DAYTON

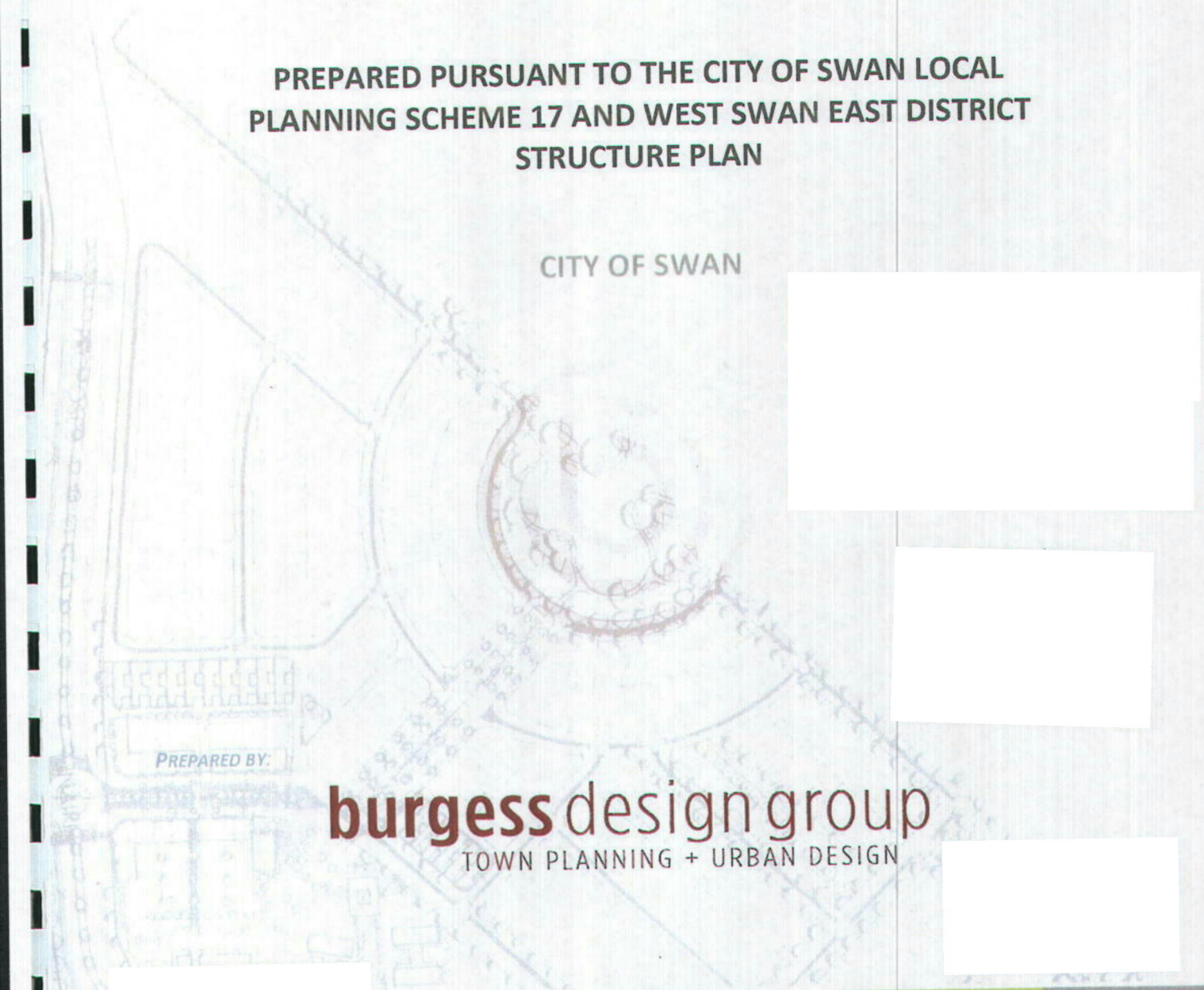
LOCAL STRUCTURE PLAN 1

VOLUME NO. 1

(MAY 2015)

PREPARED PURSUANT TO THE CITY OF SWAN LOCAL PLANNING SCHEME 17 AND WEST SWAN EAST DISTRICT STRUCTURE PLAN

CITY OF SWAN



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TOWN PLANNING + URBAN DESIGN

DAYTON

CITY OF SWAN

LOCAL STRUCTURE PLAN 1 FOR CELL 1

Issue 4: May 2015

PREPARED PURSUANT TO THE CITY OF SWAN LOCAL PLANNING SCHEME
17 AND WEST SWAN EAST DISTRICT STRUCTURE PLAN

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File reference: 150526RLGA_LSP1 - Dayton Structure Plan 3 Modification (Revision 4)
Revision No: 4

ENDORSEMENT

This structure plan is prepared under the provisions of the City of Swan Local Planning Scheme No. 17

IT IS CERTIFIED THAT THIS STRUCTURE PLAN WAS APPROVED BY RESOLUTION OF THE WESTERN AUSTRALIAN PLANNING COMMISSION ON:

14 March 2012

In accordance with Schedule 2, Part 4, Clause 28 (2) and refer to Part 1, 2. (b) of the *Planning and Development (Local Planning Schemes) Regulations 2015.*

Date of Expiry: 19 October 2035

TABLE OF AMENDMENTS

Amendment No.	Amendment Summary	WAPC Endorsed Date
1	Modification to include the Narrow Lot Innovation Precinct to allow for a minimum lot size of 144m2	08 October 2012
2	Modification to remove the 500m mushroom farm buffer and textual alterations to reflect its removal.	03 October 2013
3	Modification of structure plan area to include Lots 580, 581 and 582.	12 October 2015

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EXECUTIVE SUMMARY

The Dayton Local Structure Plan No.1 (LSP 1) was initially commissioned by Aspen Living for approval pursuant to the provisions of Schedule 4 'Special Use – West Swan' zone of the City of Swan Local Planning Scheme No.17 and the West Swan East Structure Plan for the broader Dayton area.

The LSP 1 encompasses approximately 66.32ha of land in a south-west corner position of the suburb of Dayton (previously known as West Swan), east of Lord Street and north of the Reid Highway, in what is known both as 'Dayton' (previously West Swan East) and 'St Leonards Estate'. The ultimate objective of the LSP 1 is to facilitate the creation of a range of urban land uses, being predominantly residential, and development within a coordinated planning framework. The intended land uses within LSP 1 are partly guided by the associated Sub Regional and District Structure Plans and the approved subdivision applicable to a significant portion of the site and includes:-

- Approximately 844 residential lots achieving approximately 1187 dwelling units at a range of densities;
- A 3,000m^2 'Special Use – Community' site;
- Protection of a site of Aboriginal heritage significance within public open space;
- 4 areas of public open space; and
- An integrated transport network.

The Dayton LSP 1 has been prepared in consultation with a consulting project team, both in the context of the preparation of the District Structure Plan and now at the refined local structure plan level. These consultants include:-

- Traffic;
- Environmental;
- Ethnographic;
- Odour;
- Contamination;
- Noise;
- Acid Sulfate Soils;
- Hydrology;
- Fire and Emergency Management;
- Community & Economic Development;
- Commercial Centres Analysis; and,
- Landscape Management.

A copy of the consultant reports and findings, as relevant, are included within the body text and/or appendices of this LSP 1 report if not previously applicable and included within the advertised and adopted District Structure Plan for Dayton. The District Structure Plan should therefore be read in conjunction with this report for a more comprehensive and broader appreciation to the background technical analysis which has lead to the creation of LSP 1.

This Local Structure Plan has been modified to include Lots 580-582 Lord Street. This land previously formed part of the LSP3 area and contained a site earmarked for use by Western Power, which has subsequently become surplus to its requirements. The inclusion of this land in LSP1 provides a seamless integration of residential uses across LSP1 and the former LSP3 area. It also recognises the distinction between the proposed residential and service commercial uses of the former LSP3 area, and the tailored planning approaches they require. It should be noted that the process of modifying this LSP involved inputs from the appropriate experts in the form of addendums to technical appendices and technical notes, these are included as appendices.

Once endorsed, this Local Structure Plan will dictate the statutory zoning and reservations as well as the Residential Design Code applicable to individual land holdings and shall form the framework for landowners to proceed towards subdivision and development in a well planned and logical manner. The LSP 1 will also enable the relevant government agencies to assess such future proposals in a coordinated fashion, noting that an Early Release Subdivision was previously approved over a portion of the site through the State Administrative Tribunal.

1.0 INTRODUCTION

1.1 Overview

This Local Structure Plan (LSP) report was initially prepared on behalf of Aspen Living to formally recognise the previously approved subdivision and corresponding density allocation and facilitate the further subdivision and development of the balance of the LSP 1 area. This modification to LSP 1 has been prepared on behalf of St Leonards Estate Pty Ltd, through its Project Manager, Progress Developments.

The modified LSP 1 area, being generally bound by the Reid Highway, the Primary Regional Road Reserve (former Perth-Darwin Highway), Cranleigh Street and Arthur Street within the suburb of Dayton (previously known as West Swan), is known and referred to as 'Dayton Local Structure Plan 1' and marketed as 'St Leonards Estate' and forms an important expansion area of the Perth Metropolitan Area.

This Local Structure Plan has been modified to include Lots 580-582 Lord Street. This land previously formed part of the LSP3 area and contained a site earmarked for use by Western Power, which has subsequently become surplus to its requirements. The inclusion of this land in LSP1 provides a seamless integration of residential uses across LSP1 and the former LSP3 area. It also recognises the distinction between the proposed residential and service commercial uses of the former LSP3 area, and the tailored planning approaches they require. It should be noted that the process of modifying this LSP involved inputs from the appropriate experts in the form of addendums to technical appendices and technical notes, these are included as appendices.

The proposed modification is critically important in continuing to deliver a diverse lot product to the market in a timely manner. It is proposed to commence development immediately on the approval of the modification to LSP 1 and subsequent subdivision application.

The philosophy and technical background associated with the layout of the proposed LSP 1 is described in detail herein.

1.2 Background

Dayton (or West Swan East as it was referred to previously and is referred to still in earlier planning documentation) has been earmarked for urban development in the Metropolitan Region Scheme for many years, having been rezoned to 'Urban' from 'Urban Development' in 2002 and rezoned from 'Rural' to 'Special Use' under the City of Swan Local Planning Scheme No. 17 in 2008. Both zonings enable development for a range of urban uses subject to the appropriate structure planning and background investigations as relevant to the site.

Given that Dayton is part of a larger future development area stretching from Albion in the north to Caversham in the south and West Swan (West) to the west, a Swan Sub-Regional Structure Plan was prepared, advertised and subsequently endorsed in early 2009. This Structure Plan then guided the key land use components and framework for the greater area, ensuring that the more detailed planning continued to progress in a coordinated manner. This included the West Swan East District Structure Plan preparation which reflected the recommendations of the Sub-Regional Structure Plan.

The West Swan East District Structure Plan was advertised during late 2009 and early 2010 and subsequently adopted by Council in April 2010 and endorsed by the WA Planning Commission in February 2011, providing the direction for the preparation of this LSP.

Alongside of the structure planning processes sits an 'Early Release Stage One Subdivision' approved by the State Administrative Tribunal after a negotiated process involving various government agencies to facilitate the release of some much needed housing lots within a self contained, unconstrained and well serviced corner of Dayton and as guided by the Sub-Regional Structure Plan. The outcome of which is the construction of lots within a portion of the LSP 1 area as is evident on the Site Analysis Plan at **Figure 3**.

2.0 SUBJECT AREA

2.1 Location

The subject Dayton LSP 1 land parcel is located approximately 20 kilometres from the Perth CBD and 8 kilometres from the Midland Regional Centre on the north side of the Reid Highway and accessed from off Lord Street via the road pavements of Marshall Road and Cranleigh Street and a new roundabout south of Marshall Road, with access also available from within Dayton via the existing road networks of Arthur Street, Victoria Road and Coast Road (refer to Location Plan at **Figure 1**).

2.2 Locality Context

The subject site forms part of a greater developing sub-region within which a district shopping centre, district educational facilities, district sporting facilities and an integrated transport network is planned. LSP 1 is strategically sited towards the centre of the Sub Region with Albion proposed district facilities to the north, the developing West Swan West on the western side of Lord Street, Caversham future development area to the south of Reid Highway, and the balance of the Dayton future urban development to the east. The Swan Sub-Regional Structure Plan at Figure 6 illustrates the context of the subject site within the broader planning for the Sub Region and the distribution of key land uses proposed within this Region.

Beyond the developing Sub Region lies the Swan Valley to the east, Ellenbrook district facilities to the north, Morley Regional Centre to the south-west, Malaga Industrial Area to the west and the Swan Valley rural area further to the east, within which numerous tourism and employment opportunities exist. Also, the Midland Regional Centre to the south-east which caters for a greater diversity of commercial, employment, entertainment and tertiary educational needs.

Collectively, these surrounding areas provide a diversity of local employment opportunities within easy reach of future residents via the existing road and bus network as well as satisfying shopping, educational, tourism, entertainment and lifestyle needs of the community beyond that proposed to be catered for within the LSP itself.

2.3 Land Ownership

The majority of the LSP 1 area is owned by St Leonard's Estate Pty Ltd, with some of the approved subdivision lots owned by St Leonard's Estate having been advertised for sale to the public as single residential blocks.

To date, the current ownership within LSP 1 is summarised within **Figure 4**.

2.4 Current Land Uses

The LSP 1 area comprises rural residential type uses reminisce of its previous semi-rural status, as is evident in the Orthophoto at **Figure 2** as well as progressive construction of residential lots. The existing road networks of Cranleigh Street, Lord Street, Marshall Road, Coast Road, Victoria Road and Arthur Street can also be seen on the orthophoto. The subdivision approval and subsequent approval to commence subdivision construction over St Leonard's Estate Pty Ltd owned land south of Marshall Road has resulted in a change to land uses in recent time, creating residential lots generally ranging from 250m^2 to 600m^2 as well as some larger grouped housing lots and three areas for future public open space and one vacant lot for a Community Purpose site.

2.5 Site History

The LSP 1 now including Lots 580-582 have previously been cleared and grazed and converted to predominantly rural residential and rural lifestyle uses, including some low intensity agricultural activities in a 'hobby farm' type scenario with a number of homes constructed throughout the subject area.

As the planning process has progressed towards urban use, and as the St Leonard's Estate Pty Ltd purchased land in the area over the past 5 years, the land has gradually been vacated ready for residential subdivision, the exception being a couple of homes which have continued to be occupied and may likely continue to be into the future.

3.0 SITE ANALYSIS

A Site Analysis Plan is included at **Figure 3** to assist in summarising the following key land use opportunities and constraints.

3.1 Environmental

In accordance with the provisions of Schedule 4 of the City of Swan Local Planning Scheme No.17, a full Environmental Assessment Report applicable to the subject land and extending to the full district was included within the appendices of the associated West Swan East District Structure Plan and should be read in conjunction with this report. A list of these documents that may be found within the District Structure Plan document is as follows:

- A Local Water Management Strategy;
- An Environmental Assessment Report;
- A Wetland Management Plan (incorporating mosquito management plan);
- A Field Ambient Odour Impact Assessment Study;
- A Noise Impact Assessment;
- A Preliminary Acid Sulfate Soils Investigation Report;
- A Preliminary Contamination Investigation Report; and,
- A Cultural Heritage Report.

These environmental reports and management plans more accurately identify key land capability opportunities and constraints within the subject land, the features of which then impact on the LSP 1 planning are identified on the Site Analysis Plan contained at Figure 3 and summarised below:

- Noise attenuation requirements stemming from the adjoining Primary Regional Road Reserves;

- Previous uses, generally agricultural and storage in nature, have resulted in some evidence of contamination on properties which then requires further investigation or some level of remediation;

- Preliminary acid sulfate soil investigations has revealed there is the potential for acid sulfate soils to exist within locations across the LSP 1 area which then require further investigation or the preparation of management plans at the subdivision stage(s);

- No significant remnant vegetation or rare or threatened species of flora or fauna requiring protection were identified within the LSP 1 area. Similarly, the only wetland related vegetation was located outside of the subject LSP 1 area, separated from the site by the existing road pavement of Arthur Street;A Local Water Management Strategy has been prepared and endorsed over the greater district, identifying drainage catchment areas, drainage requirements (volumes and general locations) required for accommodating the intended urban development. The endorsed LWMS has therefore guided both the extent of the LSP 1 and the general location, distribution and use within the nominated public open space areas.

- At The request of the City of Swan a revision to the LWMS was completed by JDA, July 2012. Favourable comments have been received from the City of Swan, Department of Water, and Swan River Trust and the report will shortly be consolidated and submitted to the City.

Additionally, a mushroom farm, with an associated 500 metre buffer precluding any residential development, and a 1000 metre notification area was formerly located on Lot 52 Victoria Road, West Swan. In 2012 a legal agreement was reached between the owner of the mushroom farm, and the Lester Group, Aspen and Qube (being the main developers in the area) to cease operation of the mushroom farm, and place a restrictive covenant on the Certificate of Title. As such, the notations and provisions associated with this buffer are hereby deleted from the DSP.

These environmental investigations and environmental constraints have not revealed any features that then prevent the site from being developed for urban purposes in accordance with the LSP 1 land use allocation now proposed, subject to consideration and relevant conditions as may be appropriate.

3.2 Servicing Infrastructure

A servicing strategy plan is included at Figure 8 to summarise and supplement the information provided in Section 5.9 of this report. In addition, an engineering servicing report prepared by Tabec is included within the LSP 1 documentation at Appendix 1. The key existing servicing features applicable to the LSP 1 area are summarised as follows:

- Existing 330KV powerlines within a 70m wide easement parallel to the south side of the Marshall Road reserve bisects the LSP 1 site and constrains development;

- Existing 132KV above ground powerlines are located along the western side of the Arthur Road pavement between Reid Highway and Marshall Road, partially within the road reserve. These powerlines then continue westwards along the south side of Marshall Road, with extensions to the existing network proposed along the public purposes reserve adjoining the Primary Regional Road Reserve. The powerline easement along Arthur Street will impact (not significantly) on residential lots fronting Arthur Street;

- Reticulated water is available to the area with extensions and upgrades already occurring as part of the current subdivision construction works;

- The subject land is not historically connected to reticulated sewer and as such the initial Early Release subdivision works has had to extend and upgrade services from the south, with a current limit of 500 lots capable of being serviced;

- A 350mm steel high pressure gas distribution pipeline is located parallel to the southern side of the Marshall Road reserve, consistent with the 330KV powerline easement. The gas main has an impact on any construction or excavation works proposed within 15m of this pipeline;

- Alinta Gas has recently installed a gas Pressure Reduction Station on the south western side of the intersection of Marshall Road and Arthur Street enabling the local area and future lots to be serviced by reticulated gas; and,

- The LSP 1 area is already serviced by a normal telecommunications network with extensions readily capable of being achieved as part of any future subdivision works.

3.3 Movement Network

Existing access points, road reserves and pavements are also notated on the Site Analysis Plan and are incorporated into the preparation of the LSP 1 plan with required upgrades and district and neighbourhood connector extensions addressed in more detail in section 5.7 of this report and in the associated Traffic Impact Assessment Report contained at Appendix 2.

The key existing road and movement features are summarised as follows:

- Access to the LSP 1 area is currently available via the existing north-south and east-west aligned roads of Lord Street, Cranleigh Street, Arthur Street, Coast Road and Victoria Street, all of which are proposed for retention in a modified form (some road reserves widened and some reserves deleted) but all upgraded from their previous rural status;

- A Primary Regional Road is reserved under the Metropolitan Region Scheme along the LSP 1's western boundary, access to which is constrained and as yet unfinalised;

- Arthur Street currently ends in an unconstructed cul-de-sac head but has been identified and reserved for conversion to a 'fly-over' (bridge) across the Reid Highway to connect Dayton with Caversham in the south, the timing of which is not known;

- Marshall Road has been identified as connecting to West Swan (west) in the longer term. The details of intersection and road treatments is being reviewed;

- Through the approval of the Early Release Subdivision, formal controlled access via a round-about on Lord Street, south of Marshall Road, has been designed and constructed as the primary access to the southern portion of LSP 1 in the interim;

- Access onto the adjoining Reid Highway to the south of the subject land is not available other than via the current intersection at Lord Street;

- The LSP 1 area is surrounded by other development cells and future road networks, consideration to this and their respective anticipated timeframes is required so as to facilitate appropriate short, medium and longer term transport arrangements;

- An existing public bus route exists down Lord Street to service the local area;

- A 'Public Purposes Reserve' intended to accommodate a public transport route of some description is included within the Metropolitan Region Scheme reservation to the west of LSP 1, with a possible public transport station nominated generally near the existing Lord Street/Reid Highway intersection;

- There is a general lack of footpaths and dual use paths within and adjoining the subject area other than those already approved as part of the subdivision works for the 'Early Release' subdivision within LSP 1.

4.0 PLANNING CONTEXT

4.1 Metropolitan Region Scheme

The Metropolitan Region Scheme (MRS) is the statutory land use planning scheme for the Perth metropolitan region. The principal functions are to reserve and zone land and control development on reserved and zoned land. The MRS reflects the agreed strategic direction for land within the metropolitan region and is a catalyst for changes to planning controls at the local level and subsequent local area planning.

The entire subject area is zoned 'Urban' and has been zoned as such since 2002. The proposed development of the LSP 1 area, as is the balance of the Dayton district, is consistent with the 'Urban' zoning, refer **Figure 5A**.

The adjoining MRS 'Primary Regional Road' reservations applicable to the Reid Highway and the former Perth-Darwin Highway alignment help to form the logical boundary to the LSP 1 area whilst also defining where access to (none directly from LSP 1) and across (being two future flyovers, one at Marshall Road and another at Arthur Street) the highways may be achieved in the interim and the future.

4.2 City of Swan Local Planning Scheme

The City of Swan Local Planning Scheme No.17 (LPS 17) zones the Dayton district site 'Special Use – West Swan' within which the LSP 1 is situated (refer **Figure 5B**). The relevant objectives and Scheme provisions are included within Schedule 4 of the Scheme text and guide both the preparation of the District Structure Plan (DSP) as well as this Local Structure Plan and subsequent local structure plans.

This LSP 1 has been prepared in accordance with both the generic Scheme provisions relating to structure plan sites and also Schedule 4 - the objectives of the Special Use zone as detailed further below in Table 1.

Table 1: LPS 17 Special Use Provisions

	Objectives of Special Use Site No.11	**Structure Plan Achieves Objectives By:**
1.	To ensure that development in the estate achieves optimal integration with development in surrounding area;	Ensuring consistency with Swan Sub-Regional Structure Plan and Swan Urban Growth policies and guidelines. Consultation with adjoining developers during the plan preparation stages also assists in achieving integration particularly from a road connection and servicing point of view.
2.	To provide for the development of a functional and cohesive community consistent with the orderly and proper planning and in the interest of the amenity of the Estate;	The Local Structure Plan has been prepared in accordance with Liveable Neighbourhoods and other planning principles to achieve a well-planned design in the best interests of the resulting Estate, ultimately aiming to create a cohesive community.
3.	To develop the Estate in a manner that protects, conserves and enhances the natural environment and cultural assets and to investigate and manage impacts upon the natural environment;	The background investigations have identified environmental features requiring protection or enhancement which have been suitably acknowledged and protected within both the District Structure Plan and now also the LSP 1 as relevant.

4.	To encourage variety in the range of lot sizes and dwelling types within the Estate but consistent with cohesiveness;	The DSP identifies a broad category of low, medium and high density residential land uses, within which a wide spectrum of dwellings, including aged and dependant persons dwellings, single residential dwellings, lower density lifestyle lots, grouped housing and multiple dwellings may be accommodated. The LSP is consistent with the DSP and now further refines the variety of lot sizes by designating a range of specific R Codes.
5.	To enhance the Estate with the provision of open space and recreation networks and facilities with particular attention being given to the timely provision of appropriate community services;	Four public open spaces and a 0.3ha Community Purpose Site are nominated within LSP 1 in the context of the other POS areas proposed on the DSP. Three of the four areas of POS have previously been granted approval through the subdivision process, the exception being the southern end of the lineal POS, though this reflects the local water management strategy and heritage findings. The 4th and most northern POS was not previously identified in the DSP and is discussed in the LSP1 Report.
6.	To make provision for school sites and other appropriate education facilities within the Estate in a manner that facilitates their management and use as a resource for local communities;	A large (one and a half size) primary school is nominated within the Sub Regional and District Structure Plans at a size and location as negotiated with the Department of Education and Training. No further school sites exist or are proposed within the LSP 1 area. It is noted that the Swan Christian School originally intended to develop a private school within the LSP 1 boundary, however this is no longer the case and the intended site is now proposed for residential development.
7.	To provide appropriate retail and commercial facilities to service the needs of residents of the Estate and with a view to the integration of retail areas with other commercial and business areas and with social services so as to maximise convenience;	A local neighbourhood commercial centre is identified in a central and well accessed position adjoining the first stage of development of the estate to cater for daily retail and some commercial/business needs of the Estate in accordance with Council's commercial strategy. This retail site is part located within LPS 1, along the Activity Corridor and Marshall Road/Arthur Street intersection. The balance of the retail site is located within abutting LSP 2A.
8.	To provide retail and commercial centres, business parks and service areas to satisfy the need for such services within the Estate and to provide local employment opportunities; and,	The LSP excludes any retail or commercial sites in accordance with the adopted DSP land use allocation.
9.	To employ strategies and design aimed at optimising accessibility to the local centre and future public transport node(s) by the use of comprehensive movement networks and by other means which will facilitate connection with public transport and arterial road links to Midland, Perth and other parts of the Metropolitan Region.	The DSP centrally located the local neighbourhood centre and 'Activity Corridor' to maximise accessibility and encourage walkable catchments, supported by adjoining medium densities. The LSP 1 proposes some medium near the neighbourhood centre as well as higher densities and direct road connections towards and adjoining what may be a future public transport node in the south-west of the LSP site. The intention is that the road reserve containing the 330KV powerline, once landscaped and pathed shall also assist in directing pedestrian and cyclists from the east and west directly to the local centre.

The Dayton district is also included within 'Development Contribution Area 2' (DCA 2) of LPS 17 which requires a 'Development Contribution Plan' to be prepared in accordance with Schedule 13 of the Scheme, this matter is addressed in the District Structure Plan report via a Financial Assessment Report included in the final adopted version of the West Swan East District Structure Plan and more recently in a draft Development Contribution Plan currently being prepared for the DCA 2 area as also discussed in section 7 of this report.

4.3 Sub-Regional Structure Plan

The City of Swan and the Department of Planning, in consultation with key landowners and other government agencies, prepared and advertised a Sub-Regional Structure Plan for the Swan Urban Growth Corridor, being land located generally between Midland and Ellenbrook in the suburbs of West Swan, Caversham and Albion, all surrounding the subject area.

The Sub-Regional Plan is a strategic planning document designed to guide the coordinated growth and development of the Swan Urban Growth Corridor to ultimately accommodate over 30,000 new residents plus associated community, commercial, open space and infrastructure land uses.

The Sub-Regional Plan contains the following key features of relevance to the LSP 1 area:

- An 'Activity Corridor' connecting Albion district centre to Caversham in the south via the Arthur Street flyover across the Reid Highway, is to run through the heart of West Swan and forming the eastern boundary of the subject area, with medium/higher residential densities, public transport and home based business opportunities encouraged along the Corridor;

- One local neighbourhood centre centrally located along the Activity Corridor is to be provided within Dayton, immediately east of LSP 1;

- A predominance of residential land uses across the LSP 1 area achieving a net residential density of 22 dwelling units per hectare;

- Recognition of the existing power easements and setbacks (as required) and need for extensions to the 132KV powerlines;

- Recognition of the possible future transit station towards the intersection of Reid Highway and Lord Street associated with a possible future public transport corridor; and,

- An integrated traffic management study across the Sub-Region, confirming road networks and hierarchy as proposed, including an upgraded intersection in the interim for Marshall Road (west) and Lord Street, also acting as the entry to LSP 1 from off Lord Street.

The above has formed the basis for progressing the planning, traffic management, infrastructure provision and land use allocation within LSP 1 and across the greater district.

4.4 District Structure Plan

As required by LPS 17, a District Structure Plan (DSP) for Dayton was prepared and advertised for public comment during December 2009 to February 2010, was adopted by Council subject to modifications in April 2010 and is anticipated for final endorsement during mid 2010. The DSP broadly guides the land uses across all of Dayton, ensuring coordination of district matters such as drainage, road connections, schools and employment opportunities.

The DSP also nominates local structure plan cells, predominantly based upon drainage catchments, existing street networks and logical boundaries for ease of future planning. LSP 1 is one such cell and within which the broad land uses (including public open space), key road networks and infrastructure corridors are already defined.

This LSP report and plan remains consistent with the DSP particularly in terms of:

- Extent of LSP coverage;
- Allocation of nominated residential densities;
- Location and areas for public open space and drainage;
- External and internal road network, including opportunity for future flyovers;
- Provision for a 'Special Use – community' centre;
- Provision and access to an adjoining 'Activity Corridor';
- Provision for a landscaped corridor for the existing 330kv powerlines which does not form part of a POS function; and,
- Recognition of a possible longer term public transport node and a land use plan which provides access to it and flexibility.

In relation to Lot 582 Lord Street, the DSP identified the majority of the site as SPECIAL USE - INFRASTRUCTURE SITE and stated that the Special Use - Infrastructure site may be required for a 2 ha power substation site. In the event agreement is reached for an alternative location, this site is designated for low density residential. Western Power has confirmed that this site is no longer required. We have however, reviewed the designation of the site to include a range of densities rather than just low density residential. Given the passage of time since the preparation of the DSP, the LSP including a range of densities provides a better reflection of the density and housing choice sought in Dayton.

4.5 City of Swan Urban Growth Policies

In response to the State's significant existing and projected levels of population growth and the *Network City* document, the City of Swan has prepared and adopted an Urban Growth Policy package, incorporating the 'Urban Growth Policy', the 'Neighbourhood Planning Policy', 'Environmental Planning Policy' and the 'Community and Economic Planning Policy'. In summary, these policies contain objectives for Structure Plans within the Swan Urban Growth Corridor (relating to Dayton) including (though not restricted to):-

- Responding to the social and economic needs of the Community;

- Encouraging innovation and best practices in urban design and environmental management;
- Taking a partnership approach with government, non-government and other landowners in the Urban Growth Corridor in respect to land use and water management;
- Providing choice and affordability in housing;
- Creating safe and convenient access;
- Encouraging an identifiable sense of place;
- Minimising the impact on the natural environment;
- Minimising energy, infrastructure and water costs; and,
- Ultimately ensuring that the urban growth contributes to sustainable urban communities.

The LSP 1 helps achieve the above objectives in that it:-

- Facilitates a range of permeable transport movements (car, bus and possible future rail) through appropriate road widths, gridlike street networks, appropriate road hierarchy, provision for future public transport, and regular cell blocks ultimately allowing for a well connected and surveilled local street network;
- Identifies a range of housing densities achieving a net dwelling density well exceeding the Urban Growth Policy minimum of 22 dwelling units per hectare, with medium and higher densities closer to public open space, future public transport nodes and the local commercial centre with convenient access for all dwellings to key destination facilities and parks;
- Accommodates infrastructure retention, upgrades and extensions which will cater for the anticipated growth with drainage infrastructure to encourage stormwater retention;
- Proposes a design which depicts a good level of integration with neighbouring planning, predominantly through the road network, land use allocation, infrastructure provision and environmental (including groundwater and drainage) analysis.

Also in accordance with the 'Planning for Urban Growth' requirements of the Policy, the LSP 1 is premised on the engineering, ethnographic, community and economic development, financial reporting commitments, fire and emergency access information and environmental management strategies and plans prepared at the District Structure Plan stage, with additional landscape management, traffic management and refinement of servicing provided within the LSP documentation.

In this regard the Dayton LSP 1 is consistent with the suite of Urban Growth Policies and their specific objectives and requirements applicable to structure plan preparation.

4.6 Liveable Neighbourhoods

Liveable Neighbourhoods is a state-wide development control policy to facilitate the development of sustainable communities. It provides an integrated planning and assessment policy for the preparation of Structure Plans and subdivision designs and represents an alternative performance-based approach to conventional subdivision policies.

The Local Structure Plan presented within this report adopts the principles of *Liveable Neighbourhoods* policy and should be assessed against the objectives and requirements of each of the *Liveable Neighbourhoods* design elements.

Liveable Neighbourhoods promotes a number of key principles for creating a vibrant and sustainable community. These principles include the following and are embodied in the elements of the Liveable Neighbourhoods document:

- Walkability;
- Site responsive design;
- Safety and Surveillance;
- Neighbourhood Structure;
- Efficiency.

The LSP has been designed with these principles in mind by helping recognise a support a future neighbourhood centre to the east; by ensuring lots are orientated to encourage passive surveillance and appropriate solar orientation; by creating clear and appropriate neighbourhood connector street blocks; a distribution of public open space; plus ensuring residential densities appropriately reflect the broader neighbourhood structure and responds to the sites' opportunities and constraints.

4.7 Early Release Subdivision

As part of the Sub-Regional Plan preparation process, an agreement was reached to provide for what is known as an 'early land release program' as a means of assisting in the timely production of a supply of residential lots to cater for the current population growth of the Perth Metropolitan Region. The Sub-Regional Structure Plan contains criteria for determining the area, extent and planning process of land suitable for the early land release program.

An early release subdivision application for the Aspen owned south-west quadrant of Dayton (within the LSP 1 boundaries) was prepared and approved through the State Administrative Tribunal process in accordance with the Sub-Regional Structure Plan criteria in advance of the District Structure Plan process. The early release subdivision covered an area of 23.73ha (as shown on the Site Analysis Plan at Figure 3) of which 18.57ha has contributed to the cost contributions associated with the Developer Contribution items (ie excludes reserved land and balance lots). Any subsequent land releases however, were not to be supported until the District Structure Plan and the relevant Local Structure Plan is approved, as such, this LSP 1 is being pursued to facilitate the subdivision of the balance of this south-west quadrant.

The LSP reflects the agreed land use allocation and road and path network approved within the early land release subdivision, ensuring full coordination between that now proposed and that previously approved.

5.0 LOCAL STRUCTURE PLAN

The 66.32ha of land contained within the Dayton LSP 1 is intended primarily for residential development, serviced with three previously agreed areas for public open space, a community purpose site, an 'activity corridor' forming the eastern boundary of the site and a significant infrastructure corridor bisecting the site.

The broad allocation of land uses as reflected on the LSP 1 plan is described in more detail in the following table and sub-sections.

Table 2: Land Use Summary

Land Use	Total Area
Special Use - Community Purpose site	0.30 ha
Public Open Space (excludes community site)	5. 16 ha
Western Power Easement	2.20 ha
MRS Regional Road Reserve	1.78 ha
Low Density Residential (R20)	4.55 ha
Medium Density Residential (R30)	14.98 ha
Medium Density Residential (R40)	11.87 ha
Medium Density Residential (R60)	1.55 ha
High Density Residential (R80)	3.72 ha
Nett Residential Area (excludes roads, reservations, easements & POS)	**46.11 ha**

5.1 Structure Plan Vision

The LSP 1, being part of the overall DSP, seeks to create an urban environment where a strong sense of community is forged and where the physical, social and mental health of that community can be encouraged and sustained.

The urban environment facilitated by the LSP is based on a logical and permeable network of streets, partially already defined by the existing road reserves and Reid Highway, and which combine with the public open space and proposed landscaped powerline corridor to create a pleasant walking/cycling environment within the cell and towards destinations external to the LSP. Emphasis has also been placed on ensuring integration with the other future LSP areas so that once constructed, the LSP is not a standalone estate but part of a larger community and larger suburb.

Creating a site offering a wide range of housing diversity, ultimately assisting in improving the vibrancy and economic viability of any future public transport node to the south-west, Activity Corridor to the north and east, and local commercial centre to the east, was of significant importance and hence, within a relatively small area, a full range of residential densities is proposed.

5.2 Residential Areas

5.2.1 Lot Pattern

The Structure Plan is comprised of a large range of residential densities ranging from low density (R20) single residential allotments through to higher density (R60 and R80) housing sites. Lots overall have been orientated such that they would provide effective surveillance of (and achieve an effective relationship with) public/community areas such as the streets, existing bus stops down Lord Street, future public transport routes and local parks, both within and abutting the subject area.

The lot pattern, including the proposed additions of Lots 580-582 is generally based on a traditional grid network and utilises the existing road alignments to maximise the number of east/west or north/south lots for best attempts at climate responsive design, whilst also facilitating a highly permeable and legible street layout which protects views through the site and towards the local commercial centre to the immediate east. A range of route alternatives are therefore presented to residents as a result of the lot pattern and street network.

Of the medium density single residential lots (the R30 and R40 coded sites) emphasis is placed on narrower lot dimensions to allow opportunities for cross ventilation in the built form with rear laneways offered in some instances so as to reduce the impact of garages dominating the streetscape, particularly along key roads and opposite public open space.

The higher density lot sites, R60 adjoining the entry boulevard and R80 in the south-west, have been placed to reinforce the future public transport route and node and create the opportunity for an estate identity as viewed from the two major highways. The balance of the medium and higher density sites have also been strategically placed overlooking public open space to offer additional amenity to future residents, where access to public transport shall be higher and to support the future 'Activity Corridor' and local commercial centre, though with variety added across the cell so as not to create an enclave of density or monotony.

5.2.2 Housing Products

The LSP primarily intends to provide the opportunity for family sized homes generally at R20, R30 or R40 densities, with some strategically placed grouped housing sites suited to smaller families or single people in the form of smaller single residential cottage lots and a grouped housing opportunity next to the Activity Corridor.

The R60 and R80 sites provides the opportunity for either grouped or multiple dwellings, such as a town house, unit or apartment style homes which may be attractive to those future residents seeking a lower maintenance or more affordable housing product and within which onsite shared facilities such as swimming pools may be offered. The street layout however still allows for these sites to also be developed for single residential purposes, particularly in the interim whilst transport and commercial opportunities are not yet developed.

Also aimed at achieving variety in housing form is the inclusion of a provision on the LSP which allows for R20 coded corner lots to be developed at an R30 density if desired. A maximum lot area of 750m^2 has been inserted to avoid the complete amalgamation and re-subdivision of several lots to form the one 'corner lot'. The intention in allowing such a provision is to allow flexibility by landowners to consider developing their low density corner lots as duplex developments, with each dwelling then expected to achieve street frontage.

Three corner lots on St Leonards Boulevard have been identified as R40 in recognisition of the sites proximity to local amenities including open space. This will further assist with the diversity of the lot and dwelling product.

5.2.3 Future Lot Yield

The following table provides a summary of the estimated residential yield of the LSP and confirms the achievement of Table 6 of the District Structure Plan whereby a minimum of requirement of 981 dwelling units (being 90% of 1090 estimated total) is to be provided for within LSP 1. Similarly, this yield exceeds the Western Australian Planning Commission and City of Swan objective of achieving a minimum of 22 dwelling units per nett hectare of residential land.

Table 3: Residential Lot Yield Analysis

Lot Type	Density Code	Average Lot Size as per R Codes	Indicative Average Lot Size	Estimated Lot Yield	Estimated Dwelling Yield	Total Area (nett)
Low Density Residential	R20 (R30 corner lots)	450m^2	550m^2	83	83*	4.55 ha
Medium Density Residential	R30	300m^2	450m^2	333	333	14.98 ha
Medium Density Residential	R40	220m^2	250m^2	475	475	11.87 ha
Medium Density Residential	R60	150m^2	200m^2	60	77	1.55 ha
High Density Residential	R80	120m^2	170m^2	152	219	3.72 ha
TOTAL YIELD					**1187**	**36.67 ha**

** This yield estimate does not include the opportunity for corner R20 lots to be developed at R30 density.*

The above calculations indicate that a good range of housing products shall be made available and equates to an average housing density of 36 dwelling units per nett hectare of residential land if developed generally at its ultimate capacity, including high density sites.

5.2.4 Population

Based on an average (Australian Bureau of Statistics) household size of 2.53, the LSP 1 area could result in a residential population of approximately 3,003 persons, a figure which will help improve the vibrancy of the locale and ensure a good number of families are located in short walking distance to a range of future services and facilities. It is noted however that the real population figure for LSP 1 may likely be less than the average or less than in other adjoining local structure plan cell areas, given the LSP1 comprises a significant portion of the site where smaller dwellings are proposed and therefore where the average household size may only be 2 persons or fewer.

5.2.5 Detailed Area Plans

The intention is for Detailed Area Plans (DAP) to be prepared for portions of the LSP as is determined relevant at the subdivision stage, primarily the rear lane accessed lots, lots directly fronting POS, R40 or R80 single residential areas where lots are anticipated at less than 260m^2 in area and lots which are subject to noise attenuation requirements. The DAP's within areas subject to noise attenuation are required to detail quiet house design measures (to achieve the recommended internal noise levels of AS 107:2000 or equivalent) and in the case of two storey development the need for any further acoustic assessment as per the Lloyd Acoustics report (September 2009), and subsequent Lloyd George Acoustics report (February 2015) contained at **Appendix 7**.

DAP's are also proposed for the R80 sites immediately adjoining the proposed 'Possible Future Transit Station' site so as to ensure an appropriate interface between the two land uses ultimately results. Such DAP(s) are likely to require addressing:

- Orientation;
- Interface with adjoining POS (if relevant);
- Interface and access to public transport stops or entry points (if relevant);
- Setbacks;
- Surveillance and designing out crime principles;
- Pedestrian permeability;
- Access and egress;
- Noise;
- Robustness in design if not immediately developed at its maximum density potential;
- Integration with other residential and non-residential uses.

The DAP sites notated on the LSP 1 Plan does not however negate the opportunity for the City of Swan to require a DAP to be prepared as a condition of subdivision of the R60, R80 or other lots if subsequently considered appropriate.

In general, DAP's will ultimately assist in addressing more detailed matters such as setbacks, surveillance from the home, air circulation, car parking, solar access, fencing and built form so as to ensure a high quality and well planned dwelling layout ultimately results on each lot, contributing to sustainable streets and the estate.

5.2.6 Additional Uses

An additional use is a land use that is permitted on a specific portion of land in addition to the uses already permitted or permissible in the zone that applies to the land.

Additional Uses apply to Lots 300 & 301 Cranleigh Street and Lots 581 & 582 Lord Street. These lots may be used for the specific use or uses that are listed below, subject to the City of Swan exercising its discretion by granting planning approval, in addition to any other uses permissible within the Residential zone under the Local Planning Scheme Zoning Table:

" Temporary Car Park" *means premises used for a limited period of time for parking vehicles open to the public and incidental to the sale of land and dwellings in new residential estates but does not include any part of a public road used for parking, or any premises in which cars are displayed for sale.*

"Residential Sales Office" *means a building of either a temporary or permanent nature, and incidental car parking, used directly in relation to the sale of land and dwellings in new residential estates.*

"Home Centre" *means a group of two or more dwellings and incidental car parking which are intended to be open for public inspection as examples of dwelling design."*

The above land uses are designated under this Local Structure Plan and apply to the land within it as if the definitions were incorporated into the Scheme.

5.3 Public Open Space

5.3.1 Objectives

The objective of the POS provision was never simply to meet the statutory requirements, but rather to create an estate based upon the following aims:

- Integration of internal and external living in a legitimate attempt to encourage healthy outdoor recreation;
- Increasing passive interaction opportunities with other residents as a means to address social isolation and improve mental health;
- Provide safe and attractive movement networks that are not solely reliant upon car ownership and within the context of anticipated destinations (such as the future transit node and local commercial centre);
- Accommodate drainage in a usable landscaped manner to create an amenity for residents as well as allowing for natural nutrient stripping and infiltration processes to occur;
- Protect Aboriginal heritage within POS;
- Encourage maximum surveillance of POS areas to discourage opportunities for criminal activities;
- Recognition of proposed land uses and POS locations and types external to the subject area as also depicted on the DSP; and

- Provision of some variety in the POS types and sizes in acknowledgement of the likely diversity of family types and needs resulting from the proposed density and cell structure.

5.3.2 Distribution

The POS is distributed across six areas and generally reflective of the POS sizes and distribution allocated in the adopted DSP. with the inclusion of Lots 580-582 there are now two areas of POS are allocated north of Marshall Road Located on Lot 582 is an area of approximately 5000m2 of POS and drainage.

The largest and most central POS is located so as to offer a recreational, landscape and drainage function adjoining a community purpose site and neighbourhood centre so as to create a hub of activity and identifiable node for the locality. The lineal POS is located so as to reflect the agreed position and width of an Aboriginal heritage site whilst also offering a landscaped route towards the public transport node and amenity for the higher density sites. The most southern POS abuts the Reid Highway and distributed so as to retain drainage on site whilst again offering an amenity and buffer for those residents closer to the Highway.

The POS distribution ensures Aboriginal heritage protection; opportunity for revegetation alongside a degraded drainage line; creates a lineal POS linkage for walking and cycling towards the future public transport node and a link towards the future local neighbourhood shops; enables drainage to be accommodated in a sustainable and usable recreational manner; and provides recreation opportunities within a 200m walk for all residents.

The POS distribution equates to a total Gross area of POS of 5.6ha for parkland. Some of the POS also offers a drainage function which is not then included in the contribution towards POS, as is also summarised in 5.5.3 below. As a result, the total area of POS which has been granted credit is 4.66ha (or 7.56% of the subdivisible area/gross residential area) within LSP 1.

5.3.3 Function

The six different POS areas each offer a different function, some with a variety of functions within the one POS. The Landscape reporting included at **Appendix 3**, as prepared by consulting landscape architects Emerge, best explains the variation in function, summarised below.

In addition to the recreational function, all six of the POS areas offer a drainage component, the specific calculations of which have evolved in consultation with the consulting project engineers and landscape architects.

These POS areas and the resultant usable credit confirm that each POS constitutes a Neighbourhood Park in accordance with *Liveable Neighbourhoods* and that whilst they accommodate drainage these drainage areas would add to the overall functionality of the POS areas by adding a focus and contributing to the landscaping.

Table 4: Public Open Space Summary

LSP1 POS SCHEDULE - TABLE 1			
LSP1/references/	141010_LSP1 POS Schedule.xlsx	ha	ha
	Gross Area		
	LSP 1	66.3200	
A	**TOTAL**		**66.3200**
	Less Environmental/Ecological Considerations		
	Non Creditable open area's (1:1 drainage)	0.6100	
	Non Creditable open area's (Wetland Core)	0.0000	
B	**TOTAL**		**0.6100**
C	**NET SITE AREA (A-B=C)**		**65.7100**
	Non-Residential Deductions		
	Special Use - Community	0.3306	
	Transmission Corridor - Power	2.1999	
	MRS Regional Road Reserve	1.5746	
D	**TOTAL**		**4.1051**
E	**Net Subdivisible Area (C-D=E)**		**61.6049**
F	**10% Requirement (10% of E = F)**		**6.1605**
	POS Requirement		
G	Minimum 80% Unrestricted Open Space (80% of F=G)	4.9284	
H	Maximum 20% Restricted Open Space (20% of F=H)	1.2321	
	POS Provided		
U	Total Unrestricted Open Space (T)		3.4250
V	Total Restricted Open Space (S)		1.5700
W	Creditable Restricted Open Space (to a max H)		1.2321
X	**Total Unrestricted + Creditable Restricted POS Provided** (U+W)		**4.6571**
Y	**Total Unrestricted POS + Creditable POS** (U+W as a %)		**7.56%**
Z	**Surplus POS Area** (X-F)		**-1.5034**
Z1	Gross POS (I)		**5.6050**
Z2	Gross POS /Gross Area (I/A)		**8.45%**

5.3.4 Implementation

10 per cent of the subdivisible area (as defined by WAPC policy) of each development site is required to be ceded free of cost at the time of subdivision, alternatively, a cash equivalent to the land value can be paid. A condition of subdivision approval is usually imposed to enforce this requirement. The District and Local structure planning processes then become the frameworks for guiding the location, distribution and function of POS areas so that the community ultimately obtains a variety of accessible, logical and well planned parklands. As some landowners have no allocation of POS within their current landholdings and others have in excess of 10 per cent, the Development Contribution Plan then becomes the mechanism for cost sharing and reimbursement, implemented by the City of Swan.

In implementing the LSP 1 POS areas, it is noted that the LSP 1 plan nominates locations of POS areas with further details given in the POS Schedule (Table 4). While the credit percentage of POS in LSP 1 is less than 10% of the gross subdividable area of the LSP 1 area, this is acceptable given the extent of POS is generally consistent with the endorsed West Swan East District Structure Plan. The implementation of individual POS areas is required to also abide by the following principles:

a) The subsequent accreditation of a particular POS is subject to design and landscape concept plans, demonstrating its function and usability for recreational purposes to the satisfaction of the City of Swan;

b) Where residential lots abut public open space, a footpath (or an alternative that encourages casual surveillance) is to be provided reasonably near the common boundary on the POS, to the satisfaction of City of Swan officers;

c) Public Open Spaces are to be designed using hydro zoning principles; and,

d) Developers will be responsible for maintaining public open spaces in accordance with Council policies (a period between two and five years) and rectify any design faults during this time.

5.4 Special Use – Community Site

5.4.1 Location

A 3,000m^2 community purpose site, zoned as a Special Use site, is proposed within the LSP 1 area, towards the intersection of Marshall Road and Arthur Street, the location of which is located in accordance with the Council resolution on the associated District Structure Plan.

Its location is alongside the proposed Activity Corridor (and probable future public transport route), opposite the local commercial centre, opposite an area for active public open space uses and adjoins the existing powerline corridor, the benefits of which include:

- Provision for the future community building to help form a ‘main street’ style community and shopping precinct down the Activity Corridor;

- The encouragement of a community hub consisting of passive and active recreation, retail and commercial uses, public transport and bike routes, opportunities for public art and/or quality streetscape treatment and formal community activities within the community site;

- Provision for ease of access via private car, bus, bicycles and pedestrians via the gridlike road network, the path within the powerline corridor, the Activity Corridor and the proposed path network;

- Provision for overflow car parking within the existing powerline corridor during community events; and,

- Relatively centrally located within the broader district and sub-region, allowing ease of access to those outside the LSP 1 and Dayton District boundary.

5.4.2 Function

A 335m^2 facility (approximately), compliant with the City of Swan's Community Building Design Guidelines is intended for the proposed 3,000m^2 site. The balance of the site shall likely be made available for car parking, landscaping, pedestrian accessways and possibly other community uses or longer term expansion associated with the main building. Ideally the use of the site shall assist in creating a neighbourhood feature and add to the function of a key destination or 'hub' for the district.

The site also offers a public open space function and contribution to POS credits as allowed for in accordance with WAPC Development Control Policy and as previously agreed with Council.

5.4.3 Implementation

The community site and building are items within the draft Development Contribution Plan, being the mechanism for cost sharing and reimbursement. The ceding of this site and development shall therefore be paid for by the Dayton developers, implemented by the City of Swan.

Uses within the 'Special Use – Community' site are restricted to the following (as defined in the City of Swan Local Planning Scheme text):

- Car Park (P – Permitted)
- Civic Use (P - Permitted)
- Community Purpose (P - Permitted)
- Family Day Care (P –Permitted)
- Kiosk (D - Discretionary)
- Museum (A - Discretionary and subject to advertising)
- Place of Assembly (A - Discretionary and subject to advertising)
- Recreation – Public (P - Permitted)

5.5 Western Power Easement

5.5.1 Context

The existing 330KV powerline, contained within its own easement, runs parallel to the south side of Marshall Road through the centre of the LSP1 and creates a significant constraint to land use and design. The corridor and intended use is reflected on the Sub-Regional and District Structure Plans as an Infrastructure Corridor and Gas Pipeline Easement. The LSP 1 proposes to now reflect the more recent position and decisions of the City of Swan in agreement with the Department of Planning. The land containing the 330kv power lines has been nominated as road reserve, with the retention of the easement.

5.5.2 Principles and Use

In LSP1, land encumbered by the 330kV powerlines easement is to be landscaped to the satisfaction of the City (on the advice of those parties benefiting from the easement) and transferred to the Crown free of cost and without any payment of compensation for incorporation into the adjoining road reserve. Where the adjoining road is DCP infrastructure, any land requirements and embellishments that are beyond the need and scope of the delivering the road cannot be claimed as an offset or credit under the DCP.

The road reserve containing the 330KV powerlines does not form part of any POS contribution, and instead would be suitable for low maintenance, low water consuming landscaping and cycleways linking to the broader region. A landscape concept plan and indicative cross section through the 330KV powerline easement (refer Figure 12) has been prepared and agreed to in principle by Western Power given that it complies with their land use and height restrictions.

The proposed corridor may also assist in pedestrian and cyclist movement in an east-west direction through Dayton via the local commercial centre and Activity Corridor. Similarly, it assists in providing access between the north and south sides of the LSP 1 and may be an opportunity for inventive initiatives such as community gardens, low height native biodiversity corridor.

Consistent with this designation, portions of the subdivisional roads are proposed, or already constructed, within the 330KV powerline easement. This improves the efficiency of land development and helps minimise maintenance costs for the land constrained by the easement

In summary, permitted uses within the road reservation containing the 330kv power line easement include; road reserve, car parking associated with the community site, low maintenance open space, community garden and pedestrian and cyclist network.

The 132KV powerlines along the western side of Arthur Street, south of Marshall Road, are not proposed to be contained within a Public Utility Reserve. Instead this 132KV powerline and its associated easement shall be partially contained within the road reserve and partially within residential zoned land.

5.6 Activity Corridor

5.6.1 Context

The Swan Sub-Regional Structure Plan and West Swan East District Structure Plan both designate an 'Activity Corridor' leading from Albion in the north, down Lord Street to Cranleigh Street and then running down Arthur Street to Caversham in the south. This Activity Corridor forms both the northern and western boundary to LSP 1 as shown on the plan.

The Activity Corridor relies upon the construction of a fly-over across the Reid Highway to connect Dayton with the Caversham urban development to the south. The timing of this fly-over is still uncertain and as such, the 'Activity Corridor' is unlikely to operate as intended until the connection to Caversham is complete and local neighbourhood centres in Dayton and Caversham are developed. Similarly, a public transport route down Arthur Street is also unlikely in the short term.

5.6.2 Function

The Activity Corridor is literally a corridor intended to accommodate a range of activities, including higher vehicular transport use, public transport, dedicated pedestrian and cyclist routes, developments and land uses which generate higher visitation such as retail uses and community destinations and in a manner that is easily accessible. The Activity Corridor through Dayton acts as a central spine through the suburb, connecting cells together and intended as helping form part of the character and vibrancy for the broader estate once complete.

5.6.3 Principles and Uses

In recognition of the purpose of the Activity Corridor, the road network within LSP 1 has been designed to ensure a high level of permeability connecting to it, particularly from the entry roundabout on Lord Street and the use of east-west and north-south gridlike roads. Similarly, the location of active public open space and the community purpose site along the Corridor is intended to help stimulate visitation along the Corridor. Whilst the higher density residential uses are proposed closer to the possible future public transport node in the south-west, direct routes for vehicles and pedestrians back to the Activity Corridor is made available.

Opportunity for medium density residential uses are proposed along the Activity Corridor and within close proximity to it with the objective of attempting to maximise activity and increase the number of residents nearby, facilitating a viable public transport route. Lots fronting the Activity Corridor may accommodate home office/home based businesses (in accordance with Residential zoning Scheme provisions) in future to utilise exposure from the Corridor and again assist in its activation.

The refinement and subsequent implementation of approved development along the Activity Corridor shall be ongoing throughout the life of the LSP 1 and is also reliant upon the development of adjoining local structure plans and the later development of land within the poultry farm odour buffer. Its success shall also continue to evolve after the construction of the Reid Highway flyover at Arthur Street and after the development of the local commercial centre to the east, service commercial site to the north of the LSP 1 and district sporting facilities and primary school also to the north of the LSP1.

The realisation of conditional subdivision and development and the use of Detailed Area Plans, Planning Approval, careful consideration to engineering plans for the road design and the consideration to building licenses for lots abutting the Corridor shall help further the achievement of the Corridor.

5.6.4 Design Objectives

The design objectives for the Activity Corridor are intended to promote pedestrian movement to, along and across the Corridor to reduce the reliance on private cars, promote healthier living and to help facilitate a friendlier and safer neighbourhood. In doing so, the following are included:

- No garages or driveways along the Arthur Street portion so as to avoid garage domination and traffic conflict caused by reversing cars;
- The community centre and commercial buildings are to help activate and surveil the Activity Corridor by having their primary visitor/customer access and related windows fronting Arthur Street. Their associated car parking is encouraged to be orientated behind the building, potentially accessible via the secondary street with minimum crossovers to the Activity Corridor;
- A zero metre setback to Arthur Street from the community centre and commercial buildings is encouraged so as to assist in creating a 'main street' style frontage to the Activity Corridor;
- Awnings and verandahs and a high standard of articulation to the front facade is encouraged to any community building, commercial building or residential dwelling fronting the Activity Corridor to assist in street activation and a friendly pedestrian environment;
- Any home office or home based businesses fronting the Activity Corridor should assist in activating and beautifying the streetscape again through a high standard of front facade, use of verandahs and awnings, quality signage and a clear relationship to the street.
- Pathways (footpath or dual use path) will be required on both sides of the Activity Corridor with use of pedestrian refuges, crosswalks or directional signage used to assist pedestrians ability to readily cross the Activity Corridor;
- Good quality and 'themed' street furniture and street trees offering a shading function to the satisfaction of the City of Swan are to be used along the Activity Corridor with an emphasis on the proposed 'main street' area immediately south of Marshall Road;
- Integration of the public open space design with the path and street tree theme of the Activity Corridor, particularly to encourage walkability to and between the POS and community/commercial areas;

- Any corner lots and dwellings with a frontage to the Activity Corridor must clearly address both streets such as through the use of wrap-around verandahs, balconies on a second storey, windows from habitable rooms overlooking the street, the use of quality semi-permeable fencing where fencing is necessary and high quality and well maintained front landscaping.

In addition, the use of Detailed Area Plans and design guidelines for residential and commercial land uses along the Activity Corridor shall help assist in achieving good design outcomes.

5.7 Movement Network

5.7.1 Road Network and Hierarchy

The proposed road network of LSP 1 is based upon integration with the existing roads generally forming the perimeter of the subject land as well as district and regional linkages to the broader area such as to the Albion district centre to the north, the future Henley Brook Avenue to the east, and existing and proposed public transport routes and facilitating access to surrounding proposed neighbourhood parks and schools within the West Swan and Caversham Districts.

A series of local access streets extend though the LSP 1, creating a legible and permeable grid-like pattern. Such an outcome encourages efficiency both for motor vehicles and, in combination with an extensive dual use path/footpath network and POS linkages, encourages walking and cycling. The proposed road network also links with the proposed road network created as part of the broader District Structure Plan and hence the associated Dayton DSP should be read in conjunction with this LSP.

The majority of the roads are proposed to be constructed within a minimum 15.4m or 16m road reserve, reduced down to a minimum of 14 metres where immediately abutting POS, or down to 6 metres within laneways. The key entry or neighbourhood roads are wider at 18 metres, 20 metres and 25 metres so as to accommodate additional traffic movement, buses, cycle routes and possibly some additional car parking and landscaping.

In support of these road widths and series of road networks, the Traffic Impact Assessment Report has been included at **Appendix 2** for illustration and analysis purposes and should be read in conjunction with this LSP 1 report.

5.7.2 Road Modifications and Treatments

Considerable attention was given to safe integration with the existing road network of Lord Street, Arthur Street and Cranleigh Street in the design preparation of the LSP. As such, the 'key intersections' now notated on the Structure Plan have all been carefully reviewed by the consultant Traffic Engineer in consultation with the City of Swan to ensure safe access and egress into the site, particularly via the roundabout on Lord Street.

The Coast Road alignment (now renamed to St Leonards Boulevard) is proposed to be modified via LSP 1 through the formal road closure of a portion of the undeveloped road, immediately west of Arthur Street. This road reserve is instead proposed for inclusion into future public open space and shall continue to offer a pedestrian and cyclist access instead. This road closure is notated on the LSP 1 plan however the statutory process for achieving the land conversion lies outside of the structure plan process and shall be pursued separately. Similarly, the width of the Cranleigh Street road reserve immediately west of Arthur Street is in excess to road reserve needs. This small section of road reserve shall also require a formal road closure process and likely amalgamation with adjoining Lot 566 as part of the subdivision process.

Both Lord Street and Arthur Street are currently 20m wide road reserves, but as a result of their conversion to an urban standard, they require widening to 25m, the additional 5m width to be resumed from the eastern side of each road, only as it applies to LSP 1.

The Traffic Impact Assessment, as well as the subsequent technical note, also further addresses road and intersection treatments, the key treatments and road modifications are summarised as follows.

Table 5: Summary of Key Road Treatment/Modifications

Description of Road Treatment
2 lane roundabout at Lord St & Cranleigh St
Roundabout at Cranleigh St & Arthur St
Upgrade of Arthur St between Cranleigh & Reid Hwy including onstreet car embayments associated with commercial centre and possible pedestrian refuges (any road widening of Arthur St is to be accommodated along eastern side and notated accordingly on LSP 2A and 2B)
Roundabout at Marshall Rd & Arthur St
Upgrade of Marshall Rd including drainage treatment and widening of existing road reserve
Lord Street and Marshall Road east intersection is to ban right turn movements on to Lord Street.
Roundabout at Lord St & St Leonards Blvd as the interim access arrangement into LSP1, to be removed upon creation of flyover at Marshall Road in longer term – subject to review
Roundabout along St Leonards Blvd
Intersection of St Leonards Blvd & Arthur St
Longer term conversion of St Leonards Blvd to a cul-de-sac
Longer term roundabout at the intersection of Marshall Rd flyover and Lord St realignment – subject to review
Intersection of Victoria Rd & Arthur St (possibly roundabout in the ultimate scenario, with an interim arrangement that Victoria Rd east be cul-de-sac)
Closure of portion of Coast Road immediately west of Arthur Street and conversion to POS reserve.
Upgrade of Victoria Rd (between Lord St and Arthur St) from a rural to urban standard
Upgrade of Cranleigh St (between Lord St and Arthur St) from a rural to urban standard, including closure of portion of road reserve adjoining Lot 566
Upgrade of Lord St from a rural to urban standard including widening of road reserve from 20m to 25m along the eastern side of road
Possible road widening requirements to facilitate MRS road reservations including near the intersection of Marshall Road and Lord Street
Roundabout at Marshall Road near intersection of Lord Street in the longer term upon

removal of the roundabout at St Leonards Blvd
Temporary closure of Victoria Road at the eastern side of intersection with Arthur Street.
Road widenings to facilitate the truncations required for the intersection treatments at Lord St/Cranleigh St, Lord St/Marshall Rd, Arthur St/Marshall Rd and Arthur St/Victoria Rd as conceptually shown on plans at Appendix 6.

5.7.3 Future Road Network

In addition to the above, and as notated on the Structure Plan, the road connections between Lord Street and Marshall Road and Lord Street and St Leonard's Boulevard, and the relationship between, has both an interim and future arrangement.

At present, a roundabout is constructed along Lord Street to provide access into the Early Release Subdivision area via St Leonards Boulevard. In addition, Marshall Road also remains connected to Lord Street and a new subdivisional road has been approved to connect St Leonards Boulevard (previously Coast Road) directly to Marshall Road.

Future road treatments and intersections along the Primary Regional Road Reserve (formerly intended to accommodate the Perth-Darwin Highway, which has now been realigned) are subject to further investigation by the City of Swan and Main Roads WA. These treatments may include the closure of the roundabout at Marshall Road, Lord Street and St Leonards Boulevard, and the possible installation of a flyover to connect Marshall Road and St Leonards Boulevard.

A flyover is also proposed across the Reid Highway via an extension to Arthur Street as also currently planned for in the Metropolitan Region Scheme reservations. In the interim, Arthur Street shall continue to remain as a cul-de-sac head terminating the road before reaching the Reid Highway. However upon agreement to future planning and budgeting, Arthur Street shall be extended via a bridge over the Highway, connecting Dayton with Caversham to the south, the timing of which is unknown.

5.7.4 Public transport

The LSP area has access to an established public transport route down Lord Street which shall continue to operate as the interim high frequency public transport corridor with a local bus route down Marshall Road past the central local commercial centre as per Figure 7 of the Traffic Impact Assessment report. Road connections directly back to Lord Street and Marshall Road for pedestrians to follow was a consideration in the LSP 1 preparation.

A future public transport route has been designed to run along Cranleigh Street and Arthur Street, coinciding with the nominated Activity Corridor once the Arthur Street flyover has been constructed over the Reid Highway, linking Dayton with Caversham to the south and also Albion in the north.

The intersection of the Reid Highway and the Primary Regional Road Reserve (former Perth-Darwin Highway Alignment) has been nominated as a possible future transit station as part of the Special Purpose reserve of the MRS, the timing and form of which is yet to be refined by the State government. Upon construction of the public transit node, a logical bus route would likely evolve through the centre of LSP 1 alongside the lineal POS and returning back to Arthur Street via Victoria Road or similar.

5.7.5 Bicycle and Pedestrian Network

Emphasis has been placed on maximising the potential for cycling and walking throughout the subject land, particularly via the POS, the landscaped powerline corridor and the proposed gridlike streetscapes which will offer an attractive incentive to walk or cycle. Recognition of the broader context, including possible future transport node, primary schools, highschool in Albion and various commercial centres internal and external to Dayton in the plan preparation stage has also assisted in ensuring bicycle and pedestrian movement opportunities are maximised in accessing important destinations, rather than a reliance on the private motor vehicle.

Furthermore, walking and cycling has been promoted through a designated dual use path and pedestrian network outlined in the Traffic Report and intended to be implemented as conditions of subdivision approval on the applicable land parcels.

5.7.6 Accessibility

As noted previously, the site is highly permeable with cell blocks less than 200m long and in a grid-like layout so as to offer variety in route possibilities. Being a relatively rectangular shape with POS distribution outlined in the DSP ensures all lots shall be within a 200m direct walk to POS, not including the open space value offered by the powerline corridor.

All lots are also located within 400m an existing or proposed bus route, within 500m of a proposed commercial and retail node and within 1 kilometre of a proposed primary school (government and existing private).

Lord Street and Reid Highway also provide road connections to the regional light industrial employment node of Malaga to the west, Midland to the south-east, Morley to the south-west and Albion and Ellenbrook to the north. Tonkin Highway via Reid Highway also provides a ready access route to those travelling further afield to Welshpool, the airport and Perth CBD for employment and services. As such, the site is highly accessible on both a micro and macro level and via a variety of proposed and existing transport methods.

5.8 Environmental Considerations

5.8.1 Heritage

In 2007 an Aboriginal Heritage Survey was undertaken by R & E O'Connor in support of the District Structure Plan. This investigation revealed the presence of a degraded drainage line also identified as having Aboriginal heritage value and known as Little Creek/One Hundred Year Creek (DIA number 22159) traversing a small part of the south-west corner of the LSP 1 site, the location and width of such has been agreed to be protected within public open space through the appropriate consultation process with all sub-groups of the Region Six Single Noongar Claim native title holders and a Section 18 application now approved and requiring no further additional protection. The LSP 1 POS boundary for the lineal park now reflects the agreed heritage protection boundaries with a 20m setback to the creekline incorporated into the POS.

The Department of Indigenous Affairs (DIA) has indicated that further archaeological investigations are required for the area of LSP 1 north of Marshall Road to supplement the original 2007 report, as such, a Cultural Heritage Management Plan (CHMP) was been compiled in 2010, again by R & E O'Connor and covering the whole District (including the LSP 1 area north of Marshall Road) in more detail, a copy of which is included at Appendix 4.

The purpose of the CHMP being to ensure that any subdivision and development works associated with the conversion of Dayton to urban development will, wherever possible, protect and preserve the known Aboriginal heritage sites and any yet to be identified sites. Should protection and preservation not be viable, the CHMP provides the guidance to ensure that all actions in respect to those sites occur in a manner consistent with the legislative requirements. The key recommendation applicable to LSP 1 being that the developers nominate a heritage officer familiar with the requirements of the CHMP to help ensure the protection of any objects or skeletal remains should they be uncovered during development works and to assist in any liaising during the construction process. The Aspen Group has committed to this arrangement, other subsequent developers within the LSP 1 area shall also heed the CHMP recommendations.

5.8.2 Odour

An operating Poultry Farm is located at No. 60 Cheltenham Street Bennet Springs. As a result, a 500m odour buffer has been established around the poultry farm and is imposed on this Structure Plan. No subdivision or development of land for residential purposes is permitted within the 500m buffer until such time as:

i. A technical study recommending the buffer may be removed or reduced is approved by the Department of Environmental Regulation (DER) ;

ii. The poultry farm is decommissioned and removed.

