HALE ROAD / WOOLWORTHS DRIVE INTERSECTION AND COMMERCIAL ACCESS REVIEW

Porter
Consulting Engineers

Summary Report

Hale Road / Woolworths Drive Intersection and Hale Road Commercial Access Review

Porter

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Job No: 17-10-115
Date: 6 June 2018
Our Ref: R06.18
Rev: D
Checked:

CONTENTS

1.0 INTRODUCTION

The City of Kalamunda has commissioned Porter Consulting Engineers to investigate potential improvement options along Hale Road between Woolworths Drive and Strelitzia Avenue, Forrestfield.

The two key objectives are to:

- improve traffic safety at the Hale Road and Woolworths Drive intersection; and
- rationalise the existing Commercial access/egress crossovers that front Hale Road thereby improving the safety and efficiency of traffic flow along Hale Road.

Hale Road is classified a District Distributor A Road under the Main Roads WA's *Functional Road Hierarchy*. This classification of road "carrys traffic between industrial, commercial and residential areas and generally connect to Primary Distributors. These are likely to be truck routes and provide only limited access to adjoining properties."

The intersection of Hale Road and Woolworths Drive is an uncontrolled T-junction with Hale Road as the major road having priority over Woolworths Drive. There are eight crossovers along this 310m length of Hale Road.

The study area is as shown in **Figure 1.**

Figure 1: Hale Road, Woolworths Drive to Strelitzia Avenue

2.0 TRAFFIC MODELLING

Three different treatments for the intersection of Hale Road and Woolworths Drive were identified at the outset of the project. These treatments in addition to the existing layout were modelled using SIDRA to determine the respective operating conditions. To summarise these include:

- Existing Layout – Channelisation
- Modified Channelisation
- Roundabout
- Traffic Signals

With the proximity of Woolworths Drive to other intersections to the east along Hale Road of Hanover Street and Strelitzia Avenue those intersections are included in this assessment with respect to their impacts on design options and the analysis of traffic movements.

2.1 Existing Traffic Volumes

A video survey of traffic movements was undertaken on Monday, 30 October 2017 between the hours of 3.00pm and 5.30pm covering the intersections of Woolworths Drive/Hale Road and Hanover Street/Hale Road. From the survey data the pm peak hour was determined to be 4.30pm-5.30pm.

In addition to the turning movement counts at each of these intersections, a count of the number of weaving movements between the two intersections was undertaken. Approximately 60% or 29 vehicles turning left from Hanover Street then turned right into Woolworths Drive. Whilst 51% or 36 vehicles turning left out of Woolworths Drive then turned right into Hanover Street. The maximum observed queue length of 2 vehicles was observed for the right turn into Hanover Street while the maximum observed queue length of 4 vehicles was observed for the right turn into Woolworths Drive.

Appendix A includes a copy of the peak hour intersections turning movement count.

Traffic volumes for Strelzia Avenue and Hale Road was sourced from the Main Roads WA SCATS database for the week 16 - 22 October 2017.

2.2 SIDRA Analysis

SIDRA modelling analysis for the pm peak hour was performed for each of the intersection improvement options proposed for Hale Road/Woolworths Drive. The existing layout and the intersection improvements were modelled as a network that includes the adjacent intersections to the east along Hale Road being Hanover Street (approximately 40m east of Woolworths Drive) and the existing traffic signals at Strelitzia Avenue (approximately 240m east of Woolworths Drive).

The analysis was performed for the pm peak hour for two timeframes being:
- 2017 – existing volumes
- 2027 – existing volumes + 10%

A summary of the results for the various intersection treatments are outlined in **Tables 1** and **2.**

The SIDRA summary output results of the analysis are contained in **Appendix B.**

Existing Layout – 2017

At present the T-intersection of Hale Road and Woolworths Drive has a channelisation treatment on Hale Road that provides a short right turn pocket on Hale Road for the right turn into Woolworths Drive. No right turn lane is provided on Hale Road to accommodate the right turns into the Hanover Street T-intersection. The T-intersection of Hale Road and Strelitzia Avenue is signalised.

The intersection of Hale Road and Woolworths Drive currently operates with a maximum degree of saturation (DOS) of 0.644. The highest average delay is associated with the right turn out of Woolworths Drive onto Hale Road at 31 seconds with a Level of Service (LOS) of D. The highest 95% queue length is along Woolworths Drive being 28m or 4 vehicles. The 95% queue along Hale Road waiting to turn right into Woolworths Drive is 4-5m or 1 vehicle. (The observed maximum queue length was 4 vehicles although this was not typical). In this instance the predicted increase in the future scenario will be added to the observed max queue).

The intersection of Hale Road and Hanover Street currently operates with a highest DOS of 0.362. The highest average delay is associated with the right turn from Hanover Street into Hale Road at 14 seconds with a LOS B. The highest 95% queue length is along Hale Road turning right being 10m or 1-2 vehicles.

The signalised intersection of Hale Road and Strelitzia Avenue currently operates with a highest DOS of 0.664 and a cycle time of 40 seconds. The highest average delay is associated with the right turn out of Strelitzia Avenue onto Hale Road at 24 seconds with a LOS C. The highest 95% queue length is along Hale Road being 35m or 5 vehicles. The queue along Hale Road (west) towards Hanover Street is 31m or 4-5 vehicles.

Channelisation Option – 2017

An option to provide a short right turn lane along Hale Road for vehicles turning right into Hanover Street has been modelled. The results suggest that the highest average delay may increase slightly by 5 seconds to 19.9 seconds whilst the queue length may decrease 1m to 8.2m. The short right turn lane will allow for some storage of the longest queue observed at 2 vehicles, although this was not typical.

Roundabout Options – 2017

A single-lane roundabout in accordance with the Public Transport Authority standard geometry at the intersection of Hale Road and Woolworths Drive would operate with a highest DOS of 0.607 (compared to the exiting DOS of 0.644). The highest average delay is still associated with the right turn out of Woolworths Drive onto Hale Road however the delay decreases from the existing layout by 20 seconds to 10.4 seconds (30.5 existing) with a LOS B. The highest 95% queue length is along Hale Road (west) being 44m or 6-7 vehicles. The queue along Hale Road waiting to turn right into Woolworths Drive is 26m or 3-4 vehicles. Minor operational improvements associated with introducing a roundabout are suggested by banning the right turn movement into Hanover Street.

Traffic Signal Option – 2017

The intersection of Hale Road/Woolworths Drive under traffic signal control would operate at a highest DOS of 0.861 (compared to the exiting DOS of 0.644) with a cycle time of 50 seconds. The highest average delay is associated with turning movements from Woolworths Drive with a delay of 35.6 seconds with a LOS D. The highest 95% queue length is along Hale Road (west) being 66m or 9-10 vehicles. The queue along Hale Road (east) is 54m or 7-8 vehicles. This would block the intersection of Hanover Street but be well clear of Strelitzia Avenue.

The cycle time of the existing signals at the intersection of Hale Road and Strelitzia Avenue is altered under this option from 40 seconds to 50 seconds to co-ordinate with the new signals at Woolworths Drive. The signalised intersection of Hale Road and Strelitzia Avenue will operate with a highest DOS of 0.968 (compared to the exiting DOS of 0.664). The highest average delay is associated with the right turn out of Strelitzia Avenue onto Hale Road of 52 seconds (compared to the existing average delay of 24 seconds) with a LOS D. The highest 95% queue length is along Strelitzia Avenue being 57m or 8 vehicles. The queue along Hale Road (west) towards Hanover Street is 42m or 6 vehicles.

Existing Layout– 2027

In 2027 the intersection of Hale Road/Woolworths Drive can be predicted to operate with a highest DOS of 0.859 (compared to the exiting DOS of 0.644). The highest average delay is associated with the right turn out of Woolworths Drive onto Hale Road of 54 seconds (compared to the existing 31 seconds) with a LOS F. The highest 95% queue length is along Woolworths Drive being 56m (compared to the existing 28m). The queue along Hale Road waiting to turn right into Woolworths Drive remains at approximately 1 vehicle unaltered from the 2017 analysis. The observed longest queue length was 4 vehicles although this was not typical and only occurred on a few occasions. It is estimated that this observed queue length would typically remain unaltered and would be less for the majority of the peak.

The intersection of Hale Road and Hanover Street will operate with a highest DOS of 0.404 (compared to the existing 0.362). The highest average delay is associated with the right turn from Hanover Street into Hale Road of 16 seconds with a LOS C. The highest 95% queue length is along Hale Road turning right being 13m or 2 vehicles.

The signalised intersection of Hale Road and Strelitzia Avenue is likely to operate with a highest degree of saturation of 0.730 and a cycle time of 40 seconds. The highest average delay is associated with the right turn out of Strelitzia Avenue onto Hale Road of 25 seconds (compared to the existing 24 seconds) with a LOS C. The highest 95% queue length is along Hale Road west being 40m (compared to the existing 35m).

Roundabout Options – 2027

A single-lane roundabout at the intersection of Hale Road/Woolworths Drive would operate with a highest DOS of 0.678 (compared to 0.859 if the existing layout with 2027 traffic volumes). The highest average delay is still associated with the turning movements out of Woolworths Drive onto Hale Road however the delay decreases from the existing layout 2027 by 7 seconds to 47.1 seconds (54.1 existing layout with 2027 traffic volumes) with a LOS D. The highest 95% queue length is along Hale Road (west) being 55m or 7-8 vehicles. The queue along Hale Road waiting to turn right into Woolworths Drive is 31m or 4-5 vehicles. Minor operational improvements are

suggested with the banning of the right turn movement into Hanover Street.

Traffic Signal Option -2027

The intersection of Hale Road/Woolworths Drive under traffic signal control would operate with a highest DOS of 0.947 (compared to 0.859 if the existing layout with 2027 traffic volumes). The cycle time is 50 seconds. The highest average delay is associated with the turning movements from Woolworths Drive with a delay of 47.1 seconds with a LOS D. The highest 95% queue length is along Hale Road (west) being 72m or 10 vehicles. The queue along Hale Road (east) is 63m or 9 vehicles. This would block the intersection of Hanover Street but be well clear of Strelitzia Avenue.

The cycle time of the existing signals at the intersection of Hale Road and Strelitzia Avenue is altered under this option from 40 seconds to 50 seconds to co-ordinate with the new signals at Woolworths Drive. The signalised intersection of Hale Road and Strelitzia Avenue will operate with a highest degree of saturation of 0.913 (compared to 0.730 for the existing layout with 2027 traffic volumes). The highest average delay is associated with the right turn out of Strelitzia Avenue onto Hale Road of 41 seconds (25 seconds existing layout with 2027 traffic volumes) with a LOS D. The highest 95% queue length is along Strelitzia Avenue being 54m or 7-8 vehicles. The queue along Hale Road (west) towards Hanover Street is 49.5m.

Table 1: SIDRA Analysis Comparison for 2017 Options

	Max DOS	Max. Ave. Delay	Max LoS	Movement with Max Delay	Highest 95% Queue Length	Queue Length toward adjacent intersection
Existing Layout						
Woolworths Dr	0.644	30.5	D	Right from Woolworths Dr	28.1m Woolworths	4.3m Hale Rd (east)
Hanover St	0.362	14.4	B	Right from Hanover St	9.9m Hale Rd (west)	9.9m Hale Rd (west)
Strelitzia Ave Cycle Time = 40secs	0.664	24.3	C	Right from Strelitzia Ave	35.4m Hale Rd (west)	35.4m Hale Rd (west)
Channelisation with right turn pocket for Hanover St and Woolworths Dr						
Hanover St	0.304	19.9	B	Right from Hanover St	8.2m Hale Rd (west)	8.2 Hale Rd (west)
Roundabout at Woolworths Dr / Hale Rd – Option A						
Woolworths Dr	0.607	10.4	B	Right from Woolworths Dr	43.8m Hale Rd (west)	25.7m Hale Rd (east)
Hanover St	As per the existing layout					
Strelitzia Ave Cycle Time = 40secs	As per the existing layout					
Roundabout at Woolworths Dr / Hale Rd – No Right Turn (NRT) into Hanover St – Option B						
Woolworths Dr	As per roundabout option					
Hanover St	0.324	7.8	A	Left from Hanover St	2.2m Hanover St	0m - NRT Hale Rd (west)
Strelitzia Ave Cycle Time = 40secs	As per the existing layout					
Traffic Signals at Woolworths Dr / Hale Rd						
Woolworths Dr Cycle Time = 50secs	0.861	35.6	D	Left/right from Woolworths Dr	65.8m Hale Rd (west)	53.6m Hale Rd (east)
Hanover St	0.269	5.7	A	Left from Hanover St	1.3m Hanover St	0m - NRT Hale Rd (west)
Strelitzia Ave Cycle Time = 50secs	0.968	52.0	D	Right from Strelitzia Ave	56.7m Strelitzia Ave	42.0m Hale Rd (west)

Table 2: SIDRA Analysis Comparison for 2027 Options

	Max DOS	Max. Ave. Delay	Max LoS	Movement with Max Delay	Highest 95% Queue Length	Queue Length towards adjacent intersection
2027						
Existing Layout						
Woolworths Dr	0.859	54.1	F	Right from Woolworths Dr	55.5m Woolworths	5.4m Hale Rd (east)
Hanover St	0.404	16.8	C	Right from Hanover St	13.2m Hale Rd (west)	13.2m Hale Rd (west)
Strelitzia Ave Cycle Time = 40secs	0.730	25.4	C	Right from Strelitzia Ave	40.4m Hale Rd (west)	40.4m Hale Rd (west)
Channelisation with right turn pocket for Hanover St and Woolworths Dr						
Hanover St	0.335	23.9	C	Right from Hanover St	10.9m Hale Rd (west)	10.9m Hale Rd (west)
Roundabout at Woolworths Dr / Hale Rd – Option A						
Woolworths Dr	0.678	10.9	B	Right from Woolworths Dr	54.6m Hale Rd (west)	31.2m Hale Rd (east)
Hanover St	As per the existing layout					
Strelitzia Ave Cycle Time = 40secs	As per the existing layout					
Roundabout at Woolworths Dr / Hale Rd – No Right Turn (NRT) into Hanover St – Option B						
Woolworths Dr	As per roundabout option					
Hanover St	0.357	8.2	A	Left from Hanover St	2.6m Hanover St	0m - No right turn Hale Rd (west)
Strelitzia Ave Cycle Time = 40secs	As per the existing layout					
Traffic Signals at Woolworths Dr / Hale Rd						
Woolworths Dr Cycle Time = 50secs	0.947	47.1	D	Left/right from Woolworths Dr	72.4m Hale Rd (west)	62.6m Hale Rd (east)
Hanover St	0.295	6.0	A	Left from Hanover St	1.5m Hanover St	0m - No right turn Hale Rd (west)
Strelitzia Ave Cycle Time = 50secs	0.913	40.6	D	Right from Strelitzia Ave	53.5m Strelitzia Ave	49.5m Hale Rd (west)

2.3 Modelling Summary and Conclusion

The existing channelisation layout operates satisfactorily from an operational perspective both with current traffic volumes and in 2027 with a 10% increase in traffic. The intersection of Woolworths Drive and Hale Road in 2027 is approaching capacity with a degree of saturation of 0.859 whilst Hanover Street and Strelitzia Avenue have additional spare capacity with degrees of saturation of 0.404 and 0.730 respectively. Under this option the queue lengths along Hale Road are minimised with the queues occurring on the side roads. Observed queues during the survey suggest that the longest queue length on Hale Road turning right into Woolworths Drive is 4 vehicles. The analysis suggests negligible increase in queue lengths (1m) along Hale Road between 2017 and 2027 hence the longest observed queue length is not expected to alter significantly.

