CAVERSHAM LOCAL STRUCTURE PLAN

TRANSPORT ASSESSMENT
Caversham Local Structure Plan

Transport Assessment

Prepared for:
Western Corporate,
Lester Group and
Estate Development Company

June 2010

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## Document history and status

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<td>r01d</td>
<td>B Bordbar</td>
<td>10 June 2010</td>
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**File name:** t09.138.rw.r01d.doc

**Author:** R White

**Project manager:** B Bordbar

**Client:** Western Corporate, Lester Group and Estate Development Company

**Project:** Caversham Local Structure Plan

**Document version:** r01d

**Project number:** t09.138

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1.0 Summary

This Transport Assessment addresses the proposed Caversham Local Structure Plan (LSP).

Caversham is anticipated to accommodate around 2,240 dwellings, a primary school and a neighbourhood centre.

Staging of construction of the Lord Street extension south of Reid Highway is an important consideration for the implementation of the LSP. Timing will be determined by the capacity of West Swan Road to accommodate increasing traffic south of Reid Highway.

The LSP makes provision for future construction of a flyover at Arthur Street across Reid Highway, and for a future Activity Corridor along Patricia Street and Arthur Street in accordance with the Swan Urban Growth Corridor Sub Regional Structure Plan.

The proposed Activity Corridor will ultimately form the main public transport corridor within Caversham.

2.0 Introduction and Background

This Transport Assessment of the proposed Caversham Local Structure Plan (LSP) has been prepared by Transcore on behalf of Western Corporate, Lester Group and Estate Development Company.

A traffic report for the Caversham Structure Plan was originally prepared by Sinclair Knight Merz in November 2006. Following appointment of SKM to undertake work for the City of Swan in relation to the Urban Growth Management Strategy, Transcore assumed responsibility for traffic and transport planning work for the Caversham Structure Plan. Transcore provided a “preliminary update to traffic consulting advice” on 28 November 2006.

Transcore prepared a Caversham Structure Plan Traffic Report in November 2008. That report remained largely as written by SKM except where Transcore updated appropriate sections to reflect recent developments such as the Sub Regional Structure Plan for the Swan Urban Growth Corridor (draft May 2008).

Cardno Eppell Olsen have subsequently prepared the Caversham North Local Structure Plan Transport Assessment (October 2009) for QUBE Property Pty Ltd, which looks at the northwest precinct of Caversham.

This latest Transcore transport assessment report assesses the forecast daily traffic volumes resulting from the structure plan, recommends an appropriate
road hierarchy, intersection treatments, potential bus routes and pedestrian and bicycle routes.

3.0 Structure Plan Proposal

The location of the Caversham LSP area is illustrated in Figure 1, which shows it in its regional context within the Metropolitan Region Scheme.

![Figure 1. Site location](image)

Reid Highway forms the northern boundary and the future Lord Street alignment is along the western boundary. The Dampier-Bunbury Natural Gas Pipeline runs along the eastern side with West Swan Road further east and Benara Road just to the south of the LSP area.

The proposed Caversham Local Structure Plan is included at Appendix A of this report.
The LSP area comprises approximately 198 hectares, with some 140 hectares or 80% of the project owned by landowners participating in the Caversham Main Landowners Group (MLG). A neighbourhood centre and a primary school have been proposed along with medium to high density dwellings. The neighbourhood centre is to be located at the intersection of Patricia Street and Waldeck Road extension with higher density land uses proposed for the 400 m ped shed surrounding the centre. These land uses and densities are intended to promote alternative transport modes, such as walking, cycling and public transport. The proposed land uses are listed in Table 1.

Table 1. Proposed land uses for the Caversham Local Structure Plan

<table>
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<tr>
<th>Cell</th>
<th>No. of dwellings by residential density</th>
<th>Primary School (ha)</th>
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A detailed centre layout incorporating land use has not been completed at this time for the Neighbourhood Centre, though the City of Swan Commercial Centres Strategy indicates a size range of 3,500 m2 to 4,500 m2 Net Leasable Area for the Caversham Village Centre. A separate retail study has been completed for the Caversham Project, which considers external travel demand as well as internal travel demand and recommends the proposed village centre location. The catchment area for the primary school and the neighbourhood centre is largely within the area bound by Bennett Brook to the west, Reid Highway to the north, West Swan Road to the east and Benara Road to the south. For this traffic assessment it is assumed the Neighbourhood Centre is 4,000 m2 NLA and 600 students are assumed at the primary school.

The local structure plan makes allowance for the future construction of a grade-separated road link across Reid Highway at Arthur Street.

One particular transport issue raised by the City of Swan that is to be addressed in this report relates to the traffic impact on Bennett Street, located to the west of the LSP area, and the extent of construction of the Lord Street extension required for development of this LSP area.

Various other issues raised by the City of Swan, including making allowance for possible widening of the Lord Street Other Regional Roads reservation, are addressed within the proposed local structure plan.
4.0 Existing Situation

Existing land uses within Caversham are predominantly rural. There are a number of dwellings within this precinct mainly located along Arthur Street and Patricia Street.

The surrounding area to the north, east and south is similarly rural with a number of dwellings along Benara Road, West Swan Road and, north of Reid Highway, along Arthur Street, Victoria Road and Coast Road. Other land uses along these roads include two vineyards and Taylor Park on West Swan Road. There are three vineyards, the Ironbark Brewery, a Buddhist temple and Perth Holiday Park along Benara Road.

However, to the west of the future Lord Street alignment there is existing suburban residential development accessed by Bennett Street from Benara Road.

There are several existing primary schools in neighbouring suburban areas west of Caversham, all at least one kilometre from the site, and Caversham Primary School on Coast Road, approximately 600m north of Reid Highway. The closest secondary school is Lockridge Senior High School, approximately 2.5km to the west on Benara Road.

The closest existing shopping centre is Altone Park, located on Altone Road approximately 1.5km west of Caversham.

4.1 Existing road network

The Caversham LSP area is bordered to the north by Reid Highway and to the west by the future Lord Street. Benara Road (to the south) and West Swan Road (to the east) do not directly abut the LSP area.

4.1.1 Reid Highway

Reid Highway is classified as a Primary Regional Road (PPR) under the Metropolitan Region Scheme (MRS) It is managed by Main Roads Western Australia (MRWA). A design and construct contract was awarded in August 2008 for construction of a 2.6km dual carriageway for Reid Highway between West Swan Road and Great Northern Highway. This section should be completed by March 2010. The Department of Planning (DP) is finalising the final design for the section of Reid Highway from Lord Street to Great Northern Highway, which allows for a six-lane freeway with grade separated interchanges and provision for a public transport system in the median.