5.8.3 Acid Sulfate Soils

Preliminary Acid Sulfate Soil investigations to a depth of 7 metres were undertaken as part of supporting the District Structure Plan, revealing no presence of Acid Sulfate Soils to a depth of 3 metres within the LSP 1 area, with some risk at depths greater than 3 metres, of which the first stage Early Release subdivision construction has appropriately avoided or addressed. All future subdivision approvals/works shall be required undertake further Acid Sulfate Soils investigations as recommended in the Preliminary Acid Sulfate Soils Investigation report and shall then ensure that:

a) An Acid Sulfate Soils Management Plan shall be prepared at the subdivision stage and/or as a requirement of a dewatering licence application; and,

b) Acid Sulfate Soils will be managed as per the approved Acid Sulfate Soil Management Plan in accordance with the relevant DEC Guidelines.

5.8.4 Contaminated Sites

A Preliminary Contaminated Sites Investigation Report covering 18 lots within the broader West Swan District was prepared in July 2008 and forms part of the West Swan District Structure Plan document. The investigation revealed evidence of possible pesticide use, trace metals, nutrients, pathogens, petroleum hydrocarbons and solvents associated with past or existing uses on some properties and some evidence of uncontrolled fill. None of these contaminants are of great significance and can be (or have been already) remediated as part of the subdivision works to the satisfaction of Council and the DEC.

As a result of the Preliminary Contaminated Sites Investigation, a recommendation was made for detailed site investigations to be undertaken for the locality, these more detailed analyses have been undertaken as part of the lodged subdivision application areas. Additional Contaminated Site Assessment and Soil Contamination and Remediation Plans will subsequently be required to be prepared at the subdivision stage by the proponents of any sites/landholdings where a potential source of contamination exists, including non-Aspen owned land. The identified contaminated site will then be managed as per the relevant approved Contaminated Site Assessment and Soil Contamination and Remediation Plan in accordance with DEC Guidelines.

5.8.5 Local Water Management

A Local Water Management Strategy (LWMS) has been developed by JDA Consultant Hydrologists on behalf of West Swan Estate Pty Ltd for the West Swan East District Structure Plan area. The compilation of this document has included a range of expertise and guidelines from leading authorities to assist in achieving the implementation of best practice in sustainable urban development and urban water management in Dayton. The LWMS is consistent with the North East Corridor Urban Water Management Strategy (GHD, 2006), prepared on behalf of the Department of Water (DoW) as the overarching regional drainage strategy for the area. It is also consistent with the requirements of the Swan Urban Growth Corridor Drainage and Water Management Plan (DoW, January 2009).

The LWMS was prepared to an appropriate level of detail to support both the District Structure Plan and individual Local Structure Plans for Dayton, including LSP 1. The LWMS was approved by both the DoW and City of Swan in June 2009.

The LWMS is consistent with DoW's recommended approach for urban water management and the Western Australia land use planning system as outlined in Better Urban Water Management (WAPC, 2008).

Key elements of the LWMS have been incorporated into the LSP 1 preparation, namely the siting of the proposed public open spaces (POS) and allocation of POS credits in the context of drainage requirements, the exception being the most northern POS which has been amended in size and location since the endorsement of the LWMS, an addendum included at Appendix 5 of this report however clarifies the suitability of this POS. The LSP 1 boundary was also selected in the context of logical LWMS catchments to ensure future planning coordinates well with drainage requirements. JDA Consultant Hydrologists have since been consulted in the preparation of the LSP 1 plan to ensure continued consistency with the LWMS and reaffirm drainage requirements.

5.9 Servicing Infrastructure and Utilities

The Engineering Servicing Report at Appendix 1, and as also supplemented by Figure 8, confirms the manner in which infrastructure will be provided. An addendum to the Engineering Servicing Report has been prepared to address the modified LSP 1 and the inclusion of Lots 580-582 A summary of the report is provided below. The Report confirms that there are no identified servicing constraints that prevent the land from being developed as intended, with the site able to be serviced with all essential services and infrastructure.

5.9.1 Power

All power lines, with the exception of the 330KV and 132KV lines, will be relocated underground as part of the subdivision construction and Western Australian Planning Commission approval requirements. The existing 330KV and 132KV powerlines along Arthur Street and Marshall Road reserves will be maintained in their current status and within their current easements.

The 330KV powerline easement is predominantly identified as road reserve. The 132KV powerline easement along Marshall Road is similar to the 330KV land allocation. The 132KV along Arthur Street however differs in that it is partially included within road reservations and partially within proposed residential zoned lots. The 132KV easement width however typically only encroaches a couple of metres into the front setback area of proposed lots where the development of a residential dwelling is not ordinarily permissible under the relevant Residential Design Code, as such, the impact of the existing easement does not present a significant constraint to the realisation of the adjoining lands residential potential. The subdivision design of lots containing the 132KV easement along Arthur Street will require consideration to the location and extent of the easement to ensure the proposed lot dimensions accommodate a practical buildable area.

5.9.2 Communications

Both optical fibre and local cable communication infrastructure is available to the LSP 1 area. Developers within the LSP 1 area can therefore provide connection to all normal telecommunication infrastructure by applying directly to Telstra, in doing so, consideration can also be given to broadband internet connections. As there is no statutory requirement for this to be provided as an essential infrastructure item as a condition of subdivision approval, discretion by each developer may result and each developer should undertake their own investigations in this regard, noting that the earlier staged subdivisions do not restrict the ability for subsequent developers (or landowners) to extend or connect to the network(s).

5.9.3 Water

The Water Corporation's current planning is for the installation of 2690m of 600mm water main from the intersection of Benara and Altone Roads to the intersection of Patricia Street and Lord Street extension. This is intended to improve the supply of water to residential areas in Caversham. Design works are well progressed for this service. From here the Water Corporation's planning is for the construction of a 250mm water main east along Patricia Street then north along Arthur Street, which will provide a water supply for the initial stages of the West Swan (East) District Structure Plan area. This 250mm water main will be constructed as part of the development to be completed to the south of the subject land, owned by Qube. As such it will be completed in a staged approach and therefore co-operation is required between the developers to ensure the timely delivery of services.

All lots will be provided with connections in accordance with Water Corporation requirements via the installation of water reticulation throughout the subject area within the common trench, along with other essential services. The Water Corporation's expectation is that the developer shall fund all water, sewer and drainage reticulation and that contributions towards headworks may also be required. Additionally, the developer may be required to fund new works or the upgrading of existing works and protection of those works. Any temporary works will need to be fully funded by the developer and land ceded for these works. Developers will therefore liaise with the Water Corporation at:

- The preliminary planning stage of any development to determine the Corporation's current servicing and land requirements; and/or;
- Every 6 months to confirm if the information provided is still valid.

5.9.4 Sewer

The provision of reticulated sewer to the LSP 1 area is intended as a three phase process.

The first stage land release area (being the 500 lots in the south of the LSP 1) requires the construction of a Type 40 pumping station on Qube land in Patricia Street near the low point in the site in the vicinity of the ungazetted tributary, with rising main infrastructure to connect into an existing gravity sewer near the intersection of Patricia and Bennett Streets. The sewerage pumping stations and rising mains are developer funded works. These works will be funded through an agreement with Qube (developers to the south).

The ultimate reticulated sewer expansion to service the balance of the Dayton catchment (being more than the initial 500 lots), as well as other developments in Caversham to the south, requires the construction of a Type 180 Pumping Station near the intersection of Benara Road and Bennett Street to deliver a permanent wastewater treatment system to the additional residential lots. There is potential that this will be constructed in a staged approach starting as a Type 40, then Type 90 pumping station up to its final configuration as a Type 180 PS, (this will be determined in an upcoming Project Design Review or PDR which will be undertaken by the Water Corporation). The Water Corporation requires developer contributions towards the purchase of the landholding for the pumping station site. The infrastructure includes the construction of a rising main connecting the proposed pump station to infrastructure approximately 4 kilometres away near the intersection of Benara Road and Tonkin Highway.

The internal servicing of the district will be via the Water Corporations' two separate sewerage catchment areas which includes a smaller catchment and associated Type 10 pump station (pumps at a maximum rate of 10 litres per second) that is contained entirely within the site and located along the eastern boundary of the district structure plan area and includes less than one third of the overall development area. The second larger catchment includes the remainder of the structure plan area and is part of a much larger catchment that also includes all of the developable area south of Reid Highway immediately adjacent to the site and east to Bennett Brook as well as much of the land to the west of the site, which is the West Swan (West) Structure Plan area. The smaller catchment will then discharge, via a 100mm rising main, into the larger overall catchment.

The entire development will be serviced by reticulated gravity sewer. Earthworks may be required in the north-east and north-west to achieve lessened excavation depths in the southern sections of the site and into the Qube properties to the south.

Aspen Group has negotiated connection to the proposed Type 40 pumping station in Patricia Street via Arthur Street, and in a southerly direction under the Reid Hwy to Patricia Street in Caversham, then west along Patricia Street adjacent to the proposed Qube development. This alignment has been agreed by both Qube and the Water Corporation as suitable for development. The approval and construction of the Early Release subdivision in Stage 1 of LSP1 has triggered the need to construct the Type 180 pumping station to service these initial lots.

All future lots will ultimately be provided with reticulated sewer connections in accordance with Water Corporation requirements. As also noted in 5.9.3, the Water Corporation's expectation is that the developer shall fund all sewer reticulation and that contributions towards headworks may also be required. Additionally, the developer may be required to fund new works or the upgrading of existing works and protection of those works. Any temporary works will need to be fully funded by the developer and land ceded for these works. Developers will therefore liaise with the Water Corporation at:

- The preliminary planning stage of any development to determine the Corporation's current servicing and land requirements; and/or;
- Every 6 months to confirm if the information provided is still valid.

5.9.5 Site Drainage

Development outfall flows will need to be attenuated to pre-development flows as presented in the DWMP (DoW, 2009), necessitating installation of compensating basins/swales with the accompanying bioretention areas for frequent storm events, some of which is proposed within public open space and some within road reserves, including Marshall Road. This is addressed in the report by JDA Consultants contained in the related DSP for Dayton, but in essence will involve provision of piped street and roof drainage water to site flood attenuation areas, with the major storm events being discharged offsite via connections to existing drainage installations. The endorsed Local Water Management Plan prepared for Dayton addresses the flow discharges.

Site disposal of roof drainage will be via soakwells where capacity to infiltrate stormwater exists. Fill will be required to lift developed lots to the level above the estimated annual average groundwater level (AAMLG) as required by the Western Australian Planning Commission, and as agreed with the City of Swan, JDA Consultants and Tabec Engineering Consultants, this level generally being RL16m AHD with the exception of designated sites designed to be lower and accommodate storm events.

5.9.6 Gas

A Pressure Reduction Valve to the existing 350mm High Pressure Gas line running along Marshall Road from the west was installed near the intersection of Marshall Road and Arthur Street as part of the Early Release subdivision works. Whilst gas is not an essential service required as a condition of subdivision by the Western Australian Planning Commission, the newly extended infrastructure is sufficient to supply gas to the rest of the LSP 1 area with only some minor local extensions within road reserves to then be constructed as part of the subdivision works to service those future lots.

Where any section of the 350mm High Pressure gas pipeline is not already adequately protected in an easement, an easement will be required as part of the subdivision works.

5.9.7 Noise Wall

As recommended in the Noise Impact Assessment undertaken as part of the District Structure Plan to identify land affected by (day) noise levels less than 55 dB(A), between 55-60 dB(A) and greater than 60 dB(A), there is a need for noise attenuation along the adjoining Reid Highway boundary, and a portion of the Primary Regional Road Reserve (former Perth-Darwin Highway alignment) along the western boundary, which includes an acoustic sound wall of a minimum height of 2.7 metres, or similar approved measure, to be constructed at the time of subdivision works to the specifications of Main Roads WA. Such a wall has already partially been constructed as part of the subdivision works associated with the Early Release Subdivision Approval; the balance of the wall construction will likely form a condition of subdivision for the remaining undeveloped lots adjoining the highway reservations as shown on the LSP 1 plan.

Dwellings that are within Exposure Level 2 (50dBA and above at night time) will require notification on their lot titles advising of the possible noise impacts associated with the location of their lots. Additionally these lots will require Detailed Area Plans to be prepared and approved following subdivision approval. These will outline Quiet House Design measures to be applied to dwellings to achieve the recommended acceptable internal noise levels of AS107:2000. Additionally any two-storey developments within this area will need further acoustic assessments, in accordance with the Lloyd George Acoustics Report.

Conditions addressing the above have already been imposed on the subdivision approval of land adjoining the Reid Highway and the Primary Regional Road Reserve and the expectation is that a similar condition will be applied to those other lots that were excluded from the subdivision approval but are also affected by noise associated with the highway, all are located south or west (being closest to the Primary Regional Road Reserves) of the noise line reflected on the Site Analysis Plan at Figure 3.

It should be noted that an updated Noise Report was prepared to support the Subdivision of Lot 301 Cranleigh Street and Lot 581 Lord Street, Dayton (refer **Appendix 7**). In light of updates to the policy framework (namely, the WAPC's *State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning*), this report found that a number of lots adjacent to the Primary Regional Road Reserve require Noise Package Treatment A or Noise Package Treatment B. Additionally, the report found that there was no longer a need for a Noise Wall along this portion of the road reserve. These findings are reflected on the Structure Plan Map.

6.0 IMPLEMENTATION

A summary of the statutory mechanisms for the implementation of the Local Structure Plan 1 is listed below:

Table 6: Statutory Implementation of LSP1

<table>
<tr><th>Element of Local Structure Plan 1</th><th>Statutory Provision to be Applied</th></tr>
<tr><td>1. Structure Plan Area</td><td>This Local Structure Plan shall apply to land generally bounded by Cranleigh St in the north, Reid Highway in the south, Arthur St in the east and Lord Street and the Primary Regional Road Reserve to the west within the suburb of Dayton being the land contained within the inner edge of the line denoting the subject area on the Local Structure Plan Map.</td></tr>
<tr><td>2. Structure Plan Map</td><td>The Local Structure Plan Map (figure ASPWESLSP1 2-02w) outlines land use, zones and reserves applicable within the Structure Plan area.

The zones and reserves designated under this Structure Plan apply to the land within it as if the zones and reserves were incorporated into the Scheme.</td></tr>
<tr><td>3. Use Class permissibility</td><td>Land use permissibility within the structure plan area shall be in accordance with the corresponding zone or reserve under the Scheme with the exception of the following:
<table>
<tr><th>Applicable Zone</th><th>Additional Use Class & Permissibility</th></tr>
<tr><td>Residential</td><td>‘Sales Office’ is an ‘A’ Use</td></tr>
<tr><td>Special Use - Community</td><td>Refer to 5.4.3 of Structure Plan report</td></tr>
</table>
The following “Additional Land Uses”, as defined below, are applicable to Lots 300 & 301 Cranleigh Street and Lots 581 & 582 Lord Street only and considered ‘D’ uses under the Scheme:

“Residential Sales Office” means a building of either a temporary or permanent nature, and incidental car parking, used directly in relation to the sale of land and dwellings in new residential estates.

“Home Centre” means a group of two or more dwellings and incidental car parking which are intended to be open for public inspection as examples of dwelling design.

“Temporary Car Park” means premises used for a limited period of time for parking vehicles open to the public and incidental to the sale of land and dwellings in new residential estates but does not include any part of a public road used for parking, or any premises in which cars are displayed for sale.</td></tr>
</table>

4. Residential Design Requirements	The Local Structure Plan Map defines the Residential Density that applies to specific areas within the Structure Plan. Residential development is to be consistent with the *Residential Design Codes* with the exception of the variations outlined within 5.2.4 of the Structure Plan Report or may as otherwise be varied by Detailed Area Plans prepared in accordance with 5.2.6.
5. Development Contribution Arrangements	The Structure Plan area is within Development Contribution Area 2 (DCA2) as identified in the Schedule 13 of the City's Local Planning Scheme 17 (LPS17). The following provisions apply: a) A Development Contribution Plan applies to this Structure Plan area and should be read in conjunction with the Structure Plan. b) Any landowner seeking subdivision within the Structure Plan area is to contribute in accordance with the endorsed Development Contribution Plan. c) If subdivision is sought; • for land which has not already been approved for subdivision under an early release subdivision approval; **and;** • prior to the DCP's incorporation into Schedule 13 of LPS17 so as to be given effect under that Scheme; the owner/developer shall first enter into a deed with the City of Swan that requires the owners/developers to make an appropriate cost contribution upon notification by Council that payment is required and securing payment of any balance that might be due on gazettal of the DCP for DCA 2, as contemplated by Clause 5A.2.5.2 of LPS17. Subdivision or development of those lots which are not the subject of a deed is not to occur until such time as the provisions of the relevant Development Contribution Plan for DCA 2 - Dayton (West Swan East) have been incorporated in Schedule 13 of LPS17. d) The staging of some (but not all) DCP infrastructure works and arrangements is summarised in Table 7 within 6.1 of the report.
6. Limitations or restrictions affecting subdivision and/or development	Subdivision is not to occur until the DCP is approved and incorporated into the Scheme or the developer/landowner first enters into a Deed of Agreement with the City in accordance with Section 5 above and 6.1 of the Local Structure Plan report.
7. Detailed Area Plans Requirements	Detailed Area Plans are to be prepared in accordance with Clause 5A.1.15 of the Scheme, prior to any subdivision and/or development for residential zoned lots as generally reflected on the Structure Plan in accordance with 5.2.6 of the Local Structure Plan report.
8. Public Open Space	The structure plan map nominates locations of POS areas, with POS to be provided in accordance with 5.3 and Table 4 of the Local Structure Plan report. The final accreditation of a particular POS is subject to detailed design and landscape plans, demonstrating its function and usability for recreational purposes to the satisfaction of the City.

9. Additional Reports/Tasks Required at Subdivision / Development	In accordance with the City of Swan Local Planning Scheme 17 as it applies to Special Use Zone 11 - West Swan (East), the District Structure Plan for Dayton (ODP-159) and various agencies requirements, additional investigations, reporting or infrastructure considerations are required as part of, or prior to subdivision approval over the balance of the Structure Plan area. The investigations / tasks summarised in 6.4 of the Local Structure Plan report (as applicable) shall be implemented upon approval of subdivision or development and read in conjunction with provision 6.2 of Special Use Zone 11 - West Swan in Schedule 4 of the Scheme.
10. Operation Date	In accordance with clause 5A.1.12.1 of the Scheme, this Local Structure Plan shall come into operation on the day on which it is endorsed by the Commission, pursuant to clause 5A.1.10.2 of the Scheme.

6.1 Development Contributions Arrangements

West Swan East District Structure Plan area, which includes the LSP 1 area, is identified as 'Developer Contribution Area 2' (DCA 2) within Schedule 13 of LPS 17. DCA 2 in Schedule 13 gives effect to the Dayton Development Contribution Plan ('DCP').

The objective of the DCP is to ensure equitable distribution of development costs between stakeholders and is the mechanism that delivers the Swan Urban Corridor Sub Regional Structure Plan, the Urban Growth Corridor – Sub Regional Planning Community Facilities Analysis and the West Swan East District Structure Plan outcomes.

The DCP applicable to DCA2 identifies a number of infrastructure items within or immediately adjoining the LSP 1 area, as well as throughout the wider District, which are required to be ceded, resumed or constructed as part of the process of converting Dayton from a predominantly rural use to an urban use consistent with the structure planning outcomes. The 'Infrastructure Demand' is apportioned across the development in order to derive Infrastructure Contribution Rates for each network of Infrastructure. Each developer will be required to make Cost Contribution payment based on the area that they develop and the applicable Contribution Rate for DCA 2.

Table 7 below (and the table on the LSP 1 plan) lists:

a) The DCP items that are within or borders the LSP1 area or are works/arrangements that need to commence as part of the development of LSP1, and;

b) The triggers for the completion of these DCP items before or at the subdivision clearance of deposited plan that generates the lot (or its unit of equivalent demand) that meets or exceed the trigger specified in that table.

This is not a comprehensive listing of works and land identified in the endorsed Development Contribution Plan for DCA 2, so where a DCP item is not listed in the table below, the trigger for the acquisition and/or construction of the DCP item is addressed in its relevant Local Structure Plan and the 'Capital Expenditure Plan for the Urban Growth Corridor' ('CEP'). In the absence of an endorsed LSP or CEP, the CEP advertised by City of Swan applies.

Any developers seeking subdivision within LSP1 must contribute to the endorsed DCP applicable to DCA 2 as contemplated by Clause 5A.2.5.2 of the City of Swan Local Planning Scheme No.17. If however subdivision is sought prior to the final endorsement of the DCP and its incorporation into Schedule 13 of LPS17, the owner/developer shall first enter into a deed with the City of Swan that requires the owners/developers to make an appropriate cost contribution upon notification by Council that payment is required and securing payment of any balance that might be due on gazettal of the DCP for DCA 2.

Table 7: Triggers for DCP items/works required as part of LSP1

Item on LSP plan	DCP Code	Description of DCP item	Description if the DCP item needs to be acquired and/or constructed in stages	Trigger (dwelling units 'DU' or equivalent)
1	E-ITF04	Roundabout Cnr Lord Street and Cranleigh Street	Construct roundabout	80% LSP1 (760 DU)
2	E-TRF18	Upgrade Cranleigh Street (Lord St to Arthur St)	Upgrade to neighbourhood connector B	Northern LSP1 (800 DU)
3	E-TRF19			
4	E-IRF03	Roundabout Cnr Arthur Street and Cranleigh Street	Construct roundabout	At time of Primary School/ LSP2B
5	E-TRF20	Upgrade Lord Street (Cranleigh St to Marshall Rd east)	Upgrade to 4 lanes	80% LSP1 (760 DU)
6	E-TRF21			
7	E-IRF02	Roundabout Cnr Marshall Road and Lord Street east	1. Ban right turn out	80% LSP1 (760 DU)
			2. Upgrade T-junction	LSP 2A / 2B
			3. Relocate & construct as 4-way roundabout	With Marshall Rd flyover across PDHN (long term)
8	E-TRF03	Upgrade Arthur Street (Marshall Rd to Cranleigh St)	1. Widen and kerb west side	Northern LSP1 (800 DU)
			2. Upgrade to integrator B standard	LSP 2B
9	E-IRF01	Roundabout Cnr Marshall Road and Arthur Street	Construct roundabout	80% LSP1 (760 DU)
10	E-TRF05	Upgrade Marshall Road (Lord St to Arthur St)	Upgrade to integrator B standard	LSP 2A / 2B
11	E-TRF04			
12	E-TRF44	Upgrade Lord Street	Upgrade to 4 lanes	80% LSP1 (760 DU)
13	E-IRF07	Roundabout Cnr Marshall Road and Lord Street west	Upgrade roundabout	80% LSP1 (760 DU)
15	E-ITF01	Priority T intersection at Arthur Street and St Leonards Boulevard	Construct T-junction (done)	Central LSP1 (200 DU)
17	E-TRF36	Upgrade Arthur Street (Coast Rd to Victoria Rd)	1. Widen and kerb west side	Southern LSP1 (950 DU)
			2. Upgrade to integrator B standard	LSP 2A
21	E-IRF06	Roundabout Cnr Victoria Road and Arthur Street	Construct roundabout	With Arthur St flyover across Reid Hwy (long term)
22	E-TRF37	Upgrade Arthur Street (south of Victoria Rd)	Connect to future flyover across Reid Hwy	With Arthur St flyover across Reid Hwy (long term)
23	E-TRF01	Upgrade Arthur Street (Marshall Rd to Coast Rd)	1. Widen and kerb west side	Central LSP1 (200 DU)
24	E-TRF02		2. Upgrade to integrator B standard	LSP 2A

6.2 Groundwater and Stormwater Management

Groundwater and stormwater management systems will be implemented by the subdivider(s) separate to the Development Contribution Plan (DCP) for Development Contribution Area 2 (DCA 2). While drainage infrastructure does not form part of the cost-sharing arrangements in the DCP for DCA 2, it is noted that the adopted Dayton Local Water Management Strategy (LWMS) recommends that Public Open Space (POS) perform a drainage function. Therefore, POS, which is proposed to be part of the contributions arrangements of the DCP for DCA 2, is likely to contain some form of stormwater and groundwater management systems.

As the precise nature of the drainage infrastructure will be determined in the Urban Water Management Plan(s) at subdivision, it is premature to speculate on the costs and design of all drainage infrastructures in all Public Open Spaces. Consequently stormwater and groundwater management in LSP1 will be implemented as follows:

a) The approved Urban Water Management Plan shall be implemented by the subdivider, including the construction of the identified stormwater and groundwater management systems;

b) Although subdivision may be prepared over a single landholding, the arterial drainage planning in a UWMP cannot be limited to the extent of the subdivision and must be extended to include the full upstream and downstream extent of the drainage sub-catchment proposed the approved LWMS to demonstrate how the UWMP integrates with the LWMS and regional planning undertaken in the Swan Urban Growth Corridor DWMP;

c) Where a modification to the drainage sub-catchment is approved by the Department of Water and Local Government, the relevant UWMP is to state that there has been a modification to the LWMS subcatchment and future development within the modified subcatchment should be undertaken in a manner consistent with that modification accordingly. If the Department of Water or City of Swan requests the LWMS to be amended this is to be undertaken at the applicant's expense with the structure plan modified in accordance with the provisions of 5A.1.14 of Local Planning Scheme 17;

d) Where groundwater and stormwater management systems are proposed in a POS, all works and land required for the drainage functions will be delivered through conditions of subdivision;

e) Where the work/embellishment of a POS is in excess to what is prescribed in the adopted DCP for DCA 2, the completion of this component of the work by a landowner or a collective group of landowners cannot offset their liability under the DCP for DCA 2;

f) As per the Swan River Trust's advice and Council's resolution on the District Structure Plan, Urban Water Management Plans at subdivision shall:

- Use the most recent data for estimated annual flow for Bennett Brook for its percentage runoff calculations and design, which is available from the Swan River Trust website;
- Use information on the ecological water requirements from the recently released Swan Canning Water Quality Improvement Plan, which is available from the Swan River Trust website; and,

- Where Controlled Groundwater Levels (CGL) are proposed, provide justification regarding the implications for water quality treatment, and where necessary specify alternative treatment measures.

g) Subsequent Urban Water Management Plans are to implement the water efficiency and conservation principles of the approved Local Water Management Strategy.

6.3 Staging of Subdivision and Development

Development is well advanced in LSP 1, with The Enclave due for completion in 2013. Upon successful advertising, adoption and endorsement of the modified LSP, subdivision and development is planned to occur immediately over Lots 580-582.

An indicative staging plan is included at **Figure 10** to assist in illustrating the likely order of staging and subdivision construction works within the LSP 1 area.

6.4 Subsequent Technical Reports Required

In accordance with the City of Swan Local Planning Scheme No.17 as it applies to Dayton (West Swan East) and also in accordance with the District Structure Plan and various agency guidelines and policies, additional investigations, reporting or infrastructure considerations are required as part of, or prior to, achieving subdivision construction over the balance of the LSP 1 area and to which developers and landowners should take note. These additional studies are summarised in **Figure 12** of this report and are generally an extension of broader level investigations undertaken as part of the structure plan preparation.

7.0 CONCLUSION

This Local Structure Plan has been modified to include Lots 580-582 Lord Street. This land previously formed part of the LSP3 area and contained a site earmarked for use by Western Power, which has subsequently become surplus to its requirements. The inclusion of this land in LSP1 provides a seamless integration of residential uses across LSP1 and the former LSP3 area. It also recognises the distinction between the proposed residential and service commercial uses of the former LSP3 area, and the tailored planning approaches they require.

The Local Structure Plan as described in this report satisfies the planning frameworks adopted by the City of Swan and the Western Australian Planning Commission and the previous advice received during consultation with other agencies. The Plan should ultimately assist in achieving a contemporary and well integrated suburb that helps provide a transition from west to east and south to north (both via the road and path network, public transport access, land use allocation and residential densities) whilst creating its own vibrant heart centred around a local commercial main street and public open space amenities, linked by an Activity Corridor along its eastern and northern boundaries.

The proposed modification is critically important in continuing to deliver a diverse lot product to the market in a timely manner. It is proposed to commence development immediately on the approval of the modification to LSP 1 and subsequent subdivision application.

In light of the above, the Local Structure Plan modification as submitted would represent a logical, well planned and timely addition to the ongoing development of the City of Swan's Urban Growth Corridor and the first stage of implementing the District Structure Plan.

FIGURE 1

LOCATION PLAN

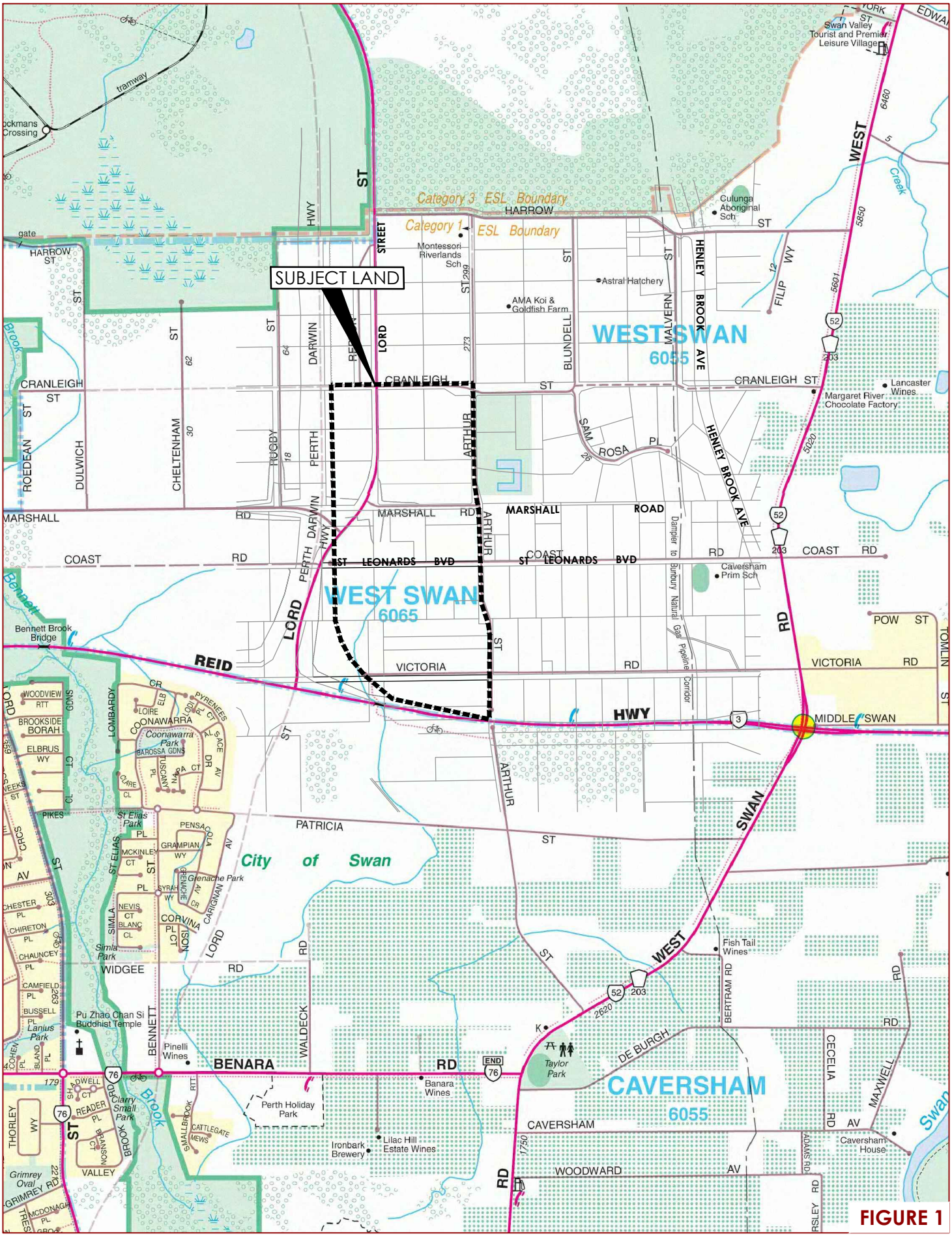

FIGURE 1

NORTH

LOCATION PLAN

LSP 1 DAYTON

CITY OF SWAN

Planner: KW
Client: St Leonards Estate Pty Ltd
Date: 11.03.13
Plan No: ASP WESLSP1 9-01

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FIGURE 2

ORTHOPHOTO

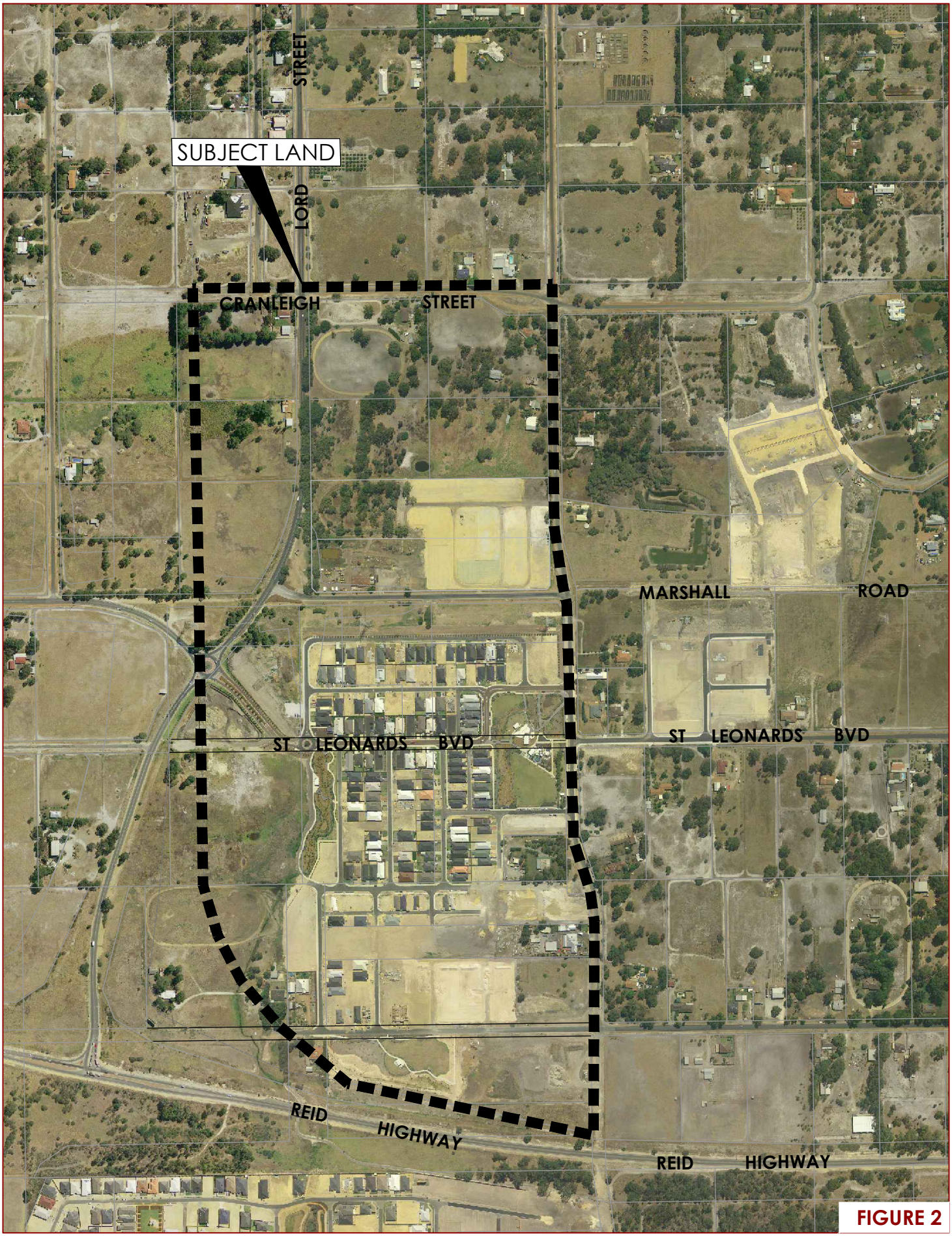

FIGURE 2

NORTH

0 100 200 300 400 500m

SCALE 1:7,500 (A4)

AERIAL PHOTO
LSP1 DAYTON
CITY OF SWAN

Planner: KW
Client: St Leonards Estate Pty Ltd
Date: 11.03.13
Plan No: ASP WESLSP1 9-01

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FIGURE 3

SITE ANALYSIS

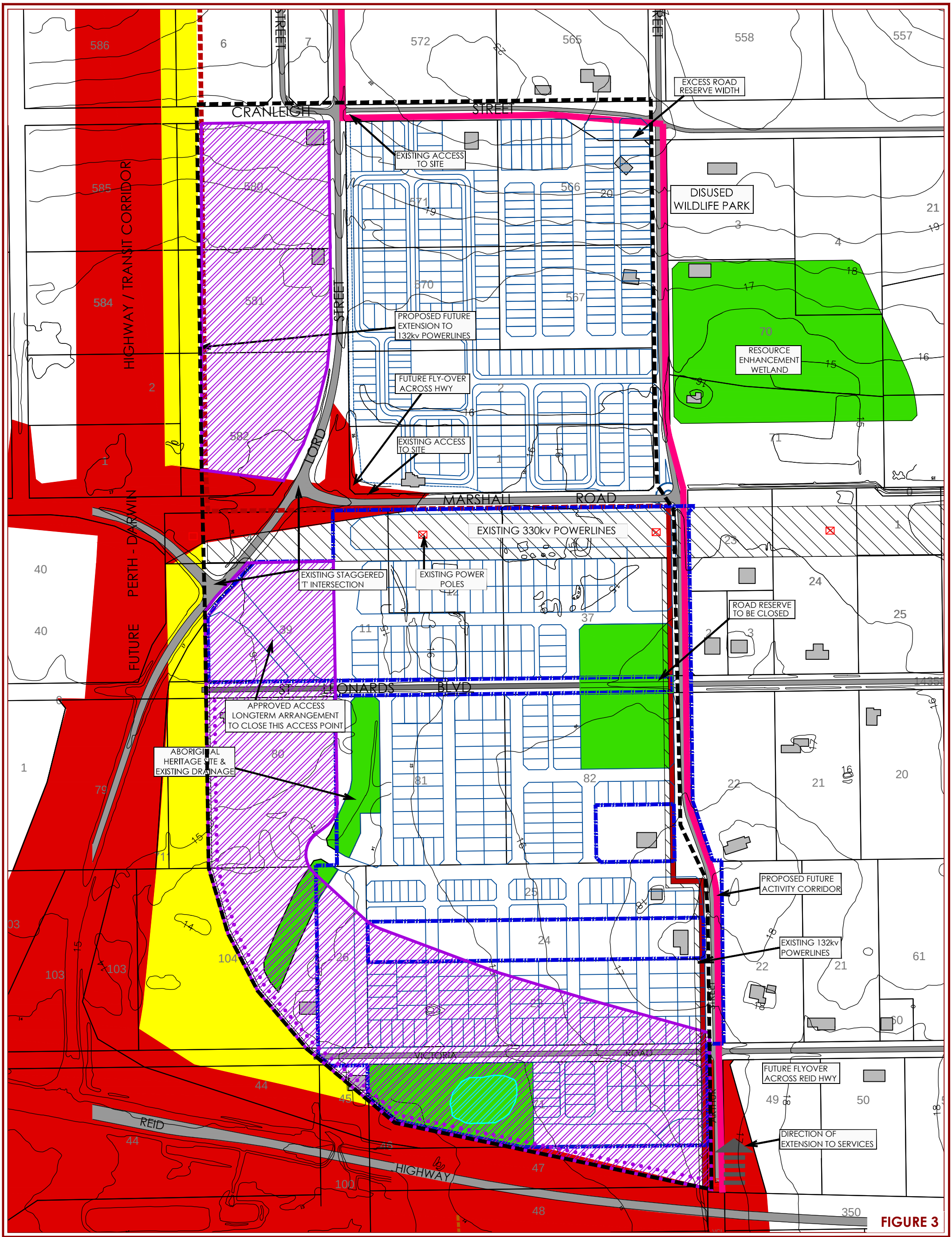

FIGURE 3

LEGEND:

- Subject Land
- Approved Subdivision
- Public Open Space
- Existing houses
- Activity Corridor
- Noise Wall Required
- Areas Affected by Noise requiring notice on title
- MRS Regional Road Reserve
- Public Purpose Reserve
- Drainage Required

NORTH

0 25 50 75 100m

SCALE 1:4,000 (A3)

SITE ANALYSIS
DAYTON
CITY OF SWAN

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Plan No: ASP WES LSP1-4-02f
Planner: KW
Date: 14.03.13
Client: ST LEONARDS ESTATE PTY LTD

FIGURE 4

LAND OWNERSHIP

Lot 300 - 0.19ha
CT 2800-94
St Leonards
Estate Pty Ltd

CRANLEIGH STREET

Lot 580 - 2.53ha
CT 2800-95
St Leonards
Estate Pty Ltd

Lot 571 - 2.73ha
CT 1358-398
Aspen Communities
Nominees PTY Ltd

Lot 566 - 2.52ha
CT 1817-507
Triple Power
Reality PTY Ltd

Lot 581 - 2.22ha
CT 1731-190
St Leonards
Estate Pty Ltd

LORD STREET

Lot 570 - 2.22ha
CT 1540-359
Aspen
Communities
Nominees PTY Ltd

Lot 567 - 2.23ha
CT 1358-396
K.H.Law &
S.A.Tiong

Lot 582 - 2.59ha
CT 1740-642
St Leonards
Estate Pty Ltd

Lot 9025 - 3.80ha
CT 2803-177
Enclave at
St Leonards Ltd

HIGHWAY 1

Lot 4 - 1.21ha
(1.21ha is
MRS/LPS reserved)
CT 1393-654
Shire of Swan

DAYTON BLVD

LORD STREET

PERTH - DARWIN

FUTURE

ST LEONARDS BLVD

STREET

Majority Single Lots in
Private Ownership

Lot 821
6671m²
CT 2680-183
D.M & J.A Faulkner

Lot 24 - 2.02ha
Ct 3-370A
C & D.A Filardo

Lot 9024 - 0.00ha
CT 00-000
kbjnerbboi

ARTHUR

VICTORIA ROAD

Lot 45 - 4723m²
(2151m² is
MRS/LPS reserved)
CT 1702-311
Commissioner of
Main Roads

Lot 8001 - 1.56ha
CT LR3161-214
State of WA

Lot 9016 - 2.08ha
CT 2775-48
St Leonards Estate Pty Ltd

Lot 9016

REID HIGHWAY

Lot 47 - 2.02ha
(1.46ha is MRS reserved)
CT 1296-482
Commissioner of Main Roads

All areas and dimensions are subject to survey, engineering and detailed design and may change without notice.

FIGURE 4

LEGEND

- Subject Area LSP 1
- Public Utility in LPS
- Public Purpose in MRS
- Primary Regional Road in MRS
- 330 KV Power Easement

NORTH

0 25 50 75 100m
SCALE 1:4,000 (A3)

LAND OWNERSHIP PLAN
LSP1 DAYTON
CITY OF SWAN

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F (08) 9328 6511

Plan No: ASP WESLSP1-4-04c Client: St Leonards Estate Pty Ltd
Date: 12.03.13 Planner: KW

FIGURE 5A

METROPOLITAN REGION SCHEME EXTRACT

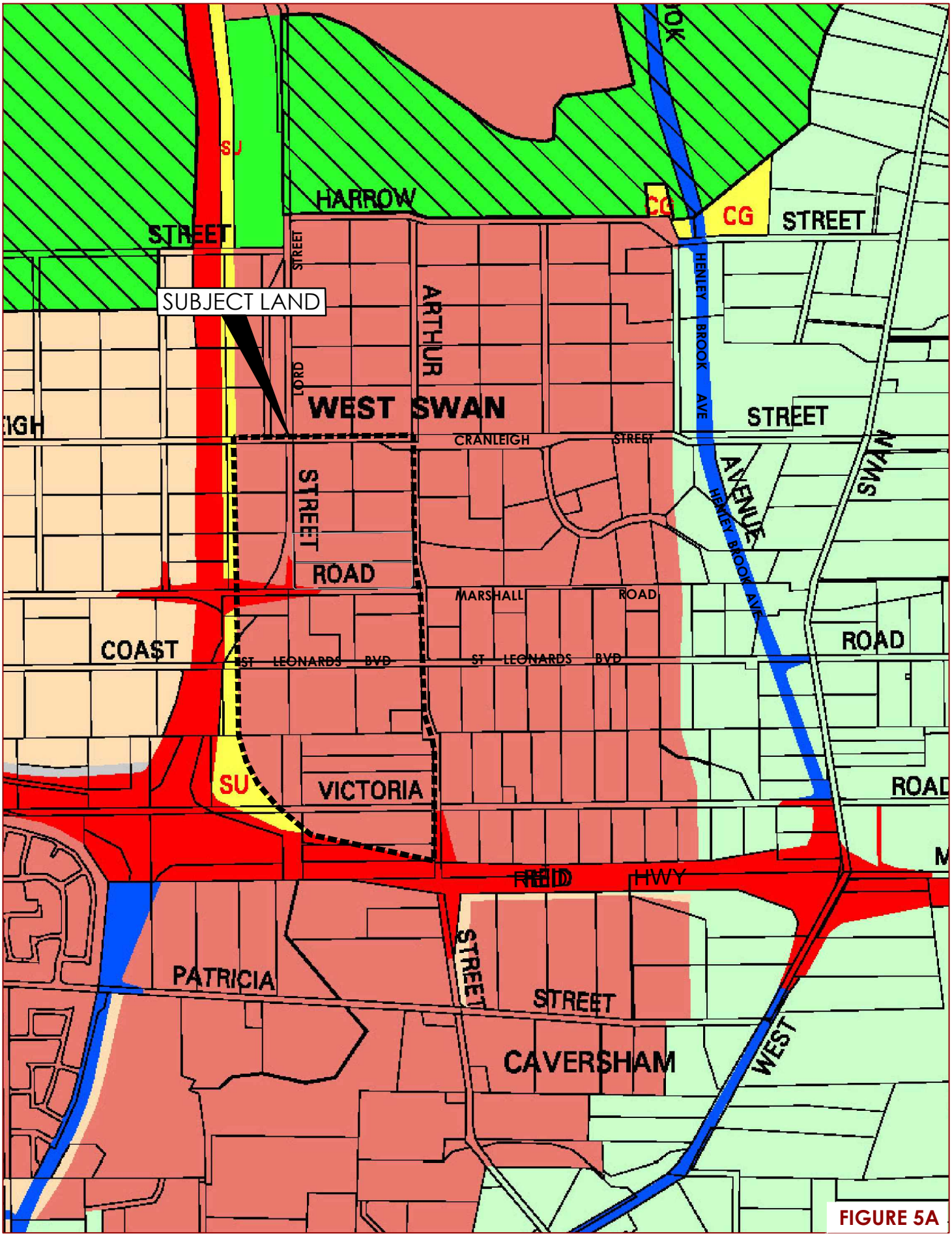

FIGURE 5A

NORTH

METROPOLITAN REGION SCHEME MAP

LSP 1 DAYTON

CITY OF SWAN

Planner: KW
Client: St Leonards Estate Pty Ltd
Date: 11.03.13
Plan No: ASP WESLSP1 9-01

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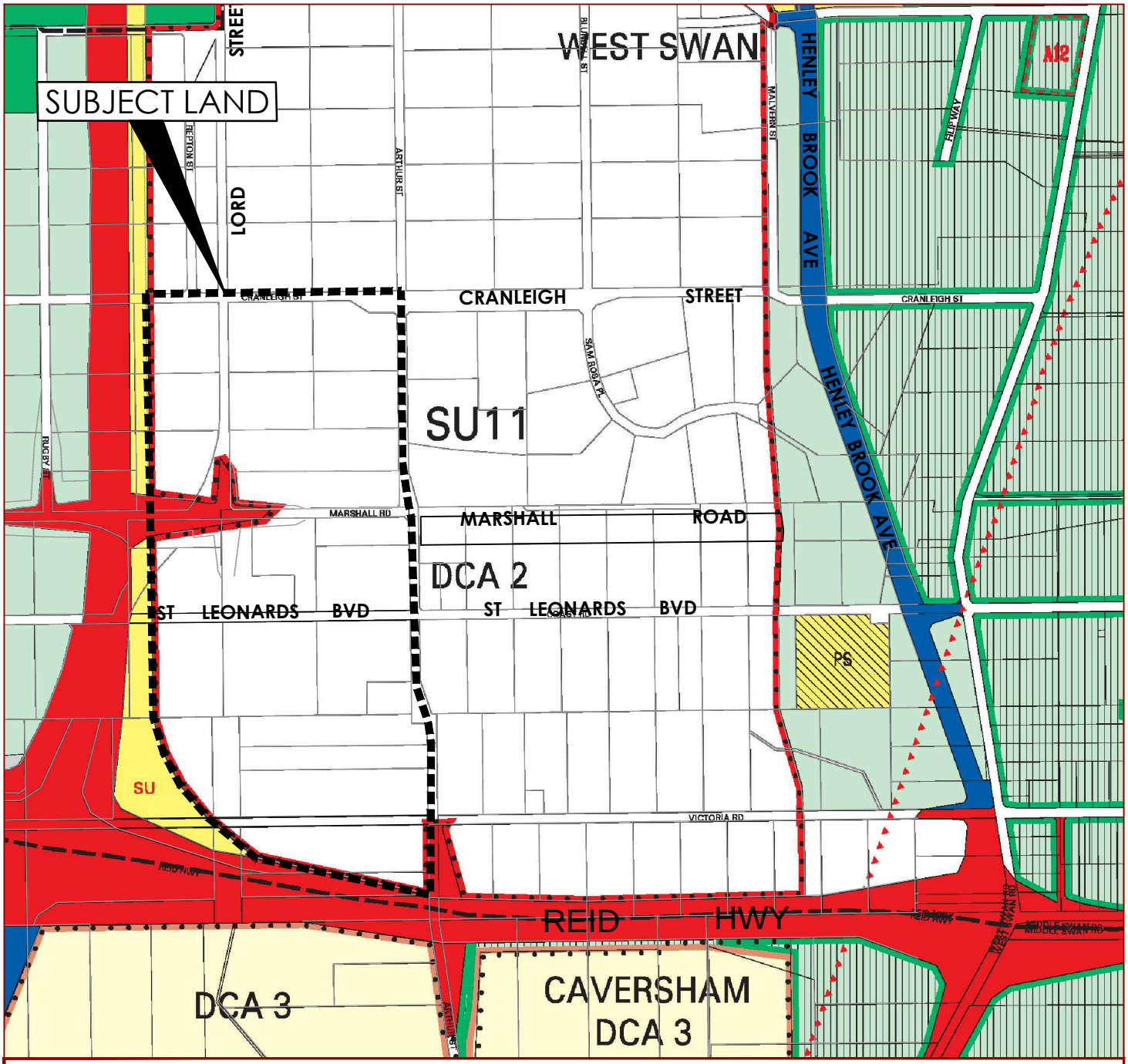
FIGURE 5B

LOCAL PLANNING SCHEME 17 MAP EXTRACT



LEGEND

METROPOLITAN REGION SCHEME RESERVES

- PARKS AND RECREATION
- PRIMARY REGIONAL ROADS
- OTHER REGIONAL ROADS
- PUBLIC PURPOSES - DENOTED AS FOLLOWS:
  - H HOSPITAL
  - CG COMMONWEALTH GOVERNMENT
  - SU SPECIAL USES

LOCAL SCHEME RESERVES

- LOCAL ROAD
- PUBLIC PURPOSES DENOTED AS FOLLOWS:
  - PS PRIMARY SCHOOL
- RECREATION

ZONES

- RESIDENTIAL
- RESIDENTIAL DEVELOPMENT
- SPECIAL USE
- GENERAL RURAL
- RURAL RESIDENTIAL
- SPECIAL RURAL
- SWAN VALLEY RURAL

OTHER

- R20 R CODES
- A1 ADDITIONAL USES
- SPECIAL USE AREA (SEE SCHEME TEXT)
- DCA 1 DEVELOPMENT CONTRIBUTION AREA BOUNDARY (SEE SCHEME TEXT)
- FLOOD PRONE AREA
- AIRCRAFT NOISE EXPOSURE
- STRATEGIC REGIONAL CENTRE BOUNDARY

FIGURE 5B

NORTH

LOCAL PLANNING SCHEME No17

LSP1 DAYTON

Planner: KW
Client: St Leonards Estate Pty Ltd
Date: 11.03.13
Plan No: ASP WESLSP1 9-01

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FIGURE 6

SUB REGIONAL STRUCTURE PLAN

LEGEND

- Residential
- PS — Primary School
- EdS — Educational Support
- High School
- Commercial Centre
  - LC — Local Centre
  - NC — Neighbourhood Centre
  - LNC — Large Neighbourhood Centre
- Mixed Business
- Conservation
- District Open Space
- Primary Regional Roads
- Other Regional Roads
- Pumping Station
- Activity Corridor (key bus route)
- MRS Railways Reserve
- MRS Special Purpose
- Future Transit Station

Constraints:

- Gas Pipeline Easement
- Sensitive Landuse Buffer

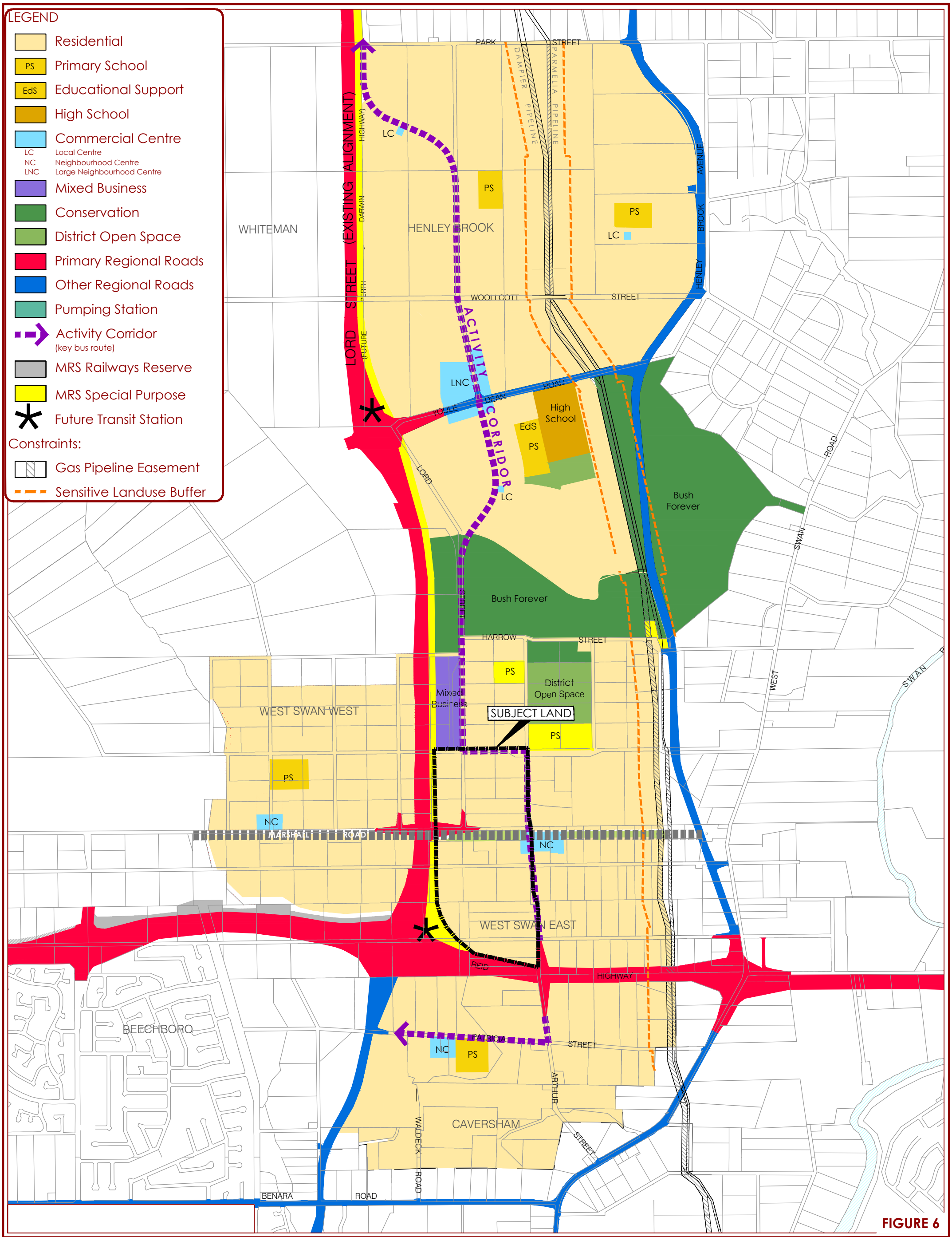

FIGURE 6

NORTH

0 200 400 600 800 1000m

SCALE 1:20,000 (A3)

SUBREGIONAL STRUCTURE PLAN
SWAN URBAN GROWTH CORRIDOR
CITY OF SWAN

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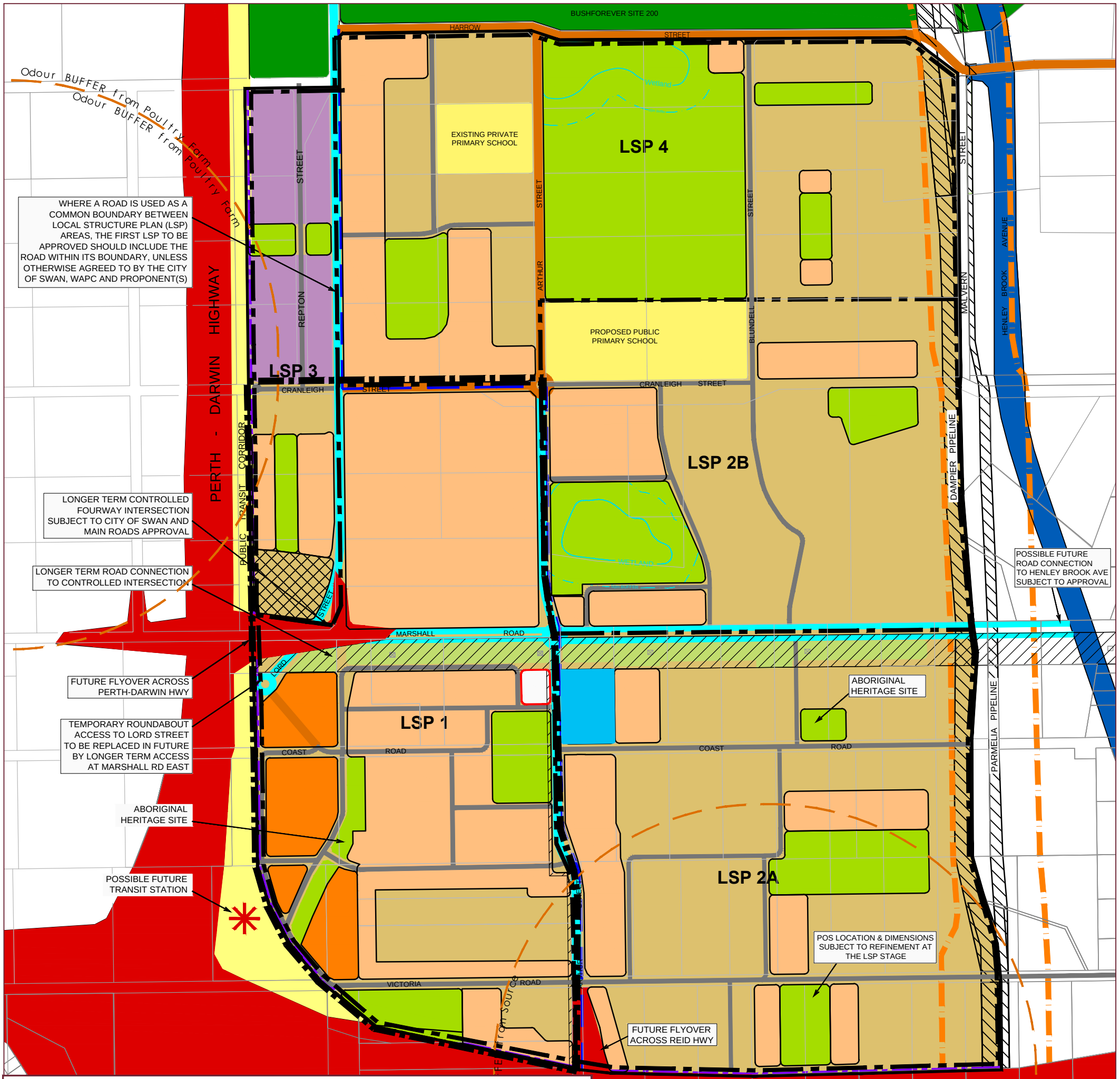
Plan No: ASP WES 2-15a_3 Client: St Leonards Estate Pty Ltd
Date: 05.02.13 Planner: JB

FIGURE 7

DISTRICT STRUCTURE PLAN



ESTIMATED RESIENTIAL YIELDS & PUBLIC OPEN SPACE PER LSP.

LSP	Gross Area	Gross Subdivisible Area	Gross Residential Area	Nett Residential Area	Low Density	Medium Density	High Density	Total Dwelling Yield	Gross POS	Approx POS Credit
1	58.5	55.1ha	50.4ha	36ha	80	640	300	1020	4.96ha	4.4ha
2A	67.2	60.4ha	55ha	38ha	530	200	0	730	5.37ha	4.1ha
2B	48.8	42.9ha	36.25ha	24ha	360	160	0	520	6.52ha	2.7ha
3	17.6	8.7ha	6.47ha	5ha	20	50	0	70	1.75ha	1.1ha
4	63.9	61.6ha	39.5ha	28ha	290	260	0	550	21.99ha	16.7ha
Total	256ha	228.7ha	187.62ha	131ha	1280	1310	300	2890	40.59ha	29ha (12.7%)

All figures are estimates only & subject to refinement at the local structure planning stages.

NOTES

PUBLIC OPEN SPACE AND DRAINAGE
Public Open Space and Drainage areas are indicative and subject to detailed design and modelling at the Local Structure Plan stage.

DISTRICT OPEN SPACE FACILITIES
12ha of District Open Space Facilites are to be located within a minimum of 15ha of public open space, co-located with the Resource Enhancement Wetland and adjacent to the Public Primary School along Arthur street.

SERVICE COMMERCIAL
Uses within the site are as per the Service Commercial Use class table listed in the District Structure Plan with emphasis on creating a Mixed Business/Service Commercial development site to cater for commercial uses not suitable for the local neighbourhood centre.

LOCAL NEIGHBOURHOOD CENTRE
Uses within the local neighbourhood centre site are as per the City of Swan General Commercial use class with emphasis on encouraging a main street style local neighbourhood centre.

SPECIAL USE - COMMUNITY SITE
Uses within the site are generally intended for civic and community purposes, with emphasis on a design complementary to the Activity corridor and public open space.

SPECIAL USE - INFRASTRUCTURE SITE
The Special Use - Infrastructure site may be required for a 2 ha power substation site. In the event agreement is reached for an alternative location, this site is designated for low density residential.

ODOUR BUFFER
Subdivision within the designated odour buffer is not permitted until the satisfactory removal or reduction of the buffer in accordance with section 4.4 of the report

HERITAGE
The identified heritage sites are to be protected within public open space or alternative, subject to detailed design at the Local Structure Plan stage.

RESIDENTIAL
Uses within the Residential areas are as per the City of Swan Residential Zone use class. Residential densities are indicative only and shall be confirmed at the local structure plan stage, aiming to achieve a minimum of 22 dwelling units per hectare across the structure plan area with higher/medium densities concentrated along the Activity Corridor, Commercial centre and areas of POS.

ACTIVITY CORRIDOR
The Activity Corridor is intended as the central spine for movement and activity connecting Albion with Caversham through West Swan and shall provide the function of a frequent public transport route with higher residential densities, home based businesses and some commercial and community uses encouraged alongside it.

INFRASTRUCTURE CORRIDOR & EASEMENT
Use, development and ownership of the infrastructure corridor & easement are to be to the satisfaction of the City of Swan and Western Power and is subject to more detailed design at the Local Structure Plan stage.

GAS PIPELINE SETBACK
Use and development within the gas pipeline setback area is restricted and subject to futher refinement at the Local Structure Plan Stage.

LOCAL STRUCTURE PLANS
Subdivision and development of the subject area is to be in accordance with an endorsed applicable Local Structure Plan unless otherwise approved by the City of Swan and/or Western Australia Planning Commission.

LEGEND

- Subject Area
- Low Density Residential (R5-R20)
- Medium Density Residential (R20-R60)
- High Density Residential (R60-R100)
- Local Neighbourhood Centre
- Service Commercial
- Primary Schools
- POS/Drainage/Conservation Area
- Special Use - Community
- Powerline Easement
- Gas Pipeline Easement
- Infrastructure Corridor
- Special Use- Infrastructure
- Gas Pipeline Setback
- Noise Attenuation Measures as appropriate
- Odour Buffer
- Possible Future Transit Station
- Activity Corridor
- MRS Primary Regional Road
- MRS Other Regional Roads
- Integrator B Road
- Neighbourhood Connector Road
- Access Streets
- MRS Public Purpose Reserve
- Local Structure Plan Boundaries

ENDORSED March 2012

NORTH

0 100 200 300 400 500m

SCALE 1:7,500 (A3)

WEST SWAN (EAST) DISTRICT STRUCTURE PLAN

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Plan No: ASP WES 2-03h Client: Aspen Living
Date: 16.12.11 Planner: RVS

CITY OF SWAN

FIGURE 8

SERVICING STRATEGY

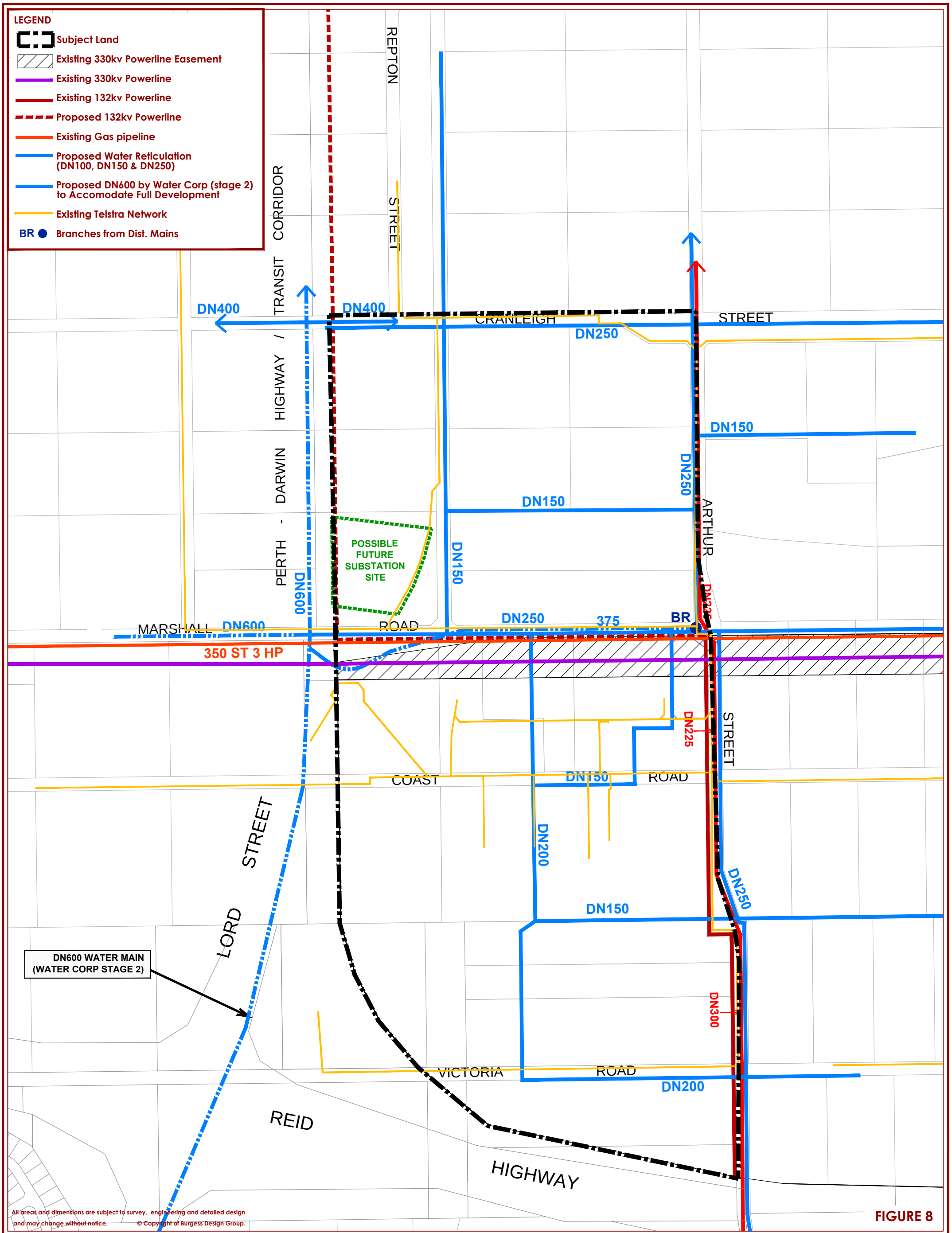

FIGURE 8

Endorsed by:

....

