIBLE FUTURE CARPARKING 85 CAR BAYS
	POSSIBLE ULTIMATE CARPARKING 92 CAR BAYS
	POSSIBLE ULTIMATE PshP ALIGNMENT

POSSIBLE ULTIMATE TOTAL CARPARKING
207 PROPOSED CAR BAYS
85 POSSIBLE FUTURE CAR BAYS
92 POSSIBLE ULTIMATE CAR BAYS
SUBTRACT 20 CAR BAYS
356 CAR BAYS
6 MOTORCYCLE BAYS

REV	DATE	AMENDMENT	DSN	DRN	CHK	APP
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B	08/02/23	RE-ISSUED FOR RD	R.T.	M.B.	F.O.	A.E.
A	05/08/22	ISSUED FOR RD - PTA REVIEW	R.T.	M.B.	Y.K.	A.E.

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R30-MET-XRF-CI-200-00003
_LOGO_METCONNX
R30-UDL-XRF-LA-230-00001
R30-DEA-XRF-ST-170-01001
R30-MET-XRF-TR-100-00510

SCALE

1:250

DATUM

HORIZONTAL: PCG2020
VERTICAL: AHD71

DESIGNED R. THOMPSON
DRAWN M. BLIGH-SHEPPARD
CHECKED R. THOMPSON
APPROVED A. EYRES
DATE 17/05/23

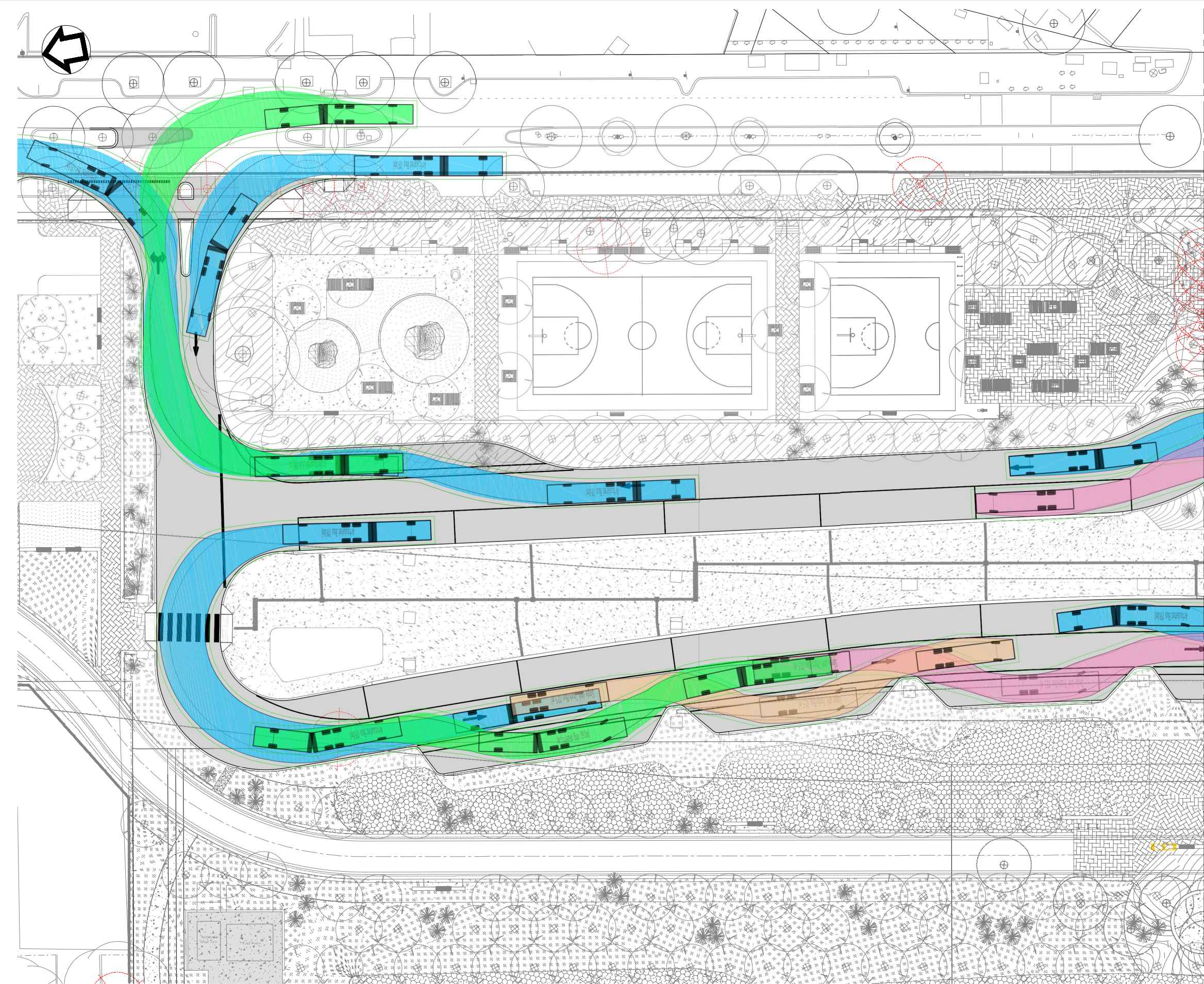
REFERENCE DESIGN

Government of Western Australia
Public Transport Authority

BYFORD RAIL EXTENSION

ARMADALE PRECINCT
CIVIL WORKS
CARPARK STRATEGY PLAN

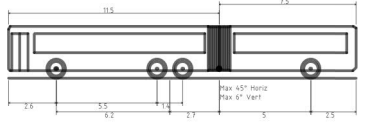
PTA Drawing No: 11-A-107-CI0048 Rev: B



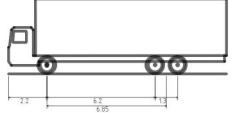
MATCHLINE

NOTES

1. FOR DRAINAGE OF HARDSCAPE AREAS AND CONNECTION INTO CIVIL DRAINAGE SYSTEM, REFER TO LANDSCAPE PLANS FOR FURTHER DETAILS. FURTHER COORDINATION REQUIRED IN SUCCESSIVE DESIGN PHASES
2. FOR DRAINAGE OF BUILDINGS AND ROOF AREAS AND CONNECTION INTO CIVIL DRAINAGE SYSTEM, REFER TO HYDRAULIC PLANS FOR FURTHER DETAILS. FURTHER COORDINATION REQUIRED IN SUCCESSIVE DESIGN PHASES
3. FOR DRAINAGE OF VIADUCT STRUCTURES AND CONNECTION INTO CIVIL DRAINAGE SYSTEM, REFER TO VIADUCT STRUCTURE PLANS FOR FURTHER DETAILS. FURTHER COORDINATION REQUIRED IN SUCCESSIVE DESIGN PHASES