1 Source: Main Roads WA website:
4.1.2 **Benara Road**

Benara Road is reserved as an Other Regional Road (ORR) under the MRS. Benara Road is classified as a District Distributor (A) Road and is a two lane single carriageway in the vicinity of Caversham managed by the City of Swan. The existing four-way intersection of Lord Street and Benara Road to the west of the development site is roundabout controlled. A second roundabout has been constructed for the intersection of Benara Road and Bennett Street to the immediate west of the development area. The location of this roundabout will ultimately mark the connection of Benara Road with the Lord Street extension, which is reserved under the MRS.

4.1.3 **West Swan Road**

West Swan Road is reserved as an Other Regional Road (ORR) under the MRS. West Swan Road is classified as a District Distributor (A) Road and is a two lane single carriageway managed by the City of Swan. There is no dualling proposed for West Swan Road, however the road reserve width across Reid Highway provides for a future flyover, the timing and funding for which has not been established by MRWA or the City of Swan.

The intersection of Reid Highway and West Swan Road is traffic signal controlled. The T-junction of Benara Road and West Swan Road is priority controlled.

4.1.4 **Lord Street**

Lord Street is reserved as an Other Regional Road (ORR) in the MRS. The existing MRS ORR reservation provides for Lord Street to be ultimately connected from Guildford Road, Bassendean through to Reid Highway immediately adjoining the project area. Lord Street is currently constructed between Guildford Road and Benara Road, though the 1km section immediately south of Benara Road currently lies to the west and outside the MRS reserved alignment.

The Lord Street extension forming the western edge of the project area between Benara Road and Reid Highway is not yet constructed.

North of Reid Highway Lord Street is a District Distributor (A) road. It has been constructed as a two-lane single carriageway rural road with a priority controlled T-junction at Reid Highway.

4.1.5 **Arthur Street**

Arthur Street is not reserved under the MRS, excepting the section intersecting with Reid Highway where land is reserved as Primary Regional Road (PRR) for a future flyover. Arthur Street is classified as a Local Distributor managed by the City of Swan and has been divided into two segments by Reid Highway. There are no connections between the north and the south sections of this street. Because Reid Highway is a Controlled Access Highway there is no access between Arthur Street and Reid Highway.
4.1.6 Patricia Street

Patricia Street is not subject to any reservation requirements and is a two lane single carriageway Access Road managed by the City of Swan. It runs east-west through the area from West Swan Road to Bennett Street, with a short link in-between not yet constructed.

4.1.7 Bennett Street

Bennett Street is a two-lane single carriageway road with driveway access to abutting residential properties. It has roundabouts at both ends (at Benara Road and at Patricia Street), and also one more roundabout and one blister island traffic management treatment along its one kilometre length.

4.2 Existing traffic volumes

Existing weekday traffic volumes on the road network around the Caversham LSP area are shown on Figure 2. These traffic counts have been obtained from Main Roads Western Australia, apart from counts at the Bennett Street / Benara Road and Bennett Street / Patricia Street intersections undertaken by Cardno Eppell Olsen on Thursday, 4 September 2009.

In addition, the City of Swan has provided a March 2010 traffic count for West Swan Road that recorded an average weekday traffic count of 15,675 vehicles per day (vpd) on West Swan Road.
No existing counts are available for Arthur Street or Patricia Street within the LSP area but as there is little existing development the existing traffic volumes would be low.

4.3 **Existing public transport**

Bus route 337 services Lord Street to the west of the development and operates during the peak hours from Monday to Friday. Bus route 52 operates along Benara Road and route 63 has been extended to service the Bennett Brook Estate; however this is currently an infrequent service. Bus route 52 runs from Benara Road along West Swan Road (turning into Middle Swan Road), however this is also a very infrequent service.

Existing bus routes in this area are illustrated on Figure 3.

![Figure 3. Existing bus routes](image)

4.4 **Existing pedestrian and cyclist facilities**

The Perth Bike Map series published by the Department of Transport shows a Perth Bicycle Network route along Benara Road connecting to other routes in the suburbs west of Caversham. Arthur Street (both within Caversham and north of Reid Highway) and local roads north of the site are good road riding
environments. There are also bicycle lanes on sections of Reid Highway, West Swan Road and Lord Street in this area.

There are shared paths along West Swan Road, Benara Road and Bennett Street that link to other shared path networks particularly in the suburbs west of Caversham. There is also a shared path link across Reid Highway via an underpass west of Arthur Street that provides pedestrian and cyclist access from Caversham to West Swan north of Reid Highway as shown in Figure 4.

Figure 4. Existing cycling facilities

5.0 Proposed Internal Transport Network

5.1 Road Hierarchy
The hierarchy of roads within and adjacent to the Caversham LSP area is illustrated in Figure 5 using the road hierarchy defined in Liveable Neighbourhoods (2007).
Figure 5. Road Hierarchy
Indicative cross sections for typical roads within the Caversham development are provided in Appendix B.

**Access Streets**
Most minor access streets are proposed to have a 15m road reserve. These correspond to Access Street C and D in Liveable Neighbourhoods, the difference being a 7.2m carriageway for type C and 6m carriageway for type D access streets. An indicative cross section is provided in Figure B1, which represents the 7.2m carriageway version. The Access Street C will be used for streets adjacent to medium-density development (R30 and R40) and other access streets with volumes likely to exceed 1,000 vpd. The Access Street D (typical reservation of 14.2m) will be used for low volume (less than 1,000 vpd) streets adjacent to residential development of R20 or less. The dimensions of Access Street D will be in accordance with Figure 22 contained in Liveable Neighbourhoods 2007. Both allow for informal parking (staggered) on both sides of the street.

If more formal parking is desired on some type C Access Streets, the reserve will be widened to 16m, as shown in Figure B2. This will be determined at subdivision stage. Note that this cross section is a minor modification of a 16.5m Access Street B (Liveable Neighbourhoods Element 2 Figure 20 Note 3) for this lower order street.

A road reserve of 13m is proposed for most access streets abutting public open space (see Figure B3). The City of Swan has advised that it would only consider a 13m road reserve on access streets that abut public open space and also have no services on the verge of the POS, otherwise these access streets have to be 15m.

The Access Street B classification (typical reservation of 16.5 to 18m – see cross-section at Liveable Neighbourhoods Element 2 Figure 20) will be used for streets adjacent to high-density residential development (R60 and R80), schools, and shops. On-street parking will be highly utilised in these areas. A reservation width of 18m is recommended for Access Street B roads that may potentially form future bus routes. As an alternative to the Liveable Neighbourhoods cross-section an 18m road reserve could accommodate a 7m carriageway (allowing flexibility for future bus routes if required) and 5.5m verges with embayed parking. The appropriate cross-section will be determined at subdivision stage. The City has advised that it would only consider a 13m road reserve on access streets that abut public open space and also have no services (including street lights) on the verge of the POS, otherwise these access streets have to be 15m.