From an operational perspective the roundabout option has a lower highest degree of saturation in 2017 and 2027 compared to the existing layout. (0.678 compared to 0.859 for 2027). Queue lengths along Hale Road are estimated to be 55m (west) and 31m (east). The queue to the east extends to Hanover Street but typically does not block this intersection so Hanover Street remains fully operational.

The coordinated traffic signals along Hale Road at Woolworths Drive and Strelitzia Avenue operate satisfactorily under the existing traffic volumes and with a 10% increase. Under the 2027 estimated volumes the maximum degree of saturation is 0.947 and 0.913 respectively. The highest delays are experienced on the minor legs of the intersections being Woolworths Drive and Strelitzia Avenue with typically a LOS D under both the 2017 and 2027 volumes. The queue lengths estimated are manageable on the road network.

All options operate satisfactorily based on 2017 volumes and 10% growth. The channelisation and traffic signal option start to near their maximum capacity under the 2027 scenario whilst comparatively the roundabout option has additional spare capacity.

3.0 CONCEPT PLANS

Whilst three intersection improvements were identified and subsequently modelled using SIDRA i.e. channelisation, traffic signals and a roundabout with slight variations of these treatments have produced a total of five options as follows:

- Channelisation – Option A - one approach lane on Woolworths Drive
- Channelisation – Option B - two approach lanes on Woolworths Drive
- Traffic Signals
- Roundabout –Option A - Hanover Street All Movements
- Roundabout – Option B – Hanover Street Left Turns Only

There are concept layout drawings of these options included in **Appendix C**.

3.1 Channelisation – Option A - one approach lane on Woolworths Drive

This channelisation option requires the least construction work and has the lowest complexity of the five options. Potential service relocations are minimised by maintaining existing kerblines where possible. In order to maintain existing kerblines as much as possible only one approach lane on Woolworths Drive is provided. A seagull treatment has been incorporated at the Hanover Street intersection which allows for a more formalised storage of vehicles on Hale Road and provides vehicles with a marked lane to queue out of the eastbound through lane.

The proximity of Crossover 2 servicing lots 76, 72 and 70 Hale Road to Hanover Street creates traffic flow and safety issues. It is proposed that this crossover be relocated with the proposed channelisation works.

The existing "Shopping Centre" pylon sign installed within the central median has a significant presence to drivers along the Woolworths Drive approach. Consideration should be given to relocation of this sign away from the island which will assist in creating a more "open" environment with improvement to visibility for vehicles exiting Woolworths Drive.

This channelisation layout maintains the major flow along Hale Road thereby reducing disruption to the priority movements. Woolworths Drive being the minor road, it is subject to delays whilst drivers seek gaps in the Hale Road traffic stream.

3.2 Channelisation –Option B - two approach lanes on Woolworths Drive

This option was developed after discussion with the City of Kalamunda in order to improve the intersection capacity and reduce queue lengths compared to that of option A.

The construction works and complexity of this channelisation Option B increase compared to Option A due to the additional widening works required on Woolworths Drive. The layout separates the left and right turning vehicles over a short length hence reduces the queue length and delays on this approach compared to Option A.

Whilst the operational conditions can be improved through the introduction of a second approach

lane there are potential safety issues. There is the potential for right turning vehicles to obstruct sight lines between left turning vehicles and eastbound traffic. In this situation with the reduced sight lines left turning drivers can misread gap length, become impatient and take risks when entering the eastbound traffic stream.

The proximity of Crossover 2 still creates traffic flow and safety issues.

The road widening for this option is proposed on the western side of Woolworths Drive in order to avoid service relocation on the northeast corner of the intersection. This option will require land acquisition to accommodate the road widening on Woolworths Drive.

3.3 Traffic Signals

The traffic signal option requires some road construction work in addition to the traffic signals installation. As per the channelisation option, potential service relocations are minimised by maintaining existing kerblines where possible.

Hanover Street is proposed to be closed to right turn movements due to its proximity to Woolworths Drive. The proximity of Crossover 2 servicing lots 76, 72 and 70 Hale Road to Hanover Street is no longer an issue however the width and geometry of the crossover creates additional safety issues that should be addressed. This is discussed further within the report.

The existing "Shopping Centre" pylon sign installed within the central median will be required to be removed and relocated in order to install traffic signals and maintain visibility to the signal aspects.

Traffic signals will add some interruption to the major traffic flow along Hale Road which will result in queuing. There is likely to be a change in existing crash patterns at the intersection i.e. increase in rear-end collisions compared to right angle crashes.

3.4 Roundabout Option A – Hanover Street Left Turns Only

Option A for the roundabout restricts Hanover Street movements to left turns only. Prohibiting right turn movements into Hanover Street improves traffic flow by reducing the potential for queuing on Hale Road behind a vehicle stopped to turn right.

As per the channelisation and traffic signal options, Crossover 2 creates safety issues that need to be addressed in conjunction with the intersection treatment improvement.

The roundabout impacts numerous services and in particular the services located within the northeast corner of the intersection and the overhead low voltage and high voltage power lines. The roundabout is the most complex geometry to construct and will require the purchase of abutting private land as the existing road reserve is inadequate.

3.5 Roundabout Option B – All Movements at Hanover Street

Option B for the roundabout is primarily the same as Option A except it allows all vehicle movements into and out of Hanover Street. Option A is the preferred option as maintaining access to Hanover Street is an added risk.

4.0 CRASH HISTORY

A study of the recent crash history for the section of Hale Road from Woolworths Drive to Strelitzia Avenue has been conducted for the five year period to the end of December 2016 from the Main Roads Western Australia Integrated Road Information System (IRIS) crash database. There was a total of 44 crashes within the extracted data which is summarised as follows:

- 5 crashes at the intersection of Woolworths Drive and Hale Road: 4 right angled crashes and 1 object hit. 1 crash required medical attention and the remaining 4 involved property damage.
- 3 midblock crashes between Woolworths Drive and Hanover Street: 2 rear end crashes and 1 right angle crash. All involved property damage only.
- 7 crashes occurred at the intersection of Hanover Street and Hale Road: 4 right angled crashes; 1 right turn through; 1 side swipe; 1 reversing/or rolling in traffic. 1 crash involved hospitalisation with the remaining 6 involving property damage.
- 18 midblock crashes between Hanover Street and Strelitzia Avenue: 9 right angle crashes; 5 side swipe same direction crashes; 2 rear end crashes; 1 right turn through and 1 rear end. 1 crash involved hospitalisation, 1 required medical attention and the remaining 16 were property damage only.
- 11 crashes occurred at the intersection of Strelitzia Avenue and Hale Road: 8 right turn through crashes; 2 rear end crashes and 1 side swipe same direction.

5.0 RATIONALISATION OF CROSSOVERS

There are eight crossovers located along the 310m section of Hale Road adjacent to the commercial properties extending from the west of Woolworths Drive to Strelitzia Avenue. Including the Woolworths Drive access makes nine connections to Hale Road. Hale Road by its definition as a "*District Distributor A road*" is intended to facilitate the flow of traffic and typically provide only limited access. However, the historic nature and progressive commercial developments that front Hale Road are such that individual properties are typically serviced via their own crossover.

Moving forward from the historical development of properties which resulted in a crossover for each individual property, there is now the opportunity to rationalise the number of crossovers on Hale Road through the creation of a de-facto service road by joining their carparks. Benefits to adjoining businesses, Hale Road traffic flow and the local community could all be realized. Those benefits include:

- Less disruption to through traffic along the section of Hale Road;
- Increased flow of traffic/trade between commercial properties fronting Hale Road via the pseudo "service road";
- Commercial properties patronage effectively have access to all crossovers along Hale Road;
- Decrease in potential vehicle conflict points along Hale Road; and
- Less vehicle /pedestrian conflict points as less crossovers.

5.1 Crossover 1 – 82 Hale Road

This is the only crossover located along Hale Road, west of Woolworths Drive. The crossover primarily services no. 82 Hale Road. Access is also possible from a crossover on Woolworths Drive primarily to service no. 88 Hale Road. The Hale Road crossover should be maintained as there are no other crossovers within close proximity and it assists with reducing demand at the Hale Road and Woolworths Drive intersection.

Photo 1: Crossover 1 along Hale Road

5.2 Crossover 2 – 76, 72, 70 Hale Road

There are a number of safety and design issues associated with the crossover located directly adjacent to Hanover Street that services no. 76, 72 and 70 Hale Road referred to as Crossover 2. The crossover is approximately 6 wide with minimal radii. There is a power pole located on the western side on the kerbline that restricts the entrance radius into the driveway. There is evidence of this in that the kerbline immediately adjacent to the pole is damaged. Vehicles were observed to almost come to a stop to negotiate the driveway especially when a vehicle was stopped on the crossover waiting to exit onto Hale Road.

The proximity of this crossover to Hanover Street is also undesirable and influences the flow of traffic along Hale Road.

Crossover 3 is located some 40m to the east of Crossover 2. Due to the existing safety issues it is proposed that Crossover 2 be closed.

Photo 2: Crossover 2 along Hale Road showing power pole proximity

5.3 Crossover 3 – 70, 72 Hale Road

Crossover 3 is located immediately opposite the McDonalds drive thru exit. Crossover 3 has a width of approximately 8m and the ingress and egress movements are clearly defined with pavement marking. The McDonalds drive through waiting bays are located immediately to the east of Crossover 3. This presents some safety issues. The McDonalds drive thru waiting bays are currently located next to Crossover 2. McDonalds staff walking a customer's order to a waiting vehicle is required to stand at the driver's window effectively within the Crossover 2 exit pathway and subsequently exposed to moving vehicles.

Photo 3: Crossover 3 along Hale Road with the Waiting Bays

An opportunity exists to improve this existing safety issue created by the current design. The closure of Crossover 3 and Crossover 2 and the creation of a new crossover in between has merit. The closure of Crossover 3 allows for the creation of 2 waiting bays opposite the store. The existing pedestrian zebra crossing pavement marking can then be used by staff to safely access vehicles within the waiting bays.

5.4 Crossover 4 – 64, 64B Hale Road

Crossover 4 services no.64 and 64B Hale Road also known as Hale Road Tavern and the Forrestfield TAB. At present Crossover 4 is located approximately 20m from Crossover 3. No existing safety issues have been identified with this crossover. It is located at the start of the left hand turn lane for the signalised intersection of Hale Road and Strelitzia Avenue.

The closure of Crossover 3 would increase the distance to this crossover to approximately 50m.

Crossover 4 is located some 20m to the west of Crossover 5. One of these crossovers should be closed due to their close proximity to each other. The concept plans show the closure of Crossover 4.

5.5 Crossover 5 – 60 Hale Road

Crossover 5 services no. 60 Hale Road which includes Red Rooster and Subway. At present crossover 5 is located approximately 20m from Crossover 4. No existing safety issues have been identified with this crossover. It is located within the left hand turn lane for the signalised intersection of Hale Road and Strelitzia Avenue.

Crossover 5 is located some 20m to the east of Crossover 4. One of these crossovers should be closed due to their close proximity to each other.

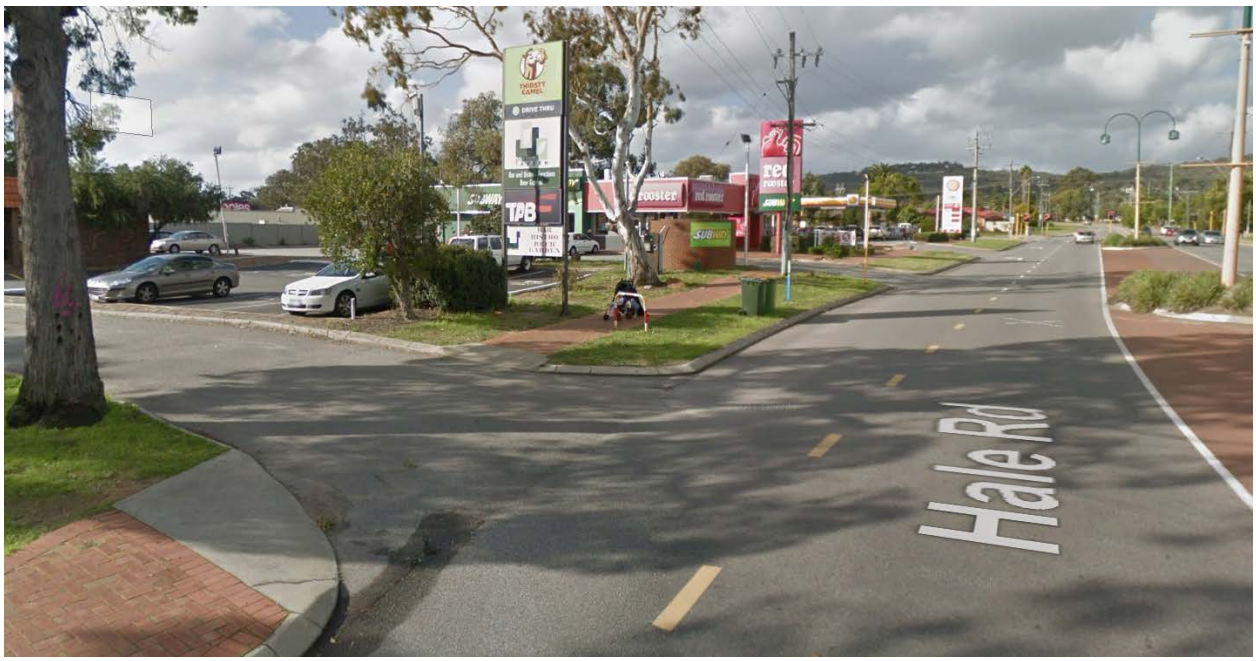


Photo 4: Crossover 4 along Hale Road with Crossover 5 and 6 in the background

Photo 5: Crossover 5 along Hale Road

5.6 Crossover 6 – Red Rooster Drive through exit, Crossover 7 – 2 Strelitzia Avenue

The drive through exit is immediately adjacent to the crossover that services the Coles Express Service Station. This is not ideal and creates potential safety issues as vehicles exiting from the Red Rooster Drive Through may be interpreted by approaching drivers to be on the wrong side of crossover 7.