Tabec Engineering Date

NORTH

0 50 75 100 150

SCALE 1:5,000 (A3)

DISTRICT SERVICING STRATEGY
LSP1 DAYTON
CITY OF SWAN

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PO Box 374 Northbridge WA 6865 P (08) 9328 6411
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Plan No: ASP WESLSP1 4-03d Client: St Leonards Estate Pty Ltd
Date: 13.03.13 Planner: KW

FIGURE 9

LOCAL STRUCTURE PLAN 1

NOTES:

1. Areas and dimensions subject to survey.
2. The road layout is subject to final design at subdivision. See the Traffic Assessment Report (Appendix 2) and Preliminary Intersection Designs (Appendix 6) for further information.
3. All corner lots that are coded R20 can be developed/subdivided to a maximum density of R30.
4. The function and design of public open space areas shall be generally in accordance with the concept plans included in the LSP 1 documentation, though still subject to refinement as part of Landscape Management Plans to be approved prior to construction.
5. Subdivision and development within residential areas shall comply with the 'Residential' zone of Local Planning Scheme No.17 and the Residential Design Codes as they apply to the designated R Codes reflected on this plan or referred to in Note 3 and Note 11.
6. Use and development within the designated 330KV Powerline Easement shall be subject to approval by Western Power and the City of Swan, the intention being for this corridor to be utilized for low maintenance open space, community garden opportunities, pedestrian/cyclist path network, road reserves and car parking associated with the community site and in a manner consistent with the existing power line easement.
7. A Developer Contribution Plan (DCP) applies to this cell & should be read in conjunction with the Structure Plan. Triggers for DCP Items/Works (see s.6.1).
8. Detailed Area Plans may be required by the WAPC on advice from the City of Swan as a condition of subdivision (see s.5.2.6.).
9. Dwellings within the noise exposure level 2 area will require notification to be placed on the Certificate of Title advising of the possible noise impacts associated with nearby transport routes. Additionally, DAPs will be required for any lots within this Level 2 Area, DAPs are to detail the required quiet house design measures, and in the case of two storey development the need for any further acoustic assessment.
10. Narrow Lot Innovation Precinct - minimum lot size is 144m². Development is to be in accordance with the R60 provisions of the Residential Design Codes unless otherwise varied by a council approved Detailed Area Plan.
11. No subdivision or development of land for residential purposes within the 500m odour buffer emanating from the poultry farm at (No.) 60 Cheltenham Street, Bennett Springs, until:
    i. A technical study recommending the buffer may be removed or reduced has been accepted by the Department of Environment Regulation (DER); or
    ii. The poultry farm is decommissioned and removed.

5m Road Widening Required on Eastern Side of Arthur Street as part of LSP 2A & 2B

Medium Term Roundabout

Possible Future MRS Road Widening Subject to Acquisition

Possible Future Flyover - subject to review

Primary Regional Road - subject to review

Future intersection treatment to be determined

POSSIBLE FUTURE TRANSIT STATION

Possible Future Transit Station Location

CRANLEIGH STREET

MARSHALL ROAD

St LEONARDS BVD

KENNEDIA ENT

GRANDIS ROAD

REID HWY

ARTHUR STREET

LORD STREET

Public Open Space/ Drainage 5331m² E-POSF16 0.5331ha

Public Open Space/ Drainage 5093m²

PT E-POSF13 0.4404ha POS/ Drainage 4404m²

PT POSF 8 0.6256ha POS/ Drainage 6256m²

Public Open Space/ Drainage 1.9123ha E-POSF08 1.9123ha

Public Open Space/ Drainage 1.6486ha E-POSF09 1.6486ha

Community Site Special Use

LSP 1

LEGEND

- Subject Area LSP 1
- Public Open Space/Drainage/Wetlands
- Residential Zone
- Special Use - Community (see s.5.4)
- MRS Primary Regional Road
- Narrow Lot Innovation Precinct
- Noise Attenuation Measures as appropriate (see s.5.9.7)
- Activity Corridor - Home Based Business / Home Office Opportunites
- Indicative Carriageway
- Dual Use Footpath
- Refer Appendix 6
- 330KV Powerline Easement & Road Reserves (see s5.5.2)
- Creation of titles for these lots is subject to the future removal of odour buffer
- 132 KV Powerline Easement (see s.5.9.1)
- Boundary of area affected by noise exposure (see note 9)
- 500m Odour Buffer from Poultry Farm

AU Additional Use:

'D' Residential Sales Office

Means a building of either a temporary or permanent nature, and incidental car parking, used directly in relation to the sale of the land and dwellings in residential estates.

'D' Home Centre

Means a group of two or more dwellings and incidental car parking which are intended to be open for public inspection as examples of dwelling design.

'D' Temporary Car Park

Means premises used for a limited period of time for parking vehicles open to the public and incidental to the sale of land and dwellings in new residential estates but does not include any part of a public road used for parking or any premises in which cars are displayed for sale.

Signed by an officer duly authorised by the Western Australian Planning Commission pursuant to section 16 of the *Planning and Development Act 2005*

NORTH

0 50 100 150 200m

Scale: 1:4,000 (A3)

Plan No: ASP WES LSP1-2-02za
Date: 07.05.15

LOCAL STRUCTURE PLAN 1 DAYTON

CITY OF SWAN

FIGURE 9 -

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FIGURE 10

INDICATIVE STAGING PLAN

CONSTRUCTION TO COMMENCE NOVEMBER 2013

FUTURE STAGE

"THE ENCLAVE" - UNDER CONSTRUCTION

"ST LEONARDS" SOUTH OF MARSHALL ROAD PRIMARILY EITHER CONSTRUCTED OR UNDER CONSTRUCTION

CRANLEIGH STREET
LORD STREET
MARSHALL ROAD
ST LEONARDS BVD
KENNEDIA ENT
GRANDIS ROAD
REID HWY
VICTORIA RD
ARTHUR STREET
WATERCRESS GARDENS
LITORIA PASS
SALIGNA WAY
FLORIBUNDA GATE
DROSERA PWY

LSP 1

NORTH

FIGURE 10

LEGEND

- Subject Area LSP 1
- Public Open Space/Drainage/Wetlands
- Residential Zone
- Special Use - Community (see s.5.4)
- MRS Primary Regional Road
- Narrow Lot Innovation Precinct
- Noise Attenuation Measures as appropriate (see s.5.9.7)
- Activity Corridor - Home Based Business / Home Office Opportunites
- Indicative Carriageway
- Dual Use Footpath
- Refer Appendix 6
- 330KV Powerline Easement & Road Reserves (see s5.5.2)
- 132 KV Powerline Easement (see s.5.9.1)
- Boundary of area affected by noise exposure (see note 10)

ASPEN GROUP

STAGING PLAN DAYTON

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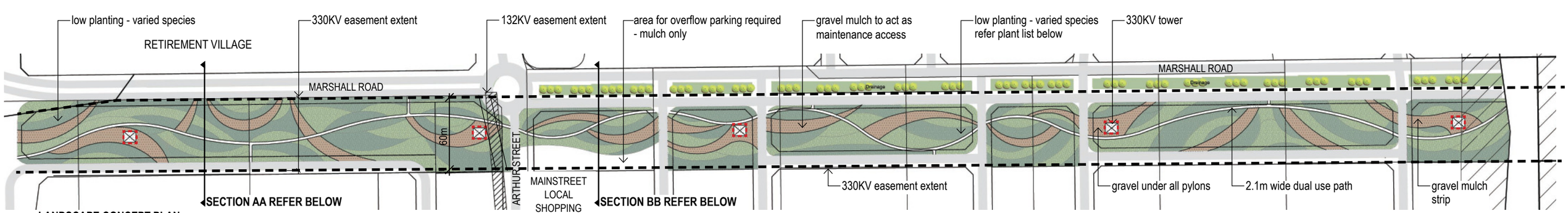
Scale: 1:4,000 (A3)

Plan No: ASP WESLPS1-2-02v
Date: 07.03.13

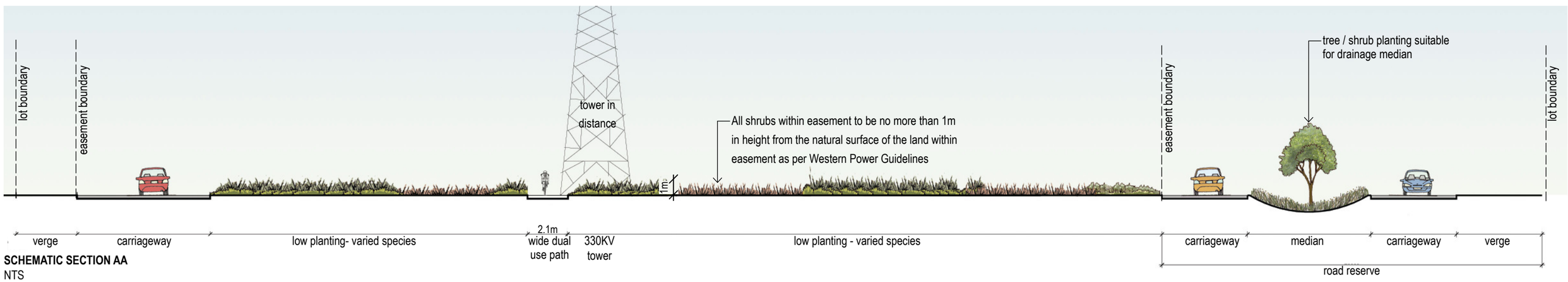
CITY OF SWAN

FIGURE 11

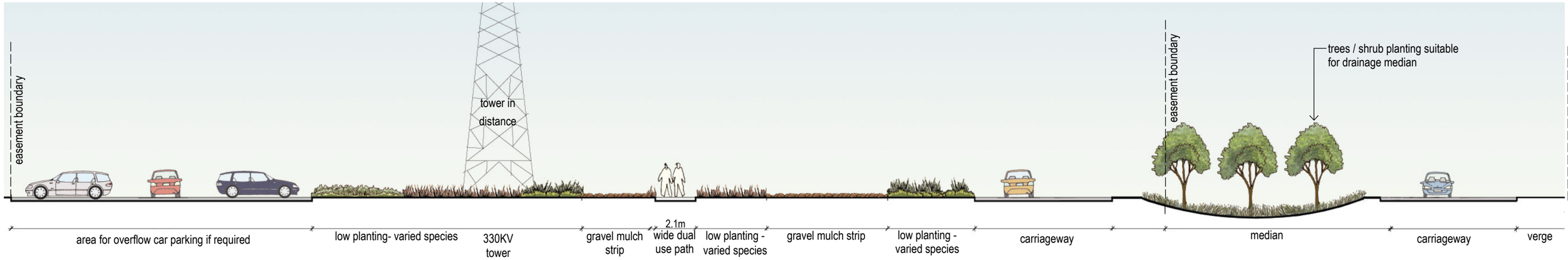
INDICATIVE LANDSCAPE PLAN FOR POWERLINE CORRIDOR



LANDSCAPE CONCEPT PLAN
NTS



SCHEMATIC SECTION AA
NTS



SCHEMATIC SECTION BB
NTS

PLANT SPECIES SUITABLE FOR WESTERN POWER EASEMENT

Botanical Name	Common Name	Height	Spread
SHRUBS			
Acacia stenoptera	Narrow-winged Wattle	0.3m	1.5m
Acacia pulchella	Prickly Moses	1.0m	1.5m
Anigozanthos flavidus	Pink Joey	0.5m	0.5m
Anigozanthos manglesii	Kangaroo Paw	0.7m	0.5m
Anigozanthos viridis	Green Kangaroo Paw	0.7m	0.5m
Calytrix fraseri	Pink Summer Starflower	0.5m	0.5m
Calytrix flavesens	Summer Starflower	0.5m	0.5m
Dampiera linearis	Common Dampiera	0.5m	0.5m
Hibbertia racemosa	Stalked-Guinea Flower	0.5m	0.5m
Melaleuca conothamnoides	Coast Honey-myrtle	1.0m	1.0m
PERENNIAL HERBS			
Conostylis aculeata	Spiny Cottonheads	0.3m	0.5m
Conostylis candicans	Grey Cottonheads	0.3m	0.5m
Dianella 'Cassa Blue'	Cassa Blue	0.5m	0.4m
Grevillea thelemanniana	Spider Net Grevillea	0.3m	1.5m
Hakea prostrata	Harsh Hakea	1.0m	1.5m
Lomandra longifolia	Spiny Headed Mat Rush	0.5m	1.0m
Patersonia occidentalis	Purple Flag	0.3m	0.5m
GROUNDCOVERS			
Banksia blechnifolia	Prostrate Banksia	0.7m	0.5m
Hemiandra pungens	Snake Bush	0.5m	1.0m
Kennedia prostrata	Running Postman	0.5m	1.0m

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ST LEONARDS
GATEWAY TO THE SWAN VALLEY

FIGURE 12

IMPLEMENTATION FRAMEWORK OF TECHNICAL TASKS/REPORTS

Figure 12: Implementation Framework of Technical Tasks/Reports

Item	Task	Responsible	Reference
1	Urban Water Management Plan	The relevant developer	Clause 6.2(b) of Special Use site 11 in LPS17 & Appendix 4 of Dayton DSP
2	Acid Sulfate Soil Management Plan	The relevant developer/proponent of subdivision application	Section 5.8.3 of LSP1 & Appendix 7 of Dayton DSP
3	Contaminated Site Assessment and Soil Contamination and Remediation Plan (as may be applicable to sites of potential sources of contamination)	The relevant developer/proponent of subdivision application	Clause 6.2(a) of Special Use site 11 in LPS17 & Appendix 8 of Dayton DSP
4	Preparation and adoption of Detailed Area Plans (as may be applicable)	The relevant developer/proponent of subdivision application	Liveable Neighbourhoods & Section 5.2.6 of LSP 1
5	A technical odour study to remove or further reduce the 500m odour buffer around the poultry farm located at No. 60 Cheltenham Street, Bennett SPrings	Affected landowners/developers	Section 5.8.2 of LSP1 & Appendix 5 of Dayton DSP
6	Endorsement of the Development Contribution Plan for DCA2 and the 'Capital Expenditure Plan for the Urban Growth Corridor'	City of Swan	Clause 5A.2 of LPS17 & Section 6.1 of LSP1
7	Implementation of the groundwater and stormwater management systems in public open spaces	The developer(s)	Sections 5.3.4 & 6.2 of LSP1
8	The implementation of permanent wastewater treatment infrastructure to enable subdivision outside the Early Release Subdivision Area and above current capacity restrictions	The developer(s) in consultation with Water Corporation	Section 5.9.4 of LSP1 and Appendix 1 of LSP 1
9	The implementation of noise mitigation measures	The developers/landowners adjoining the required noise wall and those affected by the level 2 noise levels.	Section 5.9.7 of LSP1 and Appendix 6 of Dayton DSP

APPENDIX 1

ENGINEERING SERVICING REPORT AND ADDENDUM

TABEC
Civil Engineering Consultants

WEST SWAN (ST LEONARDS) INFRASTRUCTURE REPORT – LSP 1

FOR ASPEN LIVING

SEPTEMBER 2011

TABLE OF CONTENTS

INTRODUCTION

TABEC have been requested to provide an infrastructure assessment for the West Swan (East) Local Structure Plan 1 Area landholdings held by Aspen Group. This area is bounded by Lord Street to the west, Reid Hwy to the south, Arthur Street to the east and Cranleigh Street to the north.

This document will form the basis of the engineering input into the overall submission for the West Swan (East) Local Structure Plan 1 Area, which will be compiled by the nominated planner, Burgess Design Group. The document will aim to satisfy the requirements of the WAPC, DPI and other relevant regulatory authorities in the rezoning process. At this early stage, we understand this report will be an iterative and consultative process. The report will be used as a basis to continue discussions and arrive at servicing solutions with the various regulatory authorities.

Our preliminary layout for this infrastructure assessment is setout in accordance with the overall requirements for the West Swan (East) Local Structure Plan 1 Area submission as follows: -

- Introduction
- Section 1 Existing Community & Environment
    - Section 1.1 Environmental
        - Section 1.1.1 Topography and Landform
        - Section 1.1.2 Soils and Geomorphology
        - Section 1.1.3 Surface Hydrology and Groundwater
    - Section 1.2 Service Infrastructure
        - Section 1.2.1 Sewerage System
        - Section 1.2.2 Water Supply
        - Section 1.2.3 Electricity
        - Section 1.2.4 Gas
        - Section 1.2.5 Telecommunications
- Section 2 West Swan (East) Structure Plan Area
    - Section 2.1 Engineering
        - Section 2.1.1 Earthworks
        - Section 2.1.2 Stormwater Management
        - Section 2.1.3 Roadworks
        - Section 2.1.4 Water Supply
        - Section 2.1.5 Waste Management
        - Section 2.1.6 Power Supply
        - Section 2.1.7 Telecommunications
        - Section 2.1.8 Gas Supply

Notes:

a) The information in Section 1.1 will be delivered in consultation with reporting from the nominated environmental consultant;

This infrastructure assessment is based upon Burgess Design Group's concept sketches current to February 2010.

1 EXISTING COMMUNITY AND ENVIRONMENT

1.1 Environmental

This section will be completed in conjunction with information provided by the nominated environmental consultant and the nominated geotechnical consultant.

This section examines the existing site topography, vegetation and other natural or man-made features which are known to be on the site, and which may impose risks upon the development, or to the cost of construction. Where possible, we will seek to clarify these risks and show potential mitigation strategies.

1.1.1 Topography and Landform

The site is generally flat and comparatively low lying but features some remnant sandy ridges and knolls rising to a maximum height of approximately 27 metres AHD in the northeast. The northern third of the site, (north of Cranleigh Street) is generally at or above 20 metres AHD, with topography mostly grading moderately toward the south from the vicinity of Cranleigh Street. The remainder of the site is generally flat with slight grades toward the south-western corner, with levels between 14 metres and 18 metres AHD.

The site has been extensively cleared, however there are some pockets of significant vegetation, particularly in the northern areas of the site at high points in the topography, near the intersection of Cranleigh Street and Arthur Street.

There are a number of existing houses, buildings and workshops within the subject site. The condition of these varies from habitable to part-demolished. There is visual evidence of some uncontrolled fill on properties within the subject site. RPS have provided commentary regarding the status of the uncontrolled fill for Stages 1 and 2 of the St Leonards development. Stage 1 is the “early release area” bounded by Lord Street, Marshall Road East, Arthur Street and Reid Highway. Stage 2 is the proposed Over 55’s Village bounded by Lord Street, Marshall Road East, Arthur Street and Cranleigh Street.

1.1.2 Soils and Geomorphology

Based on the 1:50,000 scale Environmental Geology Series Mapping (Perth Sheet) and Coffey Geosciences report (P7174.02-AA-Rev2 dated 21 August 2006), titled “Residential Subdivision, West Swan – Report on Preliminary Geotechnical Investigation”, it is anticipated that the subsurface profile of the site can generally be subdivided into three different formations. The first includes two areas of thin Bassendean Sand over Guildford Formation in the northern third of the site, generally around or north of Cranleigh Street, and a smaller area in the southeast corner of the site. In accordance with Australian Standard AS2870-1996, it is anticipated that “A” lot site classifications can easily be achieved for these areas. The second formation is a relatively small area of swamp deposits in the middle-eastern portion of the site that will have to be excavated and removed from the site due to both environmental and geotechnical requirements and subsequently replaced with imported fill, after which it is anticipated that “A” lot site classifications would be achieved. The final formation , which covers the remainder of the site, is that of Guildford Formation alluvium and if a minimum of 1.2m of existing or imported sand fill is achieved over these areas then it is anticipated that “S” lot site classifications could be achieved, otherwise “M” lot site classifications are likely. The occurrence of layers of weakly

cemented dark brown silty sand and well (iron)-cemented silty sand or “coffee rock” is also likely. It is noted that the geotechnical investigation referred to above is extremely preliminary in nature and comprehensive geotechnical investigations will need to be carried out for each of the proposed subdivision areas. All earthworks will be carried out in accordance with the provisions of Australian Standard AS3798-1996 “Earthworks for Residential and Commercial Development”.

1.1.3 Surface Hydrology and Groundwater

The West Swan Estate Local Water Management Strategy (LWMS) prepared by Jim Davies & Associates “*proposes a Controlled Groundwater Level (CGL) approach to water table control, to minimise the requirement for imported fill*”. This would include the installation of subsoil drainage within all road reserves serving lots with design / finished pad levels that are less than 1.5 metres above Average Annual Maximum Groundwater Levels (AAMGL’s). Whilst the northern region of the site typically has in excess of one metre of fill above the AAMGL’s, the majority of the central and southern portions (with the exception of the south-eastern corner), have less than one metre. As a result these areas will require substantial amounts of imported fill, at significant cost. Where possible suitable material may be cut from areas where there is more than 1.5 metres of existing sand fill above the AAMGL’s, however other factors such as minimising depth of services across the site, maintaining existing topography character and vegetation need to be considered.

It should also be noted that within the LWMS, “Figure 12: Wetland Map” there are two “Resource Enhancement Wetland” areas identified. These are located within the central and northern regions of the site and may be retained within, or adjacent to POS areas.

The site generally drains toward the south-west toward an un-named gazetted creek which forms a tributary to the Bennett Brook.

1.2 SERVICE INFRASTRUCTURE

This section documents the locations of existing services infrastructure pertinent to the development of the subject site. Commentary regarding the suitability of services for connection to the site, and likely extension / upgrade requirements is documented in Section 2 of this report.

1.2.1 Sewerage System

Existing sewer infrastructure is not available within the vicinity of the site, however the nearest points of connection are available south of the Reid Highway as follows: -

- An existing temporary pumping station in Bennett Street between Patricia Street and Benara Road with excess capacity to service approximately 500 lots, located approximately 2.5 kilometres south of the subject site, dependent upon the route chosen.
- An existing rising main from the temporary pumping station in Bennett Street heading north toward the intersection of Patricia Street.
- An existing gravity main in the vicinity of the intersection of Bennett Street and Patricia Street, approximately 1 kilometre south of the subject site.

1.2.2 Water Supply

Existing minor water infrastructure is available within the site, however does not have sufficient capacity to service the proposed development. Augmentation and extension of existing major network supplies are required from the following locations: -

- A 600mm-diameter service located near the intersection of Benara Road and Altone Road, west southwest of the proposed development; and
- A 250mm-diameter service located near the intersection of Bennett Street and Patricia Street, southwest of the proposed development.

1.2.3 Electricity

Existing power services are available within the vicinity of the site as follows: -

- Existing aerial LV is available on a number of roads within the subject site including Arthur Street, Cranleigh Street, Harrow Street, Victoria Road and Marshall Road.

Existing underground power services are not available within close proximity to the site, with the nearest underground network located in the existing subdivision south-west of the Lord Street / Reid Highway intersection.

1.2.4 Telecommunications

Existing telecommunications services are available within the vicinity of the site as follows: -

- Arthur Street (north and south of the Reid Highway) – optical fibre on the western side of the existing road carriageway.
- Arthur Street – local cable (some nominated as dead) on the western side of the existing road carriageway.

- Victoria Street – local cable on the northern side of the existing road carriageway.

1.2.5 Gas

Existing gas infrastructure for domestic connection is not available within the vicinity of the site, however the nearest point of connection is available south of the Reid Highway as follows: -

- In existing residential subdivisions along Patricia Street west of the Lord Street road reserve, consisting of 80mm-diameter and 50mm-diameter services.
- The nearest 150mm-diameter services are approximately 2 kilometres west of the subject site in Altone Road on the eastern side of the road reserve, near the intersection of Reid Highway.
- The nearest 100mm-diameter services are approximately 400 metres from the subject site in Lord Street on the western side of the road reserve, south of Reid Highway.

Existing major infrastructure traverses the site in a number of locations including: -

- An existing high pressure main runs adjacent to Marshall Road in an easement from west to east.

2 WEST SWAN (ST LEONARDS) STRUCTURE PLAN AREA

This section documents the expected infrastructure upgrades required to service the proposed subdivision on the subject site. It is based upon an assessment of the existing infrastructure, its proximity to the site and our experience with similar projects. Please note, the bulk of the commentary in this report is still to be confirmed by the relevant regulatory authorities and this is expected to be an iterative, consultative process.

2.1 Engineering

This section summarises the infrastructure requirements for the future residential population of the West Swan (St Leonards) Structure Plan area.

2.1.1 Earthworks

Most areas subject to development are expected to require significant modification to its topography, due to the proximity of the AAMGL and the existing ground surface.

The site offers a number of key issues in the earthworks phase, namely: -

- Dust control measures during earthworking in drier periods;
- High groundwater / saturated conditions in wetter periods;
- Removal of some areas of imported debris and fill;
- Removal of some areas of remnant floodplain materials with potential (albeit minimal) acid sulphate risks and / or general deleterious materials such as peats.

Dust control measures will need to be assessed in detail. Removal of topsoil presents a risk to both the maintenance of on-site vegetation and the promotion of future vegetation growth. Transportation of nutrient-rich topsoil also presents a risk to downstream environments where the nutrients are collected in drainage catchments and water-bodies.

The high natural groundwater in some of the areas of the site means the timing of earthworks and deep excavations is important. The high natural groundwater provides an opportunity to minimise air-borne dust materials in general earthworking, however provides an added impediment to deep excavations. The proposed works programme for the earthworks and excavations will be discussed in detail with the Contractor at the time of commencement of the works.

The removal of dumped imported materials has been reviewed in detail by RPS. The management plans proposed for Stages 1 and 2 will be followed in detail by the Contractor, and will be reviewed and audited as prescribed.

Remnant floodplain areas have been mapped in Stages 1 and 2 and are the subject of extensive potential acid sulphate soils reporting by Bioscience. The management plans prescribed for the excavation of potential acid sulphate soils in deep excavations will be reviewed and audited as prescribed.

2.1.2 Stormwater Management

The subdivision drainage within the subject area will need to be constructed in accordance with the City of Swan's subdivision "Guidelines and Standards" and Jim Davies and Associates' West Swan Estate Local Water Management Strategy (LWMS).

Particular reference is made to Section 4.3 on Surface Water Management within the LWMS for further detail on drainage treatment and regional & local flood management. In short for the regional flood management this concludes that "*no flows are entering the site from upstream catchments*" and that "*the site is sufficiently upstream of both the Swan River and Bennett Brook to be unaffected by the 100 year flood levels of these watercourses*".

For the local flood management it states that it will "*consist of a series of pipes, swales, multiple use corridors, living streams, and ephemeral and existing permanent water storage areas to attenuate and infiltrate peak surface water flows, and provide water quality treatment for the proposed development prior to discharge from the Study Area to Bennett Brook and the Swan River. The stormwater drainage system will be designed using a major/minor approach. The minor drainage system is defined as the system of underground pipes, swales, kerbs, gutters etc. designed to carry runoff generated by low frequency ARI storms, typically less than 5 year ARI. The major drainage system is defined as the arrangement of roads, drainage reserves, attenuation/infiltration areas and open space planned to provide safe passage of stormwater runoff from extreme events which exceeds the capacity of the minor system*".

Effectively the LWMS emphasises the use of Water Sensitive Urban Design (WSUD) principles and in particular a treatment train approach for the area and management of water quality. From "*Figure 6: Study Area Surface Water Catchments*" within the LWMS it is understood that there are three distinct catchment areas and for the major events the stormwater runoff either discharges to the Swan River or Bennett Brook. The overland flow paths for the major storm events will be relatively easily catered for as the land generally falls away in the direction of the receiving bodies.

The cost per lot to install the subdivision drainage system is expected to be relatively high when compared to conventional development as a result of the following: -

- The likelihood that many of the drainage lines deeper than 2 metres below finished surface may require dewatering during the construction phase.
- The DEC potentially requiring trench backfill to be neutralised with lime and the dewatering treated with a lime dosing unit where there is some evidence of potential and / or actual acid sulphate soils.
- The requirement for subsoil drainage in low-lying areas of the site, particularly expected close to POS areas and the tributary in the south-western corner of the site near the intersection of Lord Street and Reid Hwy.
- The requirement for direct lot connections where the depth to clay, or clay equivalent soil types with low infiltration qualities from design levels is less than 2.0 metres.
- The requirement for gross pollutant traps (GPTs) and potentially significant retention basins.

2.1.3 Roadworks

There are significant major roadworks and transportation links planned for the long term within the vicinity of the site.

Initial discussions suggest the following items are planned for the long term with land set aside in the MRS and these are being considered in the overall designs for the St Leonards area: -

- A major freeway-style interchange will be required at the intersection of Reid Highway / Perth to Darwin Highway;
- Designs for flyovers and associated batters and drainage infrastructure on Arthur Street (over Reid Hwy) and Marshall Road (over the Perth to Darwin Highway);
- Extension of Henley Brook Drive to the east of the St Leonards landholdings;
- A heavy rail, light rail and / or busway corridor will be required on the eastern side of the Lord Street carriageway, with a transit station located near the intersection of Lord Street and Reid Hwy.

This information will be confirmed in further discussions with DPI Officers.

The status and land requirement of these infrastructure upgrades will be considered in the short term, with commentary provided on the likely opportunities and constraints and any risks which require mitigation.

The subdivision roads within the subject area will be constructed in accordance with the City of Swan's subdivisional "Guidelines and Standards". We would expect the following configurations, pending confirmation by the nominated traffic and transport consultant: -

- **Distributor Roads** 20 to 30 metre wide road reservations, with 3.5 metre wide lanes, 1.5 metre wide on-road cycle lanes and on-road parking where required;
- **Neighbourhood Roads** 18 to 20 metre wide road reservations, with 3.0 metre wide lanes, on-road cycling accommodated within 6.0 metre wide pavement and designated on-road parking where required; and
- **Community Roads** 10 to 16 metre wide road reservations, with 2.5 metre wide lanes.

The majority of paving will be black asphalt with entry statements, intersections, traffic calming devices and designated car-parking areas in red asphalt or brick paving. Road reserve and pavement widths will be determined by the nominated traffic and transport consultant Transcore, and are in accordance with Liveable Neighbourhoods criteria.

Mountable and semi-mountable kerbing will bound the roads with flush kerbing to be considered where POS abuts the road reserve to allow runoff into grassed areas, (with bollards or similar to City of Swan approval provided to prevent vehicular access into the POS and anti-social behaviour).

Dual Use Paths and footpaths will also be provided in accordance with the guidelines and the Department for Planning and Infrastructure requirements and additional footpath links may be provided in other areas as required.

It is not anticipated that any of the existing roads within the site will be able to be maintained as they are in effect rural roads with inappropriate longitudinal and / or horizontal gradients. In many areas they will also need to be raised significantly to suit the post development finished levels due to the high groundwater levels.

2.1.4 Water Supply

The Water Corporation's current planning is for the installation of 2690m of 600mm water main from the intersection of Benara and Altone Roads to the intersection of Patricia Street and Lord Street extension. This is intended to improve the supply of water to residential areas in Caversham. Design works are almost complete on this service. From here the Water Corporation's planning is for the construction of a 250mm water main east along Patricia Street then north along Arthur Street, which will act as a temporary water supply for the initial stages of the West Swan (East) Structure Plan area. This 250mm water main will be constructed as part of the development to be completed to the south of the subject land, owned by Qube. As such it will be completed in a staged approach and therefore co-operation is required between the developers to ensure the timely delivery of services. For future development of the St Leonards estate it is expected a 600mm diameter water main will need to be extended north along the Lord Street road reservation to the intersection of Lord Street and Marshall Road.

The provision of water services is an iterative process and will be confirmed with the Water Corporation, and further dialogue is expected.

All lots will be provided with connections in accordance with Water Corporation requirements via the installation of water reticulation within the development within the common trench, along with other essential services.

2.1.5 Waste Management

This section on waste management will focus on three phases of the waste management process: -

- **The initial capacity expansion for approximately 500 additional lots**

This requires the construction of a Type 40 pumping station on Qube land in Patricia Street near the lowpoint in the site in the vicinity of the ungazetted tributary, with rising main infrastructure to connect into an existing gravity sewer near the intersection of Patricia and Bennett Streets. The sewerage pumping stations and rising mains are developer prefunded works that are normally reimbursed twelve months after practical completion but agreement will need to be sought with the Water Corporation. The developer of the Caversham East property, (Qube) will pre-fund these works in an agreement with the Water Corporation.

- **The ultimate capacity expansion to service the entire West Swan (East) catchment plus other developments in Caversham**

This requires the construction of a Type 180 Pumping Station near the intersection of Benara Road and Bennett Street. There is potential this will be constructed in a staged approach starting as a Type 40, then Type 90 pumping station up to its final configuration as a Type 180 PS, (this will be determined in an upcoming Project Design Review or PDR which will be undertaken by the Water Corporation). The Water Corporation requires developer contribution to the purchase of the landholding for the pumping station site. The infrastructure includes the construction of a rising

main connecting the proposed pump station to infrastructure approximately 4 kilometres away near the intersection of Benara Road and Tonkin Highway.

- **The internal servicing**

The Water Corporation's current planning allows for two sewerage catchment areas within the overall West Swan (East) Structure Plan area. These include: -

- A smaller catchment located on the eastern boundary of the structure plan area that is contained entirely within the St Leonards subject site.
- A larger catchment including the developable area south of Reid Highway immediately adjacent to the St Leonards subject site and east to Bennett Brook as well as land to the west of the site, which is the West Swan (West) Structure Plan area.

The Water Corporation's current planning allows for two separate sewerage catchment areas within the overall West Swan (East) Structure Plan area. This includes a smaller catchment and associated Type 10 pump station (pumps at a maximum rate of 10 litres per second) that is contained entirely within the site and located along the eastern boundary of the structure plan area and includes less than one third of the overall development area. The second larger catchment includes the remainder of the structure plan area and is part of a much larger catchment that also includes all of the developable area south of Reid Highway immediately adjacent to the site and east to Bennett Brook as well as much of the land to the west of the site, which is the West Swan (West) Structure Plan area. The smaller catchment will then discharge, via a 100mm rising main, into the larger overall catchment.

The development will be serviced by reticulated gravity sewer. Earthworks may be required in the northeast and northwest to achieve lessened excavation depths in the southern sections of the site and into the Qube properties.

Aspen Group have negotiated connection to the proposed Type 40 pumping station in Patricia Street via Arthur Street through the subdivision area, and in a southerly direction under the Reid Hwy to Patricia Street, then west along Patricia Street adjacent to the proposed Qube development. This alignment has been agreed by both Qube and the Water Corporation as suitable for development.

All proposed lots will be provided with connections in accordance with Water Corporation requirements. The cost per lot to install the internal sewerage reticulation is expected to be relatively high as a result of: -

- The likelihood that many of the sewer lines deeper than approximately 2.5 metres below finished surface level may need to be dewatered.

- The DEC potentially requiring trench backfill to be neutralised with lime and the dewatering treated with a lime dosing unit where there is some evidence of potential and / or actual acid sulphate soils.

- The potential for deep sewer lines due to the relatively flat nature of the site.

2.1.6 Power Supply

The Structure Plan site is currently serviced by an above ground residential power supply as well as being traversed by 330KV and 132KV power transmission lines along the south side of Marshall Road, which will require a 100m easement / green buffer. At the intersection of Marshall Road and Arthur Street the 132KV line travels south along the western verge of Arthur Street and continues across Reid Highway. High voltage 22KV and low voltage distributor aerial lines are also located in several of the road reserves within the structure plan area.

All power lines, with the exception of the 330KVA and 132 KVA lines, will be relocated underground as part of the subdivision construction as this is an anticipated Western Australian Planning Commission (WAPC) approval requirement. The costs for which will be covered via the system charges except for the actual removal of the overhead infrastructure.

Long Term Servicing

To facilitate the full development of the West Swan Structure Plan Areas, Western Power have completed a long term review of requirements over the next 20 years. Western Power are proposing the extension of major infrastructure through the region, with requirements for an additional 132kV line along Marshall Road and north toward Ellenbrook. Planning for the 132kV alignment has commenced with the current preferred alignment in the Transit Corridor / Perth to Darwin Highway. Two substation sites will also be required, one of which is planned for land in the vicinity of the intersection of the Perth to Darwin Highway and Marshall Road.

Short Term Servicing

Aspen Group have commenced discussions with regard to first stage servicing with Western Power and Western Power have confirmed there is capacity to service initial development stages within the existing infrastructure. This has been confirmed through the Developer Information Plan (DIP) process.

This infrastructure however is not expected to be required in the short to medium term, as existing networks can be bolstered in the short term to meet expansion of the local urban area. This is confirmed by initial discussions with Western Power as quoted below: -

Western Power has indicated that they have planned to install a new Zone Substation at the corner of Lord Street and Gnangara Road within the near future to cater for the load growth in this area and to the north of Gnangara Road. Western Power will most likely allow the first few stages to come on with no substantial requirements but there may be constraints if the area developed rapidly and / or for future stages, which could include a non-refundable contribution. External to the subdivision there is a headworks charge policy that may or may not apply to this area.

Power in the subdivision will be through an underground power network. This will consist of high voltage and low voltage cables and necessary substations/equipment to be installed throughout each subsequent stage. The existing above ground power lines will need to be progressively removed and undergrounded as the project develops.

This development will be constructed as an Option B, (Option A was phased out as on the 1 June 2007). From our experience in similar outer-lying areas, an indicative cost for power supply to the subject site could be in the range $7,500.00 to $9,500.00 per lot. It is important to note that Western Power have some capacity issues in the sections of the SWIS network, from the northern extents of the metropolitan region up to Geraldton. This is a potential risk for the project, in terms of infrastructure, cost and time delay and should be resolved through discussion as early as practical.

Intersection lighting will be provided to relevant standards throughout the development, with increased requirements at all major intersections, particularly at intersections onto Lord Street, which may be to MRWA standards given the expected future traffic volumes.

2.1.7 Telecommunications

There is Telstra network within the development area, with both optical fibre and local cable available. It is likely that Telstra will require the developer to upgrade / augment existing infrastructure such as switchgear.

Consideration should be given to the provision of broadband internet connections to each lot and this could be bundled with underground free to air TV, pay tv and other infrastructure.

The suitability of any connections for extension into the subject site needs to be confirmed by Visionstrem through Telstra. This is usually completed after submission of the electrical drawings to Western Power as Telstra services are provided within the subdivision within the joint trench provided by the developer.

Developers can provide telecommunications infrastructure for any lot developments within LSP 1 by applying directly to Telstra. In the future, these applications for telecommunications will be through the NBN.

2.1.8 Gas Supply

For the development of the area bounded by Lord Street, Marshall Road, Arthur Street and Reid Hwy, St Leonards Estates Pty Ltd provided a Pressure Reduction Valve (PRV) to existing Medium Pressure ATCO Gas assets in Marshall Road. This connection is sufficient for supply to all proposed land uses in LSP 1.

Some local extensions of infrastructure within dedicated road reserves may be required at the developers' expense, pending timing of upstream and downstream development.

No further major infrastructure upgrades are required for the development of land within LSP 1.

WEST SWAN ST LEONARD (LOT 580, 581, 582 LORD ST) – LSP3

FOR ST LEONARDS PRIVATE ESTATE PTY LTD

MARCH 2013 – REV A

Contents

1. INTRODUCTION

TABEC has been engaged to provide an infrastructure assessment for modified Local Structure Plan 1, Dayton area landholding held by St Leonards Estate Pty Ltd' and Project Managed by Progress Developments, as shown in Figure 1 on the Burgess Design Group plan ASP WESLSP1-2-02V (dated 07-3-13).

The area of interest is bound by Cranleigh St to the north, Lord St to the east, Marshall Road to the south, and the future Perth-Darwin Highway to the east.

It is intended that the existing Local Structure Plan 1, will be amended and extended to include the subject area of Lot 580, 581 and 582 Lord St. It is intended that this document will be an addendum to Tabec's West Swan (St Leonards) Infrastructure Report-LSP1. The document will aim to satisfy the requirements of the Western Australian Planning Commission (WAPC), Department of Planning Infrastructure (DPI), and other relevant regulatory authorities.

2. EXISTING COMMUNITY AND ENVIRONMENT

This section examines the existing site topography, vegetation and other natural or man-made features which are known to be on the site, and which may impose risks upon the development, or the cost of construction.

2.1. Topography and landform

The site is generally flat and relatively low lying, with a slight gradient along the length of the site, with approximate levels of 20m AHD to the north at Cranleigh St, and 16m AHD to the south by Marshall Road.

The site has been extensively cleared with a pocket of trees remaining within the portion of lot 581, along with a number of significant trees in the northern portion of lot 580.

There are a number of existing buildings and sheds workshops within the subject site, ranging from habitable brick and tile dwellings to steel frame workshops. Agriculture style fencing borders much of the site and divides the respective lots.

2.2. Soils and Geomorphology

Based on the 1:50 000 scale Perth Metropolitan Region Environmental Geology Series Mapping, it is anticipated that the subsurface profile of the site is Bassendean sand over Guildford Formation to the northern half of lot 580 and south west portion of lot 582, with the remainder of the site Guildford Formation alluvium.

Monitoring bore logs ((JDA Consulting Hydrologists, March 2007), logged there is 1m of silty sand above sandy clay at bore AS5 (nominally at the boundary of lot 581/582 by Lord St), and over 2.2m of sand without encountering clay at bore AS10 (by Cranleigh St). Figure 19 of the LWMS (JDA Consulting Hydrologists, July 2012) maps the depth to clay below the natural surface across the site, ranging nominally from 0.5m within lot 582, 1m within lot 581, and 1.5m to 2m with lot 580.

2.3. Surface hydrology and groundwater

There are no obvious surface drainage formations, but the grade of the site lends itself to have surface flows flow from the north to the south. There is a localized minor depression

which appears to be an agriculture dam in the south west corner of lot 580, and that retains water throughout the year, which is most likely groundwater. (Nearmap)

The Perth Groundwater Atlas, from the Department of Water webpage, indicates that the estimated average annual maximum groundwater levels (AAMGL) within the subject site range from 15m AHD in lot 582, nominally 1m below the natural surface, to 16m AHD a the boundary of lot 581 / 582, 1m below the natural surface, and 16.8m AHD at Cranleigh St, some 3.2m below natural surface. This information is supported by the evidence of water being retaining in the agriculture dam throughout the year.

The West Swan Estate Predevelopment Hydrological Monitoring report (JDA Consulting Hydrologists, March 2007), is consistent with the Perth Groundwater Atlas, with the monitored results at location AS5 (lot 581) of 16.1m AHD, location AS10 (lot 580) of 18.2m, which is slightly higher reading that the Atlas. Figure 9 of the West Swan Estate Local Water Management Strategy (LWMS) (JDA Consulting Hydrologists, July 2012) has mapped the estimated average annual maximum groundwater level contours.

Historical maximum ground water levels shown on the Perth Groundwater Atlas shows that for lot 581, the historical maximum is 17m AHD suggesting groundwater is at the surface level of lot 581.

Figure 12 of the LWMS maps the subject site as a multiple use wetland management classification.

The LWMS (JDA Consulting Hydrologists, July 2012, p. 8) indicates that the minimum elevation of 16m AHD of the subject area is well above the 100 year flood level of Bennett Brook, of 6.18m

2.4. Acid Sulphate Soil

Illustrated in Figure 13 of the LWMS maps a low to nil risk of Acid Sulphate Soil (ASS) or Potential Acid Sulphate Soil (PASS) to lot 582, and the majority of lot 581, with a moderate to high risk of ASS or PASS occurring greater than 3m from the existing surface for the remaining subject site.

2.5. Contaminated Sites

The LWMS mentions that “RPS (2005) reported no historical land uses that suggest significant contamination issues within the study area” (JDA Consulting Hydrologists, July

2012, p. 15). However, based on works undertaken from previous stages, asbestos may be encountered as part of the demolition works of the existing building, as asbestos may have been used in the building construction. If located this will be managed through the development process, gaining the appropriate approvals prior to site works commencing.

3. INFRASTRUCTURE SERVICE

This section of the document identifies existing service infrastructure pertinent to the subject site, its suitability for connections, and likely extensions or upgrades to service the site.

3.1. Electrical

3.1.1. Existing electrical

Along Lord St there is overhead low voltage power on the western verge fronting lot 580 and 581, and along the southern verge of Cranleigh St fronting lot 580. To the south of lot 582, there is an existing overhead 330 kV transmission line with lattice towers and a 132 kV overhead line.

There is some existing underground low voltage power along the western verge of Lord St by lot 580. At the boundary of lot 580 /581 on Lord St, the underground power alignment is located within lot 581 with no obvious explanation.

3.1.2. Servicing requirement – electrical

It is not anticipated that servicing the subject site with electricity will be an issue, as there is existing overhead low voltage power on Lord St and Cranleigh St, which will need to be relocated underground as part of the subdivision constructed works, under a WAPC condition. The costs for which will be covered via the system charges except for the actual removal of the overhead infrastructure. The overhead 330 kV and 132 kV transmission line will not be altered. The portion of existing underground power that is located within lot 580 / 581 will need to be relocated to into Lord St.

Power in the subdivision will be through an underground power network, consisting of high and low voltage cables along with necessary substation / equipment to be installed as required for each stage.

Long term servicing

To facilitate the full development of the West Swan Structure Plan Areas, Western Power has to complete a long term review of requirements over the next 20 years. Western Power is proposing the extension of major infrastructure through the region, with requirements for an additional 132kV line along Marshall Road and north toward Ellenbrook. Planning for the 132kV alignment has commenced with the current preferred alignment in the Perth to Darwin

Highway. Two substation sites will also be required, one of which is planned for land in the vicinity of the intersection of the Perth to Darwin Highway and Marshall Road.

3.2. Telstra / NBN

3.2.1. Existing Telstra / NBN

There is existing Telstra infrastructure along the western verge of Lord St, the alignment of the conduits located within lot 582.

NBN is currently being installed as part of the Enclave Stage 2 works, to the east of Lord St.

3.2.2. Servicing requirement – Telstra / NBN

It is anticipated that there should not be any issues in servicing the site with Telstra, as there is existing Telstra infrastructure in Lord St. The portion of Telstra infrastructure that is located within lot 582 will need to be relocated so that it is within the Lord St road reserve. As the pavement of Lord St is approximately 1m higher than the verge and surrounding land fronting lot 581 and 582, the existing Telstra in Lord Street may also need to be raised to match the ultimate finished verge levels of Lord St.

NBN is also likely to be able to serve the project with optic fibre, as it is greater than a 100 lot development, via the reticulation of pit and pipe through the estate, connecting to the existing NBN infrastructure on the eastern side of Lord St, as part of the Enclave Stage 2 works.

3.3. Gas

3.3.1. Existing Gas

There is an existing 160 diameter PE main that currently terminates at the intersection of Dayton Boulevard (formally Marshall Road east) and Lord St. Also currently there are gas mains being installed as part of the Enclave stage 2 works, and a 110 diameter PE main along Cranleigh St being installed as part of the Enclave 3B works.

There is an existing 350 diameter steel high pressure gas main (5700 kPA) within a gas easement to the south of lot 582, but outside the study area.

3.3.2. Servicing requirement – Gas

Servicing of the gas to the subject area is possible via connections to the mains in Dayton Boulevard, and Cranleigh St, and reticulated mains throughout the subdivision.

3.4. Water

3.4.1. Existing water

There is an existing 250 diameter P-12 water main terminating at the intersection of Dayton Boulevard / Lord St. Currently under construction is a 250 diameter P-12 water main at the intersection of Cranleigh St and Lord St as part of the Enclave 3B works.

3.4.2. Servicing requirement – water

Consistent with the Water Corporation planning on drawing FQ21-27-7-01 Issue A (Water Corporation, 2008), servicing the subject site is available via the existing 250 diameter main in Dayton Boulevard, by extending the 250 diameter across to the western verge of Lord Street to the site. To the north, the 250 diameter main would need to continue along Cranleigh St, by lot 580. Reticulation mains will be distributed throughout the development.

3.5. Sewerage

3.5.1. Existing sewers

There is no existing gravity sewer infrastructure immediately surrounding the site, but there are existing gravity sewers suitable to connect into on the east side of Lord St, as part of the Enclave Stage 2 works currently under construction.

3.5.2. Servicing requirement – sewerage

In accordance with the Water Corporation Waste Water Scheme Planning Service, Part of Eden Hill SD024 Conceptual Planning Long Term Scheme (Water Corporation, June 2008), the subject site forms part of sewer catchment B028, and is to connect to the gravity sewers to the east of Lord St, namely Enclave Stage 2, pit AD2147on Sirocco Promenade, where a 150 diameter connection has been provided.

To service the subject site for appropriately with gravity sewers, portions of the site will need to be filled, with approximately 1m of fill to lot 581 and 582. Further investigation as part of the detailed engineering design will confirm the required finished levels for sewer servicing.

It should be anticipated that groundwater dewatering will be required as part of works to install the sewers, and allowances should be made for neutralising the dewatering and excavations where there is evidence of potential and /or actual acid sulphate soils.

3.6. Pressure mains

3.6.1. Existing pressure mains

There is an existing Water Corporation oxygen injection pressure main, immediately to the south of lot 582, and the western verge of Lord St with a number of scour valve concrete pits along Lord St.

3.6.2. Servicing requirements – pressure main

It is likely that the Water Corporation will insist that the existing oxygen injection pressure main invert level and valve pits be raised to the required depth below the ultimate verge level of Lord St if the verge levels are to be raised to match the existing pavement, as the pavement of Lord St is approximately 1m above the surround natural surface and current verge levels.

3.7. Irrigation

3.7.1. Existing irrigation

There is no known irrigation infrastructure along Lord St or Cranleigh St, or within the subject site.

3.8. Drainage

3.8.1. Existing drainage

There is little in the form of structured drainage infrastructure, with an informal road side drain on the western verge of Lord St, flowing to the Dayton Boulevard intersection, where a 375 diameter culvert crosses under Lord St, and then flows cross Dayton Boulevard via a 375 diameter culvert continuing overland southwards towards the St Leonards Estate, as part of the Bennet St catchment (JDA Consulting Hydrologists, July 2012).

3.8.2. Servicing requirement – drainage

In accordance with the Figure 12 of the LWMS (JDA Consulting Hydrologists, July 2012), lot 580, 581, 582 falls within the Marshall Road catchment under the post development scenario, where flows are to be directed to Dayton Boulevard (formally Marshall Road).

Figure 17 of the LWMS (JDA Consulting Hydrologists, July 2012) shows a requirement for drainage basins, nominally in the location of the Public Open Space within lot 582.

Further detailed engineering design is required and should adhere to the City of Swan subdivision guidelines and standards, and the LWMS, and should comprise of drainage pits and pipes to address the minor storm events of up to the 5 year ARI, and overland flows within road reserves, drainage reserves, retention basins /swales to manage greater storm events that exceed the capacity of the pits and pipes.

Provisions for subsoil drainage within the road reserves should be made within lot 581 and 582 and part of 580, where the interaction of groundwater is likely to be within 1.8m (JDA Consulting Hydrologists, July 2012, p. 27) of the finished surface. Direct lot drainage connections will be required where the depth to clay, or low permeability soil exists is less than 2.0m (JDA Consulting Hydrologists, July 2012, p. 27), and should also be considered for lots smaller than 300m^2 or where there are constraints in installing soakwells within the subdivided lot.

It should be anticipated that groundwater will be encountered during the installation of drainage pits and pipes, particularly within lot 581 and 582, and allowances made for neutralising dewatering and excavations with lime where there is evidence of potential and / or actual acid sulphate soils.

3.9. Engineering

3.9.1. Earthworks

Most of the subject site is expected to require significant modification due to the proximity of the groundwater, insitu clay and minimum earthwork levels for sewer servicing.

To achieve an anticipated “A” class site classification in accordance with AS2870-1996, approximately 1.8m of clean imported compacted fill should be placed above the clay or low permeability soil, or approximately 1.2m of fill for anticipated “S” class lot classification. This would generally apply to lot 581 and lot 582, and the southern half of lot 580, where the soil is of silty sand (JDA Consulting Hydrologists, March 2007). Additional geotechnical investigation is required to confirm the conditions onsite and required earthworks to be incorporated into the detailed engineering design.

As discussed in Section 3.5.2 of this report, the filling of lots 581 and 582 is anticipated to sufficiently allow for reticulated gravity sewers. The placement of fill to achieve “A” or ”S” class lot classifications will also be of benefit to the proposed gravity sewers and interaction of groundwater, but it is recommended that subsoil drainage still be installed.

Dust control during the clearing and topsoil stripping process will need to be carefully managed by the civil works contractor to minimise airborne dust as part of the contractors approved dust management plan.

Due to the relatively flat grade of the site, it is not anticipated that extensive and high retaining walls will be required but will utilise retaining walls nominally less than 1.5m high is areas.

3.9.2. Roadworks

Bound by the east and west of the site are two significant road links, with Lord St to the east, a City of Swan district 80km/hr neighbourhood connector road, which carries approximately 15,960 vehicles per day (Transcore, November 2012), comprises of two 3.5m black asphalt lanes, with a 1m wide red asphalt unkerbed shoulder to each side, of which is in a good condition and should not require any refurbishment of the pavement. The City of Swan may require kerbing to be installed to part of Lord St, particularly where the proposed subdivided lots front Lord St. However the cost of the kerbing and associated drainage is understood to be covered under the development scheme costs.

To the north, Cranleigh Street is currently a 6m rural standard road that fronts part of lot 580, which will need to be upgraded to an urban standard of kerbs and drainage pits on a 6m carriageway. The Local Structure Plan 1 on shows a roundabout is proposed at the intersection of Lord Street and Cranleigh Street. Sufficient road reserve widening has been provided to allow for the future roundabout. However based on the preliminary designs of the roundabout undertaken by Tabec, should the homestead remain at the south west corner of the intersection, access into the existing homestead is problematic when the roundabout is constructed It is recommended that either the homestead be demolished, or an alternative entry access be negotiated and agreed by the homestead owner.

The roads within the subject site, are to be of an urban standard in accordance to the City of Swan's Guidelines and standards, and would be expected to comprise of kerbs and drainage pits on a 6m carriageway within the 15m road reserves, and 6m laneways. Footpaths and Dual use paths will also be provided in accordance with the guidelines, and footpath links likely required to be provided to the east of Lord St. A dual use path may be required on Lord St, connecting with the dual use path in Dayton Boulevard. Internally, is should be assumed that all roads will required a footpath within the verge.

On-street parking will be required to service the cottage lot at a ratio of one parking bay for two cottage lots.

3.9.3. Fencing

It should be assumed that a noise attenuation barrier or wall will be required on the boundary of the Perth-Darwin Highway, uniform fencing along the southern boundary to the gas / power easement and it may be a requirement that uniform fencing is also applied to the subdivided lots abutting to Lord St.

3.9.4. Sequencing the works

For the convenience of an existing sewer connection near the boundary of Lot 581/582, and being the local low point for drainage, it may be favourable to stage the development of lot 582 ahead of the other lots; however consideration on vehicle access to lot 582 will need to be further investigated.

Staged development then could occur with lot 581 then 580.

Figure 1: Local Structure Plan 1, Dayton (Burgess Design Group Plan ASP WESLSP1-2-02V (dated 07-3-13

Land Use Schedule		Plan: ASP WES LSP1-2-02v
Gross Area	66.3247 ha	Date: 09.03.13
Western Power Easement	2.2000 ha	
MRS Road Widening Reserve	1.7788 ha	
Gross Subdivisible Area	**62.3459 ha**	

Average lot size	Lot Area	GH Area	Total Area	Lots	GH Lots	GH/DU	Total DUs
R20 550 m²	4.5323 ha	0 ha	4.5323 ha	84	0	0	84
R30 450 m²	15.3615 ha	0.7847 ha	16.1462 ha	369	4	23	392
R40 300 m²	9.8601 ha	1.3911 ha	11.2512 ha	297	4	53	350
R60 200 m²	0 ha	1.5490 ha	1.5490 ha	0	2	77	77
R80 145 m²	1.8922 ha	1.8254 ha	3.7176 ha	94	2	126	220
Total	31.6461 ha	5.5502 ha	**37.1963 ha**	**844**	**10**	**279**	**1123**

5m Road Widening Required on Eastern Side of Arthur Street as part of LSP 2A & 2B

Possible Future MRS Road Widening Subject to Acquisition

Medium Term Roundabout

Future Flyover across Perth-Darwin Hwy

Roundabout to be removed and replaced by a cul-de-sac arrangement upon future construction of the Lord Street/ Marshall Road intersection & fly-over

E-POSF06 0.5093ha

E-POSF16 0.5331ha

E-POSF08 1.9123ha

PT E-POSF13 0.6256ha

PT E-POSF13 0.4404ha

E-POSF09 1.6486ha

Community Site Special Use

EXISTING ROAD RESERVE TO BE CLOSED

LSP 1

CRANLEIGH STREET

LORD STREET

MARSHALL ROAD

ROAD WIDENING

St LEONARDS BVD

KENNEDIA ENT

GRANDIS ROAD

REID HWY

VICTORIA RD

ARTHUR STREET

FLORIBUNDA GATE

WATER CRESS GARDENS

LITORIA PASS

SALIGNA WAY

DROSERA PWY

NOTES:

1. Areas and dimensions subject to survey.
2. The road layout is subject to final design at subdivision. See the Traffic Assessment Report (Appendix 2) and Preliminary Intersection Designs (Appendix 6) for further information.
3. All corner lots that are coded R20 can be developed/subdivided to a maximum density of R30.
4. The function and design of public open space areas shall be generally in accordance with the concept plans included in the LSP 1 documentation, though still subject to refinement as part of Landscape Management Plans to be approved prior to construction.
5. Subdivision and development within residential areas shall comply with the 'Residential' zone of Local Planning Scheme No.17 and the Residential Design Codes as they apply to the designated R Codes reflected on this plan or referred to in Note 3 and Note 11 .
6. Use and development within the designated 330KV Powerline Easement shall be subject to approval by Western Power and the City of Swan, the intention being for this corridor to be utilized for low maintenance open space, community garden opportunities, pedestrian/cyclist path network, road reserves and car parking associated with the community site and in a manner consistent with the existing power line easement .
7. A Developer Contribution Plan (DCP) applies to this cell & should be read in conjunction with the Structure Plan. Triggers for DCP Items/Works (see s.6.1).
8. Detailed Area Plans may be required by the WAPC on advice from the City of Swan as a condition of subdivision (see s.5.2.6.).
9. Dwellings within the noise exposure level 2 area will require notification to be placed on the Certificate of Title advising of the possible noise impacts associated with nearby transport routes. Additionally, DAPs will be required for any lots within this Level 2 Area, DAPs are to detail the required quiet house design measures, and in the case of two storey development the need for any further acoustic assessment.
10. Narrow Lot Innovation Precinct - minimum lot size is 144m². Development is to be in accordance with the R60 provisions of the Residential Design Codes unless otherwise varied by a council approved Detailed Area Plan.

NORTH

LEGEND

- Subject Area LSP 1
- Public Open Space/Drainage/Wetlands
- Residential Zone
- Special Use - Community (see s.5.4)
- MRS Primary Regional Road
- Narrow Lot Innovation Precinct
- Noise Attenuation Measures as appropriate (see s.5.9.7)
- Activity Corridor - Home Based Business / Home Office Opportunites
- Indicative Carriageway
- Dual Use Footpath
- Refer Appendix 6
- 330KV Powerline Easement & Road Reserves (see s5.5.2)
- 132 KV Powerline Easement (see s.5.9.1)
- Boundary of area affected by noise exposure (see note 10)

LOCAL STRUCTURE PLAN 1
DAYTON

FIGURE 9

burgess design group
TOWN PLANNING + URBAN DESIGN
PO Box 374 Northbridge WA 6865
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P (08) 9328 6411
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Scale: 1:4,000 (A3)

Plan No: ASP WESLPS1-2-02v
Date: 07.03.13

CITY OF SWAN

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APPENDIX 2

TRAFFIC IMPACT ASSESSMENT AND TECHNICAL NOTE

DAYTON
LOCAL STRUCTURE PLAN 1

TRANSPORT ASSESSMENT

transport planning • traffic engineering • project management

Dayton
Local Structure Plan 1

Transport Assessment

Prepared for:
Aspen Group

April 2011

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R White	r01c	B Bordbar	8 Nov 2010	Final (plan revised)
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Author: R White

Project manager: B Bordbar

Client: Aspen Group

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TABLE OF CONTENTS

APPENDICES

1.0 Summary

This Transport Assessment addresses the proposed Local Structure Plan 1 (LSP1) for Dayton (formerly known as West Swan East) in the City of Swan.

LSP1 is anticipated to accommodate up to 950 dwellings and a 0.4ha community purposes site.

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

The proposed Activity Corridor will ultimately form an important public transport corridor within Dayton.

LSP1 also responds to the future transit station adjacent to the Reid Highway / Lord Street intersection with a higher density, transit oriented development precinct proposed in the southwest corner of the LSP1 area.

The transport assessment considers two road network scenarios: an interim scenario with improved access into the LSP1 area from a new roundabout at the Lord Street / Marshall Road West intersection; and an ultimate scenario when the Perth-Darwin National Highway is constructed with a flyover at Marshall Road over PDNH and the Arthur Street flyover across Reid Highway.

2.0 Introduction and Background

This Transport Assessment of the proposed Dayton Local Structure Plan 1 (LSP1) has been prepared by Transcore on behalf of the Aspen Group.

LSP1 covers the southwest portion of the West Swan East District Structure Plan.

Transcore prepared a report titled *West Swan East Structure Plan, City of Swan, Transport Impact Statement Update* (October 2009), which will be referred to in this transport assessment as the West Swan East TIS report.

3.0 Structure Plan Proposal

The location of the Dayton LSP1 area is illustrated in Figure 1, which shows it in its regional context within the Metropolitan Region Scheme.

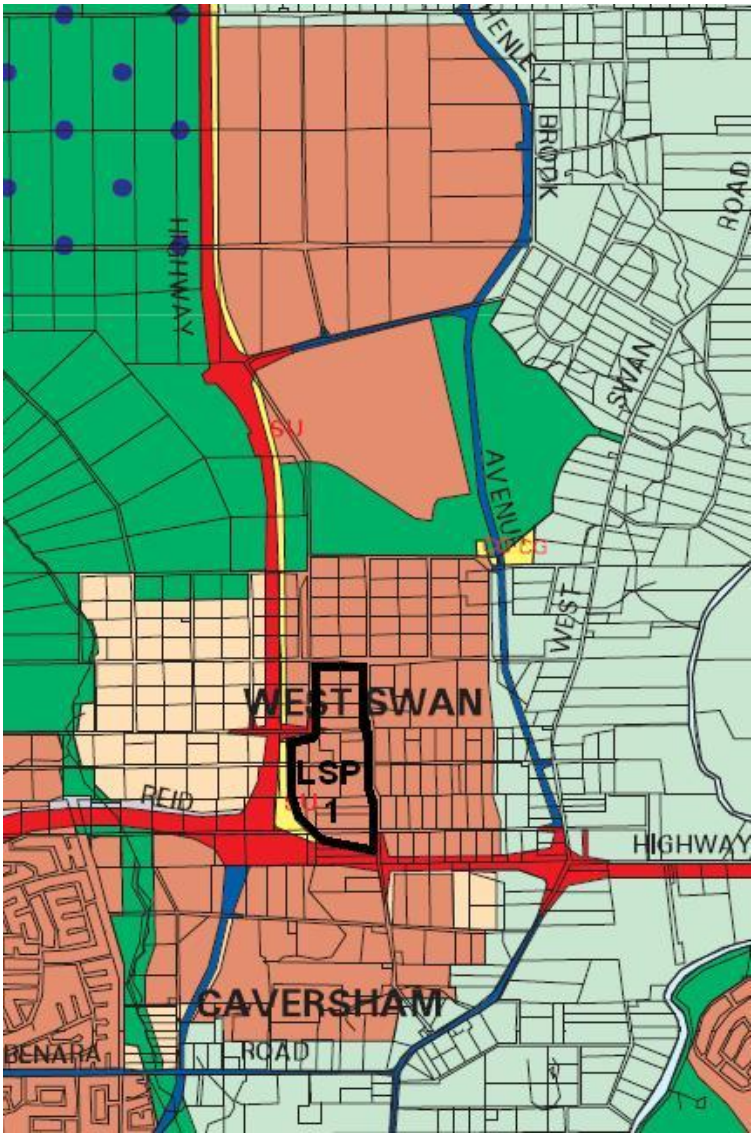


Figure 1. Site location

LSP1 is bounded by Lord Street and the transit corridor reservation in the MRS on its western side, Reid Highway on the south, Arthur Street on the east and Cranleigh Street on the northern side.

The proposed LSP1 plan (as at March 2011) is included at Appendix A of this report.

The wider West Swan East District Structure Plan provides for a total of approximately 2,800 dwelling units (including a wide range of residential densities), two school sites, a neighbourhood shopping centre, community facilities and a 6.5-hectare service/commercial site.

In the proposed LSP1 plan the proposed 10.7ha retirement village site is proposed to be developed as residential lots and group housing. The full area of LSP1 will accommodate up to an anticipated 950 dwellings.

LSP1 also includes a 0.4ha community purposes site on the west side of Arthur Street. This will be located opposite a proposed neighbourhood centre on the other side of Arthur Street, which is not included in the LSP1 area.

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

LSP 1 also makes allowance for future construction of a grade-separated road link across the future Perth-Darwin National Highway at Marshall Road. In the interim the local structure plan includes a new road connection to Lord Street as shown on the LSP1 plan at Appendix A.

4.0 Existing Situation

The LSP1 area is located approximately 18 km northeast of the Perth CBD.

There are a number of existing rural dwellings units and other agricultural and rural land uses currently in place on existing properties within the LSP1 area. There is an existing primary school on Arthur Street, south of Harrow Street, north of the LSP1 area.

4.1 Existing road network

Table 1 outlines the existing road system in and around the LSP1 area.

Table 1: Existing Boundary and Internal Road Network

Road	*Existing Cross-Section*	*Speed Limit*	*Road Classification*	*Jurisdiction*
Reid Highway	2-lane undivided	90 kph (transition to 80 kph on approach to Lord Street)	Primary Distributor	MRWA
Lord Street	2-lane undivided with break down lane on either side	80 kph	District Distributor A	City of Swan
Marshall Road (West of Lord Street)	2-lane undivided, rural cross-section	80 kph	Local Distributor between Lord Street and Beechboro Road and District Distributor B west of Beechboro Road	City of Swan
Marshall Road (East of Lord Street)	2-lane undivided	80 kph	Access Road	City of Swan
Arthur Street (South of Marshall Road)	2- lane undivided, cul-de-sacked at southern terminus	70 kph	Local Distributor	City of Swan
Arthur Street (South of Harrow Street)	2-lane rural cross-section, school zone south of Harrow Street	50 kph (unposted); transition to 40 kph posted in vicinity of school	Local Distributor	City of Swan
Cranleigh Street	2-lane undivided unmarked narrow rural cross-section	50 kph (unposted)	Access Road	City of Swan

Table 2 outlines the existing traffic control measures at the primary intersections within the surrounding road system:

Table 2: Existing Traffic Control Measures

Intersection	*Level of Traffic Control*	*Turn Pockets/Intersection Flaring*
Lord Street/Reid Highway	Stop control T-intersection	• Dedicated westbound-southbound right-turn pocket on Reid Highway • Localised median at intersection on both Reid and Lord approaches • Eastbound-northbound channelised left-turn • Lord Street approach southbound flared wide to accommodate outbound simultaneous left- and right-turns
Lord Street / Marshall Road west	Single lane 4-way roundabout	Intersection has recently been constructed as 4-way roundabout to provide access to the LSP1 area west of Lord Street.
Lord Street / Marshall Road east	Give Way control on Marshall Road approach	Lord Street northbound approach intersection flares to the west to allow northbound through traffic to bypass right turning vehicles.
Marshall Road / Arthur Street	Give Way control on Arthur Street approaches	
Lord Street / Cranleigh Street	Stop control on Cranleigh Street approaches	
Cranleigh Street / Arthur Street	Give Way control on Arthur Street approaches	
Lord Street / Harrow Street	Stop control T-intersection on Harrow Street approach	
West Swan Road / Reid Highway	Traffic signals	Southbound approach (West Swan Road) consists of channelised left-turn lane and two through lanes. Eastbound channelised left-turn lane and westbound right-turn pocket.

4.2 Existing traffic volumes

Table 3 details the existing daily traffic volumes for the road network in and around the LSP1 area.

