Road Planning Study Report

East Wanneroo District Structure Plan
Road Planning Study

CW1016300

Prepared for

Department of Planning, Lands and Heritage

11 September 2019

Cardno®

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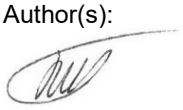

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Executive Summary

The Department of Planning, Lands and Heritage have engaged Cardno to undertake a collaborative multi-disciplinary planning study to review and provide updated road concept plans for the network in East Wanneroo, in support of the proposed East Wanneroo District Structure Plan. The outputs from this study comprise the design information required to commence land protection of the Other Regional Road reserves in the Metropolitan Regional Scheme (MRS) to support planning within the study area and the basis upon which to commence future design development of the road network concept.

The concept design has been developed through consideration of known and investigated constraints (refer **Section 3**), proposed land uses, future public transport and servicing planning and forecast traffic volumes at 2051. Planning design and typical cross-sections are presented for the proposed Other Regional Road network within the East Wanneroo District Structure Plan Area in **Appendix B**. This work is the basis upon which the MRS land protection plans will be developed.

Recommended actions to progress the development of the road network concept include:

- Public Comprehensive Community Consultation on supporting land development, amenity, environmental and heritage considerations;
- Progression of engineering design development with detailed base data;
  - Detailed site survey (including topography, rail corridor & engineering service locations); and
  - Groundwater monitoring.
- Development of a District Water Management Strategy and Local Water Management Strategies to determine stormwater drainage whilst protecting natural watercourses within, and adjacent to, the study area;
- Commissioning of additional site-specific environmental assessments, mapping and reporting to confirm the values of priority areas identified in the Environmental Assessment Study;
- Confirmation of PTA rapid transit routes for buses;
- Confirmation of the proposed transit line alignment and stations, including development timing and coordination with the proposed road network;
- Key intersection preliminary design development and associated comprehensive traffic modelling;
- Confirmation of existing and future service planning requirements;
  - Site-specific protection requirements for existing water, gas, communications and power infrastructure;
  - Coordination of utilities network expansion (water, sewer, gas, communications and power) with project execution timing; and
  - Coordination and staging of service relocations, as required.
- Coordination of road upgrade timing with adjacent land use developments for optimisation of access and earthworks across the study area.

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Abbreviations

CW	Cossil & Webley
DBCA	Department of Biodiversity, Conservation and Attractions
DoT	Department of Transport
DPLH	Department of Planning, Lands and Heritage
DWER	Department of Water and Environmental Regulation
EAS	Environmental Assessment Study
Emerge	Emerge Landscape Associates
EWDSP	East Wanneroo District Structure Plan
GIS	Geographic Information System
IWMF	Integrated Water Management Framework
MRS	Metropolitan Region Scheme
MRWA	Main Roads Western Australia
ORR	Other Regional Road
PRAMS	Perth Regional Aquifer Modelling Systems
PRR	Primary Regional Road
PSG	Project Steering Group
PTA	Public Transport Authority
RAV	Restricted Access Vehicle
RPS	RPS Group
STEM	Strategic Transport Evaluation Model
TEC	Threatened Ecological Communities
the City	City of Wanneroo
WAPC	Western Australian Planning Commission
WC	Water Corporation
WP	Western Power
WYH	Whiteman Yanchep Highway

1 Introduction and Background

1.1 Introduction

Cardno have been engaged by the Department of Planning, Lands and Heritage (DPLH) to deliver this road planning study report, which reviews the existing *Planning Study for Primary Roads in East Wanneroo* report prepared by AECOM in 2010 and provides updated road concept plans for the regional movement network in East Wanneroo in coordination with the proposed East Wanneroo District Structure Plan (EWDSP).

1.2 Background and Scope

In January 2011, the Western Australian Planning Commission (WAPC) published the draft East Wanneroo Structure Plan (EWSP); a sub-regional level plan that provided a framework for the preparation of more detailed structure plans for the locality. This is to form the basis for future Metropolitan Region Scheme (MRS) amendments in the area.

The purpose of the EWSP was to ensure that the planning for the physical and community infrastructure of the area is coordinated at a district level and that infrastructure and servicing are provided in an efficient, equitable, accessible and timely manner to the future East Wanneroo community.

In addition to a regional movement network for the area, servicing infrastructure (including water, drainage, sewerage, electricity, gas, and telecommunications) will be required as part of the development of the East Wanneroo area. The capacity of the infrastructure will need to cater for the future population of the area and support local industry, businesses and activity centres; be flexible in order to accommodate future changes, and be staged in order to respond to budget constraints.

DPLH is currently reviewing the EWDSP which will provide guidance to the future land-use intensification, employment and density targets, protection of environmental assets, coordination and provision of major infrastructure based on Transport @3.5 Million and WAPC's draft Perth and Peel @ 3.5 Million 2051) planning frameworks. A draft of the EWDSP is provided in **Appendix A**.

This study report considers known and investigated constraints, proposed land uses, future public transport plans and forecast traffic volumes to produce concept design drawings and indicative land protection plans for the proposed Other Regional Roads (ORR) within the study area.

1.3 Methodology

This study aims to inform the EWDSP such that the ORR reserves are protected in the MRS to guide future planning within the study area. To this end, the ORR network concept design has been developed in consideration of the following activities:

- Identification, review and collation of relevant existing information and literature for the study area (refer **Section 2**);
- Key stakeholder liaison via DPLH;
- Coordination with DPLH for land use and road network integration during the evolution of the EWDSP concept;
- Analysis and interpretation of the Strategic Transport Evaluation Model (STEM) for a Perth population of 3.5 Million in 2050 for transport scenarios (refer **Section 4**);
- ORR concept design including plan, profile, typical mid-block cross sections and key intersections (refer **Section 6**); and
- Identification of risks, constraints and considerations for future design development of the regional road network within the study area (refer **Section 7**).

1.4 Current and Proposed Other Regional Roads

The following roads within the EWDSP have been identified as having existing or future ORR status and are considered in the development of the planning concept design (**Appendix A)**:

- Lenore Road – From Ocean Reef Road to Franklin Road (approx. 500m north of Elliot Road);
- Franklin Road – From Lenore Road the Flynn Drive extension;

- Elliot Road – From Lenore Road extending eastwards to the proposed Whiteman Yanchep Highway (WYH);
- Badgerup Road – From Ocean Reef Road to Hawkins Road;
- Sydney Road – From Ocean Reef Road extending northwards to Hawkins Road (ORR status ends north of Ross St, reverting to neighbourhood connector);
- Hawkins Road – From Badgerup Road to the Lakeview Road extension; and
- Lakeview Road – From Franklin Road to the proposed WYH.

The existing layout of the transport network will require that the following roads be extended to form the EWDSP, enabling the required connectivity identified in planning frameworks:

- Franklin Road – Extended to replace Rousset Road and provide connectivity to the Flynn Drive extension;
- Elliot Road – Extended to replace Jambanis Road and Joyce Road and provide connectivity to the WYH;
- Sydney Road – Extending to provide connectivity to Hawkins Road; and
- Lakeview Road – Replacing Townsend Road and Amarante Road and providing connectivity to WYH.

Existing posted speeds within the study area for the above roads vary between 60 to 80km/h. Where the existing roads revert to local access streets, the posted speeds drop to below 60km/h.

Each of the above roads have been designed to a concept level with consideration to horizontal and vertical alignments.

1.5 Other Considered Roads

Although not identified as having a future ORR status, the following roads are deemed essential in the wider connectivity of the proposed EWDSP road network and have also been considered in the planning design:

- Stoney Road – From Badgerup Road to Sydney Road; and
- Sydney Road Extension – From the Elliot Road extension to Hawkins Road (the existing layout of the transport network will require that Sydney Road be extended northwards to provide connectivity with Hawkins Road).

Each road has been designed to a concept level with consideration to horizontal alignments. Sydney Road extension has also been designed to consider a concept vertical alignment.

Neighbourhood distributor roads (refer **Appendix A**) that require connection into the proposed ORR network have been considered insofar that appropriate left-in, left-out turning pockets and median breaks for right-turn access are accommodated within the intersecting ORR concept design.

The proposed Whiteman Yanchep Highway (WYH), concept design by Main Roads Western Australia (MRWA), provides key tie-ins for east-west accessibility through the study area for the Flynn Drive extension (concept design by others), and the Lakeview Road and Elliot Road extensions.

1.6 Scope Exclusions & Tie-ins

Although identified as ORRs within the EWDSP area, designs for Neaves Road and Flynn Drive have been undertaken by others. The concept design is such that it ties in with these ORRs in horizontal and vertical alignments for the purposes of intersection design, as far as practicable.

Intersection design to the Primary Regional Roads (PRR) bordering the study area have been excluded from the scope. The planning concept design ties-in to the PRRs with the assumption that vertical and horizontal alignments are fixed at these intersections. Allowance has been made for ensuring upstream road cross-sections are accommodated and sufficient land is identified for upgrades to these intersections, as required, in the future:

- Lenore Road and Ocean Reef Road;
- Badgerup Road and Ocean Reef Road; and
- Sydney Road and Ocean Reef Road.

2 Literature Review

Cardno have conducted a review of the existing environmental, planning and engineering documents as part of the literature review for the EWDSP, as detailed below.

2.1 Sub-regional Planning Frameworks

The Perth and Peel @ 3.5 Million Sub-regional Planning Frameworks for the North-West Sub-region identifies roads within the study area proposed to become Integrator Arterial standard roads.