**Patricia Street**
The proposed Patricia Street 21.7m road reserve allows for indented parking adjoining activity and traffic generating land uses and the proposed 3.7m traffic lanes are appropriate for this future bus route. Figure B4 suggests an indicative cross section for Patricia Street and includes a median to allow for safe pedestrian crossings. The Caversham North Local Structure Plan Transport Review (April 2008) by Cardno BSD indicated that the central
median would be designed as a drainage swale and the City of Swan’s response to that report indicated a 5m swale would be accepted. Front lot access is considered acceptable given traffic volumes in the order of 5,000 vpd or less on Patricia Street.

**Arthur Street**

It is considered that a road reserve of 25 m for Arthur Street is sufficient to carry future traffic levels, including future traffic generated by the development north of Reid Highway, post construction of the Arthur Street flyover. Figure B5 suggests an indicative cross section for Arthur Street and includes a median for safe pedestrian crossing, cycle lanes, bus access, indented parking and shared use paths along both sides.

The City of Swan has advised that it is likely that Arthur Street will become a key public transport route in the future (hence the need to consider buses within cross section design) and cycle lanes and shared use paths are recommended to reflect its future importance in terms of north-south connectivity.

**Waldeck Road**

Figure B6 does not include cycle lanes and is proposed for Waldeck Road (20m reserve).

**Laneways**

In relation to the minimum requirements for the proposed rear laneways within the Structure Plan area, a minimum width of 6.0 metres (in accordance with Liveable Neighbourhoods) is acceptable to accommodate two-way movement and rubbish collection. Details relating to the design of these laneways will be addressed in more detail during the subdivision planning stages.

Visitor car parking (in a ratio of 1 bay per 2 lots) is to be constructed in the road reserve adjacent to proposed lots serviced by laneways.

**5.2 Public Transport**

In previous discussions with the PTA it has been suggested that a future bus route may operate from Bennett Street along the extension of Patricia Street towards West Swan Road.

However, it is not envisaged that the bus route will continue into West Swan Road. PTA has advised that a turning loop at the eastern end of Patricia Street would likely be required as right turning movements into West Swan Road are not desirable and also the patronage in this area does not justify a bus route along West Swan Road. This could be accommodated at a proposed roundabout on Patricia Street.

The road cross sections proposed under section 5.1 provide for bus access along Patricia Street. Bus access could also be accommodated within the road reserves proposed for Waldeck Road and Arthur Street.
Ultimately, if the Arthur Street flyover is constructed across Reid Highway and Patricia Street – Arthur Street becomes an Activity Corridor as proposed in the *Swan Urban Growth Corridor Sub Regional Structure Plan* then it is anticipated that bus services will also run along this Activity Corridor. The Sub Regional Structure Plan indicates that services from Ellenbrook to Morley and Ellenbrook to Bassendean, which currently use Lord Street, would operate along the Activity Corridor in future.

These future possible bus routes are shown in **Figure 6**.
Figure 6. Public transport
5.3 Pedestrian and Cyclist Facilities

Walking and cycling have an important role within the overall transportation system of an urban area. When integrated with compatible land uses, a strong walk/cycle network can:

- reduce private car dependency for residents;
- increase accessibility to employment and other urban activities for residents;
- reduce adverse environmental impacts of vehicular and motorised transport;
- increase resource efficiency in a multi-modal transport system; and
- reduce transport-related crashes or injuries.

The objective of a pedestrian and cycle network is to provide for the convenient and safe movement of pedestrians and cyclists through and between urban cells, having regard for the need to service schools, shops, recreation and other land uses as well as public transport access points.

The Caversham Structure Plan aims to maximise pedestrian and cyclist connections to the local and regional pedestrian/cycle network.

The neighbourhood centre and primary school can be easily accessed on foot from most of the residential lots in cells 1, 4 and 5. Pedestrian/cyclist movements between the cells within the structure plan area can be made along Patricia Street, Arthur Street and Waldeck Road. Local movements within the cell are readily facilitated by other local streets, which provide direct or indirect linkage to the three major streets namely Patricia Street, Arthur Street and Waldeck Road.

The proposed shared use path and footpath network shown in Figure 7. This plan also illustrates the connections to path networks outside the structure plan area.

It is proposed to accommodate on-street cycle lanes on Arthur Street as shown in Figure 7 to connect with the existing cycle lanes on Reid Highway and West Swan Road south of Arthur Street.
Figure 7. Path network
Provision has been made within the cross sections of Arthur Street, Patricia Street and Waldeck Road for a 2.5m shared use path along one side. A shared path is also proposed along three access streets that serve the neighbourhood centre, primary school and central public open space (POS). Another shared path is proposed along the linear POS between Patricia Street and Reid Highway to connect to the existing shared path north of Reid Highway as shown on Figure 7. The existing shared path on Reid Highway will be extended to Lord Street and a shared path will be included on the eastern side of the Lord Street extension abutting the development.

Footpaths should be provided along at least one side of all streets within the development, except very minor local access streets. These footpaths have a minimum recommended width of 1.5m.

The proposed pedestrian and cyclist network will provide efficient access to activity nodes such as the neighbourhood centre, as well as the primary school, public open space and public transport stops.

### 6.0 Changes to External Transport Network

#### 6.1 External Road Network

**6.1.1 Reid Highway**

Previous discussions with the former Department for Planning and Infrastructure (DPI) indicated that Reid Highway is proposed to be upgraded to a dual carriageway with the transit corridor to be relocated into the central median. This may result in an expansion to the south of the Reid Highway reserve by up to 10m. This potential land requirement is currently zoned as Urban Deferred in the Metropolitan Region Scheme (MRS) and the Caversham Structure Plan makes allowance for this potential future road widening.

**6.1.2 Lord Street**

Lord Street, north of Reid Highway, will form the start of the Perth Darwin National Highway (PDNH). This National Highway is reserved Primary Regional Road in the MRS.

Lord Street is planned to be relocated to the east of Bennett Street and the MRS in this area has provision for a grade separated interchange at this location. It is currently proposed as a standard diamond interchange with Lord St (connection to south) going over the top of Reid Highway. In the interim, it is likely to be signalised as part of the staging for the development of the road network. The extension of Lord Street south of Reid Highway is proposed but is not in the current construction program.

Ultimately, the southern end of the Lord Street extension will tie in to the existing roundabout at Bennett Street and Benara Road, although the City of
Swan has indicated that this intersection may ultimately be reconstructed as a signalised intersection.

Officers of the City of Swan have advised that Caversham developers will be required to construct the first carriageway of the Lord Street extension from Reid Highway to Benara Road.

6.1.3 Patricia Street

The City of Swan, DPI and Main Roads Western Australia (MRWA) have all previously indicated support for the future linkage of Patricia Street between the east and west. However, if the Lord Street extension is constructed in two stages, Reid Highway to Patricia Street and Patricia Street to Benara Road, connection of Patricia Street west of Lord Street would create an attractive through route via Lord, Patricia and Bennett Streets until the southern section of the Lord Street extension was completed. This is anticipated to attract more traffic onto Bennett Street (already carrying 2,000 to 4,000 vpd) than this existing residential street could accommodate. Two options are feasible. Either the Lord Street extension must be constructed all the way from Reid Highway to Benara Road in a single stage, or a Patricia Street connection west of Lord Street should not be provided for general traffic until the southern section of the Lord Street extension is also constructed.