Table 3: Existing Traffic Volumes

LOCATION	SOURCE	DAILY VOLUME (vpd)	DATE
Arthur Street, North of Cranleigh Street	City of Swan	60 vpd	July 2007
Arthur Street, North of Marshall Road	City of Swan	210 vpd	July 2007
Arthur Street, North of Coast Road	City of Swan	640 vpd	July 2007
Arthur Street, North of Victoria Road	City of Swan	340 vpd	July 2007
Coast Road, East of Arthur Street	City of Swan	310 vpd	July 2007
Coast Road, West of West Swan Road	City of Swan	770 vpd	March 2010
Cranleigh Street, East of Lord Street	City of Swan	165 vpd	July 2007
Lord Street, north of Reid Highway	MRWA	13,800 vpd	December 2007
Lord Street, North of Marshall Road	City of Swan	12,850 vpd	August 2007
Marshall Road, West of Lord Street	City of Swan	7,050 vpd	September 2006
Marshall Road, East of Lord Street	City of Swan	530 vpd	July 2007
Reid Highway, West of West Swan Road	MRWA	26,650 vpd	March 2007
Victoria Road, West of West Swan Road	City of Swan	490 vpd	March 2010
West Swan Road, North of Reid Highway	City of Swan	15,340 vpd	March 2010

4.3 Existing public transport

The main existing bus service consists of a line haul service via Lord Street from Ellenbrook to Morley (Route 336: Ellenbrook-Morley Bus Station). This service operates generally at 30-minute headways throughout the weekday, with hourly service provided during the evening off-peak period and lower frequencies on weekends.

Route 337 (Ellenbrook – Bassendean Station) provides additional bus services during weekday peak hours only.

Route 335 (Ellenbrook – Midland Station) runs a very limited number of services for commuters and students via West Swan Road.

These existing bus routes are illustrated on Figure 2.

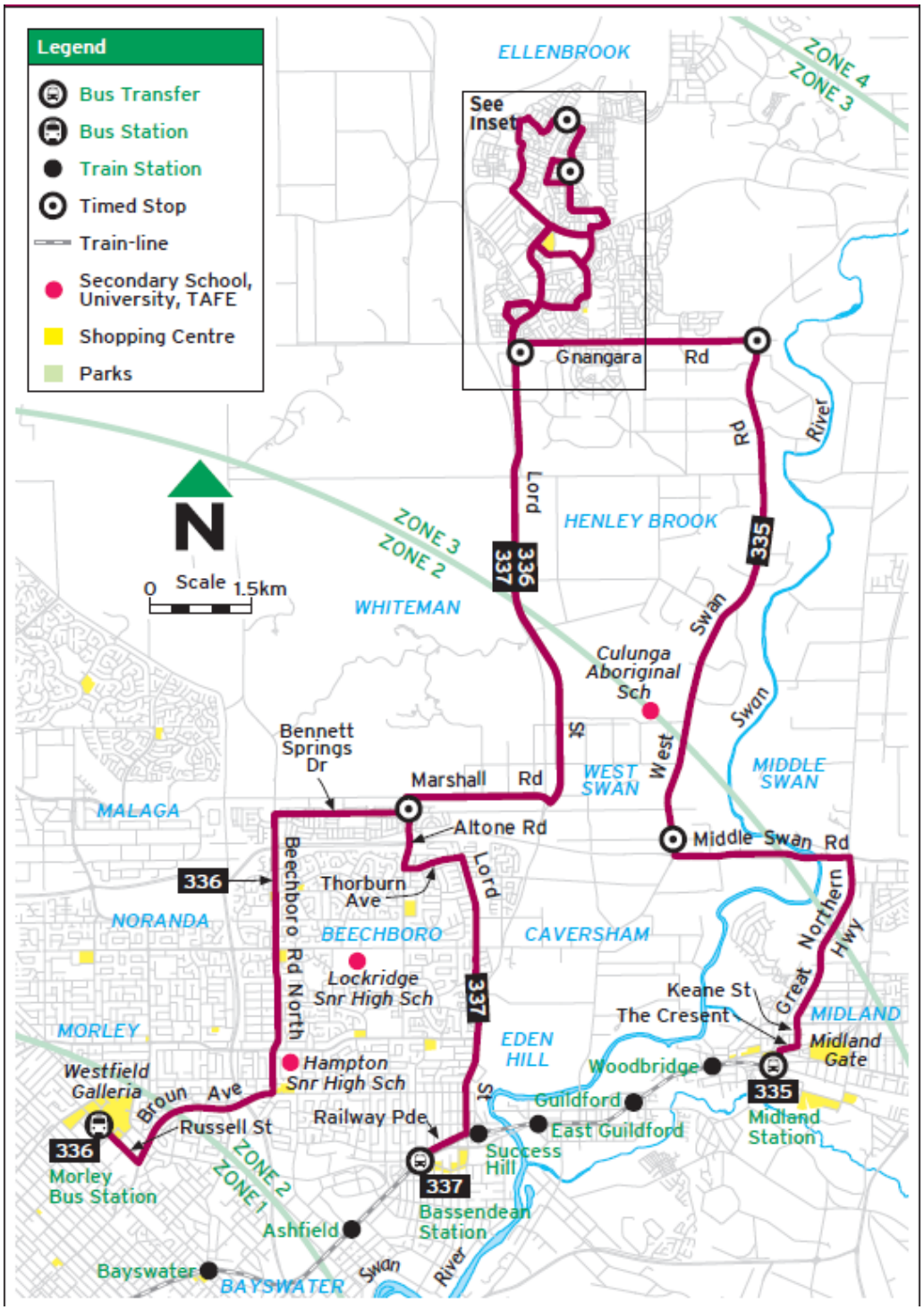


Figure 2. Existing public transport

4.4 *Existing pedestrian and cyclist facilities*

The Perth Bike Map series published by the Department of Transport shows the local roads around 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 and a shared path along sections of West Swan Road.

There is also a shared path link across Reid Highway via an underpass west of Arthur Street that provides pedestrian and cyclist access from Victoria Road within LSP1 to Caversham south of Reid Highway as shown in Figure 3.

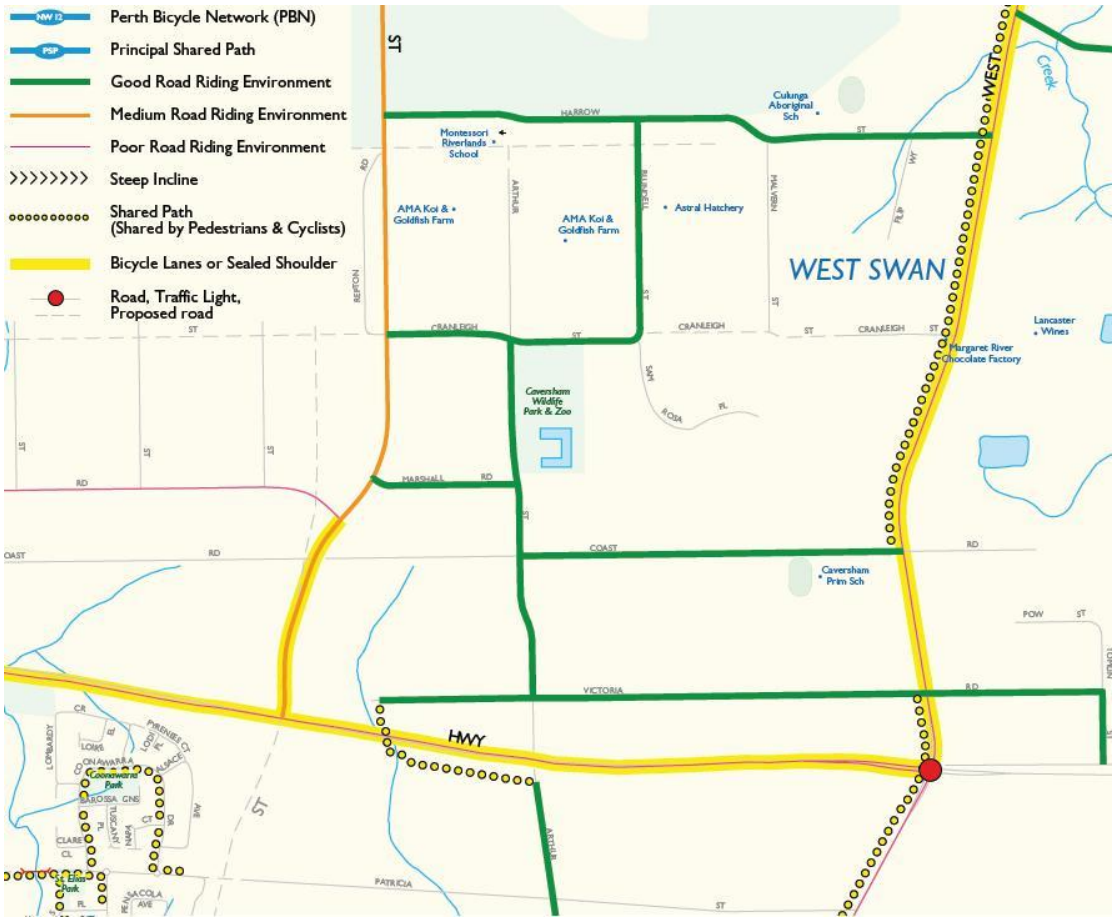


Figure 3. Existing cycling facilities

5.0 Proposed Internal Transport Network

5.1 *Road Hierarchy*

The hierarchy of roads within and adjacent to the LSP1 area is illustrated in Figure 4 using the road hierarchy defined in *Liveable Neighbourhoods (2007).*

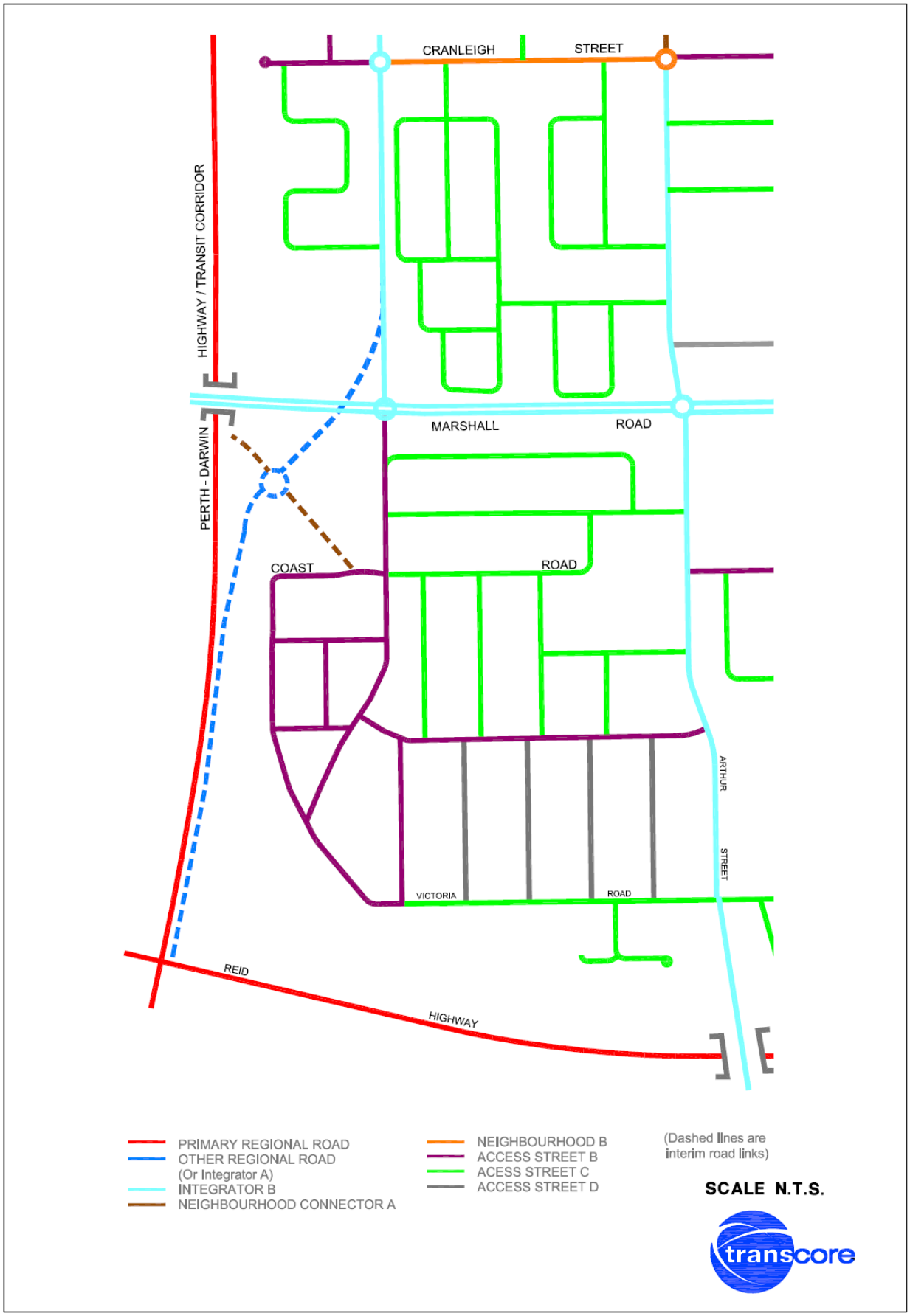


Figure 4. Road Hierarchy

Some key characteristics of the relevant road classifications have been summarised from Liveable Neighbourhoods in Table 4 below. The relevant cross-section diagram in Liveable Neighbourhoods is also indicated and copies of each are included at **Appendix B**.

Table 4. Road Hierarchy

Road Classification	Indicative upper volume (vpd)	Indicative road reserve width (m)	Indicative road pavement width (m)
Integrator B – outside centres *(LN Figure 15)*	15,000	29.2	2 x 7.5m (incl. on-street parking and cycle lanes), 6m median
Integrator B – centres *(LN Figure 16)*	15,000	25.2	2 x 7.5m (incl. on-street parking and cycle lanes), 2m median
Neighbourhood Connector A *(LN Figure 17)*	7,000	24.4	2 x 7.1m (incl. on-street parking and cycle lanes), 2m median
Neighbourhood Connector B *(LN Figure 18)*	3,000	18.0 – 19.4	11.2m (incl. embayed or on-street parking)
Access Street B *(LN Figure 20)*	3,000	16.5 – 18.0	9.7m (incl. embayed or on-street parking)
Access Street C *(LN Figure 21)*	3,000	15.4 – 16.0	7.2m
Access Street D *(LN Figure 22)*	1,000	14.2 – 15.0	6m typical
Laneway *(LN Figure 24)*	300	6.0 – 6.4	6m typical

It should be noted that these reserve widths are indicative and might be subject to further adjustment in consultation with the Department of Planning during detailed subdivision design.

Lord Street

Under the ultimate scenario, following construction of the PDNH, Lord Street will ultimately have traffic flows of 8,000 – 9,000 vpd, which are appropriate to an *Integrator B*. Therefore a road reserve width of approximately 25m would be appropriate in this ultimate scenario.

In the interim period the traffic volumes on Lord Street could potentially build up to over 20,000 vpd. During this period Lord Street could be upgraded to a four-lane undivided road (15m carriageway) within this 25m road reserve. A 15m carriageway would allow wider kerbside lanes (eg. 4.2m wide) to be shared by motor vehicles and cyclists. On-street parking would not be appropriate on Lord Street during this interim period.

Depending on the timing of future construction of the PDNH in relation to full development of this area (including Albion, West Swan West and Caversham), interim traffic volumes on Lord Street south of Marshall Road could potentially be as high as 30,000 vpd in this interim scenario. Various staging options would be available to relieve this situation, such as widening parts of Lord Street to four-lane undivided carriageway, construction of one carriageway of the PDNH, construction of the Arthur Street flyover, or upgrading sections of Henley Brook Avenue. This would be a matter for further discussion between state and local government agencies at that time. The best solution, and the one recommended, is timely construction of the PDNH to minimise unnecessary expenditure on upgrading of temporary infrastructure.

Marshall Road

Marshall Road is anticipated to carry up to 8,000 vpd through West Swan East, 11,000 vpd at Henley Brook Avenue and up to 13,000 vpd at the Lord Street flyover in the ultimate scenario. This is consistent with a classification of *Integrator B*. A 25m road reserve width is proposed between Lord Street and Arthur Street. East of Arthur Street (outside of the LSP1 area) the reserve will be designed to accommodate drainage in a widened central median as shown in the cross-section included at Appendix B.

Arthur Street

Arthur Street is anticipated to function as a *Neighbourhood Connector* road in the interim scenario but the planning needs to take into consideration the ultimate scenario of an Arthur Street flyover over the Reid Highway. Extensive consultation has previously been carried out on this issue with adjoining landowners, DPI, MRWA and City of Swan.

In the ultimate scenario all of Arthur Street south of Cranleigh Street is planned to form part of an activity corridor linking through Albion, West Swan and Caversham. This section is expected to carry up to 7,500 vpd and will be classified as an *Integrator B*. A 25m road reservation will be appropriate for this section of Arthur Street. Suggested 25m cross-sections for Arthur Street are illustrated in Appendix B.

North of Cranleigh Street (outside of the LSP1 area) the standard *Neighbourhood Connector A* cross-section is appropriate, which is 24.4m. This is very similar to the Arthur Street cross-sections in Appendix B with minor changes to width of verges and parking bays.

Other Neighbourhood Connectors

The section of Cranleigh Street between Lord and Arthur Streets, which forms part of the planned activity corridor is designated as a *Neighbourhood Connector* road in LSP1. The existing 20m road reserve is sufficient to accommodate a *Neighbourhood Connector B* cross-section as illustrated in the 20m Neighbourhood Connector cross section in Appendix B, which is a modified version of the standard *Neighbourhood Connector B* cross-section.

The new access link constructed from Coast Road to Lord Street in the interim scenario would have a Neighbourhood Connector A status due to the anticipated traffic flows on this link. It is designed as a boulevard treatment as an entry statement to the first stages of subdivision. However no on-street or embayed parking or paths are provided on this temporary link as these will be provided on adjacent access streets that will remain in the ultimate scenario when the Marshall Road flyover is constructed over PDNH.

Access Streets
Other existing roads within the LSP1 area will be classed as Access Streets. Some of these roads, such as Coast Road and Victoria Road are already 20m wide road reserves and will not be changed from this existing reserve width.

The *Access Street B* classification (typical reservation of 16.5m) will be used for streets adjacent to high-density residential development (R60 and R80), schools, shops and the service industrial area. 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 to the transit station. This 18m road reserve could accommodate a 7.4m carriageway as required by City of Swan for bus routes and 5.3m verges with embayed parking.

The *Access Street C* (typical reservation of 15.4m) 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 to 15m) will be used for low volume (less than 1,000 vpd) streets adjacent to residential development of R20 or less. The standard Access Street D width in *Liveable Neighbourhoods* is 14.2m although the City of Swan prefers 15m road reserve width. The City of Swan has advised that it would consider a 13m road reserve on access streets that abut public open space provided that they have no services (including street lights) on the verge of the POS, otherwise these streets have to be 15m unless previously approved.

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

Existing bus services in this area are described in section 4.3 of this report.

Liaison with PTA/Transperth has indicated some opportunities to service the West Swan East District Structure Plan area (and LSP1) with bus services.

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), to the immediate west of the LSP1 area and along the east side of the proposed PDNH alignment and north of Reid Highway. There is also a proposal to extend the transitway east of the PDNH to run along Reid Highway in the central median of the future dual carriageway.

A transitway station is currently planned at the Reid Highway interchange with PDNH, immediately southwest of the LSP1 area. In this report park-and-ride facilities have not been assumed at this potential future transit station due to the proposed high-density residential transit precinct around this location. There are different opinions among planners of transit and transit-oriented development regarding the desirability of park-and-ride parking at locations like this but the road network in the Structure Plan is robust enough to accommodate this additional traffic if required.

The future activity corridor along Lord Street – Cranleigh Street – Arthur Street would ultimately offer a high-frequency bus service through Albion, West Swan and Caversham.

There would also be potential to run feeder bus services through this area from the future transit station in the southwest corner of the structure plan.

Potential bus routes servicing the LSP1 area are shown in **Figure 5**. This is consistent with the potential public transport routes shown at Figure 7 of the *West Swan East Structure Plan – City of Swan – Transport Impact Statement Update* (Transcore, October 2009), which shows the extension of these potential bus routes through neighbouring local structure plan areas.

It should be noted that the City of Swan requires that roads for bus routes have a minimum two-way 7.4m carriageway width or 3.7m for a one-way carriageway.

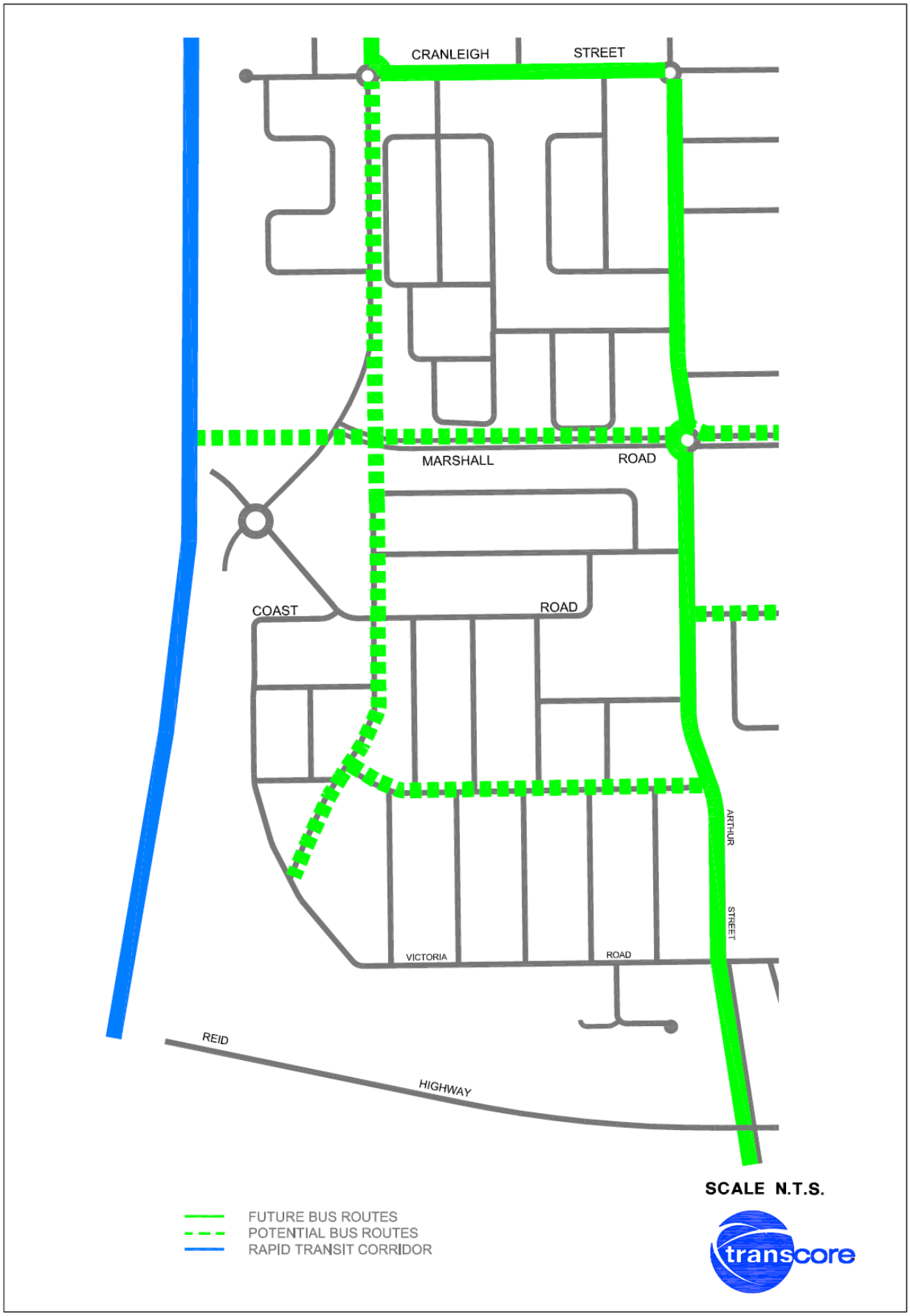


Figure 5. Potential public transport routes

5.3 Pedestrian and Cyclist Facilities

The reasonably flat topography of the area and the proposed permeable grid of the road network within the LSP1 area create an excellent opportunity for provision of good pedestrian and cyclist facilities to maximise non-motorised transport modes.

Figure 6 outlines the proposed pedestrian and cyclist network for the Structure Plan area.

It is proposed to provide shared paths on the *Integrator Arterial* and *Neighbourhood Connector* roads. These roads would also have a footpath on the opposite site as required in Liveable Neighbourhoods. In the case of Marshall Road the service corridor along its southern side provides an opportunity for a regional shared path through Dayton and across the future PDNH, linking the Swan Valley to Whiteman Park.

It is also proposed to provide shared paths on some of the *Access Street B* roads where a demand is anticipated such as next to a school and on approaches to the local shopping centre and future transit precinct.

Footpaths would be provided on at least one side of all roads. There would be paths on both sides of roads adjacent to schools.

Laneway lots are to have footpath access to the visitor parking bays provided for them in the road reserve.

On-street cycle lanes will be included on the Integrator B and Neighbourhood Connector A roads, as indicated in the details of the road hierarchy listed in Table 4.

Figure 6. Pedestrian and cyclist facilities

6.0 Changes to External Transport Network

6.1 External Road Network

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 does not affect the LSP1 area.

Main Roads WA comments on the West Swan East District Structure Plan advised that access to Primary Regional Roads will be limited to the existing planned locations.

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.

The City of Swan has previously advised that their planning had anticipated the existing staggered intersections at Lord Street of Marshall Road West and Marshall Road East would be realigned into a single 4-way intersection and that the upgrading of the existing single carriageway extending east of Beechboro Road North through to the subject lands to a dual carriageway will likely only occur as development in the area comes on stream.

Arthur Street

Arthur Street will ultimately form part of a sub-regional activity corridor through this area. This corridor is proposed to include the northern portion of Lord Street, western portion of Cranleigh Street, and Arthur Street south of Cranleigh Street. This activity corridor will connect the district centre within Albion in the north, to the mixed business site in West Swan East and the local commercial centres in West Swan East and Caversham, ultimately offering a high frequency public transport service. A range of uses is to be encouraged along this activity corridor, supported by medium and higher densities to help achieve overall viability and vibrancy.

The future Arthur Street flyover at Reid Highway is reserved as a Primary Regional Road reserve under the Metropolitan Region Scheme. The West Swan East District Structure Plan and the neighbouring Caversham Structure Plan have at all times reflected the existence of this reservation as part of the primary regional road network, which therefore would fall under the jurisdiction of MRWA. This reservation is shown, however, to reflect the potential long-term (ultimate) transport network. Hence the transport assessment (detailed in Section

4 of this report) has included this flyover as part of the ultimate scenario for this area.

Perth-Darwin National Highway

The Department of Planning is currently undertaking a planning study of the Perth-Darwin National Highway from Reid Highway to Gnangara Road. Detailed concept designs have been developed by the Department for this section of the alignment; however, only simple concept planning for the proposed highway north of Gnangara Road to Maralla Road has been undertaken. Previous discussions with the Department indicate that there may be several interchanges and flyovers in the vicinity of the Structure Plan area, including a flyover serving the site directly at Marshall Road and full interchanges at Reid Highway and Youle-Dean Road (to the south-west and north-west of the subject lands, respectively.).

In the vicinity of the LSP1 area, the PDNH would function as the primary north-south road transport corridor in the area, resulting in the removal of most of the through traffic currently carried by Lord Street. It should also be noted that although the existing alignment of Lord Street would provide access to the boundary road system in the short to medium term, once the PDNH has been constructed, north-south through traffic within the general vicinity of the Structure Plan will be accommodated by West Swan Road and the proposed Henley Brook Avenue east of the subject lands.

Main Roads WA comments on the West Swan East District Structure Plan advised that access to Primary Regional Roads will be limited to the existing planned locations.

6.2 Public Transport

Future public transport developments in the surrounding area have been discussed in section 5.2 of this report.

6.3 Pedestrian and Cyclist Networks

As noted in section 5.3 the proposed shared use path and footpath network shown in **Figure 6** 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 and Marshall Road to connect with the existing cycle lanes on Reid Highway, Lord Street and West Swan Road.

7.0 Integration with Surrounding Area

As the LSP1 area is being planned in accordance with the West Swan East District Structure Plan the integration of the transport network across this wider area is assured.

Shared path links to the existing pedestrian underpass beneath Reid Highway west of Arthur Street already provide for pedestrian and cyclist movements between Dayton 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

Detailed traffic modelling was undertaken for the West Swan East TIS update report of October 2009. That traffic model has now been further refined to model the LSP1 area in more detail.

Traffic generation rates for the structure plan land uses were primarily sourced from the Roads and Traffic Authority, NSW, *"Guide to Traffic Generating Developments",* with additional information from the Institute of Transportation Engineers *"Trip Generation Manual, 7th Edition"* where required.

The residential traffic generation rates used range from 9 vehicles per day (vpd) per dwelling for the lower residential densities, 7 vpd for medium density dwellings, 5 vpd for high-density units close to transit, and 3 vpd for retirement village units.

The shopping centre traffic generation has been based on the Thursday traffic generation formula from the NSW guidelines, which results in a total of 5,250 vpd for the particular mix of uses anticipated in this shopping centre as detailed in the West Swan East TIS report. The rate assumed for the community facilities is 20 vpd per 100m^2 GFA. The trip generation rate used for the service industry area west of Lord Street is 150 vpd per hectare based on ITE trip rates.

Based on guidance in the WAPC *Transport Assessment Guidelines for Developments* (2006) a school trip generation rate of 2 vpd (vehicles per day) per student has been adopted for this assessment.

The trip distribution to the surrounding regional road network has been estimated based on information previously obtained for a similar study in Caversham from a sub area matrix of the MRWA regional traffic model. The resultant external distribution used in this analysis is as follows:

- 8% Lord Street north;
- 8% Henley Brook Avenue north;
- 16% Reid Highway east;

- 19% West Swan Road south,
- 20% Lord Street south,
- 5% Benara Road west,
- 20% Reid Highway west, and
- 4% Marshall Road west.

8.2 Road Network Scenarios

The assessment was undertaken for two major long-term scenarios:

Interim scenario: Lord Street functions as the primary north-south travel corridor in the area prior to the construction of the PDNH. Lord Street and Marshall Road (East and West) maintain their staggered geometry while Lord Street, Marshall Road West and Coast Road form a 4-way intersection (roundabout). Refer to the LSP1 plan attached in Appendix A, which illustrates the interim access arrangement for the pre- PDNH construction period.

Ultimate scenario: the PDNH has been constructed and Marshall Road realigned to form a fly-over over PDNH. The access arrangement to the primary boundary road system has been modified and includes the downgrade of Coast Road to a cul-de-sac (at its western end) and realignment of Lord Street to form a 4-way intersection (roundabout) with Marshall Road and an internal subdivision road. The ultimate scenario also includes the future construction of the Arthur Street flyover across Reid Highway as part of a future activity corridor link through Dayton and Caversham.

In this ultimate scenario, site-generated traffic wishing to travel south and west is doing so via Marshall Road to the west and the proposed Henley Brook Avenue to the east.

Both scenarios include Henley Brook Avenue. Connections from the West Swan East District Structure Plan area to Henley Brook Avenue are assumed at Harrow Street, Marshall Road and Victoria Road.

Short-term scenario: A short-term scenario based on development of LSP1 only, with only the existing road network in the surrounding area, has also been modelled and is documented in **Appendix C**.

8.3 Traffic Flow Forecasts

The existing traffic volume along Lord Street north of Marshall Road East is approximately 12,850 vehicles, although some of this traffic would be expected to use Henley Brook Avenue in future. In addition, the Albion Structure Plan area to the north of the West Swan East District Structure Plan is anticipated to generate approximately 8,000 vehicles per day on Lord Street, some of which will filter through the West Swan East District Structure Plan area.

The daily traffic generated by the West Swan East District Structure Plan area (including LSP1) has been assigned onto the road network by a traffic model using the *emme* transport modelling software package.

Total daily traffic flows for the ultimate scenario have been derived based on regional road network traffic projections prepared by consultants for DPI for a traffic and transport workshop held on 13 September 2007 for development of a sub-regional structure plan for Albion, Caversham and West Swan. Total daily traffic flows for the interim scenario are estimated based on consideration of this work and other information such as existing traffic volumes on Lord Street.

Figure 7 shows daily traffic flows in the interim scenario in the LSP1 area and **Figure 7A** shows the wider road network connections (including Henley Brook Avenue). The numbers not in brackets are the estimated daily traffic flows generated by the LSP1 area. Total daily traffic flows including the rest of Dayton as well as through traffic from surrounding areas are shown in brackets.

Future traffic volumes on Lord Street, in particular, may never reach the levels indicated in Figure 9, depending on the timing of future construction of the PDNH in relation to full development of this area (including Albion, West Swan West and Caversham).

Figure 8 illustrates the ultimate scenario, which shows the reduction in traffic along Lord Street with the build-out of the PDNH and construction of the Marshall Road and Arthur Street flyovers. **Figure 8A** shows the wider road network connections (including Henley Brook Avenue)

The traffic flows in Figures 7, 7A, 8 and 8A do not include park-and-ride traffic to the potential future transit station in the southwest corner of the LSP1 area. This could potentially add around 500 to 1000 vehicles per day on Victoria Road and the access road south from Lord Street in the ultimate scenario, depending on number of parking bays. As discussed in section 5.2 there are different opinions among planners of transit and transit-oriented development regarding the desirability of park-and-ride at locations like this but the road network in LSP1 is robust enough to accommodate this additional traffic if required.

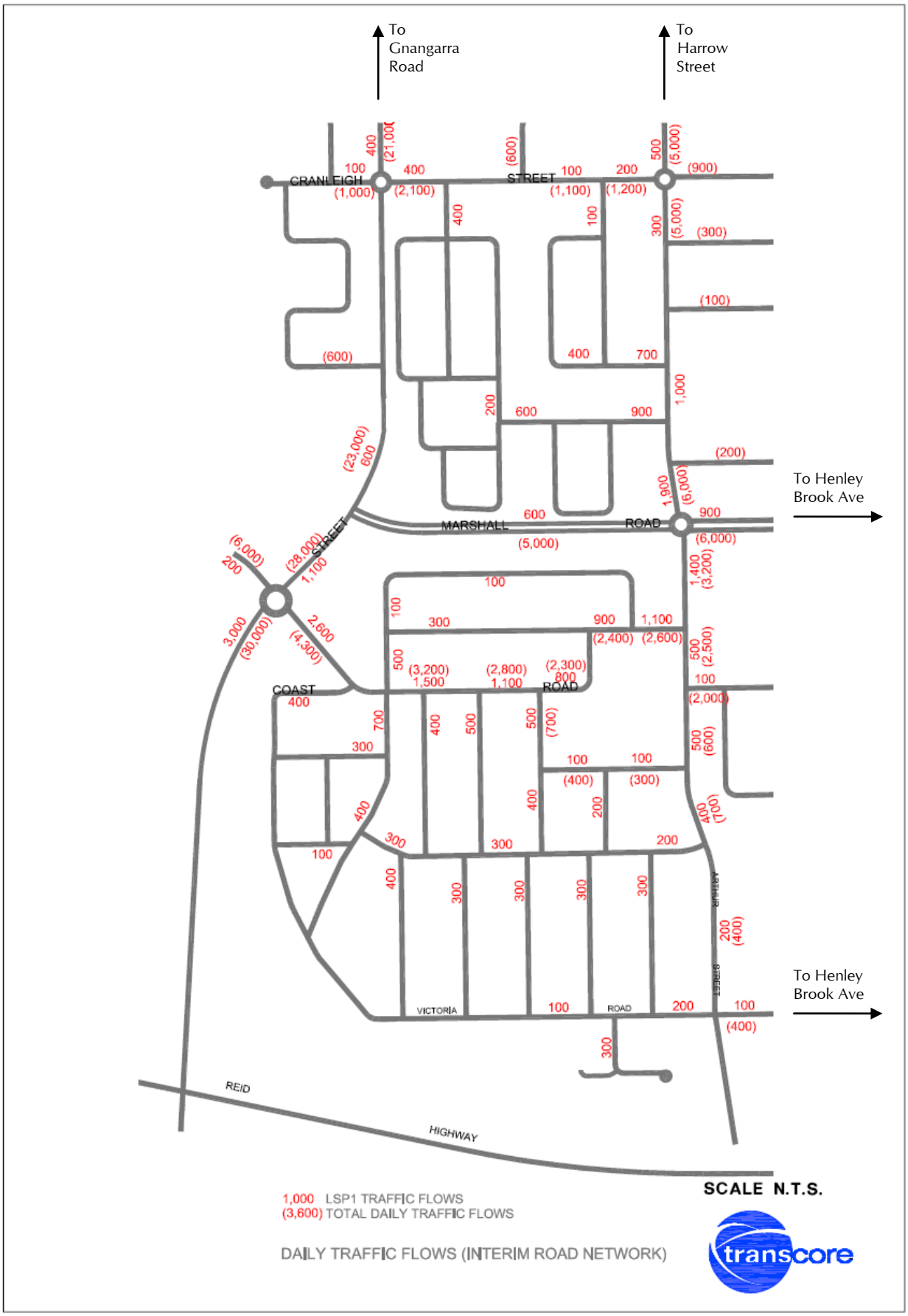


Figure 7. Daily Traffic Volumes – Interim Scenario

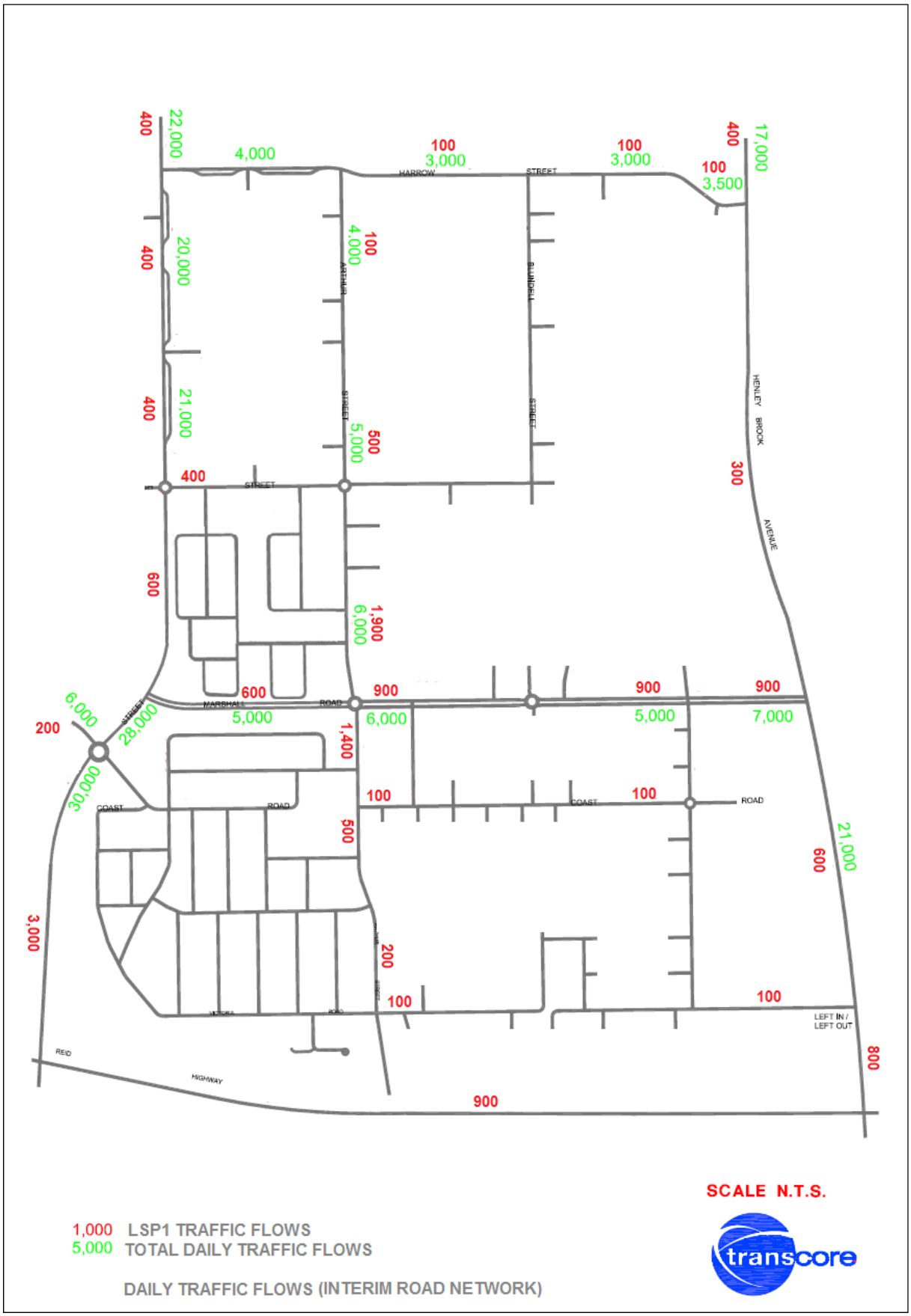


Figure 7A. Daily Traffic Volumes – Interim Scenario (wider area)

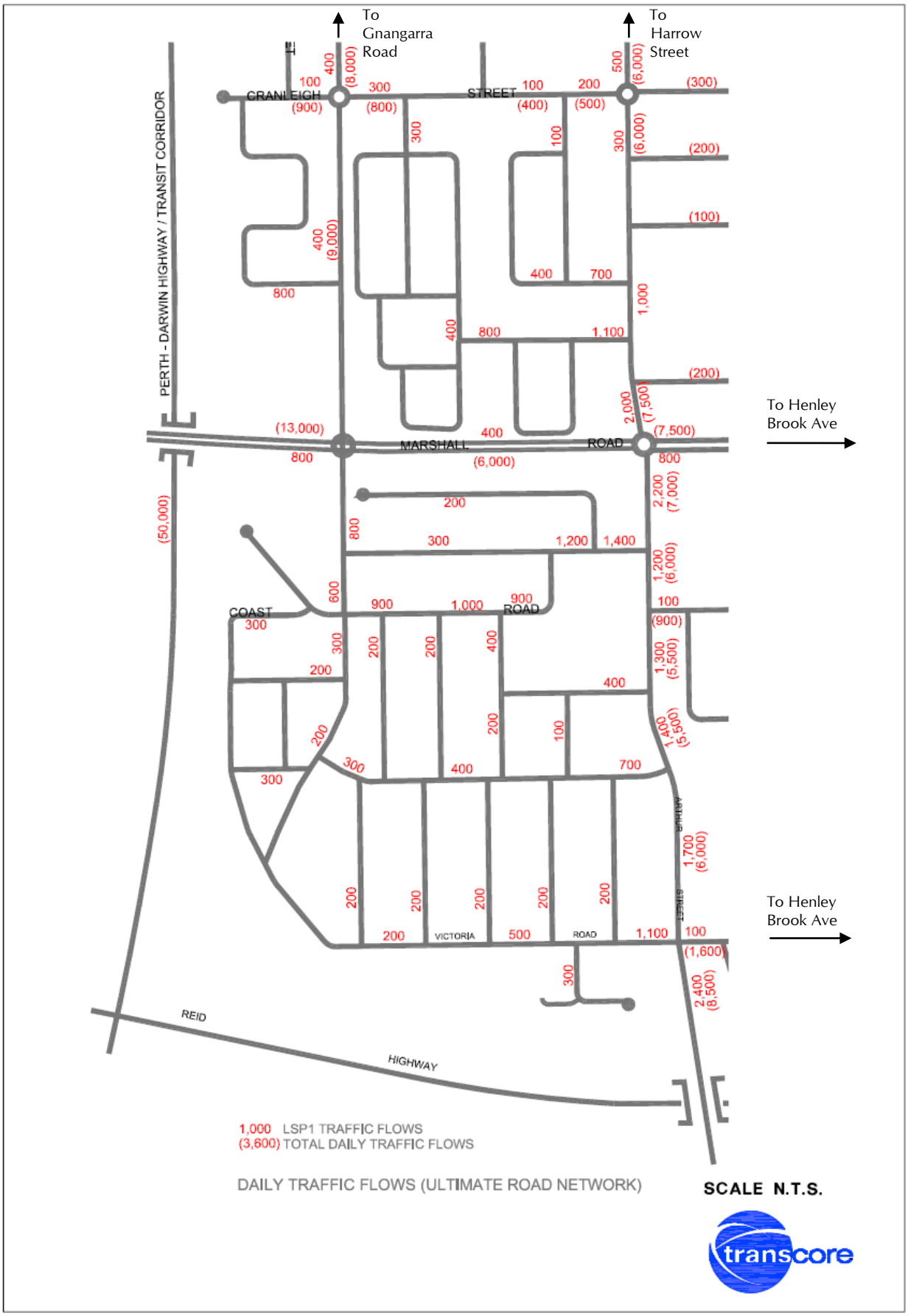


Figure 8. Daily Traffic Volumes – Ultimate Scenario

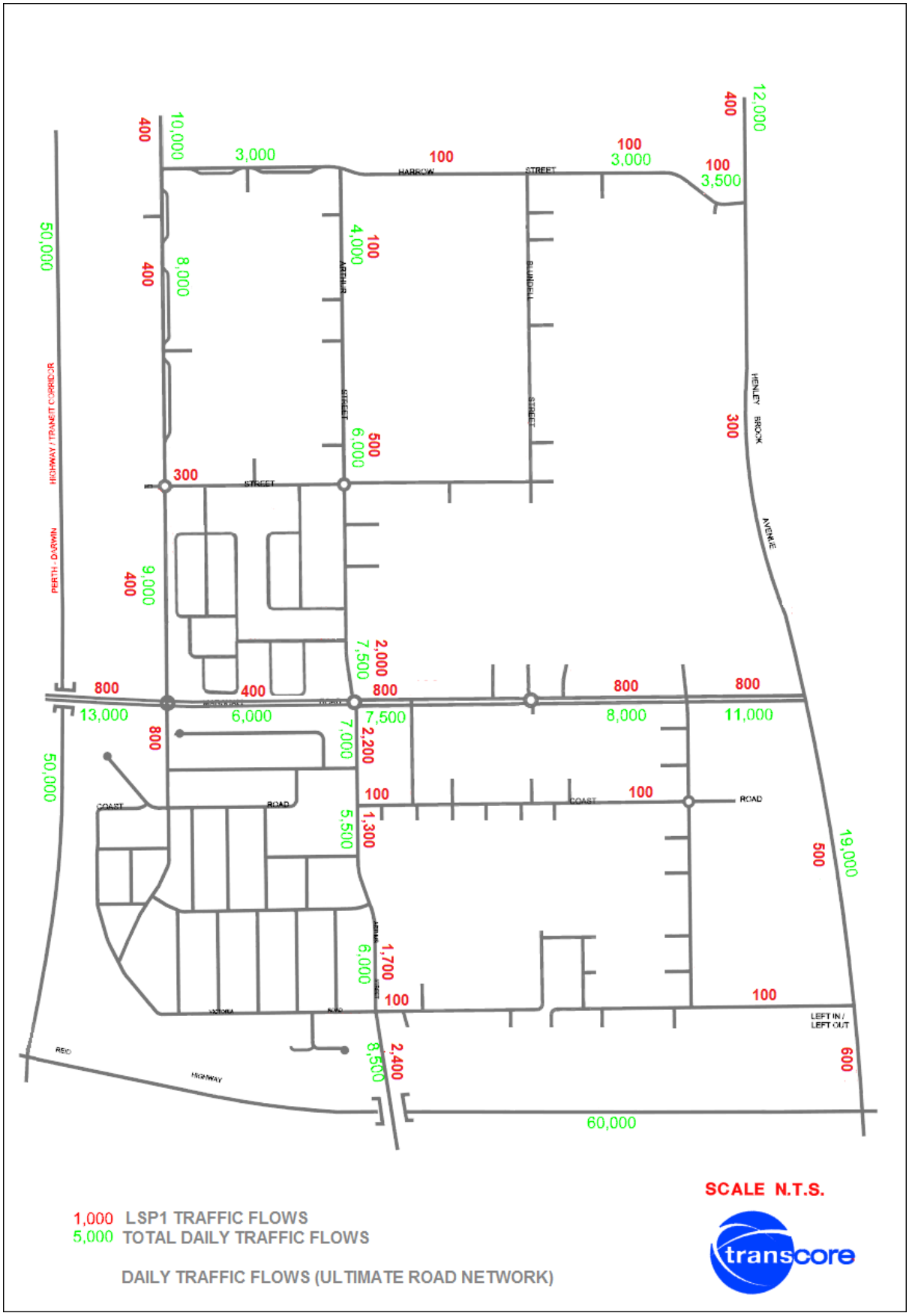


Figure 8A. Daily Traffic Volumes – Ultimate Scenario (wider area)

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 and proposed cross sections in section 5.1.

8.4.1 Intersection Treatments

Figure 9 details the proposed intersection controls for the key internal and external intersections of the LSP1 area for the interim scenario. In establishing the proposed intersection controls, consideration was given to the road network layout and classifications, estimated traffic volumes and requirements and plans by relevant authorities.

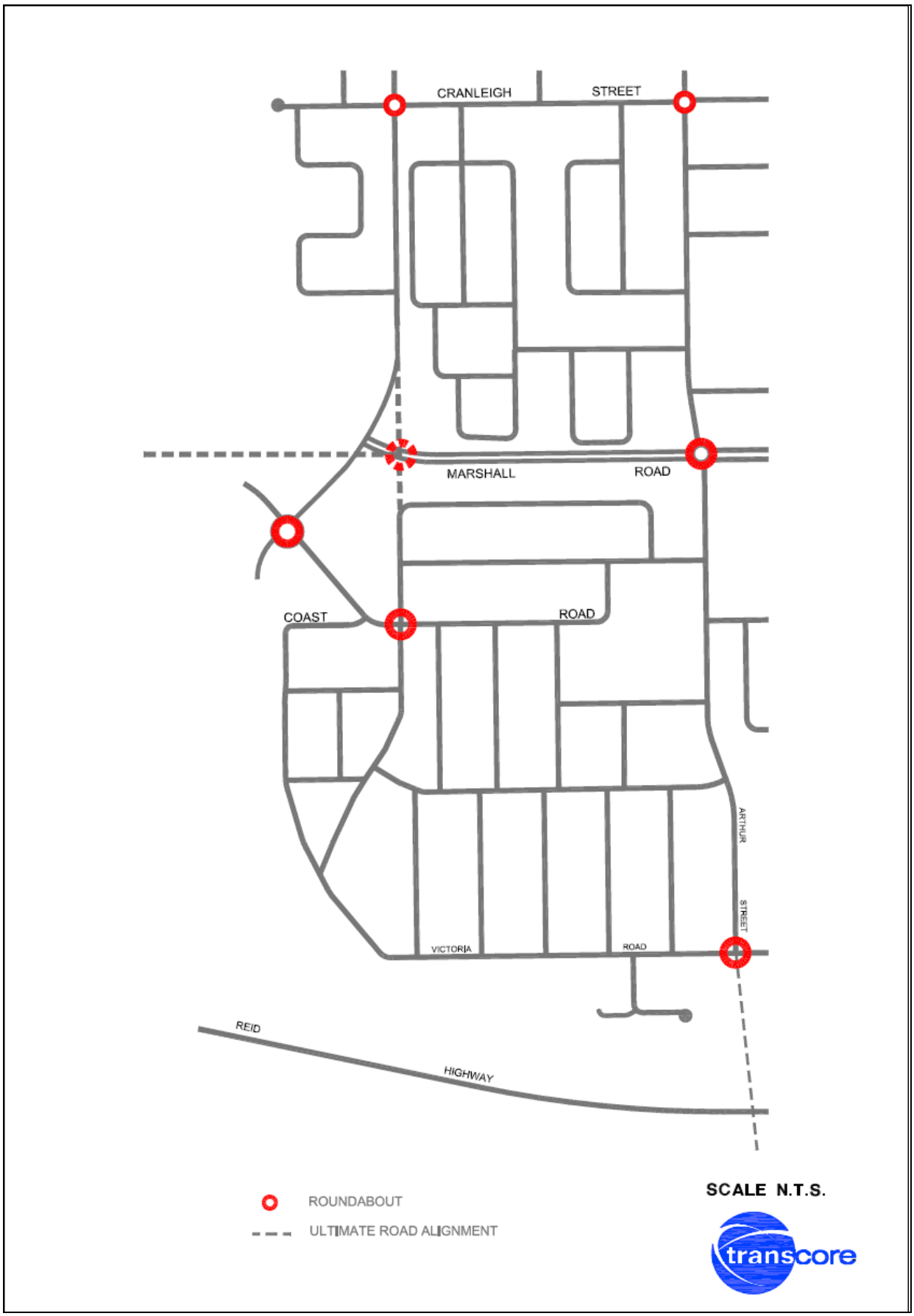


Figure 9. Intersection treatments

Lord Street Intersections

Peripheral to the LSP1 area, there is a general understanding that a traffic signal is likely to be implemented in the short- to medium-term (interim scenario) at the Lord Street/Reid Highway intersection.

The issue of access to Lord Street from the LSP1 area has previously been extensively discussed with DPI, Main Roads WA and City of Swan engineers. The preferred access strategy has subsequently been implemented for access to the Early Release Stage 1 development area in LSP1. This involved the construction of a roundabout at the Lord Street / Marshall Road West intersection to serve the new road link from Coast Road (now St Leonard's Boulevard) as the primary access into the District Structure Plan area.

The location of this St Leonard's Boulevard connection was carefully considered in terms of the existing road geometry of Lord Street. The previous Marshall Road four-way intersection has been adjusted to a staggered tee configuration, likely due to sub-standard intersection sight distances for a four-way intersection at the existing Marshall Road East location.

The location of the roundabout at Lord Street / Marshall Road West / St Leonard's Boulevard meets the current design speed requirements of Lord Street, with an improvement in capacity compared to the previous T-junction.

Access into the development area is also maintained with connection at Marshall Road East onto Lord Street in its current configuration. To improve the legibility of interim and future access requirements, the future access to the Stage 1 Early Release Area will also be provided off Marshall Road East at the proposed future four-way intersection with Lord Street North.

The existing Lord Street / Marshall Road East intersection will be progressively upgraded as traffic volumes on Lord Street increase. First a right turn pocket will be provided on Lord Street. Later, depending on future traffic volumes, the right turn out from Marshall Road East to Lord Street may become unviable and may need to be prohibited. This right turn traffic flow would then be accommodated at the proposed Lord Street / Marshall Road West / Coast Road roundabout or another proposed roundabout at the Lord Street / Cranleigh Street intersection.

In the ultimate scenario these existing Lord Street / Marshall Road intersections disappear with the construction of the Marshall Road flyover across the PDNH and transit corridor. (The State Administrative Tribunal has directed that appropriate notification of this ultimate change in access arrangements and change of levels around the Marshall Road flyover is to be included on the titles of affected lots created in this area.) A new Marshall Road East / Lord Street North intersection would be constructed as a four-way roundabout, with the southern leg providing access to the Stage 1 Early Release Area (already fully developed by that time) and the future transit station precinct.

It should be noted that the roundabout at Lord Street / Marshall Road West / St Leonard's Boulevard intersection will also maintain access for Lord Street during the future construction of PDNH and the Marshall Road flyover.

In the ultimate scenario this interim St Leonard's Boulevard link will become redundant. There are several options for future treatment of this road reserve. It could be retained as parking and service access as well as providing some open space amenity for the adjacent R60 residential precinct. Alternatively, it could be closed completely and redeveloped as part of this R60 precinct to further increase dwelling yields in this transit precinct. Another option is to be left in its current configuration but made a private space (rather than public road reserve) serving the R60 developments with ongoing maintenance becoming the responsibility of the R60 owners.

Internal Intersections
Within the structure plan area there are a number of proposed four-way intersections. The busiest of these are recommended to be roundabouts, as shown in **Figure 9**.

At detailed design stage the design of roundabouts along the activity corridor will pay particular attention to requirements to facilitate pedestrian and cycle movement.

Details relating to future traffic control within and on the immediate periphery of the LSP1 area, along with the requirements for slip lanes and localised intersection widening, will also be addressed through the subdivision planning process.

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.

8.4.2 Timing of Internal Road Network Upgrades

Lord Street
Under the ultimate scenario, following construction of the PDNH, Lord Street will ultimately have traffic flows of 8,000 – 9,000 vpd, but in the interim scenario (before PDNH is constructed) the traffic volumes on Lord Street could potentially be over 20,000 vpd within the LSP1 area and up to 30,000 vpd north of Reid Highway.

Existing traffic flows on Lord Street north of Reid Highway were 8,970 vpd in 2001/02 and increased to 10,520 vpd in 2003/04 and to 13,810 in December 2007. This indicates a growth rate of about 800 vpd each year.

Lord Street north of Marshall Road recorded 12,850 vpd in 2007, so by the end of 2011 traffic volume along this section of Lord Street is likely to be around 16,000 vpd and by 2015 about 19,250 vpd. In comparison, Figure C1 in Appendix C shows that LSP1 will add about 700 vpd north of Marshall Road east and 2,300 vpd between Marshall Road east and the roundabout at St Leonards Boulevard, taking the traffic volumes along these sections to approximately 20,000 vpd and 21,500 vpd, respectively. 2015 is assumed to be the year that LSP1 development will be completed. These traffic volumes would warrant upgrading of these sections of Marshall Road to 4 lanes during this period of development, however it should be noted that the LSP1 traffic volumes will not add significant traffic volumes on Lord Street and even without the LSP1 traffic by 2015 consideration should be given to upgrading of Lord Street if past traffic growth levels continue in the immediate future.

Arthur Street

Arthur Street is anticipated to carry less than 3,000 vpd until some of the other external road connections are constructed. The future Marshall Road connection to either Henley Brook Avenue (long term) or West Swan Road (anticipated to be required for development of LSP 2A and 2B east of Arthur Street) will increase traffic volumes on Arthur Street north of Marshall Road. Similarly, the construction of the Arthur Street flyover across Reid Highway will increase traffic volumes on Arthur Street south of Marshall Road as well.

Sections of Arthur north and south of Coast Road Street (abutting early release subdivision development in LSP1) have been upgraded to a seal width of approximately 6.2m with kerbing on the western side. This is sufficient for traffic volumes less than 3,000 vpd but not for a bus route. Therefore it is recommended that Arthur Street abutting LSP1 be upgraded to this standard during development of adjacent sections of LSP1 and that the full widening to integrator B standard be implemented during development of adjacent parts of LSP 2A and 2B on the eastern side of Arthur Street.

Marshall Road

Marshall Road has been upgraded to a sealed width of approximately 7m with kerbing on both sides. This will be sufficient to accommodate traffic volumes from LSP1, which will be less than 3,000 vpd. When Marshall Road is extended east of Arthur Street to serve LSP 2A and 2B the traffic volumes on this existing section will increase, particularly if it is extended to connect to West Swan Road, so full upgrading to integrator B standard of this section of Marshall Road will be required at that time (i.e. in conjunction with development of LSP 2A and 2B).

Cranleigh Street

Cranleigh Street (between Lord Street and Arthur Street) is expected to carry less than 3,000 vpd in all scenarios but the existing narrow rural road will need to be upgraded to a suitable urban standard as discussed in section 5.1. The existing rural road will not be suitable for traffic from the abutting part of LSP1 residential development (likely to be one of the last parts of LSP1 developed) so the road should be widened at the same time as development of the adjacent part of LSP1.

8.4.3 Timing of Intersection Improvements

To evaluate timing of intersection improvements, intersection capacity has been analysed for seven key intersections along Lord Street and Arthur Street adjacent to the LSP1 area.

Intersection capacity has been analysed using the SIDRA intersection analysis software program. SIDRA outputs are presented in the form of Degree of Saturation, Level of Service, Average Delay and 95% Queue. These items are defined as follows:

- **Degree of Saturation**: is the ratio of the arrival traffic flow to the capacity of the approach during the same period. The Degree of Saturation ranges from close to 0% for very low traffic flow up to 100% for saturated flow or capacity.
- **Level of Service**: is the qualitative measure describing operational conditions within a traffic stream and the perception by motorists and/or passengers. In general, there are 6 levels of service, designated from A to F, with Level of Service A representing the best operating condition and Level of Service F the worst. In SIDRA intersection analysis the level of service is based on the average delays experienced by each traffic movement.
- **Average Delay**: is the average of all travel time delays for vehicles through the intersection.
- **95% Queue**: is the queue length below which 95% of all observed queue lengths fall.

Arthur Street Intersections

The following four intersections along Arthur Street have been assessed:

- Arthur Street / Cranleigh Street
- Arthur Street / Marshall Road
- Arthur Street / Coast Road
- Arthur Street / Victoria Road

All have been assessed as simple 3-way or 4-way intersections controlled by stop or give-way signs for the traffic flows shown in Figure 7, which represents the long term interim road network scenario with full development of Dayton in accordance with the West Swan East District Structure Plan.

All four intersections will operate at a very good level of service in this long term interim scenario with minimal queues and delays. All movements will be at level of service A except the eastern approach on Marshall Road, which will operate at level of service B. Therefore, in terms of intersection capacity, no intersection upgrades are required on Arthur Street until the Arthur Street flyover across Reid Highway is constructed in the ultimate scenario.

However, from a more practical point of view it would be appropriate for the Arthur Street / Marshall Road intersection to be upgraded to a roundabout when Marshall Road is extended east of Arthur Street to serve LSP 2A and 2B.

Arthur Street / Cranleigh Street intersection should be upgraded to a roundabout prior to opening of the proposed primary school immediately northeast of this intersection, which is part of LSP 2B.

Arthur Street / Coast Road will automatically be upgraded as a simple give-way controlled T-junction when this section of Arthur Street is fully upgraded, which is suggested to be in conjunction with development of adjacent parts of LSP 2A.

Arthur Street / Victoria Road intersection will not carry significant traffic volumes until the Arthur Street flyover is constructed, so construction of a roundabout at this intersection could be incorporated in the Arthur Street Flyover construction project.

Lord Street / Marshall Road west / St Leonards Boulevard roundabout
This existing single-lane roundabout has been analysed for the LSP1 short term scenario documented in Appendix C and for the long term interim scenario traffic flows in Figure 7. In both scenarios this roundabout will require further upgrading to provide sufficient capacity to accommodate the forecast traffic volumes.

To determine when upgrading is required it is assumed that LSP1 will develop at 20% per year in 2011 to 2015, while existing Lord Street traffic volumes increase at 800 vpd per year. The SIDRA analysis indicates that by 2014 (with 80% of LSP1 development) the Marshall Road west approach will be at level of service E during peak hours and all approaches (except St Leonards Boulevard) will have 95% queues greater than 120m. By 2015 (with full development of LSP1) the Marshall Road west approach will be at level of service F during peak hours and queue lengths will have doubled. In the interim scenario the whole single-lane roundabout would be at level of service F.

Therefore, it is anticipated this roundabout will need to be upgraded by about 2014 when LSP1 is assumed to be approximately 80% developed. This should be linked to upgrading of the adjacent sections of Lord Street to 4 lanes as discussed in section 8.4.2.

Lord Street / Marshall Road east intersection
This existing T-junction has been analysed for the LSP1 short term scenario documented in Appendix C and for the long term interim scenario traffic flows in Figure 7. In both scenarios this intersection will require further upgrading to provide sufficient capacity to accommodate the forecast traffic volumes.

The SIDRA analysis indicates that by 2014 (with 80% of LSP1 development) the right turn movement out from Marshall Road east approach will be at level of service F during peak hours. All other movements will operate satisfactorily (all at level of service C or better), even in 2015 with full LSP1 development.

The suggested initial treatment (at about 2014) is to ban the right turn out from Marshall Road. This is forecast to be a relatively low volume traffic movement

and these movements can be accommodated at the Lord Street / Marshall Road west / St Leonards Boulevard roundabout or proposed Lord Street /Cranleigh Street roundabout instead.

Further upgrading of this intersection may be appropriate when Marshall Road is extended to connect to West Swan Road or Henley Brook Avenue, which will be assessed in further detail in the transport assessments to be prepared for LSP 2A and 2B.

Ultimately this intersection will be relocated further east to form a 4-way intersection as part of the construction of Marshall Road flyover across the future Perth-Darwin National Highway and this 4-way intersection will be constructed as a roundabout.

Lord Street / Cranleigh Street intersection

This existing stop-sign controlled crossroads has been analysed for the LSP1 short term scenario documented in Appendix C and for the long term interim scenario traffic flows in Figure 7. In both scenarios this intersection will require upgrading to provide sufficient capacity to accommodate the forecast traffic volumes.

The SIDRA analysis indicates that by 2014 (with 80% of LSP1 development) the Cranleigh Street east approach will be at level of service E and Cranleigh Street west will be at level of service F during peak hours. There will also be significant queues and delays for Lord Street traffic due to vehicles waiting to turn right from Lord Street into Cranleigh Street.

Therefore, it is anticipated this intersection will need to be upgraded by about 2014 when LSP1 is assumed to be approximately 80% developed. It is recommended that this be construction of a roundabout as proposed in Figure 9. This should be linked to upgrading of the adjacent sections of Lord Street to 4 lanes as discussed in section 8.4.2.

8.4.4 Summary of Timing of Improvements

The timing of road network improvements and intersection improvements is discussed in sections 8.4.2 and 8.4.3 respectively. The suggested timing of these improvements is summarised in Table 5.

Table 5. Timing of Road Network Improvements

Item on LSP plan	DCP Code	Description of DCP item	Description if the DCP item needs to be acquired and/or constructed in stages	Trigger (dwelling units or equivalent)
1	E-ITF04	Roundabout Cnr Lord Street and Cranleigh Street	Construct roundabout	80% LSP1 (760 du)
2	E-TRF18	Upgrade Cranleigh Street (Lord St to Arthur St)	Upgrade to neighbourhood connector B	Northern LSP1 (800 du?)
3	E-TRF19			
4	E-IRF03	Roundabout Cnr Arthur Street and Cranleigh Street	Construct roundabout	Primary School and/or LSP2B
5	E-TRF20	Upgrade Lord Street (Cranleigh St to Marshall Rd east)	Upgrade to 4 lanes	80% LSP1 (760 du)[1]
6	E-TRF21			
7	E-IRF02	Roundabout Cnr Marshall Road and Lord Street east	1. Ban right turn out	80% LSP1 (760 du)
			2. Upgrade T-junction	LSP 2A / 2B
			3. Relocate & construct as 4-way roundabout	With Marshall Rd flyover across PDHN (long term)
8	E-TRF03	Upgrade Arthur Street (Marshall Rd to Cranleigh St)	1. Widen and kerb west side	Northern LSP1 (800 du?)
			2. Upgrade to integrator B standard	LSP 2B
9	E-IRF01	Roundabout Cnr Marshall Road and Arthur Street	Construct roundabout	80% LSP1 (760 du)
10	E-TRF05	Upgrade Marshall Road (Lord St to Arthur St)	Upgrade to integrator B standard	LSP 2A / 2B
11	E-TRF04			
12	E-TRF44	Upgrade Lord Street	Upgrade to 4 lanes	80% LSP1 (760 du)[1]
13	E-IRF07	Roundabout Cnr Marshall Road and Lord Street west	Upgrade roundabout	80% LSP1 (760 du)
15	E-ITF01	Priority T intersection at Arthur Street and St Leonards Boulevard	Construct T-junction (done)	Central LSP1 (200 du?)
17	E-TRF36	Upgrade Arthur Street (Coast Rd to Victoria Rd)	1. Widen and kerb west side	Southern LSP1 (950 du?)
			2. Upgrade to integrator B standard	LSP 2A
21	E-IRF06	Roundabout Cnr Victoria Road and Arthur Street	Construct roundabout	With Arthur St flyover across Reid Hwy (long term)
22	E-TRF37	Upgrade Arthur Street (south of Victoria Rd)	Connect to future flyover across Reid Hwy	With Arthur St flyover across Reid Hwy (long term)
23	E-TRF01	Upgrade Arthur Street (Marshall Rd to Coast Rd)	1. Widen and kerb west side	Central LSP1 (200 du?)
24	E-TRF02		2. Upgrade to integrator B standard	LSP 2A

Note: 1. Even without the LSP1 traffic consideration should be given to upgrading of Lord Street by 2015 if past traffic growth levels continue in the immediate future.

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, Marshall Road and Lord Street. Therefore, special consideration of vehicle access from properties abutting these roads is required.

The proposed LSP1 plan indicates that most residential development abutting Arthur Street will be provided with side or rear access. Many of these areas will be medium density development served by rear laneways. Access arrangements for all properties along 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 Dayton, 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 (north east of Arthur Street / Cranleigh Street) and the proposed Neighbourhood Centre on Arthur Street.

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 7,500 vpd adjacent to the LSP1 area in the ultimate scenario. The proposed one traffic lane in each direction, with a central median, should therefore be satisfactory for pedestrians and cyclists to cross Arthur Street.