Articulated Bus (19.0m)
 Overall Length 19.000m
 Overall Width 2.500m
 Overall Body Height 2.823m
 Min Body Ground Clearance 0.410m
 Track Width 2.500m
 Lock-to-lock Time 6.00s
 Curb to Curb Turning Radius 15.000m



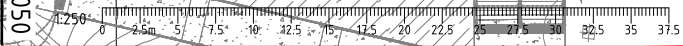
Single Unit Truck/Bus (12.5 m)
 Overall Length 12.500m
 Overall Width 2.500m
 Overall Body Height 4.300m
 Min Body Ground Clearance 0.430m
 Track Width 2.500m
 Lock-to-lock Time 6.00s
 Curb to Curb Turning Radius 12.500m

DFES HARDSTAND LOCATION SUBJECT TO FURTHER REVIEW AND COORDINATION WITH TRANSPERTH AND DFES

CAUTION: HIGH PRESSURE GAS IN VICINITY.
 CONTRACTOR TO LOCATE AND DETERMINE DEPTH PRIOR TO COMMENCEMENT OF WORKS. ALL WORK UNDERTAKEN WITHIN PROXIMITY OF THE PIPELINE SHALL BE IN ACCORDANCE WITH THE RELEVANT AUTHORITY REQUIREMENTS.



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REFERENCES

XR01GN_CADAstral_BDY_PCG2020
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BRE_C3D_SERVICES_ALL_POINTS
R30-MET-XRF-CI-200-00001
R30-MET-XRF-CI-200-00002
R30-MET-XRF-CI-200-00003
R30-UOL-XRF-LA-230-00001
_LOGO_METCONNX

SCALE

1:250

DATUM

HORIZONTAL: PCG2020
 VERTICAL: AHD71

DESIGNED R. THOMPSON
 DRAWN M. BLIGH-SHEPPARD
 CHECKED R. THOMPSON
 APPROVED A. EYRES
 DATE 17/05/23

Government of Western Australia
 Public Transport Authority

BYFORD RAIL EXTENSION

ARMADALE PRECINCT
 CIVIL WORKS
 TURNING TEMPLATES PLAN - SHEET 1 OF 4
 PTA Drawing No: 11-A-107-CI0049 Rev: B

Appendix B

Transport Impact Assessment Checklist

Checklist for a transport impact assessment for individual development

- Tick the provided column for items for which information is provided.
- Enter N/A in the provided column if the item is not appropriate and enter reason in comment column.
- Provide brief comments on any relevant issues.
- Provide brief description of any proposed transport improvements, for example, new bus routes or signalisation of an existing intersection.

ITEM	PROVIDED	COMMENTS/PROPOSALS
Summary		
Introduction/Background		
name of applicant and consultant	Yes	Section 1
development location and context	Yes	Section 1, also Section 2
brief description of development proposal	Yes	Section 1, also Section 3, 4
key issues	Yes	Section 1
background information	Yes	Section 1
Existing situation		
existing site uses (if any)	Yes	Section 2.2
existing parking and demand (if appropriate)	Yes	Section 2.4. Also refer to Section 19.
existing access arrangements	Yes	Section 2.4
existing site traffic	Yes	Section 2.5
surrounding land uses	Yes	Section 2.1 and 2.2
surrounding road network	Yes	Section 2.3
traffic management on frontage roads	Yes	In Road Network section
traffic flows on surrounding roads (usually AM and PM peak hours)	Yes	Section 2.5
traffic flows at major intersections (usually AM and PM peak hours)	Yes	Section 2.5
operation of surrounding intersections	Yes	Section 2.5, Section 10.1 for detailed operations
existing pedestrian/cycle networks	Yes	Section 2.6
existing public transport services surrounding the development	Yes	Section 2.7
crash data	Yes	Section 2.8

ITEM	PROVIDED	COMMENTS/PROPOSALS
Development proposal		
regional context	Yes	Refer Section 2.1, 2.2, 6
proposed land uses	Yes	N/A
table of land uses and quantities	No	N/A
access arrangements	Yes	Section 5, also Section 4.2
parking provision	Yes	Section 2.4, 19
end of trip facilities	No	N/A
any specific issues	No	N/A
road network	Yes	Section 4.1
intersection layouts and controls	Yes	Section 4.2
pedestrian/cycle networks and crossing facilities	Yes	Section 4.3
public transport services	Yes	Section 4.4
Integration with surrounding area		
surrounding major attractors/generators	Yes	Section 5.1
committed developments and transport proposals	Yes	Section 5.2, also Section 6
proposed changes to land uses within 1200 metres	Yes	Section 5.2
travel desire lines from development to these attractors/generators	Yes	Section 5.3
adequacy of existing transport networks	Yes	Section 5.3
deficiencies in existing transport networks	No	N/A
remedial measures to address deficiencies	No	N/A
Analysis of transport networks		
assessment years	Yes	Section 7.1
time periods	Yes	Section 7.2
development generated traffic	Yes	Section 8.1
distribution of generated traffic	Yes	Section 8.2
parking supply and demand	Yes	Section 19
base and 'with development' traffic flows	Yes	Section 2.5.2, 9.1, 9.2
analysis of development accesses	Yes	Section 10
impact on surrounding roads	Yes	Section 11
impact on intersections	Yes	Section 12

TRANSPORT IMPACT ASSESSMENT GUIDELINES

ITEM	PROVIDED	COMMENTS/PROPOSALS
Analysis of transport networks		
impact on neighbouring areas	Yes	Section 13
road safety	Yes	Section 14
public transport access	Yes	Section 15
pedestrian access/amenity	Yes	Section 16
cycle access/amenity	Yes	Section 16
analysis of pedestrian/cycle networks	Yes	Section 17
safe walk/cycle to school (for residential and school site developments only)	Yes	Section 18
traffic management plan (where appropriate)	Yes	Section 21
Conclusions	Yes	Section 22

Appendix C

Forrest Rd-Third Ave and Church Ave Lane Configuration Assessment

Byford Rail Extension

Armadale Station

Lane Configurations Under Rail Crossings

Metronet November 2022

Enquiries Jason Petsos

Attention to John Perrott



Urbsoi

1 Introduction

The Byford Rail Extension (BRE) project is an initiative by METRONET that facilitates the extension of the Armadale rail line by approximately 8km south to Byford. This project will result in the upgrade of Armadale Station (elevated) and the provision of a new station at Byford. MetCONNX is responsible for the design, procurement, manufacture, construction, installation and commissioning of rail infrastructure and ancillary works for the project.