The intersection control of the future Lord Street and Patricia Street intersection is discussed under section 8.4. Patricia Street is also part of a proposed Activity Corridor as discussed in section 6.1.5.

6.1.4 Arthur Street

An overpass across Reid Highway has been proposed to connect the northern and southern section of Arthur Street. Road reserve widths across Reid Highway are planned to provide for a future flyover, however there is no program for the timing or funding of a flyover at this stage.

Assuming construction of the northern section of the Lord Street extension as discussed above, the Arthur Street flyover is not considered crucial to the Caversham development in traffic terms. However it is considered desirable in terms of overall connectivity in the regional area in the longer term. Arthur Street is also part of a proposed Activity Corridor, as discussed in section 6.1.5, and the Arthur Street overpass is important for that Activity Corridor.

It is considered that the Arthur Street flyover is not required in the shorter term; however it has benefits for sub-regional connectivity and, as the general road network is still developing in the area, it is assumed that Arthur Street will be timed to fit into staged construction of the network in the longer term.

In many cases MRWA funds the construction costs for land reserved as a primary regional road in the MRS, as the land for this future flyover is, though funding details will need to be agreed between the developer, MRWA and the City of Swan.
6.1.5 Proposed Activity Corridor

The Swan Urban Growth Corridor Sub Regional Structure Plan (SRSP) prepared for the Western Australian Planning Commission (February 2009) proposes a future Activity Corridor through Caversham, West Swan (East) and Henley Brook (Albion).

The SRSP indicates that the Activity Corridor functions to service the neighbourhood centre destinations, rather than acting as a high-speed thoroughfare, with associated public transport and supportive land uses. This is in accordance with Network City principles”.

The proposed Activity Corridor runs along Patricia Street (connecting to the future Lord Street alignment at Patricia Street) and northwards along Arthur Street to cross Reid Highway.

The SRSP therefore says, “A flyover is required where Arthur Street crosses Reid Highway linking Caversham with West Swan and Albion. The Arthur Street flyover is critical:

- To ensure local connectivity allowing residents to travel north/south without being forced to use the busier intersections; and
- For bus services to operate effectively along the Activity Corridor."

6.2 Public Transport

Transperth’s Better Public Transport: 10-Year Plan 1998-2007 proposed a new transitway from Perth to Morley and north to serve developing areas such as Ellenbrook and Upper Swan (located to the north of the subject lands). The Metropolitan Region Scheme (MRS) has reserved an alignment for a rapid transit public transport service through Ellenbrook (from Maralla Road connecting with the Perth-Midland railway line) and along the east side of the proposed PDNH alignment and north of Reid Highway. There are currently discussions underway to extend the transitway east of the PDNH to run along Reid Highway in the central median of the future dual carriageway, as noted in section 5.1.1 above.

A transitway station is currently planned at the Reid Highway interchange with PDNH, to the northwest of the LSP area, and at the West Swan Road interchange with Reid Highway.

The future activity corridor along Arthur Street and Patricia Street would ultimately offer a high-frequency bus service through Albion, West Swan and Caversham.
6.3 Pedestrian and Cyclist Networks

As noted in section 5.3 the proposed shared use path and footpath network shown in Figure 7 illustrates the connections to path networks outside the structure plan area. This includes shared path links to the existing pedestrian underpass beneath Reid Highway west of Arthur Street.

It is also proposed to accommodate on-street cycle lanes on Arthur Street to connect with the existing cycle lanes on Reid Highway and West Swan Road south of Arthur Street.

7.0 Integration with Surrounding Area

The existing residential development along Bennett Street (west of Caversham) contains approximately 520 dwellings. Currently it only has access southwards via Bennett Street. Ultimately there will be a connection to Caversham via Patricia Street but timing of this link is discussed in section 6.1.3 above.

In terms of interaction between this Bennett Street area and the proposed development in Caversham it is most important that this link is available when the proposed neighbourhood centre and primary school are built.

Ultimately this link will meet the potential desire line for travel between this area and Caversham but in the interim the existing level of access by car will remain unchanged.

A shared path connection would also be constructed along the Patricia Street alignment to provide pedestrian and cyclist access between this area and Caversham.

There would also be future demand for travel between Caversham and the West Swan East structure plan area north of Reid Highway. Ultimately this would be served by the planned Arthur Street flyover across Reid Highway but in the interim this traffic movement would be via Patricia Street to Lord Street or West Swan Road.

Shared path links to the existing pedestrian underpass beneath Reid Highway west of Arthur Street already provide for pedestrian and cyclist movements between West Swan and Caversham. Future pedestrian and cyclist connections will also be implemented when the Arthur Street flyover is constructed.
8.0 Analysis of Internal Transport Network

8.1 Development trip generation and distribution

A trip is a one-way movement from an origin to a destination. A trip rate of 6 vehicle trips per dwelling per day (vpd) is considered appropriate for the higher density residential land uses R60, with 7 vpd per dwelling considered appropriate for the medium density residential land uses R30 and R40. For the larger transition lots in the buffer areas and for residential densities of R15, R20 and R25 a trip rate of 8 vpd has been applied. For the retirement village a trip rate of 3 vpd per dwelling is appropriate. This results in a total trip production from the residential land uses of approximately 15,300 vpd. However, it is estimated that approximately 25% of these trips would be to internal trip attractors such as the primary school and neighbourhood centre.

The neighbourhood centre and the primary school would attract approximately 4,800 and 1,200 vpd respectively. Most of the vehicle trips related to these two facilities would be characterised as drop off/pickup or shopping activities on the way to other destinations as a secondary trip purpose. It is estimated that 60% of the trips associated with the neighbourhood centre and the primary school will be internal trips (ie. trips originating from within the development area).

A sub area matrix from the MRWA model has been used to determine the internal/external trip distribution pattern. The vehicle trips generated by the proposed development are shown in Table 2.

Table 2 Forecast trip generation for the Caversham development

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<th>Cell</th>
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<th>I-E &amp; E-I trips per day</th>
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<td>3624</td>
<td>14110</td>
<td>1462</td>
</tr>
</tbody>
</table>

8.2 Through traffic
Through traffic movements are the external trips that are not generated by the proposed development but travel through the study area on the internal road network or surrounding roads.

Traffic generated by the proposed West Swan and Henley Brook (Albion) developments was evaluated by SKM for a September 2007 transport workshop for the Sub Regional Structure Plan for the Swan Urban Growth Corridor. This showed a through traffic flow of 7,000 vpd on Arthur Street from West Swan Road, through Caversham and across Reid Highway at the future Arthur Street flyover.

The SKM plan also showed future total traffic volumes on the surrounding major road network based on Main Roads WA transport modelling.