Marshall Road is expected to carry up to 6,000 vpd within the LSP1 area in the ultimate scenario and pedestrian movements across this road are expected to operate satisfactorily.

Lord Street could potentially carry over 20,000 vpd in the interim scenario. Pedestrian movements across this road are expected to be relatively few but it would be appropriate to include pedestrian facilities (islands, pram ramps, grab rails, etc.) in the design of intersections to facilitate pedestrian movements.

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 from the south of Reid Highway and west of Lord Street.

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 grid of potential bus routes shown on Figure 5 are spaced approximately 400m apart, so they can easily 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 LSP1 area on the surrounding road links are shown in Figures 7 and 8.

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 7 it can be seen that traffic volumes generated by LSP1 are expected to be higher than this threshold on Lord Street (between the Marshall Road roundabout and Reid Highway) in the interim scenario. From Figure 8, traffic volumes generated by LSP1 are expected to be higher than this threshold on Arthur Street (adjacent to the LSP1 area and south of Reid Highway) in the ultimate scenario.

Future total daily traffic volumes are shown in brackets on Figures 7 and 8. The source of these future daily traffic flow estimates is detailed in section 8.3 above.

The potential interim traffic volumes on Lord Street may warrant upgrading of this section to four lanes in the interim scenario, although this requirement is not generated by the traffic increase associated with LSP1 alone. Potential alternatives to this upgrading are discussed in section 5.1 of this report (under the heading "Lord Street").

Planning for the Caversham structure plan south of Reid Highway already takes into consideration the total traffic volume forecast on Arthur Street in the ultimate scenario, including the through traffic from LSP1 and the rest of Dayton.

9.2 Intersections

Intersection treatments at several intersections surrounding the LSP1 area will be affected by traffic flows generated within Dayton. Most of these are on Lord Street and Arthur Street and as they abut the study are they are already addressed in the intersection treatments shown in Figure 9 and section 8.4 of this report.

The future requirement for Reid Highway / Lord Street intersection to be signalised is also noted in section 8.4. The timing of installation of signals at this intersection will depend upon the relative timing of development at Dayton, Albion and Caversham, as well as the rate of growth of regional through traffic on Reid Highway and Lord Street. LSP1 traffic will contribute to the need for signalisation if it has not already been installed before new dwellings are constructed and occupied in the LSP1 area.

9.3 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 West Swan East Local Structure Plan 1 (LSP1) are outlined below.

- Dayton Local Structure Plan 1 is located in the southwest quadrant of the larger West Swan East District Structure Plan.

- The future traffic flows and road network of the West Swan East District Structure Plan are assessed in the *West Swan East Structure Plan, City of Swan, Transport Impact Statement Update* (October 2009).

- Two long-term road network scenarios have been assessed:

    - Interim Scenario: Perth-Darwin National Highway (north of Reid Highway) and Arthur Street flyover (across Reid Highway) not yet constructed. LSP1 has access to Lord Street at Marshall Road east and a new road link from Coast Road to a new roundabout at the Lord Street / Marshall Road West intersection.

    - Ultimate Scenario: Perth-Darwin National Highway (PDNH, north of Reid Highway), Marshall Road flyover (across PDNH) and Arthur Street flyover (across Reid Highway) all constructed. LSP1 access west and south is via these two flyovers and connections to Henley Brook Avenue in the east.

- Traffic volumes could potentially be up to 30,000 vpd on Lord Street between Marshall Road and Reid Highway in the interim scenario, depending on timing of other road network improvements such as the Arthur Street flyover or first stages of PDNH. However, the traffic generated by LSP1 alone will not require upgrading of Lord Street.

- In the ultimate scenario the PDNH will significantly reduce traffic volumes on Lord Street to 8,000-9,000 vpd adjacent to LSP1, Arthur Street will carry 6,000-8,500 vpd adjacent to LSP1 and Marshall Road will carry 6,000 vpd within LSP1.

- In the LSP1 area, 25m road reserves are proposed for Lord Street (north of Marshall Road), Marshall Road (between Lord and Arthur Streets) and Arthur Street.

- Existing 20m road reserves will be retained for sections of Victoria Road, Coast Road and Cranleigh Street within the LSP1 area.

- Appropriate road cross sections based on Liveable Neighbourhoods guidelines have been identified for all roads within the LSP1 area.

- Ultimately, a sub-regional activity corridor is planned along the northern portion of Lord Street, western portion of Cranleigh Street and Arthur

Street south of Cranleigh Street. This activity corridor will link Albion, West Swan East and Caversham via the future Arthur Street flyover, ultimately offering a high frequency public transport route adjacent to the LSP1 area.

- A network of other roads within the LSP1 area have been identified as suitable to carry future bus routes connecting to a future transit station and higher density, transit oriented development precinct in the southwest corner of LSP1.

- Shared paths are to be provided on one side of Arthur Street, Lord Street, Cranleigh Street and Marshall Road, as well as several other access streets serving the neighbourhood centre and future transit station.

- 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 and Marshall Road to connect to the existing external cycle network.

- Access arrangements for the short-term scenario of development of Dayton LSP1 prior to construction of Henley Brook Avenue are addressed in Appendix C.

- Timing of road network improvements in and abutting the LSP1 area is discussed in section 8.4 and summarised in Table 5 in that section.

- West Swan Road intersections will not be able to accommodate traffic from full development of LSP1 so it is proposed to temporarily close Coast Road and Victoria Road at appropriate locations to ensure LSP1 traffic will use Lord Street instead of West Swan Road.

- It should be noted that this temporary access strategy is only applicable for LSP1. It is anticipated that the early construction of Marshall Road is likely to be required for development in LSP 2A and 2B (east of Arthur Street) and this will be addressed in the traffic report that will be prepared for LSP 2A and 2B.

APPENDIX A

DAYTON
LOCAL STRUCTURE PLAN 1

Developer Contribution Items				
Item No.	DCP Code	Description of DCP item	Description of whether the DCP item needs to be acquired and/or constructed in stages	Trigger (dwelling units or equivalent)
1	E-ITF04	Roundabout Cnr Lord Street and Cranleigh Street		
2	E-TRF18	Upgrade Cranleigh Street		
3	E-TRF19	Upgrade Cranleigh Street		
4	E-IRF03	Roundabout Cnr Arthur Street and Cranleigh Street		
5	E-TRF20	Upgrade Lord Street		
6	E-TRF21	Upgrade Lord Street		
7	E-IRF02	Roundabout Cnr Marshall Road and Lord Street		
8	E-TRF03	Upgrade Arthur Street		
9	E-IRF01	Roundabout Cnr Marshall Road and Arthur Street		
10	E-TRF05	Upgrade Marshal Road		
11	E-TRF04	Future Upgrade Marshall Road		
12	E-TRF44	Upgrade Lord Street		
13	E-IRF07	Roundabout Cnt Marshall Road and Lord Street		
14	E-CIF1	Local Community Centre		
15	E-ITF01	Priority T, Arthur Street and St Leonards Boulevard		
16	E-POSF08	Local Park - Passive		
17	E-TRF36	Upgrade Arthur Street		
18	E-POSF13	Local Park - Passive		
19	E-POSF13	Local Park - Passive		
20	E-POSF09	Local Park - Passive		
21	E-IRF06	Roundabout Cnr Victoria Road and Arthur Street		
22	E-TRF37	Upgrade Arthur Street		

Land Use & Public Open Space Schedule		Plan: ASP WES LSP1-2-02
Gross Area	60.1371 ha	Date: 09.03.11
Public Purpose Reserve	2.2000 ha	
MRS Road Widening Reserve	1.7788 ha	
Gross Residential Area	56.1583 ha	

Public Open Space (Gross)		
Gross	5.44 ha	9.68%
Credit	4.4300 ha	7.86%

Nett Residential Area		32.5667 ha				
	average lot size	Area	DU	GH	GH/DU	Total DUs
R20	550 m²	4.8929 ha	89			89
R30	450 m²	13.7435 ha	305			305
R40	300 m²	8.3948 ha	219	2	20	239
R60	200 m²	1.5491 ha	77			77
R80	145 m²	3.9864 ha	275			275
Total		32.5667 ha	966	2		986

Nett Nett Res Area (lot areas only - no rd res)	32.5667 ha

Assumptions:
The lot yield calculated is based on an assumed average lot size by Rcode unless otherwise previously approved

Possible Future MRS Road Widening Subject to Acquisition

Medium Term Roundabout

Future Flyover across Perth-Darwin Hwy

Roundabout to be removed and replaced by a cul-de-sac arrangement upon future construction of the Lord Street/ Marshall Road intersection & fly-over

Possible Future Transit Station Location

Future Flyover Across Reid Hwy

NOTES:
1. Areas and dimensions subject to survey.
2. The road layout is subject to final design at subdivision. See the Traffic Assessment Report (Appendix 2) for further information.
3. Within all land designated Residential R20, corner lots with a maximum area of 750m², may be developed at a density of R30.
4. The function and design of public open space areas shall be generally in accordance with the concept plans included in the LSP 1 documentation, though still subject to refinement as part of Landscape Management Plans to be approved prior to construction.
5. Subdivision and development within residential areas shall comply with the 'Residential' zone of Local Planning Scheme No.17 and the Residential Design Codes as they apply to the designated R Codes reflected on this plan.
6. Use and development within the designated Public Purpose Reserve shall be subject to approval by Western Power and the City of Swan, the intention being for this corridor to be utilized for low maintenance open space, community garden opportunities, pedestrian/cyclist path network, road reserves and car parking associated with the community site and in a manner consistent with the existing power line easement .
7. A developer contribution plan applies to this cell & should be read in conjunction with the Structure Plan.
8. Detailed Area Plans may be required as a condition of subdivision for the areas as designated. (see s.5.2.6.)
9. Residential lots created within the 1000m Interim Mushroom Farm Notification Area require notification to be placed on the Certificate of Title. The notification is to state: "This lot is in proximity to an existing mushroom farm located a Lot 52, Victoria Road, West Swan and may adversely affected by odour emissions from that land use.
10. Dwellings within the noise exposure level 2 area are likely to require notification on their lot titles advising of the possible noise impacts and Quiet House Design measures to be applied to dwellings to achieve the recommended acceptable internal noise levels of AS 107:2000 or equivalent.

Subject Area LSP 1
Public Open Space/Drainage/Wetlands
Residential Zone
Public Purpose Reserve (see s.5.5)
Special Use - Community (see s.5.4)
MRS Primary Regional Road

Noise Attenuation Measures as appropriate (See s.5.9.7)
Activity Corridor - Home Based Business / Home Office Opportunites
Detailed Area Plans Required (note 8)
Road Reserves
Dual Use Footpath
Developer Contribution Item (see table)

500m Interim Mushroom Farm Odour Buffer
1000m Odour Notification Area (see note 9)
Creation of titles for these lots is subject to the future removal of odour buffer
330KV Powerline Easement
132 KV Powerline Easement (see s.5.9.1)
Boundary of area affected by noise exposure (see note 10)

LOCAL STRUCTURE PLAN 1
DAYTON
CITY OF SWAN

ASPEN GROUP
burgess design group
TOWN PLANNING + URBAN DESIGN
PO Box 374 Northbridge WA 6865
W www.burgessdesigngroup.com.au
P (08) 9328 6411
F (08) 9328 6511

0 50 100 150 200m
Scale: 1:4,000 (A3)

Plan No: ASP WESLPS1-2-02
Date: 09.03.11

APPENDIX B

ROAD CROSS SECTIONS

West Swan LSP 1 Road Cross-sections

Standard cross-sections referred to in Table 4 Road Hierarchy (extracted from WAPC Liveable Neighbourhoods, January 2009). These are typical versions of each cross-section but variations are possible. Refer to Liveable Neighbourhoods for footnotes for each cross-section.

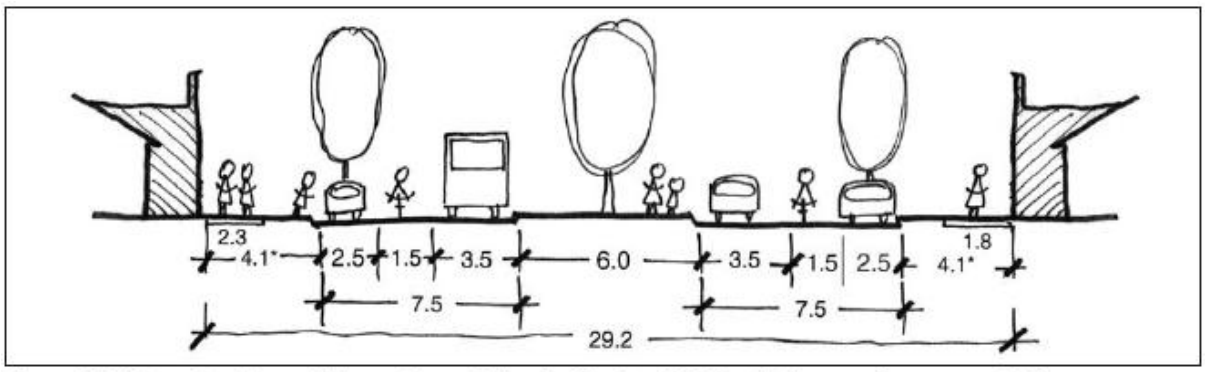


Figure 15: Integrator B – outside centres – 60 km/hr (up to 15 000 vehicles per day - see note 2).

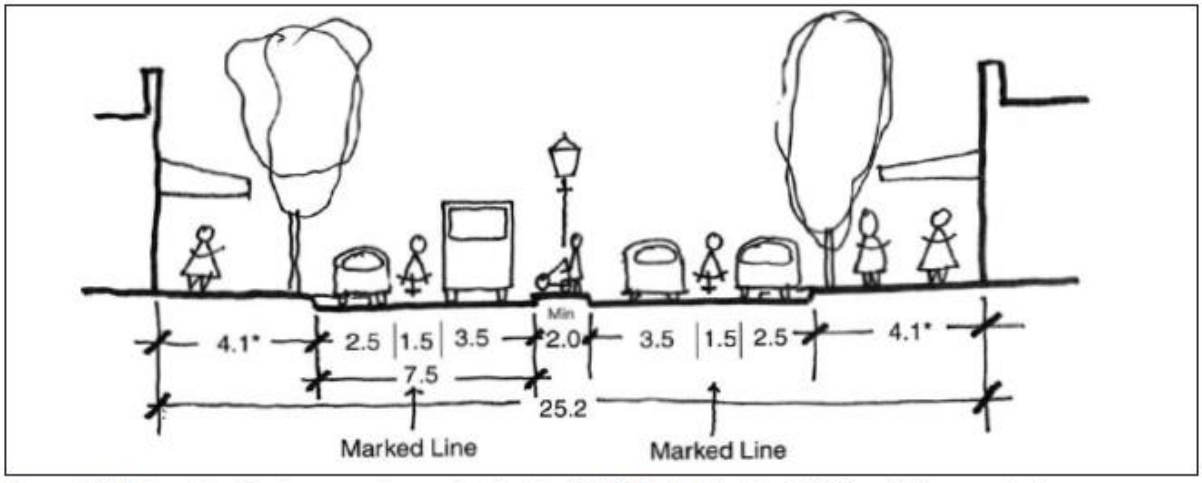


Figure 16: Integrator B – town centre main street – 40-50 km/hr (up to 15 000 vehicles per day).

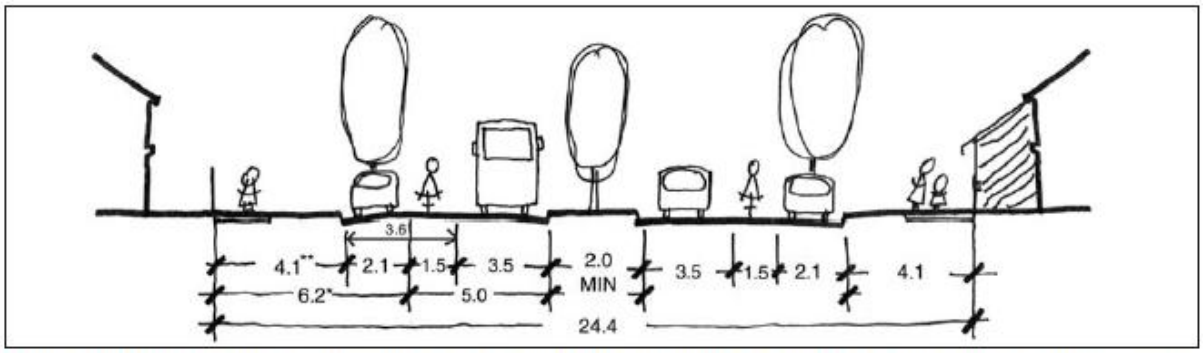


Figure 17: Neighbourhood connector A – 50 km/hr (up to 7000 vehicles per day, with >3000 vehicles per day preferred).

(Note – Figures 15-17: City of Swan requires 3.7m traffic lanes on bus routes, which will reduce the verge widths where required. LN allows verge reduction if parking is embayed.)

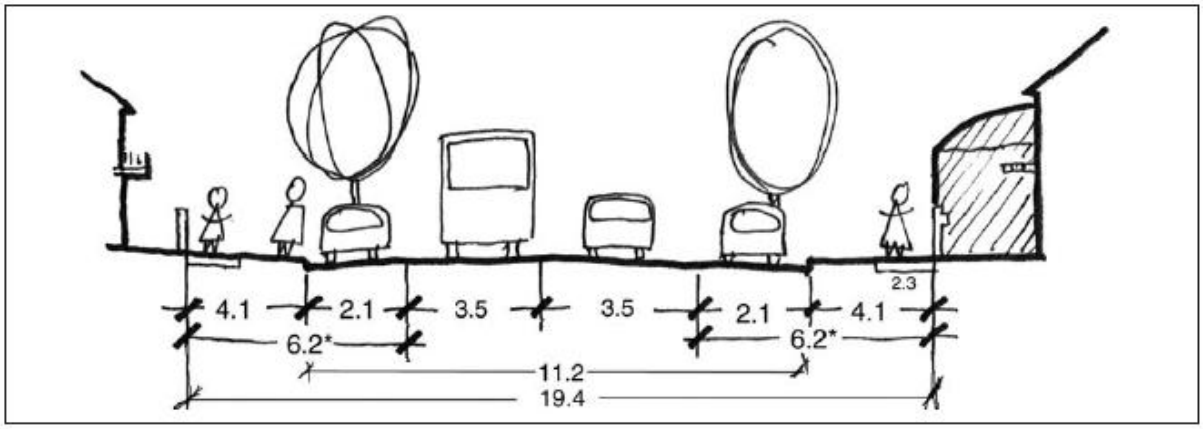
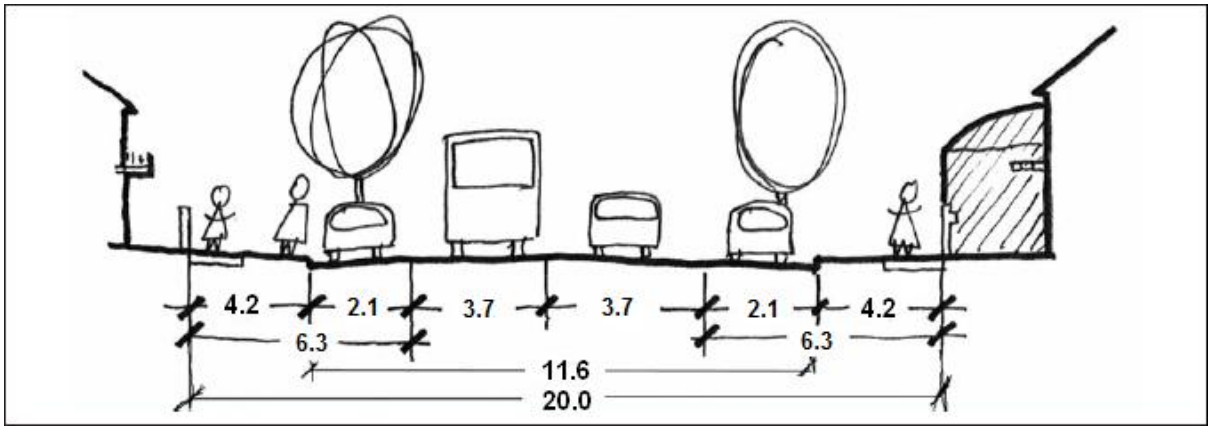


Figure 18: Neighbourhood connector B – 50 km/hr (<3000 vehicles per day).

(Note – Figure 18: City of Swan requires 3.7m traffic lanes on bus routes, which will reduce the verge widths where required. LN allows verge reduction if parking is embayed.)



Variant 20-metre Neighbourhood Connector B Cross-section

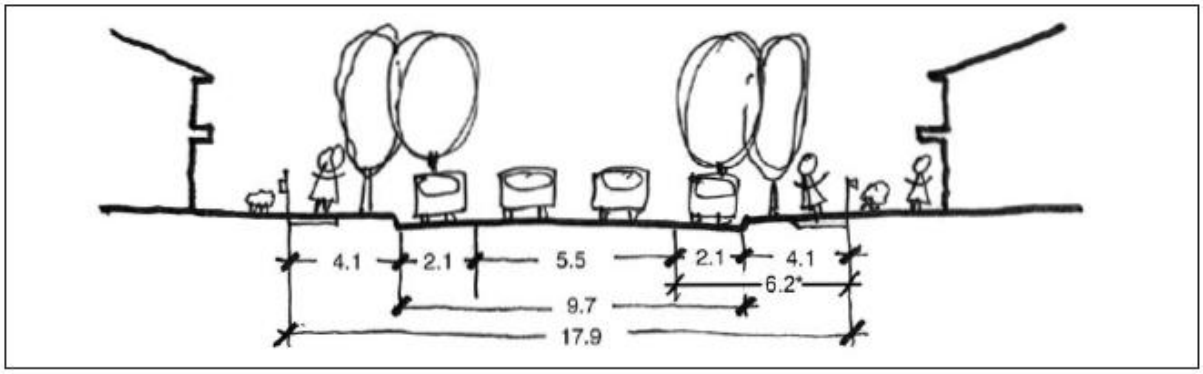


Figure 20: Access street B – wider access street Target speed 40 km/hr (< 3000 vehicles per day).

(Note – Figure 20: On an Access Street B that is a potential future bus route, on-street parking would only be permited on one side to meet City of Swan requirement of bus route 7.4m carriageway.)

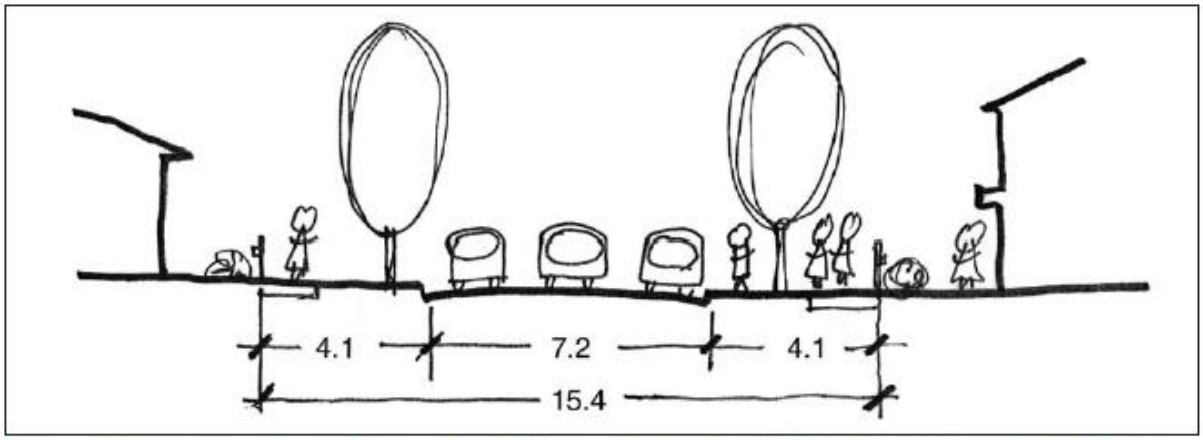


Figure 21: Access street C – yield (or give way) street – Target speed 40 km/hr (< 3000 vehicles per day).

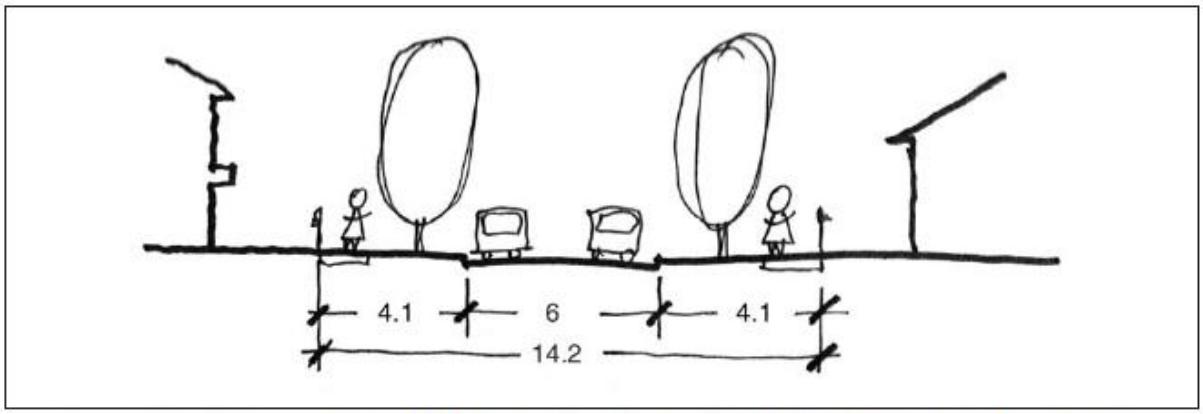


Figure 22: Access street D – narrow yield (or give way) street – Target speed 30 km/hr (< 1000 vehicles per day).

(Note – Figure 22: City of Swan prefers 15m road reserve width for Access Street D, which will increase the verge widths to 4.5m)

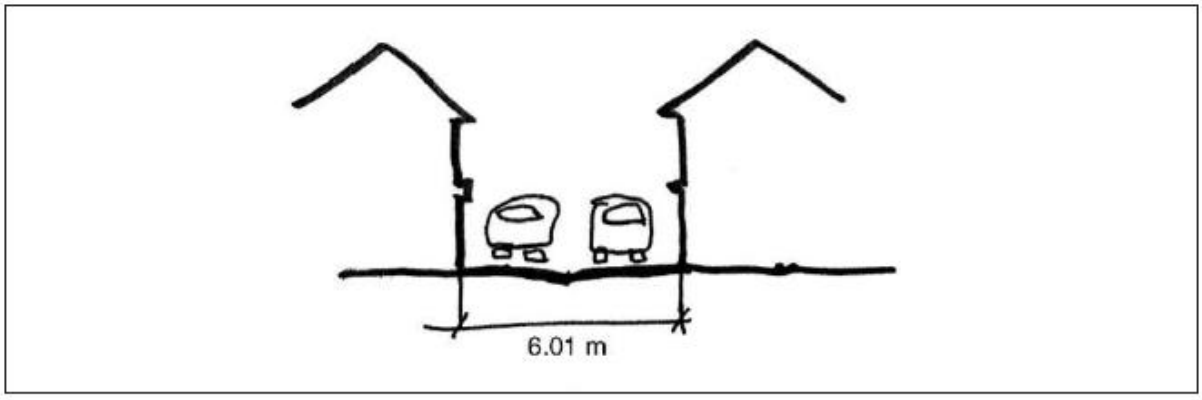
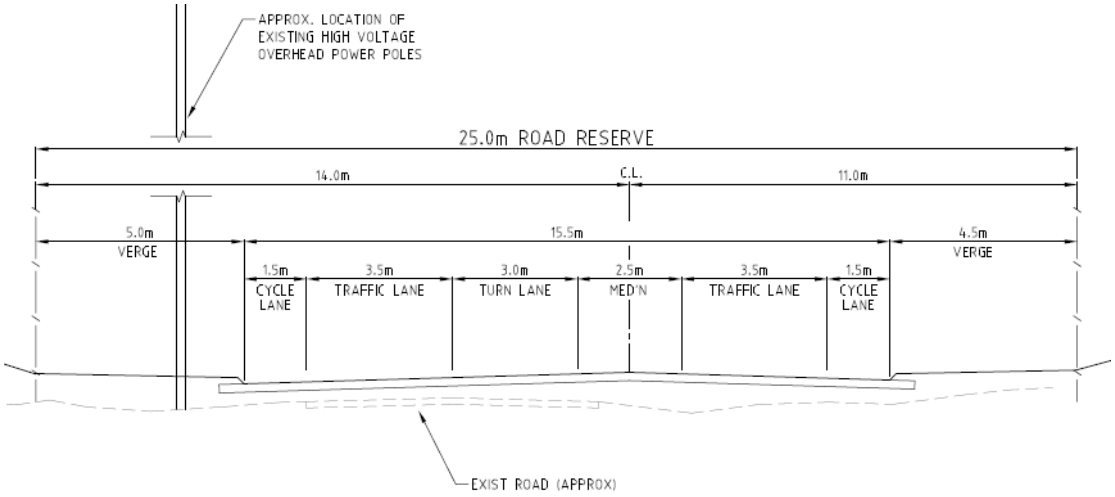
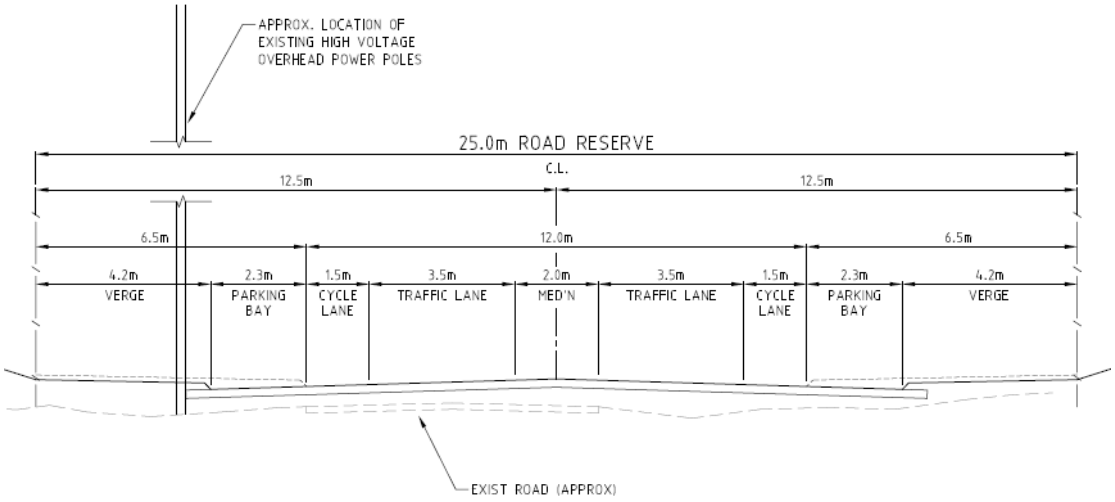


Figure 24: Laneway – for rear vehicle access – Target speed 15 km/hr.

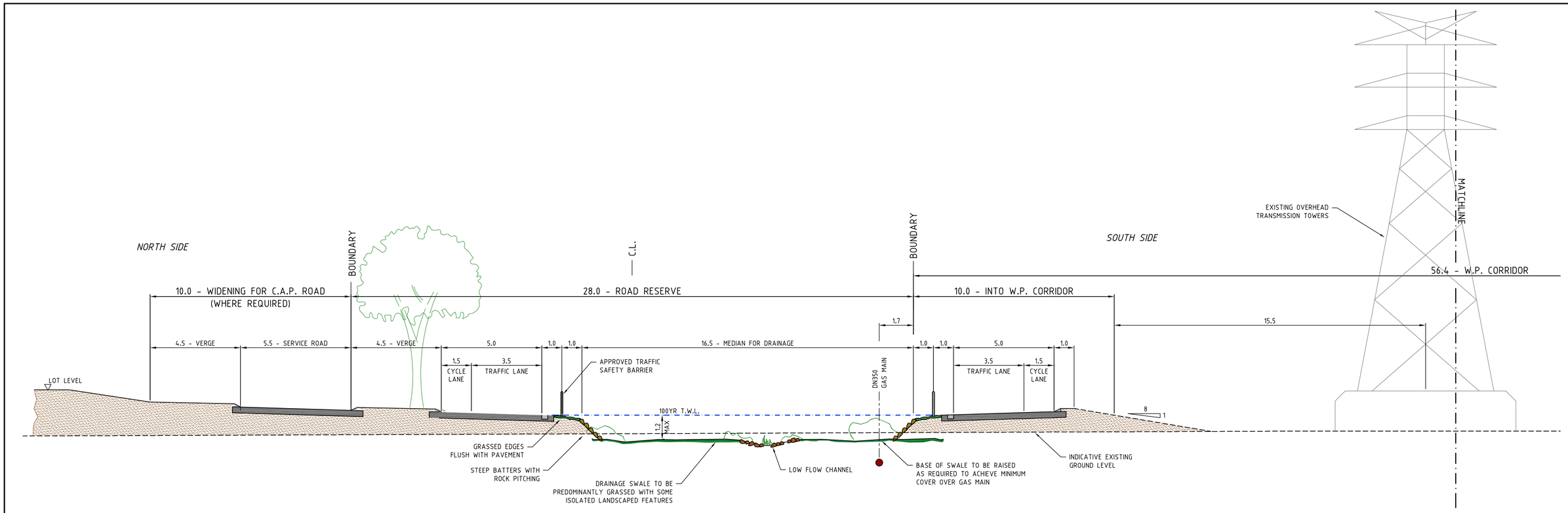
Arthur Street Cross-sections



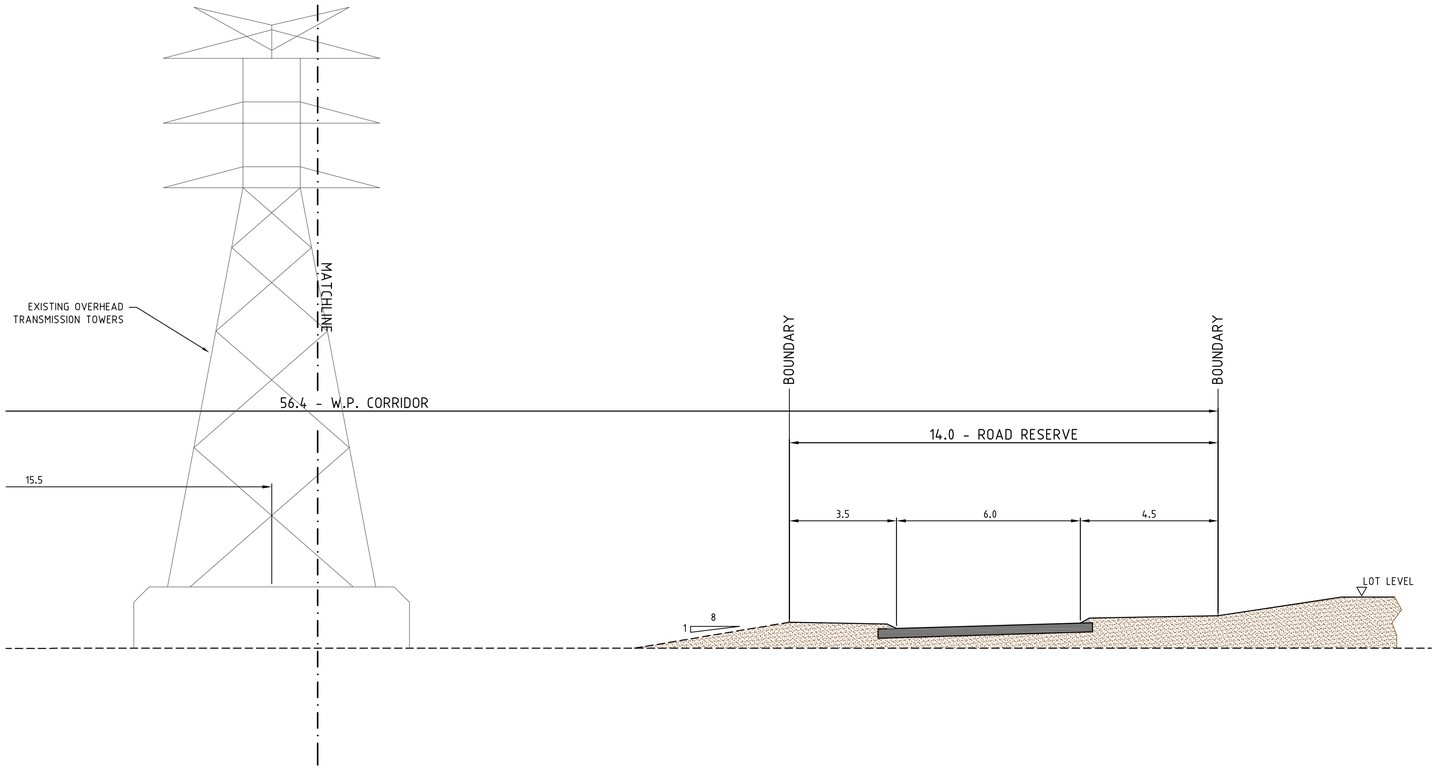
AT INTERSECTIONS EXCEPT ROUNDABOUTS



MIDBLOCK WITHIN ACTIVITY CENTRES



MARSHALL ROAD CROSS SECTION



MARSHALL ROAD CROSS SECTION

Marshall Road
Ultimate Cross Section

DRAWING NUMBER 2223-00-SK36-1

ISSUE D

SCALE 1:100

A1

TABEC Civil Engineering Consultants
TABEC Pty Ltd ACN 090 796 204
14 Wickham Street, East Perth WA 6004
Telephone 9225 4100, Fax 9225 4188
Email info@tabec.com.au

Plotted By: REvans Plot Date: 21/01/11 - 09:57 Cad File: T:\Projects\2223\Design\CAD\Sketches\2223-00-SK36 Marshall Rd Drainage.dwg

APPENDIX C

SHORT TERM ACCESS STRATEGY FOR LSP1

APPENDIX C

SHORT TERM ACCESS STRATEGY FOR LSP1

1. Introduction

Transcore has previously prepared transport assessment reports for structure planning of Dayton (formerly known as West Swan East) on behalf of the Aspen Group. This has included a report for Local Structure Plan (LSP) 1, which is the first area of development within the broader West Swan East District Structure Plan area.

The transport planning for the West Swan East District Structure Plan and LSP 1 areas has focussed on two medium- to long-term scenarios. The interim scenario envisages construction of Henley Brook Avenue and the roundabout on Lord Street at Marshall Road west that has recently been constructed. The ultimate scenario looks forward to the future construction of the Perth-Darwin National Highway with a bridge over the highway at Marshall Road and a bridge over Reid Hwy at Arthur Street.

The City of Swan requested additional traffic modelling of a short-term scenario in which Henley Brook Avenue is not yet constructed and existing road links such as Victoria Road, Coast Road, Harrow Street and West Swan Road carry the traffic from development at West Swan East instead.

Subsequent analysis by Transcore indicated that the existing West Swan Road / Coast Road and West Swan Road / Victoria Road intersections could only cope with the additional traffic from development of 290 residential lots in West Swan East before major upgrading of those intersections would be required. Various intersection treatments were considered but the most feasible scheme involved intersection upgrading and traffic lights at West Swan Road / Coast Road and banning of right turn movements at West Swan Road / Victoria Road.

City of Swan officers advised that they could not support that short-term access strategy and recommended that a solution for LSP1 (only) could be the temporary closure of access to Coast Rd from LSP1, and a similar temporary closure of Victoria Rd. They advised that the proposed locations of these closures should be proposed in the plan for consideration and public comment.

This technical note therefore documents the traffic flows that will be generated in the short-term scenario of development of LSP1 prior to construction of Henley Brook Avenue, with the temporary closure of Coast Road and Victoria Road at an appropriate location between Arthur Street and West Swan Road.

It should be noted that this temporary access strategy is only applicable for LSP1. It is anticipated that the early construction of Marshall Road is likely to be required for development in LSP 2A and 2B (east of Arthur Street) and this will be addressed in the traffic report that will be prepared for LSP 2A and 2B.

2. Modelled Land Uses

LSP1 will accommodate up to an anticipated 950 dwellings and also includes a 0.4ha community facilities site on the west side of Arthur Street. This will be located opposite a proposed neighbourhood centre on the other side of Arthur Street, which is not included in the LSP1 area and has not been modelled in this short-term scenario.

3. Modelled Road Network

The local road network of LSP1 has been modelled in accordance with the local structure plans and is consistent with modelling undertaken for the transport assessment for this application.

Outside of LSP 1 the surrounding road network has been modelled in its existing form although, as noted in the introduction above, temporary road closures have been included on Coast Road and Victoria Road. This includes:

- Harrow Street (70 km/h area speed limit) connection to West Swan Road;
- Coast Road and Victoria Road temporary closure between Arthur Street and West Swan Road;
- Harrow Street, Cranleigh Street and Marshall Road (all 70 km/h area speed limit) connections to Lord Street and new connection to Lord Street roundabout in LSP1;
- Arthur Street discontinuity at the private primary school south of Harrow Street;
- Blundell Street connection to Harrow Street (70 km/h area speed limit);
- West Swan Road (70km/h speed limit);
- Lord Street north of Reid Highway (80 km/h speed limit), with Lord Street not extended south of Reid Highway; and
- Reid Highway (90 km/h speed limit).

Note that the short-term road network in this technical note is different than the interim scenario modelled in the transport assessment reports for LSP 1. The interim scenario is a long-term scenario where Henley Brook Avenue and the Lord Street extension south of Reid Highway have been constructed. These additional road links will change the routes taken by traffic travelling to and from external locations so differences in traffic patterns are to be expected between the short-term and interim scenarios.

4. Traffic Generation and Distribution

Detailed traffic modelling of full development of Dayton was undertaken for the West Swan East TIS update report of October 2009. That traffic model was subsequently refined to model the LSP1 area in more detail for the LSP1 transport assessment report.

Traffic generation rates for the structure plan land uses were primarily sourced from the Roads and Traffic Authority, NSW, *"Guide to Traffic Generating*

Developments", with additional information from the Institute of Transportation Engineers *"Trip Generation Manual, 7th Edition"* where required.

The residential traffic generation rates used range from 9 vehicles per day (vpd) per dwelling for the lower residential densities, 7 vpd for medium density dwellings and 5 vpd for high-density units close to transit.

Based on guidance in the WAPC *Transport Assessment Guidelines for Developments* (2006) a school trip generation rate of 2 vpd (vehicles per day) per student has been adopted for this assessment.

The same trip generation rates have been applied in the short-term scenario modelled in this technical note.

The same trip distribution to the surrounding regional road network has been used in this short-term scenario as was developed for the full development scenarios as documented in the previous transport assessment reports. The external distribution used in this analysis is as follows:

- 8% Lord Street north;
- 8% Henley Brook Avenue north;
- 16% Reid Highway east;
- 19% West Swan Road south,
- 20% Lord Street south,
- 5% Benara Road west,
- 20% Reid Highway west, and
- 4% Marshall Road west.

5. Modelled Daily Traffic Flows

The modelled daily traffic flows generated by the LSP1 area in this short-term road network scenario are illustrated in Figure C1.

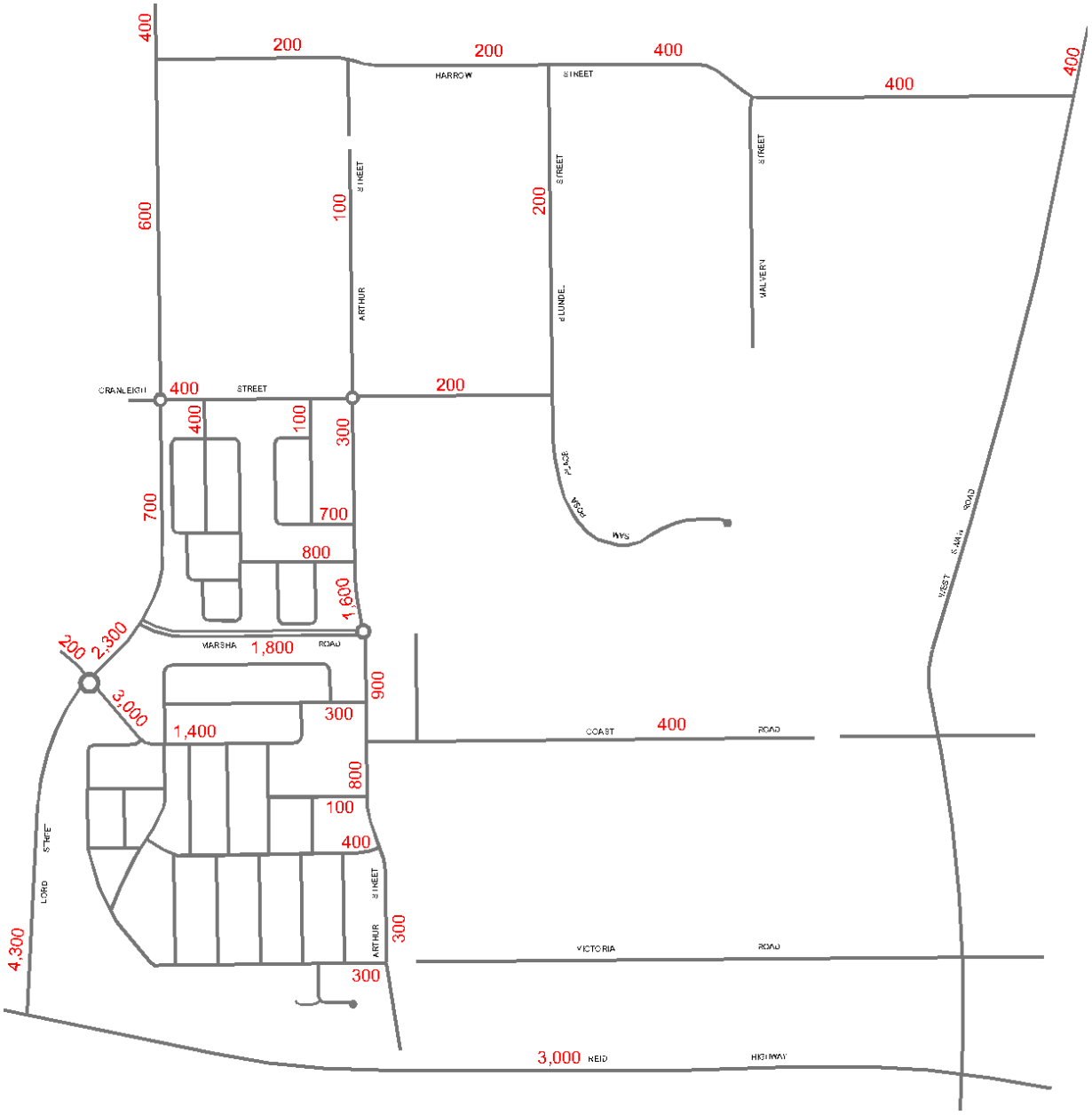


Figure C1. Daily traffic generated by LSP1 (short-term scenario)

The existing traffic volumes on the existing road network in the West Swan East area are presented in Table C1, together with the traffic generated by LSP 1 in this short-term scenario.

Table C1. Existing traffic volumes and total with LSP 1

LOCATION	SOURCE & COUNT DATE	EXISTING TRAFFIC (vpd)	LSP1 TRAFFIC (vpd)[1]	TOTAL TRAFFIC (vpd)[1]
Arthur Street, North of Cranleigh Street	City of Swan July 2007	60 vpd	100 vpd	200 vpd
Arthur Street, North of Marshall Road	City of Swan July 2007	210 vpd	1,600 vpd	1,800 vpd
Arthur Street, North of Coast Road	City of Swan July 2007	640 vpd	900 vpd	1,500 vpd
Arthur Street, North of Victoria Road	City of Swan July 2007	340 vpd	300 vpd	600 vpd
Blundell Street, South of Harrow St	City of Swan July 2007	90 vpd	200 vpd	300 vpd
Coast Road, East of Arthur Street	City of Swan March 2010	480 vpd	400	800 vpd
Coast Road, West of West Swan Road	City of Swan March 2010	770 vpd	None	Reduced
Cranleigh Street, East of Lord Street	City of Swan July 2007	165 vpd	400 vpd	600 vpd
Harrow Street, West of Blundell Street	City of Swan July 2007	750 vpd	200 vpd	900 vpd
Harrow Street, East of Fillip Way	City of Swan July 2007	830 vpd	400 vpd	1,200 vpd
Lord Street, north of Reid Highway	MRWA Dec 2007	13,800 vpd	4,300 vpd	18,100 vpd
Lord Street, North of Marshall Road	City of Swan August 2007	12,850 vpd	700 vpd	13,600 vpd
Marshall Road, West of Lord Street	City of Swan Sept 2006	7,050 vpd	200 vpd	7,300 vpd
Marshall Road, East of Lord Street	City of Swan July 2007	530 vpd	1,800 vpd	2,300 vpd
Reid Highway, West of West Swan Road	MRWA March 2007	26,650 vpd	3,000 vpd	29,700 vpd
Sam Rosa Place, Sth of Cranleigh St	City of Swan July 2007	110 vpd	None	No change
Victoria Road, West of West Swan Road	City of Swan March 2010	490 vpd	None	Reduced
West Swan Road, North of Reid Hwy	City of Swan March 2010	15,340 vpd	None	No change
West Swan Road, South of Woollcott	City of Swan June 2007	10,250 vpd	400 vpd	10,700 vpd

Note: 1. Future traffic volumes rounded to nearest 100.

The results of the traffic model show traffic increases of 3000vpd or more only on:

- Lord Street (south of Marshall Road); and
- Reid Highway (Lord Street to West Swan Road).

These roads would be able to operate satisfactorily with these traffic flows.

6. Temporary Road Closures

Temporary road closures are proposed on Coast Road and Victoria Road because the existing intersections at West Swan Road would not be able to accommodate the full amount of traffic that would result from full development of the LSP1 area. Intersection upgrades would be required that would involve land acquisition as well as signalisation at West Swan Road / Coast Road intersection and right turn bans at West Swan Road / Victoria Road.

City of Swan officers have indicated they could not support this short-term access strategy and recommended temporary road closures on these two roads until either Marshall Road is extended to West Swan Road or Henley Brook Avenue is constructed. Henley Brook Avenue is currently not expected to be completed until 2022/23 but the transport assessments that will be undertaken for Dayton LSP 2A and 2B will consider suitable interim road network strategies such as the Marshall Road extension.

The locations of the proposed road closures on Coast Road and Victoria Road are quite flexible as far as LSP1 is concerned but it is anticipated that this will be a sensitive issue for the existing property owners along these two roads as it will restrict their choice of access east or west.

On Coast Road the existing Caversham Primary School requires access from both east and west so it is suggested that the temporary road closure on Coast Road should be located directly opposite the school. This would allow access to one car park from the eastern section of Coast Road and another car park from the western section of Coast Road. A number of variations of this concept are possible and would be subject to detailed discussions with representatives of the school to develop the preferred strategy.

On Victoria Road it is anticipated that the general preference will be for access towards the east (West Swan Road), particularly for an existing bed & breakfast accommodation operating at one property along this road. It is therefore suggested that Victoria Road be closed east of Arthur Street.

It is anticipated that the location of these closures may attract comments from affected landowners during the advertising period for LSP1, which will further inform the decision process for selection of preferred locations of these closures.

7. Conclusions on Short-term Access for LSP1

This technical note documents the traffic flows that will be generated in the short-term scenario of development of West Swan East LSP1 prior to construction of Henley Brook Avenue.

West Swan Road intersections will not be able to accommodate traffic from full development of LSP1 so it is proposed to temporarily close Coast Road and Victoria Road at appropriate locations to ensure LSP1 traffic will use Lord Street instead of West Swan Road. (See section 6 of this appendix for suggested locations for these road closures.)

It should be noted that this temporary access strategy is only applicable for LSP1. It is anticipated that the early construction of Marshall Road is likely to be required for development in LSP 2A and 2B (east of Arthur Street) and this will be addressed in the traffic report that will be prepared for LSP 2A and 2B.

WEST SWAN EAST (DAYTON) LSP1

Technical Note:
Traffic volumes and Lord Street intersection requirements with addition of residential land west of Lord Street to LSP1

1. Introduction

Transcore has previously prepared transport assessment reports for structure planning of West Swan East (now Dayton) on behalf of the Aspen Group, Little Property Group and GM Dayton Land Pty Ltd. This has included reports for Local Structure Plans (LSP) 1, 2A, 2B and 4 within the broader West Swan East Structure Plan area.

Those reports included modelling of future traffic flows and intersection requirements on the district distributor road network adjacent to each of those LSP areas.

This technical note considers a proposal to include additional land west of Lord Street into LSP1 and provides updated modelling of future traffic flows and intersection requirements on this section of Lord Street.

2. Structure Plan Proposal

The current LSP1 area is bounded by Lord Street and the transit corridor reservation in the MRS on its western side, Reid Highway on the south, Arthur Street on the east and Cranleigh Street on the northern side. It is now proposed to transfer another parcel of future residential land from the LSP3 area and amalgamate it into LSP1. This additional land is located on the western side of Lord Street and extends west to the transit corridor reservation. It is bounded by Cranleigh Street to the north and Marshall Road to the south.

The current LSP1 plan accommodates up to an anticipated 950 dwellings and the additional land west of Lord Street is anticipated to yield another 100 residential lots plus two homestead lots to accommodate two existing dwellings in this area.

3. Traffic Flow Forecasts

The EMME traffic model developed by Transcore for the West Swan East Structure Plan and LSP1 has been progressively updated for each subsequent LSP area in Dayton and has been updated again to reflect the 100 residential lots now proposed west of Lord Street in the modified LSP1 area.

Figure 1 shows daily traffic flows in the modified LSP1 area in the long term interim scenario, which assumes Henley Brook Avenue is constructed and

Marshall Road is extended east to connect to it. Therefore Figure 1 is an updated version of Figure 7 in the *Dayton Local Structure Plan 1 Transport Assessment* (April 2011). The numbers not in brackets are the estimated daily traffic flows generated by the modified LSP1 area. Total daily traffic flows including the rest of Dayton as well as through traffic from surrounding areas are shown in brackets.

Figure 2 illustrates the ultimate scenario, which shows the reduction in traffic along Lord Street after construction of the Perth-Darwin National Highway (PDNH) and construction of the Marshall Road and Arthur Street flyovers across PDNH and Reid Highway, respectively. Thus Figure 2 is an updated version of Figure 8 in the April 2011 transport assessment report.

This ultimate scenario is in accordance with current reservations in the Metropolitan Region Scheme (MRS) and has been the basis for long-term planning in this corridor. If current Main Roads WA proposals to realign the future PDNH alignment to the western side of Whiteman Park do proceed through the MRS amendment process it is assumed that a district distributor road would ultimately be constructed on the current PDNH alignment west of Dayton as planning of this area has been based on this road alignment ultimately relieving traffic demand on Lord Street.

Two short term scenarios have also been modelled. **Figure 3** shows daily traffic flows generated by the modified LSP1 area on the existing surrounding road network, which has connections to West Swan Road in the east via Coast Road, Victoria Road and Harrow Street. (Note that Victoria Road has been modelled as a left in / left out intersection on the west side of West Swan Road in this scenario.)

Figure 4 shows daily traffic flows generated by the modified LSP1 area in the other short-term road network scenario, which has road closures on Coast Road and Victoria Road to restrict traffic from Dayton from using West Swan Road, as recommended in the April 2011 transport assessment report. Thus Figure 4 is an updated version of Figure C1 in the April 2011 transport assessment report.

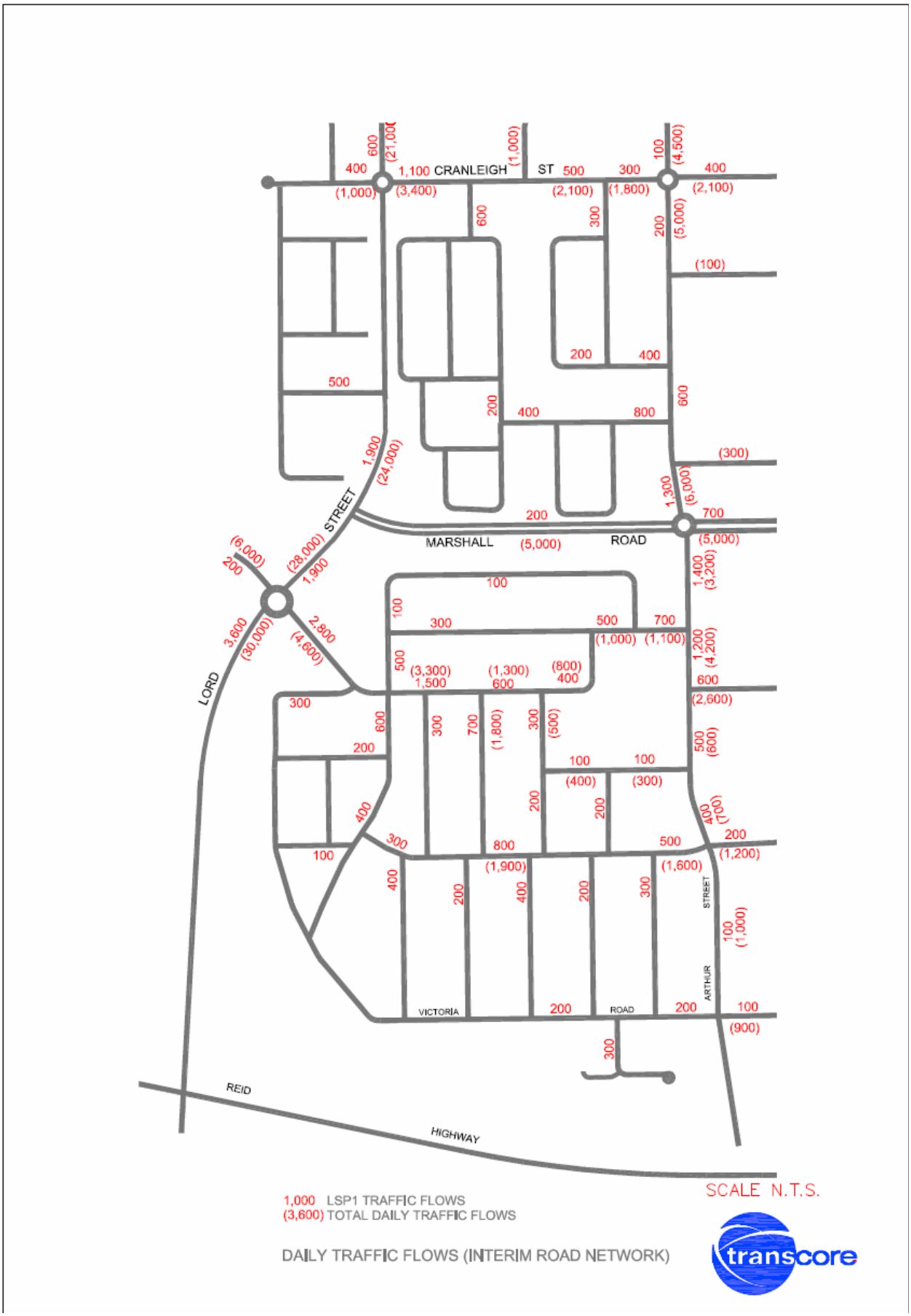


Figure 1. Daily Traffic Volumes – Long Term Interim Scenario

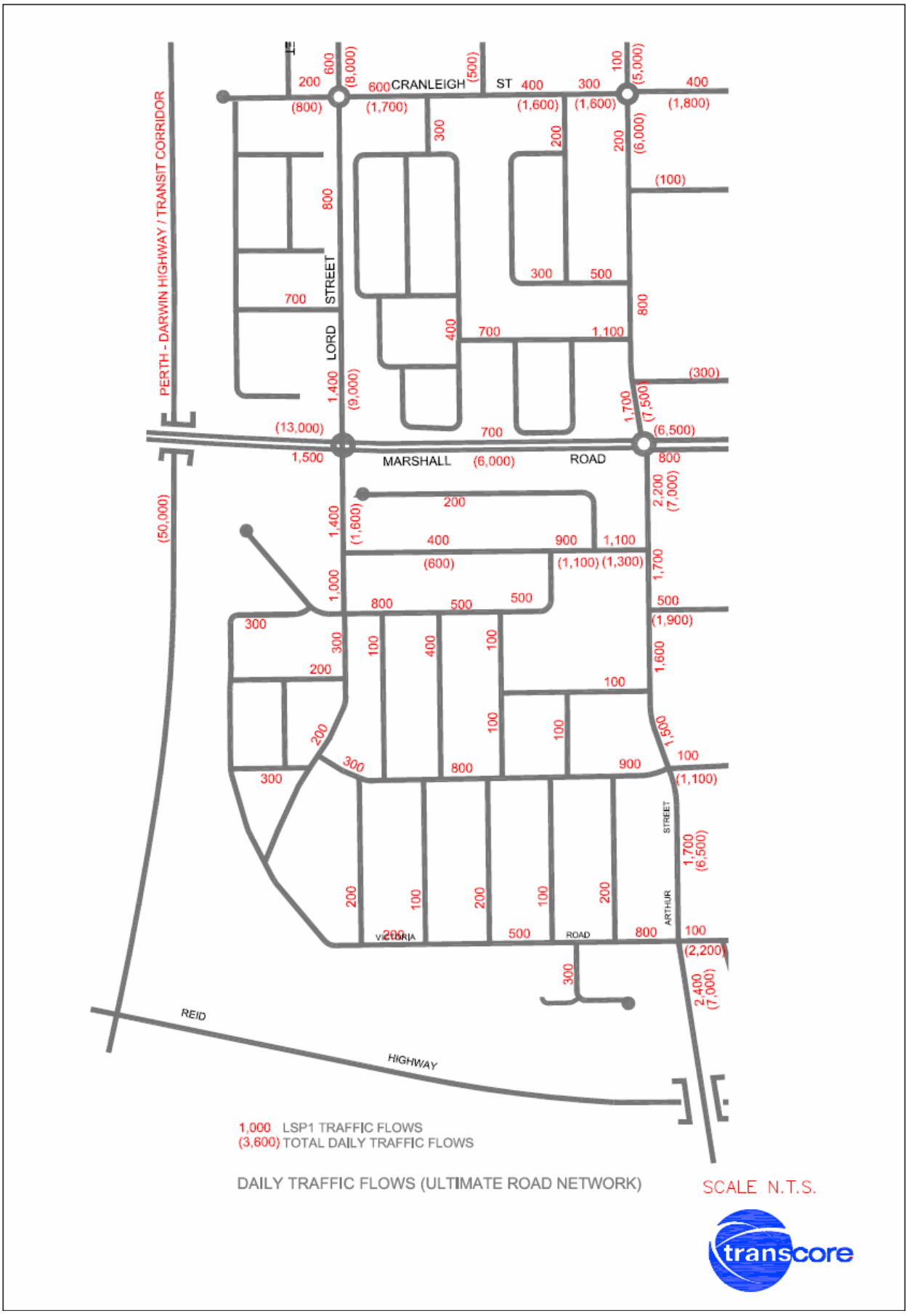


Figure 2. Daily Traffic Volumes – Long Term Ultimate Scenario

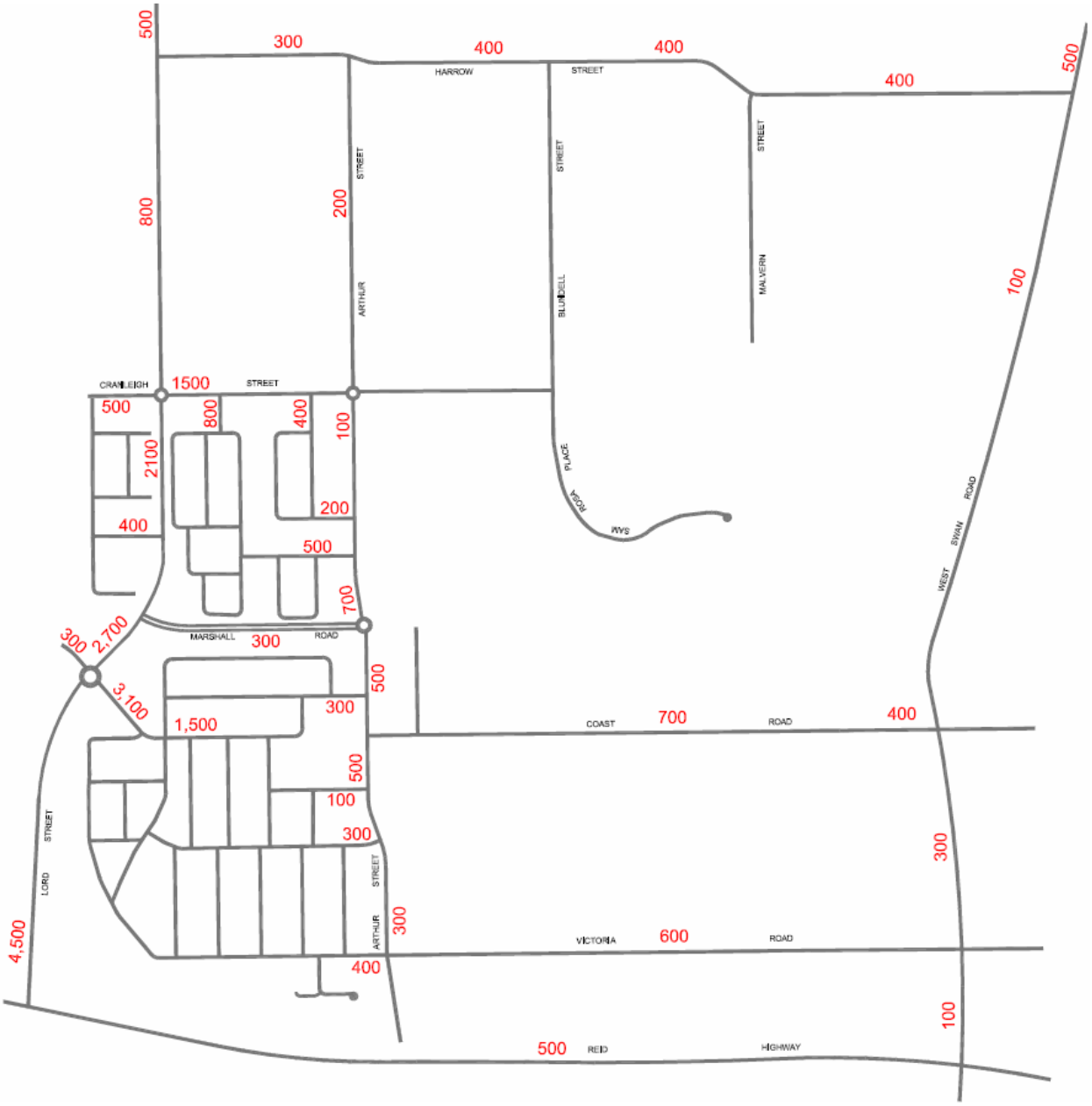


Figure 3. Daily Traffic Volumes generated by Modified LSP1 only – Short Term Scenario with Coast Road connection to West Swan Road

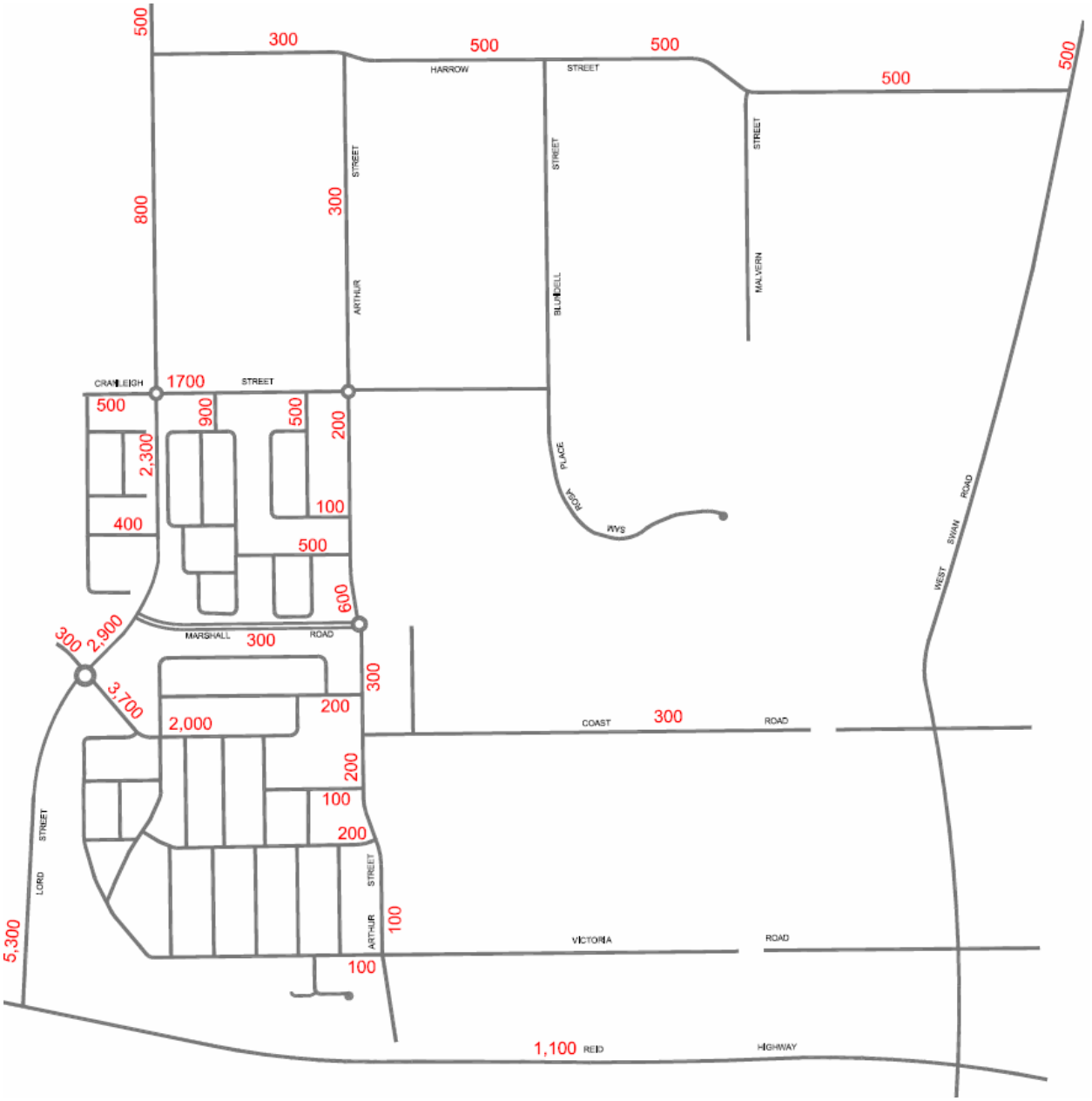


Figure 4. Daily Traffic Volumes generated by Modified LSP1 only – Short Term Scenario without Coast Road connection to West Swan Road

4. Lord Street Intersections

An initial short-term strategy was assessed in the April 2011 Dayton LSP1 transport assessment report and was found to operate satisfactorily until approximately 760 dwellings have been constructed in Dayton. After that level of development:

- a roundabout would be required at the Cranleigh Street / Lord Street intersection;
- right turn movements out from Marshall Road to Lord Street would not be permitted; and
- the Lord Street / Marshall Road / St Leonards Boulevard roundabout would require upgrading.