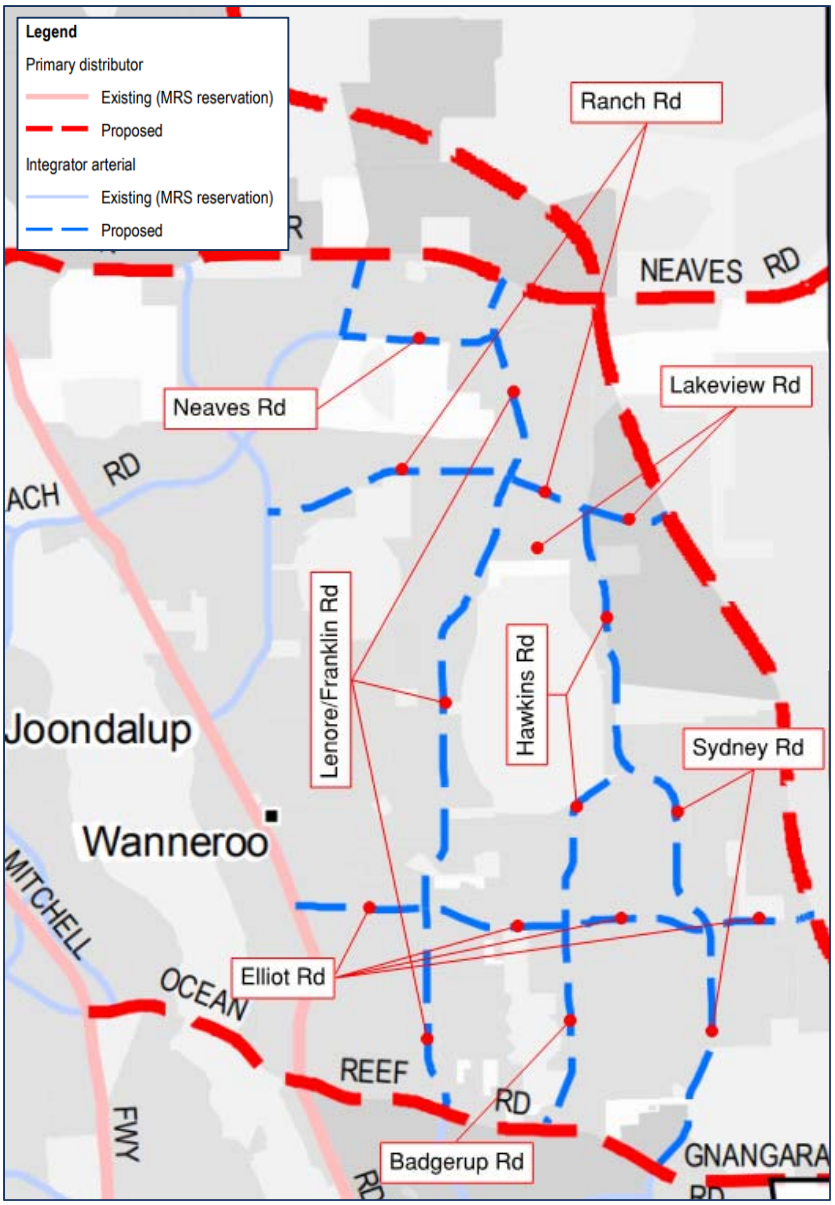


Figure 2-1 North-west Sub-regional Planning Frameworks – Regional Roads (DPLH, 2018)

The proposed alignments of the regional roads align with those previously identified in AECOM's *Planning Study for Primary Roads in East Wanneroo* (AECOM 2010), with changes to reflect MRWA's WYH design.

The overall layout and specific locations and/or alignments of the regional roads identified in the sub-regional planning frameworks differ slightly from those identified for consideration in this road planning study. The following changes to the proposed network are noted:

> The Ranch Road Extension from Pinjar Road to WYH has been replaced with Lakeview Road from the Franklin Road Extension to WYH with no ORR status connectivity through to Pinjar Road;

- Sydney Road between the proposed Stoney Road and Sydney-Hawkins Road intersection is not to receive ORR status; and
- Adjustments to road and intersection alignments throughout the study area to comply with road design standards.

2.2 Planning Studies and Schemes

2.2.1 Metropolitan Region Scheme

The Metropolitan Region Scheme (MRS) provides a legal basis for planning within the Perth metropolitan region by dividing it into zones and reservations used to define future land uses.

In accordance with the MRS, the EWDSP area is spread across multiple map sheets:

- Map Sheet 7 – Neerabup;
- Map Sheet 8 – Ellenbrook Townsite;
- Map Sheet 11 – Kingsley; and
- Map Sheet 12 – Whiteman Park.

Within the MRS, the only roads with existing ORR status within or near the EWDSP area are Pinjar Road, Joondalup Drive and Ocean Reef Road. Wanneroo Road to the west is an existing PRR. The subregional frameworks identify that Ocean Reef Road is to be upgraded to PRR status.

The MRS mapping indicates that the majority of the EWDSP area is zoned Urban Deferred, Parks and Recreation and Rural. A number of Bush Forever Sites have also been identified within the MRS.

2.2.2 East Wanneroo District Structure Plan

The East Wanneroo District Structure Plan is being prepared in parallel with this study to reflect the land use intensification expectations outlined in the *Perth and Peel@3.5million* (DPLH 2018) and *North-West Sub-regional Planning Framework* (DPLH 2018) reports. Cardno have worked closely with DPLH to ensure the ORR road concept supports the proposed EWDSP and associated land use changes being considered to year 2050.

2.2.3 East Wanneroo District Structure Plan Engineering Servicing Report

Cossil & Webley (CW) were engaged by DPLH to prepare an Engineering Service Report for the East Wanneroo District Structure Plan Area, producing their *East Wanneroo District Structure Plan Engineering Servicing Report* (Cossil & Webley 2019). The purpose of this report was to summarise the results of an engineering assessment of servicing strategies and constraints in the EWDSP area. The preparation of the report is based on preliminary advice received from various service authorities, the findings of which are discussed further in **Section 3.2**

2.2.4 Environmental Assessment Study

Emerge Associates (Emerge) were engaged by DPLH to prepare an Environmental Assessment Study (EAS), producing their *Environmental Assessment Study – East Wanneroo District Structure Plan* report (Emerge Associates 2018). The aim of the EAS was to investigate, at a district level, the areas of environmental significance that should be protected.

Key findings of the EAS identified known occurrences of Threatened Ecological Communities (TEC), threatened and priority flora and fauna habitat, groundwater dependent ecosystems and conservation category wetlands.

Data compiled by Emerge has been reviewed and used to inform the alignments of the concept design. Where practicable, effort has been made to ensure the concept road design does not impact upon identified conservation areas whilst maintaining minimum road design requirements for safety. Refer **Section 3.3** for discussion of the key environmental constraints identified by Emerge and the corresponding impact on the proposed alignment of the ORRs.

2.2.5 Integrated Water Management Framework

RPS Group (RPS) were engaged by DPLH to inform water management and design objectives and guide future preparation and finalisation of future documents for the EWDSP area, producing their *Integrated Water Management Framework – East Wanneroo District Structure Plan* report (RPS Group 2019).

The key finding relating to the proposed ORR alignments identified in the Integrated Water Management Framework (IWMF) states that modelling recently undertaken by DWER to estimate future groundwater levels suggest several areas of the EWDSP will be inundated with water by 2030. This is expected as a function of increased recharge and lower evapotranspiration in the EWDSP area, due to removal of the pines and extensive urbanisation, resulting in the Superficial aquifer groundwater levels increasing 3-4m.

In order to reduce development costs and unnecessary use of raw materials, critical design criteria will need to be determined in a future District Water Management Strategy, to set a controlled groundwater level across the EWDSP area. More detailed and targeted modelling is recommended to inform this, with the model intended to better inform changes in water balance as a result of changing land uses and assess options to control groundwater.

Drainage is suggested to be managed at-source as much as practical, with any remaining run-off that cannot be managed at-source conveyed to treatment systems such as bioretention basins or equivalent.

2.3 Concept Designs by Others

To inform the broad alignments of the proposed ORRs and their interfacing to future roads and other modes of transport within the EWDSP area, relevant planning studies and designs prepared previously were reviewed. The following sections address the relevant studies and designs prepared within the study area, and the anticipated role these play in the roads planning concept design. Consideration will be required for the coordination and interfacing of earthworks between the concept ORR and future adjacent land development.

2.3.1 AECOM's Planning Study for Primary Roads in East Wanneroo

AECOM were engaged by DPLH to undertake a planning study for the primary regional roads in East Wanneroo in 2010, producing their *Planning Study for Primary Roads in East Wanneroo* report (AECOM 2010). The aim of this study was to prepare initial planning concepts for the roads identified in the regional road network, accommodating the movement requirements of the network while minimising impacts on environmentally sensitive areas, properties, and existing and planned major services that would control the road alignment and reservation requirements.

The proposed alignments were reviewed by Cardno against updated constraints and study inputs, to identify areas of concern and allow for refinements to the previous alignments.

2.3.2 MRWA's Whiteman Yanchep Highway

MRWA's Whiteman Yanchep Highway (WYH) is a proposed north-south route in the north-west corridor of Perth, intended to ease traffic on Wanneroo Road and the Mitchell Freeway as a function of forecast population growth.

WYH is identified in the sub-regional planning frameworks as a PRR. The proposed WYH alignment and interchange locations supersede some of the network movements assumed in AECOM's Planning Study, particularly with the interfacing of WYH with Neaves Road.

The latest design for WYH (dated October 2017) was obtained from MRWA to overlay with Cardno's planning concept design to allow for coordination of horizontal and vertical alignments to the proposed interchanges. Minor amendments will be required to MRWA design to accommodate the adjusted approach alignment at Lakeview Road. Elliot Road concept design ties in with MRWA ramp approach alignment.

2.3.3 Arup Rail Alignment

Arup were engaged by METRONET to undertake a design concept for a passenger rail alignment through the EWDSP area, producing their *East Wanneroo District Rail Alignment – Land Reservation Study* (Arup 2018). The preparation of the rail alignment design aims to assist in identifying future transit corridors to maximise land use benefits.

Cardno's design concept for other regional roads within the study area assumes road over rail grade separations at conflict points, noting DPLH's preference to provide underground transit stations at neighbourhood and town centres.

Given the changes to the EWDSP and ORR designation since the completion of the rail study – in particular the shift of the road alignment to the western side of the rail alignment - and the further identification of environmental conservation areas, the horizontal alignment of the transit corridor has been adjusted to accommodate and be directly adjacent to the concept ORR design, as appropriate. Vertical coordination between adjacent road and rail infrastructure (particularly along Elliot Road and Franklin Road) will need particular attention in future design development.