The SKM traffic flows only considered regionally significant road links in this area and did not take into account the future Patricia Street connection to Lord Street. Based on modelling undertaken for the West Swan East structure plan it is estimated that this through traffic flow of approximately 7,000 vpd at the Arthur Street flyover would be divided at Patricia Street, with around 2,000 vpd using the Patricia Street – Lord Street route to Benara Road and around 5,000 vpd remaining on Arthur Street between Patricia Street and West Swan Road.

### 8.3 Traffic flow forecast

The trips generated by the proposed Caversham development were assigned onto the road network to estimate the forecast traffic volumes on individual roads. Figure 8 shows this Caversham traffic assigned onto the existing road network (i.e. without the Lord Street extension, Arthur Street flyover or Patricia Street link). The traffic volumes generated by the Caversham development on the main elements of the internal road network are shown in Figure 8. Other local roads within this development have not been evaluated individually but can each expect less than 1,000 vpd.

Future total traffic volumes are not shown on Figure 8 as this is not a recognised long term scenario and no regional modelling is available that would correspond to it.

The ultimate scenario is shown in Figure 9, which assumes the Lord Street extension between Reid Highway and Benara Road has been constructed. As the planning authorities are adamant that the Arthur Street flyover will ultimately be constructed across Reid Highway this link has been included in the road network for this traffic assignment. The traffic assignment also includes the future extension and ultimate alignment of Lord Street between Reid Highway and Benara Road.

Inclusion of the Arthur Street flyover attracts less than 1,000 vpd of the traffic generated within Caversham so the volumes on the internal road network will generally not be significantly affected by the presence or absence of this link.
Future total traffic volumes on Arthur Street, Patricia Street and the surrounding major road network are shown in brackets in **Figure 9**.
Figure 8. Caversham traffic without Lord Street extension, Patricia Street link or Arthur Street flyover
Figure 9. Forecast daily traffic volumes
The proportion of future total traffic on the regional road network that is attributable to Caversham can be determined from Figure 9.

Lord Street is projected to carry up to 25,000 vpd adjacent to Caversham. Caversham will contribute 2,500 vpd (10%) on Lord Street between Reid Highway and Patricia Street, and 1,800 vpd (7%) on Lord Street between Patricia Street and Benara Road.

8.4 Roads and Intersections
The proposed road network to accommodate these traffic volumes has been detailed in section 5 of this transport assessment, including the details of the proposed road hierarchy in section 5.1 and proposed cross sections in Appendix B.

There are a number of 4-way intersections within the proposed structure plan, particularly along Arthur Street, Patricia Street and Waldeck Road. The majority of these are proposed as roundabouts as indicated in Figure 10. These roundabouts will have the benefit of functioning as traffic management devices to slow traffic and enhance road safety on these comparatively long roads.

There are also two four-way intersections on access streets within the LSP area that will be designed with suitable threshold treatments on the side roads to slow traffic and enhance road safety at these intersections.

There are a number of four-way intersections formed where laneways intersect access streets within the LSP area. These will be designed with suitable threshold treatments or use of a different paving material such as red asphalt or brick paving on the laneway to alert drivers to the presence of the intersection to reduce the potential for speed problems and enhance road safety at these locations.
Figure 10. Intersection treatments
8.5 Access to Frontage Properties

The WAPC Liveable Neighbourhoods requires that “Development along integrator B and neighbourhood connector streets with ultimate vehicle volumes over 5000 vehicles per day should be designed either so vehicles entering the street can do so travelling forward, or are provided with alternative forms of vehicle access. Wider lots with paired driveways and protected reversing areas in the parking lane may be used on streets with up to 7000 vehicles per day.”

Future traffic volumes will be greater than 5,000 vpd on Arthur Street and some sections of Patricia Street west of Arthur Street. Therefore, special consideration of vehicle access from properties abutting these roads is required.

The proposed structure plan indicates that residential development fronting the western half of Patricia Street will be medium density development served by rear laneways.

Development adjacent to Arthur Street north of Patricia Street is planned with access from other streets because the future embankments for the Arthur Street flyover will make direct access from this section of Arthur Street impractical.

Figure 9 shows that traffic flows of 7,000 vpd are forecast on Arthur Street south of Patricia Street within the LSP area. Therefore the guidance from Liveable Neighbourhoods quoted above offers another potential design solution for access to properties abutting this section of Arthur Street. The final decision on access strategy for properties along this section of Arthur Street should be resolved in consultation with the City of Swan at subdivision design stage.

8.6 Pedestrian / Cycle Networks

The proposed network of footpaths and shared use paths for pedestrians and cyclists is described in section 5.3 of this transport assessment. This network of paths will provide an excellent level of accessibility and permeability for pedestrians and cyclists within Caversham, and connections to neighbouring precincts at strategic locations.

There are several locations where there is anticipated to be strong demand for pedestrian and cyclist movements crossing the road network, which warrant further consideration. In particular these are around the school site and the proposed Neighbourhood Centre.

The WAPC Transport Assessment Guidelines for Developments (2006) provides guidance on the levels of traffic volumes that are likely to affect the ability for pedestrians to cross various types of road. Based on that guidance
an undivided two-lane road should be acceptable for pedestrians crossing traffic volumes of up to approximately 11,000 vpd and this threshold can be increased to around 28,000 vpd by adding a central median or pedestrian refuge islands. On a four-lane road, because of its greater carriageway width, this threshold is lower; even with a median island the threshold is only around 16,000 vpd.

Arthur Street is expected to carry up to 8,000 vpd through the LSP area. The proposed one traffic lane in each direction, with a central median, should therefore be satisfactory for pedestrians and cyclists to cross Arthur Street.

Patricia Street is expected to carry around 5,000 vpd adjacent to the neighbourhood centre and primary school site. At this level of traffic flow pedestrians should not experience difficulties crossing this proposed two-lane road. However, it would be appropriate to include pedestrian facilities (islands, pram ramps, grab rails, etc.) in the design of intersections near the proposed school site and neighbourhood centre.

Patricia Street is the main issue in terms of safe routes to schools within this area, so these pedestrian facilities are particularly important adjacent to the school site. Generally the structure plan provides a highly interconnected, grid based, road network with associated footpaths and shared path network providing very good access to the proposed school site. Location of additional pedestrian facilities on the roads adjacent to the school should be addressed at detailed design stage for the school site.

Reid Highway has forecast traffic flows up to 60,000 vpd ultimately. Pedestrian and cyclist movements across this highway will be facilitated by the existing underpass, future Arthur Street flyover, existing traffic signals at West Swan Road and future traffic signals at Lord Street. The latter, in particular, will assist future movements to the potential future transit station north of this intersection.