The trigger point of 760 dwellings constructed in Dayton is the point where the existing intersections will no longer operate satisfactorily with the forecast traffic demand.

At that point, at the Lord Street / Marshall Road East intersection the right turn out from Marshall Road East should be banned and an alternative is required, which is the proposed roundabout at the Lord Street / Cranleigh Street intersection.

The existing single-lane Lord Street / St Leonards Boulevard roundabout will also reach capacity at about the same point (760 du) and then needs to be upgraded to a two-lane roundabout (or some other treatment such as traffic signals).

To evaluate long term intersection requirements, intersection capacity has been analysed for four key intersections along Lord Street adjacent to the proposed modification of the LSP1 area, for the long term interim scenario.

Intersection capacity has been analysed using the SIDRA intersection analysis software program. SIDRA outputs are presented in the form of Degree of Saturation, Level of Service, Average Delay and 95% Queue. These items are defined as follows:

Degree of Saturation: is the ratio of the arrival traffic flow to the capacity of the approach during the same period. The Degree of Saturation ranges from close to 0% for very low traffic flow up to 100% for saturated flow or capacity.

Level of Service: is the qualitative measure describing operational conditions within a traffic stream and the perception by motorists and/or passengers. In general, there are 6 levels of service, designated from A to F, with Level of Service A representing the best operating condition and Level of Service F the worst. In SIDRA intersection analysis the level of service is based on the average delays experienced by each traffic movement.

Average Delay: is the average of all travel time delays for vehicles through the intersection.

95% Queue: is the queue length below which 95% of all observed queue lengths fall.

4.1 Lord Street / Marshall Road west / St Leonards Boulevard roundabout

Previous analysis has indicated this existing single-lane roundabout will require further upgrading to provide sufficient capacity to accommodate the forecast traffic volumes. The suggested upgrading is shown at **Figure A1** in Appendix A of this technical note. This involves widening all four approaches to two lanes and the two Lord Street exits to two lanes with corresponding widening of the roundabout to two lanes for traffic movements on Lord Street.

Tables A1a and A1b show the SIDRA results for the revised AM and PM peak hour traffic flows, respectively, for the long term interim scenario. The analysis confirms this treatment would provide sufficient capacity for the forecast traffic flows. The roundabout would be at approximately 72% to 74% of capacity, overall level of service A with no movement worse than level of service C (very good) and longest 95% queue lengths less than 70m occurring on the peak direction approach on Lord Street in each peak hour.

4.2 Lord Street / Marshall Road east intersection

This existing T-junction has previously been analysed for the LSP1 short term scenario and for long term interim scenario traffic flows. In both scenarios this intersection will require further upgrading to provide sufficient capacity to accommodate the forecast traffic volumes.

The suggested initial treatment is to ban the right turn out from Marshall Road. This is forecast to be a relatively low volume traffic movement and these movements can be accommodated at the proposed Lord Street / Cranleigh Street roundabout instead.

The revised traffic forecasts for the long term interim scenario (taking into consideration progressive changes in other LSP areas as well) indicate slightly higher traffic flows on Lord Street in the long term than previously estimated and an unsignalised intersection treatment will not be able to function satisfactorily for the forecast AM peak hour traffic flows.

It is therefore anticipated that this intersection may need to be signalised if traffic flows on Lord Street increase to the anticipated levels shown in Figure 1 before PDNH (or an alternative road on that alignment) is constructed to relieve traffic volumes on Lord Street. It is important to note that if PDNH is constructed before Lord Street traffic volumes reach the threshold levels shown in Figure 1 then signalisation of this intersection will not be required.

A potential signalised intersection treatment is shown at **Figure A2** in Appendix A. The right turn out from Marshall Road is still banned in this suggested intersection treatment so that there is no need to stop northbound traffic flows on Lord Street. If northbound traffic on Lord Street was stopped by traffic lights it would queue back into the roundabout at St Leonards Boulevard, so the option of a full movement signalised intersection here is not supported.

Tables A2a and A2b show the SIDRA results for this signalised intersection treatment in the long term interim scenario. The analysis confirms this treatment would provide sufficient capacity for the forecast traffic flows. The intersection

would be at approximately 87% of capacity in the AM peak hour (and significantly less in the PM peak), overall level of service B with no movement worse than level of service C (very good) and longest 95% queue lengths of approximately 175m occurring on the north approach on Lord Street in the AM peak hour. All queue lengths can be accommodated without affecting other nearby intersections.

4.3 Lord Street / Cranleigh Street intersection

This existing stop-sign controlled crossroads has previously been analysed for the LSP1 short term scenario and for long term interim scenario traffic flows. In both scenarios this intersection will require upgrading to provide sufficient capacity to accommodate the forecast traffic volumes. The suggested upgrading is a roundabout as shown at **Figure A4** in Appendix A. This involves two-lane approaches and exits on Lord Street and single-lane approaches and exits on Cranleigh Street.

Tables A4a and A4b show the SIDRA results for the revised AM and PM peak hour traffic flows, respectively, for the long term interim scenario. The analysis confirms this treatment would provide sufficient capacity for the forecast traffic flows. The roundabout would be at approximately 52% of capacity, overall level of service A with no movement worse than level of service B (very good) and longest 95% queue lengths of approximately 30m occurring on the peak direction approach on Lord Street in each peak hour.

4.4 Lord Street / western residential access intersection

Previous analysis of other T-junctions along Lord Street north of Cranleigh Street indicates that they would be able to operate satisfactorily as priority-controlled, full-movement T-junctions (i.e. give way control) only if turn pockets are constructed and a wide median (6m wide) was provided on the major road to allow right turns to be undertaken in two stages.

However, Lord Street is not planned to have a wide median like that so that sort of intersection treatment would require significant widening on Lord Street. It is therefore recommended that the proposed Lord St / western residential access intersection should be restricted to left in / left out movements only. The roundabout proposed at Lord St / Cranleigh St will allow right turn access to and from Lord Street for this area.

Tables A3a and A3b show the SIDRA results for the AM and PM peak hour traffic flows, respectively, for the long term interim scenario. The analysis confirms this treatment would provide sufficient capacity for the forecast traffic flows. The roundabout would be at approximately 43% to 45% of capacity, with no movement worse than level of service D (satisfactory) and minimal queues.

One other issue needs to be taken into consideration at this proposed intersection location. The side street is located on the inside of a curve on Lord Street, so sight distances need to be checked. Lord Street currently has an 80km/h posted speed limit. Road design in this environment is based on a 90km/h design speed. The Safe Intersection Sight Distance (SISD) required for this design speed is 214m, which is measured from 5m back from the through

traffic lane at the intersection to the middle of the traffic lane upstream on Lord Street. This sight distance requirement is illustrated on **Figure 5**. It is apparent from Figure 5 that the required sight line will encroach several metres within the land on the western side of the Lord Street Road reserve. This means that future subdivision design within that proposed residential zone will need to be set back sufficiently to ensure that the area between that sight line and the carriageway of Lord Street is kept clear of obstacles that would block the line of sight between the proposed intersection and vehicles northbound on Lord Street.

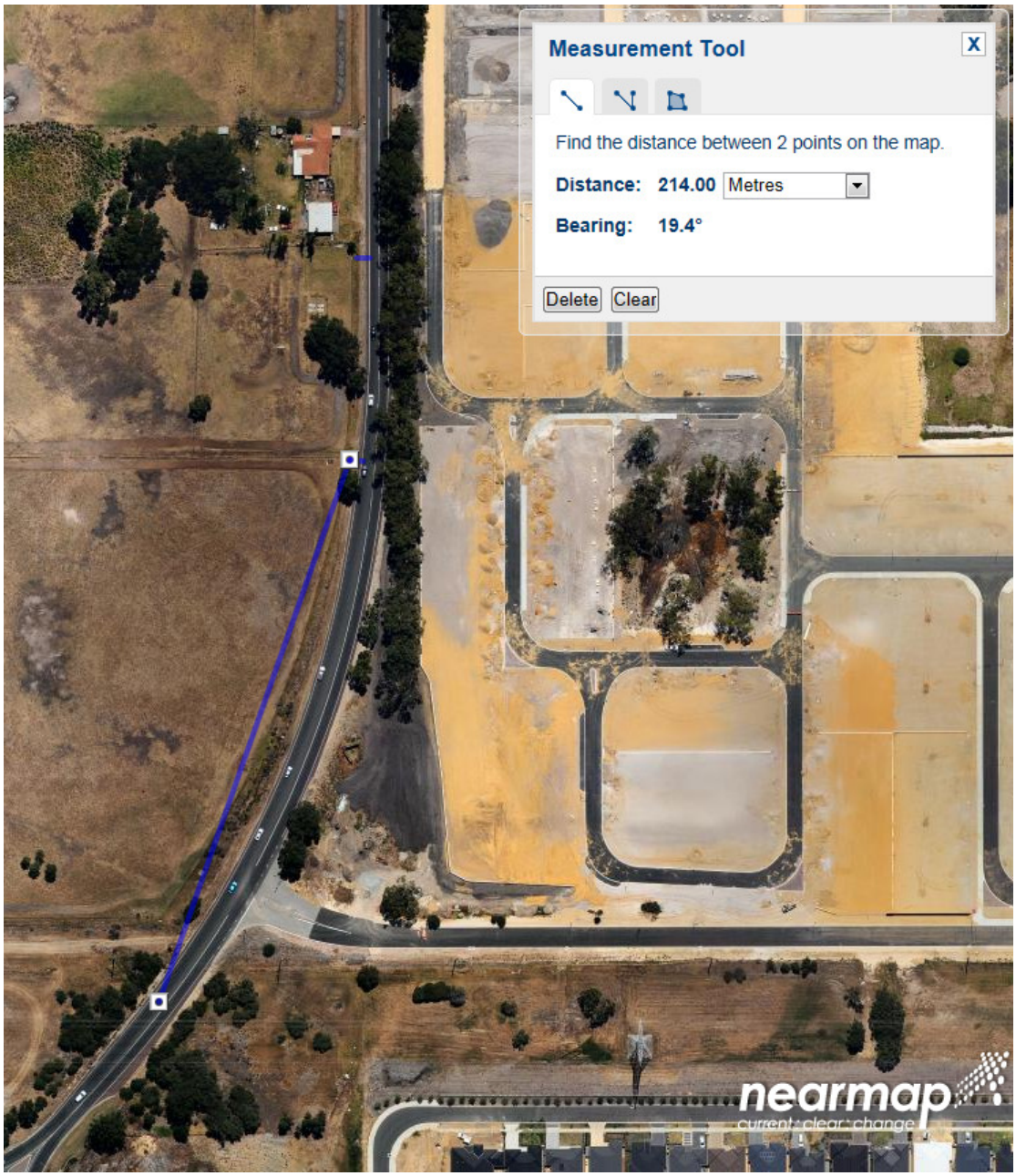


Figure 5. Safe Intersection Sight Distance from proposed intersection location

5. Conclusions

This technical note addresses a proposal to incorporate land on the west side of Lord Street into Dayton Local Structure Plan 1.

Revised traffic forecasts are provided for the long term interim scenario before construction of Perth-Darwin National Highway (PDNH) west of Dayton and for the long term ultimate scenario after construction of PDNH.

Revised traffic modelling of LSP1 traffic flows is also provided for short term scenarios prior to construction of Henley Brook Avenue east of Dayton.

Intersection analysis has been undertaken for the long term interim scenario prior to construction of PDNH (or an appropriate alternative), which is the highest traffic volume scenario considered.

An upgraded roundabout at Lord St / Marshall Rd west / St Leonards Bvd will be able to accommodate the forecast traffic flows satisfactorily.

At Lord St / Marshall Rd east intersection it is planned that the right turn out from Marshall Rd should be banned when traffic flows exceed the capacity of this existing movement. In the longer term, depending on how long it is until the construction of PDNH (or an appropriate alternative), it may also be necessary to signalise this intersection, however if PDNH is constructed before Lord Street traffic volumes reach the necessary threshold levels then signalisation of this intersection will not be required.

At Lord St / Cranleigh St intersection it is proposed that a two lane roundabout should be constructed, which will be able to accommodate the forecast traffic flows satisfactorily.

The proposed western residential access road intersection on Lord Street north of Marshall Rd should be planned as a left in / left out intersection, which will be able to accommodate the forecast traffic flows satisfactorily. The subdivision design west of this section of Lord Street will need to avoid obstruction of Safe Intersection Sight Distance sight lines for this intersection.

Robin White
Senior Traffic & Transport Engineer

APPENDIX A

SIDRA INTERSECTION ANALYSIS

Table A1a. SIDRA results – Lord Street / Marshall Rd West / St Leonards Bvd – long term interim scenario 7-8 AM peak

Movement Performance - Vehicles								
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m
South East: St Leonards Bvd (SE)								
1	L	295	0.0	0.472	17.8	LOS B	3.2	22.1
2	T	21	0.0	0.472	19.1	LOS B	2.7	18.8
3	R	27	0.0	0.472	25.3	LOS C	2.7	18.8
Approach		343	0.0	0.472	18.5	LOS B	3.2	22.1
North East: Lord St (NE)								
4	L	12	0.0	0.739	9.1	LOS A	9.1	64.9
5	T	1660	2.0	0.739	8.3	LOS A	9.4	67.0
6	R	253	2.0	0.739	15.2	LOS B	9.4	67.0
Approach		1925	2.0	0.739	9.2	LOS A	9.4	67.0
North West: Marshall Rd (NW)								
7	L	110	2.0	0.146	8.7	LOS A	0.6	4.4
8	T	7	0.0	0.166	6.9	LOS A	0.7	5.3
9	R	147	2.0	0.166	13.2	LOS B	0.7	5.3
Approach		264	1.9	0.166	11.2	LOS B	0.7	5.3
South West: Lord St (SW)								
10	L	63	2.0	0.369	7.7	LOS A	2.7	19.4
11	T	727	2.0	0.369	6.5	LOS A	2.7	19.4
12	R	110	0.0	0.369	12.9	LOS B	2.6	18.3
Approach		900	1.8	0.369	7.4	LOS A	2.7	19.4
All Vehicles		3432	1.7	0.739	9.8	LOS A	9.4	67.0

Table A1b. SIDRA results – Lord Street / Marshall Rd West / St Leonards Bvd – long term interim scenario 5-6 PM peak

Movement Performance - Vehicles								
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m
South East: St Leonards Bvd (SE)								
1	L	126	0.0	0.088	8.2	LOS A	0.4	2.7
2	T	9	0.0	0.088	7.4	LOS A	0.4	2.6
3	R	12	0.0	0.088	13.7	LOS B	0.4	2.6
Approach		147	0.0	0.088	8.6	LOS A	0.4	2.7
North East: Lord St (NE)								
4	L	29	0.0	0.353	7.7	LOS A	2.5	17.6
5	T	711	2.0	0.353	6.7	LOS A	2.5	17.6
6	R	108	2.0	0.353	13.2	LOS B	2.4	16.8
Approach		848	1.9	0.353	7.5	LOS A	2.5	17.6
North West: Marshall Rd (NW)								
7	L	256	2.0	0.455	13.2	LOS B	2.8	19.7
8	T	17	0.0	0.207	11.8	LOS B	0.9	6.7
9	R	63	2.0	0.207	18.1	LOS B	0.9	6.7
Approach		336	1.9	0.455	14.0	LOS B	2.8	19.7
South West: Lord St (SW)								
10	L	147	2.0	0.716	7.3	LOS A	8.5	60.6
11	T	1695	2.0	0.716	6.2	LOS A	8.5	60.6
12	R	256	0.0	0.716	12.5	LOS B	8.4	59.6
Approach		2098	1.8	0.716	7.0	LOS A	8.5	60.6
All Vehicles		3429	1.7	0.716	7.9	LOS A	8.5	60.6

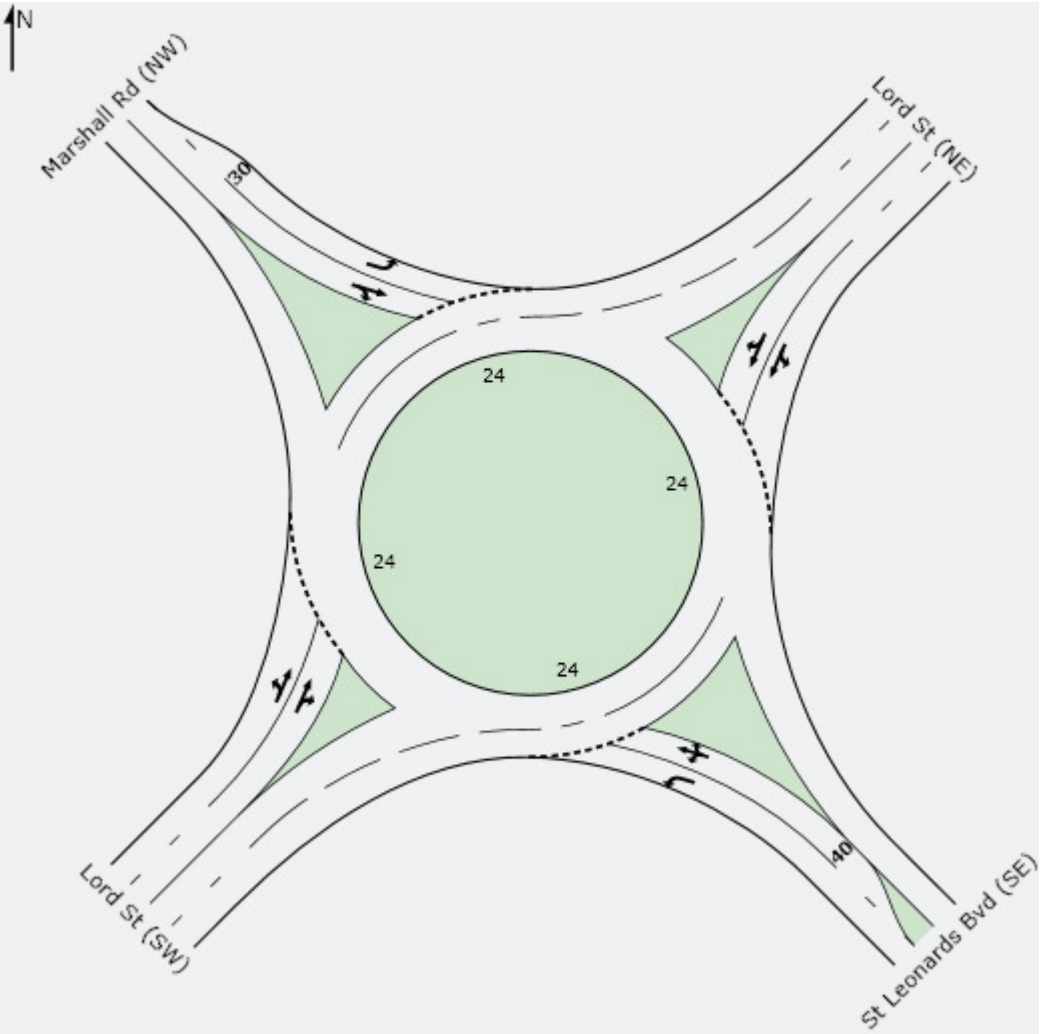


Figure A1. Intersection layout analysed in SIDRA

Table A2a. SIDRA results – Lord Street / Marshall Rd East – long term interim scenario 7-8 AM peak

Signals - Actuated Cycle Time = 63 seconds

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m
South: Lord St (S)								
11	T	714	2.0	0.227	0.8	LOS A	1.3	9.3
12	R	164	2.0	0.279	28.5	LOS C	3.9	27.4
Approach		878	2.0	0.279	6.0	LOS A	3.9	27.4
East: Marshall Rd (E)								
1	L	341	2.0	0.581	28.2	LOS C	9.0	64.1
Approach		341	2.0	0.581	28.2	LOS C	9.0	64.1
North: Lord St (N)								
4	L	25	2.0	0.026	11.0	LOS B	0.1	0.9
5	T	1670	2.0	0.873	18.0	LOS B	24.6	175.1
Approach		1695	2.0	0.873	17.9	LOS B	24.6	175.1
All Vehicles		2914	2.0	0.873	15.5	LOS B	24.6	175.1

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

Phase Timing Results

Phase	A	B
Green Time (sec)	31	20
Yellow Time (sec)	4	4
All-Red Time (sec)	2	2
Phase Time (sec)	37	26
Phase Split	59 %	41 %

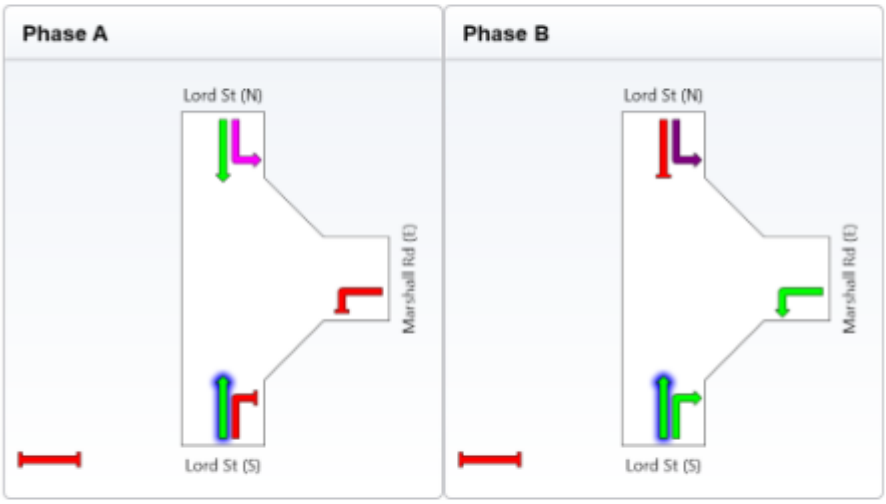


Table A2b. SIDRA results – Lord Street / Marshall Rd East – long term interim scenario 5-6 PM peak

Signals - Actuated Cycle Time = 40 seconds

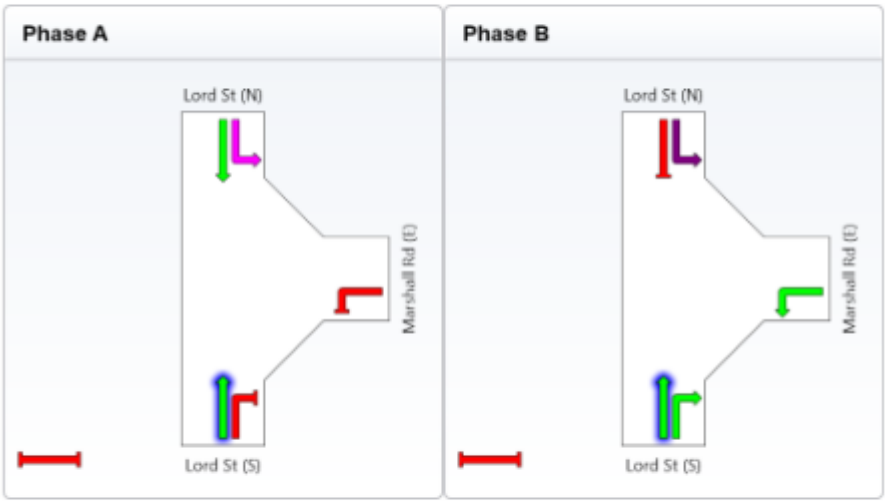
Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m
South: Lord St (S)								
11	T	1666	2.0	0.612	1.9	LOS A	4.5	32.0
12	R	383	2.0	0.592	22.7	LOS C	6.4	45.7
Approach		2049	2.0	0.612	5.8	LOS A	6.4	45.7
East: Marshall Rd (E)								
1	L	146	2.0	0.226	18.1	LOS B	2.1	14.8
Approach		146	2.0	0.226	18.1	LOS B	2.1	14.8
North: Lord St (N)								
4	L	59	2.0	0.063	12.8	LOS B	0.4	2.9
5	T	716	2.0	0.526	12.1	LOS B	5.8	41.3
Approach		775	2.0	0.526	12.1	LOS B	5.8	41.3
All Vehicles		2970	2.0	0.612	8.0	LOS A	6.4	45.7

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

Phase Timing Results

Phase	A	B
Green Time (sec)	14	14
Yellow Time (sec)	4	4
All-Red Time (sec)	2	2
Phase Time (sec)	20	20
Phase Split	50 %	50 %



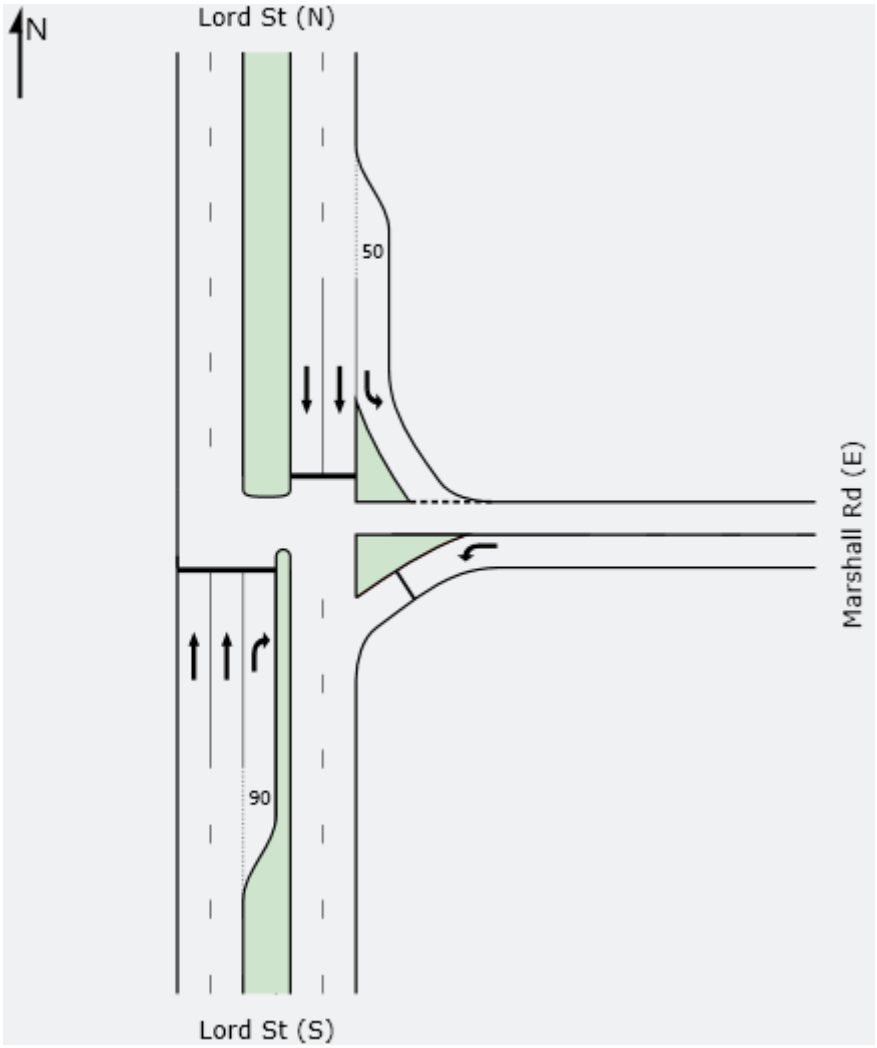


Figure A2. Intersection layout analysed in SIDRA

Table A3a. SIDRA results – Lord Street / Western residential access – long term interim scenario 7-8 AM peak

Movement Performance - Vehicles								
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m
South: Lord St (S)								
4	L	21	0.0	0.011	11.1	X	X	X
5	T	660	2.0	0.171	0.0	LOS A	0.0	0.0
Approach		681	1.9	0.171	0.3	NA	0.0	0.0
North: Lord St (N)								
11	T	1729	2.0	0.449	0.0	LOS A	0.0	0.0
Approach		1729	2.0	0.449	0.0	NA	0.0	0.0
West: West Residential Access (W)								
1	L	20	0.0	0.028	10.8	LOS B	0.1	0.7
Approach		20	0.0	0.028	10.8	LOS B	0.1	0.7
All Vehicles		2430	2.0	0.449	0.2	NA	0.1	0.7

X: Not applicable for Continuous movement.

Table A3b. SIDRA results – Lord Street / Western residential access – long term interim scenario 5-6 PM peak

Movement Performance - Vehicles								
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m
South: Lord St (S)								
4	L	49	0.0	0.026	11.1	X	X	X
5	T	1649	2.0	0.428	0.0	LOS A	0.0	0.0
Approach		1698	1.9	0.428	0.3	NA	0.0	0.0
North: Lord St (N)								
11	T	741	2.0	0.192	0.0	LOS A	0.0	0.0
Approach		741	2.0	0.192	0.0	NA	0.0	0.0
West: West Residential Access (W)								
1	L	9	0.0	0.067	33.5	LOS D	0.2	1.4
Approach		9	0.0	0.067	33.5	LOS D	0.2	1.4
All Vehicles		2448	2.0	0.428	0.3	NA	0.2	1.4

X: Not applicable for Continuous movement.

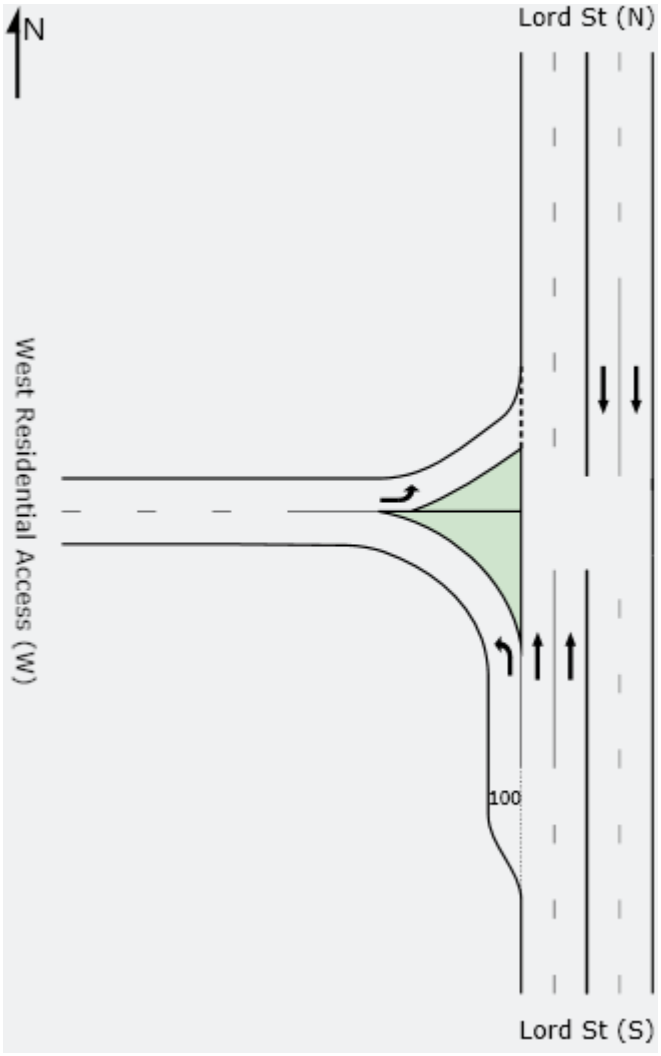


Figure A3. Intersection layout analysed in SIDRA

Table A4a. SIDRA results – Lord Street / Cranleigh Street – long term interim scenario 7-8 AM peak

Movement Performance - Vehicles								
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m
South: Lord St (S)								
10	L	34	2.0	0.237	6.7	LOS A	1.6	11.4
11	T	549	2.0	0.237	5.4	LOS A	1.6	11.4
12	R	110	0.0	0.237	11.9	LOS B	1.5	11.0
Approach		693	1.7	0.237	6.5	LOS A	1.6	11.4
East: Cranleigh St (E)								
1	L	181	0.0	0.507	13.4	LOS B	2.9	20.3
2	T	4	0.0	0.507	12.6	LOS B	2.9	20.3
3	R	90	0.0	0.507	18.8	LOS B	2.9	20.3
Approach		275	0.0	0.507	15.2	LOS B	2.9	20.3
North: Lord St (N)								
4	L	12	0.0	0.518	7.1	LOS A	4.1	29.3
5	T	1447	2.0	0.518	6.0	LOS A	4.1	29.3
6	R	8	0.0	0.518	12.9	LOS B	4.1	28.8
Approach		1467	2.0	0.518	6.1	LOS A	4.1	29.3
West: Cranleigh St (W)								
7	L	3	0.0	0.074	8.1	LOS A	0.3	2.0
8	T	4	0.0	0.074	7.2	LOS A	0.3	2.0
9	R	54	2.0	0.074	13.5	LOS B	0.3	2.0
Approach		61	1.8	0.074	12.8	LOS B	0.3	2.0
All Vehicles		2496	1.7	0.518	7.4	LOS A	4.1	29.3

Table A4b. SIDRA results – Lord Street / Cranleigh Street – long term interim scenario 5-6PM peak

Movement Performance - Vehicles								
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m
South: Lord St (S)								
10	L	14	2.0	0.516	6.5	LOS A	4.7	33.1
11	T	1390	2.0	0.516	5.3	LOS A	4.7	33.1
12	R	241	0.0	0.516	11.6	LOS B	4.6	32.8
Approach		1645	1.7	0.516	6.2	LOS A	4.7	33.1
East: Cranleigh St (E)								
1	L	78	0.0	0.149	8.1	LOS A	0.6	4.3
2	T	4	0.0	0.149	7.3	LOS A	0.6	4.3
3	R	39	0.0	0.149	13.5	LOS B	0.6	4.3
Approach		121	0.0	0.149	9.8	LOS A	0.6	4.3
North: Lord St (N)								
4	L	28	0.0	0.263	7.5	LOS A	1.6	11.5
5	T	620	2.0	0.263	6.4	LOS A	1.6	11.5
6	R	7	0.0	0.263	13.4	LOS B	1.6	11.0
Approach		655	1.9	0.263	6.6	LOS A	1.6	11.5
West: Cranleigh St (W)								
7	L	4	0.0	0.134	11.2	LOS B	0.6	4.0
8	T	5	0.0	0.134	10.3	LOS B	0.6	4.0
9	R	66	2.0	0.134	16.6	LOS B	0.6	4.0
Approach		75	1.8	0.134	15.9	LOS B	0.6	4.0
All Vehicles		2496	1.7	0.516	6.8	LOS A	4.7	33.1

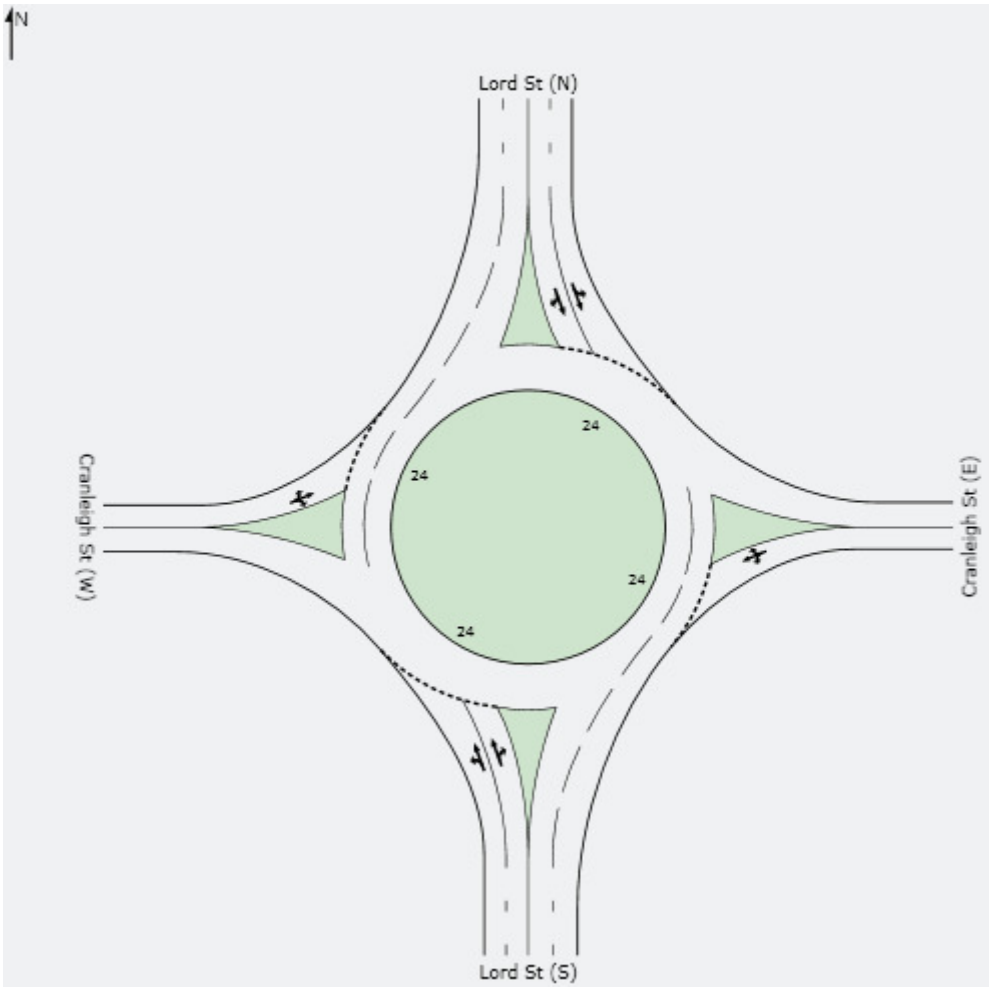


Figure A4. Intersection layout analysed in SIDRA

APPENDIX 3

LANDSCAPE MANAGEMENT REPORT

TABLE OF CONTENTS

1. PLANNING AND DESIGN

1.1. PUBLIC OPEN SPACE

The public open space at St Leonard's Estate within the suburb of Dayton, is designed as the focal point for community gathering and activities, informal recreation, public facilities, and visual relief from the urban form. It also takes on a ecological significance as a key area for the control and biofiltration of stormwater flows and therefore presents an opportunity for habitat creation and educational interpretation.

The design of these POS areas aims to locate various facilities and feature elements at focal points which are easily visible from vehicles and by pedestrians.

This maximises passive surveillance and clearly conveys the facilities available. All passive and active POS areas within St Leonards are integrated and linked through a network of shared paths, and the continuity of the living streams flowing through the public open space provides a visual and functional connection.

The depth of fill proposed to the entire development enables the POS area to be elevated above the groundwater table. Stormwater flows are directed from the catchments into living streams and biofiltration areas to strip nutrients and detain the flows prior to the water re-entering the groundwater flows. A specifically selected Biofiltration media assists in the reduction of nutrients entering the ground water system and enhances the biofiltration of drainage. The use of living streams enables a larger area of open space to remain dry during the winter months and thereby increases the amount of usable open space available.

The basins designated for biofiltration and detention are designed to encourage residents to appreciate the flows of water through the catchments and through the placement of interpretive signage and displays the developers aims to educate the community about the need for careful management of stormwater, limiting the use of fertilisers, the importance of vegetation and biofiltration media in stripping nutrients and the importance of these areas as habitat for flora and fauna.

Planting in POS areas will consist mainly of native species which will enhance the original nature of the site and reduce the amount of turfed areas over the development. In general there will be an emphasis in these areas on indigenous plantings as opposed to turf. In areas where it is preferred to have turf, irrigation and fertiliser management measures applied.

The design aims to locate various facilities and feature elements at focal points which are easily visible from vehicles and by pedestrians. This maximises passive surveillance and clearly conveys the facilities available.

Various facilities proposed for creation within the public realm may include:

- Discovery and learning playgrounds
- Shelters
- Viewing platforms
- BBQs and gathering spaces
- Boardwalks
- Integrated path systems
- Feature lighting
- Security and safety lighting
- Informal open recreation spaces
- Smaller contemplative spaces
- Interpretive signage
- Public art

1.2. RECREATION FACILITIES

- Discovery and learning playgrounds catering for children 2 to 5 years old
- One off adventure level playground catering for children 5 to 14 years old
- Shelters catering for parents and informal gathering
- BBQs and gathering spaces catering for parents and informal or formal gathering
- Integrated path systems and Boardwalks catering for walking, dog walking, cycling, skateboarding
- Informal open recreation spaces for general undefined uses by all ages
- Smaller contemplative spaces for less active persons and relaxation for all ages

Recreation facilities throughout St Leonards will cater for a wide range of residents. There will be discovery and learning playgrounds catering for children two to five years old as well as one adventure level playground catering for children five to 14 years old. Shelters will be established to cater for parents and informal gatherings as well as BBQs and gathering spaces.

Integrated path systems and boardwalks will create areas suitable for walking, dog walking, cycling, skateboarding and similar. Informal open recreation spaces will be available for a wide range of uses as well as formal recreation spaces associated with schools and organised sports for all ages. An educational display shelter is proposed as a key tool in providing the community with information regarding the filtration basins and the seasonal variations of the living stream.

1.3. PROPOSED LANDSCAPE PLANTING

The provision of planting in public areas and streetscapes serves to provide character, shade, interest, habitat and a point of reference in major streets or feature locations. The following list is an indication of the species proposed for the site. Full detailed design, co-ordination and approval through City Of Swan will be sought prior to implementation.

Locations

The locations of public planting and types of vegetation will include:

- Exotic specimen and shade trees at feature points,
- Exotic feature tree avenues in nominated high profile street or entry locations,
- Native habitat trees in nominated locations,
- Bushland and habitat regeneration in disturbed areas,
- Shrub planting to screening and spatial definition areas,
- Groundcover planting to medians, planters and areas requiring clear view sheds,
- Stabilisation planting to banks and batters,
- Reed and sedge planting to wetlands, swales and watercourses,
- Grass to usable formal or informal usable space and recreation areas,

Character

The proposed mix of endemic native species and exotic cultural plantings in feature locations will provide a blend of character and define feature points.

Design Considerations

The selection and placement of species shall consider adjacent elements so as to limit future maintenance and public health and safety issues, promote the survival and health of the vegetation concerned and provide ongoing social and visual benefits. Items of consideration may include:

- Suitable proximity to traffic sightlines to ensure suitable view corridors
- Suitable proximity and alignment to underground services to ensure no adverse impact
- Maximised seasonal influence of shade on adjacent facilities and areas
- Passive solar benefits influencing adjacent built form and residential dwellings
- Provision of seasonal visual colour
- Provision of a seasonal food source to local fauna
- Plant selection based on suitability to local climate, soils, rainfall and temperatures
- Selection based on reduced maintenance, trimming, pruning, fertilising and watering
- Develop a species palette with subtle variations through the development to tie in with identifiable communities
- Buffer screening will be provided to residential or sensitive areas where required

Street trees

- Along major roads, proposed trees will form a strong visual avenue, and not impede traffic flow, safety or sightlines
- In residential streets, the roads may vary in character from precinct to precinct; however they are characterised as smaller scale pedestrian friendly environments. Therefore street trees will be of a smaller scale, and take advantage of passive solar principles allowing summer shade and winter sun.

Parkland Planting (POS Areas) Species List

Shrubs/Sedges/Herbs/Groundcovers	
Species Name	Common Name
Acacia cognata 'Limelight'	Limelight
Anigozanthus 'Coral Queen'	Kangaroo Paw
Anigozanthus 'Gold Fever'	Kangaroo Paw
Adenanthos sericea	Albany Woolly Bush
Baumea articulata	Jointed Twig Rush
Brachychome 'Jumbo Tricolur'	
Callistemon 'Great Balls of Fire'	Great Balls of Fire
Convulvulus 'Moroccan Beauty'	
Dianella 'Baby Bliss'	Dianella
Dianella 'Cassa Blue'	Dianella
Dianella revoluta 'Variegated'	Dianella
Dianella 'Tas Red'	Dianella
Dryandra nivea	Honeypot Dryandra
Eremophila 'Carramar Grey'	
Ficinia nodosa	Knotted Club Rush
Gardenia 'Florida'	Gardenia
Gardenia 'True Love'	Gardenia
Grevillea crithmifolia	
Grevillea thelemanniana	Spidernet Grevillea
Juncus krausii	Sea Rush
Juniperus conferta	Shore Juniper
Lomandra longifolia	Lomandra
Olearia axillaris	Coastal Daisy Bush
Rosmarinus 'Blue Lagoon'	Rosemary
Scaevola 'Mauve Clusters'	Fan Flower
Scaevola 'Misty Blue'	Fan Flower
Scaevola 'White Carpet'	Fan Flower
Tulbaghia violacea	Society Garlic
Westringia fruticosa	Coastal Rosemary
Trees	
Species Name	Common Name
Agonis flexuosa	Native Peppermint
Corymbia calophylla	Marri
Corymbia ficifolia	Red Flowering Gum
Eucalyptus rudis	Flooded Gum
Fraxinus raywoodii	Claret Ash
Jacaranda mimosifolia	Jacaranda
Melaleuca rhaphiophylla	Swamp Paperbark
Prunus cerasifera 'Nigra'	Flowering Plum
Pyrus nivalis	Snow Pear

Streetscape Planting Species List

Shrubs/Sedges/Herbs/Groundcovers	
Species Name	Common Name
Acacia cognata 'Limelight'	Limelight
Anigozanthus ssp.	Kangaroo Paw
Dianella ssp.	Dianella
Eremophila 'Carramar Grey'	
Ficinia nodosa	Knotted Club Rush
Grevillea thelemanniana	Spider Net Grevillea
Juniperus conferta	Shore Juniper
Lomandra ssp	Lomandra
Olearia axillaris	Coastal Daisy Bush
Westringia fruticosa	Coastal Rosemary
Trees	
Species Name	Common Name
Agonis flexuosa	Native Pepeprmint Tree
Corymbia ficifolia	Red Flowring Gum
Eucalyptus torquata	Coral Gum
Jacaranda mimosifolia	Jacaranda
Lagerstroemia indica	Crepe Myrtle
Fraxinus raywoodii	Claret Ash
Olea europaea	Olive
Prunus nigra	Plum
Pyrus nivalis	Snow Plum
Tipuana tipu	Pride of Bolivia

Retained Vegetation

The retention of existing vegetation in defined locations caters for existing habitat, preserves the sites natural assets and provides visual relief against broader site clearing.

Whilst most of the vegetation on site has suffered through the effect of the various past land uses and management some stands of vegetation (outside of the Stage 1 area) offer positive outcomes if the development can be engineered so as the stands are protected.

Entry Treatments

The entry road design into a project provides direct access and expresses the design character of the project and conveys various detail treatments and materials. The entry treatments will connect the entrance areas to the rest of the development.

Street trees will reinforce the significant nature of these major roads by forming strong visual avenues. Views to distant feature elements.

- Street trees will reinforce the significant nature of these major roads by forming strong visual avenues appropriate.
- The entry boulevard provides a parkland feel upon arrival.
- Views to distant feature elements to provide orientation
- Entry Median is designed to capture, detain and convey drainage.

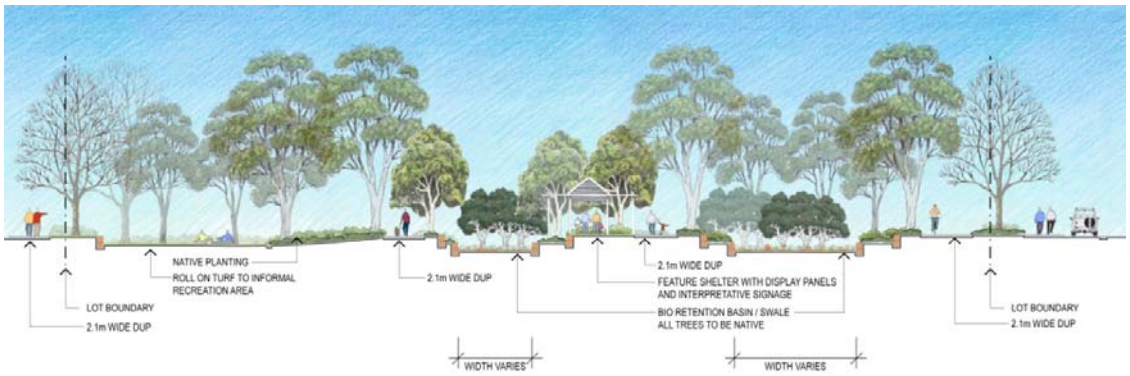
Drainage/Stormwater

The landscape design for St Leonards aims to utilise water sensitive urban design principles. Water sensitive urban design recognises the linkages in the water cycle between residential development, stormwater systems and the quality of downstream ecosystems.

The development aims to utilise water sensitive urban design principles covering the following:

- Stormwater detention in POS areas to minimise downstream flows following major storm events.
- Bio retention swales to collect stormwater runoff

- Swales/Basins should also provide for multiple uses – recreation and storm water management. They also encourage natural habitat creation.
- Reed and fringing vegetation to provide a nutrient stripping function.
- Specifically selected Biofiltration Media to assist in the nutrient stripping function of the Biofiltration Basins.



A species list outlining the species that will be used in the drainage basin planting areas is provided below.

Living Stream/Drainage Basin Species List

Shrubs/Sedges/Herbs/Groundcovers	
Species Name	Common Name
Baumea articulata	Jointed Twig Rush
Ficinia nodosa	Knotted Club Rush
Juncus krausii	Sea Rush
Gahnia trifida	Coast Saw Sedge
Lepidosperma longitudinale	Pithy Sword Sedge
Pericalymma elipticum	Swamp Teatree
Trees	
Species Name	Common Name
Eucalyptus rudis	Flooded Gum
Melaleuca rhaphiophylla	Swamp Paperbark

1.4. IRRIGATION STRATEGY

A general principle has been adopted throughout the planning stage to reduce the amount of irrigated areas within St Leonard's Estate. Reduced irrigation use methods include reduction in areas of turf, avoidance of species which require extensive irrigation and the design of irrigation systems for efficiency (to be detailed at subdivision stage).

Irrigation, when necessary shall aim to incorporate elements of subsurface, drip and trickle water application methods, with water application based on seasonal need and a reduced number of areas under surface spray water application. As described above, water-wise principles will be employed to achieve a minimum 30% of POS not requiring irrigation. This will ensure that St Leonards meets the Department of Water guidelines that groundwater allocation be 7500 kilolitres/hectare/annum.

It is proposed to install a series of groundwater bores utilizing existing allocations to irrigate the public area. Each of these bores and infrastructure will be designed and specified to suit City of Swan requirements. It is anticipated that the City will take over control of both the groundwater licence and the infrastructure at the conclusion of the Developers maintenance period.

Water Wise Planting

In line with the overall principle to reduce irrigation water demands it is proposed that native species will be the predominant planting type to minimise irrigation requirements. Soil conditioning will be employed to reduce leaching and increase soil moisture holding capacity. All garden beds will be mulched to reduce water loss through evaporation.

1.5. SITE FURNITURE

The provision of public area furniture will be in line with the intended use of POS and reserve areas. The inclusion of quality street furniture elements reinforces the intended design theory, develops a sense of community and ownership among residents and encourages and caters for outdoor use.

The location of street furniture elements will closely correspond with more intensive areas of human use, gathering and recreation. Basic functional requirements shall include the local availability for the quick and cost effective installation, ongoing replacement and maintenance of installed furniture.

Public area furniture will have a robust design to minimise the effects of vandalism or weathering and appropriate fixing methods to allow maintenance and prevent theft. Colour will be defined but neutral where possible to enable the maximum blending with other site elements and have galvanised and powder coated finishes to maximise lifespan.

Elements shall provide a visually recognisable, clear and useful function. The types of street furniture envisaged would include, picnic settings, shade structures, bridges, BBQs, seating (formal and informal), rubbish bins, tree guards and bollards.

The provision of street furniture demonstrates detailed consideration of human use and comfort. The inclusion of quality street furniture elements reinforces the intended design theory, develops a sense of community and ownership among residents and encourages and caters for outdoor use.

1.6. PUBLIC ART

The selection and installation of appropriate public art creates interest, social discussion and promotes a sense of community and ownership to public spaces. Public art can provide historic, social, cultural and environmental comment and act as a reference to define a local area, generic resident profiles and community values.

It is intended that public art be distributed at either high profile points or community gathering spaces to ensure its value in place making is maximised. Locations should include vista and axis views from roads or pedestrian paths, inclusion into playgrounds or placement adjacent picnic locations and the like. Individual lighting may be desirable in some instances to provide additional importance and focus to specific pieces.

1.7. MAINTENANCE MINIMISATION

The reduction of turf areas and use of native species will minimise the maintenance required throughout St Leonard's Estate.

A key consideration for all landscaped areas will be to minimise long term maintenance requirements given that these areas will ultimately be transferred to the City of Swan.

In conjunction with the detail design of public open space and verge areas to be ultimately vested and controlled by the Council, a maintenance minimisation review is undertaken by the design consultant team to best reduce likely future maintenance costs at the time of subdivision detailed design . This process may typically include:

- review of all materials to ensure fitness for purpose and lifespan
- review of corners, edges and trim to ensure definition of maintainable edges
- review of the volume of planting and turf areas
- review of plant and turf species and their specific growth habits and requirements
- water quality design review of open water bodies and water courses
- water monitoring of groundwater quality and levels, lakes, wetlands and overflows
- review of irrigation materials and standards to ensure best practice
- implementation of sustainability and water wise principles to enable the reduction of ongoing costs through removal of some short term landscape establishment assets
- review of all structural design to ensure fitness for purpose and lifespan

2. PUBLIC OPEN SPACE TYPOLOGIES

2.1. GENERAL

The key public open space objective is to provide a readily usable, aesthetically pleasing environment to potential residents. Open space areas shall incorporate features and facilities to provide public amenity and aesthetic value.

POS areas have been strategically located to provide good connectivity through the development. The POS designs allow for the POS's to act both as a thoroughfare and a destination. The design of the individual POS areas is aimed at providing a good mix of recreational opportunities for the residents and visitors.

The Public Open Space areas have been designed to provide an integrated network of parkland that includes neighbourhood parks, local open space, living streams, and tree lined avenues. A key design objective is to provide a balance between ecological function, amenity and public recreation that creates a readily usable, interconnected, aesthetic and liveable environment to potential residents from the development's inception.

An emphasis will be placed on the predominant use of native plant species throughout the POS areas, however, exotic plant species may be used in various locations.

A combination of passive recreational (neighbourhood parks, linear parks) and active recreational (local open space associated with the areas schools) opportunities will be provided. The landscape network will include a variety of easily accessible passive and active recreational facilities including the following:

- Discovery and learning playgrounds
- Shelters
- Viewing platforms
- BBQs and gathering spaces
- Boardwalks
- Integrated path systems
- Feature lighting
- Security and safety lighting
- Informal open recreation spaces
- Fitness trails
- Smaller contemplative spaces
- Interpretive signage and Educational areas
- Public art

The areas of POS within St Leonards have been separated into broad categories based on their specific treatments and design. The Landscape Masterplan indicates the location of these areas and includes the following:

2.2. NEIGHBOURHOOD PARKS

There are a number neighbourhood parks strategically placed throughout St Leonard's Estate. Stage 1 includes four neighbourhood parks; the Enclave includes one neighbourhood park.

Across all the parks path systems will link with the adjoining residential streets to provide a fully integrated path network. Avenues of trees and minimal shrub planting are preferred. Planted species will be a mix of natives and some exotic species at high impact points. Drainage areas may be required in these open spaces, and where provided will be landscaped basins, serving a recreational and amenity function. Drainage swales within POS areas will likely be turfed. A brief outline of the character and design of each Stage 1 Park is given below.

Park 1 Is the major focus of the community in the first stage of the development. This large park is adjacent to the future commercial area so will act as a soft edge to the neighbourhood centre and provide a congregation and passive recreation facility. The shared path system will connect the park to the wider community whilst on street parking has been provided for. The drainage function within the park provides the starting point for the living stream which incorporates three shallow basins that will enable settlement and biofiltration. These areas will be able to be viewed from nearby walkways and the developer will be providing interpretive signage to educate the community as to the purpose of the basins and the importance of the treatment of the stormwater flows and the protection of the groundwater quality.

In the broader area of the park there will be a provision for a major adventure playground and a family pavilion. A number of smaller pavilions will also be provided throughout the park together with BBQ facilities and ample space for kickabout and non organised sport pursuits amongst scattered trees in a parkland setting. .

Park 2 is an existing shallow drain that overtime has been diverted from its original course and used as an informal agricultural drain. The drain has significance to the local aboriginal community as the route to and from a natural spring. As such the alignment will be reformed and rehabilitated with native species in order to become a continuation of the living stream through the estate.. The estate path network will run adjacent to the stabilised banks and platforms will be provided to enable views along this length of stream. The area is dedicated to passive recreation and ecological function only. Shade trees will be provided as well as a shelter and benches.

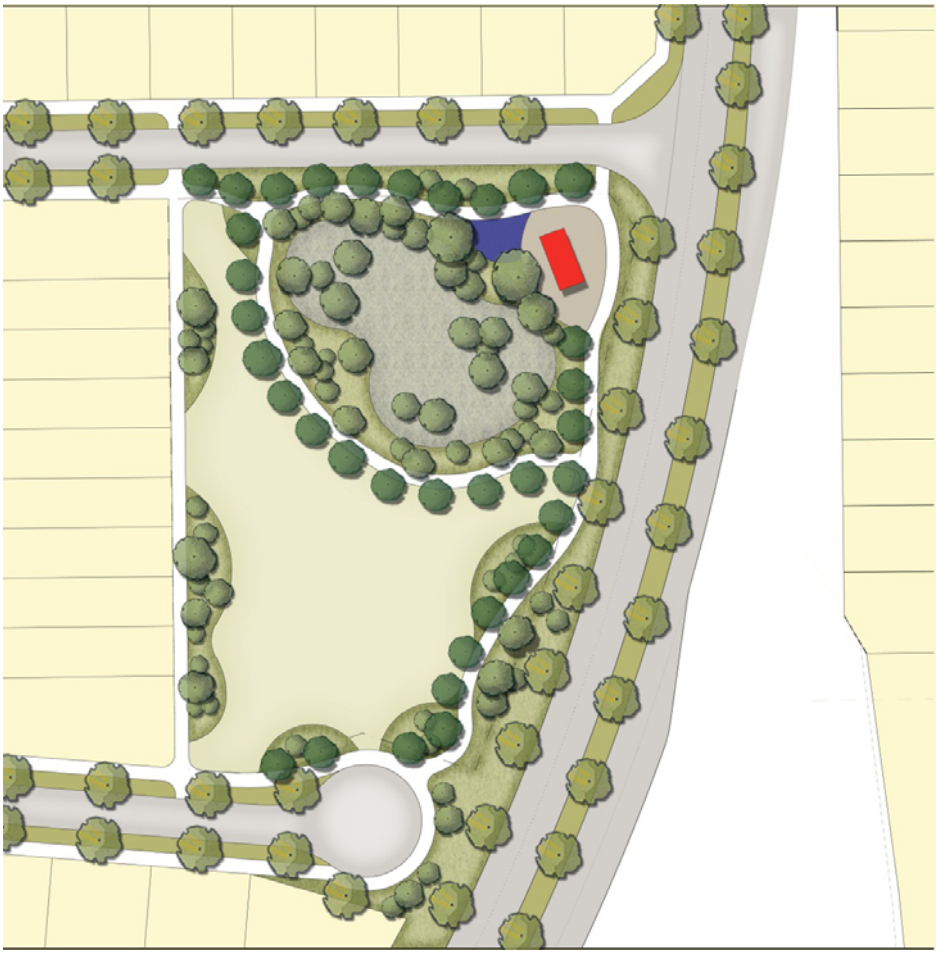
Park 3 The Southern POS provides a continuation of the Living Stream at the point of the outflow from the estate to the South. As such the POS is contoured to enable a flood detention capacity during large storm events. The shallow nature of the basin enables it to dry quickly after rainfall events and to be usable as clear open area for passive recreation.

Screen planting along the Reid Highway will provide a buffer for residents, whilst still enabling some views into the estate. Planting through this area will be predominantly native.

Park 4 is surrounded on three sides by residential lots with Lord Street along the Eastern boundary of the POS. The park act's as a soft edge between Lord Street and the surrounding neighbourhood while also providing a valuable passive recreation facility connected to the wider community through a shared path system throughout the wider community..

Feature elements such as play spaces and shelter provide a focal point at key road intersections. Planting through this area will be predominantly native with a key emphasis on a vegetated planting buffer ,screening Lord Street from the POS. View corridors created by breaks in the vegetation align to frame views and provide glimpses feature elements within the POS. Shade trees will be provided as well as a shelter and benches.

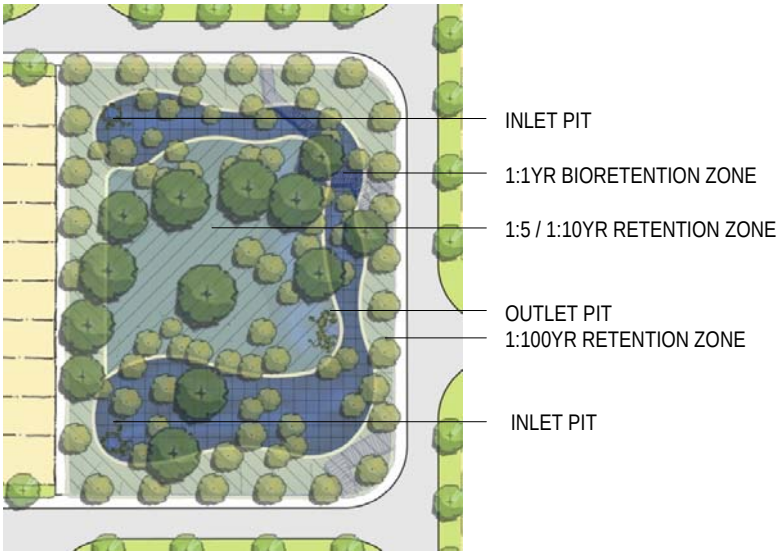
The POS design is contoured to enable a flood detention capacity during large storm events. The contoured nature of the POS enables open turf areas to dry quickly after rainfall events and to be usable as clear open area for passive recreation. The naturalistic treatment of the biofiltration basin help to recreate a natural low / wetland setting to cater for ephemeral stormwater flows. These areas will be able to be viewed from a nearby shelter and the developer will be providing interpretive signage to educate the community as to the purpose of the basin and the importance of the treatment of the stormwater flows and the protection of the groundwater quality.



Enclave Park 1 is surrounded by residential lots so will act as a soft edge to the surrounding neighbourhood and provide a passive recreation facility. The shared path system will connect the park to the wider community..

The POS is contoured to enable a flood detention capacity during large storm events. The contoured nature of the basin enables it to dry quickly after rainfall events and to be usable as clear open area for passive recreation. The naturalistic treatment of the biofiltration swales help to recreate a natural wetland setting to cater for ephemeral stormwater flows. These areas will be able to be viewed from a nearby decked viewing platform and walkways and the developer will be providing interpretive signage to educate the community as to the purpose of the basins and the importance of the treatment of the stormwater flows and the protection of the groundwater quality.

Where possible existing trees are to be retained throughout the park, providing shade and shelter. Feature elements such as viewing platforms and walkways provide a focal point at key road intersections. Planting through this area will be predominantly native.



2.3. LIVING STREAMS

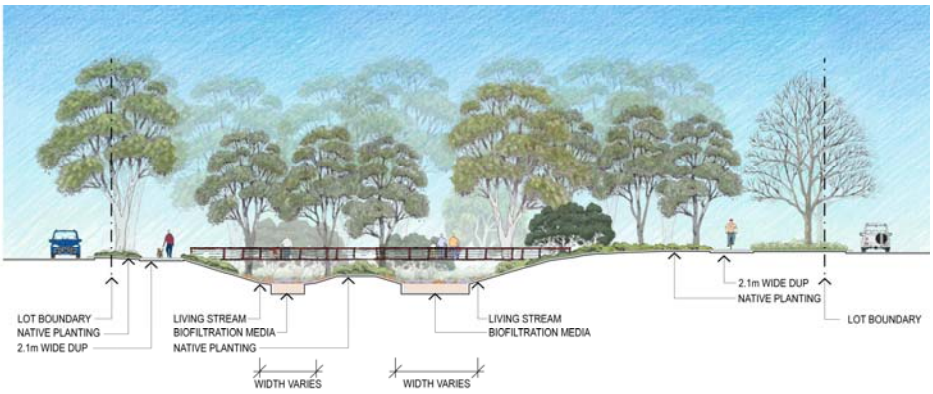
Due to the low lying nature of the site and the requirement to convey stormwater reliably away from high use areas the Living Stream runs through the majority of the public open space in one form or another. Described below are two scenarios

- The Living Stream in a Linear Park
- The Living Stream in a Neighbourhood Park

The Living Stream will provide not only a viable drainage function but also a variety of ecological zones and restoration opportunities.

Planting is to consist of endemic species with a variety of tree, shrub, groundcover, reed and sedge species to be encouraged.

The living stream will include a DUP in close proximity. There will be native shrub planting on the banks and native reed and sedge planting to enhance nutrient uptake. Bank stabilisation will be incorporated into the design and a variety of tree species will be used to provide a diverse tree canopy. The sections below show a typical cross section of the living stream with mostly revegetated areas and a passive recreational node.



Living Stream through Linear Park

- Dual Use Path to one or both sides of the Living Stream
- Irrigated native shrub planting to banks
- Irrigated native reed and sedge planting within bioretention swales to enhance nutrient uptake.
- Bank stabilisation
- Variety of tree species to provide a diverse tree canopy
- Shelter/boardwalks & feature viewing platform to encourage interaction with the Stream
- Irrigated planting to high impact areas
- Rehabilitation of streamline in accordance with Aboriginal significance

- The following photos are examples of the types of treatments which will be implemented along the living stream.

Living Stream through Neighbourhood parks

The Living Stream also runs through the Neighbourhood Parks. Some areas along the living streams, as outlined in the Landscape Masterplan will include parkland turfed areas for passive recreation.

Living Stream through Neighbourhood Park

- Dual Use Footpath to both sides of Living Stream
- Walking trail
- Irrigated native shrub planting to banks
- Irrigated native reed and sedge planting to base of Park Avenue to enhance nutrient uptake potential
- Open parkland for passive recreation
- Creek stabilisation
- Variety of tree species to provide a diverse tree canopy
- Playground, shelters and boardwalks at designated locations

2.4. PRIMARY SCHOOL AND LOCAL OPEN SPACE

Future Stages of St Leonards include the development of formal active recreation facilities which will be associated with school facilities. These open space areas will allow for the shared use of active recreation facilities with both the wider community and schools.

Typically a primary school will include a football and cricket oval, full sized mixed use sports court, cricket nets, high quality landscaping, turf and shade trees.