2.4 Constraint Mapping

Constraint mapping was conducted to determine the critical project constraints likely to affect or dictate the concept design. Social and environmental constraints were informed from GIS data obtained from the City of Wanneroo, as well as from publicly available datasets.

Environmental constraint mapping was produced from the data provided by Emerge, in line with their EAS, with the objective to identify and avoid areas of environmental significance in setting the alignments of the ORRs.

Information and data relating to engineering constraints was obtained through Dial Before You Dig enquiries for existing services, review of available literature and planning investigations, and through direct liaison with relevant service providers and stakeholders.

Refer **Section 3** for constraint mapping.

2.5 Various Guidelines for Road Design

The most recent Austroads publications, with relevant MRWA supplements, have been reviewed to determine the design requirements for the EWDSP concept road design. These include:

- Austroads Guide to Road Design Part 3 – Geometric Design (2017);
- MRWA Supplement to Austroads Guide to Road Design – Part 3 (2019);
- Austroads Guide to Road Design Part 6 – Roadside Design Safety and Barriers (2018);
- MRWA Supplement to Austroads Guide to Road Design – Part 6 (2019);
- Austroads Guide to Road Design Part 6A: Paths for Walking and Cycling (2017);
- MRWA Supplement to Austroads Guide to Road Design – Part 6A (2019); and
- Standard Restricted Access Vehicle (RAV) Route Assessment Guidelines (2018).

3 Constraints Assessment

A desktop constraint mapping exercise was undertaken to identify the social, environmental and engineering constraints within the study area, to determine critical constraints that would dictate the alignment of the concept design. Identified constraints are outlined and discussed in the following sections.

3.1 Social Constraints

Social constraints were identified through liaison with the City of Wanneroo and the use of their online Intramaps, as well as from geographic information system (GIS) data obtained from DPLH.

3.1.1 Land Zoning

Within the MRS, the study area contains the following land zonings:

- Parks and Recreation;
- State Forests;
- Water catchments;
- Primary regional roads;
- Other regional roads;
- Public purposes;
- Rural;
- Rural – water protection;
- Urban; and
- Urban Deferred.

The EWDSP aims to provide a further framework for the planning, assessment, coordination and implementation of major development initiatives within the study area, further building upon the MRS.

In comparison to the MRS, the EWDSP proposes to reduce the amount of rural zoned land and increase the amount of urban land, proposing suburban and urban neighbourhoods, with special residential and character areas adjacent to district centres and parklands. Furthermore, additional industrial areas not identified in the MRS are proposed to the east and north boundaries of the EWDSP area abutting the Whiteman Yanchep Highway.

The EWDSP also identifies the proposed ORR alignments and wider transport network, including neighbourhood connector roads and rail corridor.

3.1.2 Existing Land Use

Much of the existing study area identified for urbanisation consists of rural and residential land uses.

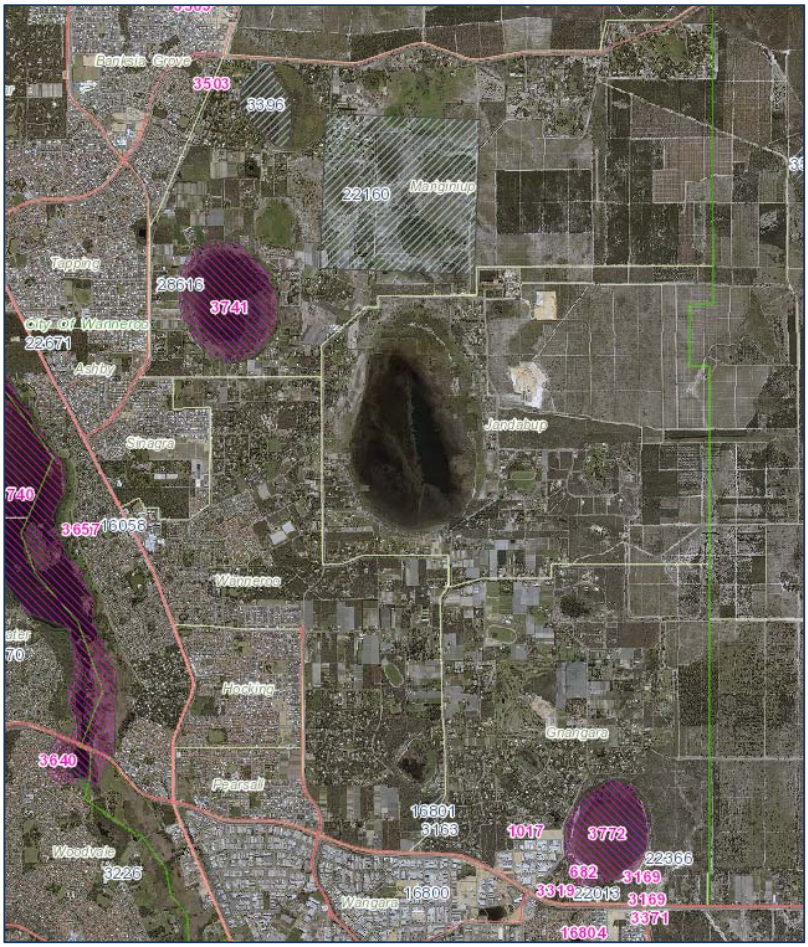
3.1.3 Aboriginal Heritage Sites

A summary of the Aboriginal Heritage sites within the study area and close to proposed ORRs are presented in **Table 3-1** and **Figure 3-1** below.

Table 3-1 Aboriginal Heritage Sites within the EWDSP Area (AHIS 2019)

Site ID	Site Name
682	Gnangara Lake SW 1 (Registered Aboriginal Site)
3163	Little Badgerup: Swamp (Other Heritage Place)
3396	Lake Adams (Other Heritage Place)
3772	Gnangara Lake (Registered Aboriginal Site)
16801	Gnangara Site 3 (Other Heritage Place)
22160	Marrynginup (Other Heritage Place)

Figure 3-1 Aboriginal Heritage Sites within the EWDSP Area (AHIS 2019)



3.1.4 European Heritage Sites

A summary of the European Heritage sites within the study area and close to proposed ORRs are presented in **Table 3-2** below.

In accordance with the inHerit listing, places listed are Heritage Listed by the City of Wanneroo in their Municipal Inventory. Accordingly, the sites are protected under the Planning and Development Act (2015) and the Local Planning Scheme.

Table 3-2 European Heritage Sites within the EWDSP Area (inHerit 2019)

Place Number	Site Name
9493	Delamare House (Hopkins House)
9505	William Townsend House
9514	Berriman House
17940	Tom Neaves House
17529	East Wanneroo School Site

3.1.5 Cycling Facilities

In line with the Perth and Peel@3.5million Sub-regional Frameworks, the Department of Transport (DoT) and Public Transport Authority (PTA) have prepared a Draft Bicycle Network Plan across the Perth and Peel Region. An extract of this network plan was provided by DoT is shown in **Figure 3-2** below.

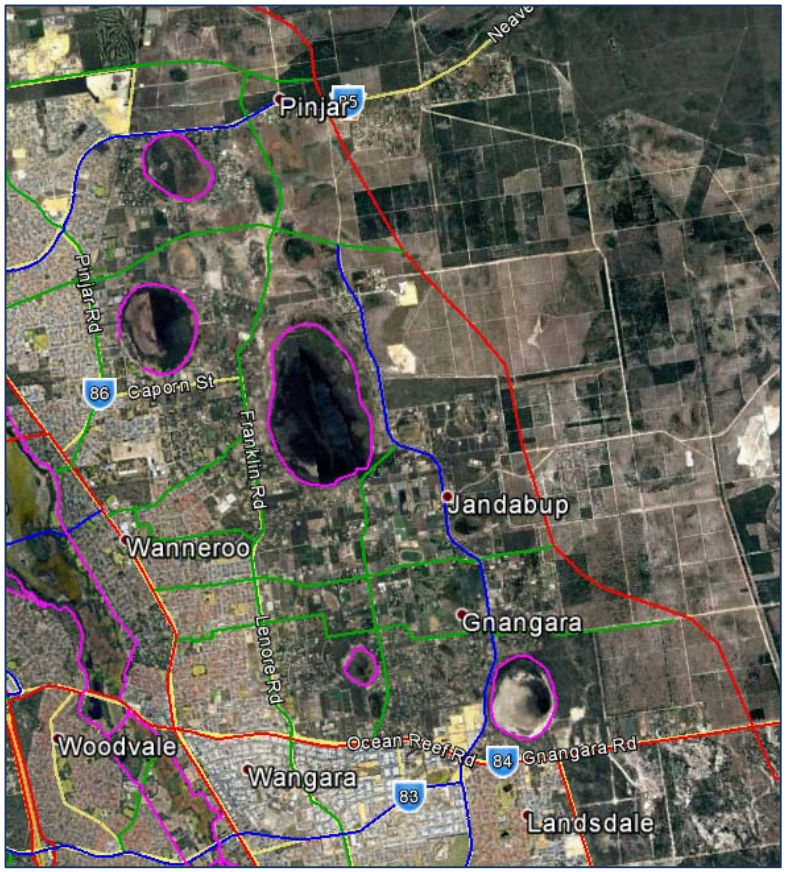


Figure 3-2 Draft Bicycle Network Plan in East Wanneroo by 2050 (DoT 2018)

The functions of the various paths within the network plan are summarised in the Draft Bicycle Network Plan.

DoT has advised that the exact form of the proposed cycle facilities have not yet been determined, requesting that road reserves are made sufficient to allow provision of protected and/or separated facilities. The ORR concept design within the study area has both Principal Shared Paths and Shared Paths provided within the proposed road reserve, as shown in the typical road cross sections (refer **Appendix B**).

3.2 Engineering Constraints

Given the existing rural land zoning of the EWDSP area, and the intense urbanisation proposed in the EWDSP, it is expected that many of the existing services will require upgrades to accommodate for future demand, as well as consideration for future trunk mains and services to meet the demands of the study area.

