

Technical Appendix G – ISR

INFRASTRUCTURE SERVICING REPORT

Forrestfield North – Residential Precinct

Forrestfield North, Western Australia

October 2021

Rev G



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1. KCTT Infrastructure Servicing Report

1.1 Executive Summary

The Forrestfield North Residential Precinct Local Structure Plan (LSP) has been carefully developed to promote equity between as many landowners as possible for the simple development of landholdings in accordance with the intent of the LSP. This Infrastructure Servicing Report focuses on a wide range of infrastructure development strategies inclusive of: -

- major road network upgrade requirements including upgrades to: -
 - Dundas Road realignment, between Berkshire Road and Maida Vale Road.
 - Berkshire Road (upgrade to 4-lanes).
 - Milner Road (upgrade to 2 lane divided carriageway, south of Sultana Road West).
 - Milner Road (upgrade to 2 lane divided carriageway between Sultana Road West and Maida Vale Road with parking and widened pedestrian environments plus cycling facilities).
 - Sultana Road West (improved industrial access road east of Milner Road).
 - Maida Vale Road (upgrade to 2-lane divided carriageway east of Milner Road).
 - Maida Vale Road (upgrade to 2 lane divided carriageway west of Milner Road).
 - Provision of new TOD Connector Boulevard linking the Forrestfield North Railway Station, through the Forrestfield North TOD and AC Precinct, the Forrestfield North Residential Precinct LSP Area to the Maida Vale South LSP Area.
- key intersection upgrades at the following locations: -
 - Ibis Place / Maida Vale Road.
 - Berkshire Road / Dundas Road / Milner Road (dual lane roundabout).
 - Milner Road / Sultana Road West.
 - Milner Road / Maida Vale Road.
 - Milner Road / TOD Connector Boulevard (new intersection).
- conceptual bridge and interchange upgrades at the Roe Highway / Maida Vale Road interchange. These existing t-intersections have been upgraded to roundabout intersections in accordance with current MRWA requirements.
- infrastructure for alternative transportation modes, inclusive of public transport, consideration of future transport modes in design, pedestrian, and cyclist requirements.
- provision of on-street car-parking on all major internal roads suitable for high-density development for interim transportation modal choice requirements in Perth, but allowing for future modal shifts.
- incorporation of streetscaping, place-making and urban design requirements in the public realm as part of the overall infrastructure planning and civil concept designs.
- upgrade requirements to existing wastewater infrastructure to cater for the full development of Forrestfield North Residential, Forrestfield North TOD and AC Precinct and the Maida Vale South Structure Plan areas, with an up-front infrastructure provision to be determined as part of future phases of the planning process in liaison with State Government to allow for development across both the Forrestfield North Residential LSP and Forrestfield North TOD and AC Activity Centre Plan (ACP) Areas considering the number of different landholders within the LSP and ACP areas.
- upgrade requirements for the reticulation of potable water.

- development of stormwater drainage strategies and the incorporation of Water Sensitive Urban Design strategies that will make Forrestfield North a strong proponent of WSUD, including: -
 - provision of infiltration drainage cells and storage cells in all major road networks.
 - at-source treatment at drainage pits.
 - infiltration / underground storage / WSUD measures at drainage collection points minimising the wastage of open space at ground levels in all POS / environmental conservation areas.
- future potential upgrade requirements for the reticulation of power assets into the Forrestfield North TOD and AC Precinct, to be determined iteratively as development proceeds and to be managed by developers on all roads abutting land to be developed as a standard WAPC condition of subdivision.
- future potential upgrade and relocation requirements for the connection of telecommunications and broadband internet, to be determined iteratively as development, to be managed by developers on all roads abutting land to be developed as a standard WAPC condition of subdivision; and
- future upgrade and relocation requirements for the provision of gas services, to be managed by ATCO Gas in coordination with developers where an open trench is provided by the developer for the reticulation of gas infrastructure.

Road Network

The road network has been designed to accommodate an interface between industrial land uses to the south and residential and activity centre uses north of Sultana Road West, with design to suit turning movements for RAV 4 and RAV 7 vehicles with key upgrades in Berkshire Road, Dundas Road, Milner Road (south of Sultana Road West) and in Sultana Road West. The Residential Precinct is expected to be a generator of local traffic in the short to medium term, therefore robust designs need to be accommodated for the expected traffic generation which will be applied to key road networks inclusive of Maida Vale Road, Milner Road north of Sultana Road West and the TOD Connector Boulevard and understanding the impacts of the trip generation on external road networks. This is examined in detail in KCTT's Transport Impact Assessments for the TOD and AC Precincts and the Residential Precinct.

Designing an interface between local residential, commercial, retail and traffic attracted to / generated by the proposed land-uses within the Residential and adjacent TOD and AC Precincts, and the regional traffic that will be attracted to the parking for the Forrestfield North Railway Station is a balancing act in the development of a strong Residential outcome on the periphery of the TOD and AC Precincts.

Therefore, within the Residential Precinct, boulevard-style pedestrian amenity, promotion of on-road cycling and strong, direct links to the TOD and AC Precinct are distinct themes in this LSP. The design for the roads within the Residential Precinct focuses on the mix of transportation usages and should not be designed with the car dominating all other forms of transportation. We recommend through the implementation phases of this project that consideration is continually given to designing road cross-sections in conjunction with the Integrated Transport Branch of the Department of Transport. These focuses include constraining vehicular speeds under 40kph and promoting mixed usage within these road reservations that allow for vehicular movement while providing safer environments for pedestrians, cyclists, and vulnerable road users. We believe that for Forrestfield North to become a vibrant centre, it is important that the streetscape environment is welcoming to more than just through vehicle movements and this is the ethos of the LSP.

Intersection Upgrades

There are a series of main intersections that require upgrade to accommodate the expected vehicular trip generations and attractions within the LSP and ACP Areas, including the Berkshire Road / Dundas Road / Milner Road intersection which is designed to be a reconfigured 4-lane, 4-way roundabout with capability for RAV 7 vehicles. The intersection of Milner Road and Sultana Road West is of high importance to the overall form and function of the residential and TOD and AC precincts because it forms the boundary between the industrial land-uses to the south and the urban land-uses to the north. This intersection is designed to accommodate left and right turn manoeuvres for RAV 4 vehicles. Additional upgrades include the intersection of Maida Vale Road and Milner Road, which will need to be upgraded to a roundabout featuring 2-lane approaches (one circulating lane) and the on-off ramps for Roe Highway / Maida Vale Road which will be reconfigured as roundabouts in accordance with current Main Roads WA policies.

Within the Residential Precinct, the intersection of Milner Road and Stewart Road, TOD Connector Boulevard and Brae Road, Brae Road and Stewart Road and the TOD Connector Boulevard and Brand Road are the intersections of high importance. These are discussed in greater detail in the KCTT Transport Impact Assessments for the LSP and ACP Precincts.

Bridge Structures

KCTT have developed a concept design for the required widening of the Maida Vale Road flyover. Due to increased traffic on Maida Vale Road, the bridge is maintained at 2-lanes. The connectivity between Maida Vale South and the Forrestfield North Railway Station is of future importance as a longer-term investment, however the earlier proposed TOD Connector bridge has been removed from this LSP due to uncertainties in development timeframes.

Alternative Transportation Infrastructure

The Forrestfield North Residential Precinct has a series of major pedestrian and cycling path networks providing full inter-connectivity within the Residential Precinct, and with High Wycombe and the TOD and Activity Centre Precincts to the west and Maida Vale South in the longer term. All roads have minimum 1.8 metre width pedestrian paths, with on-road cycling in Milner Road (north of Sultana Road West) and the TOD Connector Boulevard and shared paths on roads with higher order function.

The function of Maida Vale Road and Ibis Place is very important in the short to medium term as a main route of connectivity for local bus networks to access the Forrestfield North Railway Station. In the future, the TOD Connector Boulevard may provide direct connectivity between Forrestfield North and Maida Vale South, should the Maida Vale South LSP progress.

Wastewater Infrastructure

KCTT have held detailed discussions with the Water Corporation with relation to the upgrade and extension of wastewater infrastructure to service Forrestfield North and Maida Vale South as an interim measure, while the Water Corporation completes detailed planning for the Gooseberry Hill Planning Area. The interim plan involves the extension of wastewater infrastructure along Dundas Road for the TOD and AC Precincts and along Milner Road with 3 branch systems along Sultana Road West (picking up the proposed AC Precinct and the Industrial Composite land-uses in Sultana Road West, and into Raven Street and Stewart Road to service the majority of the Residential Precinct. Not all properties will be able to service directly off these extensions, however the premise is that the potential early delivery of wastewater infrastructure for the area will accelerate development potential across a greater number of landholdings than presently exists due to the disparate nature of land ownership in the Precinct Areas.

Given the significant changes in yields since the previous iteration of the Residential Precinct LSP, KCTT will coordinate this ISR with the Water Corporation to update planning for both wastewater and water.

Water Infrastructure

As for the wastewater above, KCTT have held detailed discussions with the Water Corporation in relation to the future requirements for water. The exact requirements for water infrastructure will be confirmed by the Water Corporation as the LSP process nears completion, however there are no impediments to short-term development in the Residential Precinct, with existing services capable of servicing initial developments.

Power

KCTT have held initial informal discussions with respected electrical consultants UPD in relation to current Western Power policies when considering large-scale / long-timeframe developments of this nature. The development of power infrastructure to suit developments of this type is an iterative process, as additional power capacity cannot be “stored”. We understand that Western Power is currently not utilising new 1-hectare transformer / substation sites but is preferring to increase the capacity of existing major substations. Some lead-in work may be required after the first 5 to 10 years of development, but this will be contingent on the rate of development in Forrestdfield North and the rate of expansion of other land-use assets connected to local substations and feeders. The main infrastructure requirement will be the undergrounding of existing HV and LV assets in roads to be widened and in road reserves to be closed. Power requirements for the area will need to allow for the relocation of many existing assets due to road widening / road reservation closure and may need to allow for either the relocation of HV assets, or the selected undergrounding of such assets. The requirements for undergrounding of existing overhead power assets are developer-funded requirements which form part of each developer’s WAPC Conditions of Subdivision, where the existing roads directly fronts the proposed development landholdings.

Undergrounding of power should only be considered a DCP item where infrastructure identified in the DCP necessitates undergrounding, and the requirement is not otherwise required through the subdivision process.

Telecommunications / Gas

Telecommunications and Gas infrastructure are available in the Structure Plan areas for immediate development and as per the discussions above in relation to power and water, telecommunications and gas infrastructure are upgraded as development commences and concept planning for headworks infrastructure is finalised as development rates per annum are known with greater certainty.

Summary

In summary, all infrastructure items have been considered in detail in the Infrastructure Servicing Reporting conducted for this project, with appropriate items costed as for consideration as part of the future DCP for the Forrestdfield North Project area.

2. Location

Table 1 - Location Information

Structure Plan	Local Structure Plan Precinct	Suburb	Locality (Shire, City etc.)
Forrestfield North District Structure Plan	Residential Precinct	High Wycombe	City of Kalamunda

Brief Description of Site

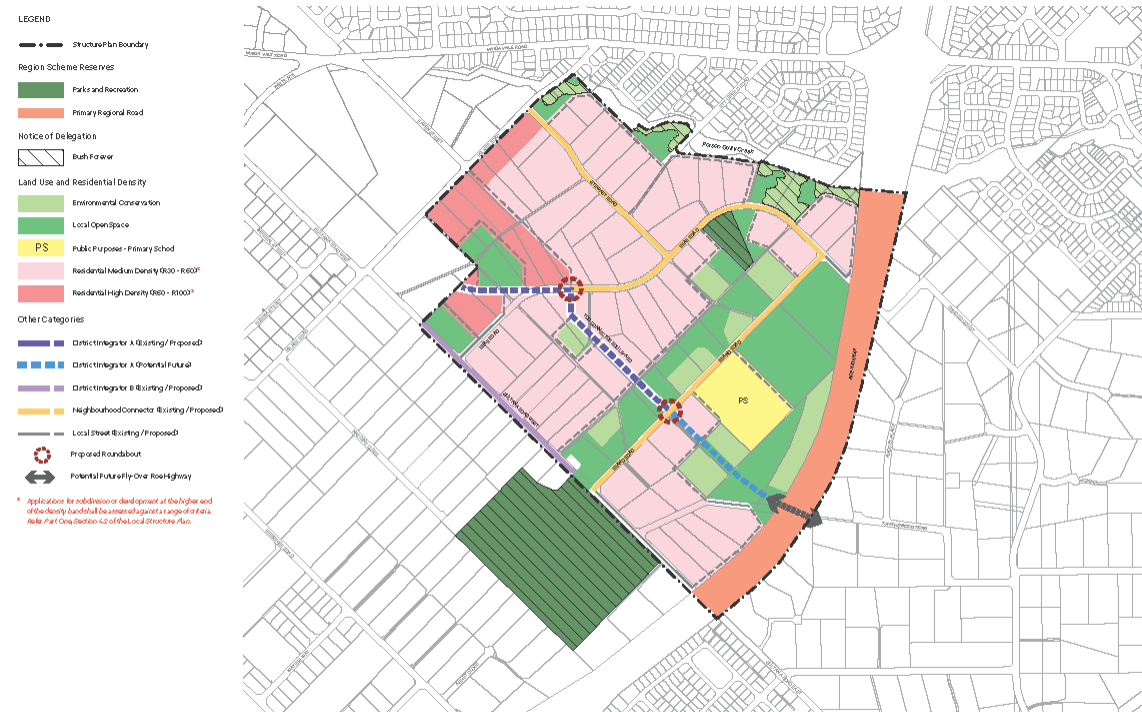
The Forrestfield North Residential Precinct Local Structure Plan (LSP) has developed iteratively with the LSP being largely influenced by the provision of the High Wycombe Railway Station. The Forrestfield North Residential Precinct area is bounded by Roe Highway to the east, Sultana Road to the south, Milner Road to the west and the Poison Gully Creek to the north-eastern corner of the intersection of Milner Road and Sultana Road West which has been planned as the future Activity Centre. The planning and engineering requirements for the Activity Centre will be discussed in detail in a separate ISR for the Forrestfield North Activity Centre and TOD Precinct ACP.