Urbsol has been commissioned by MetCONNX on behalf of the Public Transport Authority (PTA) to prepare appropriate impact assessments as required for the project, and assist with other traffic engineering investigations as required.

This technical note presents the findings of an investigation into the lane configuration of Forrest Road-Third Road and Church Avenue at the locations of their respective elevated rail crossings.

2 Background

2.1 Previous Planning Investigations

WSP was engaged by the Public Transport Authority (PTA) to assess the potential traffic impact resulting from the relevant changes to the local road network surrounding Armadale Station. SIDRA modelling was undertaken for the assessment of options around the Armadale Station, which included the impact of removing the level crossings from Forrest Road and Church Avenue on the adjacent road network.

Various base case traffic models were developed by WSP, which were reviewed and approved in accordance with Main Roads operational modelling guidelines. The development of these models was documented in the report “Armadale Rail Extension, SIDRA Base Model Calibration and Validation Report” (WSP 2021).

The development of future case options, which assessed out to the 2036 time horizon, was then documented in the report “Byford Rail Extension, Future Year Traffic Impact Analysis, Armadale” (WSP 2022).

The WSP modelling included the development of SIDRA network models for each of the Forrest Road-Third Road and Church Avenue corridors adjacent to their respective rail crossings. For the Forrest Road-Third Road corridor, the network included the following intersections:

- Forrest Road/ Aragon Court
- Forrest Road Level Crossing
- Forrest Road/ Third Road/ Neerigen Street
- Third Road/ Commerce Avenue/ Supermarket Access.

A network layout of that model, including the grade separation of the rail line, is shown in Figure 1.



Figure 1 WSP's Forrest Rd-Third Rd SIDRA Model (Rail Grade Separated)

For the Church Avenue corridor, the network included the following intersections:

- Church Avenue/ William Street
- Church Avenue/ Hobbs Drive/ Commerce Avenue
- Church Avenue Level Crossing
- Church Avenue/ Wungong Road/ Green Avenue.

A network layout of that model, including the grade separation of the rail line, is shown in Figure 2.



Figure 2 WSP's Church Ave SIDRA Model (Rail Grade Separated)

The future year traffic forecasts adopted by WSP for the assessment of the 2036 time horizon were calculated using the MRWA Urban Road Planning (URP) method. This method compares base and future year strategic model data to develop demands for the individual sites based on comparison with observed traffic patterns and allows the ROM24 data to be calibrated for adoption in the modelling.

It should be noted that some volumes differences were present in the traffic projections when comparing intersection departure and approach volumes of adjacent intersections. However it appears that the issues were raised as part of the base modelling approval process, and the inconsistencies were noted and accepted by MRWA. This is discussed in more detail in the following sections.

2.2 Current Design Process

As part of the design process of the current project, MetCONNX has submitted designs of the relevant sections of Forrest Road-Third Road and Church Avenue for review by appropriate authorities. This process has resulted in a number of suggestions relating to the lane configurations of each of those corridors by Main Roads (refer sketches in Appendix A). Specifically, and with respect to roadway layout/capacity, this included:

- On the Forrest Road-Third Road corridor:
 - Reduction of the number of lanes at the rail overpass location from two to one, via removal of the short left turn lane into Neerigen Street.
 - Banning the right turn from Third Road into Neerigan Street by removing of the short right turn lane closure of the median across the intersection.

- On the Church Avenue corridor:
 - Reduction of the number of lanes at the rail overpass location from two to one
 - Removal of the separate left turn pocket for movements from Hobbs Drive into Church Avenue.

From a geometric perspective, the separate left turn facility on Hobbs Drive cannot be removed as it is required to accommodate turning paths for the appropriate design vehicle.

It was requested that SIDRA assessments be undertaken to check the feasibility of the suggestions.

For the purposes of this assessment, it was assumed that one lane on Church Avenue would be removed for the entire section between Green Avenue/Wungong Avenue and Commerce Avenue/Hobbs Drive i.e. exclude any widening back to two lanes on the approaches to the roundabouts.

3 Methodology

The methodology for assessing the suggested design modifications included:

1. Obtaining the SIDRA corridor models previously developed by WSP
2. Making the required modifications to the models to reflect the suggestions.
3. Running the network model to extract key operational performance indicators
4. Comparing the SIDRA results of point 1 and 3.

For the Forrest Road-Third Road network, the modifications included updates to the roadway geometry and as well as a redistribution of traffic resulting from the removal of the right turn into Neerigan Street. Whilst there may be alternative routes that motorists may choose, for the purpose of providing a worst case assessment, it was assumed that the right turn movements into Neerigan Street would be diverted along Forrest Road, U-turn at the Green Avenue/Abbey Road roundabout, then back through the Aragon Court intersection and left into Neerigan Street. The assessed Forrest Road-Third Road network is shown in Figure 3.

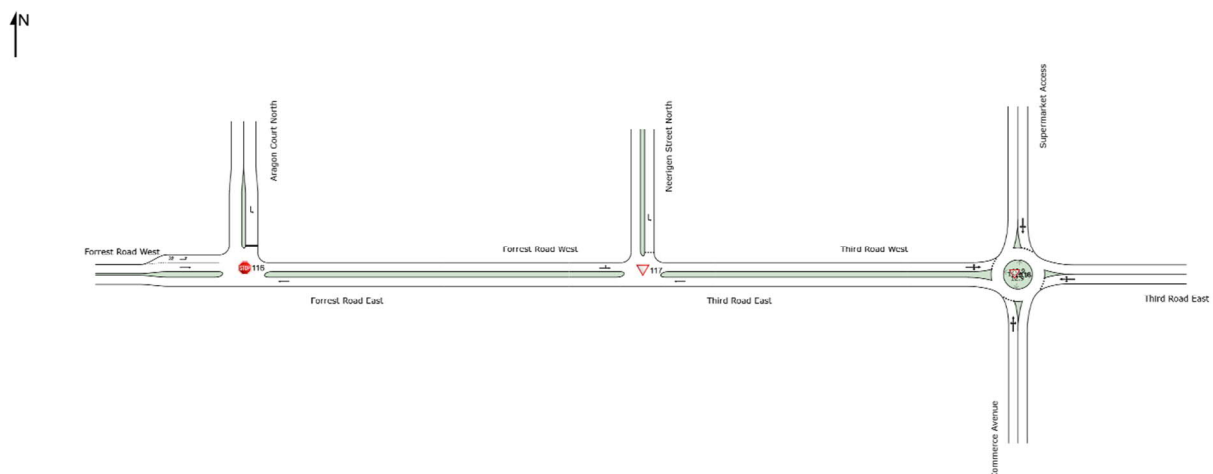


Figure 3 Assessed Forrest Rd-Third Rd SIDRA Model (Rail Grade Separated)

For the Church Avenue network, only updates to the roadway geometry were required. The assessed Forrest Road-Third Road network is shown in Figure 4.