The concept proposes to realign the drive through exit into the Coles Express Service Station thereby eliminating the potential for driver confusion.

Photo 6: Crossover 6 and 7 along Hale Road

5.7 Crossover 8 – 2 Strelitzia Avenue

Crossover 8 is the eastern most crossover along Hale Road servicing the Coles Express Service Station. The crossover is within the "traffic signal zone" and as such may lead to vehicles cutting through the site to avoid stopping on a red signal.

It is unknown if this crossover is required by the refueling tankers in order to exit the site. If not required it is suggested that this crossover should be closed. Vehicles that exit the site using this crossover enter the left hand turn lane of the signals requiring them to turn left into Strelitzia Avenue. This being the case vehicles are likely to exit the site directly onto Strelitzia Avenue and not do it via the traffic signals. Due to the proximity of the traffic signals, vehicles using exiting the crossover are not permitted to cross the barrier line to travel eastbound along Hale Road.

Photo 8: Crossover 8 along Hale Road

5.8 Priorities and Staging for Crossover Rationalisation

As previously outlined it is recommended that Crossover 2 be closed in conjunction with the intersection improvements works. Further rationalisation of the driveway along Hale Road can be implemented in stages based on their priorities or in line with when relevant approvals from land owners for associated easements are secured. **Table 3** provides an outline of the driveway works priority and possible stages.

Table 3: Priorities and Staging for Rationalisation of Driveway Works

Item	Recommendation	Priority	Staging
Crossover 1	Remain Open	-	-
Crossover 2	Close & Relocate	High	Intersection Works
Crossover 3	Close	High	2
Reconfigure Tavern and TAB carpark		Medium	2
Crossover 4	4 or 5 to close	Low	4
Crossover 5	4 or 5 to close	Low	4
Crossover 6	Close	Medium	3
Crossover 7	Remain	Medium	3
Crossover 8	Close	Low	5

6.0 SERVICE RELOCATIONS

Service Authorities have been contacted and provided with the concept design plans and their advice requested for the design of potential service relocations and order of magnitude of costs. Due to the conceptual nature of the design, the contacted Service Authorities have provided limited (where any) advice and no indicative costs.

Therefore, based on Porter's previous experience with the relocation of services for other detailed design projects the following provisional amounts are suggested. These sums are based on a desktop review and would be subject to detailed design and Authority quotations on services changes. Service Authorities, in particular Western Power will need to confirm if the relocation of services as proposed by the concept designs are feasible. **Table 4** summarises the indicative only service relocation order of costs.

Table 4: Indicative Service Relocation Costs

Service Relocation	Channelisation Options A and B	Traffic Signals	Roundabout Options A and B
Gas Valve Hale Rd	-	-	$5,000
Gas Internal Connection Woolworths Dr	$5,000	$5,000	$5,000
Communication Pits and Lowering	$10,000	$10,000	$30,000
Water Main Banding/Protection 1065S	$10,000	$10,000	$20,000
Water Main Value/Fire Service	$5,000	$5,000	$5,000
Western Power Switchboards/Pillars	-	-	$15,000
Western Power LV Frame	-	-	$40,000
Western Power LV and HV Power Poles	-	-	$130,000
Contingency (25%)	$7,500	$7,500	$62,500
Total	**$37,500**	**$37,500**	**$312,500**

The creation of a bus embayment has also been proposed within the westbound carriageway, west of Strelitzia Avenue. It is noted that there is a 1065 dia. steel water main on the southern side of Hale Road. The location of this service would need to be further investigated to establish the impact of the proposed widening to accommodate a bus embayment and whether this treatment would be cost prohibitive. In that instance, an alternative lesser effective option may be the use of line marking to better define the road geometry and the bus stop.

7.0 CONSTRUCTION ESTIMATES

Preliminary order of cost estimates for each of the intersection treatments have been developed. For the purpose of the cost estimate both roundabout options are assumed to be the same indicative order of cost. A cost for the modifications proposed to rationalise the driveways along Hale Road as well as a possible bus embayment treatment have also been estimated.

These cost estimates are order of magnitude only and will ultimately depend on a detailed design. Known construction rates where available have been used in conjunction with rates documented in *"Rawlinsons, Australian Construction Handbook, 2017"*.

Table 5 provides a summary of the order of costs including a breakdown of the various elements costed. Note that these construction costs do not include service relocations and land acquisition costs. Those are reviewed separately.

Table 5: Order of Magnitude Construction Cost Estimates

Construction Costs	Channelisation Option A	Channelisation Option B	Traffic Signals	Roundabout Options A and B
Hale Road / Woolworths Drive	**$322,200**	**$400,200**	**$486,700**	**$582,300**
Preliminaries	$19,500	$19,500	$21,500	$29,500
Clearing and Disposal	$32,900	$37,900	$31,800	$47,200
Roads and Paths	$115,600	$165,600	$124,200	$241,700
Drainage	$25,000	$25,000	$25,000	$45,000
Traffic Signals	-	-	$105,000	-
Landscaping	-	-	-	$9,000
Street Lighting	$28,000	$28,000	$28,000	$28,000
Construction Contingency Sum (25%)	$56,000	$69,000	$84,000	$101,000
Detailed Design Fee (15%)	$33,150	$41,400	$50,400	$60,100
Contract Administration (5%)	$11,050	$13,800	$17,000	$21,000
Bus Embayment near Strelitzia Ave	**$77,000**			
Rationalisation of Driveways	**$150,000**			

8.0 LAND ACQUISITION

There are various land acquisition requirements in order to provide sufficient road reserve for each of the options. Indicative Land acquisition plans have been prepared based on the concept designs. The road reserve on Hale Road has been based on maintaining a minimum verge width of not less than 3m and a minimum of 1.8m verge width is assumed to be suitable for Woolworths Drive.

The land requirements for each of the options are as listed below.

Channelisation Option A = 9.31m^2
Channelisation Option B =107.1m^2
Traffic Signals =13.2m^2 (Refer below comment)
Roundabout Option A =274.55m^2
Roundabout Option B =274.55m^2

Additional land may also need to be acquired on Woolworths Drive under the traffic signal option to potentially meet any Main Roads WA traffic signals maintenance area requirement.

A copy of the Land Acquisition Plans are contained in **Appendix D**.

An internet search for commercial land for sale in this area did not result in sufficient information to form an estimate of average per square metre land pricing. It is therefore suggested that the City consider engaging a Land Valuer to provide appropriate advice should land purchase costings be desired.

9.0 SUMMARY OF COSTS

Table 6 provides a summary of the total costs for comparison purposes. Please note that as land acquisition costs have not been able to be included an indication i.e. low, medium and high with respect to each option is provided.

Table 6: Summary of Costs for Options

Cost Items	Channelisation Option A	Channelisation Option B	Traffic Signals	Roundabout Options A and B
Service Relocation	$37,500	$37,500	$37,500	$312,500
Construction	$322,200	$400,200	$486,700	$582,300
Land Acquisition	low	medium	low	High
Total	**$359,700**	**$437,700**	**$524,200**	**$894,800**

All estimates exclude land acquisition.

10.0 MULTI CRITERIA ASSESSMENT

Each option has been assessed with respect to various criteria. Evaluation criteria were formulated so that a balanced evaluation of the options could be achieved. Each evaluation criteria was assessed for each option as either low, medium or high. Evaluation criteria were broken down into three categories being: Operational Issues, Engineering Costs and Safety and Social Issues. These categories were subsequently weighted in order to assign a greater importance to various criteria. In summary, the operational issues has a weighting of 30%, engineering costs 55% and safety/social issues 15%. **Table 7** outlines the various evaluation criteria, rating, weighting and the overall ranking of each option.

The final ranking determines the preferred option balancing all of the evaluation criteria. Based on this overall assessment the channelisation options are the two most preferred treatments. This assessment not only takes into account the operational issues but engineering costs. For instance from an operational perspective Channelisation Option B is preferred. This is also the reason why this option was developed i.e. to improve Option A. However when engineering costs are taken into consideration as is the case with the multi criteria assessment then Channelisation Option A is preferred over Channelisation Option B.

Considering all criteria the roundabout options rate the least. Whilst operationally a roundabout scores high it comes at a high cost of construction and complexity and, is unable to be constructed in the short term due to the time it will take to negotiate and purchase land. The traffic signals and roundabout options also have very high impacts on the abutting residential properties.

Table 7: Multi Criteria Assessment of Intersection Treatments

	Channelisation Option A	Channelisation Option B	Traffic Signals	Roundabout Option A and B	Weightings
Operational Issues					**30%**
Sidra LOS	Low	Medium	Medium	High	15%
Queuing	Medium	Medium	High	Medium	15%
Engineering Costs					**55%**
Construction Costs	Low	Medium	High	High	25%
Maintenance Costs	Low	Low	High	Medium	5%
Service Relocation	Low	Low	Low	High	10%
Complexity	Low	Low	Medium	High	5%
Land Acquisition Costs	Low	Medium	Low	High	10%
Safety and Social Issues					**15%**
Sight Lines	Low	Low	Medium	Medium	5%
Pedestrian Facilities/Safety	Medium	Medium	High	Low	5%
Noise	Low	Low	High	High	2.5%
Landscaping	Medium	Medium	Low	Medium	2.5%
Overall Ranking	**1**	**2**	**3**	**4 Option B 5 Option A**	

11.0 STAKEHOLDER CONSULTATION

Stakeholder Consultation for the project involved the completion of a questionnaire. The questionnaire was developed to ascertain what issues were seen as most important by the Stakeholders along Hale Road between Woolworths Drive and Strelitzia Avenue and, the subsequent traffic improvement at Hale Road/Woolworths Drive they considered would best address those concerns.

The non-residential landowners and businesses adjacent to this section of Hale Road were consulted. A total of 20 businesses were identified with 9 questionnaires completed. The questionnaire was also posted to the non-residential landowners. Face to face interview surveys using the questionnaire were conducted with the staff at these businesses or a copy left for completion where it was not able to be completed on the day. The interview surveys were undertaken on Thursday 22nd February, 2018. Feedback was also sought regarding potential access modifications along Hale Road which was not specifically covered in the questionnaire.

The nine businesses that completed the questionnaire included:

- 60 Hale Road – Red Rooster – Staff
- 64 Hale Road – Hale Tavern – Business Manager
- 64 Hale Road – TAB – Business Manager
- 72 Hale Road – Chinese Restaurant – Business Manager
- 4/76 Hale Road – Friendlies Chemist - Staff
- 3/76 Hale Road – Mead Physio Group - Staff
- 78 Hale Road – KFC – Staff
- 1/ 82 Hale Road – Forrestfield Radiology – Staff
- 2/82 Hale Road – Jetts – Staff

Face to face interview surveys using the questionnaire were conducted with the residents on Friday 23rd February, 2018. Where residents were not available, a copy of the questionnaire was left in their letterbox for completion and return. A total of 15 residents were identified with 2 questionnaires completed.

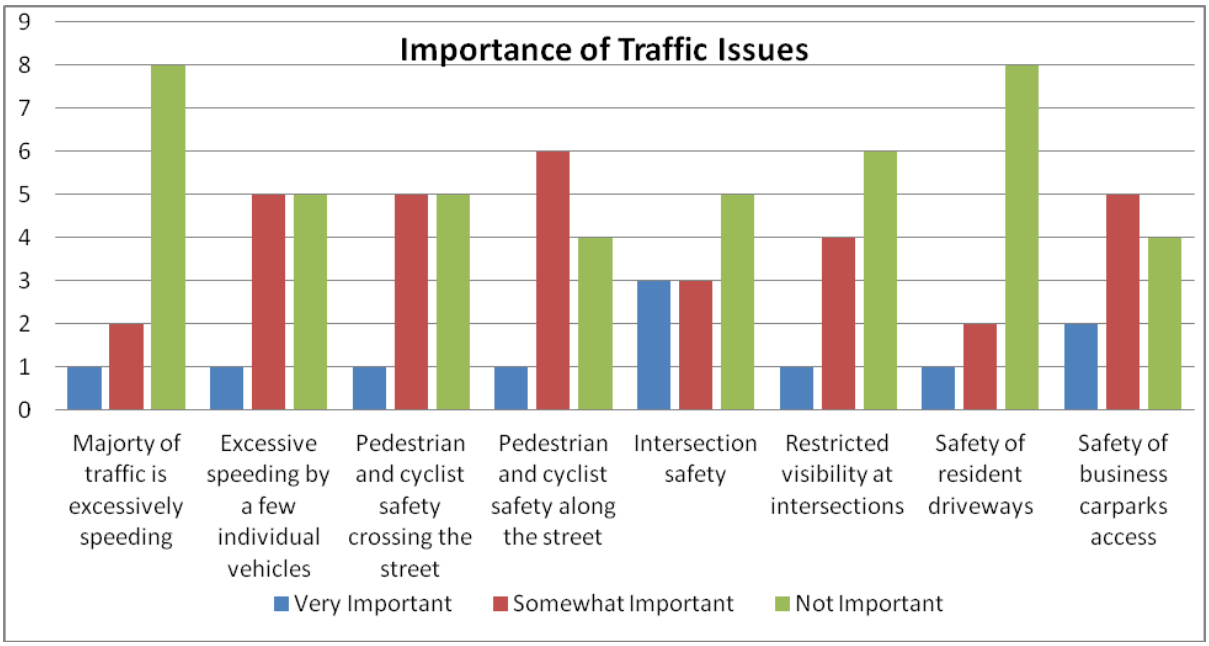
Stakeholders were asked to rate various traffic issues and list the locations where these were a concern along Hale Road (refer **Graph 1**). Of particular interest were the following comments:

- 5 out of the 11 stakeholders mentioned that intersection safety was a concern at Woolworths Drive.
- 3 out of 11 stakeholders mentioned that safety of the crossover immediately adjacent to Hanover Street was a concern. In particular, the width being too narrow for two vehicles to use simultaneously i.e. in/out and the proximity of the power pole.