Historically, the land-uses in the Forrestfield North Residential Precinct have been low density rural residential, with retention of natural vegetation (ranging from sparse to heavily populated). The land uses surrounding the proposed LSP area include recreational and residential uses to the north (High Wycombe); to the east across Roe Highway (Forrestfield and Maida Vale); and industrial land-uses to the south (Forrestfield / Hazelmere) and industrial / bulky goods to the west (Perth Airport).

2.1 Proposed Development

The proposed development entails a Residential precinct of 108 hectares as part of the Forrestfield North District Structure Plan (DSP). The residential precinct is proposing medium to high-density urban residential land-uses which shall likely range from R40 through R80 residential development (Figure 2). This project is an excellent opportunity for larger-scaled deployment of housing typologies that target the “missing middle” which describes the lack of smaller lot/dwelling product between 80m² and 250m² in Perth. One of the key objectives of this ISR is to examine conceptual design for roads that minimises wholesale changing of existing ground levels. The existing vegetation and topography to the area are the key assets to be maintained.

Figure 1 - Local Structure Plan (Draft) by Element



Plan 1: Structure Plan
 Forrestdfield North Residential Precinct

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(Element, 2021)

The Forrestdfield North DSP nominated the following development yields, with the area of interest (residential precinct yield) highlighted in bold, with the current draft yields shown for the LSP in the right column: -

Table 2 – Forrestdfield North Residential LSP Indicative Yields

Development Type	No of R30 Dwellings	No of R40 Dwellings	No of R60 Dwellings	No of R80 Dwellings	Total Number of Dwellings
Residential	360	578	1,056	424	2,418
			Total Area		
		Primary School	39,827 m ² ≈ App 4 ha		
			Total Area		
		Open Space Provision	316,802 m ² ≈ App 31.7 ha		

As shown in Table 2 above, the number of dwellings has been revised significantly since the DSP phase of Forrestdfield North. This highlights the commitment of the various agencies to Forrestdfield North (FFN) being a location that embraces TOD principles and provides a diverse range of housing typologies.

2.2 Existing Buildings

Table 3 - Data on Existing Buildings and Structures in the Forrestfield North Residential Precinct LSP

Does the feature existing buildings? If YES nominate.	YES, existing residential dwellings, mainly populated in the middle of precinct. Two businesses are in the south-east and north-east portions.
Number of buildings?	Approx. 70
Approximate age of buildings?	10-35 years, some potentially older
Is asbestos likely to be an issue? YES / NO	YES Desktop studies show that some existing buildings are at least 10-20 years old and thus asbestos could have been used in the construction of eaves fencing and other areas where asbestos was commonly used. Further investigation required to confirm.
Are septic tanks present? YES / NO	YES Wastewater plans for the precinct sourced from EsiNet show that there are minimal existing wastewater services in the FFN. Thus, the presence of septic tanks within the precinct should be considered on each private landholding.
Likely issues associated with remediation?	Key issues are likely to be asbestos in some buildings and structures to be demolished, and de-commissioning of septic tank / leach drain setups. These issues are local in nature and will be the responsibility of future land developers, therefore any structures in the future Public Open Space / Environmental Conservation areas will be addressed as part of future DCP preparation and acquisition processes.

2.3 Earthworks

Describe the general levels across the site	Ground surface contours fall from 45.0 AHD in the east to 32.0AHD in the west. The design ethos will be to retain existing topography throughout the provisions of smaller lots.
Describe AAMGL levels across the site	Strategen's LWMS shows MGL levels a minimum of 5 metres below the surface throughout the Residential Precinct LSP. The LSP is therefore not impacted by high groundwater.
Is Groundwater an issue on this site? If YES, is fill likely to be required? If YES, what is the quantum of fill?	NO Groundwater is expected to be no nearer than 5 metres within the surface topography across the site based on information provided in Strategen's LWMS.
Can cut to fill techniques be utilised? If YES, provide quantity m ³	YES, Cut to fill techniques are possible due to the large clearance between groundwater and the surface topography. However, this will be subject to further

	geotechnical investigation relatively to the quality of the in-situ material. The utilisation of cut to fill techniques will depend on and be dictated by the depth of Bassendean Sand and Yoganup Sands and will need to be reviewed at the detailed design phase for each subdivision.
What is the likely depth of topsoil (mm)?	To be indicated by Geotechnical report, expected to range between 100mm to 200mm.
Is the topsoil suitable for re-use?	POTENTIALLY. Further Geotechnical investigation required to investigate depth of Bassendean Sand and Yoganup Sands, to be confirmed. It is likely that topsoil can be re-used in verges and in POS areas.
Describe the natural vegetation on the site? Dense / Moderate / Sparse / Cleared	MODERATE-DENSE. Mature vegetation. Presence of trees with concentrated areas located in the central portion of the precinct. Western and eastern outskirts of the precinct are sparse. Explained in further detail in Environmental Reports.
Are there significant trees that need to be kept?	YES, Significant areas of existing vegetation have been maintained as part of the LSP.
What is the likely soil profile?	Perth Groundwater Atlas indicated that the site area is comprised of Bassendean Sand and Yoganup Sands: quartz sand (dunes). Further geotechnical investigation required to determine and confirm the in-situ soil.
Risk of acid sulphate soils? High / Moderate / Low	Perth Groundwater Atlas and Land Gate SLIP Portal investigations indicate that there is MODERATE-LOW risk of acid sulphates for the precinct. Further investigation required on the presence of Acid Sulphate Soils prior to conduction of works.
Is there peat or other unsuitable materials? If YES nominate the following;	UNLIKELY. Geotechnical report required for confirmation at each future development site.

For localised cut to fill (up to +/- 1.0 metre), it is highly likely that the existing soils will be suitable for re-use. This is a key component of sustainability and a key objective of the Forrestfield North Residential Precinct LSP. In 2016, KCTT completed research on the impact that overfilling land development sites has both economically and environmentally. Apart from the issues associated with difficulties in tree retention on filled developments, we found the following key metrics: -

Table 4 - KCTT Key Metrics for Earthworks Warrants (Table A)

Lot Size	Fill Depth	Fill Required Per Lot	Distance to Nearest Quarry	CO ₂ Emissions Per Lot	Volatile Organic Compound
80m ²	1.0m	230m ³	40km	952kg	34,007kg
100m ²	1.0m	250m ³	40km	1035kg	36,964kg

120m ²	1.0m	270m ³	40km	1110kg	39,921kg
160m ²	1.0m	310m ³	40km	1283kg	45,835kg
200m ²	1.0m	350m ³	40km	1450kg	51,750kg

Table 5 below shows further pollution measures from the import of raw materials for filling residential development sites. This is very important when considering warrants for importation of fill.

Table 5 - KCTT Key Metrics for Earthworks Warrants (Table B)

Lot Size	Total Hydrocarbons (THC Per Lot)	Carbon Monoxide Cost Per Lot	Nitrogen Oxides (not per lot)	Particulate Matter Under 2.5 Micron Per Lot
80m ²	34,711kg	267,246kg	49,012kg	952kg
100m ²	37,730kg	290,485kg	53,214kg	1035kg
120m ²	40,748kg	313,724kg	57,536kg	1110kg
160m ²	46,785kg	360,201kg	66,060kg	1283kg
200m ²	52,822kg	406,679kg	74583kg	1450kg

Importation of fill is therefore a significant contribution to pollution due to its labour-intensiveness in the field of transportation. Therefore the proposed road and infrastructure designs in KCTT's 15% concept design plans seek to tie-in to existing levels as closely as possible to minimise requirements for importation of fill and / or carting of excess materials.

2.4 Roadworks

Do existing roads require upgrade?	<p>YES</p> <p>With the new proposed residential development, all existing roads will need to be upgraded to compliment the new medium-high residential density development. Existing conditions of the roads are not adequate to accommodate the volume of traffic that will be generated by the new development. Current road widths are very narrow. This LSP proposes significant upgrading of key internal road networks.</p>
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In this section of the ISR, KCTT review in detail the existing road reservations and pavement composition, the proposed cross sections across the Residential and TOD and AC Precincts and provide analysis of the future road requirements for the Forrestfield North Residential and TOD and AC Precincts.

2.4.1 Existing Road Reservations and Pavements

The table below provides details on the existing roads that form a key part of the future road spine within the Forrestfield North Residential Precinct LSP area.

Table 6 - Data on the Existing Road Network

Road Name	Length (m)	Road Width (m)	Road Reserve Width (m)	Description
Sultana Road West	515	6.5	20	Two-way single road with an approximate width of 6.5m and road reserve width of 20m, according to desktop studies. With no road marking or kerbing therefore, the road will require upgrading. 2-way, 2-lane road.
Milner Road	1,630	7.5	20	Rural type road with no road markings or significant kerbing. 2-way, 2-lane road.
Dundas Road	1,150	8	20	Existing semi-mountable kerbing throughout. Major realignment works are required due to the Forrestfield North Railway Station works. 2-way, 2-lane road.
Imperial Street	310	6.5	20	Industrial type road with flush kerbing allowing drainage to flow overland onto verges. 2-way, 2-lane road.
Ibis Place	320	6.5	20	Existing coarse asphalt, rural residential road. Requires major upgrades, kerbing etc. 2-way, 2-lane road.
Raven Street	360	6.5	20	Existing coarse asphalt, rural residential road. Requires major road upgrades, kerbing etc. 2-way, 2-lane road.
Eureka Street	550	10.0	20	Industrial standard road. Fit for purposes. 2-way, 2-lane road.
Berkshire Road	1,085	9.0	20	Industrial Connector Road with 2 x 4.5m wide lanes and painted centreline.

2.4.2 LSP Road Cross Sections

The proposed road network will be discussed in detail in the Transport Impact Assessment (TIA), however from a civil infrastructure perspective the following roads have been identified as part of the road networks that are suitable for consideration as part of a future DCP, with each cross section showing the road name identifier.