Lord Street west of Caversham is forecast to carry up to 25,000 vpd ultimately. However, as the Caversham structure plan only proposes construction of Lord Street between Patricia Street and Reid Highway to serve this development the traffic flows on this section of Lord Street will be much lower and will allow safe pedestrian movement to and from Caversham in this interim period. There is likely to be some pedestrian and cyclist demand between these two communities but this demand may not be high. It is recommended that this demand be surveyed on site at a future date as part of the design process for the extension of Lord Street south of Patricia Street when the decision is made to construct that section. This would determine whether the actual pedestrian and cyclist demand would warrant provision of particular pedestrian facilities as part of that construction project.

8.7 Access to Public Transport

At this stage of the structure planning process neither bus stop locations nor subdivision lot layout are known. However, in these circumstances the WAPC
Transport Assessment Guidelines for Developments (2006) suggest that it is desirable for at least 90 per cent of dwellings to be within 400m straight line distance of a bus route.

The future bus route is anticipated to run along Patricia Street as shown on Figure 6. The southern parts of the LSP area, representing about 20% of the residential lots, are 400 to 700m from Patricia Street. Given the future function of Patricia Street as part of the proposed activity corridor it is not likely that an alternative route further south would be chosen for the future bus route, so it may be necessary to compromise on the proportion of lots within 400m so that the efficiency and legibility of the proposed activity corridor bus service can be maintained. However, if it is determined in future that this 400m guideline must be enforced then Arthur Street and Waldeck Road, which are approximately 800m apart, would be able to accommodate future bus services to satisfy this guideline.

9.0 Analysis of External Transport Network

9.1 Traffic Volumes on External Road Network

The daily (weekday) traffic volumes generated within the Caversham structure plan on the surrounding road links are shown in Figure 9.

The WAPC Transport Assessment Guidelines for Developments (2006) suggests that traffic impact should be assessed on those parts of the surrounding road network where an increase of 100 vehicles per hour is generated on any traffic lane. As daily traffic volumes have been used in this transport assessment this threshold is converted to about 1,500 vpd (which assumes the peak hour is around 10% of weekday traffic with about two thirds of the traffic travelling in the peak direction).

From Figure 9 it can be seen that traffic volumes generated by the Caversham structure plan are expected to be higher than this threshold on Lord Street (adjacent to the site and south of Benara Road), Benara Road (Lord Street to Waldeck Road, West Swan Road (south of Reid Highway), Reid Highway (west of Lord Street), Middle Swan Road (east of West Swan Road), the eastern section of Patricia Street (to West Swan Road), the southern section of Arthur Street (to West Swan Road) and the southern section of Waldeck Road (to Benara Road).

Future total daily traffic volumes are shown in brackets on Figure 9. The source of these future daily traffic flow estimates is detailed in section 8.2 above.

Reid Highway and Lord Street are ultimately planned as dual carriageway arterial roads to accommodate the forecast total volumes of 60,000 and 25,000 vpd respectively. In comparison to these totals the traffic generated by the LSP area will be a relatively small component and easily accommodated on these arterial roads.
On Benara Road the future volumes of up to 11,000 vpd, including the traffic generated by the LSP area, can be accommodated on a single carriageway two-lane road. However, without the southern Lord Street extension (i.e. between Reid Highway and Benara Road) the interim traffic flows on Benara Road will be higher. Existing traffic flows of 12,000 vpd and 9,500 vpd west and east of Bennett Street, respectively, would be increased to around 13,000 -16,000 vpd in this interim scenario with full development of the Caversham structure plan. This is still within the capacity of a two-lane single carriageway road although the level of service would be relatively low (LOS D or E). This would not be desirable as a long-term outcome but should be acceptable as a short to mid term situation until the decision is made to construct the southern section of the Lord Street extension.

The situation on West Swan Road is more critical. Existing volumes of up to 15,600 vpd on the section north of Benara Road increased by an average of 660 vpd each year between 2003/04 and 2007/08. Capacity calculations in accordance with the Austroads Guide to Traffic Engineering Practice, Part 2, Roadway Capacity indicate that this existing two-lane single carriageway rural road could carry a maximum of 25,000 vpd, although it would be very heavily congested at this volume. Traffic flows on West Swan Road will ultimately be reduced when the Lord Street extension is constructed. However, without the Lord Street extension, the additional traffic from Caversham (shown in Figure 8) would increase total traffic demand on West Swan Road above this 25,000 vpd capacity before Caversham was fully developed. Therefore, the capacity of West Swan Road is a critical factor in the timing of the Lord Street extension. This issue will be addressed further in section 9.3 below.

Patricia Street and Waldeck Road, east and south of the LSP area respectively, will both carry around 3,000 to 4,000 vpd from the Caversham LSP area. A single carriageway two-lane road (7m carriageway) will be sufficient for these roads.

Arthur Street will ultimately carry up to 8,000 vpd south of the LSP area, however only 2,600 of this will be generated by development in Caversham. The rest will be through traffic from north of Reid Highway when the Arthur Street flyover is constructed. Future widening of the existing 20m Arthur Street road reserve to the 25m proposed through the LSP area is beyond the control of landowners in the LSP area. Therefore, for this section outside of the LSP area it would be more appropriate to omit the 5m median and embayed parking shown in Appendix B cross section E.

### 9.2 Intersections

Intersection treatments at several intersections surrounding the LSP area will be affected by traffic flows generated within Caversham.

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2 A March 2010 City of Swan traffic count recorded an average weekday traffic count of 15,675 vehicles per day (vpd) on West Swan Road.
The Reid Highway / Lord Street intersection will be signalised in conjunction with the Lord Street extension to Patricia Street to provide access to development in Caversham. Reid Highway / West Swan Road intersection is already signalised. Ultimately these Reid Highway intersections are planned as grade separated interchanges.

On the Lord Street extension the intersection with Patricia Street is proposed to be constructed as a roundabout. At Benara Road the future Lord Street extension will tie into the existing Bennett Street roundabout, although the City of Swan has indicated that this intersection will ultimately be reconstructed as a signalised intersection.

The Arthur Street / West Swan Road intersection will not operate satisfactorily as a priority controlled T-junction with the traffic flows generated by full development of Caversham. The Main Landowner Group is currently assessing the feasibility of installing traffic lights. This is the preferred treatment given that a roundabout will necessitate acquisition of land external to the structure plan area.

Similarly, the Waldeck Road / Benara Road intersection will also need to be upgraded. It is proposed to upgrade it to channelised intersection standard.

At the Patricia Street / West Swan Road intersection there is not anticipated to be very much demand for the right turn movement from Patricia Street to West Swan Road south as Arthur Street provides a more convenient route from most of the LSP area. Therefore this intersection will operate satisfactorily as a priority controlled T-junction although appropriate widening on West Swan Road is recommended to provide a right turn lane to avoid delays to southbound through traffic.

The Benara Road / West Swan Road intersection will ultimately need to be upgraded as a roundabout or signalised T-junction to accommodate future traffic flows.