- 1 x Minimum size Australian Rules Oval with Cricket Pitch
- 1 x Full sized Mixed Use Sports Court, comprising tennis, netball and basketball infrastructure with associated court line markings
- 2 x Cricket Practice Nets
-

Typically the facilities associated with a high school site would include:

- A football and cricket oval
- Soccer and hockey pitches
- Full sized mixed use sports court
- Basketball/netball and tennis courts
- Cricket nets
- High quality plants
- Turf and shade trees

At this stage St Leonard's Estate does not allow for active recreational facilities within the Public Open Space.

APPENDIX 4

CULTURAL HERITAGE MANAGEMENT PLAN

WEST SWAN (EAST) DISTRICT STRUCTURE PLAN

DEVELOPMENT AREA ABORIGINAL CULTURAL HERITAGE

MANAGEMENT PLAN

Prepared by R. & E.O'Connor Pty. Ltd.
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August 2010

ABSTRACT

In July 2010, St. Leonard's Estate Pty. Ltd. commissioned R. & E.O'Connor Pty. Ltd. to prepare an Aboriginal Cultural Heritage Management Plan for the proposed West Swan (East) District Structure Plan Development Area. This document is Draft Number One (Draft #2) of that ACHMP. It contains eight sections, as follows.

Section One, which details the background to the ACHMP and discusses proposed development at the SPDA.

Section Two, which details the relevant legislation.

Section Three, which details the scope and purpose of the ACHMP.

Section Four, which details and analyses previous Aboriginal heritage studies and surveys at the SPDA and their findings.

Section Five, which discusses the potential effects of development on Aboriginal sites at the SPDA and possible mitigative management strategies.

Section Six, which outlines suggested management commitments.

Section Seven, which deals with logistics for heritage management, including Aboriginal monitoring programmes.

Section Eight, which details contingency plans that can be activated in the event of previously unidentified Aboriginal sites or objects being discovered during ground disturbance.

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1.0 INTRODUCTION

1.1 Background

In January 2007 R. & E.O'Connor Pty. Ltd. carried out an ethnographic survey of the West Swan East District Structure Plan Development Area ("the SPDA"). A desk-top archaeological study of the same project area was also carried out by Quartermaine Consultants. The ethnographic survey reached the following conclusions and made the following recommendations.

Two Aboriginal sites, namely registered Aboriginal sites numbers 3417 and 22159 are located within the Project area. In addition, registered Aboriginal site number 20030 is located close to the southern perimeter of the Project area.

The four sub-groups of the Region Six Single Noongar Claim native title holders, namely the Garlett family, Headland-Corunna family, Wilkes family and the Swan Valley Circle of Elders sub-groups were consulted in regard to the Project, as also were the Ballaruk group and the Jacobs clan. All have given approval for the Project to proceed. Four of the groups attached a condition of preservation of the registered Aboriginal sites within the Project to their approvals. The Wilkes group attached a condition of having Aboriginal monitors on site when earthworks are taking place to their approval. All signed approvals are included in this report.

This report recommends that the Project should proceed, as the relevant Aboriginal groups have approved it, subject to certain conditions. It is also recommended that registered Aboriginal sites numbers 3417 and 22159 should be preserved undisturbed by the Project through inclusion in Public Open Space. It should be noted that disturbance of these sites is an offence under the Aboriginal Heritage Act 1972, unless Ministerial consent pursuant to Section 18 of that Act has been obtained in their regard. It is also recommended that, in recognition of the concerns of the Wilkes family in regard to possible disturbance of skeletal remains or Aboriginal cultural material, an Aboriginal monitoring programme should be established during initial ground surface disturbance.

In July 2010, as planning for development of the SPDA progressed, and following receipt of comments on the Plan from the City of Swan on 18 March 2010, St. Leonard's

Estate Pty. Ltd. commissioned R. & E.O'Connor Pty. Ltd. to prepare an Aboriginal Cultural Heritage Management Plan ("ACHMP") for the SPDA. This document is a First Draft of that ACHMP.

1.2 The Land

Figure One shows the SPDA, Figure Two shows the site layout, and Figure Three shows the District Structure Plan. The SPDA is bounded to the north by Harrow Street, to the east by the Dampier to Bunbury Natural Gas Pipeline, to the south by Reid Highway and to the west by the future Perth-Darwin National Highway. As detailed in Figure Three, it comprises five Local Structure Plan ("LSP") areas, numbered 1, 2A, 2B, 3 and 4 respectively. This ACHMP considers all five LSP areas. It is the author's understanding that the SPDA is freehold land.

1.3 The ACHMP

In preparation of the ACHMP the following documents were taken into consideration:

- Aboriginal Cultural Heritage Management Plan Template 2008. A Guide for Local Governments. Prepared by Cheryl-Anne McCann, Swan Catchment Council.

- Aboriginal Heritage Management Plans, as described and detailed under *Heritage Management* in the Department of Indigenous Affairs website.
- Aboriginal Cultural Heritage Management Plans previously prepared by R. & E.O'Connor Pty. Ltd.

Specifically, the ACHMP addresses the following matters under separate rubrics:

1. Summary of Project area and proposed developments.
2. Relevant legislation.
3. Scope and purpose of ACHMP.
4. Previous studies and findings, including listing of registered Aboriginal sites.
5. Summary of potential effects of development on Aboriginal sites and possible management responses.
6. Suggested management commitments.
7. Logistics for heritage protection.
8. Monitoring, reporting and notification.
9. Contingency plans.

2.0 RELEVANT LEGISLATION

2.1 The *Aboriginal Heritage Act 1972*

The Western Australian *Aboriginal Heritage Act* ("AHA"), whose short title is *an Act to make provision for the preservation on behalf of the community of places and objects customarily used by or traditional to the original inhabitants of Australia or their descendants, or associated therewith, and for other purposes incidental thereto*, came into operation on 15 December 1972. It has been amended substantially since then. Initially, the AHA was administered by the Department of Aboriginal Sites at the Western Australian Museum. Following a series of changes, it is now administered by the Department of Indigenous Affairs. The AHA defines Aboriginal sites as follows:

> *(a) Any place of importance and significance where persons of Aboriginal descent have, or appear to have, left any object, natural or artificial, used for, or made for or adapted for use for, any purpose connected with the traditional cultural life of the Aboriginal people, past or present;*
>
> *(b) Any sacred, ritual or ceremonial site, which is of importance and special significance to persons of Aboriginal descent;*
>
> *(c) Any place which, in the opinion of the Committee is or was associated with the Aboriginal people and which is of historical, anthropological, archaeological or ethnographical interest and should be preserved because of its importance and significance to the cultural heritage of the state;*

(d) Any place where objects to this Act applies are traditionally stored, or to which, under the provisions of this Act, such objects have been taken or removed.

Over time there has developed in this State an understanding that collections of refuse from the manufacture of stone implements (referred to as "debitage" by archaeologists) constitute "Aboriginal sites" within the meaning(s) of the above definitions. Section 6 of the AHA defines "Aboriginal objects" as follows.

(1) Subject to subsection (2a), this Act applies to all objects, whether natural or artificial and irrespective of where found or situated in the State, which are or have been of sacred, ritual or ceremonial significance to persons of Aboriginal descent, or which are or were used for, or made or adapted for use for, any purpose connected with the traditional cultural life of the Aboriginal people past or present.

(2) Subject to subsection (2a), this Act applies to objects so nearly resembling an object of sacred significance to persons of Aboriginal descent as to be likely to deceive or be capable of being mistaken for such an object.

(2a) This Act does not apply to a collection, held by the Museum under section 9 of the Museum Act 1969 , which is under the management and control of the Trustees under that Act.

(3) The provisions of Part VI do not apply to an object made for the purpose of sale and which —

(a) is not an object that is or has been of sacred significance to persons of Aboriginal descent, or an object so nearly resembling such an object as to be likely to deceive or be capable of being mistaken for the same; or

(b) is an object of the kind referred to in paragraph (a) that is disposed of or dealt with by or with the consent of the Minister.

The Committee referred to is the Aboriginal Cultural Material Committee, which was established by Amendment No. 8 of 1980. Its functions are as follows:

(a) To evaluate on behalf of the community the importance of places and objects alleged to be associated with Aboriginal persons;

(b) Where appropriate, to record and preserve the traditional Aboriginal lore related to such places and objects;

(c) To recommend to the Minister places and objects which, in the opinion of the Committee, are, or have been, of special significance to persons of Aboriginal descent and should be preserved, acquired and managed by the Minister;

(d) Deleted by No. 8 of 1980, s. 10.

(e) To advise the Minister on any question referred to the Committee, and generally on any matter related to the objects and purposes of the Act;

(ea) to perform the functions allocated to the Committee by this Act;

(f) To advise the Minister when requested to do so as to the apportionment and application of moneys available for the administration of this Act.

Once again, over time there has developed a situation where the main, and at times sole,

role of the Committee at its monthly meetings is to work through a series of applications pursuant to Section 18 of the AHA (see Appendix One) and make recommendations to the Minister in their regard.

The AHA makes it an offence for any person to carry out the following actions within an Aboriginal site:

> *(a) Excavate, destroy, damage, conceal or in any way alter any Aboriginal site; or*
>
> *(b) In any way alter, damage, remove, destroy, conceal, or deal with in a manner not sanctioned by relevant custom, or assume the possession, custody or control of, any object on or under an Aboriginal site.*

Again, over time there has developed in this State an understanding that removal, or alteration, etc. of the material referred to above, constitutes an offence against the AHA, unless the requisite Ministerial consent for such actions has been obtained, as detailed in Section 18 (see Appendix One).

2.2 The *Aboriginal and Torres Strait Islander Heritage Protection Act 1984*

The Commonwealth *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* ("ATSIHPA") takes precedence over the State legislation if successfully invoked. Unlike the State legislation, this Act does not make provision for the orderly destruction of Aboriginal sites. Also, unlike the State legislation, it can be invoked only

by or on behalf of an Aboriginal person or persons. The purposes of this Act are *the preservation and protection from injury or desecration of areas and objects in Australia and in Australian waters being areas and objects that are of particular significance to Aboriginals in accordance with Aboriginal tradition.* The ATSIHPA makes provision for Emergency and Permanent Declarations in respect of significant Aboriginal areas. Significant Aboriginal areas and objects are defined as follows.

"significant Aboriginal area" *means:*

(a) an area of land in Australia or in or beneath Australian waters;

(b) an area of water in Australia; or

(c) an area of Australian waters;

being an area of particular significance to Aboriginals in accordance with Aboriginal tradition.

"significant Aboriginal object" *means an object (including Aboriginal remains) of particular significance to Aboriginals in accordance with Aboriginal tradition.*

(2) For the purposes of this Act, an area or object shall be taken to be injured or desecrated if:

(a) in the case of an area:

(i) it is used or treated in a manner inconsistent with Aboriginal tradition;

(ii) by reason of anything done in, on or near the area, the use or significance of the area in accordance with Aboriginal tradition is adversely affected; or

(iii) passage through or over, or entry upon, the area by any person occurs in a manner inconsistent with Aboriginal tradition; or

(b) in the case of an object, it is used or treated in a manner inconsistent with Aboriginal tradition;

and references in this Act to injury or desecration shall be construed accordingly.

(3) For the purposes of this Act, an area or object shall be taken to be under threat of injury or desecration if it is, or is likely to be, injured or desecrated.

In the case of an Emergency Declaration, the Act reads as follows.

(1) Where the Minister:

(a) receives an application made orally or in writing by or on behalf of an Aboriginal or a group of Aboriginals seeking the preservation or protection of a specified area from injury or desecration; and

(b) is satisfied:

(i) that the area is a significant Aboriginal area; and

(ii) that it is under serious and immediate threat of injury or desecration;

he or she may, by legislative instrument, make a declaration in relation to the area.

(2) Subject to this Part, a declaration under subsection (1) has effect for such period, not exceeding 30 days, as is specified in the declaration.

(3) The Minister may, if he or she is satisfied that it is necessary to do so, declare by legislative instrument that a declaration made under subsection (1) shall remain in effect for such further period as is specified in the declaration made under this subsection, not being a period extending beyond the expiration of 60 days after the day on which the declaration under subsection (1) came into effect.

The ATSIHPA also makes provision in Section 10 for extended or Permanent Declarations to be made in respect of Aboriginal Places or Objects. Although the Commonwealth Minister has shown himself or herself unwilling to make Declarations pursuant to Sections 9 and 10 of the ATSIPHA in the past, the Act remains on the statute books and should be regarded by developers as a potential constraint. It should also be noted that the majority of listings in the Register of Aboriginal Sites (more than 75%) are for archaeologists' sites rather than sites of spiritual or other significance to Aboriginal people. As noted above, non-Aboriginal people cannot make an application pursuant to the ATSIHPA, unless they do so on behalf of an Aboriginal person or Aboriginal people.

2.3 The *Native Title Act 1993*

This Commonwealth Act *recognises and protects native title (and) provides that native title cannot be extinguished contrary to the Act.* As noted in 1.2 above, the SPDA is freehold land. Native title has therefore been extinguished there. However, the Act has two implications for proposed developments there, both of which are relevant to this ACHMP, as follows.

- Native title claimants, whose applications cover lands including the SPDA assert the right to protect areas and places of significance to them in accordance with their laws and customs. Although native title may be extinguished within the SPDA, that assertion is relevant to both the ATSIHPA (see 2.2 above) and to the AHA.
- In regard to the operation of the AHA, should a developer of land within the SPDA make an application pursuant to Section 18 of the Act, the ACMC will require that applicant to show that they have consulted, *inter alia*, the relevant native title claimant groups.

3.0 SCOPE AND PURPOSE OF THE ACHMP

The scope of this document comprises the formulation of plans, procedures and work methods that together will satisfy the requirements of the AHA (see 2.1 above) and the aspirations vis-à-vis protection of their heritage of the relevant Aboriginal groups.

The purpose of this document is to ensure that works associated with development of the SPDA will, wherever possible, protect and preserve existing known Aboriginal heritage sites and possible yet to be identified sites. In cases where such protection and preservation are not feasible, a secondary purpose is to ensure that all actions in respect of those sites are in accordance with the relevant legislation, as outlined in 2.1, 2.2 and 2.3 above.

4.0 PREVIOUS STUDIES AND FINDINGS

4.1 Sources – DIA Register

The electronic Register of Aboriginal Sites was consulted for the polygon described by the following coordinate sets: (MGA Zone 50): 402000E 6476250N; 404000E 6476250N; 404000E 6474000N; 402000E 6474000N. The Register contains 8 listings for this polygon (see Appendix Three). Site 3692 (Bennett Brook *in toto)* is to the west of the SPDA; Site 3744 (Marshall's Paddock Burial) is to the south of Reid Highway and, by extension, of the SPDA, as also is Site 3746 (West Swan Road Camp – Moore's Camp); Site 3840 (Bennett Brook Camp Area) is to the west of the SPDA, as also is Site 22643 (West Swan Isolated Artefacts). The remaining two listings, relevant to the SPDA, are as follows.

- Site Number 3417. "Coast Road Well", a "camp and water source" site located at 403409E 6474899N. This site was recorded by Robert Bropho on 3 June 1993. It is located in a paddock on the northern side of Coast Road at a point four hundred meters (400m) east of the Coast Road/Arthur Street junction. The well was utilized by persons residing at Jack and Mabel Moore's camp, which was itself situated between Reid Highway and Patricia Street and therefore outside the Project area. The site has not been placed on the Permanent Register and is, at this stage, listed as "Insufficient Information". However, the provisions of the AHA apply to such a listing. Location details for this site, extracted from the Aboriginal

Site File at the Department of Indigenous Affairs, are included in this report as Appendix Four.

- Site Number 22159. "Little Creek/One Hundred Year Creek", a "mythological and camping" site. A note in the file states that the entire waterway is a significant Aboriginal site on the basis of its association with a Waugal myth and because it was formerly utilised as a camping area by Nyungars. Because of the general paucity of corroborative information, the site has been listed as "Stored Data". Such a listing is not covered by the provisions of the AHA. However, the fact that it is claimed as a mythological site by the Nyungars is of relevance to the SPDA. Maps of the waterway extracted from the Aboriginal Site File at the Department of Indigenous Affairs are included in this report as Appendix Five. The main arm of the creek appears to rise to the immediate south of Coast Road to the west of Arthur Street. From here it flows roughly south to pass under Reid Highway near the western end of Victoria Road. The author discussed this waterway with local landowner Mr Stephen Gregg of Coast Road in West Swan on 23 October 2007. Mr Gregg advised that the Little Creek was in fact a man-made drain rather than a natural waterway, which has been piped underground through his property. Certainly, sections of the creek do appear to have been realigned and straightened in the past. However, other sections, including that to the immediate north of Reid Highway give the impression of being a natural ephemeral and seasonal waterway.

4.2 Sources - Previous Reports

Four reports on Aboriginal heritage surveys carried out in the SPDA contain relevant information, as follows.

- R.O'Connor, November 2005. Report on a Preliminary Ethnographic Investigation of the West Swan Project Area, prepared for 360 Environmental Pty. Ltd. This report was a desk-top analysis of the then current ethnographic database and did not involve Aboriginal consultation or field inspections.
- R. O'Connor. January 2007. Report on an Aboriginal Heritage survey of the West Swan Project, prepared for RPS Bowman Bishaw Gorham. This report identified the two Aboriginal sites discussed in 4.1 above. It also identified the relevant Aboriginal stakeholders reviewed below. It included the following recommendations. *This report recommends that the Project should proceed, as the relevant Aboriginal groups have approved it, subject to certain conditions. It is also recommended that registered Aboriginal sites numbers 3417 and 22159 should be preserved undisturbed by the Project through inclusion in Public Open Space. It should be noted that disturbance of these sites is an offence under the Aboriginal Heritage Act 1972, unless Ministerial consent pursuant to Section 18 of that Act has been obtained in their regard. It is also recommended that, in recognition of the concerns of the Wilkes family in regard to possible disturbance of skeletal remains or Aboriginal cultural material, an Aboriginal monitoring programme should be established during initial ground surface disturbance.* It should be noted that the recommendation in respect of Site Number 22159 is no

longer valid, as this Register listing is now "Stored Data", and therefore not covered by the provisions of the AHA.

- G.Quartermaine, November 2005. Report on a Preliminary Archaeological Investigation for Aboriginal Sites – West Swan Project Area, prepared for 360 Environmental Pty. Ltd.. This report is a desk-top study only, which reviews the then current archaeological record for the SPDA. As such, it did not involve a field inspection and did not result in the reporting of any newly discovered archaeological sites.
- G.Quartermaine, July 2008. Report on an Archaeological Investigation for Aboriginal Sites – Stage One, St. Leonard's Estate, West Swan, prepared fro St. Leonard's Estate Pty. Ltd. This report details the results of a field archaeological survey of Local Structure Plan Area 1, as shown in Figure Four. No archaeological sites were identified as a result of the field survey.

5.0 POTENTIAL EFFECTS OF DEVELOPMENT AND POSSIBLE MANAGEMENT STRATEGIES

5.1 Effects of Development

As noted in 4.1 above, there are two listings in the Register of Aboriginal Sites relevant to the SPDA, namely Coast Road Well and Little Creek. Only Coast Road Well is currently covered by the provisions of the AHA. That site has been located on the ground and is now designated on the SPDA plans as "Public Open Space, Drainage and Conservation Area". As such, the proposed development will not have an impact upon it.

Although Little Creek is not currently covered by the provisions of the AHA, it is of stated significance to Nyungar people. Prudence, therefore, suggests that it should be treated as a *de facto* Aboriginal site – attention is drawn here to the discussion of the implications of the ATSIHPA in 2.2 above. The creek and its immediate surrounds are now designated on the SPDA plans as "Public Open Space, Drainage and Conservation Area". As such, apart from minor landscaping works which have already occurred, the proposed development will not have an impact upon it.

6.0 SUGGESTED MANAGEMENT COMMITMENTS

6.1 Aboriginal Stakeholders

The January 2007 O'Connor ethnographic survey report detailed the Nyungar stakeholders relevant to the SPDA. These can be summarised as follows.

- The Combined Metropolitan Working Group of Native Title Claimants, being four sub-groups: the Bropho family group with the Swan Valley Circle of Elders; the Garlett family; the Headland-Corunna family group; and the Wilkes-Warrell family group. Current spokespersons for the four groups are as follows: Ms. Bella Bropho, Mr Greg Garlett, Mr Stan Headland, and Mr Richard Wilkes. The native title claim is administered by a Working Group and by the South West Aboriginal Land and Sea Council, which is the primary formal point of contact for the groups. The Council can advise regarding changes to the spokespersons for the groups which take place from time to time.
- The Ballaruk Group and Bodney family group. The primary point of contact for this group is Mr Corrie Bodney or Ms. Violet Bodney.
- Mr Iva Hayward-Jackson.
- The Independent Aboriginal Environmental Group, for which the primary contact person is Mr Patrick Hume.
- The Jacobs Clan, for which the primary contact person is Rev. Cedric Jacobs.
- The Bibulmun Group, for which the primary contact person is Ms. Esandra

Colbung.

6.2 Aboriginal Involvement

It is essential for management and developers at the SPDA to understand that the heritage under consideration is, first and foremost, the heritage of local indigenous people. Bureaucratic procedures for management of that heritage must always take second place to the wishes and aspirations of those indigenous people (see Section 7, AHA). Accordingly, it is important that the relevant Aboriginal people should at all times be consulted in regard to heritage management decisions and be involved in any re-location of archaeological material which may be discovered in the future or in any fencing of heritage sites which may occur. To this end, the first draft of this ACHMP should be submitted to the South West Aboriginal Land and Sea Council and the Council's input sought for amendments and additions, as appropriate.

6.3 Suggested Management Commitments

This ACHMP suggests that the West Swan (East) developers should make the following commitments.

- Ongoing Aboriginal consultation, as outlined in 6.2 above;
- Aboriginal monitoring of initial ground disturbance in the vicinity of areas of

Aboriginal significance, as recommended in the January 2007 O'Connor ethnographic survey report (this report notes that earthworks have already taken place in the vicinity of Little Creek);

- Strict adherence at all times to the requirements of the AHA;
- Where feasible, preservation *in situ* of Aboriginal heritage sites;
- Where the above is not feasible, and following consultations with the indigenous people listed above, making timely and appropriate application(s) pursuant to Section 18 of the AHA in respect of any such sites that require disturbance;
- Salvaging of archaeological material, should such material be discovered in the future, where required by the indigenous representatives and ACMC, in accordance with archaeological best practice, under the supervision of appropriate Aboriginal monitors;
- Where such surveys have not already been executed, carrying out archaeological surveys of all areas of proposed infrastructure and other development before ground disturbance takes place It is noted in 4.2 above that only Local Structure Plan Area 1 has been the subject of an archaeological field survey;
- Dealing with archaeological sites identified by such surveys, if any, in accordance with the requirements of the AHA (see 2.1 above);
- Whilst development proceeds, dealing with discovery of Aboriginal sites not previously recorded in accordance with the suggested logistics below;
- Whilst development proceeds, dealing with the discovery of skeletal material, should such occur, in accordance with the suggested logistics below.

7.0 LOGISTICS FOR HERITAGE MANAGEMENT, INLCUDING ABORIGINAL MONITORING PROGRAMMES

7.1 Background

This ACHMP will be the controlling document for all Aboriginal heritage management and for all proposed Aboriginal heritage surveys within the SPDA. Accordingly, West Swan (East) Developers should ensure that all direct employees and consultants involved in planning and contractors engaged to execute such plans are made aware of its contents. Persons engaged to oversee development of the SPDA should also be responsible for the monitoring of those developments to ensure compliance with the ACHMP.

7.2 Senior Heritage Officer

It is proposed that West Swan (East) Developers should nominate a senior person who will have overall responsibility for implementation of the ACHMP - a "Senior Heritage Officer" (SHO). Pursuant to 7.1 above, persons responsible for the monitoring of developments at the SPDA should report where appropriate to the SHO. The SHO will also be the primary point of contact for the indigenous groups should their involvement become necessary. The SHO will also be the main point of contact in the event that

human skeletal remains, Aboriginal cultural material, or any other object or place to which Sections 5 or 6 of the AHA (see 2.1 above) may apply are discovered in the course of development at the SPDA.

7.3 Previously Identified Aboriginal Sites

The two areas of Aboriginal significance described in 4.1 above, have been identified on the ground and are now protected from future disturbance by inclusion in Public Open Space (see 5.1 above). Local Structure Plan Area 1 has also been the subject of an archaeological field survey which did not identify any previously unknown archaeological sites. Nonetheless, when any further ground disturbance is taking place in the vicinity of the two areas of significance, Aboriginal monitors should be on site to oversee ground disturbance. The normal procedure in the Perth Metropolitan Area is for two monitors to be on site each day, as required. The two monitors should be drawn from the groups listed in 6.1 above, on a rotational basis. The SHO should oversee the monitoring programme and should ensure that adequate records of attendance are kept. The duties of the monitors will be as follows.

- To convey back to their groups details of the progress of development at the SPDA;
- To notify their groups of any discoveries of Aboriginal cultural material made during works at the SPDA;
- To notify their groups of any discoveries of Aboriginal skeletal material made

during works at the SPDA; and

- To notify their groups of any discoveries of other Aboriginal objects or sites made during works at the SPDA.

8.0 CONTINGENCY PLANS

8.1 Skeletal Material

It is important that all parties involved in the development of the SPDA be made aware of the possibility of human skeletal material being unearthed and that special provisions under law apply when such skeletal material is uncovered in the course of developments in Western Australia. To comply with those provisions, the following management steps are suggested.

- In the event of discovery of verified, or possible, human skeletal material, all ground disturbance in the vicinity of the discovery must stop immediately;
- The discoverer should notify immediately the Works Supervisor or other senior person on site as appropriate;
- All contractors or employees of West Swan (East) Developers carrying out ground disturbing activities in the general vicinity of the discovery should be notified by that senior person and instructed not to carry out any ground disturbance within twenty metres of the skeletal material;
- Aboriginal monitors, if not already aware of the discovery, should be notified;
- The SHO should be notified of the discovery;
- The SHO should notify the WA Police at the nearest Police Station and should request the attendance of an Officer at the site of the discovery;
- The SHO should notify the Registrar of Aboriginal Sites at the DIA of the

discovery;

- If the skeletal material is identified by the Police as Aboriginal and as being sufficiently old to suggest pre-contact interment, then the SHO should confer with the Registrar or Registrar's Delegate and with the Aboriginal groups listed in 6.1 above in regard to management options including, if appropriate, exhumation and reburial away from areas of ground disturbance.

8.2 Other Aboriginal Objects or Sites

If, during ground disturbance, identifiable Aboriginal cultural material or other Aboriginal objects (other than skeletal material) are uncovered, or if the monitors identify any object or place which they believe to be an Aboriginal site or object as defined by Section 5 and 6 of the AHA (see 2.1 above), then the following steps should be taken.

- All ground disturbance in the vicinity of the discovered or identified place or object must stop immediately;
- The discoverer or identifier should notify immediately the Works Supervisor or other senior person on site as appropriate;
- All contractors or employees of West Swan (East) Developers carrying out ground disturbing activities in the general vicinity of the discovered or identified place or object should be notified by that senior person and instructed not to carry out any ground disturbance within an appropriate distance of the place or object; that distance to be agreed with the monitors on site;

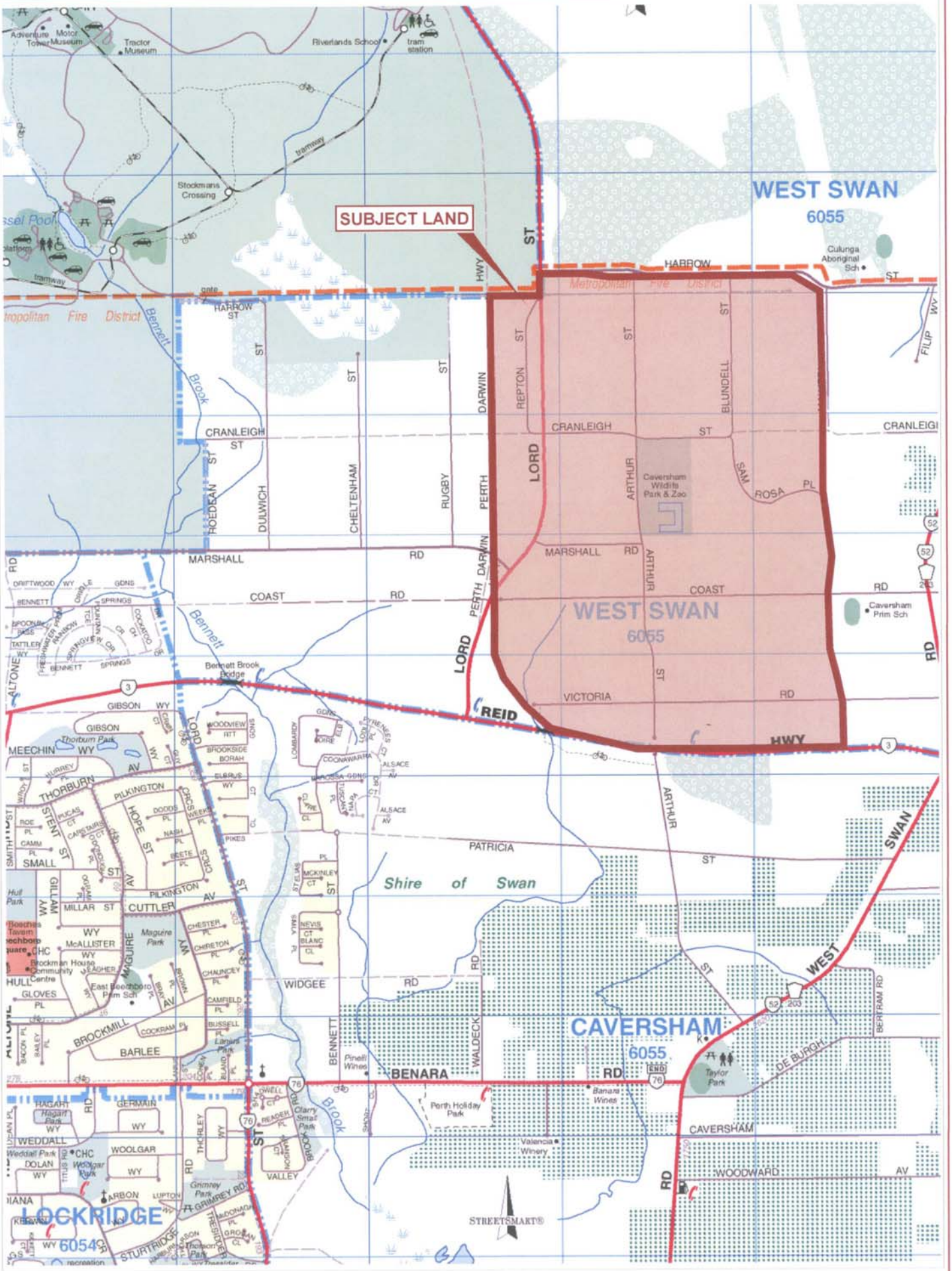
- The SHO should be notified of the discovery;
- The SHO, if appropriate, should notify the Registrar of Aboriginal Sites at the DIA of the discovery or identification;
- The SHO should confer with the Registrar and the Aboriginal monitors in regard to steps to be taken to deal with the discovery or notification.

8.3 Complaints

The SHO should institute and maintain a Complaints Register (CR). In the event of a complaint regarding the implementation of this ACHMP, or regarding any other issue relevant to Aboriginal heritage within the SPDA, the complaint or issue should be entered formally in the CR and signed by the complainant(s) and SHO. The SHO should then liaise with the complainant(s) and raise the matter at the first available general group meeting (see 6.1 above). Upon resolution of the complaint or issue, the manner of resolution should be entered in the CR and again signed by the complainant and SHO.

Figure One:

Location of SPDA



burgess design group

DWG No : ASP WES-9-03
DATE : 04.11.09
SCALE : N.T.S

LEGEND:
Subject Land.....

SOURCE: Street Smart 2008

NORTH

LOCATION PLAN
WEST SWAN (EAST)

Figure Two:

Details of SPDA


HARROW
STREET
CRANLEIGH
STREET
MARSHALL
ROAD
COAST
ROAD
VICTORIA
ROAD
REID
HIGHWAY
PERTH
DARWIN
TRANSIT CORRIDOR
HIGHWAY
STREET
STREET
STREET
STREET
STREET
STREET
STREET
PLACE
ROSA
BRUNSWICK
MALVERN
CRANLEIGH
LORD
STREET

Figure Three:

SPDA Overall Plan, Showing Local Structure Plan Areas

ESTIMATED RESIDENTIAL YIELDS & PUBLIC OPEN SPACE

LSP	Gross Area	Gross Subdivisible Area	Gross Residential Area[1]	Nett Residential Area[2]	Low Density	Medium Density	High Density	Total Dwelling Yield[3]	Gross POS	POS Credit[4]
1	58.5	53.1ha	50.4ha	36ha	80	640	300	1020	4.5ha	4.4ha
2A	67.2	60.4ha	55ha	39ha	530	200	0	730	5.3ha	4.1ha
2B	48.8	42.9ha	36.25ha	24ha	360	160	0	520	6.5ha	3.5ha
3	17.5	8.7ha	6.47ha	5ha	20	50	0	70	1.7ha	1.1ha
4	53.9	51.8ha	39.5ha	28ha	290	260	0	550	19.8ha	18.5ha
Total	256ha	228.7ha	187.62ha	131ha	1280	1310	300	2890	37.9ha	31.6ha (13.8%)

LEGEND

- Subject Area
- Low Density Residential (R5-R25)
- Medium Density Residential (R20-R50)
- High Density Residential (R50-R100)
- Local Neighbourhood Centre
- Service Commercial
- Primary Schools
- POS/Drainage/Conservation Area
- Special Use - Community
- Powerline Easement
- Gas Pipeline Easement
- Infrastructure Corridor
- Special Use- Infrastructure
- Gas Pipeline Setback
- Noise Attenuation Measures as appropriate
- Interim Odour Buffer
- Possible Future Transit Station
- Activity Corridor
- MRS Primary Regional Road
- MRS Other Regional Roads
- Integrator B Road
- Neighbourhood Connector Road
- Access Streets
- MRS Public Purpose Reserve
- Local Structure Plan Boundaries

NOTES

PUBLIC OPEN SPACE AND DRAINAGE
Public Open Space and Drainage areas are indicative and subject to detailed design and modelling at the Local Structure Plan stage.

DISTRICT OPEN SPACE FACILITIES
12ha of District Open Space Facilities are to be located within a minimum of 1.5km of public open space, co-located with the Resource Enhancement Wetland and adjacent to the Public Primary School along Arthur street.

SERVICE COMMERCIAL
Uses within the site are as per the Service Commercial Use class table listed in the Districts Structure Plan with emphasis on creating a Mixed Business/Service Commercial development site to cater for commercial uses not suitable for the local neighbourhood centre.

LOCAL NEIGHBOURHOOD CENTRE
Uses within the local neighbourhood centre site are as per the City of Swan General Commercial use class with emphasis on encouraging a main street style local neighbourhood centre.

SPECIAL USE - COMMUNITY SITE
Uses within the site are generally intended for civic and community purposes, with emphasis on a design complementary to the Activity corridor and public open space.

SPECIAL USE - INFRASTRUCTURE SITE
The Special Use - Infrastructure site may be required for a 2 ha power substation site. In the event agreement is reached for an alternative location, this site is designated for low density residential.

INTERIM ODOUR BUFFER
Subdivision within the designated interim odour buffer is not permitted until the satisfactory removal or reduction of the interim buffer in accordance with section 4.4.1 of report.

HERITAGE
The identified heritage sites are to be protected within public open space or alternative, subject to detailed design at the Local Structure Plan stage.

RESIDENTIAL
Uses within the Residential areas are as per the City of Swan Residential Zone use class. Residential densities are indicative only and shall be confirmed at the local structure plan stage, aiming to achieve a minimum of 22 dwelling units per hectare across the structure plan area with higher/medium densities concentrated along the Activity Corridor, Commercial centre and areas of POS.

ACTIVITY CORRIDOR
The Activity Corridor is intended as the central spine for movement and activity connecting Albion with Caversham through West Swan and shall provide the function of a frequent public transport route with higher residential densities, home based businesses and some commercial and community uses encouraged alongside it.

INFRASTRUCTURE CORRIDOR & EASEMENT
Use, development and ownership of the infrastructure corridor & easement are to be to the satisfaction of the City of Swan and Western Power and is subject to more detailed design at the Local Structure Plan stage.

GAS PIPELINE SETBACK
Use and development within the gas pipeline setback area is restricted and subject to further refinement at the Local Structure Plan Stage.

LOCAL STRUCTURE PLANS
Subdivision and development of the subject area is to be in accordance with an endorsed applicable Local Structure Plan unless otherwise approved by the City of Swan and/or Western Australia Planning Commission.

burgess design group

DRAWING NUMBER: ASP-WES-2-09
DATE: 30.06.2010
JOB CODE: ADP WEST

NORTH

ASPEN LIVING

WEST SWAN (EAST) DISTRICT STRUCTURE PLAN

Appendix One:

Notes on the *Aboriginal Heritage Act, 1972*

APPENDIX 1

OBLIGATIONS RELATING TO SITES UNDER THE ABORIGINAL HERITAGE ACT, 1972

Report of Findings

"15. Any person who has knowledge of the existence of anything in the nature of Aboriginal burial grounds, symbols or objects of sacred, ritual of ceremonial significance, cave or rock paintings or engravings, stone structures or arranged stones, carved trees, or of any other place or thing to which this Act applies or to which this Act might reasonably be suspected to apply shall report its existence to the Registrar, or to a police officer, unless he has reasonable cause to believe the existence of the thing or place in question to be already known to the Registrar."

Excavation of Aboriginal Sites

"16. (1) Subject to Section 18, the right to excavate or to remove any thing from an Aboriginal site is reserved to the Registrar.

(2) The Registrar, on the advice of the Committee, may authorise the entry upon and excavating of an Aboriginal site and the examination or removal of any thing on or under the site in such manner and subject to such conditions as the Committee may advise."

Offences Relating to Aboriginal Sites

"17. A person who-

(a) Excavates, destroys, damages, conceals or in any way alters any Aboriginal site; or

(b) In any way alters, damages, removes, destroys, conceals, or who deals with in a manner not sanctioned by relevant custom, or assumes the possession, custody or control of, any object on or under an Aboriginal site,

commits an offence unless he is acting with the authorisation of the Registrar under Section 16 or the consent of the Minister under Section 18."

Consent to Certain Uses

"18. (1) For the purposes of this section, the expression "the owner of any land" includes a lessee from the Crown, and the holder of any mining tenement or mining privilege, or of any right or privilege under the Petroleum Act, 1967, in relation to the land.

(2) Where the owner of any land gives to the Trustees notice in writing that he requires to use the land for a purpose which, unless the Minister gives his consent in this Section, would be likely to result in a breach of Section 17 in respect of any Aboriginal site that might be on the land, the Committee shall, as soon as they are reasonably able, form an opinion as to whether there is any Aboriginal site on the land, evaluate the importance and significance of any such site, and submit the notice to the Minister together with their recommendations in writing as to whether or not the Minister should consent to the use of the land for that purpose, and, where applicable, the extent to which and the conditions upon which his consent should be given.

(3) When the Committee submit a notice to the Minister under subsection (2) of this section he shall consider their recommendation and having regard to the general interest of the community shall either -

(a) Consent to the use of the land the subject of the notice, or a specified part of the land, for the purpose required, subject to such conditions, if any, as he may specify; or

(b) Wholly decline to consent to the use of the land the subject of the notice for the purpose required,

and shall forthwith inform the owner in writing of his decision.

(4) Where the owner of any land has given to the Committee notice pursuant to the subsection (2) of this section and the Committee have not submitted it with their recommendation to the Minister in accordance with that subsection the Minister may require the Committee to do so within a specified time, or may require the Trustees to take such other action as the Minister considers necessary in order to expedite the matter, and the Committee shall comply with any such requirement.

(5) Where the owner of any land is aggrieved by a decision of the Minister made under subsection (3) of this section he may, within the time and in the manner prescribed by the rules of court, appeal from the decision of the Minister to the Supreme Court which may hear and determine an appeal.

(6) In determining an appeal under subsection (5) of this section the Judge hearing the appeal may confirm or vary the decision of the Minister against which the appeal has been made or quash the decision of the Minister, and may make such order as to the costs of the appeal as he sees fit.

(7) Where the owner of the any land gives notice to the Committee under subsection (2) of this section, the Committee may if they are satisfied that it is practicable to do so, direct the removal of any object to which this Act applies from the land to a place of safe custody.

(8) Where consent has been given under this section to a person to use any land for a particular purpose nothing done by or on behalf of that person pursuant to, and in accordance with any conditions attached to, the consent constitute an offence against the Act."

Appendix Two:

Notes on the Recognition of Aboriginal Sites

APPENDIX 2

Notes on the Recognition of Aboriginal Sites

There are various types of Aboriginal Sites, and these notes have been prepared as a guide to the recognition of those types likely to be located in the survey area.

An Aboriginal Site is defined in the Aboriginal Heritage Act, 1972, in Section 5 as:

"(a) Any place of importance and significance where persons of Aboriginal descent have, or appear to have, left any object, natural or artificial, used for, or made for or adapted for use for, any purpose connected with the traditional cultural life of the Aboriginal people, past or present;

(b) Any sacred, ritual or ceremonial site, which is of importance and special significance to persons of Aboriginal descent;

(c) Any place which, in the opinion of the Committee is or was associated with the Aboriginal people and which is of historical, anthropological, archaeological or ethnographical interest and should be preserved because of its importance and significance to the cultural heritage of the state;

(d) Any place where objects to this Act applies are traditionally stored, or to which, under the provisions of this Act, such objects have been taken or removed."

Habitation Sites

These are commonly found throughout Western Australia and usually contain evidence of tool-making, seed grinding and other food processing, cooking, painting, engraving or numerous other activities. The archaeological evidence for some of these activities is discussed in details under the appropriate heading below.

Habitation sites are usually found near an existing or former water source such as a gnamma hole, rock pool, spring or soak. They are generally in the open, but they sometimes occur in shallow rock shelters or caves. It is particularly important that none of these sites be disturbed as the stratified deposits which may be found at such sites can yield valuable information about the inhabitants when excavated by archaeologists.

Seed Grinding

Polished or smoothed areas are sometimes noticed on/near horizontal rock surfaces. The smooth areas are usually 25cm wide and 40 or 50cm long. They are the result of seed grinding by the Aboriginal women and indicate aspects of past economy.

Habitation Structures

Aboriginal people sheltered in simple ephemeral structures, generally made of branches and sometimes of grass. These sites are rarely preserved for more than one occupation period. Occasionally rocks were pushed aside or used to stabilise other building materials. When these rocks patterns are located they provide evidence for former habitation sites.

Middens

When a localised source of shellfish and other foods has been exploited from a favoured camping place, the accumulated ashes, hearth stones, shells, bones and other refuse can form mounds at times several metres high and many metres in diameter. Occasionally these refuse mounds or middens contain stone, shell or bone tools. These are most common near the coast, but examples on inland lake and river banks are not unknown.

Stone Artefact Factory Sites

Pieces of rock from which artefacts could be made were often carried to camp sites or other places for final production. Such sites are usually easily recognisable because the manufacturing process produces quantities of flakes and waste material which are clearly out of context when compared with the surrounding rocks. All rocks found on the sandy coastal plain , for example, must have been transported by human agencies. These sites are widely distributed throughout the State.

Quarries

When outcrops of rock suitable for the manufacture of stone tools were quarried by the Aborigines, evidence of the flaking and chipping of the source material can usually be seen in situ and nearby. Ochre and other mineral pigments used in painting rock surfaces, artefacts and in body decoration are mined from naturally occurring seams, bands and other deposits. This activity can sometimes be recognised by the presence of wooden digging sticks or the marks made by these implements.

Marked Trees

Occasionally trees are located that have designs in the bark which have been incised by Aborigines. Toeholds, to assist the climber, were sometimes cut into the bark and sapwood of trees in the hollow limbs of which possums and other arboreal animals sheltered. Some tree trunks bear scars where section of bark or wood have been removed and which would have been used to make dishes, shield, spearthrowers and other wooden artefacts. In some parts of the state wooden platforms were built in trees to accommodate a corpse during complex rituals following death.

Burials

In the north of the state, it was formerly the custom to place the bones of the dead on a ledge in a cave after certain rituals were completed. The bones were wrapped in sheets of bark and the skull placed beside this. In other parts of Western Australia the dead were buried, the burial position varying according to the customs of the particular area and time. Natural erosion, or mechanical earthmoving equipment occasionally exposes these burial sites.

Stone Structures

If one or more stone are found partly buried or wedged into a position which is not likely to be the result of natural forces, then it is probable that the place is an Aboriginal site and that possibly there are other important sites nearby. There are several different types of stone arrangements ranging simple cairns or piles of stones to more elaborate designs.

Low weirs which detain fish when tides fall are found in coastal areas. Some rivers contain similar structures that trap fish against the current. It seems likely that low stone slab structures in the south west jarrah forests were built to provide suitable environments in which to trap some small animals. Low walls or pits were sometimes made to provide a hide or shelter for a hunter.

Elongated rock fragments are occasionally erected as a sign or warning that a special area is being approached. Heaps or alignments of stones may be naturalistic or symbolic representations of animals, people or mythological figures.

Paintings

These usually occur in rock shelters, caves or other sheltered situations which offer a certain degree of protection from the weather. The best known examples in Western Australia occur in the Kimberley region but paintings are also found through most of the states. One of several coloured ochres as well as other coloured pigments may have been used at a site. Stencilling was a common painting technique used throughout the state. The negative image of an object was created by spraying pigment over the object which was held against the wall.

Engravings

This term described designs which have been carved, pecked or pounded into a rock surface. They form the predominant art form of the Pilbara region but are known to occur in the Kimberleys in the north to about Toodyay in the south. Most engravings occur in the open, but some are situated in rock shelters.

Caches

It was the custom to hide ceremonial objects in niches and other secluded places. The removal of objects from these places, or photography of the places or objects or any other interference with these places is not permitted.

Ceremonial Grounds

At some sites the ground has been modified in some way by the removal of surface pebbles, or the modelling of the soil, or the digging of pits and trenches. In other places there is not noticeable alteration of the ground surface and Aborigines familiar with the site must be consulted concerning its location.

Mythological Sites

Most sites already described have a place in Aboriginal mythology. In addition there are many Aboriginal sites with no man-made features which enable them to be recognised. They are often natural features in the landscape linked to the Aboriginal Account of the formation of the world during the creative "Dreaming" period in the distant past. Many such sites are located at focal points in the creative journeys of mythological spirit beings of the Dreaming. Such sites can only be identified by the Aboriginal people who are familiar with the associated traditions.

Appendix Three:

Register of Aboriginal Sites Extract

Search Criteria

8 sites in a search polygon. The polygon is formed by these points (in order):

MGA Zone 50	
Northing	Easting
6476250	402000
6476250	404000
6474000	404000
6474000	402000

Disclaimer

Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist. Consultation with Aboriginal communities is on-going to identify additional sites. The AHA protects all Aboriginal sites in Western Australia whether or not they are registered.

Copyright

Legend

Restriction

N	No restriction
M	Male access only
F	Female access

Access

C	Closed
O	Open
V	Vulnerable

Coordinate Accuracy

Accuracy is shown as a code in brackets following the site coordinates.

[Reliable]	The spatial information recorded in the site file is deemed to be reliable, due to methods of capture.
[Unreliable	The spatial information recorded in the site file is deemed to be unreliable due to errors of spatial data capture and/or quality of spatial information reported.

Status

L	Lodged	IR	Insufficient Information (as assessed by Site Assessment Group)
I	Insufficient Information	PR	Permanent register (as assessed by Site Assessment Group)
P	Permanent register	SR	Stored data (as assessed by Site Assessment Group)
S	Stored data		

Site Assessment Group (SAG)

Sites lodged with the Department are assessed under the direction of the Registrar of Aboriginal Sites. These are not to be considered the final assessment.

Final assessment will be determined by the Aboriginal Cultural Material Committee (ACMC).

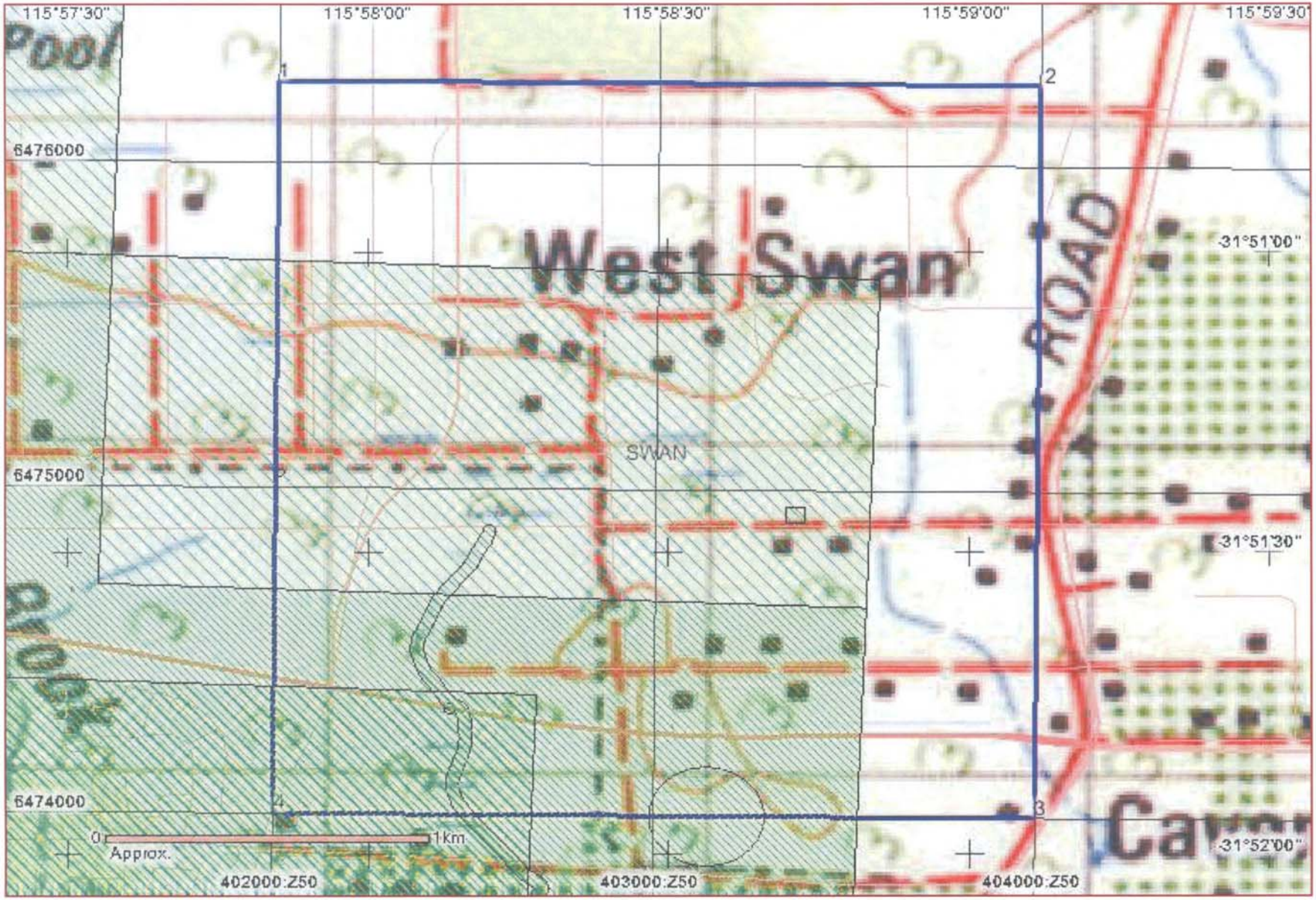
Spatial Accuracy

Index coordinates are indicative locations and may not necessarily represent the centre of sites, especially for sites with an access code "closed" or "vulnerable". Map coordinates (Lat/Long) and (Easting/Northing) are based on the GDA 94 datum. The Easting / Northing map grid can be across one or more zones. The zone is indicated for each Easting on the map, i.e. '5000000:Z50' means Easting=5000000, Zone=50.

Aboriginal Heritage Inquiry System

Register of Aboriginal Sites

Site ID	Status	Access	Restriction	Site Name	Site Type	Additional Info	Informants	Coordinates	Site No.
3417	I	O	N	Coast Road Well.		Camp, Water Source	*Registered Informant names available from DIA.	403367mE 6474925mN Zone 50 [Reliable]	S02818
3692	P	C	N	Bennett Brook: In Toto	Mythological		*Registered Informant names available from DIA.	Not available for closed sites	S02254
3744	P	C	N	Marshalls Paddock	Skeletal material/Burial		*Registered Informant names available from DIA.	Not available for closed sites	S02194
3746	S	O	N	West Swan Road Camp (Moore'S Camp)		Camp	*Registered Informant names available from DIA.	403139mE 6473999mN Zone 50 [Unreliable]	S02196
3840	P	C	N	Bennett Brook: Camp Area.	Ceremonial, Mythological, Skeletal material/Burial, Man-Made Structure, Fish Trap, Artefacts / Scatter, Historical	Plant Resource, Camp, Hunting Place, Water Source	*Registered Informant names available from DIA.	Not available for closed sites	S01997
20030	IR	O	N	Ancient Well		Water Source	*Registered Informant names available from DIA.	402462mE 6474324mN Zone 50 [Reliable]	
22159	S	O	N	Little Creek / One Hundred Year Creek	Mythological	Camp	*Registered Informant names available from DIA.	402208mE 6473584mN Zone 50 [Reliable]	
22643	L	O	N	West Swan Isolated Artefacts	Artefacts / Scatter		*Registered Informant names available from DIA.	401259mE 6474814mN Zone 50 [Reliable]	



Legend

- Highlighted Area
- Town
- Map Area
- Search Area

Appendix Four:

Aboriginal Site 3417

12 Site Description – include ethnographic and archaeological comments.
(See separate Site Recording Aid.)

Well – originally believed to be a natural soak.

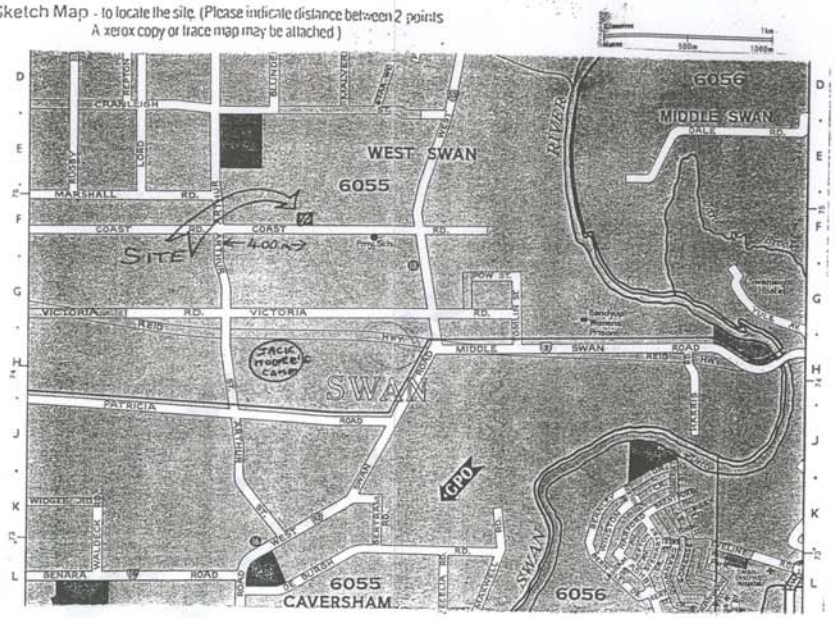
This well was used as a watersource & day camp between the 1930's & 1950's for those living at Jack & Mable Moore's camp south of Victoria road. It is also likely to have been used long before this.

People from the camp ~~had~~ came here to do their washing. Tribal members coming here when visiting the Moore's camp. The washing was hung on the fence by the road till dry. Kids used to feed from the now dead mulberry tree just to the east of the well.

13 General Remarks:

No stone artefacts seen that would indicate prehistoric occupation, however the dense ground cover, especially the lush grass around the old well is likely to prevent material been seen

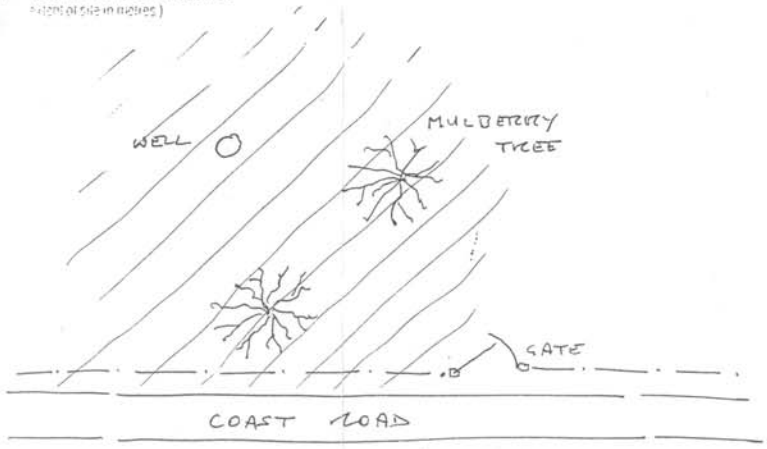
14 Sketch Map – to locate the site. (Please indicate distance between 2 points
A xerox copy or trace map may be attached.)



N

Recorder _____ Date __/__/__

15 Site Plan (Give distance between two points &
extent of site in metres.)



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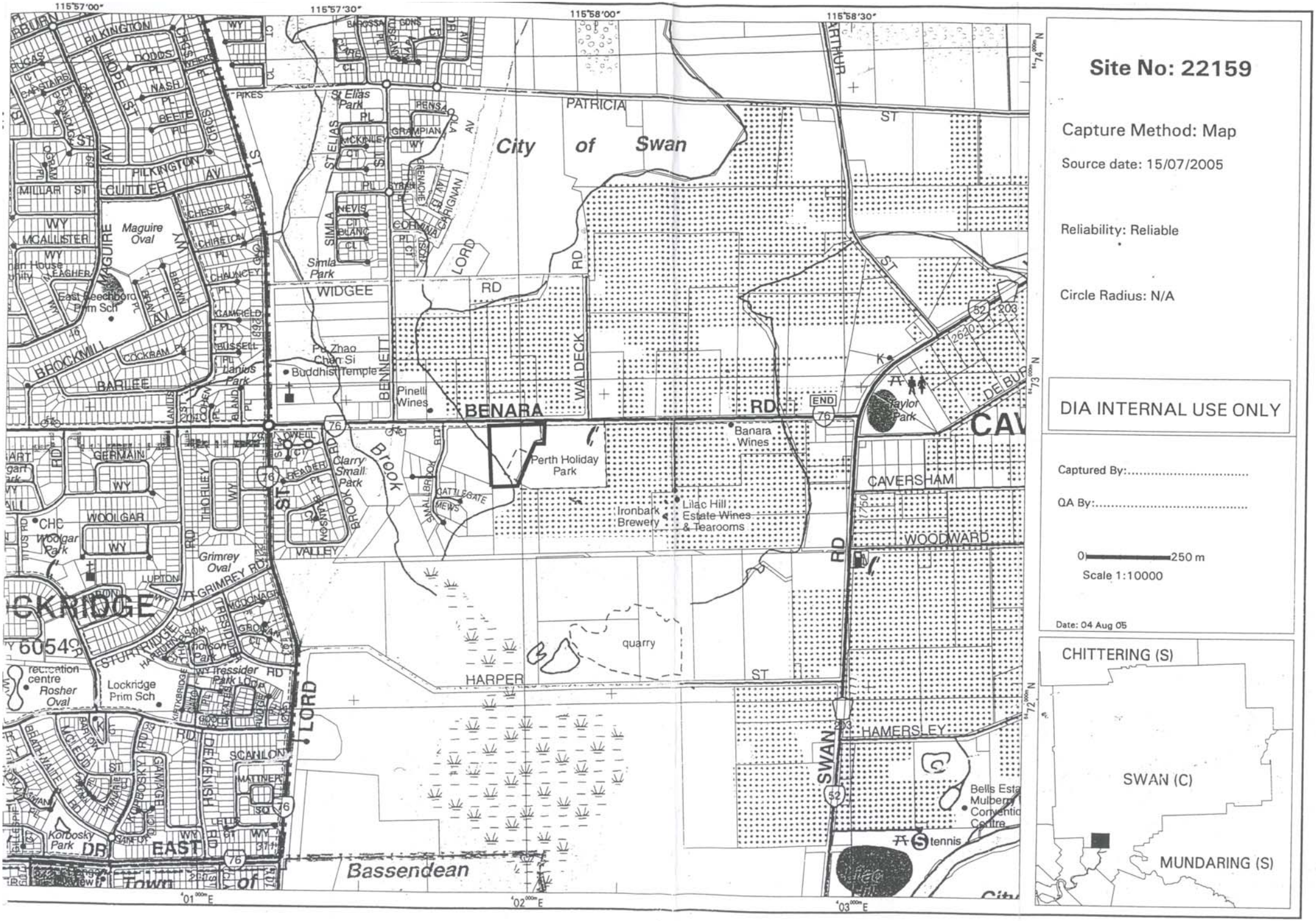
Site extent: 50 m × 50 m

Recorder R REYNOLDS Date 7.6.99



Site No: 22159

Capture Method: Map

Source date: 15/07/2005

Reliability: Reliable

Circle Radius: N/A

DIA INTERNAL USE ONLY

Captured By:.....

QA By:.....

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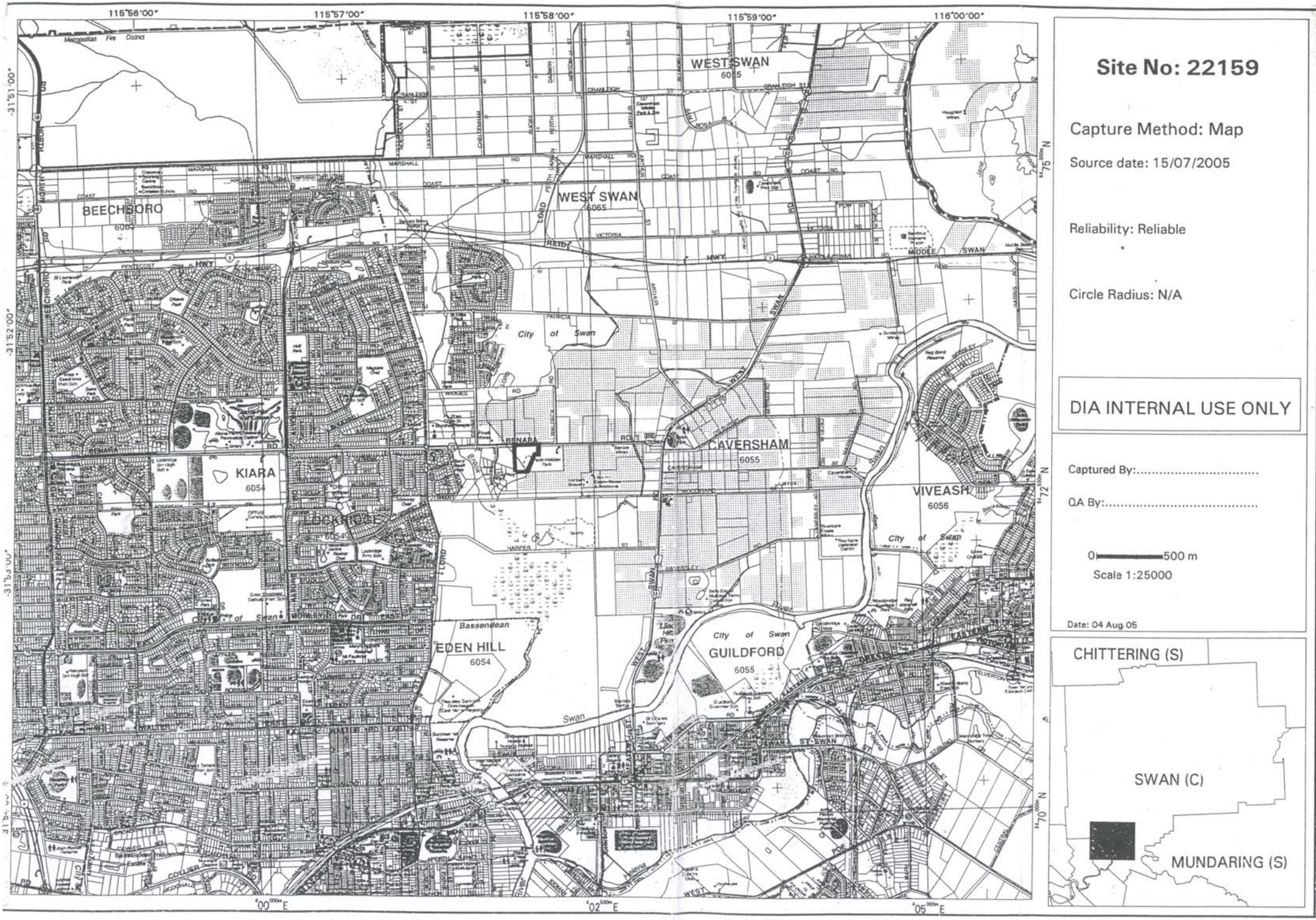
Scale 1:10000

Date: 04 Aug 05

Appendix Five:

Aboriginal Site 22159



Site No: 22159

Capture Method: Map

Source date: 15/07/2005

Reliability: Reliable

Circle Radius: N/A

DIA INTERNAL USE ONLY

Captured By:.....

QA By:.....

0 500 m

Scale 1:25000

Date: 04 Aug 05

APPENDIX 5

ADDENDUM TO THE WEST SWAN EAST LOCAL WATER MANAGEMENT STRATEGY

Jim Davies & Associates Pty Ltd
ACN 067 295 569
Suite 1, 27 York Street, Subiaco
PO Box 117, Subiaco WA 6008
Telephone (08) 9388 2436
Facsimile (08) 9381 9279
Email info@jdahydro.com.au
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CONSULTANT
HYDROLOGISTS

Your Ref:
Our Ref: J4791d

15 March 2011

City of Swan
P O Box 196
Midland
Perth WA 6936

To Whom It May Concern,

LSP1: CHANGES TO DRAINAGE DESIGN NORTH OF MARSHALL RD, DAYTON

Aspen Group is currently seeking endorsement for LSP1, West Swan East. The LSP1 submission is supported by a Local Water Management Strategy prepared by JDA in May 2009 and approved by the Department of Water, in consultation with the City of Swan, in June 2009. Due to the timeframe for advertising the Structure Plan has been modified since the submission and approval of the LWMS.

Consistent with Better Urban Water Management (BUWM) (DoW 2008) changes to catchment boundaries and POS layout for the cell North of Marshall Rd, currently known as Enclave at St Leonards (Enclave), have been incorporated into detailed drainage design and are to be presented in the Urban Water Management Plan (UWMP) for Enclave (in draft).

LWMS catchments and the POS area within Enclave are presented in Figure 1 with the changes to both catchment boundaries and POS location and required drainage area presented in Figure 2.

Table 1 presents the 1 year 1 hour ARI, 5 year ARI and 100 year ARI event stormwater modelling results for the approved LWMS (JDA 2009) and Draft Enclave UWMP (JDA 2011).

Groundwater

The relocation of the POS within WS2 has resulted in an increase in AAMGL at the POS location from 15.40 mAHD to 16.00 mAHD. The invert of the proposed flood attenuation and bioretention area within the POS has been retained at AAMGL consistent with the LWMS (JDA 2009). To achieve separation to groundwater for water quality and environmental health objectives a Design Groundwater Level (DGL) of 15.4 mAHD is proposed to be implemented via subsoils. Details of the proposed DGL will be provided in the UWMP for approval by the Department of Water in consultation with the City of Swan.

Surface Water

Changes to total area reflect a readjustment of catchment boundaries with the North East corner of LWMS WS2 having been included in the current WS3 catchment. Changes to catchment boundaries are the result of detailed engineering design for both Enclave and the Stages 1J – 1K St Leonards Estate drainage design presented in the relevant UWMP (JDA 2010). Drainage design for WS3 at UWMP stage has been partially undertaken within the Stages 1J – 1N St Leonards Estate, UWMP (JDA 2010). Further detailed design, including drainage design within the RE Wetland within WS3, will be undertaken at such time this area is developed. Drainage calculations presented in the Stages 1J – 1N St Leonards Estate UWMP (JDA 2010) indicates there is sufficient room within the catchment for required flood attenuation.

The current LSP1 plan includes a change to landuse within WS2 North of Marshall Rd from Retirement Village to Residential Lots. Despite a change in proposed landuse the flood management system and stormwater design includes up to the 1 year 1 hour event to be retained and infiltrated at source (soakwells) for over 90% of Lots (Figure 2). Water quality treatment for up to the 1 year 1 hour event from road reserve and less than 10% of Lots is undertaken within the bioretention area within the POS. Flood attenuation is undertaken within the WS2 POS prior to discharge to the Marshall Rd median in line with the overall West Swan catchment allowable discharge.