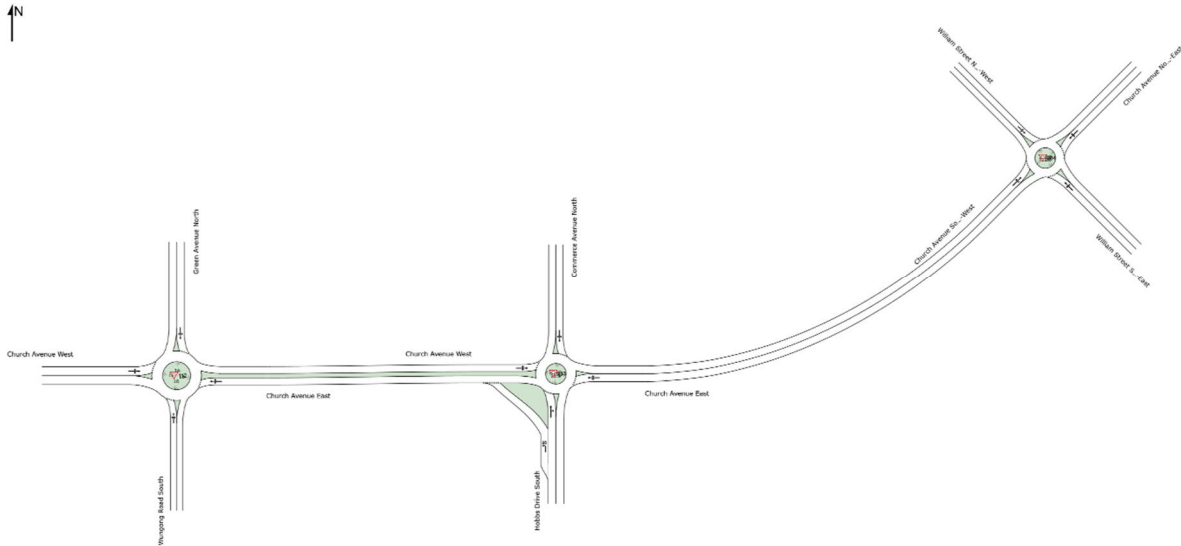


Figure 4 Assessed Church Ave SIDRA Model (Rail Grade Separated)

3.1 Traffic Projection Inconsistencies

As mentioned previously, upon inspection of the WSP traffic models, some volume differences were present in the traffic projections when comparing intersection departure and approach volumes of adjacent intersections. These differences are demonstrated in Figure 5 (for the Forrest Road-Third Road network) and Figure 6 (for the Church Avenue network). They focus only on the intersections immediately adjacent (either side) to the rail crossing locations. The figures in red show the traffic volumes downstream from the first intersection and upstream to the next intersection.

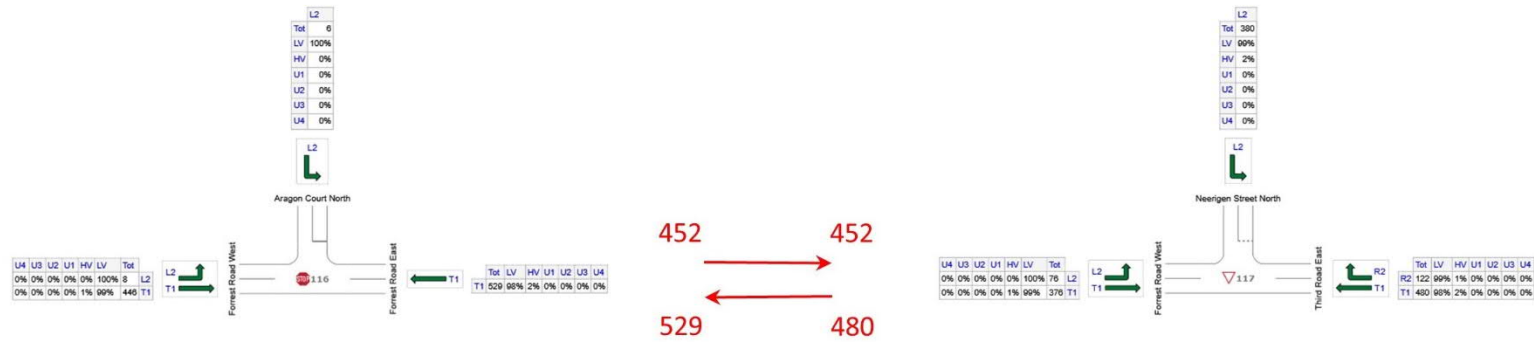
In Figure 5, it can be seen that the traffic volumes exiting one intersection are generally similar to or less than the volume entering the next intersection. For example, in the AM peak, the westbound volume of traffic exiting the Neerigan Street intersection (480vph) is lower than the westbound volume entering the Aragon Court intersection (529vph). In terms of SIDRA network modelling, this is considered acceptable as the higher volume entering the second intersection would provide for the highest opportunity (in SIDRA) to calculate any potential queueing back to the previous intersection that may have a negative impact on the network. The volume differences in the PM peak are similar. In the eastbound direction, the volumes between intersections are well matched.

In Figure 6, it can be seen that in both directions of travel, the traffic approaching the second intersection is commonly (and significantly) less than the volume exiting the first intersection. It is important to note that it appears that these inconsistencies were raised as part of WSP’s modelling process, and the inconsistencies were noted and accepted by MRWA.

Whilst these volumes were assessed in SIDRA, an additional scenario was developed by factoring up the turning volumes at the second intersection so that they matched the volumes exiting the first intersection, in order to provide a worst case network assessment. These adjusted turning volumes are shown in green.

Note that only traffic volumes at intersections immediately adjacent to the rail crossing locations were modified as these are critical locations that are being investigated. Any flow on volume discrepancies at other intersections in the network were ignored.