Figure 2 – RD01 Berkshire Road Cross Section

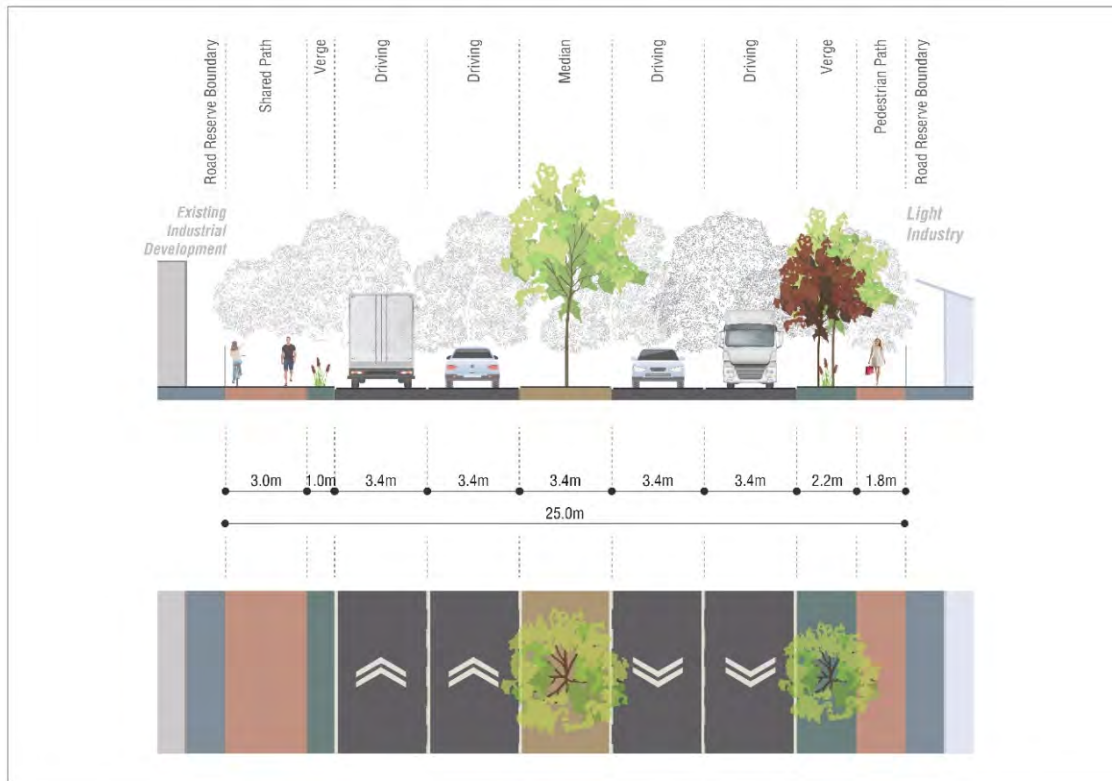


Figure 3 – RD02 Milner Road Cross Section (Sultana Road West to Stewart Road)

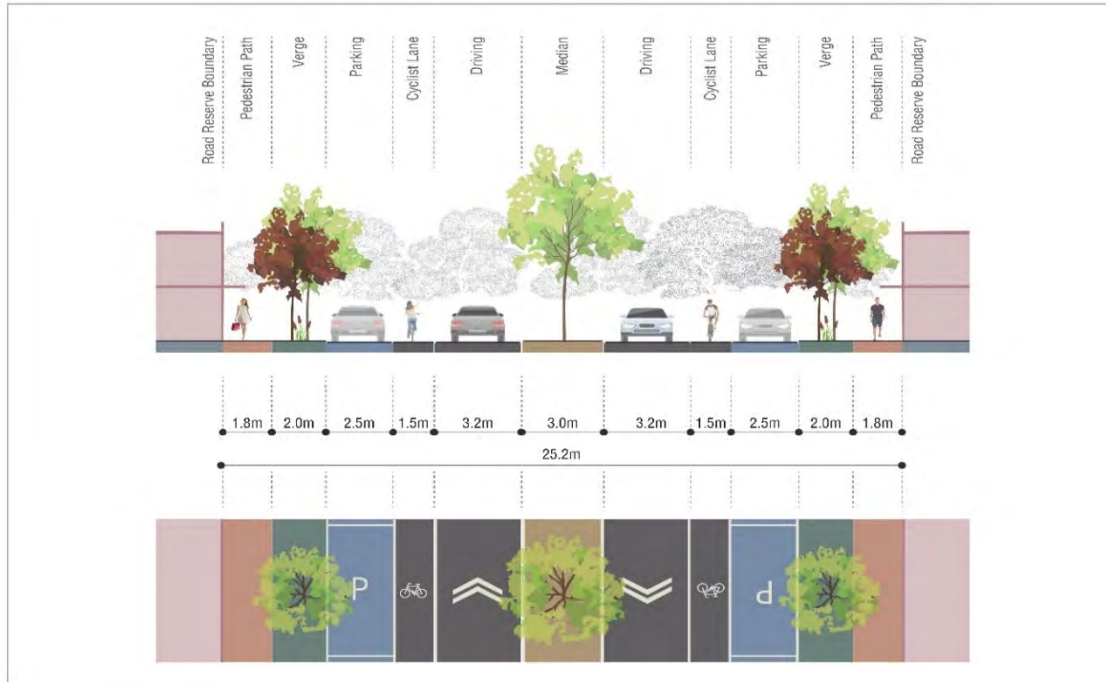


Figure 4 – RD03 Maida Vale Road (East of Milner Road), RD04 Maida Vale Road (Milner Road to Raven Street) and RD05 Maida Vale Road (West of Ibis Place)

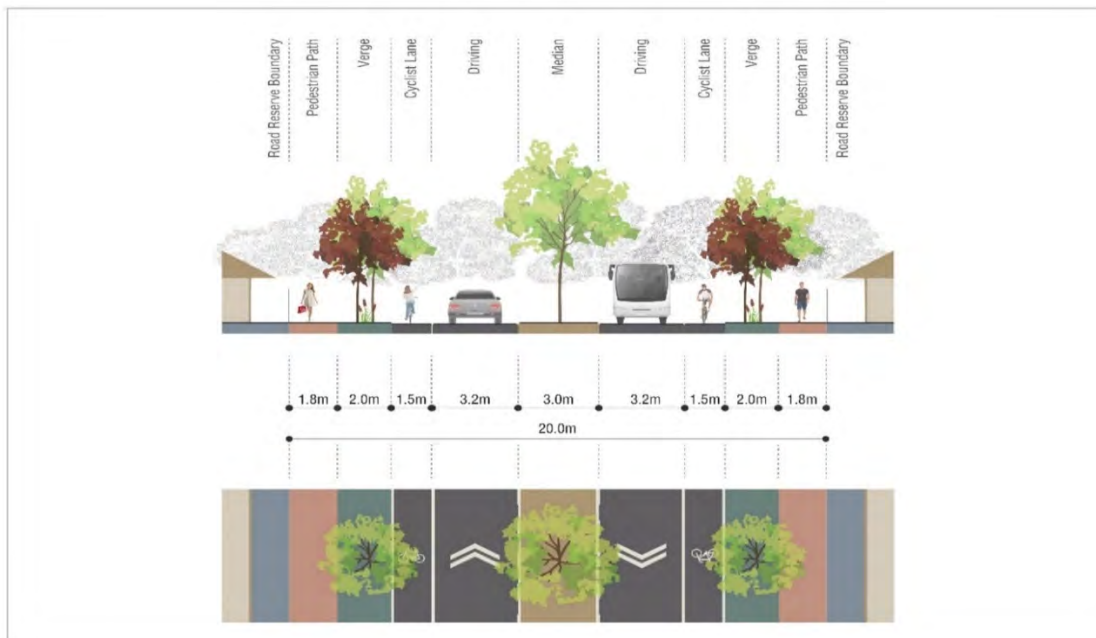


Figure 5 – RD06 Dundas Road (South of Berkshire Road), RD07 Dundas Road (Berkshire Road to Dundas Road Old) and RD08 Dundas Road (North of Deviation) Cross Section

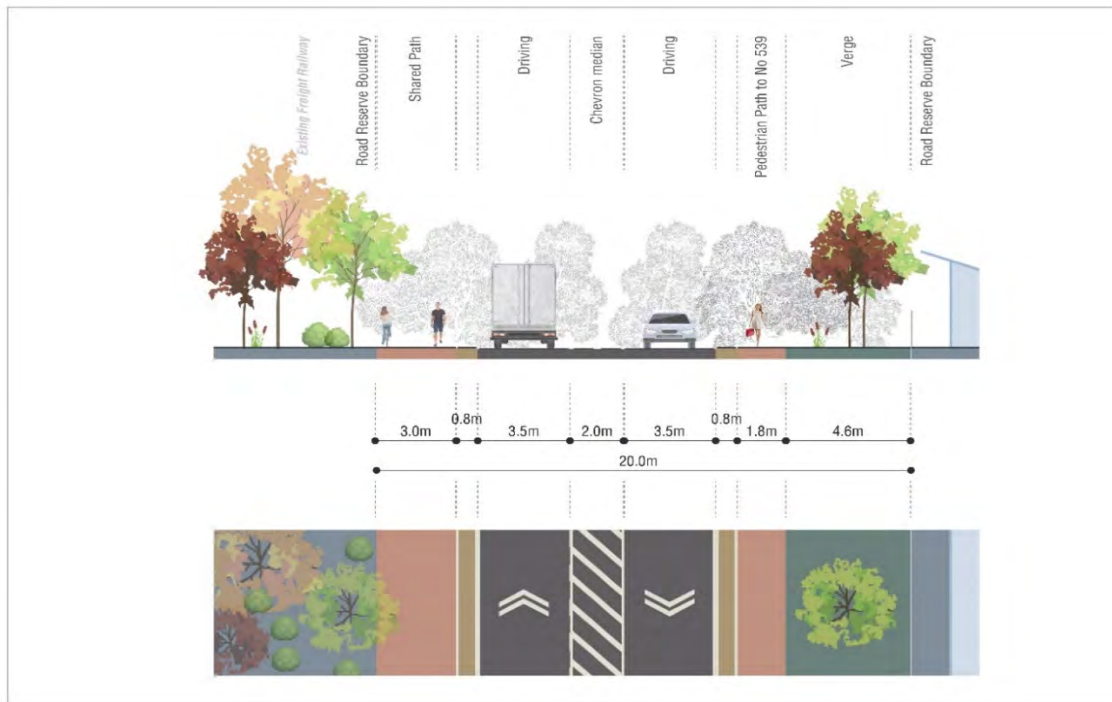


Figure 6 – RD09 Milner Road (Berkshire Road to Sultana Road West) and RD10 Milner Road (Stewart Road to Maida Vale Road) Cross Section