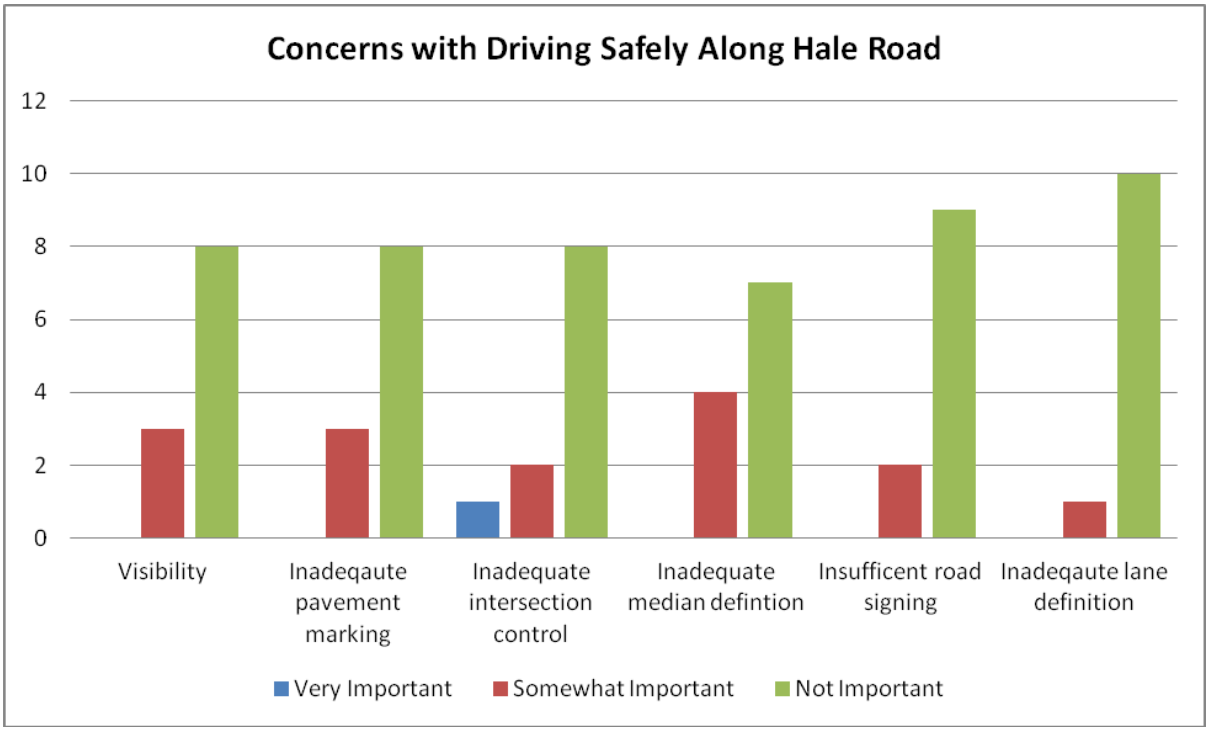
Stakeholders were asked what level of concern they had in regard to driving safely along Hale Road with respect to various issues such as visibility, pavement markings, intersection control, lane and median definition and road signing (refer **Graph 2**) In the majority of cases where there was a concern it related to the intersection of Woolworths Drive at Hale Road.

With respect to vulnerable road users such as physically handicapped, school children and the elderly, it was raised that there are a number of children that cross Hale Road near Hanover Street

due to the proximity of the Forrestfield Primary School. Also, elderly were stated as crossing Woolworths Drive as patrons to various businesses either side of Woolworths Drive.

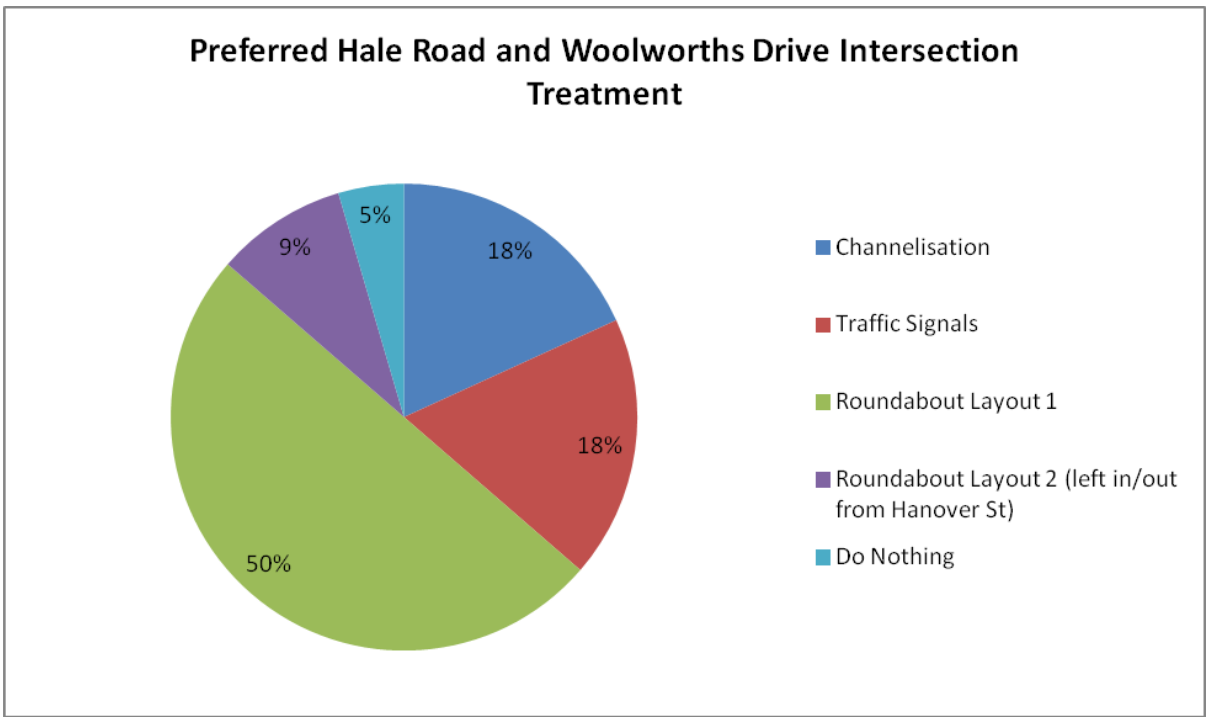


Graph 1: Importance of Traffic Issues



Graph 2: Concerns with Driving Safely Along Hale Road

Four options were presented as a proposed treatment at the intersection of Hale Road and Woolworths Drive. These being: Channelisation, Traffic Signals, Roundabout Layout 1 and Roundabout Layout 2 (left in/out only at Hanover Street). Stakeholders were also given the opportunity to propose an alternative treatment in which one respondent proposed a "do nothing" option.



Graph 3: Preferred Hale Road and Woolworths Drive Intersection Treatment

After the face to face interview surveys with businesses, a discussion with respect to the rationalisation of driveways along Hale Road occurred. Some potential access modifications were presented with feedback as follows:

- General support in the relocation of the crossover immediately adjacent to the Hanover Street intersection largely due to the existing issues with the width of the crossover, the proximity of the power pole and congestion created near the Hanover Street intersection.
- Concern was raised with respect to the closure of the driveway that currently aligns with the Hale Road tavern drive through outlet.
- The City has received a formal response on behalf of McDonalds Australia with respect to the access modifications. Concern was raised about the easement arrangements that have taken place privately between 70 and 72 Hale Road and the associated costs.

ADDENDUM 1

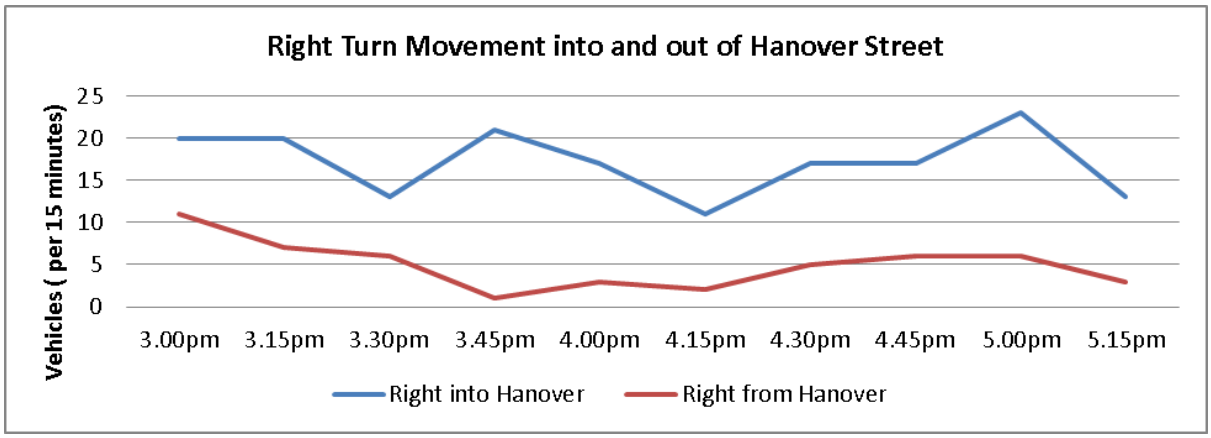
Hanover Street Discussion

Under the channelisation options the right turn traffic movements in and out of Hanover Street can be accommodated through the provision of a short right turn lane to minimise disruption to the Hale Road through traffic.

Under the traffic signal option right turn movements are prohibited due to operational and safety issues associated with the traffic signals.

From an operational perspective the removal of right turn traffic movements at Hanover Street is also preferred be included when associated with the installation of the roundabout proposals i.e. Option B. The removal of the right turn movements within close proximity to the roundabout improves safety and traffic flow along the eastbound departure leg of the roundabout.

Intersection turn counts recorded a total of 20 vehicles per hour turning right from Hanover Street into Hale Road and 70 vehicles per hour turning right into Hanover Street from Hale Road during the overall road network peak period of 4.30pm-5.30pm. Graph 4 below shows the number of vehicles per 15 minutes undertaking a right turn movement between the survey period of 3.00pm to 5.30pm.



Graph 4: Right Turn Movements into and out of Hanover Street

Figure 2 shows likely routes for eastbound vehicles should the right turn movements be prohibited at Hanover Street. Vehicles turning right onto Hale Road wanting to travel eastbound along Hale Road may easily use Mallow Way to turn right onto Hale Road with a minimum of alteration to their travel distance. Eastbound vehicles wanting to turn right from Hale Road into Hanover Street are likely to incur increased travel distances. Those vehicles may turn right into either Fife Street or Mallow Way. Due to the closure of Sussex Road east of Stratheam Road an increased travel route would be required. The re-opening of Sussex Road would result in similar travel distances of routes with or without right turn movements permitted at Hanover Street.

Under the roundabout option B, vehicles desiring to head eastbound from Hanover Street via Hale Road can instead turn left onto Hale Road and then perform a u-turn at the roundabout in order to travel east along Hale Road. This is an easily performed minor deviation.

Hanover Street currently carries in the order of 1,761 vehicles per day (Aug 2016). The volume of traffic on the possible alternative connections to Hale Road i.e. Fife Street carries 447 vehicles per day (Aug 2016), Coburg Street carries 1,240 vehicles per day (Aug 2017) and Mallow Way carries 3,217 vehicles per day (January 2017). These roads are all classified as Local Access roads with the exception of Mallow Way which is classified as Local Distributor road. Access roads typically carry up to a desirable maximum of 3,000 vehicles per day whilst Local Distributors carry up to a desirable maximum of 6,000 vehicles per day.

As Figure 2 demonstrates, the redistribution of the formerly right turning traffic at Hanover Street is likely to be to Fife Street for the right turn from Hale Road and to Mallow Way for the right turn onto Hale Road. The traffic count volumes recorded over the 2.5 hour period is estimated to represent approximately 27% of the daily traffic assumed to be 1,761 vehicles per day. Therefore the 172 vehicles counted over the 2.5hr period turning right from Hale Road into Hanover Road is estimated to equate to 643 vehicles per day. As such the volume of traffic on Fife Street is likely to increase from 447 to 1,090 vehicles per day. This is still below the desirable maximum of 3,000 vehicles per day for a local access road.

Similarly, the 50 vehicles counted over the 2.5hr period turning right from Hanover Street into Hale Road is estimated to equate to 187 vehicles per day. As such the volume of traffic on Mallow Way is likely to increase from 3,217 to 3,404 vehicles per day. This is still below the desirable maximum of 6,000 vehicles per day for a local distributor road.