### 9.3 Timing of Road and Intersection Upgrades

The City of Swan has requested that information be provided on the staging and timing of works on the external road network around the LSP area and has provided the following information that has already been established by the City:

- Completion of Patricia Street to the roundabout intersection with Bennett will occur at or before the equivalent demand* of 250
- Right-turn pocket at the intersection of West Swan Rd and Patricia St to occur prior to the equivalent demand* of 200
- Right-turn pocket at the intersection of West Swan Rd and Arthur St to occur prior to the equivalent demand* of 200
- When Development occurs outside of the early-release area (equivalent demand* of 106) Patricia Street is to be upgraded to rural
standard from the intersection of Patricia St & Arthur St through to West Swan Rd

*Equivalent demand is a unit defined for the DCP, which allows equitable apportionment on specific development outcomes.
  ▪ For a single residential lot; 1 lot = 1 equivalent demand
  ▪ For multiple or grouped dwellings; 1 dwelling = equivalent demand
  ▪ For other uses (commercial, light industry); 1 hectare = 22 equivalent demand

This definition of equivalent demand as supplied by the City will be used in the following analysis. In section 3 Table 1 indicates that the LSP area is anticipated to accommodate 1892 dwellings plus 350 retirement units and a 1.5ha neighbourhood centre. This equates to a total equivalent demand of 2275 units in the Caversham LSP area.

The proposed staging of road and intersection upgrades for the overall Caversham LSP area is illustrated on Figure 11 and detailed in the following sections.

**Figure 11. Staging of road and intersection upgrades**

**Patricia Street link to Bennett Street**
There is already an agreement between developers of the northwest section of Caversham (north of Patricia Street and west of Arthur Street) that Patricia Street is to be constructed to link to Bennett Street at or before an equivalent demand 250 units. Therefore this requirement is reflected in the proposed staging plan.
**Lord Street from Reid Highway to Patricia Street**
Officers of the City of Swan have advised that developers of the Caversham LSP area will be required to construct the first carriageway of the Lord Street extension (from Reid Highway to Benara Road).

As discussed in section 9.1 the capacity of West Swan Road (25,000 vpd maximum) is the critical factor that determines when the Lord Street extension must be constructed. Based on the current rate of traffic growth on West Swan Road and assuming development of Caversham over a ten-year period, it is anticipated that this capacity will be reached on West Swan Road (between Reid Highway and Patricia Street) when Caversham development reaches approximately 1660 units. Therefore, the section of Lord Street extension from Reid Highway to Patricia Street is required at or before the equivalent demand of 1660 units to provide an alternative route to Reid Highway for Caversham traffic and reduce demand on West Swan Road.

**Lord Street south of Patricia Street**
Traffic demand on West Swan Road between Arthur Street and Benara Road is anticipated to reach its capacity (25,000 vpd) when Caversham development reaches approximately 2100 units. Therefore, the section of Lord Street extension from Patricia Street to Benara Road is required at or before the equivalent demand of 2100 units to reduce demand on West Swan Road. However, as discussed in section 6.1.3, if the Lord Street extension south from Reid Highway stops at Patricia Street and Patricia Street already connects through to the Bennett Street roundabout it would attract more traffic onto Bennett Street than this existing residential street could accommodate. It is therefore necessary for the Lord Street extension from Reid Highway to Benara Road to be constructed as a single stage to avoid unacceptable traffic impact on Bennett Street. Therefore the first carriageway of the whole Lord Street extension from Reid Highway to Benara Road is to be constructed at or before the equivalent demand of 1660 units.

**Patricia Street west of West Swan Road**
Patricia Street is to be upgraded to rural standard from the intersection of Patricia St & Arthur St through to West Swan Rd at or before equivalent demand of 106 units, as specified by the City of Swan.

**Arthur Street northwest of West Swan Road**
As discussed in section 9.1, Arthur Street will only carry up to 2,600 vpd generated by the Caversham LSP area. This could be accommodated on the existing road until the traffic volume on this link increases when the Arthur Street flyover is constructed across Reid Highway. The timing of that construction is not linked to an equivalent demand and is therefore allocated to the fourth (final) stage of development of Caversham.

**Waldeck Road north of Benara Road**
The southern end of Waldeck Road is ultimately forecast to carry up to 3,600 vpd but this assumes the ultimate construction of the Lord Street extension south of Patricia Street. In the absence of the Lord Street extension Waldeck Road could potentially carry up to 6,100 vpd as shown in Figure 8. Road upgrading would be required by the time traffic volumes reach 3,000 vpd on Waldeck Road, which is approximately 49% of this total volume. Therefore upgrading of Waldeck Road is recommended at or before 49% of development of the LSP area, which equates to an equivalent demand of 1120 units. This upgrading should include construction of a two-lane approach on Waldeck Road at the Benara Road intersection as an interim improvement prior to the more comprehensive upgrade noted below.

**Reid Highway / Lord Street intersection**
The Reid Highway / Lord Street intersection will be signalised in conjunction with the Lord Street extension, which is indicated above at or before the equivalent demand of 1660 units.

**Patricia Street / Lord Street intersection**
When the Lord Street extension is constructed, which is indicated above at or before the equivalent demand of 1660 units, this intersection will be constructed as a roundabout.

**Lord Street / Benara Road intersection (currently Bennett Street / Benara Road roundabout)**
The City of Swan has indicated that this intersection will ultimately be constructed as a signalised intersection when the Lord Street extension from Patricia Street to Benara Road is constructed. Therefore, as discussed above for that road link, it is anticipated that it will be constructed at an equivalent demand of 1660 units.

**Patricia Street / West Swan Road intersection**
Right-turn pocket at the intersection of West Swan Rd and Patricia St to be constructed prior to the equivalent demand of 200, as indicated by the City of Swan.

**Arthur Street / West Swan Road intersection**
Right-turn pocket at the intersection of West Swan Rd and Arthur St to be constructed prior to the equivalent demand of 200, as indicated by the City of Swan.

SIDRA analysis indicates that a more comprehensive upgrade, such as a signalised T-junction, will be required when the Caversham LSP area is 25% developed, which equates to an equivalent demand of approximately 570 units.

**Waldeck Road / Benara Road intersection**
SIDRA analysis indicates that upgrading will be required when the Caversham LSP area is 64% developed (assuming Lord Street extension not yet
constructed), which equates to an equivalent demand of approximately 1450 units.

**West Swan Road / Benara Road intersection**
SIDRA analysis indicates that this intersection is probably already close to capacity. This is likely to become a critical issue when Waldeck Road is constructed through to Patricia Street because that will result in additional traffic turning right from Benara Road onto West Swan Road.

Discussions with City of Swan officers indicated that this intersection will be treated as an existing black spot and will be upgraded as soon as possible by the City of Swan. It is anticipated that the City will apply for Black Spot funding for this project.

### 9.4 Pedestrian / Cyclist Networks

The proposed network of footpaths and shared use paths for pedestrians and cyclists is described in section 5.3 of this transport assessment, including connections to neighbouring precincts. These external connections have been discussed in further detail in section 8.6.
10.0 Conclusions

The main findings of the transport assessment for the Caversham Structure Plan are outlined below.