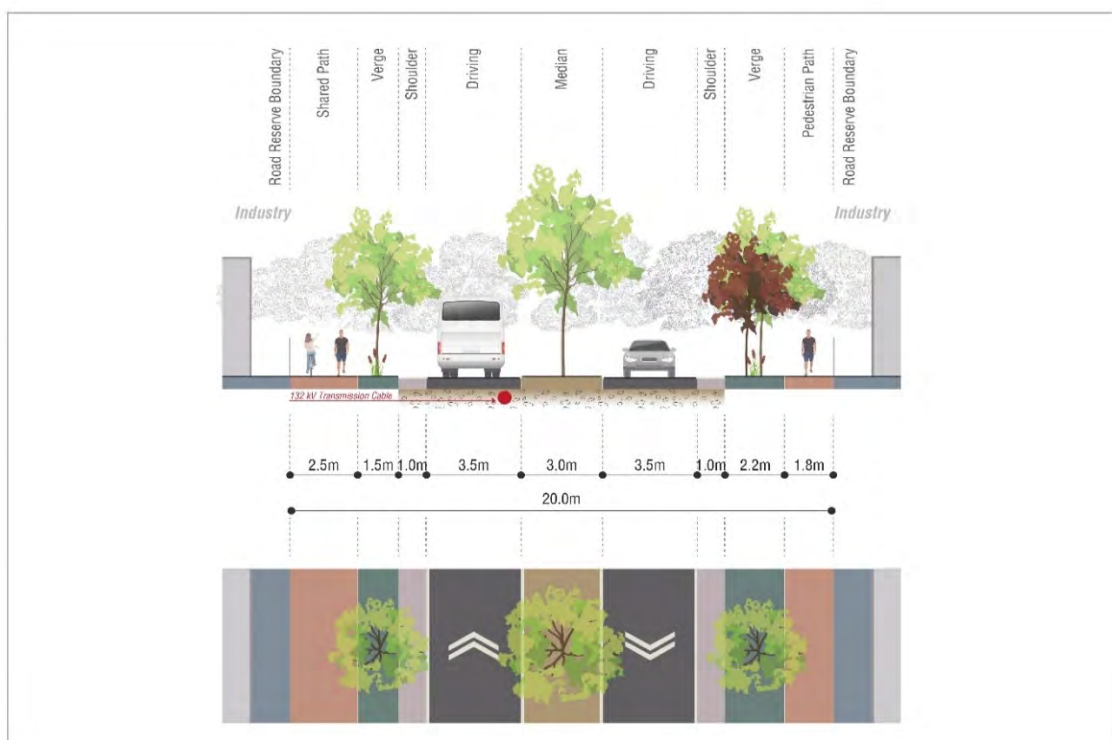


Figure 7 – RD11 Ibis Place / Enterprise Boulevard Cross Section

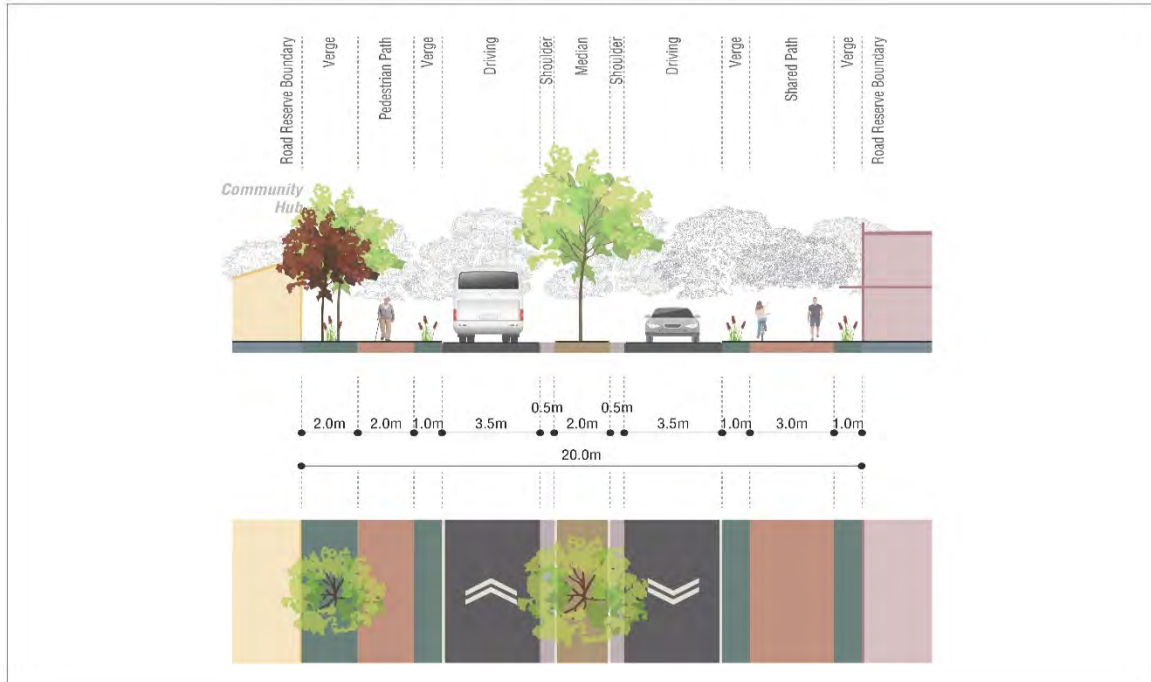


Figure 8 – RD12 Raven Street (Milner Road to Maida Vale Road) and RD13 Raven Street (Milner Road to Brae Road) Cross Section

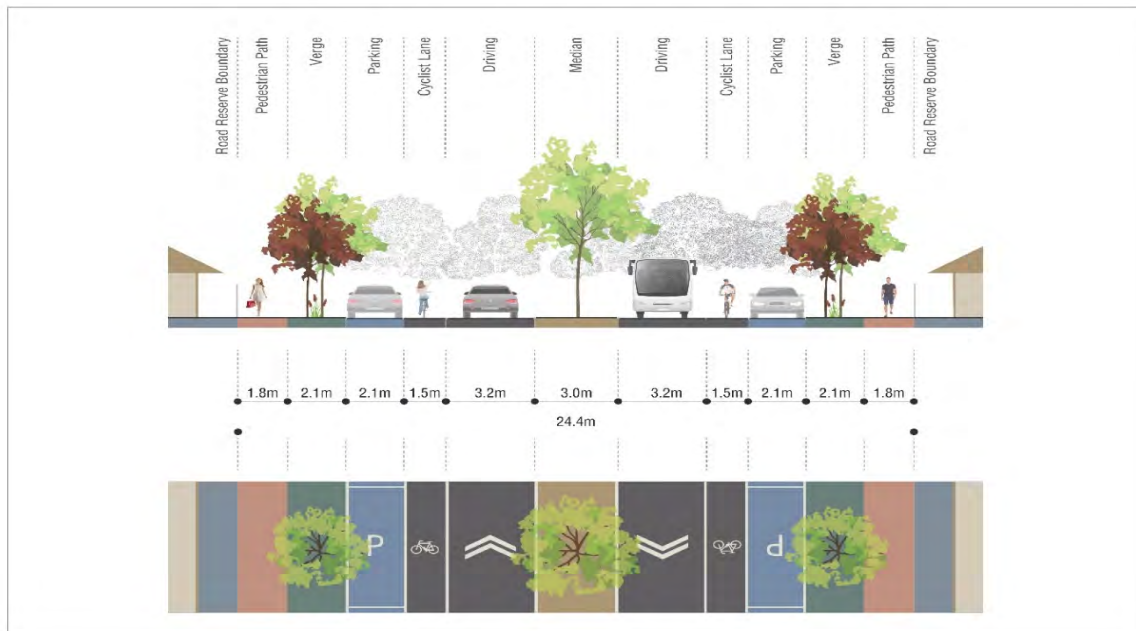


Figure 9 – RD14 TOD Connector Boulevard (Milner Road to Enterprise / Ibis), RD15 TOD Connector Boulevard (Milner Road to Brae Road) and RD16 TOD Connector Boulevard (East of Brae Road) Cross Section

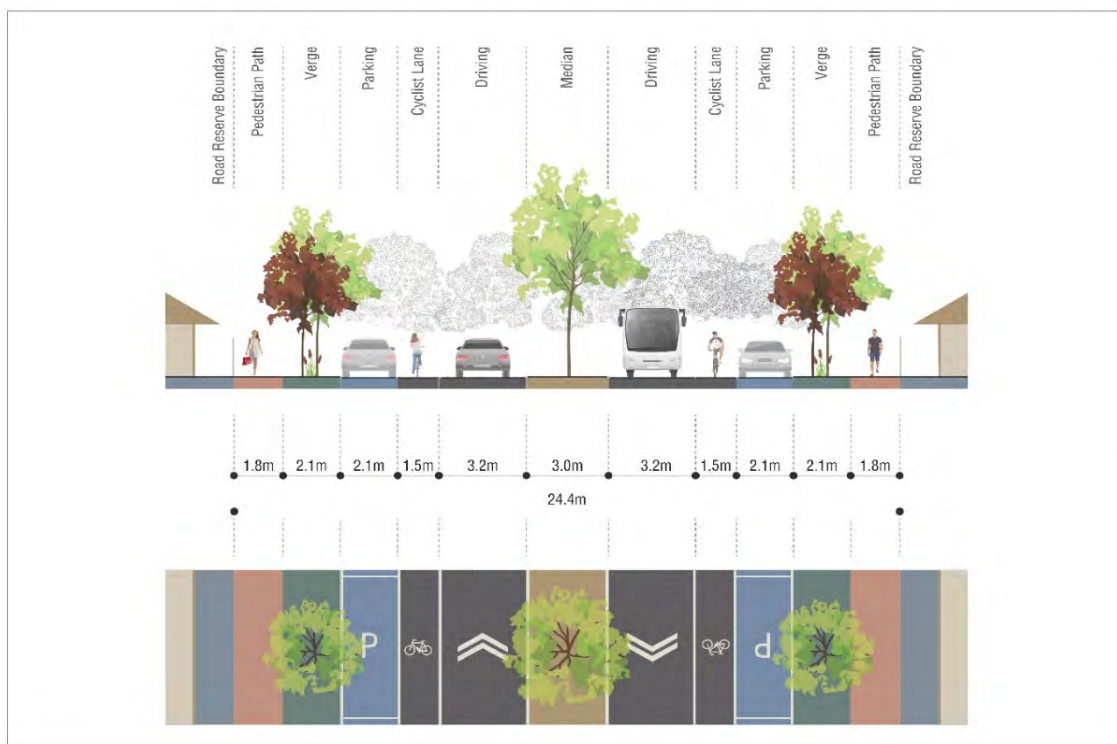


Figure 10 – RD17 Stewart Road (East of Milner Street) Cross Section

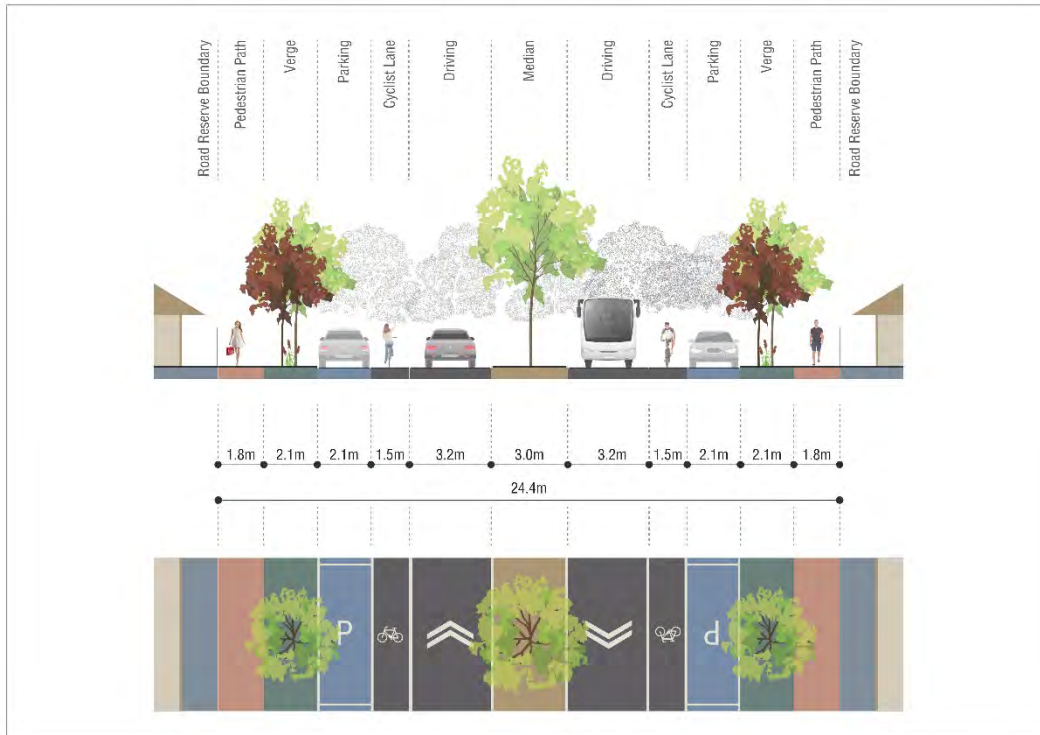
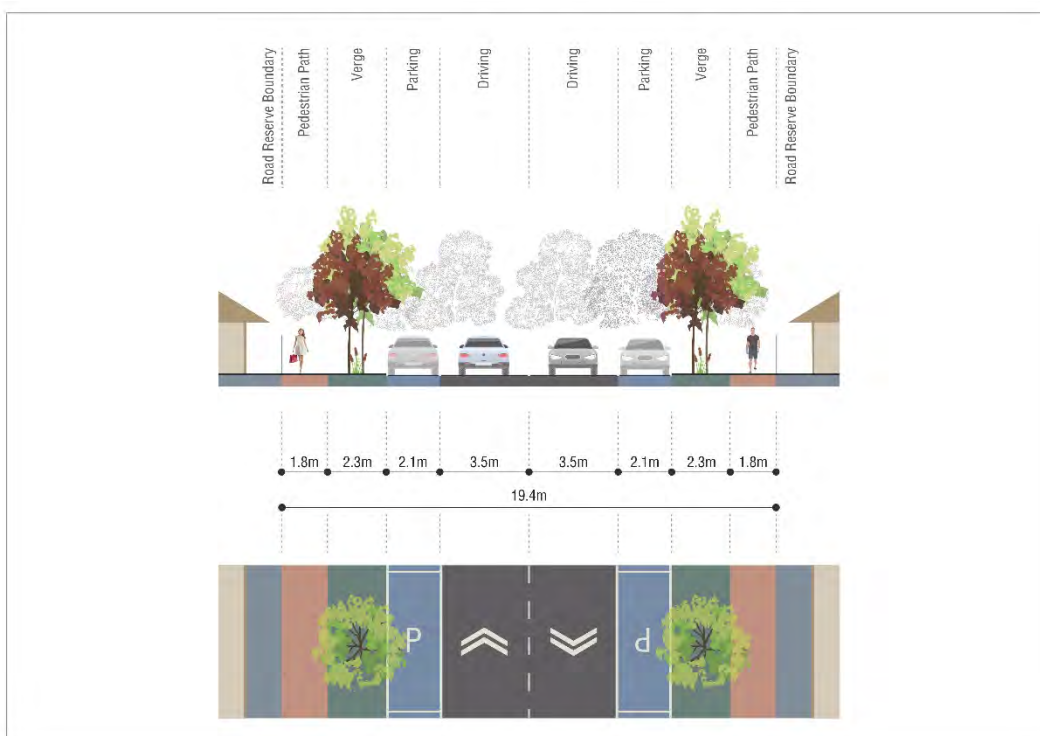


Figure 11 – RD18 Brae Road (East of TOD Connector Boulevard) and RD18A Brae Road (South of TOD Connector Boulevard) Cross Section



Note: RD18A is the same cross section in a 20.0 metre width road reserve.