Engineering servicing constraints within the EWDSP area were also investigated and summarised in CW's *East Wanneroo District Structure Plan Engineering Servicing Report* (Cossil & Webley 2019).

The following sections summarise the findings of investigations, and should be read in conjunction with CW's report.

3.2.1 Proposed Water/Wastewater Headworks

Existing water infrastructure within the EWDSP is limited to the western and southern extents of the study area, with conceptual headworks planning for water and wastewater infrastructure having been updated c.a. 2010 based on the extent of the EWDSP area at the time.

It was noted that the concept plans only provide indications as to the likely service infrastructure requirements and service corridors, with some of the infrastructure shown on the conceptual plans having already been constructed. Since the initial conceptual headworks plans were produced, the study area has expanded and experienced a change in land use and structure planning. Comments received by Water Corporation indicate that the previous conceptual planning would need to be reviewed and revised once the ultimate dwelling/population yields and land uses are determined from DPLH structure planning.

To address water servicing requirements, CW's investigations propose future water trunk mains aligning to the Lenore Road and Franklin Road alignments, as well as bore mains to convey water from the Wanneroo Ground Water Treatment Plant to elevated water tanks. Significant trunk mains are proposed adjacent to and/or around district centres.

For wastewater, CW's investigations propose a number of gravity and pressure mains traversing the study area, and various wastewater pump stations at the low points of the respective sewer catchments. Routes for the proposed mains have been aligned to the proposed ORRs where practicable, although it is noted a number of the routes will revert to what will likely become lower order local roads.

Water Corporation will ultimately determine the most suitable location, alignment and/or route for infrastructure when the need arises, based on the lands available.

The ORR concept design provides verge and median space within the road reserve for local sewer and water infrastructure, noting that regional distribution infrastructure will require more detailed investigation upon confirmation of Water Corporation's strategic planning.

3.2.2 Gas

There is currently limited reticulated gas infrastructure within the EWDSP area, confined to the outskirts and within existing residential and commercial/industrial areas.

ATCO do not currently have plans for new infrastructure within the area. They have noted that as land development occurs, developers will need to apply for mains extensions and reticulation for new estates, via high, medium and low-pressure reticulation mains.

Of the limited infrastructure within the EWDSP area, a high-pressure gas main and pressure reduction station is present along Neaves Road. Any new roads or constructions works in the vicinity of this high-pressure gas main will trigger additional design and construction requirements, in order to protect the pipeline.

The ORR concept design provides verge and median space within the road reserve for local gas infrastructure, noting that more detailed investigation will be required upon confirmation of land development staging and the corresponding servicing demands, especially in ensuring alignments avoid and/or provide sufficient separation to sources of Earth Potential Rise.

3.2.3 Power

CW's investigations indicate that a 132kV transmission line will be required, providing connectivity between the Neerabup Terminal Station and Wangara Power Substation in servicing the EWDSP area. The proposed route for this transmission line traverses the following road reserves from north to south through the EWDSP area:

> Flynn Drive between the Neerabup Terminal Station and Franklin Road extension;

- Franklin Road extension to Neaves Road;
- Portion of Neaves Road proposed to become a local access street east of Franklin Road;
- Extension of Hawkins Road north of Lakeview Road (neighbourhood connector standard road);
- Hawkins Road;
- Badgerup Road;
- Elliot Road between Badgerup Road and Lenore Road; and
- Lenore Road.

Western Power have identified that a future zone substation may also be required, although this is uncertain and subject to medium to long-term needs. Any such substation would require extension of high voltage transmission lines, and ideally be located along the proposed transmission line extensions.

Transmission lines would be located within existing road reserves where possible.

It would be expected that road infrastructure upgrades, as a function of urban development, would see the undergrounding of existing low and high voltage overhead power assets.

The ORR concept design provides verge and median space within the road reserve for local power infrastructure, noting that more detailed investigation will be required upon confirmation of power demand locally and across the EWDSP area. Where transmission lines are required, the proposed road reserves are unlikely to have sufficient verge and/or median widths to accommodate the associated 20m restriction zones, resulting in restrictions being applied to adjacent lands.

3.2.4 Communications

Future communications and upgrades to the EWDSP area will be performed by NBN, as part of frontal greenfield developments from the west and/or south.

Based on CWs' investigations, NBN have existing networks adjacent to the study area. These will be used to facilitate servicing demands, with NBN advising that two 100mm diameter conduits will be required in PRR and ORR designated roads.

Such requirements are expected to be easily accommodated within the standard verge widths proposed.

3.2.5 Existing Drainage

Most existing local roads within the EWDSP area are constructed to a rural standard. Stormwater runoff is managed via sheet-flow to the shoulders and verges, where it is assumed to infiltrate at source.

Roads recently upgraded to an urban standard have incorporated kerbed cross-sections, and appear to drain through pit and pipe networks with outfalls to infiltration basins. The recently upgraded roads include:

- Major intersections of Ocean Reef Road, with:
  - Lenore Road;
  - Badgerup Road; and
  - Sydney Road.
- The recently upgraded section of Lenore Road up to and immediately beyond Elliot Road.

Given the proposed urban cross-sections to be adopted for the ORRs across the EWDSP area, it is anticipated that pit and pipe networks will be adopted. Outfalls for these networks are expected to convey stormwater runoff to infiltration basins, roadside swales, and/or the main water bodies in the surrounding areas (subject to treatment requirements and groundwater).

3.2.6 Groundwater Levels

The '*Integrated Water Management Framework – East Wanneroo District Structure Plan*' (July 2019) prepared on behalf of DPLH by RPSGroup identifies water management outcomes for groundwater management. The DSP is located on the Gnangara Groundwater System, predominantly in the Wanneroo Groundwater Management area.

Perth Regional Aquifer Modelling Systems (PRAMS) modelling suggests that future groundwater levels in the superficial aquifer are expected to increase by 3 to 4m over most of the DSP resulting in a significant proportion of the area being inundated – predominantly in the existing geomorphic wetlands. The Water

Management Framework identifies that groundwater controls will need to be put in place and additional groundwater modelling will be required to update the PRAMS model.

RPSGroup PRAMS Groundwater Levels mapping, sourced via Landgate in August 2018 was used to identify high groundwater levels in the study area. The concept design aims to avoid areas of high groundwater (levels above natural ground level) where practicable. Where passing through areas of high groundwater levels has proven unavoidable, the concept design has assumed a nominal additional 1.0m lift in earthworks for the concept design. As future groundwater controls and drainage management practises are yet to be confirmed, this is deemed an acceptable measure as confirmed by DPLH and based on Cardno's experience at this stage of design.

3.2.7 Existing/Proposed Alignment

As a function of the transport network proposed within the EWDSP, wholesale realignments of proposed ORRs, widening of existing road reserves and extensions will be required to meet standard geometric requirements as specified by Austroads and MRWA's Supplements.

Such realignments, widenings and extensions will necessitate the relocation and/or replacement of a significant extent of existing services, as well as reconstruction of existing rural standard roads.

3.3 Environmental Constraints

The EAS prepared by Emerge has been used to inform the environmental constraints present within the study area, and formed the basis for determining suitable ORR alignments such that significant environmental values are conserved as much as practicable. Desktop and site investigations were drawn upon to inform the findings of the EAS, with the relevant digital datasets referenced into the modelling to set appropriate alignments.

The following sections outline specific constraints identified in the EAS, and their impacts on the proposed ORR alignments, and should be read in conjunction with the EAS report. It is noted that the EAS has also identified areas for further investigation.

3.3.1 Soils

Desktops studies have revealed that the site is likely to comprise sandy soils, and poorly drained peaty and clayey soils in parts of the site aligned with wetland features. Areas with poorly draining soils will limit the effectiveness of infiltration drainage systems, requiring alternate methods of stormwater runoff management.

3.3.2 Topography

The topography of the study area varies from hilly and undulating to gentle dunal formations. Low lying areas typically coincide with wetland features.

Without further consideration of development and future earthworks levels, the vertical alignments of the proposed ORRs will be based off the existing ground levels and previous design tie-ins.

Additional fill may be required in locations to raise the design centreline, where reduced clearance to groundwater is a concern.

3.3.3 Threatened Ecological Communities

Emerge's EAS investigations identified Banksia Woodlands as a listed Threatened Ecological Community (TEC) located within the study area. The Tuart Woodlands were also noted within Emerge's report and potential occurrences considered, although at the time of the EAS being prepared the outcome regarding its nomination to be listed as a TEC had not been reached.

The EAS notes that detailed surveys have not been conducted across the study area, and that there is a high likelihood that additional occurrences of TECs could be found to exist.

Wherever possible, and in adhering to geometric design standards and guidelines, the horizontal and vertical alignments have been developed to minimise impacts on TECs identified within the study area.

3.3.4 Bush Forever

The vast majority of bush forever sites identified within the study area are noted to coincide with other areas of environmental value.

Bush Forever sites have been avoided as far as practicable in the development of the proposed ORR alignments.

3.3.5 Wetlands

As with the TECs, and in adhering to geometric design standards and guidelines, the horizontal and vertical alignments have been developed to minimise impacts on conservation category wetlands, and avoid resource enhancement and multiple use wetlands where possible.

The EAS does note that some of the current wetland classifications may be over or under-stated, requiring detailed site investigations to confirm whether existing classifications are relevant.