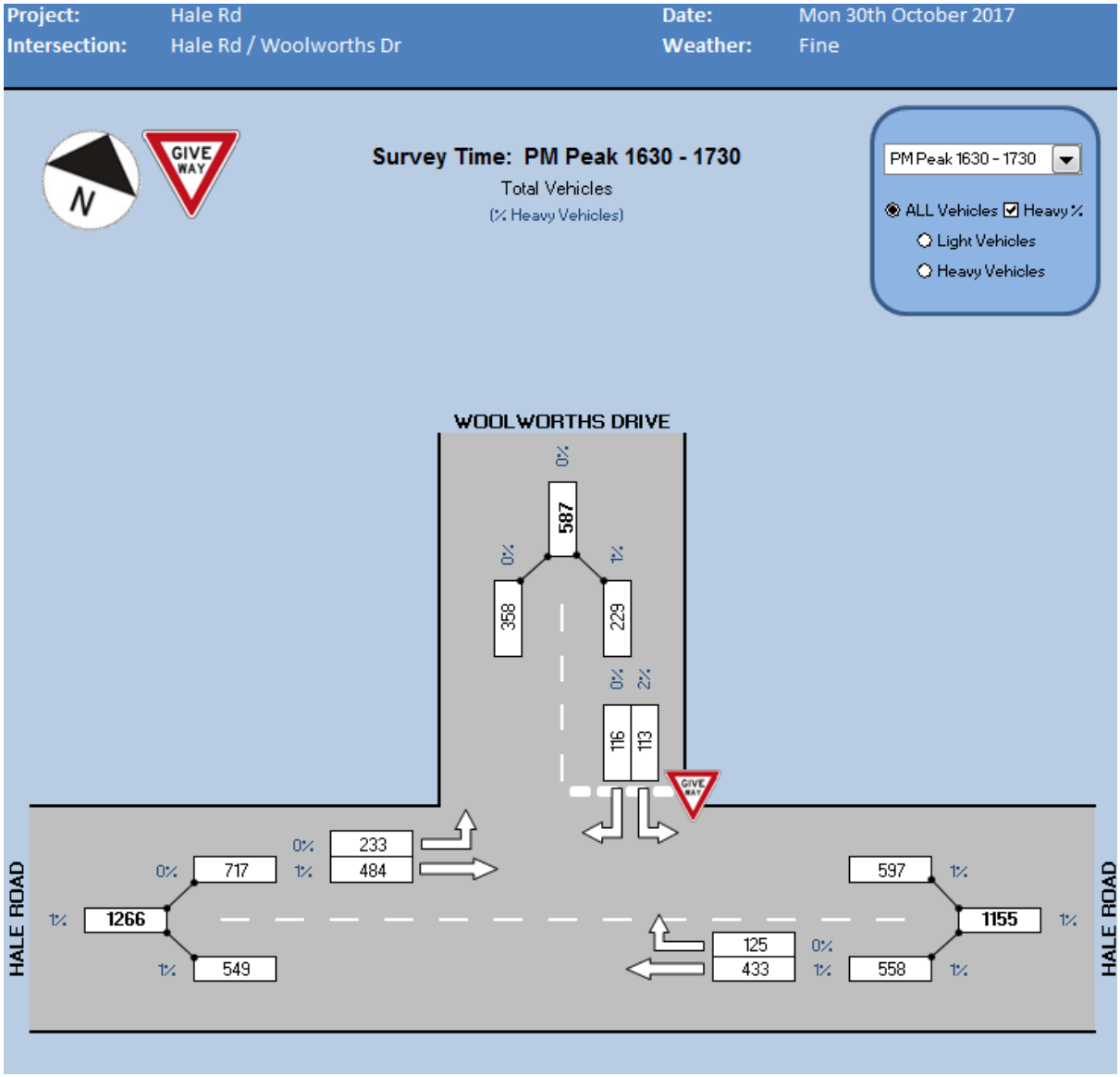
Numerous residential properties will be impacted by this proposed road modification as suggested in **Figure 2**. The further the residential properties are located from Hanover Street the lesser the impact. The closure of Sussex Road east of Strathem Road contributes to this impact. Of particular interest is the impact to traffic movements to/from the Forrestfield Primary School. It is understood from Department of Education information that Hale Road from Tonkin Highway to Hawtin Road forms a boundary of the local catchment area of Forrestfield Primary School with residents on the southern side included. There are two optional catchment areas one located to the northwest on the opposite side of Hale Road and the other to the northeast of the School along Hale Road. These areas have the potential to generate vehicular school trips along Hale Road. On this basis the demand for right turning vehicles into and out of Hanover Street associated with Forrestfield Primary School to/from the place of residence should be minimal as these catchment areas are optional i.e. residents residing in these areas can chose from a number of schools. The demand may increase if a multi-purpose trip to/from school occurs e.g. leave home to drop children at school then on the work via Hale Road and vice versa in the afternoon.

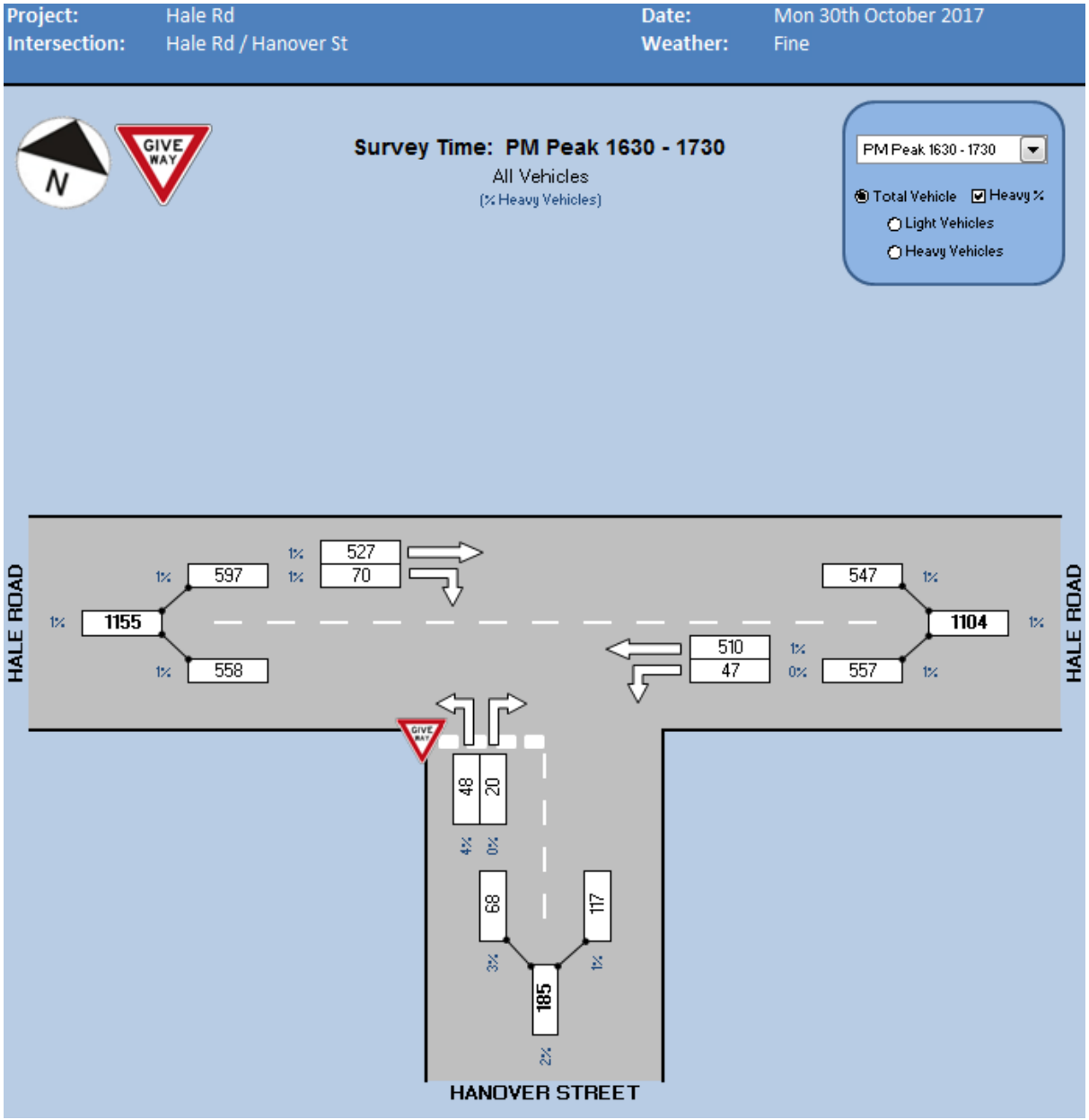
The history of the purpose of the closure of Sussex Road is unknown. Depending on whether the past purpose for the closure remains relevant, consideration by the City of Kalamunda should be given to the re-opening of Sussex Road in conjunction with any restrictions to left turn movements only at Hanover Street.

Based on the traffic volumes predicted using the existing traffic count data, the redistribution of traffic onto the surrounding road network can be readily accommodated in context with the road hierarchy of the respective roads.

Figure 2: Alternative Routes with Hanover Street as left turns only including existing traffic volumes.

APPENDIX A – INTERSECTION TURN COUNTS


Project: Hale Rd
Intersection: Hale Rd / Woolworths Dr
Date: Mon 30th October 2017
Weather: Fine
GIVE WAY
N
Survey Time: PM Peak 1630 - 1730
Total Vehicles
(% Heavy Vehicles)
PM Peak 1630 - 1730
ALL Vehicles
Heavy %
Light Vehicles
Heavy Vehicles
WOOLWORTHS DRIVE
587
358
229
116
113
233
484
717
1266
549
125
433
597
1155
558
HALE ROAD
HALE ROAD


Project: Hale Rd
Intersection: Hale Rd / Hanover St
Date: Mon 30th October 2017
Weather: Fine
N
GIVE WAY
Survey Time: PM Peak 1630 - 1730
All Vehicles
(% Heavy Vehicles)
PM Peak 1630 - 1730
Total Vehicle
Heavy %
Light Vehicles
Heavy Vehicles
HALE ROAD
HALE ROAD
1% 597
1% 527
1% 70
1% 1155
1% 558
547 1%
1104 1%
510 1%
47 0%
557 1%
48
20
4% 0%
68
117
3% 1%
185
2%
HANOVER STREET

APPENDIX B – SIDRA OUTPUTS

APPENDIX C – CONCEPT PLANS

4191-20-12-12/B	Channelisation Option A
4191-20-14-14/B	Channelisation Option B
4191-20-11-11/B	Traffic Signals
4191-20-13-13/B	Roundabout Option A
4191-20-10-10/B	Roundabout Option B
4191-20-15-15/A	Rationalisation of Crossovers

4191-20-12-12/B

WOOLWORTHS DRIVE

PIZZA

JETTS

DRYCLEANERS

X-RAY

LARGE TREES

WATER VALVE/
FIRE SERVICE

LV/HV POWER POLE
RELOCATION/UNDERGROUNDING

GAS VALVE

TELSTRA PITS

FORRESTFIELD
FAMILY
HEALTH
CARE
CENTRE

WATER VALVE

GAS VALVE

POWER CABINETS AND DOME

LV/HV POWER POLE
RELOCATION/UNDERGROUNDING

POWER/COMMS

CHINESE
RESTAURANT

MCDONALDS

REMOVE CROSSOVER

INSTALL NEW CROSSOVER

HALE ROAD

DRAINAGE PIT TO BE MODIFIED

LV/HV POWER POLE

LEFT IN, LEFT OUT ONLY
AT HANOVER STREET

DRAINAGE PITS TO BE MODIFIED

EXISTING WATER MAIN (1065S)
MAY BE IMPACTED

EXISTING WATER MAIN (1065S)
MAY BE IMPACTED

HANOVER STREET

REFER TO INTERSECTION OPTIONS ON DRAWINGS 4191-20-15

PRELIMINARY CONCEPT
FOR DISCUSSION ONLY

LEGEND

- EXISTING OPTIC FIBRE COMMS
- EXISTING TELSTRA
- EXISTING GAS
- EXISTING HIGH VOLTAGE OVERHEAD POWER
- EXISTING UNDERGROUND POWER
- EXISTING LOW VOLTAGE OVERHEAD POWER
- EXISTING WATER MAIN
- EXISTING EXISTING WATER MAIN (1065S)

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TOSAD Pty Ltd ACN 070 097 948 as trustee for the Consulting Engineering Unit Trust trading as Porter Consulting Engineers ABN 78 656 394 385

APPROVAL	NAME	SIGN	DATE
DESIGNED BY: XXXX			
DRAWN BY: XXXX			
CHECKED BY: XXXX			
APPROVED BY DIRECTOR:			

City of Kalamunda

ASSET SERVICES

HALE ROAD, FORRESTFIELD

ROAD UPGRADE
STRELITZIA AVENUE TO WOOLWORTHS DRIVE
FORRESTFIELD

CHANNELISATION OPTION A

ONE APPROACH LANE ON WOOLWORTHS DRIVE

No.	REVISION	BY	DATE	AUTH
A	ISSUED FOR PUBLIC CONSULTATION	MJV	29/11/17	
B	SERVICES AND NOTES ADDED TO THIS DRAWING.	MJV	11/4/18	

SCALE: 1:500 (50 0 5 10 15 20 25 SCALE IN METRES)
DATUM: AHD
GRID: PCG94
SURVEYED: ENGINEERING SURVEYOR /2017
DESIGNED: E.WILLIAMS 15/11 /2017 INFRASTRUCTURE DESIGN OFFICER
DRAWN: M.VINEY 15/11 /2017 INFRASTRUCTURE DESIGN OFFICER
CHECKED: COORDINATOR PROJECT DESIGN /2017
AUTHORISED: MANAGER ASSET DELIVERY /2017
APPROVED: DIRECTOR ASSET SERVICES /2017
Discipline: CI
Structure Code: 420
JOB No. 4191-20

DRAWING-No. 4191-20-12-12/B
-SHEET
/REVISION
ORIGINAL DRG. SIZE A1

4191-20-14-14/A

REFER TO INTERSECTION OPTIONS ON DRAWINGS 4191-20-15

PRELIMINARY CONCEPT FOR DISCUSSION ONLY

LEGEND

- EXISTING OPTIC FIBRE COMMS
- EXISTING TELSTRA
- EXISTING GAS
- EXISTING HIGH VOLTAGE OVERHEAD POWER
- EXISTING UNDERGROUND POWER
- EXISTING LOW VOLTAGE OVERHEAD POWER
- EXISTING WATER MAIN
- EXISTING EXISTING WATER MAIN (1065S)

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TUSNO Pty Ltd ACN 070 097 148 as trustee for the Consulting Engineering Unit Trust trading as Porter Consulting Engineers ABN 78 636 396 385

APPROVAL	NAME	SIGN	DATE
DESIGNED BY: XXXX			
DRAWN BY: XXXX			
CHECKED BY: XXXX			
APPROVED BY DIRECTOR:			