Figure 12 – RD19 Brand Road (At District Open Space) Cross Section

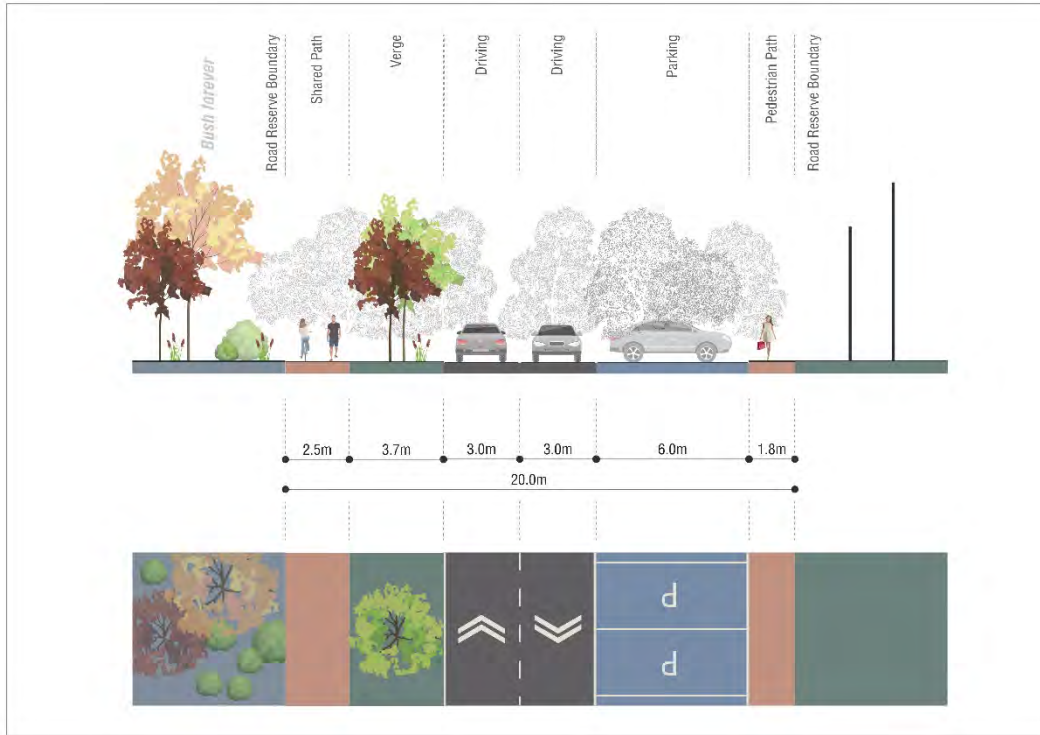


Figure 13 – RD19 Brand Road (South of District Open Space) Cross Section

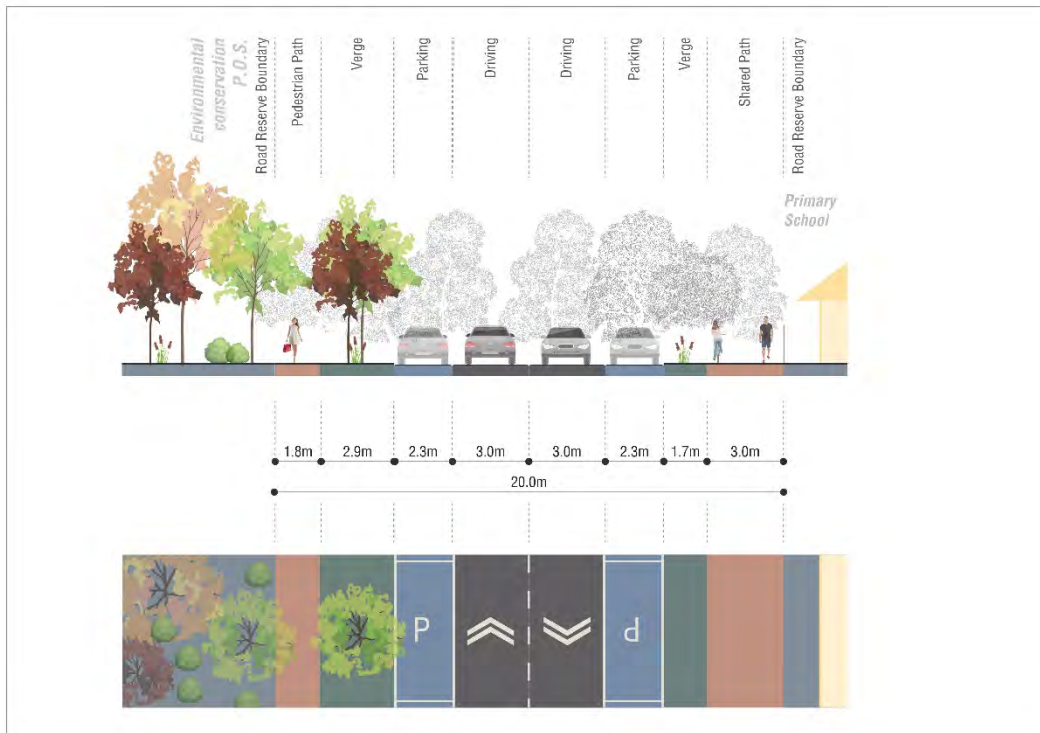
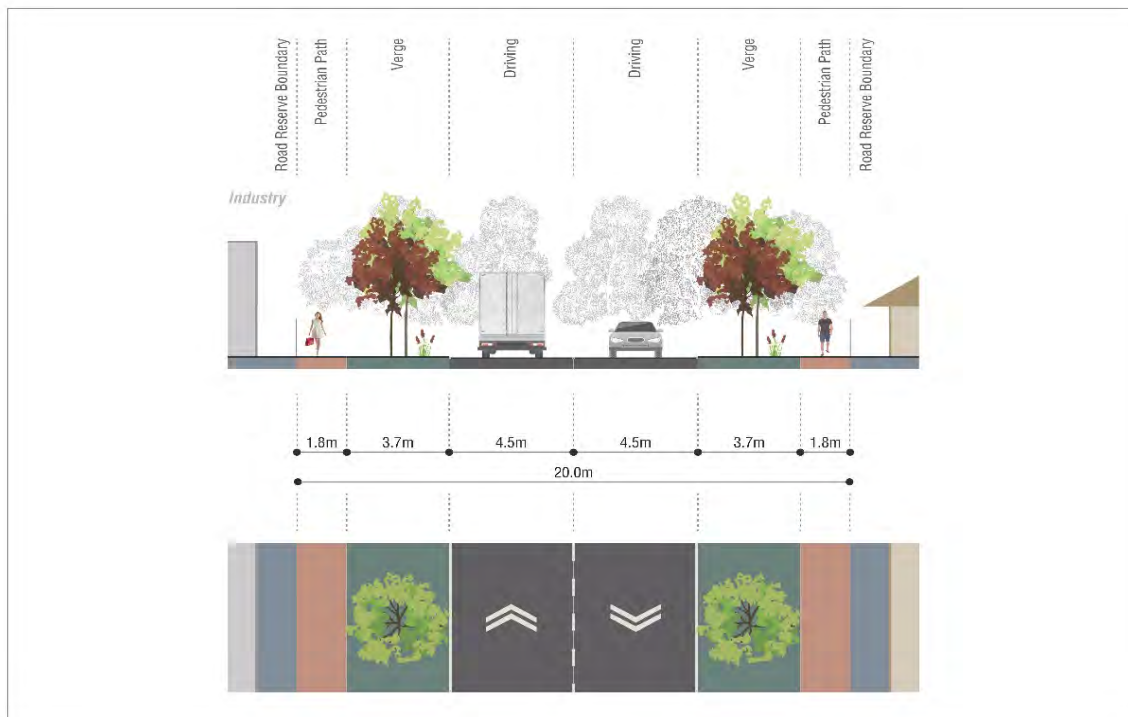


Figure 14 – Sultana Road West (East of Milner Road) Cross Section



Note: This cross section is existing.

2.4.3 Land Resumption Requirements for LSP Roads

The proposed road network will be discussed in detail in the Transport Impact Assessment (TIA), however from a civil infrastructure perspective the following roads have been identified as part of the key road networks that are suitable for consideration as part of a future DCP. The following table shows the existing road reservation, the new road reservation, the length of the road, (not including intersections) and any applicable areas of land acquisition.

Table 7 - Proposed Road Network

Road ID	Road Name	Existing Road Reserve (m)	New Road Reserve (m)	Length (m)	Land Acquisition
RD01	Berkshire Road (Between Roe Hwy and Milner Road)	20.0	25.0	976.9	$(976.9 \times 5) = 4,884.6\text{m}^2$
RD02	Milner Road (Sultana Road West to Stewart Road)	20.0	25.2	547	$(547 \times 5.2) = 2,844.4\text{m}^2$
RD03	Maida Vale Road (East of Milner Road)	20.0	20.0	690	No widening required.
RD04	Maida Vale Road (Milner to Raven)	20.0	20.0	643	No widening required.
RD05	Maida Vale Road (West of Ibis Place)	20.0	20.0	257	No widening required.
RD06	Dundas Road (south of Berkshire Road)	20.0	20.0	150	No widening required.

RD07	Dundas Road (Berkshire Road to Dundas Road Old)	0	20.0	363	No widening required. Created as condition of the Railway Station Development.
RD08	Dundas Road (North of Deviation)	0	20.0	116	No widening required. As above for RD07.
RD09	Milner Road (Berkshire to Sultana)	20.0	20.0	641	No widening required.
RD10	Milner Road (Stewart Road to Maida Vale Road)	20.0	20.0	230	No widening required.
RD11	Ibis Place (new road to be designated as Enterprise Boulevard)	20.0	20.0	280	No widening required. As above for RD07.
RD12	Raven Street (Milner Road to Maida Vale Road)	20.0	24.5	418	$418 \times 4.5 = 1,881\text{m}^2$
RD13	Raven Street (Milner Road to Brae Road only)	0.0	24.5	427	$427 \times 24.5 = 10,461.5\text{m}^2$
RD14	TOD Connector Boulevard (Milner Road to Enterprise / Ibis)	0.0	24.5	488	$488 \times 24.5 = 11,956\text{m}^2$
RD15	TOD Connector Boulevard (Milner Road to Brae Road)	0.0	24.5	495	$495 \times 24.5 = 12,127.5\text{m}^2$
RD16	TOD Connector Boulevard (East of Brae Road)	0.0	24.5	677	$677 \times 24.5 = 16,586.5\text{m}^2$
RD17	Stewart Road (East of Milner Road)	20.0	24.5	552	$552 \times 4.5 = 2,484\text{m}^2$
RD18	Brae Road (East of TOD Connector Boulevard)	19.4	19.4	875	No widening required.
RD18A	Brae Road (South of TOD Connector)	20.0	20.0	218	No widening required.
RD19	Brand Road	20.0	20.0	873	No widening required.

2.4.4 Land Resumption Requirements for Intersections

The proposed road network will be discussed in detail in the Transport Impact Assessment (TIA), however from a civil infrastructure perspective the following intersections have been identified as part of the key road intersections for consideration as part of a future DCP. The following table shows the proposed intersection, the proposed intervention or intersection type, the length of the road, and any applicable areas of land acquisition, measured from AutoCAD.

Table 8 - Key Intersections

Intersection ID	Intersection	Proposed Intervention	Land Acquisition
INT01	Milner Road / Maida Vale Road	2031:	n.a.