4 Transport Modelling

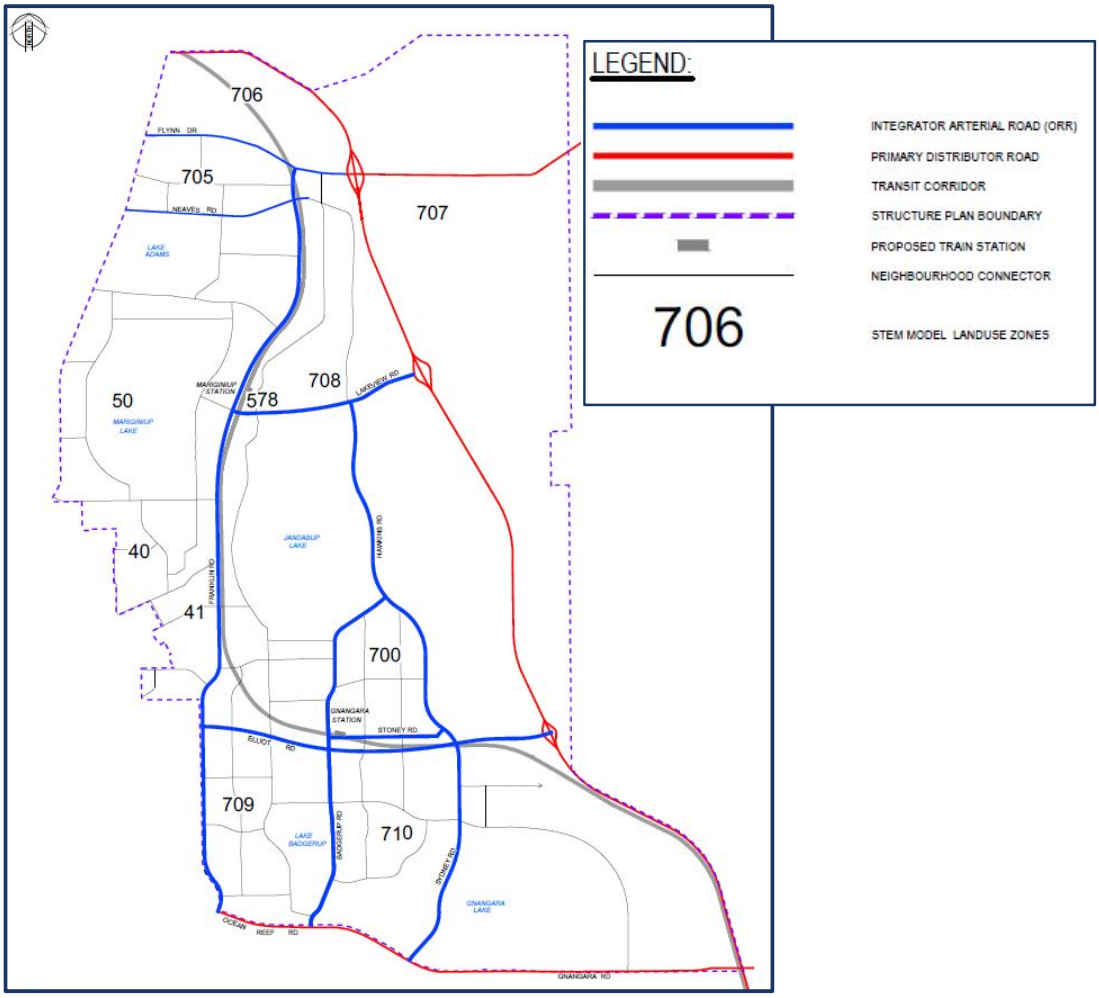
It is imperative that the proposed network and road concept design integrate with the abutting land use and network plans. STEM modelling is ideal for this high-level assessment across the study area and the project process consisted of the following:

- A review of the existing zone structure of the DSP area in the STEM model in relation to the proposed DSP layout
- A review of the future STEM model plots such as Link Volume plot to suggest proposed intersection treatment forms

4.1 Basis of the STEM Model

The STEM model is managed by the Department of Transport (DoT), Western Australia. STEM is a full multi-modal model with representation of road / public transport network and uses a strategic level land use zoning system to generate predicted traffic data. Within the STEM Model the study area has been aggregated into Zones (refer Figure 4-1) in which assumptions pertaining to land use, public transport use and employment have been provided to form a land use scenario resulting in traffic generation on regional roads.

Figure 4-1 STEM model zones within the DSP



DoT Transport Model (STEM) is developed for estimating regional traffic volumes on regional and major roads and public transport patronage at rail and bus routes, and it is to be used only for strategic level of decision-making process and interpreted by an experienced/qualified person who understands transport modelling and the limitations of the data. The data is not intended for commercial or detailed transport design use.

Table 4-1 & Table 4-2 provide population and employment estimates, respectively for the 2051 scenario within the STEM Model.

Table 4-1 Population living within the DSP by STEM Zone in 2051

Zone	No. Dwellings	Population (Total)	Children	Students
41	3 000	8 334	1 833	1 333
50	8 000	22 056	4 853	3 529
700	12 000	32 885	7 234	5 262
705	4 050	11 251	2 475	1 800
706	-	-	-	-
707	-	-	-	-
708	5 000	13 702	3 014	2 192
709	4 000	10 979	2 415	1 757
710	9 000	24 688	5 431	3 950
TOTAL	**45 050**	**123 895**	**27 255**	**19 823**

Table 4-2 Employment within the DSP by STEM Zone in 2051

Zone	Agriculture	Mining	Manufacturing	Utilities	Construction	Retail	Wholesale	Transport	Communications	Finances	Public Administration	Education	Health	Welfare & Others	Entertainment
41	8	1	-	6	109	57	4	16	2	80	20	265	58	38	80
50	-	-	-	-	-	500	-	-	-	-	-	445	-	-	-
700	-	-	-	-	-	1,200	-	-	-	150	-	445	-	150	200
705	-	-	-	-	-	500	-	-	-	-	-	90	-	-	-
706	-	150	2,290	254	1,345	1,204	1,030	710	113	658	38	-	38	56	118
707	-	19	286	32	168	150	129	89	14	82	5	-	5	7	15
708	-	97	1,483	165	871	780	667	460	73	426	24	-	24	37	76
709	-	-	-	-	-	-	-	-	-	-	-	265	-	-	-
710	7	14	128	11	203	175	35	36	5	128	41	400	96	64	159
TOTAL	**15**	**281**	**4,187**	**468**	**2,696**	**4,566**	**1,865**	**1,311**	**207**	**1,524**	**128**	**1,910**	**221**	**352**	**648**

4.1.2 Transit Station Model inputs

The rail boarding numbers and public transport patronage is estimated in STEM based on a number of factors. The key influencing factors for rail boarding include:

- The land use type, yield and location relative to train stations.
- The location and quantity of Park and Ride.

For 2051, STEM assumes a High Public Transport (HPT) scenario. This is based on an assumption that by 2051, Perth will achieve a higher mode share target of over 10% PT. Transit station modelling in 2051 for the East Wanneroo Line within the STEM Model assumes:

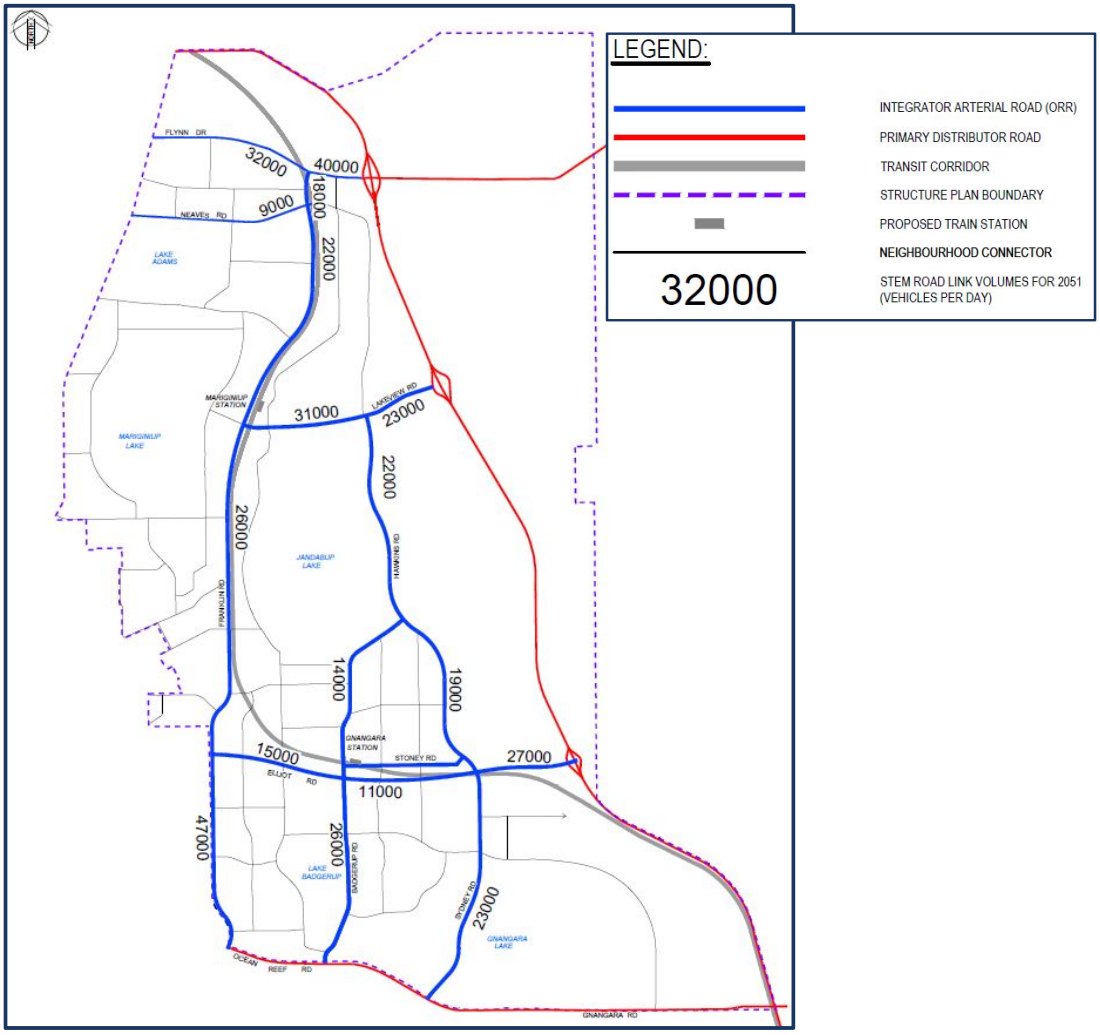
- Gnangara Station – 10,702 total daily boarding & 10,990 total daily alighting
- East Wanneroo Station – 9,948 total daily boarding & 10,045 total daily alighting

In addition, bus routes within the DSP are included in the model – refer Section 4.6 for rapid transit routes servicing transit stations.