City of Kalamunda — ASSET SERVICES

HALE ROAD, FORRESTFIELD

ROAD UPGRADE
STRELITZIA AVENUE TO WOOLWORTHS DRIVE
FORRESTFIELD

CHANNELISATION OPTION B

TWO LANE APPROACH ON WOOLWORTHS DRIVE

No.	REVISION	BY	DATE	AUTH
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DESIGNED: E.WILLIAMS 15/11 /2017 INFRASTRUCTURE DESIGN OFFICER
DRAWN: M.VINEY 15/11 /2017 INFRASTRUCTURE DESIGN OFFICER
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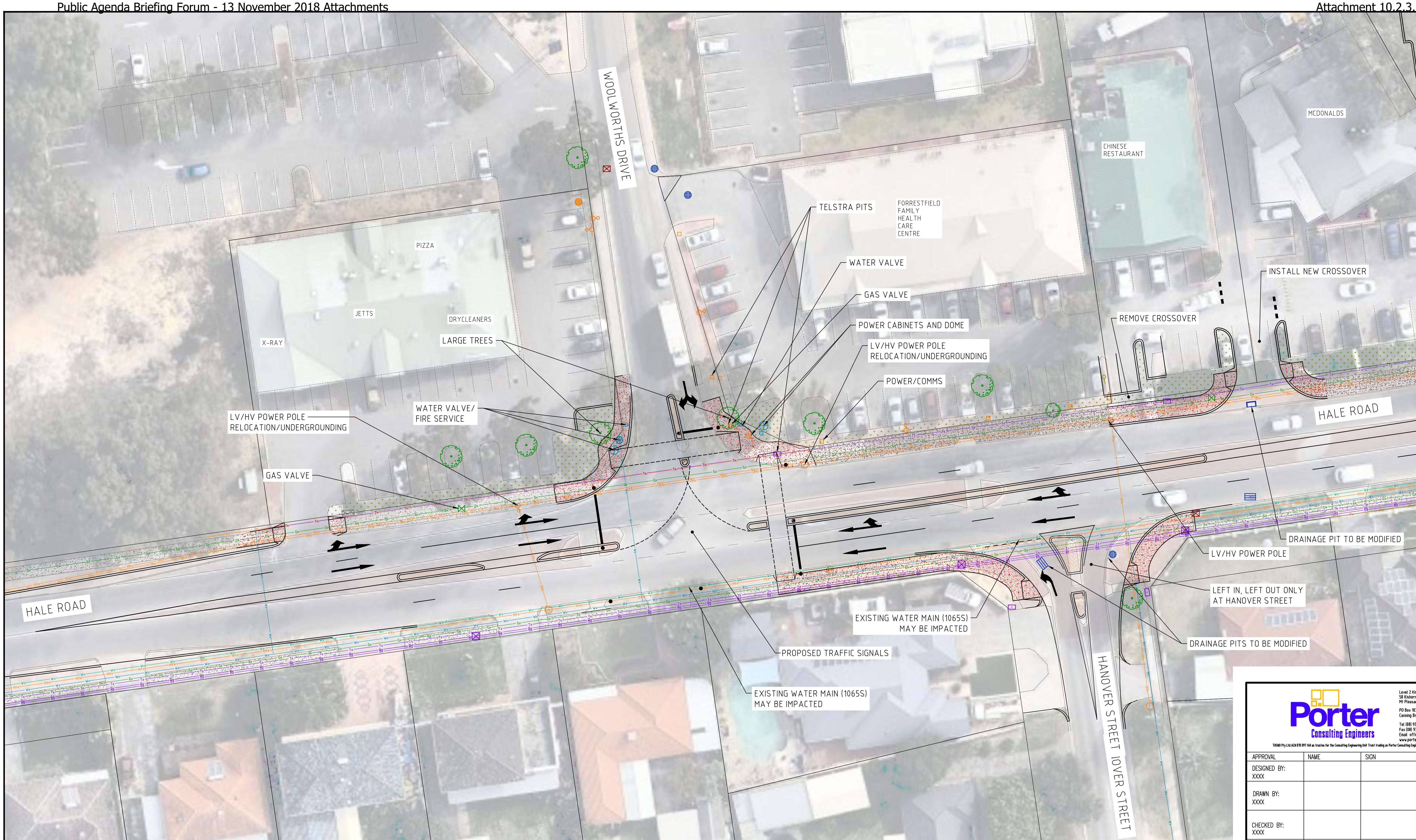
AUTHORISED: .... /2017 MANAGER ASSET DELIVERY
APPROVED: .... /2017 DIRECTOR ASSET SERVICES
Discipline: CI
Structure Code: 420
JOB No. 4191-20
DRAWING-No. -SHEET /REVISION: 4191-20-14-14/A
ORIGINAL DRG. SIZE: A1

4191-20-11-11/B



REFER TO INTERSECTION OPTIONS ON DRAWINGS 4191-20-15

PRELIMINARY CONCEPT
FOR DISCUSSION ONLY

LEGEND

- EXISTING OPTIC FIBRE COMMS
- EXISTING TELSTRA
- EXISTING GAS
- EXISTING HIGH VOLTAGE OVERHEAD POWER
- EXISTING UNDERGROUND POWER
- EXISTING LOW VOLTAGE OVERHEAD POWER
- EXISTING WATER MAIN
- EXISTING EXISTING WATER MAIN (1065S)

Porter Consulting Engineers

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DESIGNED BY: XXXX			
DRAWN BY: XXXX			
CHECKED BY: XXXX			
APPROVED BY DIRECTOR:			

City of Kalamunda — ASSET SERVICES

HALE ROAD, FORRESTFIELD

ROAD UPGRADE
STRELITZIA AVENUE TO WOOLWORTHS DRIVE
FORRESTFIELD

TRAFFIC SIGNALS

No.	REVISION	BY	DATE	AUTH
A	ISSUED FOR PUBLIC CONSULTATION	MJV	29/11/17	
B	SERVICES AND NOTES ADDED TO THIS DRAWING.	MJV	11/4/18	

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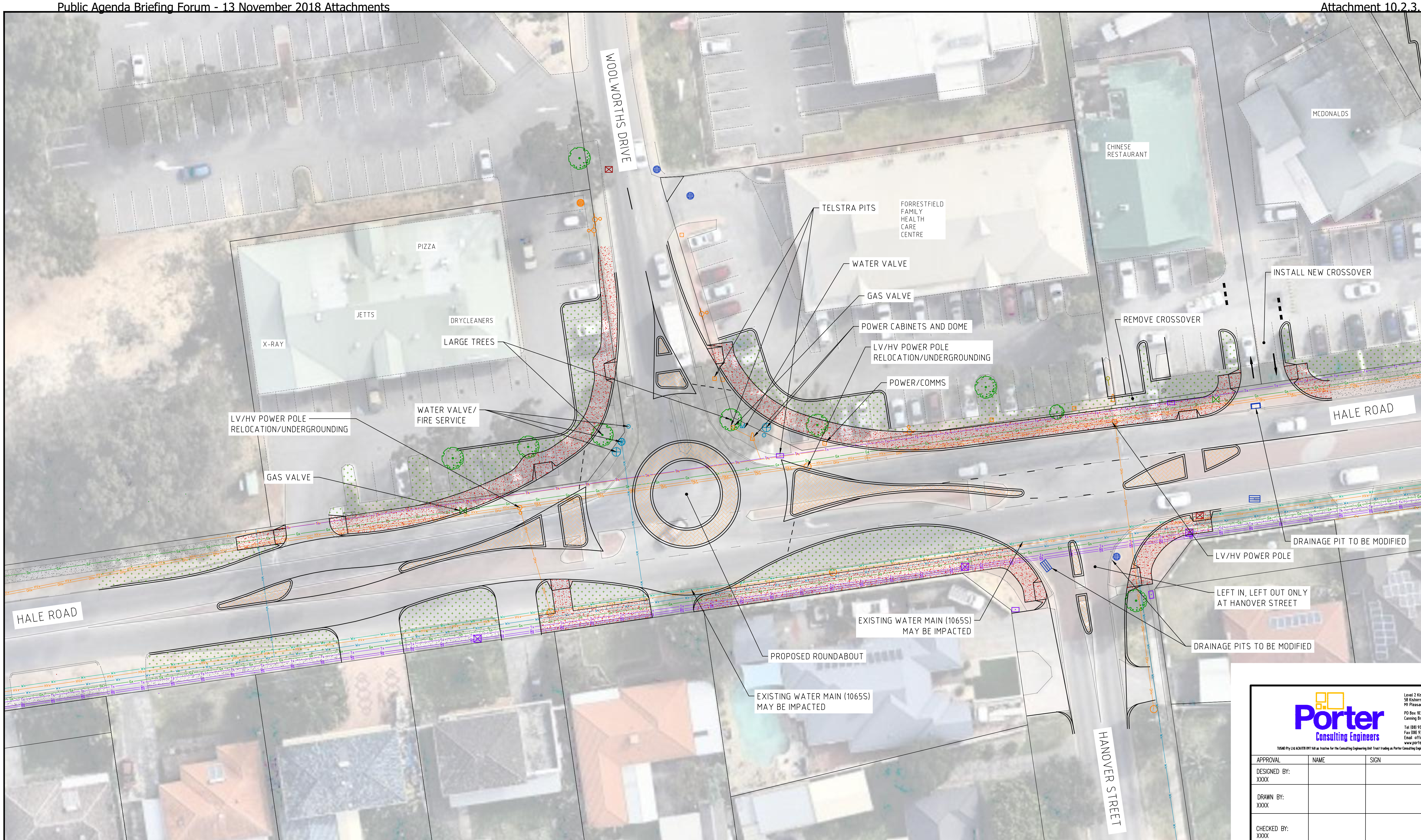
SURVEYED: ENGINEERING SURVEYOR /2017
DESIGNED: E.WILLIAMS 15/11 /2017 INFRASTRUCTURE DESIGN OFFICER
DRAWN: M.VINEY 15/11 /2017 INFRASTRUCTURE DESIGN OFFICER
CHECKED: COORDINATOR PROJECT DESIGN /2017
AUTHORISED: MANAGER ASSET DELIVERY /2017
APPROVED: DIRECTOR ASSET SERVICES /2017
Discipline: CI — Structure Code: 420
JOB No. 4191-20
DRAWING No. 4191-20-11-11/B — ORIGINAL DRG. SIZE A1



REFER TO INTERSECTION OPTIONS ON DRAWINGS 4191-20-15

4191-20-13-13/B

PRELIMINARY CONCEPT FOR DISCUSSION ONLY

LEGEND

- EXISTING OPTIC FIBRE COMMS
- EXISTING TELSTRA
- EXISTING GAS
- EXISTING HIGH VOLTAGE OVERHEAD POWER
- EXISTING UNDERGROUND POWER
- EXISTING LOW VOLTAGE OVERHEAD POWER
- EXISTING WATER MAIN
- EXISTING EXISTING WATER MAIN (1065S)

Porter Consulting Engineers

APPROVAL	NAME	SIGN	DATE
DESIGNED BY: XXXX			
DRAWN BY: XXXX			
CHECKED BY: XXXX			
APPROVED BY DIRECTOR:			

City of Kalamunda — ASSET SERVICES

HALE ROAD, FORRESTFIELD

ROAD UPGRADE
STRELITZIA AVENUE TO WOOLWORTHS DRIVE
FORRESTFIELD

ROUNDABOUT OPTION A

HANOVER STREET ALL MOVEMENTS

No.	REVISION	BY	DATE	AUTH
A	ISSUED FOR PUBLIC CONSULTATION	MJV	29/11/17	
B	SERVICES AND NOTES ADDED TO THIS DRAWING.	MJV	11/4/18	

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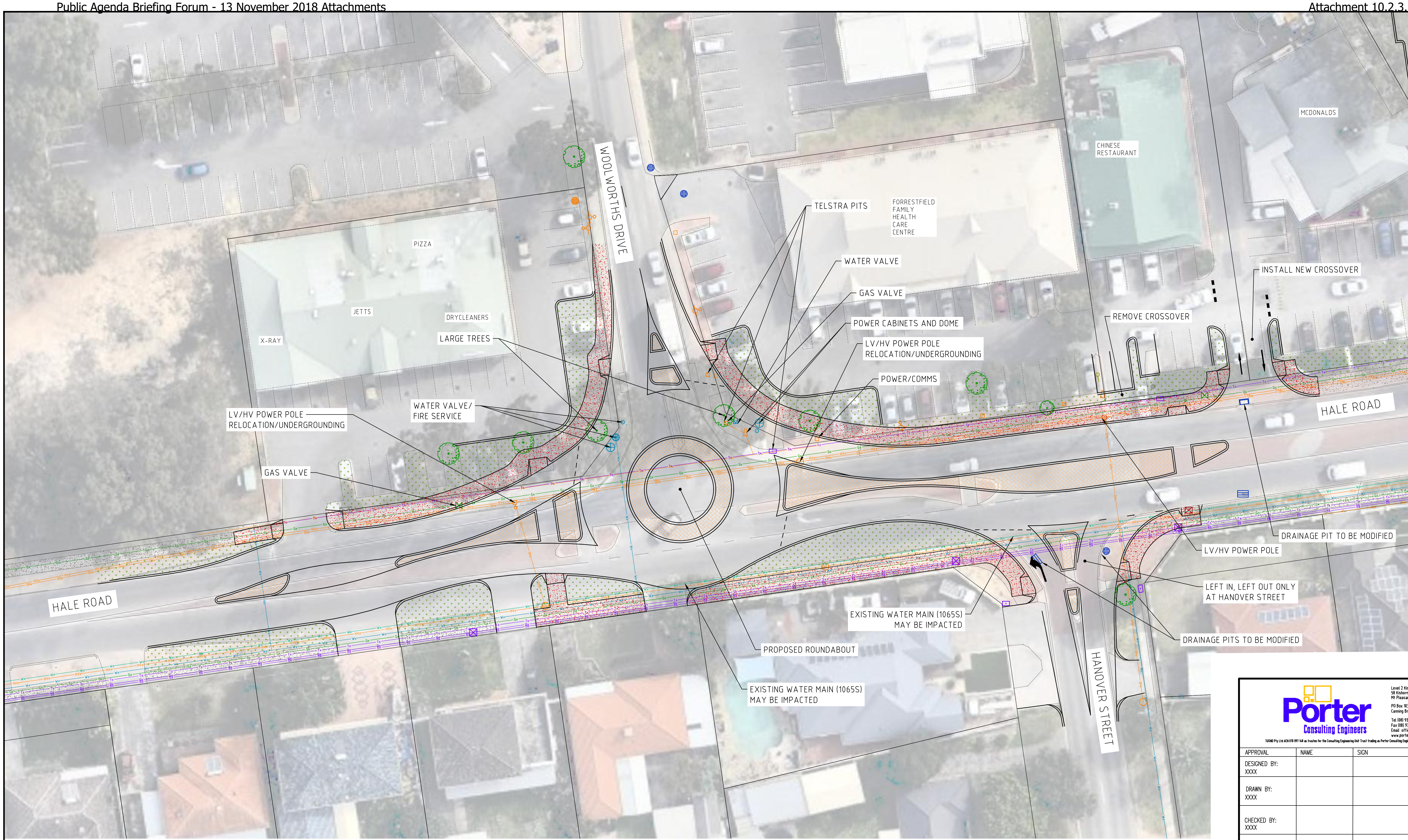
SURVEYED: ....../2017 ENGINEERING SURVEYOR — DESIGNED: E.WILLIAMS 15/11/2017 INFRASTRUCTURE DESIGN OFFICER

DRAWN: M.VINEY 15/11/2017 INFRASTRUCTURE DESIGN OFFICER — CHECKED: ....../2017 COORDINATOR PROJECT DESIGN

AUTHORISED: ....../2017 MANAGER ASSET DELIVERY — APPROVED: ....../2017 DIRECTOR ASSET SERVICES

Discipline: CI — Structure Code: 420 — JOB No. 4191-20

DRAWING No. 4191-20-13-13/B — ORIGINAL DRG. SIZE A1



REFER TO INTERSECTION OPTIONS ON DRAWINGS 4191-20-15

4191-20-10-10/B

PRELIMINARY CONCEPT FOR DISCUSSION ONLY

LEGEND

- EXISTING OPTIC FIBRE COMMS
- EXISTING TELSTRA
- EXISTING GAS
- EXISTING HIGH VOLTAGE OVERHEAD POWER
- EXISTING UNDERGROUND POWER
- EXISTING LOW VOLTAGE OVERHEAD POWER
- EXISTING WATER MAIN
- EXISTING EXISTING WATER MAIN (1065S)