- Traffic volumes in the order of 25,000 vpd are forecast for the proposed Lord Street extension.
- Traffic volumes of up to 17,000 vpd are forecast for West Swan Road ultimately but if the Lord Street extension is not constructed then West Swan Road volumes would exceed 25,000 vpd.
- Ultimate traffic volumes in the order of 3,000 to 4,000 vpd are forecast for Patricia Street to the west and in the order of 3,000 vpd to the east towards the intersection with West Swan Road.
- Ultimate traffic volumes of up to 3,600 vpd are forecast for the southern end of Waldeck Road.
- Traffic volumes less than 3,000 vpd are forecast for Arthur Street (without flyover), but this would increase to 7,000 to 8,000 vpd following future construction of the Arthur Street flyover across Reid Highway.
- The Arthur Street flyover is not considered critical to the Caversham development in terms of traffic flow or access, however it is considered desirable in terms of strategic planning for a future Activity Corridor and is reserved for construction under the MRS in the longer term.
- In accordance with an existing agreement between the City of Swan and developers in the northwest portion of Caversham, Patricia Street is to be constructed to connect though to Bennett Street in conjunction with the first 250 dwelling units in Caversham.
- Construction of the first carriageway of the Lord Street extension will be required before Caversham is fully developed, to avoid traffic demand on West Swan Road south of Reid Highway exceeding the capacity of this road. The Lord Street extension is proposed to be constructed between Reid Highway and Benara Road when Caversham is approximately 75% developed (1660 equivalent units).
- Appropriate timing for other road and intersection upgrading has also been identified in this report.
- The pedestrian network is intended to provide direct and legible access within the development and to major land uses such as the neighbourhood centre and primary school.
- It is proposed that on-street cycle lanes be provided on Arthur Street to connect to the existing external cycle network.
- Shared paths are to be provided on one side of Arthur Street, Patricia Street and Waldeck Road and several other access streets serving the neighbourhood centre and primary school. A shared path will also be provided along linear open space between Patricia Street and Reid Highway to connect to an existing shared path at Reid Highway. The existing shared path on Reid Highway will be extended to Lord Street and a shared path will be included on the eastern side of the Lord Street extension abutting the development.

- Current access to public transport in the Caversham development area is relatively low, with the general area serviced by three separate routes operating during peak hour only. The PTA has advised of the potential for a future bus route to operate along the extension of Patricia Street (not connecting into West Swan Road).

- Ultimately, if the Arthur Street flyover is constructed across Reid Highway and Patricia Street – Arthur Street becomes part of an Activity Corridor as proposed in the Swan Urban Growth Corridor Sub Regional Structure Plan then it is anticipated that some Ellenbrook bus services will also operate along this Activity Corridor.
APPENDIX A

CAVERSHAM LOCAL STRUCTURE PLAN
CAVERSHAM LOCAL STRUCTURE PLAN

General

1. The City of Swan Local Planning Scheme No. 17, Council policies and Residential Design Codes apply except where they are specifically varied by the Local Structure Plan (LSP) as detailed below. All development, including subdivision shall generally be in accordance with this LSP.

Interim Mushroom Farm Buffer

2. Subdivision, as envisaged by the LSP, shall not be permitted within the interim mushroom buffer as delineated on the LSP.

3. Within the secondary buffer area Council shall require an appropriate notification on new titles advising of potential factors associated with the mushroom farm.

4. The above requirements may be reviewed where:
   a) The mushroom farm activity ceases operation; or
   b) A study, satisfactory to the Environmental Protection Authority EPA, demonstrates that sensitive uses may proceed within the area without being impacted upon by potential odour emissions; or
   c) The manner of operation of the farm changes and it is demonstrated to the satisfaction of the EPA that potential odour emissions no longer impact upon sensitive uses.

Staging of Subdivision

5. Subdivision, as envisaged by the LSP, shall generally be in accordance with the staging plan accompanying the LSP.

6. In relation to stages 3a & 4a, subdivision as envisaged by the LSP shall not proceed until a management plan is prepared and implemented to the satisfaction of Council and the Western Australian Planning Commission.

7. The above requirements may be reviewed where Council and the Western Australian Planning Commission are satisfied that residential subdivision may proceed within the area without being impacted upon by adjoining agricultural activities.

Detailed Area Plans

8. For areas designated R30 and above, including aged person accommodation in Cell 2, Detailed Area Plans (DAP) should be prepared, prior to subdivision, detailing the following as applicable to the given area:
   a) Dwelling orientation
   b) Laneway access
   c) Setback variations
   d) Passive surveillance of public open space
   e) Noise attenuation
   f) 132kv line Patricia Street (East of Arthur Street)

9. Prior to subdivision, a DAP shall be prepared for the Neighbourhood Centre which encourages future development to address the following:
   a) Active street frontages
   b) Pedestrian amenity
   c) Building heights
   d) Passive surveillance of primary school

10. Within the four hundred metre catchment of the neighbourhood centre, provision shall be made for the establishment of home businesses. The requirement only applies to DAP areas with frontage to Patricia Street and Waldeck Road. The provisions shall address the following:
   a) Building design
   b) Car parking
   c) Plot ratio and density bonuses
   d) Use permissibility
   e) Notification on title

11. Prior to subdivision within the transition lot management area, a DAP shall be prepared and implemented which satisfactorily ameliorates potential emissions from adjoining agricultural activities.
APPENDIX B

INDICATIVE CROSS SECTIONS
B1
- Minor access road
- Standard single lots
- No cycle lane
- Informal parking (staggered)
- Low traffic volumes

Cross sections are indicative only and will be subject to consultation with approval authorities at detailed design stage.

B2
- Minor access road
- Alternative cross-section to ‘A’ where more formal parking is desired.
B3
- Minor access road abutting P.O.S.
- Parking one side
- No cycle lane
- Low traffic volumes
- No services including street lights on the side of the POS

B4
**Patricia Street**
- Neighbourhood Connector A
- Indented parking
- No cycle lanes
- Shared path on one side
- Median is drainage swale
- Lane width accommodates buses

Cross sections are indicative only and will be subject to consultation with approval authorities at detailed design stage.
**B5**

**Arthur Street**
- Future Integrator B
- Indented parking
- Cycle lanes
- Shared path on one side
- Right turn pockets in median
- Lane width accommodates buses
- City of Swan advice is 3.7m traffic lanes on bus routes and 3.5m traffic lanes can be considered where buses are not proposed*.

*Section 5.3 of the PTA Design & Planning Guidelines for Public Transport Infrastructure - Traffic Management & Control Devices states, “The minimum standard width for a lane carrying buses is 3.5m to allow the operation of bus services.”

**B6**

**Waldeck Road**
- Neighbourhood Connector B
- Indented parking
- No cycle lanes
- Shared path on one side

Cross sections are indicative only and will be subject to consultation with approval authorities at detailed design stage.