4.2 2051 Traffic Volumes

Figure 4-2 shows the 2051 East Wanneroo STEM Link Volume Plots (LVP) that provide indicative traffic volumes on key roads within the DSP for the 3.5Million Perth population scenario. The volumes provided show the highest predicted volume of vehicles per day for the ORR to ORR link.

Figure 4-2 2051 East Wanneroo STEM Link Volume Plots



4.3 Key Intersection Summary

Figure 4-3 shows the key intersections in the study area. Detailed SIDRA analysis for the intersections was not included in this scope of work; therefore, the intersection design solutions (refer Section 4.4) presented are based on STEM traffic flows only.

Department of Transport developed the 2051 link volume plots using the STEM model. The STEM model includes land use assumptions for the 3.5 million Perth population scenario and a zone boundary map with appropriate centroid connectors for the DSP area.

Cardno reviewed the 2051 STEM model link volume plots for all the key intersections. **Table 4-3** summarises the list of critical intersections in the DSP area.

Figure 4-3 Intersection Locations

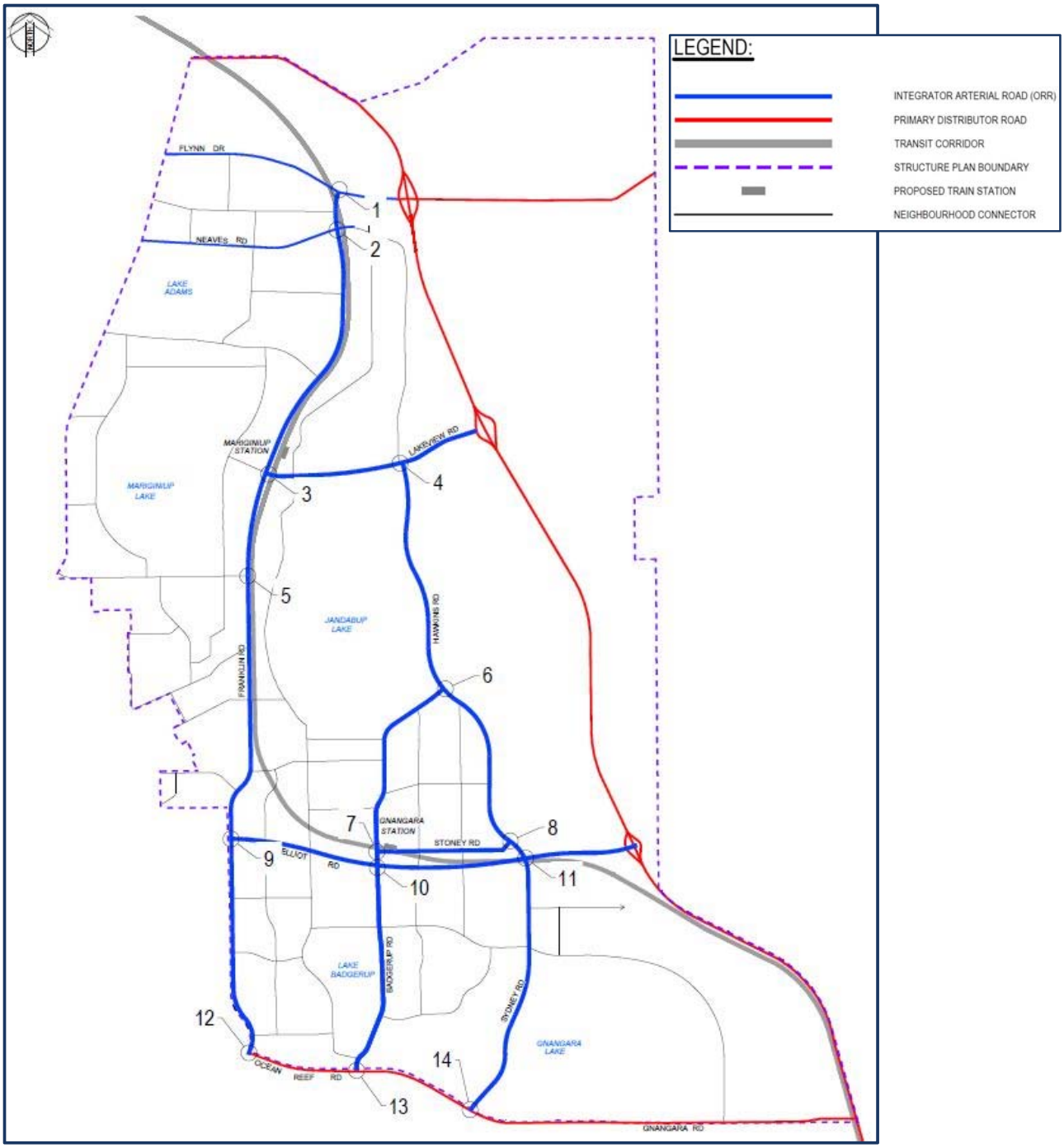


Table 4-3 Key Intersections within the DSP

Intersection	Intersecting roads	STEM Node Plot Reference
1	Franklin Road & Flynn Drive	30600
2	Neaves Road & Franklin Road	20100
3	Lakeview Road & Franklin Road	20504
4	Lakeview Road & Hawkins Road	20506
5	Franklin Road & Caporn Street	16567
6	Badgerup Road & Sydney Road & Hawkins Road	20503
7	Stoney Road & Badgerup Road	Not available
8	Sydney Road & Stoney Road	Not available
9	Lenore Road/ Franklin Road & Elliot Road	16547
10	Badgerup Road & Elliot Road	20502
11	Sydney Road & Elliot Road	17001
12	Lenore Road & Ocean Reef Road	16034
13	Badgerup Road & Ocean Reef Road	20012
14	Sydney Road & Ocean Reef Road	20153

4.4 Proposed Intersection Treatments

MRWA Traffic Guidelines and Austroads 'Guide to Road Design, Part 4: Intersections and Crossings' (2019) provide guidance on selection of intersection treatments. Austroads provides guidance to the suitability of types of traffic control to different intersection layouts based upon control options, traffic and safety factors, as summarised in Figure 4-4 below – an extract from the abovementioned Austroads document.

Figure 4-4 Austroads Traffic Control at Intersections Options (extract)

Table 2.4: Suitability of types of traffic control to different intersection layouts

Intersection layout	Roundabout	Signals	Stop or give way	Road rules only
T-intersections	All forms of control generally work well.			
Four-way intersection	Generally work well.	Generally work well.	A staggered T-intersection is preferred(1).	
Y-junction	Generally work well.	Generally work well.	Not recommended due to poor observation angle on the minor road.	Not recommended due to poor observation angle on the minor road. Also confusion regarding who has right-of-way.
Multileg intersection (more than four legs)	Single lane roundabouts generally work well. Multileg, multilane roundabouts cause significant driver confusion in terms of the appropriate lane choice for the intended movement.	Can experience high crash rates. Can result in inadequate sighting of lanterns. Can produce a high proportion of inter-green time.	Can cause confusion as to who has right-of-way.	

1 *Staggered T-intersections are deemed to be safer than four-way unsignalised intersections with aligned minor legs*

Additionally, a broad guide to the suitability of traffic control with respect to the functional classification of the road is provided by Austroads to provide a satisfactory level of safety and serviceability on arterial roads.

Figure 4-5, an extract from the Austroads 'Guide to Road Design, Part 4: Intersections and Crossings' (2019), provides suitability for each type of traffic control based upon the road type and has been taken into consideration when determining preferred intersection treatments within the study area.

Figure 4-5 Austroads traffic control based on functional road classification (extract)

Table 2.6: Suitability of types of traffic control to different road types based on operational and Safe System objectives

Road type	Primary arterial	Secondary arterial	Collector and local crossing road	Local street
Roundabouts				
Primary arterial	A	A	X	X
Secondary arterial	A	A	A	X
Collector & local crossing road	X	A	A	O
Local street	X	X	O	O
Traffic signals				
Primary arterial	O	O	O	X
Secondary arterial	O	O	O	X
Collector & local crossing road	O	O	X	X
Local street	X	X	X	X
***Stop* signs or *give way* signs**				
Primary arterial urban/(rural)	X/(X)	X/(O)	A	A
Secondary arterial urban/(rural)	X/(O)	X/(O)	A	A
Collector & local crossing road	A	A	A	A
Local street	A	A	A	A

A = Most likely to be an appropriate treatment
O = May be an appropriate treatment
X = Usually an inappropriate treatment.

STEM Link Volume Plots (summarised in Figure 4-2) have been used to infer turning volumes and expected intersection turning treatments. Where projected volumes and functional road classification treatment options (Figure 4-5) result in both signalised and roundabout viable treatment options, roundabout has been selected (unless otherwise directed) to ensure a complying and conservative approach to land protection requirements for planning purposes.

Individual intersection modelling will be required in future project development to confirm the intersection treatments including numbers of turning lanes, length of turning pockets and length requirements for channelised intersections.