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APPROVAL	NAME	SIGN	DATE
DESIGNED BY: XXXX			
DRAWN BY: XXXX			
CHECKED BY: XXXX			
APPROVED BY DIRECTOR:			

City of Kalamunda — ASSET SERVICES

HALE ROAD, FORRESTFIELD

ROAD UPGRADE
STRELITZIA AVENUE TO WOOLWORTHS DRIVE
FORRESTFIELD

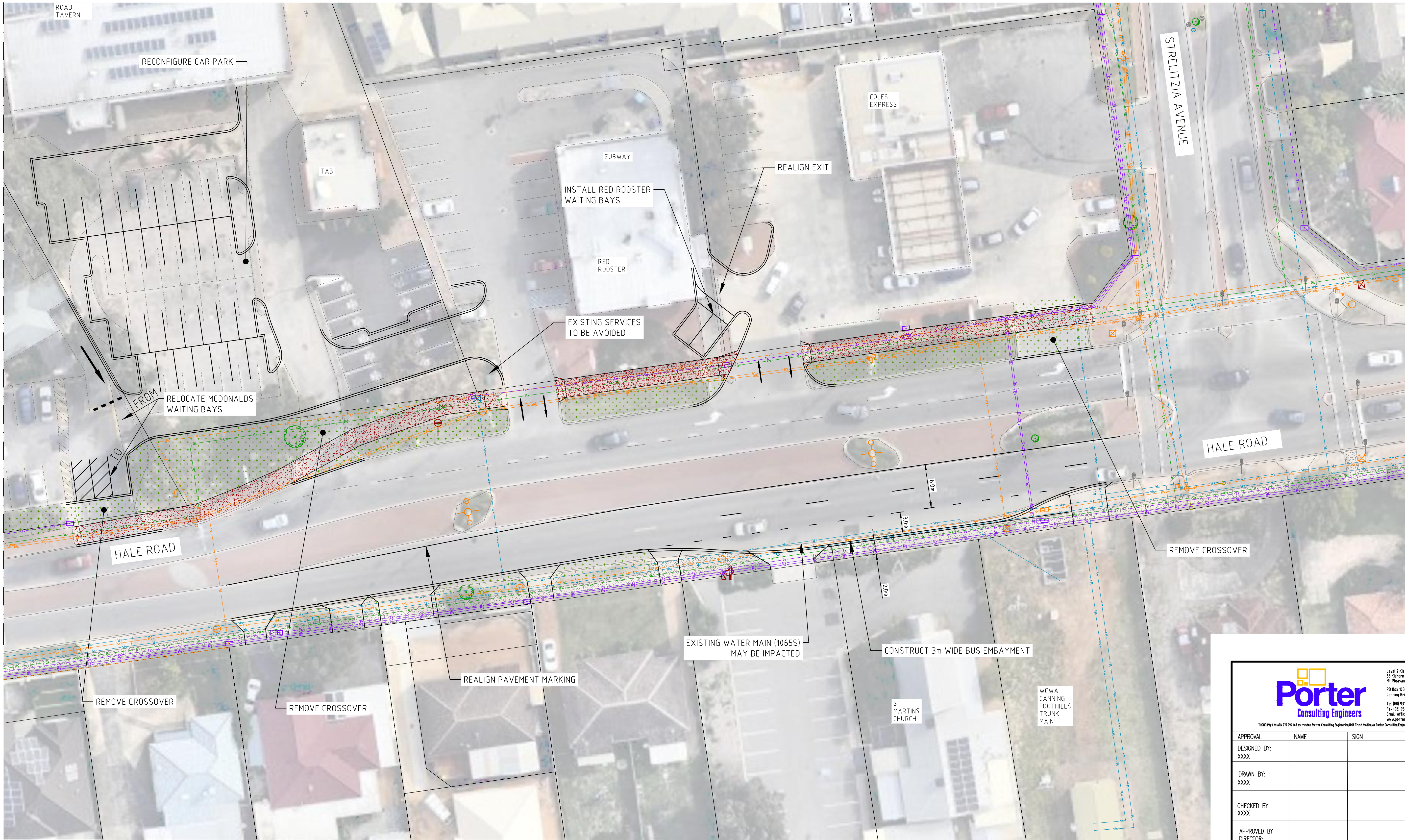
ROUNDABOUT OPTION B
HANOVER STREET LEFT TURNS ONLY

No.	REVISION	BY	DATE	AUTH
A	ISSUED FOR PUBLIC CONSULTATION	MJV	29/11/17	
B	SERVICES AND NOTES ADDED TO THIS DRAWING.	MJV	11/4/18	

SCALE: 1:500 — SCALE IN METRES (50 0 5 10 15 20 25)
DATUM: AHD — GRID: PCG94
SURVEYED: ENGINEERING SURVEYOR /2017
DESIGNED: E.WILLIAMS 15/11 /2017 INFRASTRUCTURE DESIGN OFFICER
DRAWN: M.VINEY 15/11 /2017 INFRASTRUCTURE DESIGN OFFICER
CHECKED: COORDINATOR PROJECT DESIGN /2017
AUTHORISED: MANAGER ASSET DELIVERY /2017
APPROVED: DIRECTOR ASSET SERVICES /2017
Discipline: CI — Structure Code: 420
JOB No. 4191-20
DRAWING No. 4191-20-10-10/B — ORIGINAL DRG. SIZE A1

4191-20-15-15/A

REFER TO INTERSECTION OPTIONS ON DRAWINGS 4191-20-10 TO 4191-20-14



PRELIMINARY CONCEPT
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Porter Consulting Engineers
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DRAWN BY: XXXX			
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APPROVED BY DIRECTOR:			

City of Kalamunda — ASSET SERVICES

HALE ROAD, FORRESTFIELD

ROAD UPGRADE
STRELITZIA AVENUE TO WOOLWORTHS DRIVE
FORRESTFIELD

RATIONALISATION OF CROSSOVERS

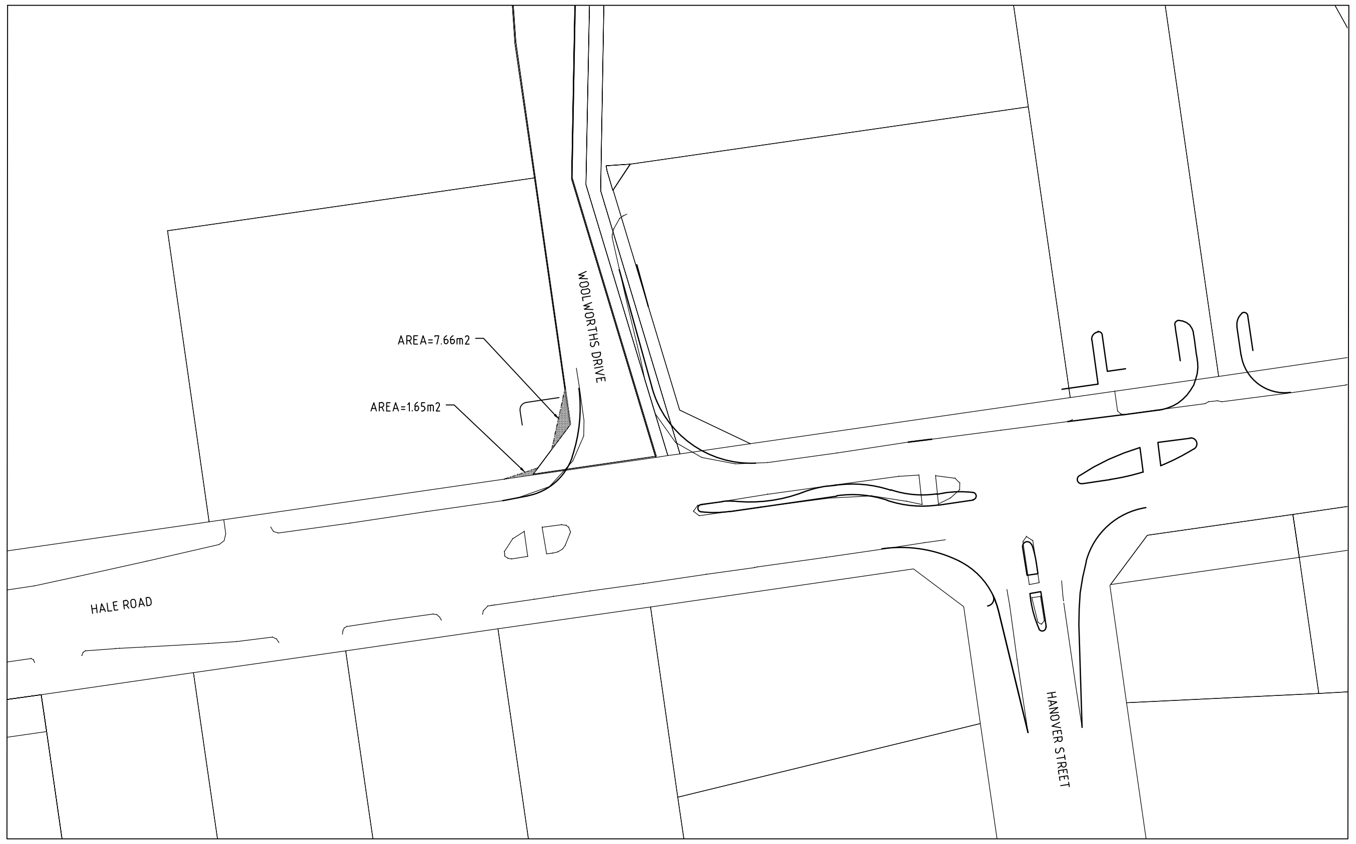
No.	REVISION	BY	DATE	AUTH
A	ISSUED FOR PUBLIC CONSULTATION	MJV	11-4-18	

SCALE: 1:500 (SCALE IN METRES: 50 0 5 10 15 20 25)
DATUM: AHD
GRID: PCG94
SURVEYED: ..../2017 ENGINEERING SURVEYOR
DESIGNED: E.WILLIAMS 15/11 /2017 INFRASTRUCTURE DESIGN OFFICER
DRAWN: M.VINEY 15/11 /2017 INFRASTRUCTURE DESIGN OFFICER
CHECKED: ..../2017 COORDINATOR PEOJECT DESIGN
AUTHORISED: ..../2017 MANAGER ASSET DELIVERY
APPROVED: ..../2017 DIRECTOR ASSET SERVICES
Discipline: CI
Structure Code: 420
JOB No. 4191-20
DRAWING-No. -SHEET /REVISION: 4191-20-15-15/A
ORIGINAL DRG. SIZE: A1

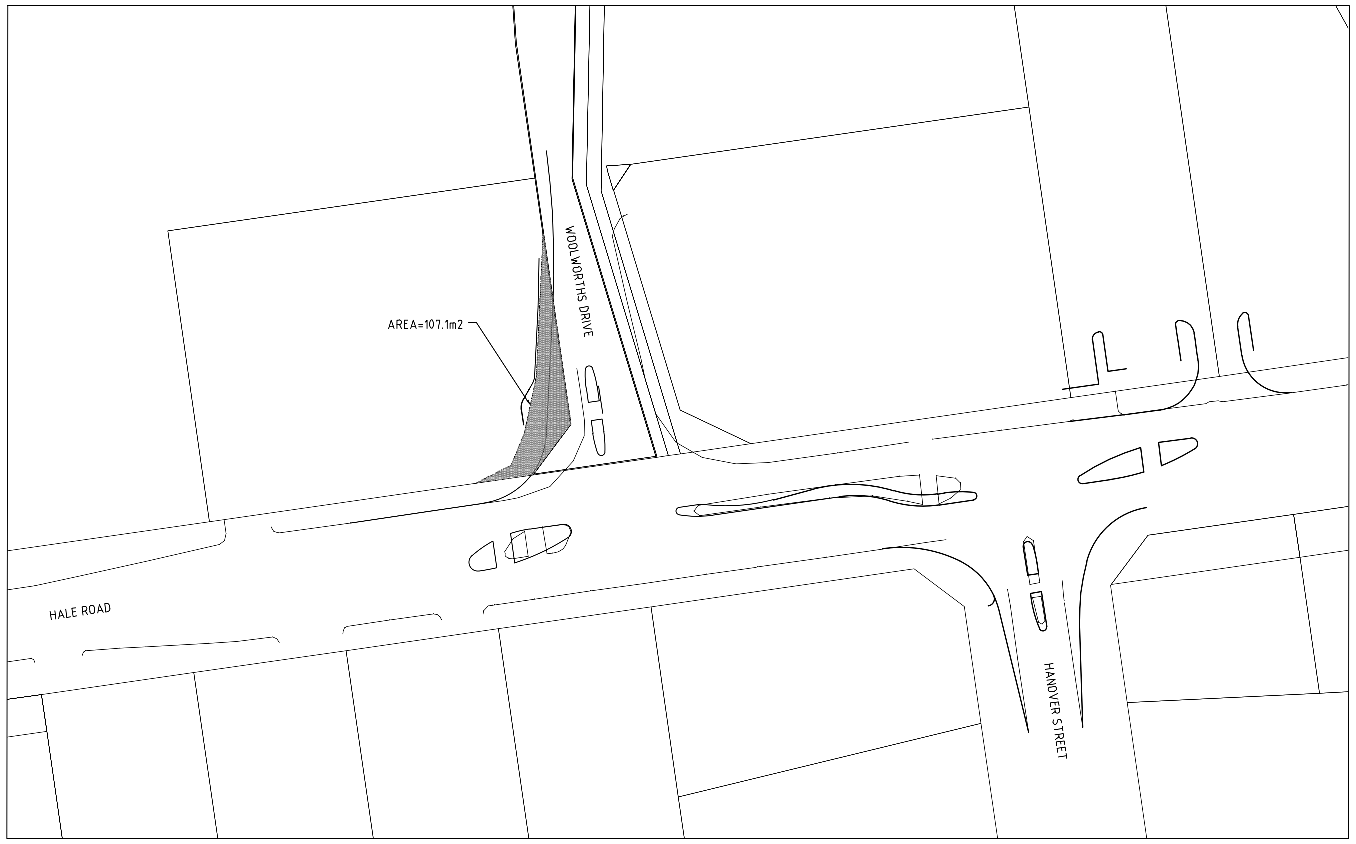
APPENDIX D – LAND ACQUISITION PLANS

4191-20-16-16/A	Land Acquisition Plan Sheet 1
4191-20-17-17/A	Land Acquisition Plan Sheet 2