2036 AM Peak



2036 PM Peak

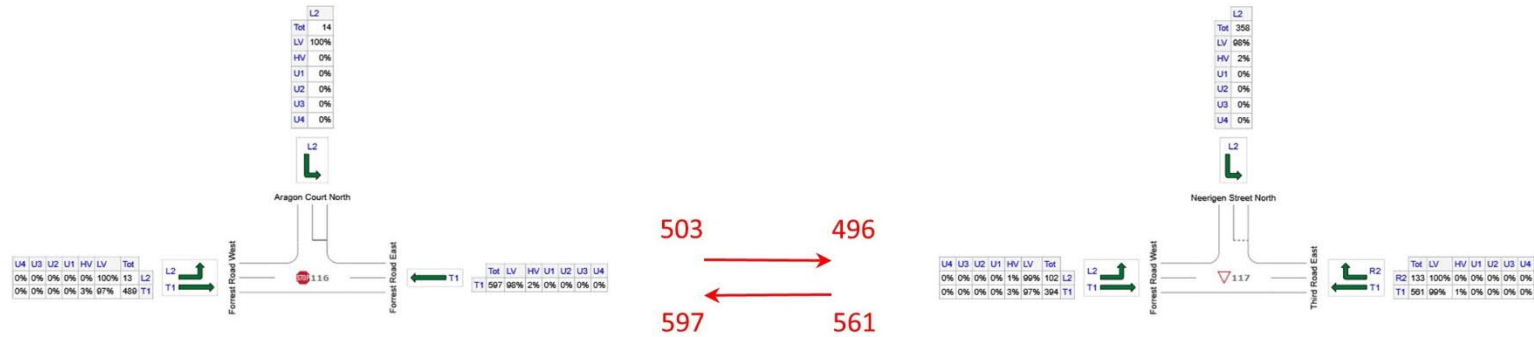
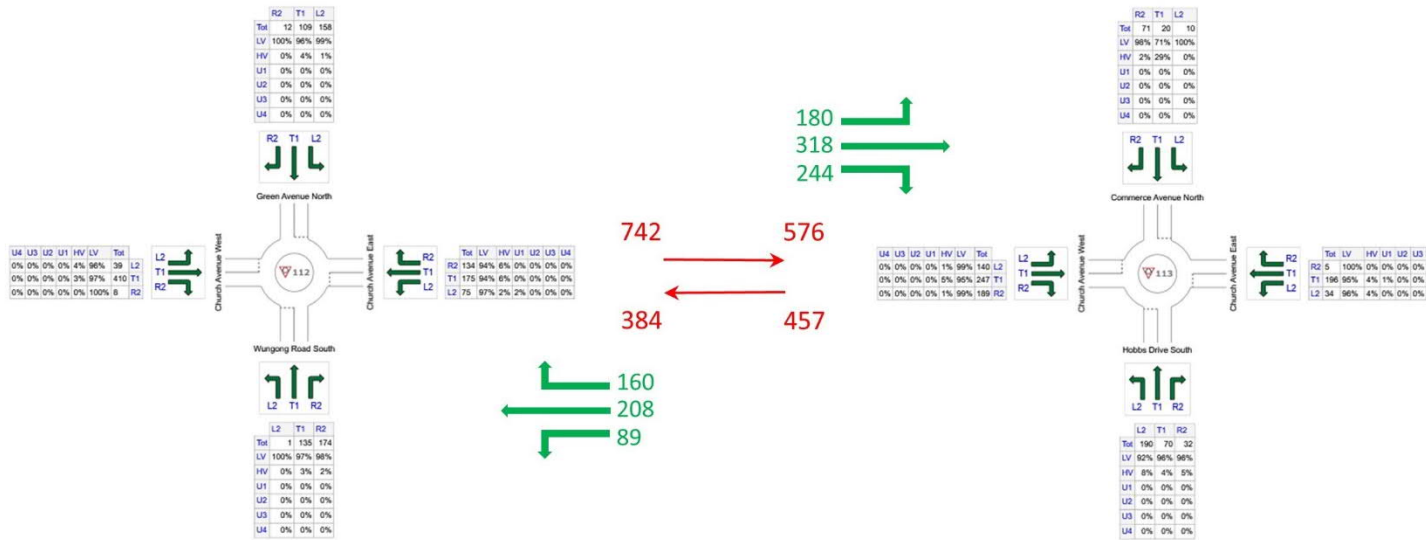


Figure 5 Traffic Projections for Forrest Rd-Third Rd Intersections Adjacent to Rail Overpass

2036 AM Peak



2036 PM Peak

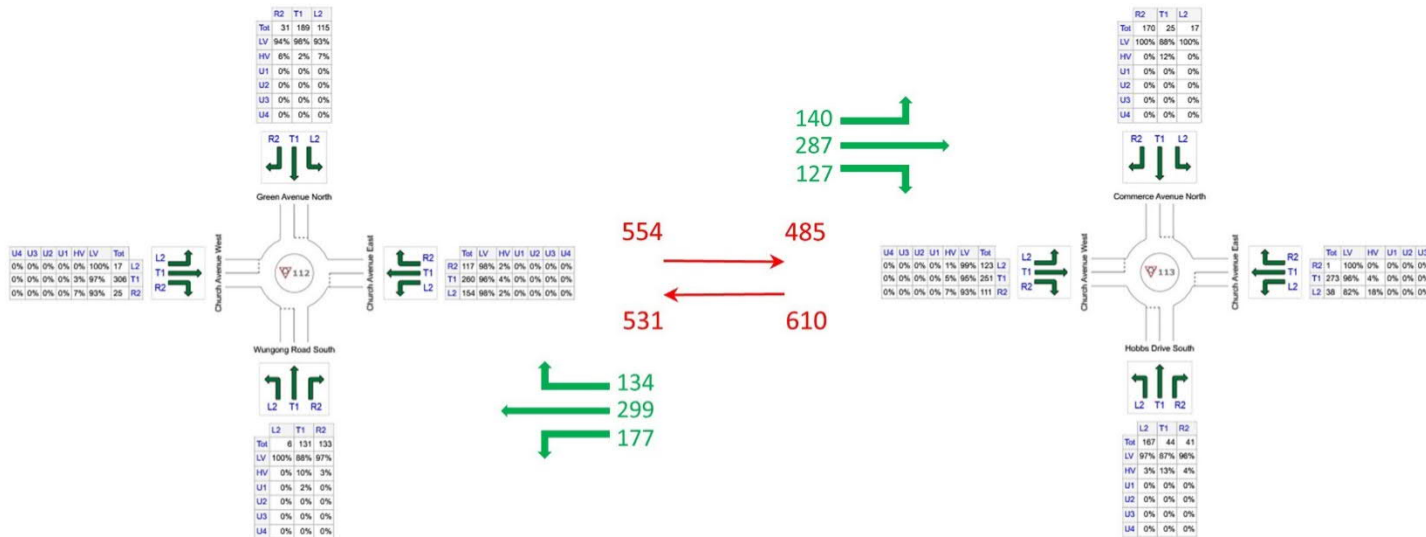


Figure 6 Traffic Projections for Church Ave Intersections Adjacent to Rail Overpass

4 Results

The results of the SIDRA assessment of the scenarios considered are shown in Table 1 (for the Forrest Road-Third Ave network) and Table 2 (for the Church Avenue network).