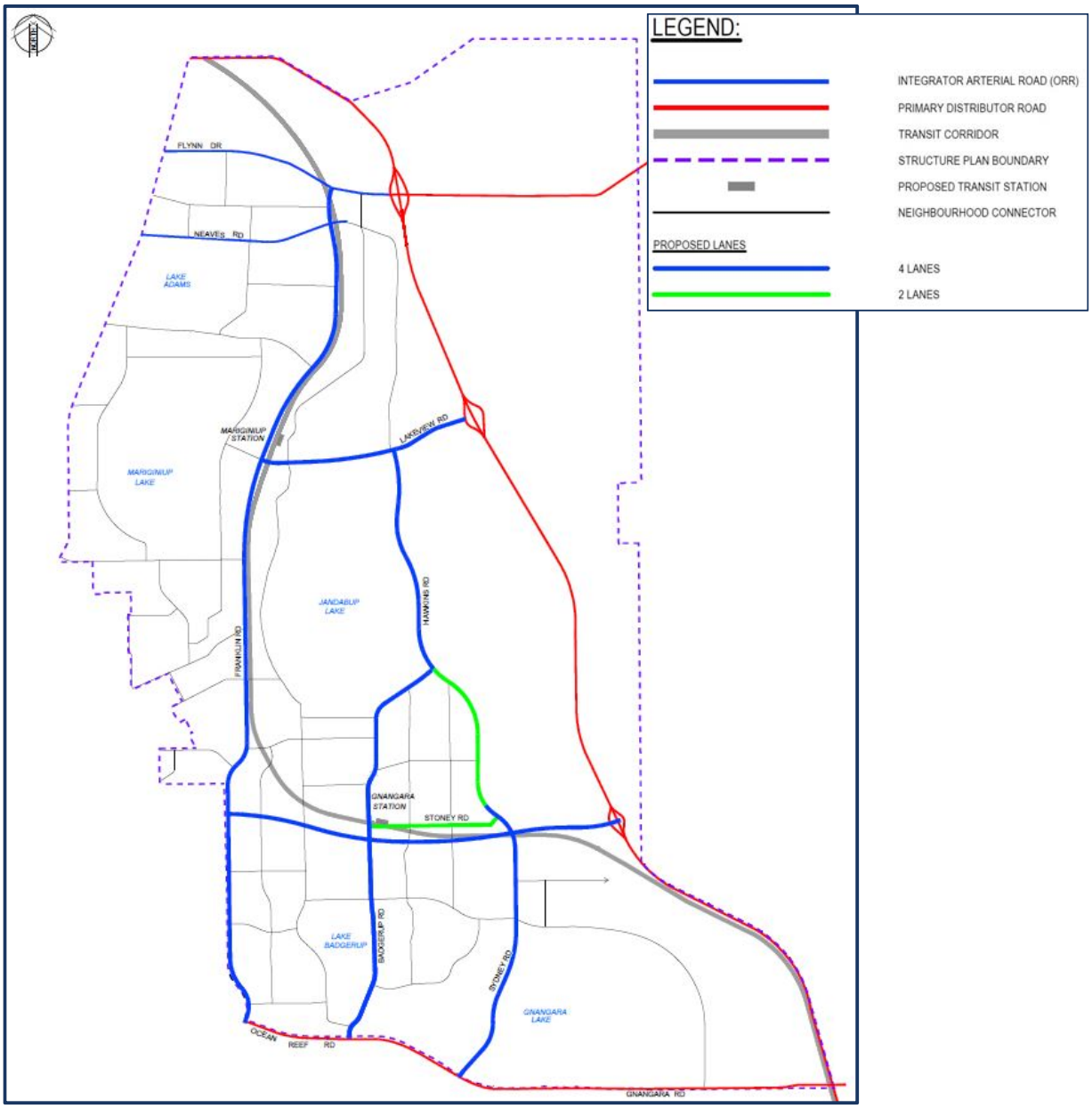
4.5 Lane Configurations

Based on the STEM model traffic volumes (refer Figure 4-2), the number of traffic lanes required to support traffic flow along the ORR within the study area are presented in **Figure 4-6.**

STEM Volumes have been compared with lane requirements using the Federal Highway Authority Technical Report - *Simplified Highway Capacity Calculation Methods for Highway Performance Monitoring System, Oct 2017*. Cardno's modelling experience suggests any sections of road exceeding 20,000 vehicles per day requires four lanes, unless there is even flow throughout the day, in which case 2 lanes will suffice. For the purposes of this study, uneven flow is assumed with 10% AADT occurring within AM & PM peak periods.

Figure 4-6 shows the East Wanneroo DSP proposed lane configuration for the Other Regional Roads (ORR). The typical cross-sections for each portion of road are presented in **Error! Reference source not found.**, as further detailed in 5.

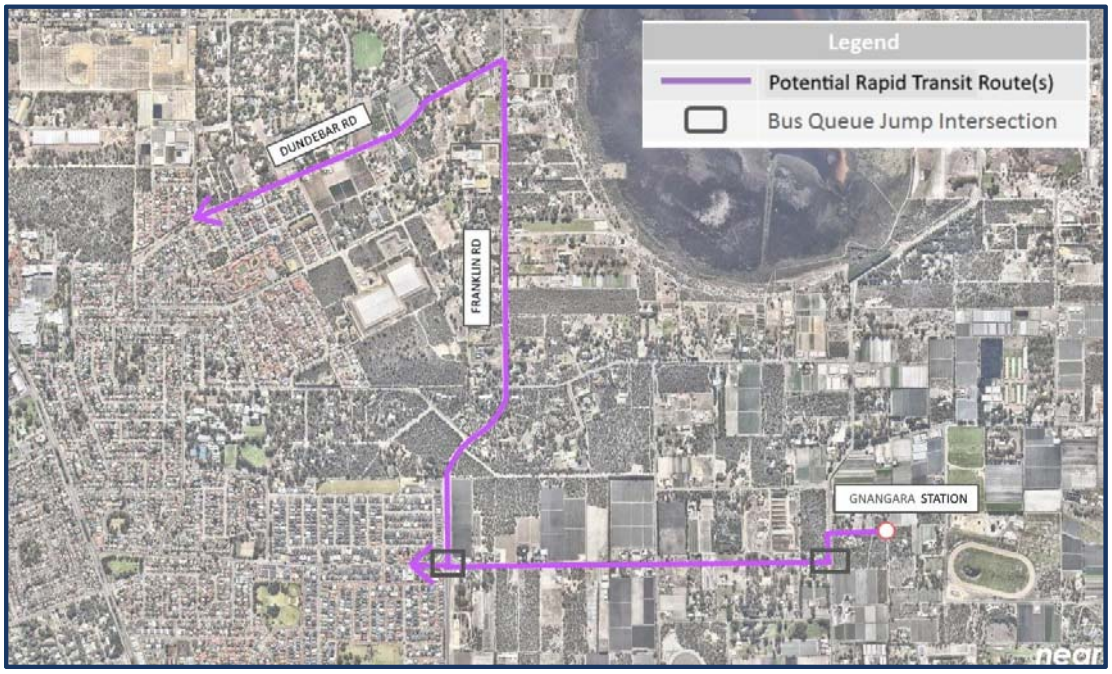
Figure 4-6 East Wanneroo DSP – Proposed Lane Configuration for ORR



4.6 Public transport Rapid Transit Routes

Figure 4-7 shows the potential future rapid transit bus route options. As Elliot Road is both a designated ORR and part of the Rapid Transit Route, a bus queue jump facility is proposed at the entry and exit to the signalised intersections. It is assumed any bus stops within the DSP and along the RTR's will be accommodated within the road reserve and will have minimal impact on traffic flow.

Figure 4-7 Future Rapid Transit Routes



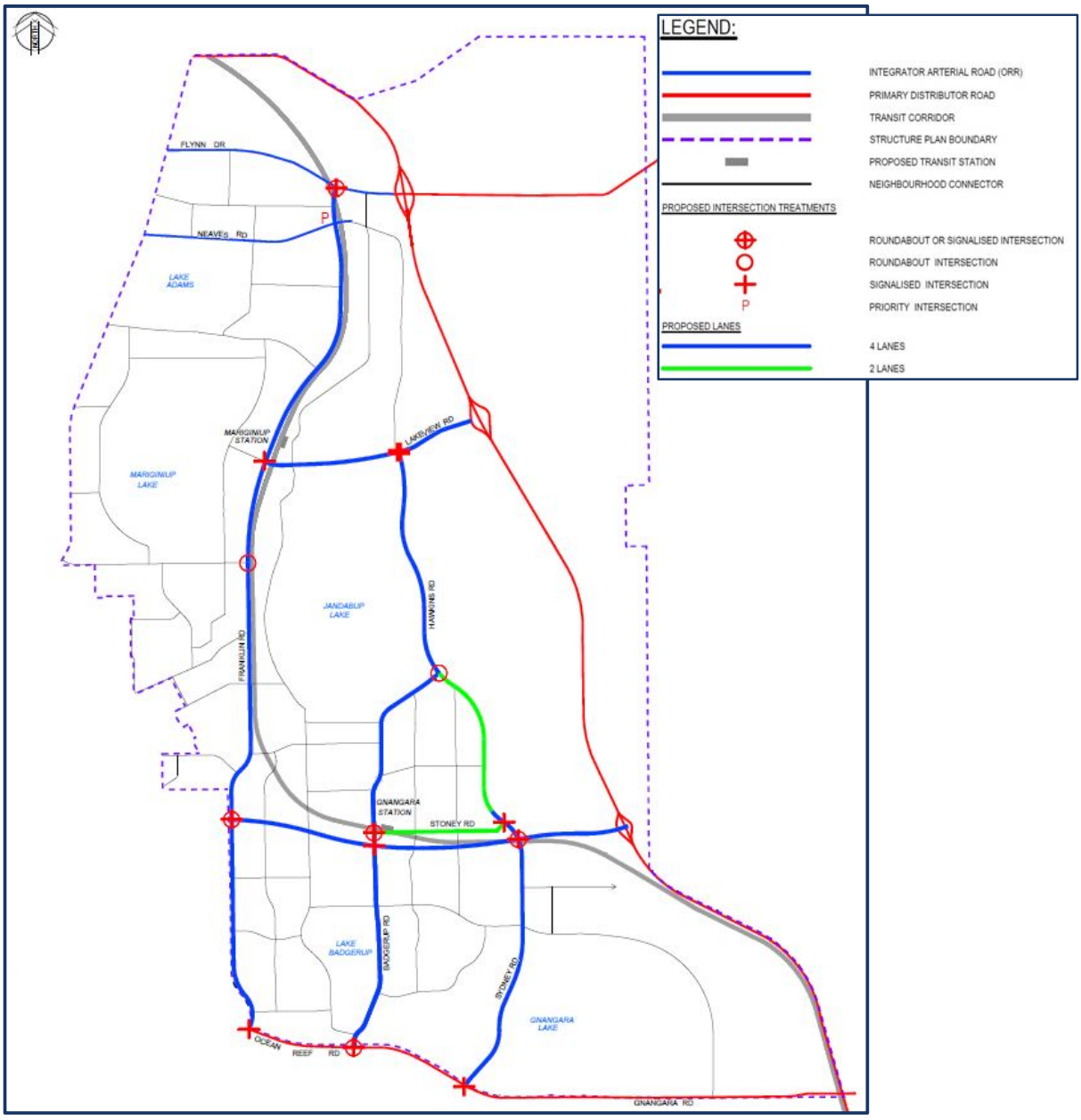
4.7 Traffic Analysis Outcomes

Cardno has reviewed the 2051 STEM traffic volumes within the study area and the proposed key intersection treatments are summarised in Table 4-4. A graphical representation of the intersection and road link design outcomes is presented in Figure 4-8.