		Give Way Sign-controlled Intersection, T-Intersection	
		2041: Roundabout, T-Intersection	420m ²
INT02A	Maida Vale Road / Roe Hwy Off Ramp	2031: Roundabout, 3-way	n.a. (within reservation)
INT02B	Maida Vale Road / Roe Hwy On Ramp	2031: Roundabout, 3-way	n.a. (within reservation)
INT03	Maida Vale Road / Newburn Road	2031 Provision of left and right turn deceleration lanes on Newburn Road	n.a.
		2041: Roundabout; T-Intersection	420m ²
INT04	Maida Vale Road / Dundas Road	2031: Roundabout, 3-way	375m ²
INT05	TOD Connector / Milner Road	2031-2050: Signalised Intersection, 4-way	n.a.
INT06	Dundas Road Old / Dundas Road New	2031: Signalised Intersection, 3-way	n.a.
INT07	Milner Road / Sultana Road West	2031: LILORI Configuration	n.a.
INT08	Milner Road / Nardine Close	2031: LILORI Configuration	n.a.
INT09	Brae Road / Stewart Road	2031: Give Way Sign-controlled Intersection, T-Intersection.	n.a.
		2041: Median addition to Stewart Road as a part of road upgrade.	n.a.
INT10	TOD Connector / Brae Road / Raven Street	2031: Give Way Sign-Controlled Intersection, 4-way.	n.a.
		2041: Medians added to Raven Street and TOD Connector Approaches as a part of road upgrades	n.a.
INT11	Brae Road / Brand Road	2031: Give Way Sign-Controlled Intersection, T-Intersection.	n.a.
INT12	Maida Vale Road / Ibis Place	Constructed.	n.a.
INT13	Maida Vale Road / Raven Street	2031: Give Way Sign-Controlled Intersection, 3-way.	
		2041: Medians added to all approaches as a part of road upgrades.	
		2050:	420m ²

		Roundabout, 3-way.	
INT14	TOD Connector / Raven Street / Brae Road	2031: Roundabout, 4-way.	550m ²
INT15	Berkshire Road / Milner Road / Dundas Road	2031: 2-lane Roundabout, 4-way.	900m ²
INT16	TOD Connector / Brand Road	2031-2050: Give Way Sign-Controlled Intersection, T-Intersection (Potential future requirement for a 4-way intersection).	420m ²
INT17	Milner Road / Raven Street	2031-2050: Roundabout, 4-way.	500m ²
	Milner Road / Sultana Road West	2031: Channelized T-Intersection with Priority for Heavy Vehicles; LILORI (No Right-Out movement).	n.a.
		2041: Median to be added to Milner Road as a part of road upgrade.	n.a.
INT18	Milner Road / Stewart Road	2031: Give Way Sign-Controlled Intersection, 4-way.	n.a.
		2041: Medians added to 3 out of 4 approaches as a part of road upgrades.	n.a.
		2050: Roundabout, 4-way.	500m ²

2.4.5 Maida Vale Road / Roe Hwy Bridge Reconstruction

Significant works are proposed for the Roe Highway and Maida Vale Road interchanges under the Forrestfield North Residential LSP and the TOD and AC Precinct ACP. This section of Maida Vale Road is RD03A and comprises of a 95-metre section of road between the two proposed roundabout intersections with the Roe Highway On and Off Ramps. The proposed length of bridge span is approximately 50 metres between these two intersections and will involve a complete reconstruction of the bridge to suit the proposed road cross section.

2.4.6 Road Pavement Designs

In this section, KCTT have calculated ultimate pavement thicknesses based on the ultimate traffic volumes, with a CBR of 8% and assuming a 40-year pavement design life in accordance with Main Roads WA requirements.

Road ID	Road Name	Traffic Volumes (VPD)	Min Base Course Thickness (mm)	Total Flexible Pavement Thickness (mm)	Standard Pavement
RD01	Berkshire Road (Between Roe Hwy and Milner Road)	25,843	185	410	230mm sub-base 200mm base course

RD02	Milner Road (Sultana Road West to Stewart Road)	5,984	165	370	200mm sub-base 170mm base course
RD03	Maida Vale Road (East of Milner Road)	13,072	175	395	220mm sub-base 175mm base course
RD04	Maida Vale Road (Milner to Raven)	4,422	160	360	200mm sub-base 160mm base course
RD05	Maida Vale Road (West of Ibis Place)	7,620	170	375	200mm sub-base 175mm base course
RD06	Dundas Road (south of Berkshire Road)	15,169	180	395	200mm sub-base 200mm base course
RD07	Dundas Road (Berkshire Road to Dundas Road Old)	13,680	175	395	200mm sub-base 200mm base course
RD08	Dundas Road (North of Deviation)	13,680	175	395	200mm sub-base 200mm base course
RD09	Milner Road (Berkshire to Sultana)	12,928	175	395	200mm sub-base 200mm base course
RD10	Milner Road (Stewart Road to Maida Vale Road)	9,288	170	380	200mm sub-base 180mm base course
RD11	Ibis Place	3,631	160	350	200mm sub-base 160mm base course
RD12	Raven Street (Milner Road to Maida Vale Road)	5,602	165	365	200mm sub-base 165mm base course
RD13	Raven Street (Milner Road to Brae Road)	5,984	165	370	200mm sub-base 170mm base course
RD14	TOD Connector Boulevard (Milner Road to Enterprise / Ibis)	2,322	150	335	200mm sub-base 150mm base course
RD15	TOD Connector Boulevard (Milner Road to Brae Road)	6,432	165	370	200mm sub-base 170mm base course
RD16	TOD Connector Boulevard (East of Brae Road)	4,520	160	360	200mm sub-base 160mm base course
RD17	Stewart Road (East of Milner Road)	4,739	160	360	200mm sub-base 160mm base course
RD18	Brae Road (East of TOD Connector Boulevard)	2,599	155	340	180mm sub-base 160mm base course
RD18A	Brae Road (South of TOD Connector)	2,500	150	340	180mm sub-base 160mm base course
RD19	Brand Road	2,011	150	330	180mm sub-base 150mm base course

2.5 Stormwater Drainage

The Residential Precinct has a simple overland flow. The northern-most portion of the site drains toward Poison Gully Creek, however this represents less than 10% of the total catchment. In the northern third of the precinct, the overland flow is directed to the west – draining from Roe Highway towards Ibis Place. Meanwhile, the remaining southern two thirds of the precinct generally exhibit south-westerly directed flows. In the south-eastern portion of the precinct, the flow drains predominately west, parallel to Sultana Road West.

The key areas for detention of major stormwater drainage events in the residential precinct are in Brand Road near Sultana Road West and in the future Town Centre Park, north of the proposed Activity Centre.

Previously this ISR referred to the Strategen LWMS for catchment measurements. Since the completion of the Strategen LWMS there have been amendments to the LSP plan, including road layouts, areas and densities of Residential Precinct development layout and yields. This table provides a quick comparative analysis of the former Strategen LWMS catchments and the new catchment layout to suit the updated Forrestfield North Residential LSP layout.

Table 9 - Post-Development Catchments

Catchment Number	Strategen LWMS (m ²)	Catchment Number	KCTT ISR Review (m ²)
AS3	455,929	1	467,718
PG6	52,269	2	49,450
AS1	209,600	3	134,110
AS2	294,218	4	164,115
PG5	66,916	5	83,200
PG4	94,958	6	86,900
Total	1,173,890		985,493

The catchment review above shows a 20% change in total area of the Forrestfield North Residential LSP catchment areas from the previous iteration in 2017 to the present layout due to amendments in the LSP boundaries for the Residential Precinct and the TOD ACSP.

The key principles of the drainage design in Forrestfield North are to develop systems that promote Water Sensitive Urban Design (WSUD) principles and promotes the capture and re-utilisation of stormwater drainage runoff, whilst allowing pre-development flows for the 1 in 1-year event to flow out of the LSP and ACP areas. The following tables show the assumptions for offsite flow under the pre-development scenario for the Forrestfield North Residential LSP: -

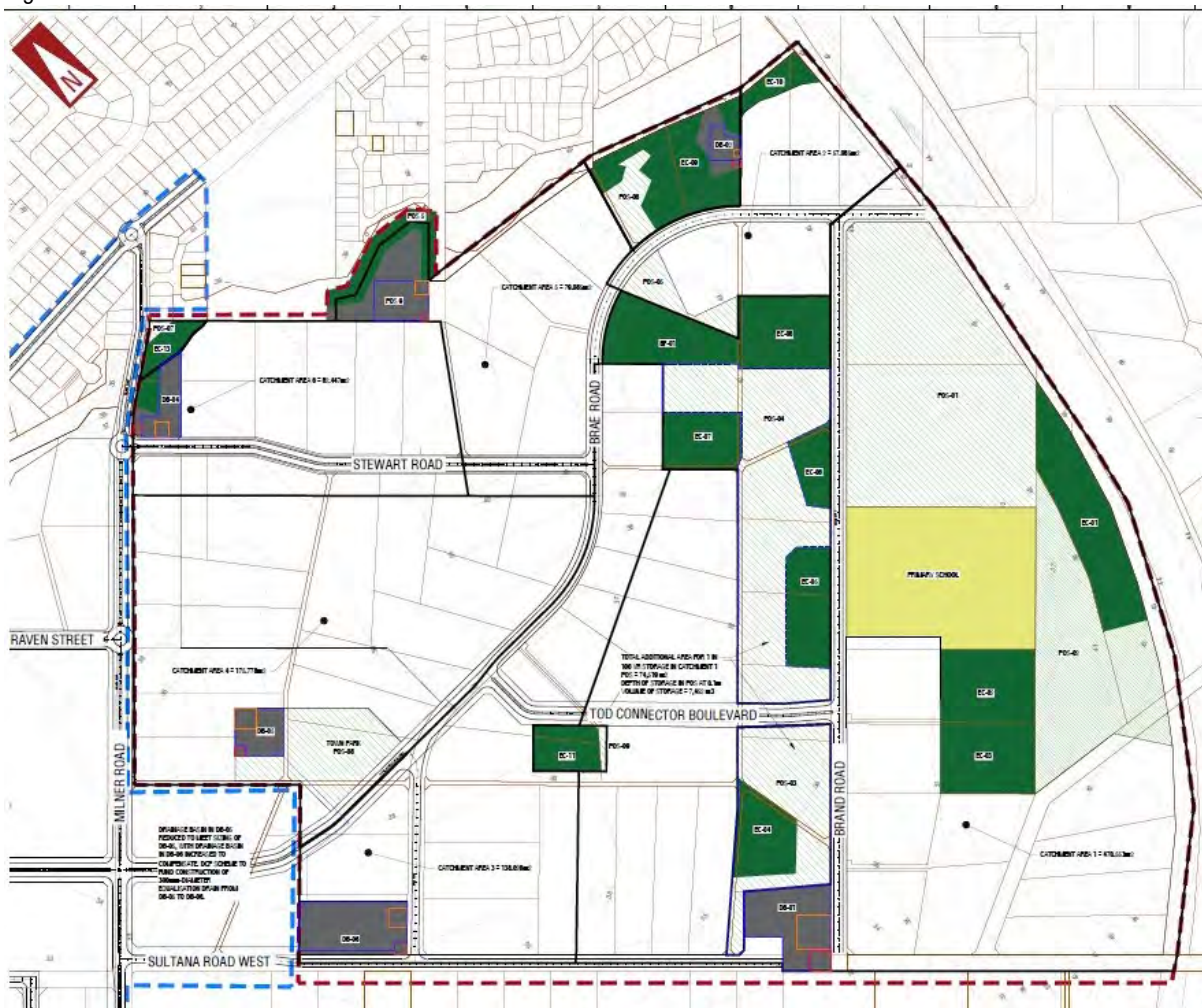
Table 10 - Pre-Development Catchment Area

Catchment Number	Area (m ²)	Description of Existing Flow Path	1 in 1 Year Flow Rate (l/sec)	1 in 1 Year Estimated Yearly Flow (ML)
1	467,718	Overland flow to existing bush forever in Industrial LSP and Into Sultana Road West	238	300.2

2	49,450	Overland flow to Poison Gully Creek	33.8	42.6
3	134,110	Overland flow into catchment 1 (TOD / Activity)	88.2	111.3
4	164,115	Overland flow directed into Sultana Road West and TOD / Activity ACP.	69.1	87.1
5	83,200	Overland flow to Poison Gully Creek	36.8	46.4
6	86,900	Overland flow to Poison Gully Creek	40.2	50.7
Total	985,493		506.1	638.3

The new catchment areas are shown on the following plan, which is included as an appendix to this report.

Figure 15 - Catchment Areas



The pre-development 1 in 1-year flows have been calculated for an approximate flow rate (in litres per second), and for an estimated outflow from site in ML / Annum. The flow rates for the 1 in 1-year event (in L / Sec), have been calculated using the following assumptions: -

- That the 1 in 1-year event is infiltrated in full in all existing lots and open space areas.
- That the 1 in 1-year event has a coefficient of runoff in all road reservations of 0.3.

In KCTT's post-development calculations we have run the coefficient of runoff for 1 in 1-year and 1 in 5-year flows at $C = 0.8$ outside of future lot areas. The increased provision for coefficient of runoff provides the City of Kalamunda with certainty at this high-level drainage review that the drainage calculations on a per cell and per development basis will be robust within the Forrestfield North Residential LSP area.