2036 AM and PM peak period for the following scenarios are included:

- Original WSP results
- Original WSP volume on modified network
- Modified WSP volumes on modified network

The following points summarise the findings of the assessment:

- For the Forrest Road-Third Avenue network, the suggested modifications to the network appear to have a marginal impact upon the operations during both AM and PM peak periods. Operations at all intersection in the modelled network are expected to be satisfactory.
- For the Church Avenue network, the suggested modifications to the network appear to have a marginal impact upon the operations during both AM and PM peak periods. Operations at all intersection in the modelled network are expected to be satisfactory.
- For the Church Avenue network, the modifications to the traffic projections to provide a more conservative approach to the traffic assessment, also appear to have a marginal impact upon the operations during both AM and PM peak periods. Similarly operations at all intersection in the modelled network are expected to be satisfactory.

Although the assessment for the Church Avenue network included a reduction of lanes over the entire length of roadway between the Green Avenue/Wungong Road and the Commerce Avenue/Hobbs Drive intersections, it may still be worthwhile providing an additional short lane on those internal approaches as per the existing configurations. It is understood that the additional channelisation may only commence on the downstream sides of the rail crossings, however they still may provide a more robust network with some operational benefit.

Intersection	AM Peak						PM Peak					
	WSP			Modified Network			WSP			Modified Network		
	LoS	DoS	Ave Delay (s)	LoS	DoS	Ave Delay (s)	LoS	DoS	Ave Delay (s)	LoS	DoS	Ave Delay (s)
Overall Network	B	0.659	-	B	0.699		B	0.677	-	B	0.785	-
Forrest Rd/ Aragon Ct	A	0.268	0.9	A	0.347	0.9	A	0.301	1.0	A	0.387	1.0
Forrest Rd/ Neerigan St	A	0.628	2.9	A	0.699	2.7	A	0.673	2.9	A	0.785	3.1
Third Rd/ Commerce Ave/ Supermarket	A	0.659	6.9	A	0.689	7.4	A	0.677	6.6	A	0.704	7.0

Table 1 SIDRA Results for Forrest Rd-Third Rd Network

Intersection	AM Peak									PM Peak								
	WSP			Modified Network			Modified Volumes and Network			WSP			Modified Network			Modified Volumes and Network		
	LoS	DoS	Ave Delay (s)	LoS	DoS	Ave Delay (s)	LoS	DoS	Ave Delay (s)	LoS	DoS	Ave Delay (s)	LoS	DoS	Ave Delay (s)	LoS	DoS	Ave Delay (s)
Overall Network	B	0.620	-	B	0.620	-	B	0.627	-	C	0.812	-	C	0.813	-	C	0.813	-
Church Ave/ William St	A	0.620	7.2	A	0.620	7.2	A	0.620	7.2	B	0.812	13.8	B	0.813	13.8	B	0.813	13.8
Church Ave/ Hobbs Dr/ Commerce Ave	A	0.341	5.8	A	0.494	5.8	A	0.627	6.0	A	0.340	6.1	A	0.413	6.1	A	0.467	6.2
Church Ave/ Green Ave/ Wungong Rd	A	0.594	7.6	A	0.593	7.7	A	0.608	7.9	A	0.462	7.0	A	0.567	7.3	A	0.645	7.8

Table 2 SIDRA Results for Church Ave Network

5 Conclusions

As part of the design process of the current project, a number of suggestions relating to the lane configurations at each of the Forrest Road-Third Road and Church Avenue corridors in the vicinity if the proposed elevated rail crossings were made by Main Roads.

This technical note documented the results of a SIDRA assessments to check the feasibility of the suggested modifications.

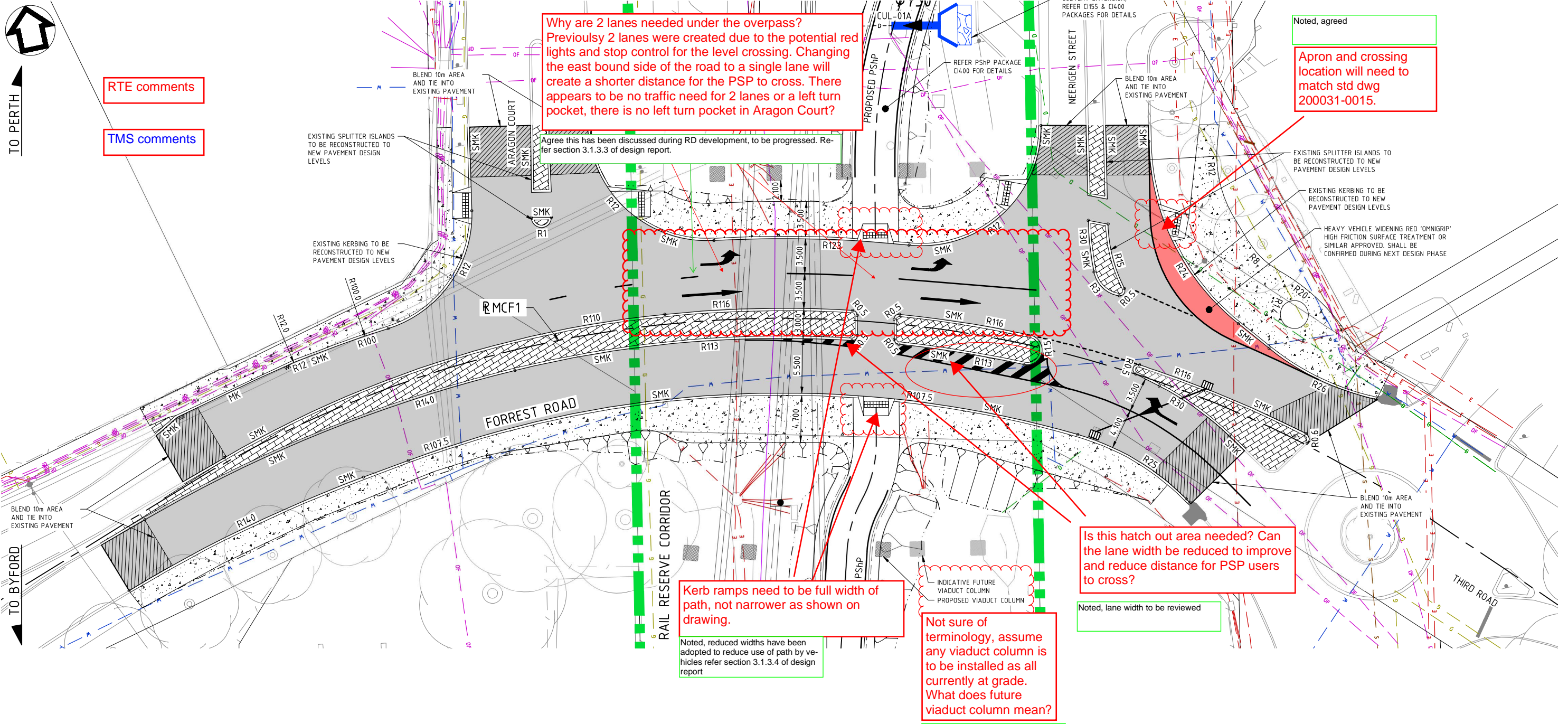
The SIDRA assessments were based on the models previously prepared by WSP, which included the preparation (and obtaining approval) for the 2036 traffic projections to be used. The proposed case models were amended to reflect the suggested modifications and a comparison of the results were presented.