The POS location within Enclave is approximately 115 m from the Marshall Rd discharge point (Figure 2); this is an additional 35m when compared to the LWMS (JDA 2009) (Figures 1). Attenuated flow is provided additional water quality treatment opportunities via the approximately 250m Marshall Rd median in a living stream prior to discharge to the regional stormwater system East of West Swan East (Figure 2). Given this distance to the regional system and additional water quality treatment opportunity JDA does not consider the additional 35m significant to the overall flood management system.

Changes to the LSP1 area, both landuse (including POS location) and distance to the discharge point at Marshall Rd are not considered significant for drainage and are consistent with the overall pronciples and objectives presented in the West Swan East LWMS (JDA 2009). Changes to stormwater system design and flood management as a result of the change to LSP1 are also considered to be consistent with the Swan Urban Growth Corridor Drainage and Water Management Plan (SUGC DWMP) (DoW 2009) and the North East Corridor Urban Water Management Strategy (UWMS) (GHD 2007).

Summary

- Design Groundwater Level to be implemented to achieve separation from groundwater at flood attenuation and bioretention area consistent with BUWM (DoW 2008).
- Catchment WS2 has decreased in total catchment area and WS3 has increased however the overall area of WS2 and WS3 as well as the overall West Swan catchment has not changed.
- WS3 has sufficient area for the increased flood attenuation requirement.
- The revised WS2 POS location and size is consistent with the objectives and stormwater system design and flood management system requirements of the LWMS (JDA 2009).
- The increased distance from WS2 flood attenuation area outlet and Marshall Rd median provides additional water quality treatment prior to discharge and is therefore consistent with the objectives of the lWMS (JDA 2009) and BUWM (DoW 2008).
- Changes to LSP1 and therefore revised modelling of the stormwater system is consistent with the Swan Urban Growth Corridor Drainage and Water Management Plan (DoW 2009) and the North East Corridor Urban Water Management Strategy (GHD 2007).

References

Department of Water (2008) Better Urban Water Management.

Department of Water (2009) Swan Urban Growth Corridor Drainage and Water Management Plan, June 2009

GHD (2007) North East Corridor Urban Water Management Strategy, respor to Department of Water February 2007.

JDA Consultant Hydrologists (2009) West Swan East Local Water Management Strategy, May 2009. Prepared for West Swan Estate Pty Ltd.

JDA Consultant Hydrologists (2011) Enclave at St Leonards Draft Urban Water Management Plan, In Draft March 2011. Prepared for Enclave at St Leonards Ltd.

JDA Consultant Hydrologists (2010) Stage One St Leonards Estate Urban Water Management Plan, May 2010. Stagse 1B, 1C and 1G St Leonards Estate. Prepared for West Swan Estate Pty Ltd.

JDA Consultant Hydrologists (2011) Stages 1J – 1N St Leonards Estate Urban Water Management Plan, February 2011. In review. Prepared for West Swan Estate Pty Ltd.

Table 1: Post-development Flood Attenuation Results

Post-Development Catchment		WS2 UWMP (IN DRAFT)	WS2 LWMS (May 2009)
Catchment Data	**R/O Coeff**		
Total Catchment Area (ha)	**-**	11.76	18.77
Contributing Catchment Area	**-**	11.76	11.00
Road & Road Reserve (ha)	**80%**	5.25	-
POS Area (ha)	**10%**	-	-
Drainage POS (ha)	**100%**	0.53	-
Residential Lots – with soakwells (ha)	**10%**	5.39	-
Residential Lots – direct connection (ha)	**60%**	0.59	-
Power Corridor (ha)	**50%**	-	-
Shopping Centre (ha)	**50%**	-	-
Commercial/ Retirement Village (ha) (LWMS Only)	**75%**	N/A	11.00
Equivalent Impervious Area (ha)	**-**	5.65	8.25
Storage Data			
AAMGL (mAHD)		16.00	15.30
DGL $(mAHD)_3$		15.40	15.30
Base Invert Level (mAHD)		16.00	15.30
Base Storage Area (ha)		0.28	0.90
Side Slopes (v:h)		1:6	1:6
Storage Outlet Level (mAHD)		16.00	15.30
Storage Pipe Outlet Diameter (mm)		150	150
1 Year ARI 1hr and Bioretention			
Storm Volume (m^3) (16mm rainfall)		905	1221
Bioretention Area Required (2% EIA)		0.11	0.17
5 Year ARI			
Top Water Level Area (ha)		0.33	1.01
Flood Storage $(m^3)_1$		1225	5885
Flood Rise $(m)_2$		0.40	0.60
TWL (mAHD)		16.40	15.90
Peak Outflow (m^3/s)		0.04	0.01
Critical Duration (hrs)		36	72
100 Year ARI			
Top Water Level Area (ha)		0.42	1.07
Flood Storage $(m^3)_1$		3480	9088
Flood Rise $(m)_2$		1.00	0.90
TWL (mAHD)		17.00	16.2
Peak Outflow (m^3/s)		0.05	0.09
Critical Duration (hrs)		72	72

If you have any queries, please do not hesitate to contact Kate Smith or Matt Yan.

Yours sincerely,

JDA Consultant Hydrologists

WC2

WS1

WS2

WS3

WS4

Catchment WS2

Base Invert (mAHD): 15.30
Base SA (ha): 0.90
Pipe Outlet Invert (mAHD): 15.30
Pipe Diam. (mm): 150 (nominal)

TWL Area (ha):	1.07
Volume (m):	9088
Rise (m):	0.90
TWL (mAHD):	16.20
Peak Flow (m^3/s):	0.09
Critical Storm (hrs):	72

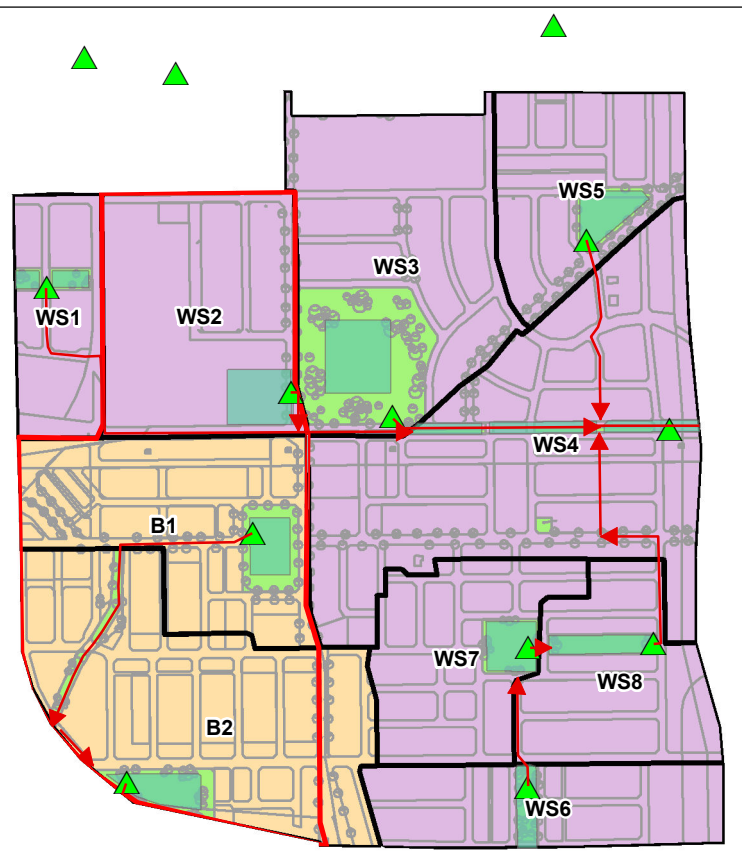
Scale: 1:2,500

0 55 110 220

Metres

N

Regional Drainage Flow
Nodes
LSP1
100 Year ARI Flood Attenuation Area
LWMS West Swan Subcatchments
POS
Catchments
1
3



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Data Source: TABEC (2010); Burgess Design (2010), West Swan Estate (2010)

Job No. J4791

West Swan Estate Pty Ltd

West Swan East: LWMS LSP1 Advice

Figure 1: LWMS LSP1 Stormwater Management System

WS1

WS2

WS3

WS4

Catchment WS2

Base Invert (mAHD): 16.00
Base SA (ha): 0.28
Pipe Outlet Invert (mAHD): 16.00
Pipe Diam. (mm): 150 (nominal)

TWL Area (ha):	0.42
Volume (m):	3480
Rise (m):	1.00
TWL (mAHD):	17.00
Peak Flow (m^3/s):	0.05
Critical Storm (hrs):	72

Scale: 1:2,500

0 55 110 220

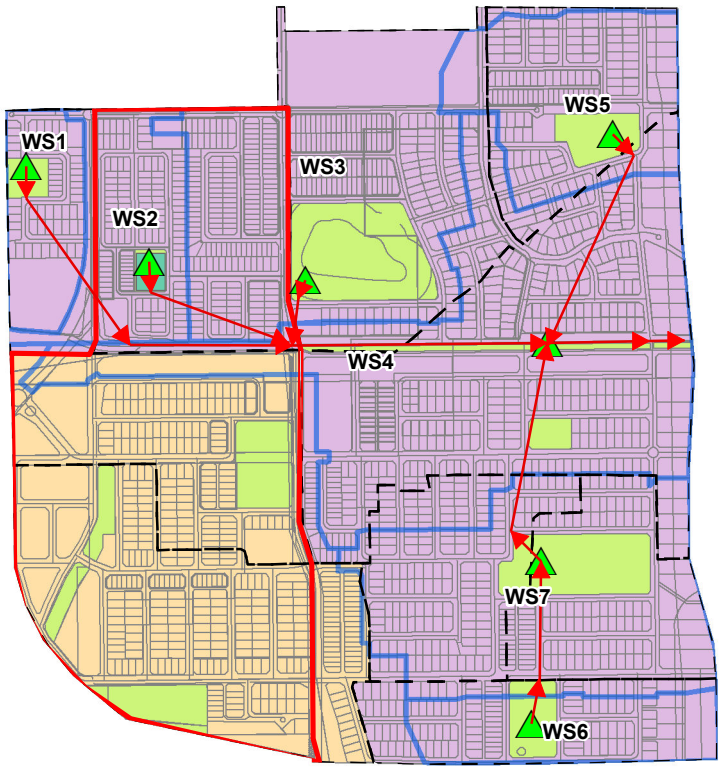
Metres

N

- Regional Drainage Flow
- Drainage Outlet Node
- LSP1
- 100 Year ARI Flood Attenuation Area
- LWMS West Swan Subcatchments
- Revised LWMS West Swan Subcatchments
- POS/ Drainage

Catchments

- 1
- 3



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Data Source: TABEC (2010); Burgess Design (2010), West Swan Estate (2010)

Job No. J4791

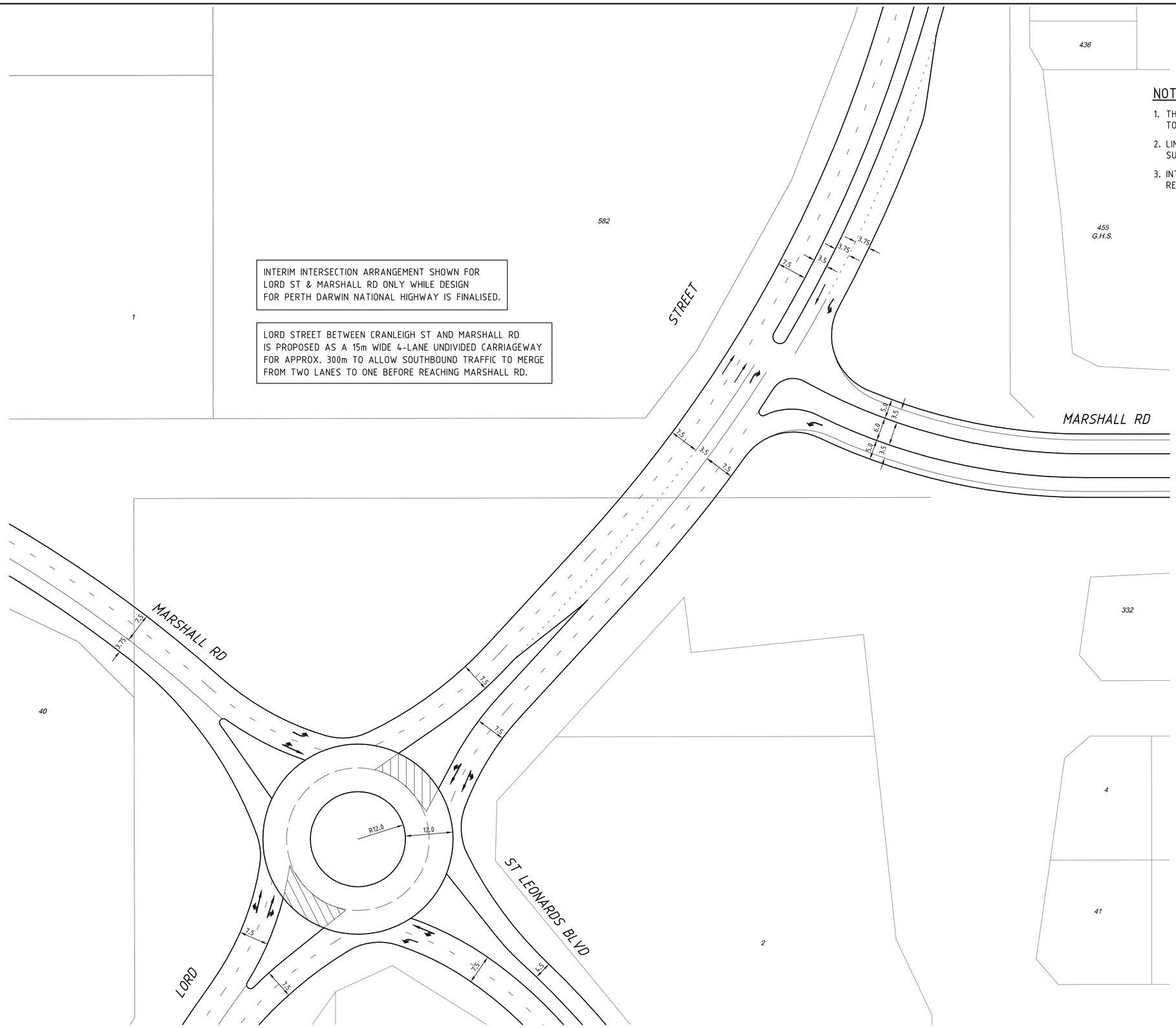
West Swan Estate Pty Ltd

West Swan East LWMS LSP1 Advice

Figure 2: DRAFT UWMP LSP1 Stormwater Management System

APPENDIX 6

PRELIMINARY INTERSECTION DESIGN



NOTES

1. THIS IS A CONCEPTUAL DESIGN ONLY & SUBJECT TO FUTURE DETAILED DESIGN.
2. LINEMARKING IS SHOWN AS INDICATIVE ONLY & SUBJECT TO FUTURE DETAILED DESIGN.
3. INTERSECTION DIMENSIONS ADOPTED FROM TRAFFIC REPORT.

LORD ST - MARSHALL RD / ST LEONARDS BLVD INTERSECTIONS

1:500

Aspen Living
St Leonards - LSP1

Conceptual Intersection Design
Lord Street

DRAWING NUMBER 2223-LSP1-INT-002

ISSUE D

TABEC Civil Engineering Consultants
TABEC Pty Ltd ACN 090 796 204
14 Wickham Street, East Perth WA 6004
Telephone 9225 4100, Fax 9225 4188
Email info@tabec.com.au

SCALE 1:500 0 10 20 30

A1

Plotted By: REvans Plot Date: 13/10/11 - 11:24 Cad File: T:\Projects\2223\Design\CAD\Stage 0 Misc\LSP1 Intersections\2223-LSP1-INT-001-003.dwg

NOTES

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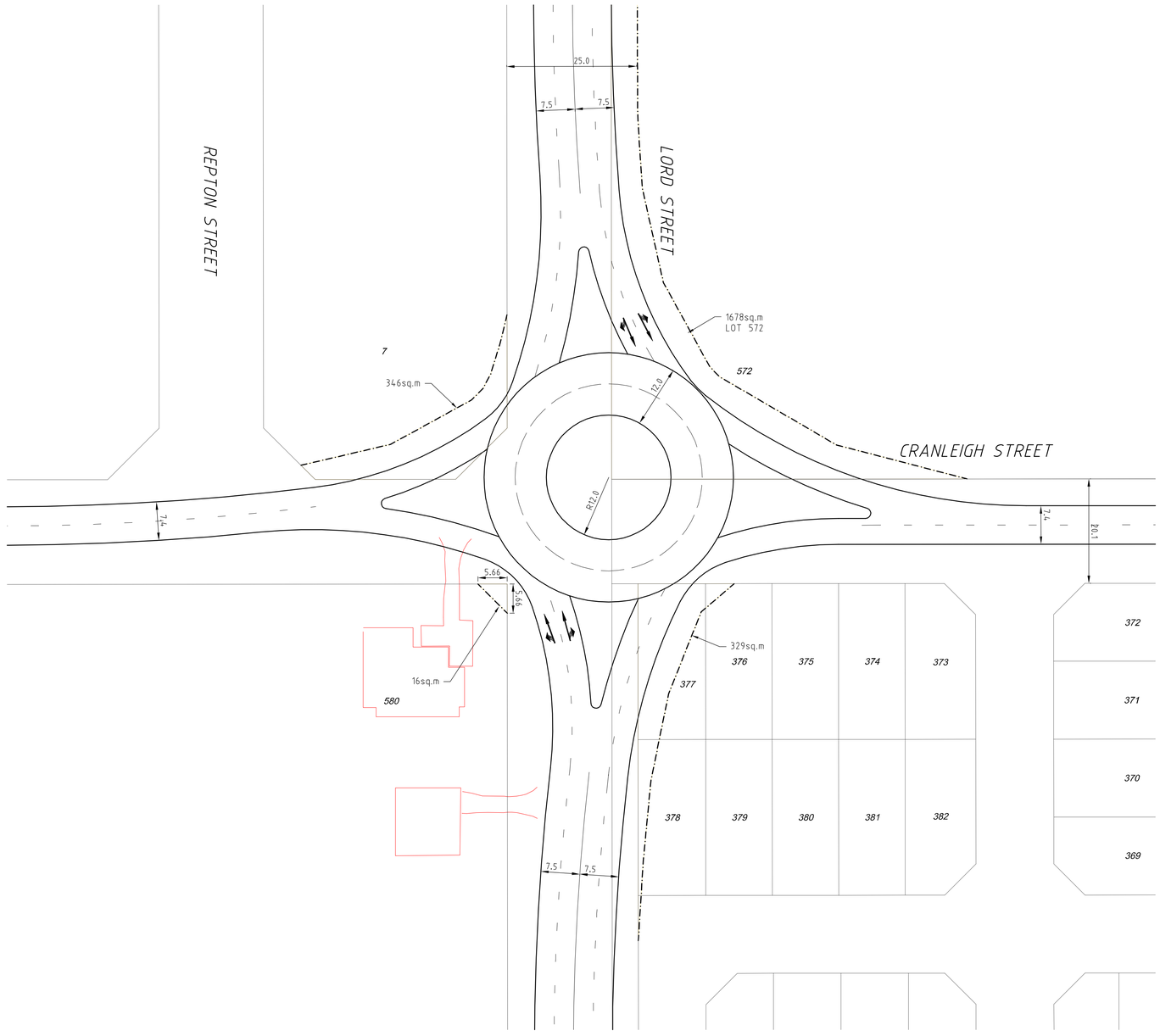
2. LINEMARKING IS SHOWN AS INDICATIVE ONLY & SUBJECT TO FUTURE DETAILED DESIGN.
3. INTERSECTION DIMENSIONS ADOPTED FROM TRAFFIC REPORT.

LORD STREET BETWEEN CRANLEIGH ST AND MARSHALL RD IS PROPOSED AS A 15m WIDE 4-LANE UNDIVIDED CARRIAGEWAY FOR APPROX. 300m TO ALLOW SOUTHBOUND TRAFFIC TO MERGE FROM TWO LANES TO ONE BEFORE REACHING MARSHALL RD.



LORD ST - CRANLEIGH ST INTERSECTION

1:500

Aspen Living
St Leonards - LSP1

Conceptual Intersection Design
Lord Street

DRAWING NUMBER 2223-LSP1-INT-003

ISSUE D

TABEC Civil Engineering Consultants
TABEC Pty Ltd ACN 090 796 204
14 Wickham Street, East Perth WA 6004
Telephone 9225 4100, Fax 9225 4188
Email info@tabec.com.au

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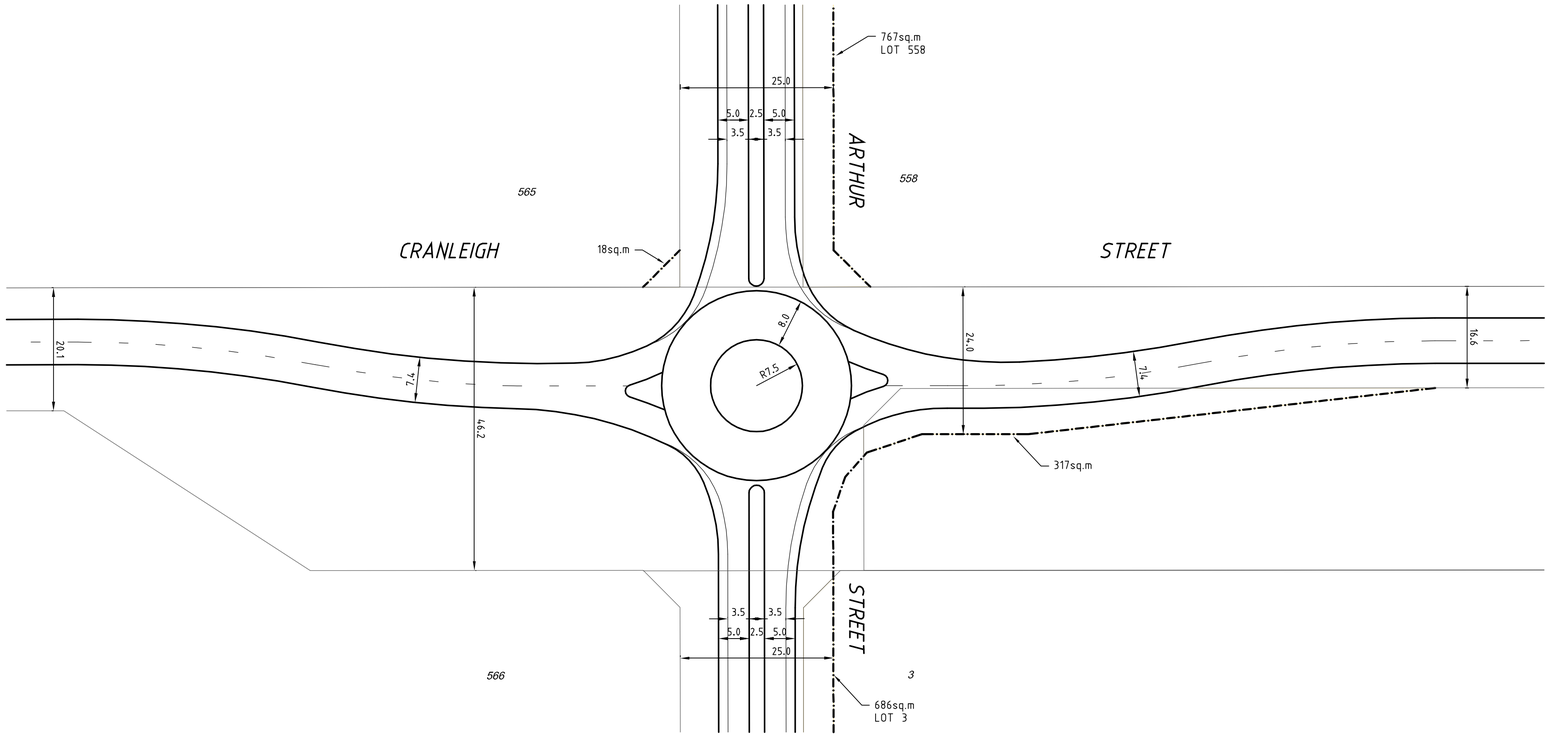

ARTHUR ST - CRANLEIGH ST INTERSECTION

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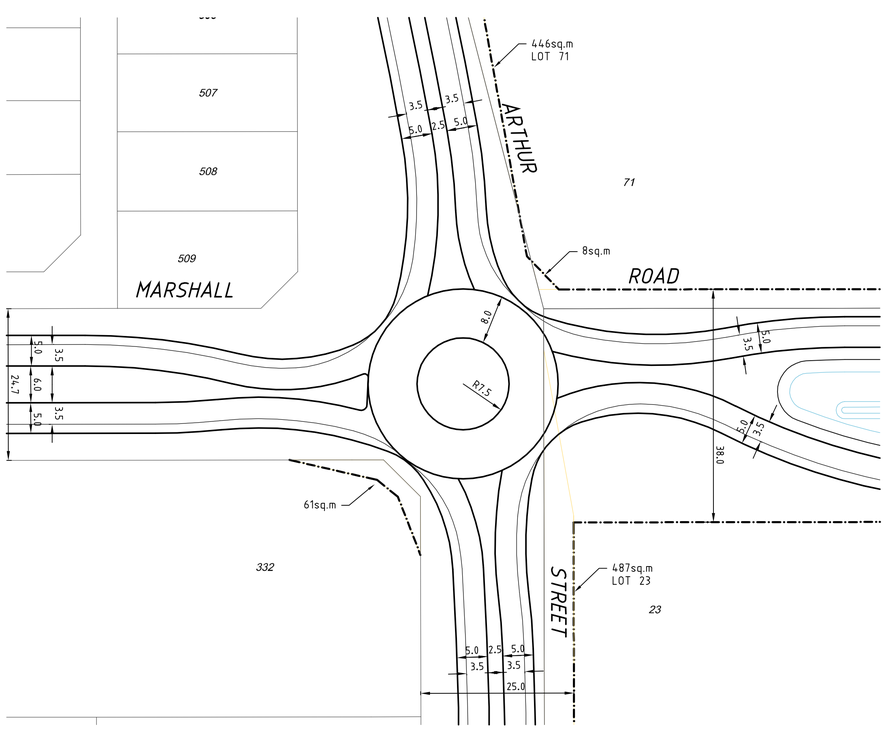

ARTHUR ST - MARSHALL RD INTERSECTION

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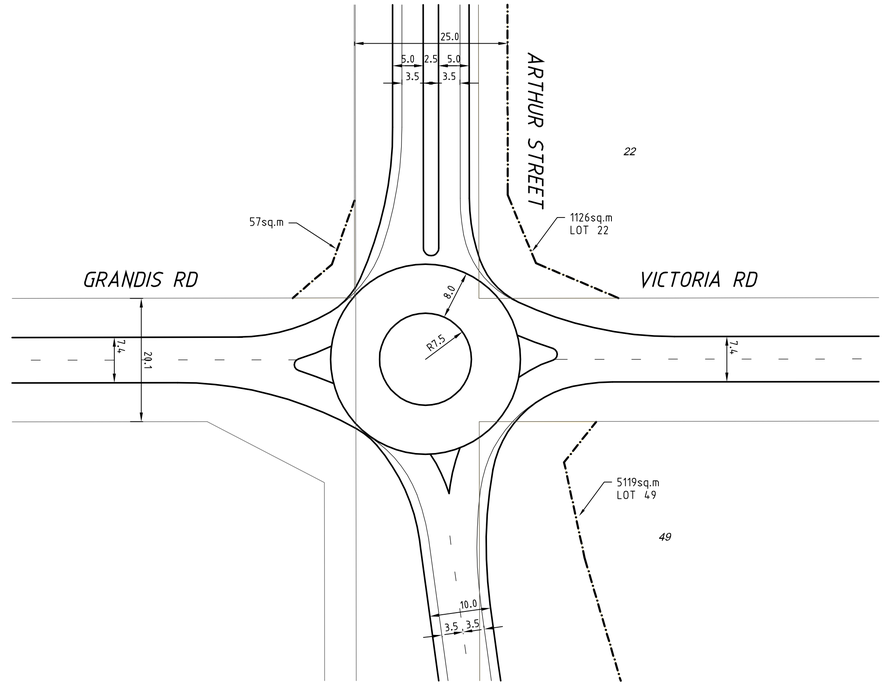

ARTHUR ST - VICTORIA / GRANDIS RD INTERSECTION

1:500

NOTES

1. THIS IS A CONCEPTUAL DESIGN ONLY & SUBJECT TO FUTURE DETAILED DESIGN.
2. LINEMARKING IS SHOWN AS INDICATIVE ONLY & SUBJECT TO FUTURE DETAILED DESIGN.
3. INTERSECTION DIMENSIONS ADOPTED FROM TRAFFIC REPORT.

Aspen Living
St Leonards - LSP1

Conceptual Intersection Design
Arthur Street

TABEC Civil Engineering Consultants
TABEC Pty Ltd ACN 090 796 204
14 Wickham Street, East Perth WA 6004
Telephone 9225 4100, Fax 9225 4188
Email info@tabec.com.au

DRAWING NUMBER 2223-LSP1-INT-001

ISSUE B

SCALE 1:500

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APPENDIX 7

NOISE ASSESSMENT

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Hillarys WA 6923
T: 9401 7770 F:9300 4199
E: terry@lgacoustics.com.au W: www.lgacoustics.com.au

Transportation Noise Assessment

St Leonards Estate Stages O & P

Reference: 14102945-01a.docx

Prepared for:
Progress Developments

Report: 14102945-01a.docx

Lloyd George Acoustics Pty Ltd

ABN: 79 125 812 544

PO Box 717
Hillarys WA 6923

T: 9300 4188 / 9401 7770
F: 9300 4199

Contacts	Daniel Lloyd	Terry George	Mike Cake	Matt Moyle
E:	daniel@lgacoustics.com.au	terry@lgacoustics.com.au	mike@lgacoustics.com.au	matt@lgacoustics.com.au
M:	0439 032 844	0400 414 197	0438 201 071	0412 611 330

Prepared By:	Terry George 
Position:	Project Director
Date:	19 February 2015

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Appendices

1 INTRODUCTION

St Leonards Estate is a proposed residential subdivision north-east of Perth that is being developed by Progress Developments. The entire subdivision, when complete, will be home to almost 10,000 families and will contain parks, playgrounds, primary school, sporting fields, shopping centres and a central plaza – refer *Figure 1-1*. The subject site of this report is Stages O & P, shown in *Figures 1-1 to 1-3*.

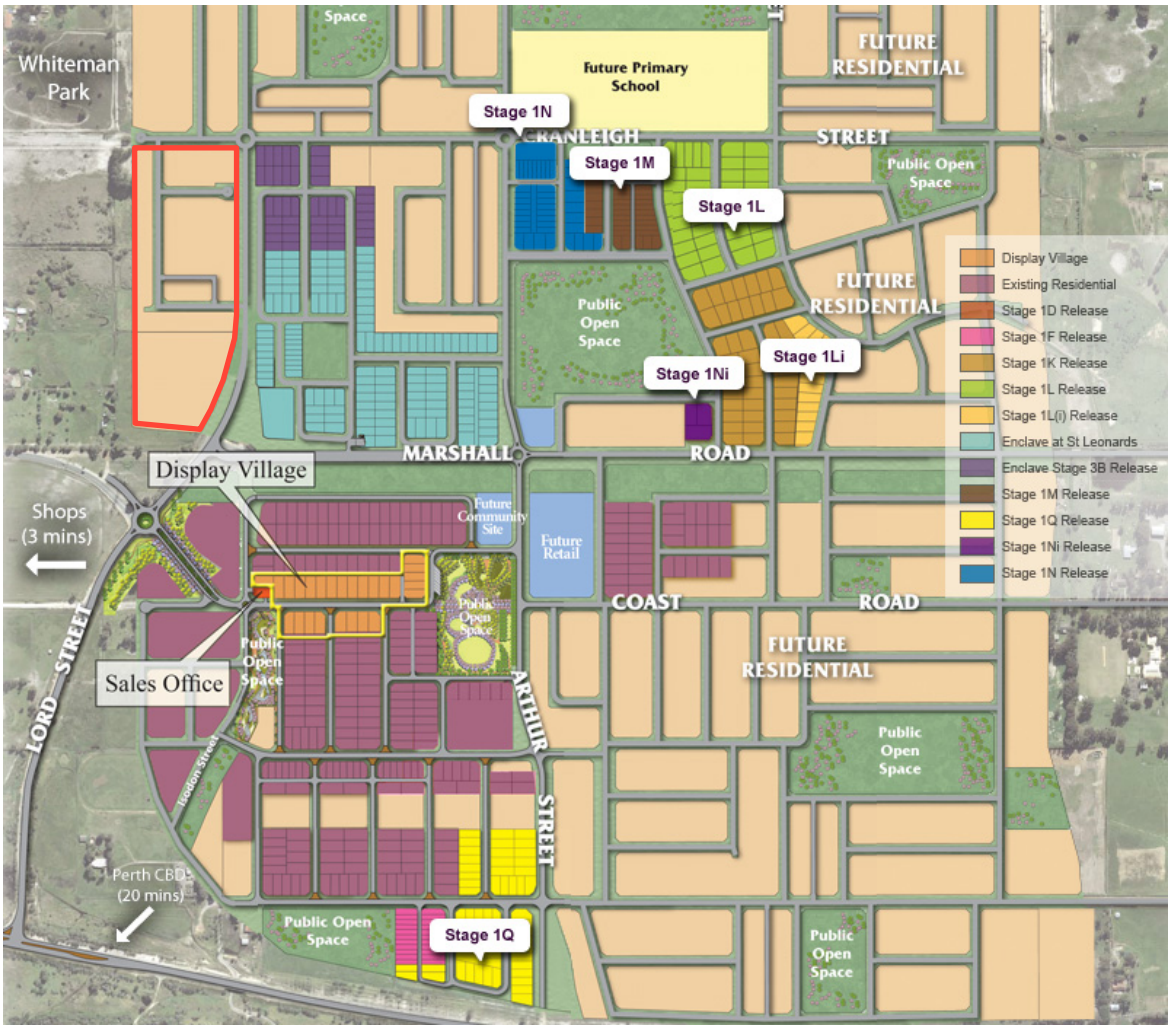


Figure 1-1 Overall Subdivision Layout

Stages O & P are bound by Lord Street to the east, Cranleigh Street to the north and Marshall Road to the south. Previously, the Perth-Darwin National Highway was to be located on the west side of this development, however this road has been relocated some 4.5km further west and is no longer an acoustic consideration. However, Lord Street will now be located on the western side as shown on *Figure 1-3*.

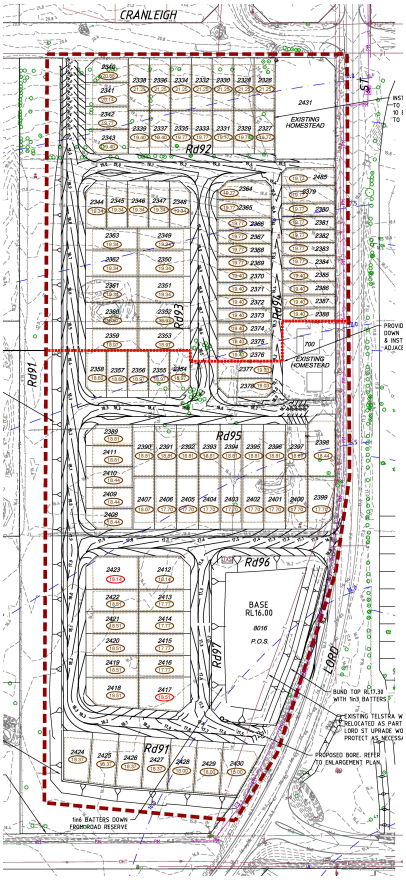


Figure 1-2 Stages O & P Layout

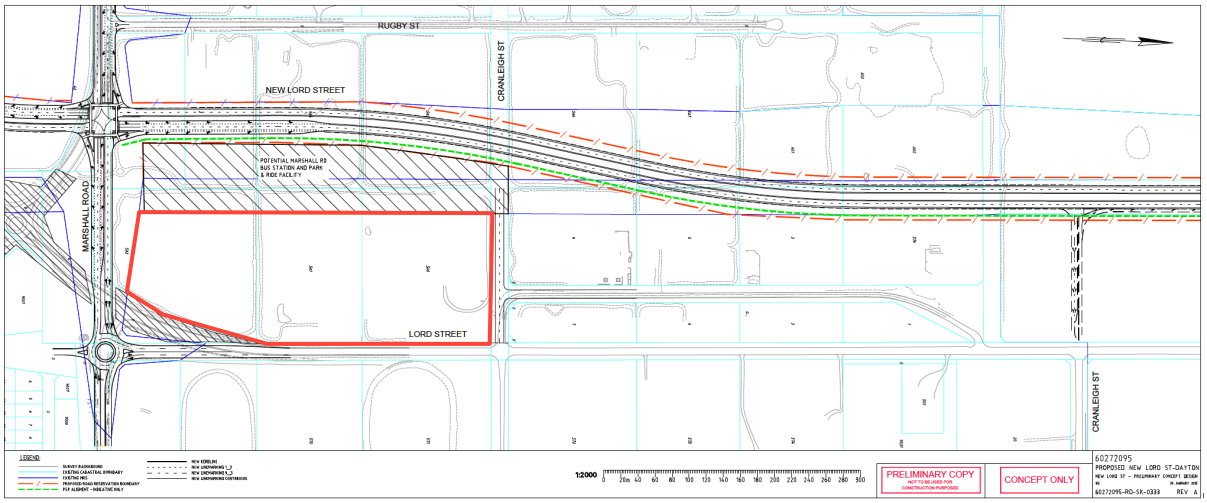


Figure 1-3 Stages O & P Layout

Lord Street is projected as carrying more than 20,000 vehicles per day and therefore the noise impacts are to be assessed in accordance with the Western Australian Planning Commission's (WAPC's) *State Planning Policy 5.4 - Road and Rail Transport Noise and Freight Considerations in Land Use Planning*.

Appendix B contains a description of some of the terminology used throughout this report.

2 CRITERIA

The criteria relevant to this assessment is the *State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning* (hereafter referred to as the Policy) produced by the Western Australian Planning Commission (WAPC). The objectives in the Policy are to:

- Protect people from unreasonable levels of transport noise by establishing a standardised set of criteria to be used in the assessment of proposals;
- Protect major transport corridors and freight operations from incompatible urban encroachment;
- Encourage best practice design and construction standards for new development proposals and new or redevelopment transport infrastructure proposals;
- Facilitate the development and operation of an efficient freight network; and
- Facilitate the strategic co-location of freight handling facilities.

The Policy's outdoor noise criteria are shown below in *Table 2-1*. These criteria applying at any point 1-metre from a habitable façade of a noise sensitive premises and in one outdoor living area.

Table 2-1 Outdoor Noise Criteria

Period	Target	Limit
Day (6am to 10pm)	55 dB $L_{Aeq(Day)}$	60 dB $L_{Aeq(Day)}$
Night (10pm to 6am)	50 dB $L_{Aeq(Night)}$	55 dB $L_{Aeq(Night)}$

Note: The 5 dB difference between the target and limit is referred to as the margin.

In the application of these outdoor noise criteria to new noise sensitive developments, the objectives of this Policy is to achieve -

- acceptable indoor noise levels in noise-sensitive areas (e.g. bedrooms and living rooms of houses); and
- a 'reasonable' degree of acoustic amenity in at least one outdoor living area on each residential lot.

If a noise sensitive development takes place in an area where outdoor noise levels will meet the *target*, no further measures are required under this policy.

In areas where the *target* is exceeded, customised noise mitigation measures should be implemented with a view to achieving the *target* in at least one outdoor living area on each residential lot, or if this is not practicable, within the *margin*. Where indoor spaces are planned to be facing outdoor areas that are above the *target*, mitigation measures should be implemented to achieve acceptable indoor noise levels in those spaces.

For residential buildings, "acceptable indoor noise levels" are taken to be $L_{Aeq\ (Day)}$ 40 dB in living and work areas and $L_{Aeq\ (Night)}$ 35 dB in bedrooms. These levels fall within the range of the Recommended Design Sound Levels for houses and apartments near major roads, as given in Australian Standard AS 2107:2000 *Acoustics – Recommended design sound levels and reverberation times for building interiors*.[1]

3 METHODOLOGY

Noise modelling has been undertaken in accordance with the requirements of the Policy and follows the Implementation Guidelines that accompany the Policy.

Predicted road traffic noise levels were modelled using the computer programme *SoundPLAN 7.3* at a height of 1.4 metres above ground floor level and at 1.0 metre from an assumed building façade (resulting in a + 2.5 dB correction due to reflected noise). The model incorporates the Calculation of Road Traffic Noise (CoRTN) algorithms, which were modified to reflect Australian conditions. The modifications included the following:

- Vehicles were separated into heavy (Austroads Class 3 upwards) and non-heavy (Austroads Classes 1 & 2) vehicle types. With non-heavy vehicles having a source height of 0.5 metres above road level and heavy vehicles having two sources, at heights of 1.5 metres and 3.6 metres above road level, representing the engine and exhaust respectively. Splitting the noise source into three distinct noise sources results in less barrier attenuation for high level sources (i.e. heavy vehicles), which is important when noise barriers are being considered. Note that a correction of –8.0 dB is applied to the exhaust and –0.8 dB to the engine, to provide consistent results with the CoRTN algorithms for the no barrier scenario[2].
- An adjustment of –1.7 dB has been applied to the predicted levels to account for Australian conditions[3].

Various input data are incorporated into the modelling and are discussed in the following sections.

3.1 Ground Topography, Road Design & Cadastral Data

Broad topographical data was already on file from previous projects. Included in the data was the road design for the Perth-Darwin National Highway, previously provided by Emerson Stewart, obtained from Main Roads Western Australia (MRWA). The now proposed Lord Street follows a slightly different alignment, however as design levels were unavailable for this road, it has been assumed Lord Street will be at a similar vertical elevation to the previous Perth-Darwin National Highway design.

Tabec provided the finished lot levels for the St Leonards Stages O & P subdivision.

[1] The "acceptable indoor noise levels" for residential buildings are exactly midway between the "satisfactory" and "maximum" recommended design sound levels for houses and apartments near major roads.

[2] Based on data from Nelson P (1987), *Transportation Noise Reference Book*.

[3] Based on research by Australian Road Research Board (1983), *An Evaluation of the U.K. D.o.E. Traffic Noise Prediction Method*, Research Report No. 122, NAASRA Planning Committee Working Group on Traffic Noise Prediction.

Buildings were incorporated into the model as these can act to screen the rest of the development from the impacts of transport noise. The houses incorporated in the model were all assumed to be single-storey buildings, with a height of 3.5 metres.

3.2 Traffic Data

Traffic data used in the modelling is shown in *Table 3-1*.

Table 3-1 Lord Street Traffic Data Used in the Modelling

Parameter	Northbound	Southbound
Forecast 24-Hour Weekday Traffic Volumes [1]	14,300	14,000
Estimated % of Heavy Vehicles [1]	8	10
% of Vehicles during 18-Hour Time Period [2]	93	93
Future Zoned Speed (km/hr) [1]	70	70
Road Surface[3]	DGA	DGA

Notes to *Table 3.1*:

1. Main Roads provided this information.
2. The 18-hour distribution of vehicles for Lord Street has been estimated.
3. Main Roads indicated the surface finish was yet to be decided. The modelling has assumed dense graded asphalt (DGA) considered typical for roads of such speed in urban areas. Noisier surfaces could be used, however MRWA would then need to incorporate noise walls as part of the road design.

The relationship between different road surface types and traffic noise is shown by *Table 3-2*.

Table 3-2 Noise Relationship Between Different Road Surfaces

Road Surfaces						
Chip Seal			Asphalt			
14mm	10mm	5mm	Dense Graded	Novachip	Stone Mastic	Open Graded
+3.5 dB	+2.5 dB	+1.5 dB	0.0 dB	-0.2 dB	-1.0 dB	-2.5 dB

3.3 Ground Attenuation

Ground attenuation values vary from 0 to 1, with 0 representing hard, reflective surfaces, such as water or bitumen, and 1 representing absorptive surfaces, such as grass. The ground attenuation has been assumed to be 0.2 (20%) for within the Lord Street reservation. A general ground attenuation value of 0.6 (60%) was assumed elsewhere throughout the subdivision, except for designated public open spaces, which were set to 1 (100%).

3.4 Parameter Conversion

The CoRTN algorithms used in the *SoundPlan* modelling package were originally developed to calculate the $L_{A10,18hour}$ noise level. However, the Policy uses the noise parameters $L_{Aeq\ (Day)}$ and $L_{Aeq\ (Night)}$. The relationship between these parameters varies depending on the composition of traffic on the road – the vehicle volumes and the percentage of heavy vehicles during each period.

The following conversion values have been used for this project:

- $L_{A10,\ 18hour}$ to $L_{Aeq\ (Day)}$ = –2.2 dB; and
- $L_{Aeq(Day)}$ to $L_{Aeq\ (Night)}$ = –7.0 dB.

As a result, the day time noise criteria is the limiting criteria for compliance with the Policy and dictates noise mitigation measures for the St Leonards subdivision.

4 RESULTS

The results of the noise modelling are provided in *Table 4-1* and by *Figure 4-1*, which shows the $L_{Aeq(Day)}$ noise level contour plot for future traffic conditions on Lord Street.

From the results it can been seen that, at the most affected residential lots, noise levels are predicted to exceed $L_{Aeq(Day)}$ 55 dB with two residences marginally exceeding 60 dB $L_{Aeq(Day)}$. As such, noise mitigation must be considered, as discussed in *Section 5*.

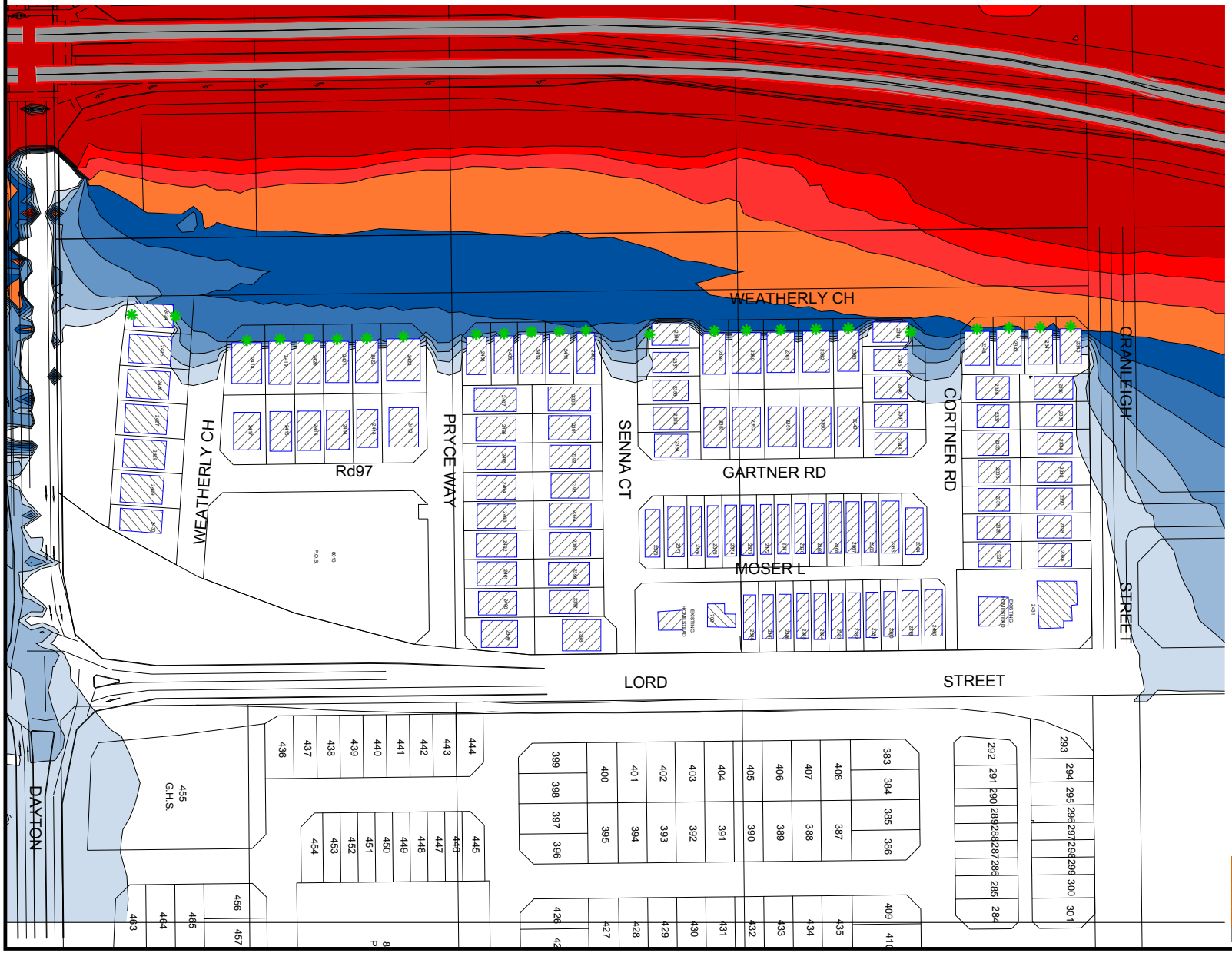
Table 4-1 Noise Modelling Results to Future Dwellings

Lot No.	Forecast 2031 $L_{Aeq(Day)}$, dB	Forecast 2031 $L_{Aeq(Night)}$, dB	Lot No.	Forecast 2031 $L_{Aeq(Day)}$, dB	Forecast 2031 $L_{Aeq(Night)}$, dB
2340	61	54	2408	59	52
2341	61	54	2409	59	52
2342	60	53	2410	59	52
2343	60	53	2411	59	52
2344	58	51	2418	58	51
2358	57	50	2419	59	52
2359	60	53	2420	59	52
2360	60	53	2421	59	52
2361	60	53	2422	59	52
2362	60	53	2423	59	52
2363	60	53	2424	58	51
2389	59	52			

St Leonards Estate - Stages O & P

LAeq(Day) Noise Level Contours - Future 2031 Lord Street

Figure 4-1



Noise levels
LAeq,Day dB

	< 55
55 <=	< 56
56 <=	< 57
57 <=	< 58
58 <=	< 59
59 <=	< 60
60 <=	< 61
61 <=	< 62
62 <=	< 63
63 <=	

Signs and symbols

- Road Surface
- Building
- Receiver

19 February 2015

Length Scale 1:2500

0 12.5 25 50 75 100 m

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5 ASSESSMENT

With no noise mitigation in place, it is predicted that some residential lots in the St Leonards estate will be exposed to traffic noise levels from Lord Street that exceed the noise *target* criteria. As such, noise mitigation measures must be considered.

In this instance, the recommended noise mitigation approach is to upgrade the construction of dwellings. The reason for this is that:

- the modelling is indicative in terms of the actual design of Lord Street; and
- it is proposed to construct a Bus Station and Park & Ride facility between the residences and Lord Street.

Figure 5-1 provides the recommended noise packages (refer *Appendix A*) for each affected dwelling. As the analysis does not incorporate any noise walls, the same package is applicable to upper floors as the ground floor. Alternative constructions would be acceptable if supported by a report undertaken by a suitably qualified acoustical consultant once the lots specific plans are available.

6 CONCLUSION

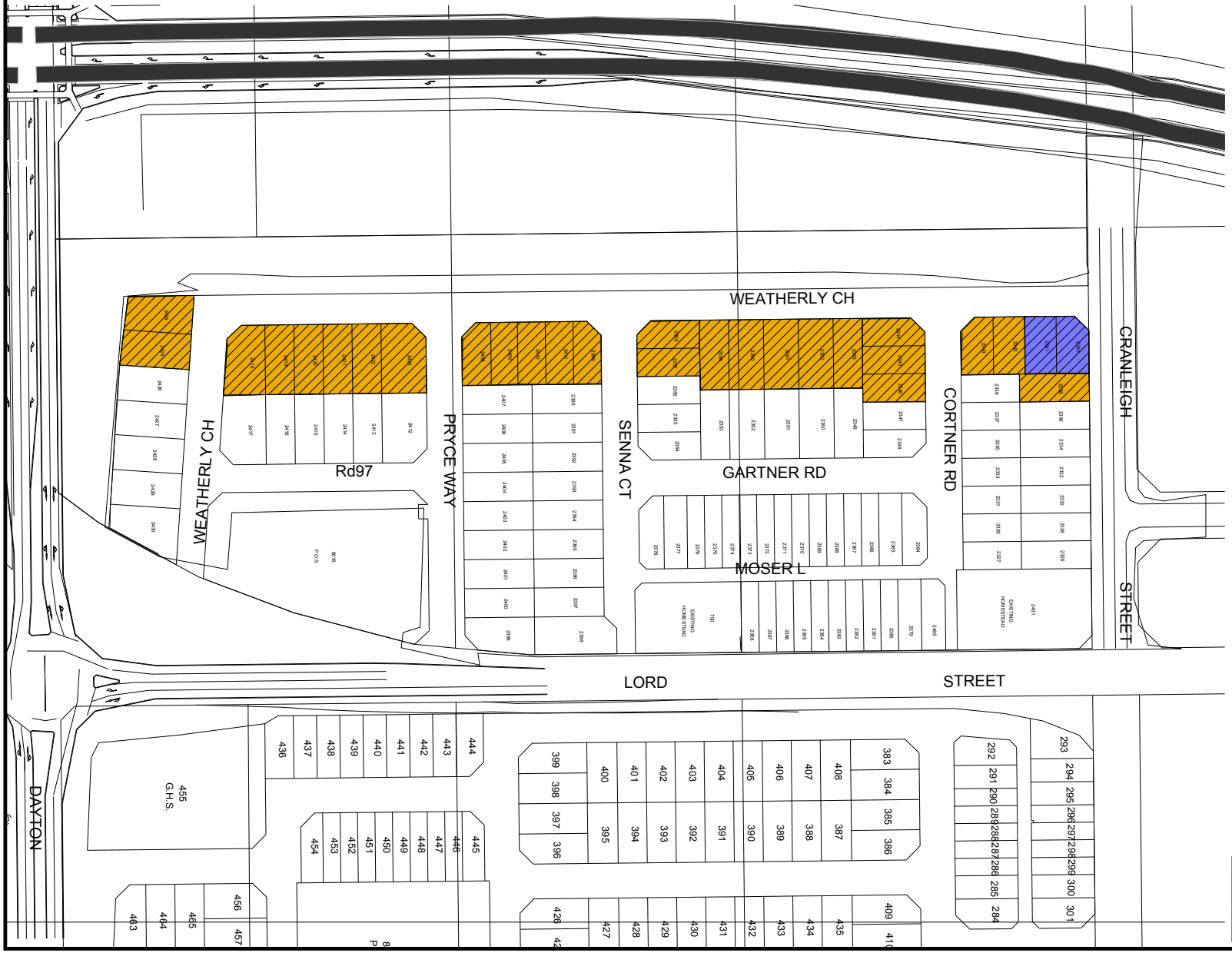
To satisfy the requirements of the *State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning*, the following is required:

- Affected dwellings are to incorporate Packages A or B as shown on *Figure 5-1* and described in *Appendix A*, with alternative treatment accepted if supported by a report by a suitable qualified acoustical engineer (member firm of the Association of Australian Acoustical Consultants).
- All affected lots are to have notifications on lot titles as per the Policy requirements – refer *Appendix A*.

St Leonards Estate - Stages O & P

Noise Mitigation Recommendations

Figure 5-1



Signs and symbols

- Road
- Package A
- Package B

19 February 2015

Length Scale 1:2500

0 12.5 25 50 75 100 m

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Appendix A

ACCEPTABLE TREATMENT PACKAGES

The packages and information provided on the following pages are taken from *Implementation Guidelines for State Planning Policy 5.4 Road and Rail Transport Noise and freight Considerations in Land Use Planning*; December 2014.

Where outdoor noise levels are above the ***target*** level, excluding the effect of any boundary fences, the Guidelines propose acceptable treatment packages that may be implemented without requiring detailed review. The packages are also intended for residential development only. At higher noise levels or for other building usages, specialist acoustic advice will be needed.

The acceptable treatment packages are intended to simplify compliance with the noise criteria, and the relevant package should be required as a condition of development in lieu of a detailed assessment.

Transition between each package should be made on the basis of the highest incident $L_{Aeq(Day)}$ or $L_{Aeq(Night)}$ value to the nearest whole number determined for the building development under assessment.

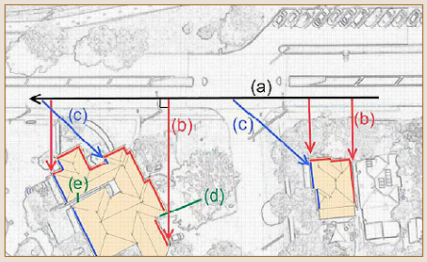
Any departures from the acceptable treatment specifications need to be supported by professional advice from a competent person that the proposal will achieve the requirements of the Policy.

With regards to the packages, the following definitions are provided:

- **Facing** the transport corridor: Any part of a building façade is 'facing' the transport corridor if any straight line drawn perpendicular to its nearest road lane or railway line intersects that part of the façade without obstruction (ignoring any fence).
- **Side-on** to transport corridor: Any part of a building façade that is not 'facing' is 'side-on' to the transport corridor if any straight line can be drawn from it to intersect the nearest road lane or railway line without obstruction (ignoring any fence).
- **Opposite** to transport corridor: Neither 'side on' nor 'facing', as defined above.

Determining building face orientation

The following sketch shows two residences in proximity to a road.



'Facing' façades are identified by drawing straight lines (b) perpendicular (at a 90 degree angle) to the road (a). Where these lines intersect a façade – without obstruction – the façades are shown in red as 'facing' the road.

Façades shown in blue are not 'facing' but have clear lines (c) that intersect the road at any angle, and are therefore classed as 'side on' to the road.

The remaining façades are 'opposite' to the road.

Package A

Area	Orientation to Road or Rail Corridor	Package A (up to 60 dB $L_{Aeq(Day)}$ and 55 dB $L_{Aeq(Night)}$)
Bedrooms	Facing	• Windows systems: Glazing up to 40% of floor area (minimum $R_w + C_{tr}$ 28) – 6mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings.
	Side	• Windows systems: As above.
	Opposite	No requirements
Other Habitable Rooms Including Kitchens	Facing	• Windows and external door systems: Glazing up to 60% of floor area (minimum $R_w + C_{tr}$ 28) – 6mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings. Doors to be either 35mm thick solid timber core door with full perimeter acoustic seals. Glazed inserts to match the above. Sliding glass doors to be same performance including brush seals.
	Side	• Windows and external door systems: As above.
	Opposite	No requirements
General	Any	• Walls (minimum $R_w + C_{tr}$ 45) – Two leaves of 90mm thick brick with minimum 50mm cavity • Roof and ceiling (minimum $R_w + C_{tr}$ 35) – Standard roof construction with 10mm plasterboard ceiling and minimum R2.5 insulation between ceiling joists. • Eaves to be closed using 4mm compressed fibre cement sheet. • Mechanical ventilation – Refer following pages.
Outdoor Living Area		• Locate on the side of the building that is opposite to the corridor; or • Locate within alcove area so that the house shields it from corridor.

Note: Any penetrations in a part of the building envelope must be acoustically treated so as to not downgrade the performance of the building elements affected. Most penetrations in external walls such as pipes, cables or ducts can be sealed through caulking gaps with non-hardening mastic or suitable mortar.

Package B

Area	Orientation to Road or Rail Corridor	Package B (up to 63 dB $L_{Aeq(Day)}$ and 58 dB $L_{Aeq(Night)}$)
Bedrooms	Facing	• Windows systems: Glazing up to 40% of floor area (minimum $R_w + C_{tr}$ 31) – 10mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings.
	Side	• Windows systems: As above.
	Opposite	• Windows systems: Glazing up to 40% of floor area (minimum $R_w + C_{tr}$ 25) – 4mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings. Alternatively, 6mm thick glass (monolithic, toughened or laminated) in sliding frame.
Other Habitable Rooms Including Kitchens	Facing	• Windows and external door systems: Glazing up to 60% of floor area (minimum $R_w + C_{tr}$ 31) – 10mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings. Doors to be either 35mm thick solid timber core door with full perimeter acoustic seals. Glazed inserts to match the above. Sliding glass doors to have laboratory certificate confirming $R_w + C_{tr}$ 31 performance. Alternative, change to hinged door with perimeter acoustic seals and 10mm thick glass.
	Side	• Windows and external door systems: Glazing up to 60% of floor area (minimum $R_w + C_{tr}$ 28) – 6mm thick glass (monolithic, toughened or laminated) in fixed sash, awning or casement opening with seals to openings. Doors to be either 35mm thick solid timber core door with full perimeter acoustic seals. Glazed inserts to match the above. Sliding glass doors to be same performance including brush seals.
	Opposite	No requirements
General	Any	• Walls (minimum $R_w + C_{tr}$ 50) – Two leaves of 90mm thick brick with minimum 50mm cavity. Cavity to include 50mm thick insulation and where wall ties are required, these are to be anti-vibration/resilient type. • Roof and ceiling (minimum $R_w + C_{tr}$ 35) – Standard roof construction with 10mm plasterboard ceiling and minimum R2.5 insulation between ceiling joists. • Eaves to be closed using 4mm thick compressed fibre cement sheet. • Mechanical ventilation – Refer following pages.
Outdoor Living Area		• Locate on the side of the building that is opposite to the corridor; or • Locate within alcove area so that the house shields it from corridor.

Note: Any penetrations in a part of the building envelope must be acoustically treated so as to not downgrade the performance of the building elements affected. Most penetrations in external walls such as pipes, cables or ducts can be sealed through caulking gaps with non-hardening mastic or suitable mortar.

Mechanical Ventilation requirements

It is noted that natural ventilation must be provided in accordance with F4.6 and F4.7 of Volume One and 3.8.5.2 of Volume Two of the National Construction Code. Where the noise *limit* is likely to be exceeded, a mechanical ventilation system is usually required. Mechanical ventilation systems will need to comply with AS 1668.2 – *The use of mechanical ventilation and air-conditioning in buildings*.

In implementing the acceptable treatment packages, the following must be observed:

- Evaporative air conditioning systems will meet the requirements for Packages A and B provided attenuated air vents are provided in the ceiling space and designed so that windows do not need to be opened.
- Refrigerant based air conditioning systems need to be designed to achieve fresh air ventilation requirements.
- External openings (e.g. air inlets, vents) need to be positioned facing away from the transport corridor where practicable.
- Ductwork needs to be provided with adequate silencing to prevent noise intrusion.

Notification

Notifications on certificates of title and advice to prospective purchasers warning of the potential for noise impacts from major transport corridors help with managing expectations.

The area of land for which notification is required should be identified in the noise management plan and contain a description of major noise sources nearby (e.g. 24-hour freight rail).

Notification should be provided to prospective purchasers, and required as a condition of subdivision (including strata subdivision) for the purposes of noise sensitive development or planning approval involving noise sensitive development, where external noise levels are forecast or estimated to exceed the 'target' criteria as defined by the Policy.

In the case of subdivision and development, conditions of approval should include a requirement for registration of a notice on title, which is provided for under Section 165 of the Planning and Development Act 2005 and Section 70A of the Transfer of Land Act 1893. An example of a suitable notice is:

Notice: This lot is situated in the vicinity of a transport corridor and is currently affected, or may in the future be affected, by transport noise. Transportation noise controls and Quiet House design strategies at potential cost to the owner may be required to achieve an acceptable level of noise reduction. Further information is available on request from the relevant local government offices.

Appendix B

Terminology

The following is an explanation of the terminology used throughout this report.

Decibel (dB)
The decibel is the unit that describes the sound pressure and sound power levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

A-Weighting
An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as L_A dB.

L_1
An L_1 level is the noise level which is exceeded for 1 per cent of the measurement period and is considered to represent the average of the maximum noise levels measured.

L_{10}
An L_{10} level is the noise level which is exceeded for 10 per cent of the measurement period and is considered to represent the "*intrusive*" noise level.

L_{90}
An L_{90} level is the noise level which is exceeded for 90 per cent of the measurement period and is considered to represent the "*background*" noise level.

L_{eq}
The L_{eq} level represents the average noise energy during a measurement period.

$L_{A10,18hour}$
The $L_{A10,18\ hour}$ level is the arithmetic average of the hourly L_{A10} levels between 6.00 am and midnight. The *CoRTN* algorithms were developed to calculate this parameter.

$L_{Aeq,24hour}$
The $L_{Aeq,24\ hour}$ level is the logarithmic average of the hourly L_{Aeq} levels for a full day (from midnight to midnight).

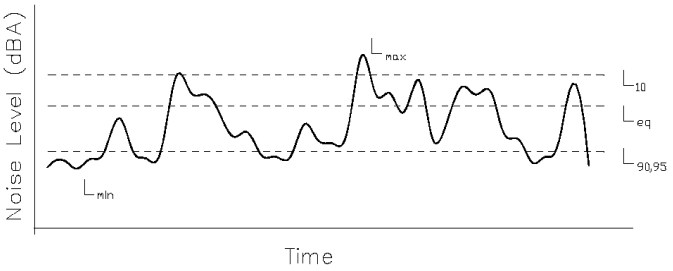
$L_{Aeq,8hour}$ / $L_{Aeq\ (Night)}$
The $L_{Aeq\ (Night)}$ level is the logarithmic average of the hourly L_{Aeq} levels from 10.00 pm to 6.00 am on the same day.

$L_{Aeq,16hour}$ / $L_{Aeq\ (Day)}$
The $L_{Aeq\ (Day)}$ level is the logarithmic average of the hourly L_{Aeq} levels from 6.00 am to 10.00 pm on the same day. This value is typically 1-3 dB less than the $L_{A10,18hour}$.

Satisfactory Design Sound Level
The level of noise that has been found to be acceptable by most people for the environment in question and also to be not intrusive.

Maximum Design Sound Level
The level of noise above which most people occupying the space start to become dissatisfied with the level of noise.

Chart of Noise Level Descriptors



Austroads Vehicle Class

AUSTROADS Vehicle Classification System

Level 1 Length (indicative) Type	Level 2 Axles and Axle Groups Axles	Groups	Level 3 Vehicle Type Typical Description	AUSTROADS Classification Class	Parameters	Typical Configuration
			LIGHT VEHICLES			
Short up to 5.5m		1 or 2	**Short** Sedan, Wagon, 4WD, Utility, Light Van, Bicycle, Motorcycle, etc	1	d(1) ≤ 3.2m and axles = 2	
	3, 4 or 5	3	**Short - Towing** Trailer, Caravan, Boat, etc	2	groups = 3 d(1) > 2.1m, d(1) ≤ 3.2m, d(2) ≥ 2.1m and axles = 3, 4 or 5	
			HEAVY VEHICLES			
Medium 5.5m to 14.5m	2	2	**Two Axle Truck or Bus**	3	d(1) > 3.2m and axles = 2	
	3	2	**Three Axle Truck or Bus**	4	axles = 3 and groups = 2	
	> 3	2	**Four Axle Truck**	5	axles > 3 and groups = 2	
Long 11.5m to 19.0m	3	3	**Three Axle Articulated** Three axle articulated vehicle, or Rigid vehicle and trailer	6	d(1) > 3.2m, axles = 3 and groups = 3	
	4	> 2	**Four Axle Articulated** Four axle articulated vehicle, or Rigid vehicle and trailer	7	d(2) < 2.1m or d(1) < 2.1m or d(1) > 3.2m axles = 4 and groups > 2	
	5	> 2	**Five Axle Articulated** Five axle articulated vehicle, or Rigid vehicle and trailer	8	d(2) < 2.1m or d(1) < 2.1m or d(1) > 3.2m axles = 5 and groups > 2	
	≥ 6	> 2	**Six Axle Articulated** Six axle articulated vehicle, or Rigid vehicle and trailer	9	axles = 6 and groups > 2 or axles = 6 and groups = 3	
Medium Combination 17.5m to 36.5m	> 6	4	**B Double** B Double, or Heavy truck and trailer	10	groups = 4 and axles > 6	
	> 6	5 or 6	**Double Road Train** Double road train, or Medium articulated vehicle and one dog trailer (M.A.D.)	11	groups = 5 or 6 and axles > 6	
Large Combination Over 33.5m	> 6	> 6	**Triple Road Train** Triple road train, or Heavy truck and three trailers	12	groups > 6 and axles > 6	

Definitions: Group: Axle group, where adjacent axles are less than 2.1m apart; Groups: Number of axle groups; Axles: Number of axles (maximum axle spacing of 10.0m); d(1): Distance between first and second axle; d(2): Distance between second and third axle

Typical Noise Levels