The purpose of understanding the pre-development flow paths and quantum's is to determine storage requirements for post-development flow catchments and the various storm events. In the residential precinct, there are several key locations for the detention and storage of stormwater runoff, in accordance with the findings in Strategen's LWMS, which have been reviewed by KCTT in the updated Residential LSP plans: -

- TOD Connector Boulevard
- Milner Road
- Stewart Road
- Brae Road
- Brand Road
- Sultana Road West

The following table shows the detailed drainage storage calculations for the revised Residential Precinct: -

Table 11 - Catchment Drainage Calculations

Storm Event	Catchment 1	Catchment 2	Catchment 3	Catchment 4	Catchment 5	Catchment 6
20% AEP Area	2,426m ²	256m ²	927m ²	1,093m ²	544m ²	603m ²
20% AEP Depth	0.6m	0.6m	0.6m	0.6m	0.6m	0.6m
20% AEP Volume	1,452m ³	157m ³	556m ³	661m ³	327m ³	363m ³
1% AEP Area	17,980m ²	1,457m ²	5,274m ²	6,006m ²	2,861m ²	3,133m ²
1% AEP Depth	0.9m	0.9m	0.9m	0.9m	0.9m	0.9m
1% AEP Volume	16,182m ³	1,312m ³	4,746m ³	5,405m ³	2,575m ³	2,819m ³

Stormwater Hydraulic Design

The sizing for the City of Kalamunda stormwater drainage network is based on calculating the 1 in 1-year storm event, 1 in 5-year storm event for local road piped drainage networks, 1 in 10-year storm event piped drainage networks for Maida Vale Road, and 1 in 100-year storm event flows generated within road reservations only and the 1 in 100-year flow from POS and Environmental Conservation areas. The reason for this is that future development sites should be tasked with the management and re-use of all stormwater that lands within their respective landholdings. The capture of all storm events on-site promotes the concept of stormwater as a resource in Forrestfield North. Developers will have the choice of: -

- Using stormwater for flushing toilets/ irrigation etc.
- Planting roof top gardens
- Providing drainage detention on-site and allowing post-storm release into the City of Kalamunda Network.

KCTT have completed calculations for an envisaged potential major drainage network for consideration as part of a future DCP. Given the potential for amendment to the drainage network, specific details are not provided in this report, however the following basic principles are used in our drainage design: -

- Minimum drainage pipe size is 300mm-diameter
- Stormwater drainage pits are offset at a targeted 35 metres along the longitudinal sections, (based on 0.5% longitudinal grades on roads) of all major roads with a targeted depth of 1.5 metres to obvert of pipe to ensure the drainage system sits below, and doesn't clash with power, gas, telco and / or water services.

Where road longitudinal grades are greater than 0.5% drainage pit spacing can be increased, however at 15% design we believe it is prudent to allow for 35 metre spacings between drainage pits.

Considerations for Drainage Re-Use at an LSP Level

The key drainage re-use schemes considered in this report, which have been reviewed and considered by Strategen's LWMS document include: -

- At-Surface Treatment / Bio-Retention Drainage Swales
- Treatment At-Source (i.e. catch basin inserts)
- ECOAID Cells
- Stormwater harvesting / roof-top gardens

A Managed Aquifer Recharge system was reviewed in the LWMS, but the recommendation in the LWMS was that this should not be pursued as an economical consideration, therefore KCTT have not considered this further.

The following figures show general KCTT schematics for the proposed potential WSUD systems: -

Figure 16 - WSUD Schematic No 1 (Stormwater Re-Harvesting)

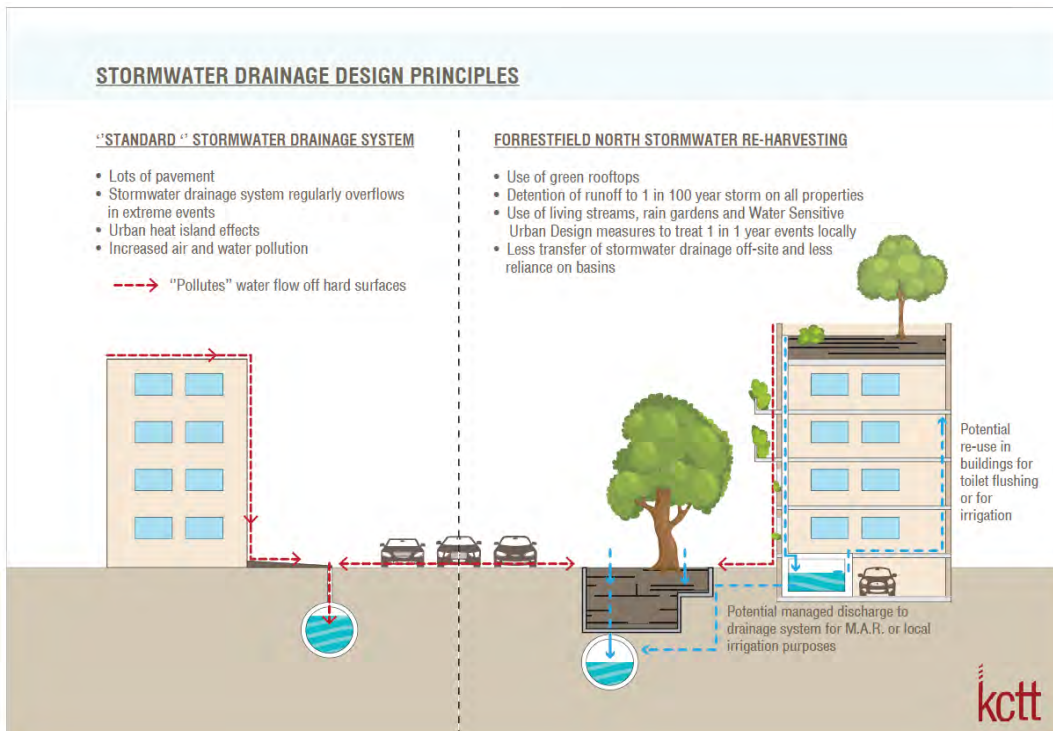


Figure 17 - WSUD Schematic No 2 Stormwater Drainage Re-use

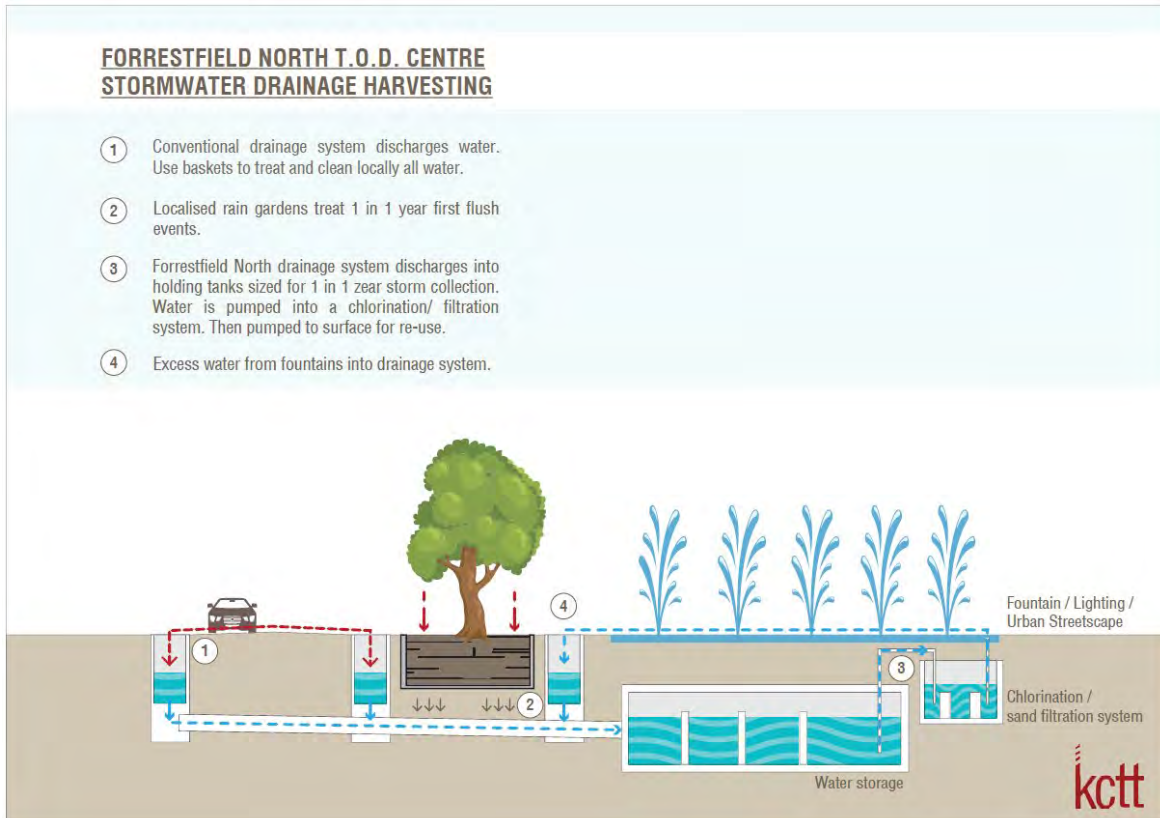


Figure 18 - WSUD Schematic No 3 (Aerial Imagery of Rooftop Gardens)



Source: CS Globe

Bio-Retention Swales

Bio-retention swales are a key component of the drainage design strategy for Forrestfield North. All medians are proposed to treat surface water, with all roads adjacent to POS and Environmental Conservation sites featuring bio-retention swales to treat and clean water prior to its entry to downstream environments.

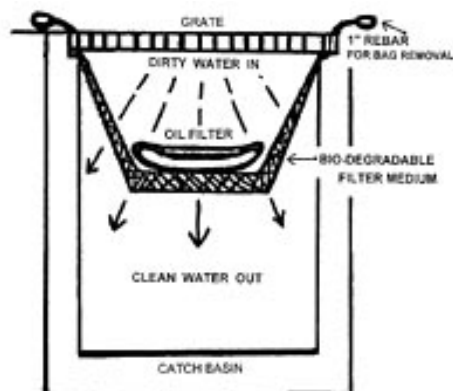
Catch Basin Inserts

Urban Stormwater Technologies has provided a quote for its scientifically proven storm water filtration devices - Catch Basin Inserts (CBI). These have been priced separately to the above, as they are a proposed addition to the pits which have been mentioned in the cost estimate. CBI's main function is the capture of and reduction of stormwater pollutants, which remove the gross pollutants (GP) at the source. To ensure this process ensures the pit floor is protected, the CBI's will be installed at each drainage pit. This means: -

- The base of the Side Entry Pit which is designed to infiltrate water will now be protected from the sand rolling onto the new road surface picking up the hydrocarbons and then entering the drain. We are seeing stagnant water in new Side Entry Pits in new subdivisions where home building has not yet started
- Protection of the Council infrastructure during the entire subdivisional works period
- Protection of the Council infrastructure during the entire construction phase this includes up to site inspection by the relevant Council
- By educating the installers of the drains and being present when they are installing them, we can ensure the drains are constructed where possible to allow the maximum size CBI to be installed

The below figure is an example of CBI's functionality: -

Figure 19 - Catch Basin Inserts



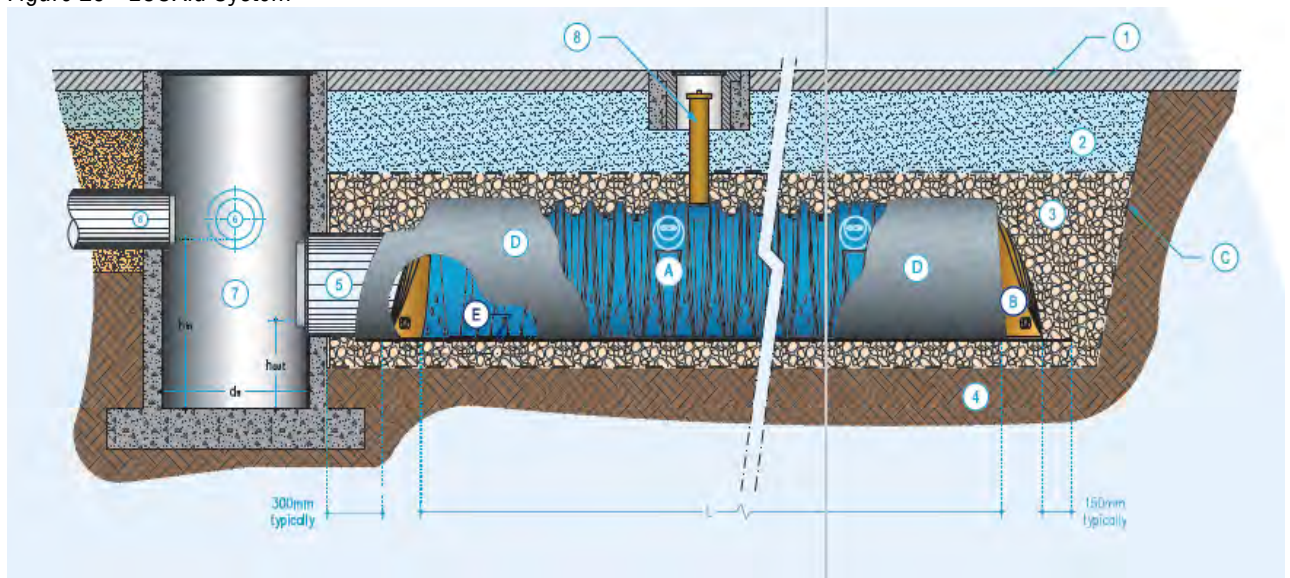
Source: http://emeraldseedandsupply.com/photos/eccat14_m.jpg

ECO Aid System

The ECO Aid is an underground modular stormwater management system used to detain, infiltrate or harvest stormwater run-off, and provides stormwater treatment by utilizing an internal gross pollutant and sediment trap. KCTT believe this is a great innovation which can be utilized throughout the entire Forrestfield North area. KCTT have sourced full pricing of the ECO Aid system for the LSP and ACP.