For both the Forrest Road-Third Avenue and Church Avenue networks, the suggested modifications appear to have a marginal impact upon the operations during both 2036 AM and PM peak periods.

An additional assessment of the Church Avenue network was undertaken to address traffic volume disparities between intersections either side of the rail crossing. The results indicated that the network operations would still be satisfactory.

For the purposes of this assessment, it was assumed that one lane on Church Avenue would be removed for the entire section between Green Avenue/Wungong Avenue and Commerce Avenue/Hobbs Drive. If geometrically possible it may still be worthwhile providing an additional short lane on those internal approaches as per the existing configurations. It is understood that the additional channelisation may only commence on the downstream sides of the rail crossings, however they still may provide a more robust network with some operational benefit.

6 Appendix A – MRWA Review Comments



LEGEND

	RAIL RESERVE BOUNDARY		PROPOSED RAIL ALIGNMENT
	PROPOSED PAVEMENT		FUTURE RAIL ALIGNMENT
	KERB TRANSITION		PROPOSED DIAGONAL PAVEMENT MARKING INSTALLED IN ACCORDANCE WITH PTA REQUIREMENTS
	PROPOSED KERBING (TYPE DEFINED BY TEXT)		PROPOSED DRAINAGE JUNCTION PIT REFER TO DRAINAGE PLANS FOR DETAILS
	SEMI-MOUNTABLE KERB (KEYED)		PROPOSED DRAINAGE GRATED GULLY PIT REFER TO DRAINAGE PLANS FOR DETAILS
	BARRIER KERB - 170mm HIGH		EXISTING DRAINAGE STRUCTURE (GRATED GULLY, SIDE ENTRY AND JUNCTION)
	PROPOSED PAVED TREATMENT (INDICATIVE ONLY) REFER TO LANDSCAPE ARCHITECTS PLANS AND SPECIFICATIONS		PROPOSED VIADUCT COLUMN REFER TO STRUCTURAL PLANS FOR DETAILS
	PROPOSED CONCRETE PATH		INDICATIVE FUTURE VIADUCT COLUMN REFER TO STRUCTURAL PLANS FOR DETAILS
	PROPOSED KERB RAMP WITH TACTILE PAVERS (TACTILE PAVERS IN ACCORDANCE WITH AS1428 TYP.)		EXISTING TREE ALL TREES SHALL BE PROTECTED FOR THE DURATION OF THE WORKS UNLESS SPECIFIED OTHERWISE
	600mm EARTHWORKS SHOULDER		

- NOTES**
1. ALL DIMENSIONS ARE IN METRES UNLESS SHOWN OTHERWISE (U.S.O.)
 2. ALL HEIGHTS ARE TO A.H.D. AND ALL LEVELS SHALL BE DERIVED FROM ESTABLISHED BENCHMARKS.
 3. REFER DRAWING R30-MET-DWG-CI-415-01002 FOR GENERAL NOTES AND LEGEND.

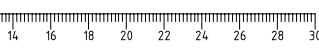
Forrest Road:

- The current design has a short left lane and a through lane on the eastbound carriageway. The left lane is not long enough to allow for deceleration, does not provide much in the way of improved traffic efficiency, could contribute to side swipe crashes for vehicles that change into the through lane at the last second and make the crossing longer and more difficult for PSP users. It is recommended that the eastbound carriageway is reconfigured to a single lane.
- There is a very short right turn pocket immediately after the roundabout on the westbound carriageway. The pocket is not long enough to allow for deceleration, could encourage queues back into the roundabout and adds an unnecessary additional level of complexity to the intersection. It is recommended that the right turn in movement is blocked. Vehicles currently undertaking this movement would not be significantly disadvantaged as they can utilise the roundabout to the west to undertake a significantly safer U-turn manoeuvre to access the east bound carriageway and enter the road via a left turn.
- It was noted that the westbound carriageway has an unusual compound curve after the roundabout. The removal of the substandard right turn pocket on the westbound carriageway and the left lane on the eastbound carriageway should provide some room to allow the curve to be designed better.
- Sightlines for the PSP crossing should be checked to ensure that they meet the required design standards.
- The southern approach of the PSP has a chicane on the approach to the road crossing. If possible this chicane should be removed to discourage riders from cutting the corner and potentially colliding with oncoming riders.



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CAUTION: FIBRE OPTIC CABLE IN VICINITY.
 TRACTOR TO LOCATE AND DETERMINE DEPTH PRIOR TO COMMENCEMENT OF WORKS. ALL WORK UNDERTAKEN IN PROXIMITY OF THE CABLE SHALL BE IN ACCORDANCE WITH THE RELEVANT AUTHORITY REQUIREMENTS.