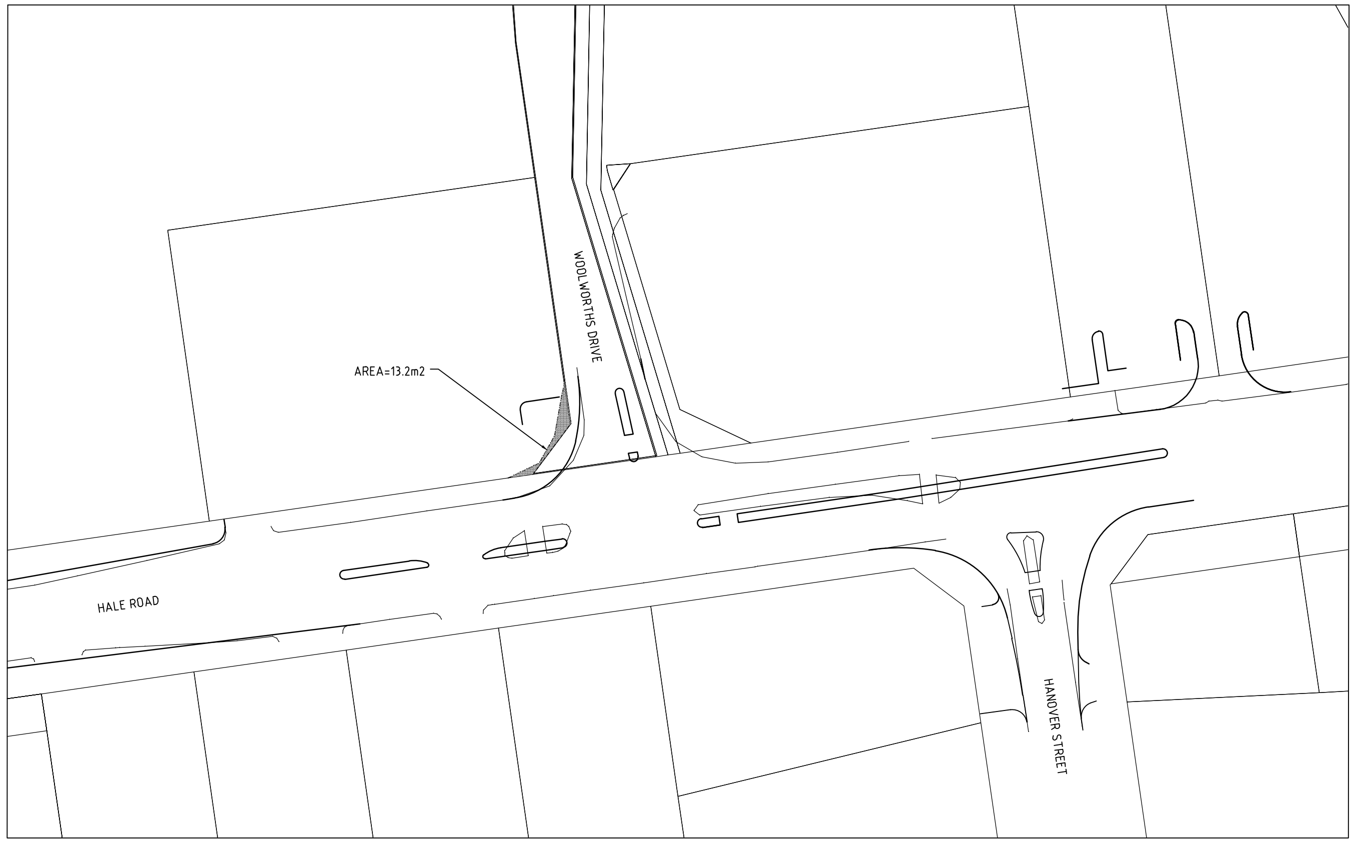
4191-20-16-16/A



CHANNELISATION OPTION A - ONE APPROACH LANE ON WOOLWORTHS DRIVE
1:500



CHANNELISATION OPTION B - TWO APPROACH LANES ON WOOLWORTHS DRIVE
1:500



TRAFFIC SIGNALS
1:500

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DRAWN BY: XXXX			
CHECKED BY: XXXX			
APPROVED BY DIRECTOR:			

City of Kalamunda — ASSET SERVICES

HALE ROAD, FORRESTFIELD

ROAD UPGRADE
STRELITZIA AVENUE TO WOOLWORTHS DRIVE
FORRESTFIELD

LAND ACQUISITION PLAN

SHEET 1

No.	REVISION	BY	DATE	AUTH
A	ISSUED FOR PUBLIC CONSULTATION	MJV	29/11/17	

SCALE: 1:500 (50 0 5 10 15 20 25 SCALE IN METRES)
DATUM: AHD
GRID: PCG94
SURVEYED: .... /2017 ENGINEERING SURVEYOR
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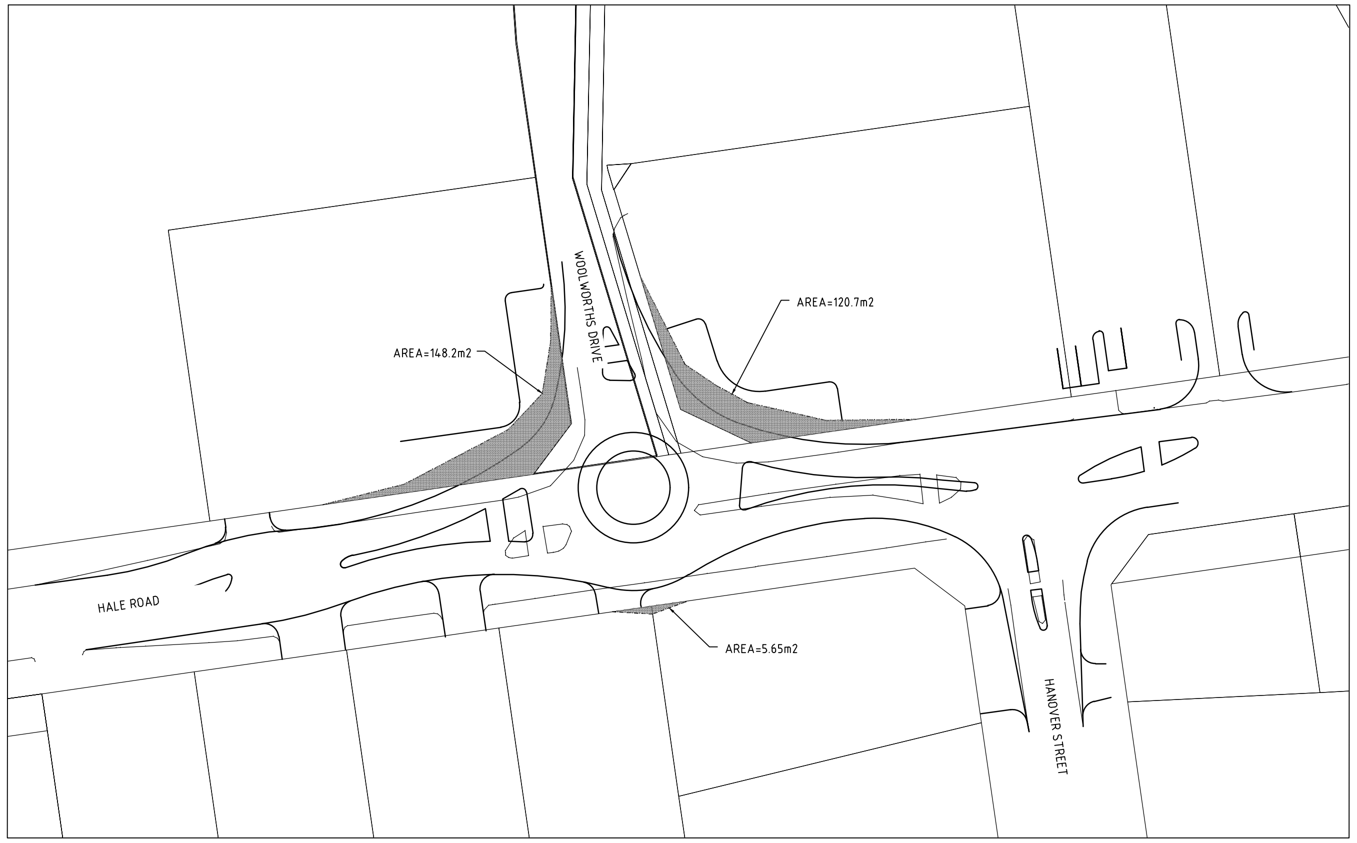
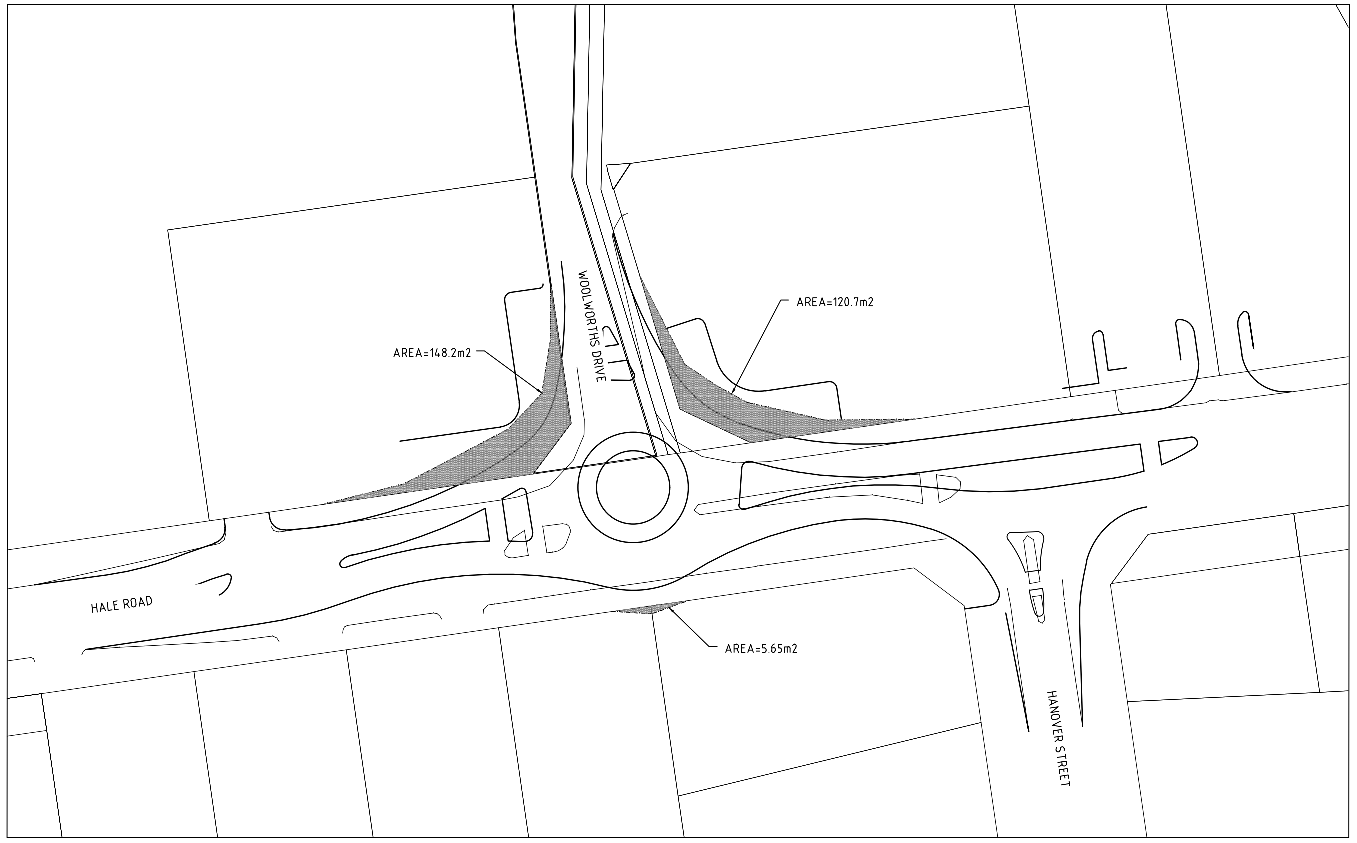
CHECKED: .... /2017 COORDINATOR PEOJECT DESIGN
AUTHORISED: .... /2017 MANAGER ASSET DELIVERY
APPROVED: .... /2017 DIRECTOR ASSET SERVICES
Discipline: CI
Structure Code: 420
JOB No. 4191-20
DRAWING-No. -SHEET /REVISION: 4191-20-16-16/A
ORIGINAL DRG. SIZE: A1

4191-20-17-17/A



ROUNDABOUT OPTION A - HANOVER STREET ALL MOVEMENTS
1:500



ROUNDABOUT OPTION A - HANOVER STREET LEFT TURNS ONLY
1:500

PRELIMINARY CONCEPT
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APPROVAL	NAME	SIGN	DATE
DESIGNED BY: XXXX			
DRAWN BY: XXXX			
CHECKED BY: XXXX			
APPROVED BY DIRECTOR:			

City of Kalamunda — ASSET SERVICES

HALE ROAD, FORRESTFIELD
ROAD UPGRADE
STRELITZIA AVENUE TO WOOLWORTHS DRIVE
FORRESTFIELD

LAND ACQUISITION PLAN
SHEET 2

No.	REVISION	BY	DATE	AUTH
A	ISSUED FOR PUBLIC CONSULTATION	MJV	29/11/17	

SCALE: 1:500 (SCALE IN METRES 50 0 5 10 15 20 25)
DATUM: AHD
GRID: PCG94
SURVEYED: ..... /2017 ENGINEERING SURVEYOR
DESIGNED: E.WILLIAMS 15/11 /2017 INFRASTRUCTURE DESIGN OFFICER
DRAWN: M.VINEY 15/11 /2017 INFRASTRUCTURE DESIGN OFFICER
CHECKED: ..... /2017 COORDINATOR PROJECT DESIGN
AUTHORISED: ..... /2017 MANAGER ASSET DELIVERY
APPROVED: ..... /2017 DIRECTOR ASSET SERVICES
Discipline: CI
Structure Code: 420
JOB No. 4191-20
DRAWING-No. -SHEET /REVISION: 4191-20-17-17/A
ORIGINAL DRG. SIZE: A1

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