The below is a figure sourced from the online ECO Aid brochure, which outlines all the technical data and benefits of the system as an alternative to standard piping and pits used for stormwater drainage.

Figure 20 - ECOAid System



Source: https://www.geofabrics.co/sites/default/files/brochures/ecoAID_Brochure.pdf

2.6 Water

KCTT have commenced planning and have submitted this planning to the Water Corporation for consideration. The development of water infrastructure is generally simpler than wastewater planning because the water network does not need to be designed to consider depth of service as it's a pressurized system. This means that development can be catered for generally anywhere within the precinct with relation to the water infrastructure network.

At this stage, the Water Corporation are completing their planning for the ultimate development scenario. The provision of water infrastructure should not be considered as part of a future DCP. The following table shows the existing water infrastructure in the residential precinct: -

Table 12 - Existing Water Assets within the Forrestfield North Residential LSP Area

Road Name	Pipe Diameter	Location
Sultana Road West	205CI	Along south-east boundary of the precinct
Raven Street	100P-12	Along north-west boundary of precinct
Milner Road	150CI	Along northern boundary of precinct
Raven Street	100P-12	Within precinct- north-western portion
Stewart Road	100CI	Within precinct – northern portion
Brae Road	100CI	Within precinct – central portion
Brand Road	150CI	Within precinct – southern portion

Smokebush Place	100P-12	Within precinct – southern portion
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2.7 Wastewater

KCTT have actively liaised with the Water Corporation through the various phases of the Forrestfield North LSP submissions for the Residential Precinct. The information is provided in detail in the below tables: -

Is the project in an existing Water Corporation Planning Area?	Yes. The LSP and ACP Areas are within the Gooseberry Hill Concept Plan.
Are amendments to Water Corporation Planning required?	Yes. Continued liaison with the Water Corporation is required with regards to future planning of infrastructure in the area. During the Forrestfield North Residential Precinct LSP submissions, KCTT provided full modelling of the estimated sewer flows based on the envisaged maximum dwelling yields likely under the planned R-codes for each area. This included review of future planning for: - <ul style="list-style-type: none"> • Maida Vale South LSP area on the eastern side of the Roe Highway, which is a total land area of over 1,200 hectares. • Forrestfield North Residential LSP Area. • Forrestfield North TOD and AC Precincts ACP. This information is shown below the current wastewater network below.

Current Wastewater Network

Location	Pipe Diameter	Lowest I.L.	Location
Sultana Road	225PVC-U	28.25	Intersection of Dundas / Sultana
Milner Road	225PVC-U	26.24	Near Intersection of Milner / Dundas / Berkshire
Dundas Road	600PVC	21.17	Near Intersection of Milner / Dundas / Berkshire
Imperial Street	225PVC-U	27.78	Intersection of Dundas / Imperial
Eureka Street	225PVC-U	26.95	Intersection of Milner / Eureka

The table below shows the breakdown of commercial, industrial, and residential zonings for the Forrestfield North Residential Precinct, with the TOD and AC Precinct and Maida Vale South combined to enable review by the Water Corporation within this document for the final sizing of sewer into the Forrestfield North Residential Precinct. The yields for the TOD and AC Precinct can be referred to in the TOD and AC Precinct ACP documents.

The yields for the Maida Vale South area are from 2017 and have not been updated further as the area is undergoing long-term planning and is not expected to be finalised in time for these LSP documents to be finalised.

Table 13 - Wastewater Flows (Residential Precinct, TOD and AC Precinct and Maida Vale South Catchments)

Catchment - Location	Total Area (ha)	Population Density / Persons Net Ha	Flow (Dry Ground)	Total Design Flow (L/s)
Residential Precinct				
Residential R30	12.0	105	180	2.8
Residential R40	14.45	120	180	3.8
Residential R60	17.6	180	180	6.9
Residential R80	5.3	200	180	2.3
Primary School	4.0	n/a	14976	0.5
Total (Residential Precinct)	53.35			16.3
TOD and AC Precinct				
Catchment 1A - Industrial	10.1	n/a	14976	1.3
Catchment 1B - Residential	8.5	180	195	3.3
Catchment 1B - Commercial	20.6	n.a.	21600	3.9
Catchment 1C – TEC	3.2	n.a.	n.a.	n.a.
Catchment 1D – Station Precinct	2.5	n.a.	9450	0.3
Catchment 1E – Commercial	2.7	n.a.	21600	0.5
Catchment 2 - Residential	14.2	200	195	6.2
Total (TOD and AC Precinct)	73.9			15.5
Maida Vale South				
Catchment 1	75	20	180	11.5
Catchment 2	83.3	30	180	19.1
Total (Maida Vale South)	158.3			30.6
Total (All Catchments)	285.55			62.4

The total ultimate wastewater flow to be accommodated into the existing Water Corporation system at the intersection of Dundas Road, Milner Road and Berkshire Road is therefore 62.4 l/sec.

Are any assets to be constructed considered trunk infrastructure (i.e. 300mm-diameter and greater?)	YES, major upgrades to the planned wastewater infrastructure are required. The Water Corporation has completed the updates to this planning. This report will be provided to the Water Corporation to enable further modification to the wastewater planning, as prior calculations were completed on higher densities within the Forrestfield North Residential and TOD and AC Precincts.
Are wastewater pumping stations required?	No.
Can the development be serviced adequately without the need for import fill? If NO, describe the fill requirements;	Yes. The planned fill around the Forrestfield North Railway Station requires consideration in the detailed design phases by each developer and the consulting engineer in coordination with the Water Corporation.
Is groundwater likely to be an issue?	Groundwater will be an issue for management throughout the TOD and AC Precincts as the main sewer for the whole of the Forrestfield North TOD, AC and Residential Precincts, plus the Maida Vale South LSP areas is fed from the intersection of Milner Road, Dundas Road and Berkshire Road and is approximately 6.5 metres depth. This depth will encounter groundwater throughout the TOD and AC Precincts. Where the works are pre-funded under instruction from the Water Corporation, the design team will need to provide full details on management of groundwater and potentially acid sulphate soils to the satisfaction of the Water Corporation, the City of Kalamunda and other agencies as is appropriate. This is a standard requirement of major infrastructure provision with the Water Corporation.

As part of our conceptual design process, we believe that a 375mm diameter pipe is required in Milner Road between Dundas Road and Sultana Road West. The following table shows likely infrastructure requirements for the development of this infrastructure: -

Table 14 - Requirements for the Extension of Wastewater Assets into the Forrestfield North Residential LSP Area

Road	Pipe Diameter (mm)	Location	Length (m)	Depth (m)
Milner Road	375	South of Sultana Road West	760.5	3-4
Milner Road	150	North of Sultana Road West to TOD Connector Boulevard.	618.2	3-4
Stewart Road	150	Length of Stewart Road between Milner and Brae Road	569.6	3-4
Sultana Road West	300	Length of Sultana Road West, between Milner and Brand Road	889.3	3-4
Brand Road	225	Between TOD Connector and Bush Forever	316	3-4
TOD Connector Boulevard (Future)	225	Between Roe Hwy and Brand Road (Long Term Extension by Maida Vale South)	431.3	3-4

Dundas Road	225	North of Milner Road Intersection. (This has been extended to the intersection of Imperial Street as at the date of this ISR.)	772	3-4
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A 225mm-diameter sewer will be required in Dundas Road to service the TOD precinct. Each of the items listed in the table above, (except for the TOD Connector Boulevard extension between Brand Road and Roe Highway) are for consideration as part of a future DCP so that development can commence generally within the Residential Precinct, given the spread of land ownership in the precinct. The concept designs prepared by KCTT require approval by the Water Corporation.

2.8 Gas

Table 15 - Existing Gas Services Within the Forrestfield North Residential LSP Area

Are suitable gas services located adjacent to the site?		YES	
Pipe Diameter	Location	Approximate Depth	
100 PVC (1.5 MP 70kPa)	Milner Road	750mm below ground level	
155 PVC (1.5 MP 70kPa)	Sultana Road West	750mm below ground level	
50 PVC (1.5 MP 70kPa)	Smokebush Place	750mm below ground level	
100 PVC (1.5 MP 70kPa)	Brand Road	750mm below ground level	

2.9 Power

Existing power services are generally considered to be adequate for interim development to occur in the Forrestfield North Residential Precinct. All existing services noted below will need to be undergrounded as part of all development works, with key infrastructure in Sultana Road West, Brand Road, Brae Road, Raven Street and Milner Road to be undergrounded for consideration as part of a future DCP. For landholdings that front development sites within the Forrestfield North Residential LSP, it will be a WAPC Condition of Subdivision that the developer undergrounds existing overhead power.

Therefore undergrounding of existing overhead power should only be considered a DCP item where infrastructure identified in the DCP necessitates undergrounding, and the requirement is not otherwise required through the subdivision process.

KCTT have consulted electrical consulting firm UPD to discuss likely requirements for power for a development of this size and stature. The process will require consultation with Western Power as development applications commence. Because of the likely long lead time to full development, a planning process for expansion of power assets is not required at this early stage of the planning process. Western Power have recently preferred upgrading existing transformer / substation sites, as opposed to managing additional 1-hectare sites. It is highly likely that this approach will be used in Forrestfield North, due to the proximity of major infrastructure in the Perth Airport landholdings. Consideration may be given to upgrading trunk infrastructure between Forrestfield North and the nearest zone substations / feeders.

Table 16 - Existing Power Assets within the Forrestfield North Residential Area LSP

Existing Services Location	Underground/Overhead	Location	Type
Sultana Road West	Overhead	Opposite side to southern boundary of the precinct	HV, LV
Smokebush Place	Overhead	Development side of road reserve	LV
Brand Road	Overhead	Within the precinct, along Brand Road	HV, LV
Brae Road	Overhead	Within the precinct	HV, LV
Stewart Road	Overhead	Opposite to development side of road reserve (northern boundary)	HV, LV
Raven Street	Overhead	Within the precinct	LV
Milner Road	Overhead	Development side of road reserve	HV, LV

2.10 Telecommunications

The provision of telecommunications into the Forrestfield North Residential LSP area is deemed to be similar in nature to the upgrade provisions required for power as described in Section 2.11 above. The existing telecommunications system in Milner Road and that presently feeds Sultana Road West, Stewart Road, Brae Road and Brand Road is not suitable for the proposed full development of the Forrestfield North Residential LSP, however the network will be upgraded both internally and externally through trunk infrastructure improvements iteratively as development cells are completed within the LSP area.

The area will also be provided with NBN communications which will assist in the overall upgrade of the trunk infrastructure into Milner Road for both the Residential and TOD and AC Precincts.

Under WAPC Conditions of Subdivision, the developer will be required to provide open trenching and pay for cabling, pits, and road ducts to reticulate their proposed subdivisions. Therefore, adjustment of telecommunications services for all roads that front developable areas should generally not form an item funded under the future DCP.

Table 17 - Existing Major Telecommunication Assets in the Forrestfield North Residential LSP Area

	YES	If YES/NO nominate type (NBN / Velocity Fibre Optic / Standard Telstra Copper / Other) and location?	If NO, distance from site (m)?
Are existing underground services available and suitable for connection immediately adjacent to the site?	YES	Telstra (Milner Road)	N/A