DESIGN

BYFORD RAIL EXTENSION

- FORREST ROAD

T 1

Rev: A

ORIG DATE	25/08/22	ISSUED FOR	RD	EA	EA	JP	FO
REV	A1	AMENDMENT		DSN	DRN	CHK	APP

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 AT ORIGINAL PLOT SIZE: 100mm

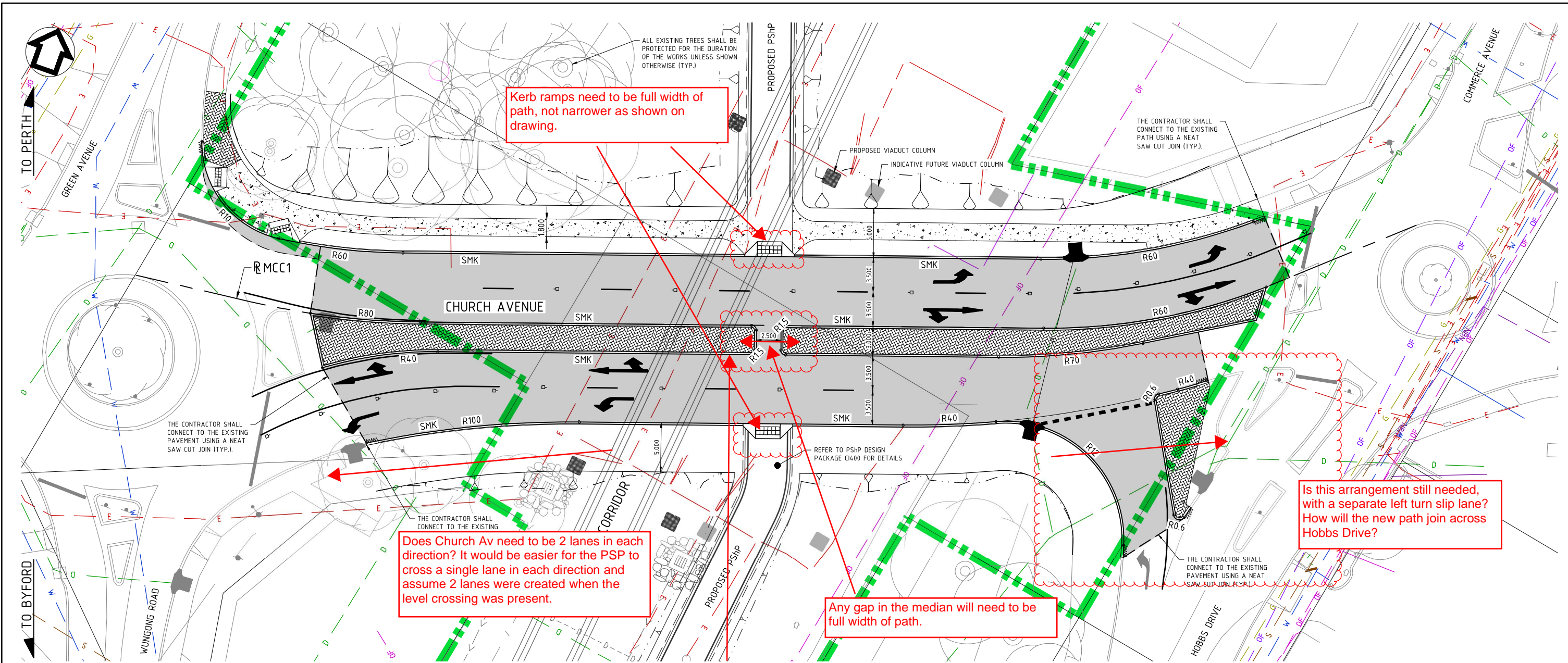
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metconnx BYFORD RAIL EXTENSION

Contractor No: R30-MET-DWG-CI-415-15500 Rev: A

REFERENCE

- XR01GN_CADAstral_Body_PCG
- XR01CI_DESIGN_PsHP_PCG2020
- R30-MET-XRF-TR-100-00510
- XR01GN_RAIL_RESERVE_BODY_PCG2020
- XR01GN_SURVEY_PCG2020
- R30-DEA-CAD-ST-170-01001
- XR01GN_ENVIRONMENTAL_SITES
- XR01UT_UTILITIES_PCG2020
- R30-MET-XREF-CI-400-00002
- R30-MET-XRF-CI-155-00011
- R30-MET-XRF-CI-155-00012
- R30-MET-XRF-CI-155-00013
- R30-MET-XRF-CI-155-00021
- XR01CI_FORREST_RD_DESIGN_PCG2020



Kerb ramps need to be full width of path, not narrower as shown on drawing.

Does Church Av need to be 2 lanes in each direction? It would be easier for the PSP to cross a single lane in each direction and assume 2 lanes were created when the level crossing was present.

Any gap in the median will need to be full width of path.

What gaps will be available for PSP users in the morning / evening peak to cross Church Av? Will the median be big enough to allow users to all wait if gaps low?

Is this arrangement still needed, with a separate left turn slip lane? How will the new path join across Hobbs Drive?

LEGEND

- RAIL RESERVE BOUNDARY
- PROPOSED PAVEMENT
- KERB TRANSITION
- PROPOSED KERBING (TYPE DEFINED BY TEXT)
- SEMI-MOUNTABLE KERB (KEYED)
- BARRIER KERB - 170mm HIGH
- PROPOSED PAVED TREATMENT (INDICATIVE ONLY) REFER TO LANDSCAPE ARCHITECTS PLANS AND SPECIFICATIONS
- PROPOSED CONCRETE PATH
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- FUTURE RAIL ALIGNMENT
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- PROPOSED DRAINAGE JUNCTION PIT REFER TO DRAINAGE PLANS FOR DETAILS
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- EXISTING TREE ALL TREES SHALL BE PROTECTED FOR THE DURATION OF THE WORKS UNLESS SPECIFIED OTHERWISE

NOTES

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3. REFER DRAWING R30-MET-DWG-CI-415-01002 FOR GENERAL NOTES AND LEGEND.

Church Ave:
-The gap in the median for the PSP crossing appears to be too narrow and should be widened.
-Sightlines for the PSP crossing should be checked to ensure that they meet the required design standards.



The Essential First Step.

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CONTRACTOR TO LOCATE AND DETERMINE DEPTH PRIOR TO COMMENCEMENT OF WORKS. ALL WORK UNDERTAKEN WITHIN PROXIMITY OF THE CABLE SHALL BE IN ACCORDANCE WITH THE RELEVANT AUTHORITY REQUIREMENTS.



REFERENCE DESIGN

ORIG SIZE	A1	AT ORIGINAL PLOT SIZE
REV	DATE	ISSUED FOR
A	25/08/22	ISSUED FOR RD
AMENDMENT	DSN	DRN
	TM	SBO
	JP	FO
	CHK	APP

Contractor No: R30-MET-DWG-CI-415-25500 | Rev: A |

REFERENCES	SCALE	DESIGNED
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DATUM	HORIZONTAL: PCG2020	DRAWN
	VERTICAL: AHD71	SBO
		CHECKED
		JP
		APPROVED
		FO
		DATE
		25/08/22

Government of Western Australia
Public Transport Authority

BYFORD RAIL EXTENSION

EXTERNAL TO PRECINCTS
CITY OF ARMADALE ROADS - CHURCH AVENUE
INTERSECTION PLAN - SHEET 1

PTA Drawing No: _____ Rev: A

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