Table 4-4 Summary of Existing and Proposed Intersections

Intersection	Intersecting roads	Existing Intersection Treatment	Proposed Intersection Treatment
1	Franklin Road & Flynn Drive	Not Applicable	Roundabout or Signalised Intersection
2	Neaves Road & Franklin Road	Not Applicable	Give Way Priority Intersection
3	Lakeview Road & Franklin Road	Priority Intersection	Signalised Intersection
4	Lakeview Road & Hawkins Road	Not Applicable	Signalised Intersection
5	Franklin Road & Caporn Street	Priority Intersection	Roundabout
6	Badgerup Road & Sydney Road & Hawkins Road	Not Applicable	Roundabout
7	Stoney Road & Badgerup Road	Not Applicable	Roundabout or Signal Intersection
8	Sydney Road & Stoney Road	Priority Intersection	Signalised Intersection
9	Lenore Road/ Franklin Road & Elliot Road	Roundabout	Roundabout or Signalised Intersection
10	Badgerup Road & Elliot Road	Not Applicable	Signalised Intersection
11	Sydney Road & Elliot Road	Not Applicable	Roundabout or Signalised Intersection
12	Lenore Road & Ocean Reef Road	Signalised Intersection	Signalised Intersection
13	Badgerup Road & Ocean Reef Road	Priority Intersection	Roundabout or Signalised Intersection
14	Sydney Road & Ocean Reef Road	Signalised Intersection	Signalised Intersection

Figure 4-8 Graphical representation of proposed road link & intersections



For the purposes of a conservative approach to land protection requirements for the future network, where a proposed intersection treatment can be roundabout or signalised, a roundabout design has been adopted in the road design. Future traffic investigations will include the following considerations:

- Detailed traffic modelling sufficient to support detailed intersection design and consideration of property access strategies
- Access Management Strategy for adjacent private and commercial properties to ORR

5 Concept Design Methodologies and Assumptions

5.1 Base Data

Designs for the Whiteman Yanchep Highway, Flynn Drive and Neaves Road were provided by others and incorporated in the planning concept design model (refer **Section 2.3**). As much as practicable, these alignments were assumed fixed and adopted for boundary and intersection tie-ins for horizontal and vertical alignment concept design.

The alignment of the proposed transit corridor (refer **Section 2.3.3**) was also included in the model, to inform the horizontal alignment of adjacent roads, where appropriate, and road over rail interactions.

Existing ground levels were obtained from LIDAR data (June 2019) provided by DPLH. The accuracy of the planning concept design and associated land protection requirements will be a function of the level of accuracy of the LIDAR data and do not accommodate any potential future land development earthworks requirements.

5.2 Proposed Posted and Design Speeds

In accordance with Section 3.1 of Austroads Guide to Road Design Part 3: Geometric Design (2017), it is current best practice to adopt a design speed 10km/h higher than the posted speed limit in urban areas or any areas that are subjected to reconstruction works.

Existing posted speed limits within the study area were obtained from MRWA's Road Information mapping System, and are shown in **Figure 5-1** below.

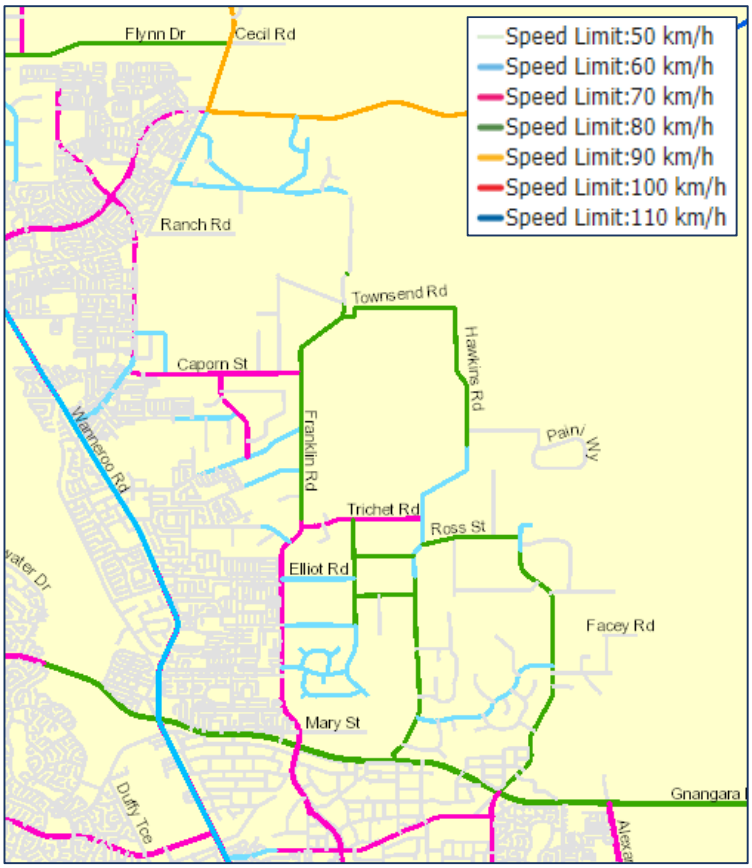


Figure 5-1 Existing Posted Speeds (MRWA 2019)

The proposed posted and design speeds adopted for the ORR and other roads within the study area, in consultation with DPLH, are provided in **Table 5-1** below:

Table 5-1 Posted and Design Speeds for ORR Links

Other Regional Road / Other Road Links	Design Speed (km/h)	Posted Speed (km/h)
Lenore Rd	80	70
Franklin Rd	80	70
Franklin Rd (Adjacent District Centre)	70	60
Elliot Rd East of Lenore Road	80	70
Elliot Rd (Adjacent City Centre)	70	60
Lakeview Rd	80	70
Badgerup Rd	80	70
Hawkins Rd	80	70
Badgerup Road (Adjacent City Centre)	60	50
Sydney Rd	80	70
Sydney Rd (Neighbourhood Connector)	80	70
Stoney Rd *(City Centre Road – not an ORR)*	50	50

Where proposed ORRs are located adjacent to District Centres lower posted and design speeds have been adopted to encourage a more suitable speed environment for pedestrians and cyclists.

5.3 Concept Design Cross-section Parameters

Cross-section requirements have been developed in consultation with DPLH and relevant stakeholders, in consideration of minimum design requirements set out in applicable Austroads, MRWA and liveable Neighbourhoods guidelines.

The cross-sections adopted in the planning design concept are presented in **Appendix B**, with **Sketch01** displaying the locations and extents of each cross-section within the road network. The minimum design parameters adopted in the concept design cross sections are presented in **Table 5-2**, stating the minimum design requirements, relevant standards and/or guidelines, and any further comments or justifications for the adopted parameters.

Table 5-2 Concept Design Cross-section Parameters

Parameter	Minimum Design Values from Standards/Guidelines	Minimum Design Values Adopted	Reference	Comment
Pavement cross-fall	3% crowned max. 6% max. superelevation	As per standards/guidelines 3% max. superelevation adopted	Austroads Guide to Road Design Part 3 Section 4.2.3	Ensures a grade change of 6% over crown lines is not exceeded, which may otherwise reduce stability in heavy vehicles
Crown lines	Parallel to traffic lanes, along the line of traffic lane edges	As per standards/guidelines	Austroads Guide to Road Design Part 3 Section 4.2.3	
Number of traffic lanes				Refer **Section 4.5**
General traffic lane width	3.0 – 3.5m	3.5m lanes for Options 1, 3 & 6 3.0 – 3.5m for Option 2 3.3m for Option 4 3.0 – 3.5m for option 5	Austroads Guide to Road Design Part 3 Section 4.2.5	3.5m general traffic lane width, 3.0 – 3.3m lanes provided to encourage low speed environment at city centres
On-street parking	2.3m min.	N/A for Options 1, 2 & 6 3.5m (off-peak) for Option 3 2.5m for Option 4 3.0m for Option 5	Austroads Guide to Road Design Part 3 Figure 4.45	Parallel parking
Turning pocket/lane width	3.5m	As per standards/guidelines	Austroads Guide to Road Design Part 3 Table 4.3	
Left shoulder width	N/A	2.0m adopted for Options 1, 3, 5 & 6 1.5m adopted (+0.2m armadillo kerb treatment) for Option 2 0.0m adopted for Option 4	Austroads Guide to Road Design Part 3 Section 4.3.2	Not required where kerbs are provided; provided to facilitate 1.5 – 2.0m dedicated cycle lanes

Parameter	Minimum Design Values from Standards/Guidelines	Minimum Design Values Adopted	Reference	Comment
Median shoulder width	N/A	0.0m	Austroads Guide to Road Design Part 3 Section 4.3.2	Not required where kerbs are provided
Median width	2.5 – 6.0m	6.0m for Options 1, 2, 3, 5 & 6 3.0m service road median for Option 6 2.5m for Option 4	Austroads Guide to Road Design Part 3 Table 4.15	6.0m to shelter turning vehicles and pedestrians, 2.5m to shelter pedestrians
Verge width	1.5-6.0m	5.0 – 6.5m adopted (+2.0m development setback in areas)	Austroads Guide to Road Design Part 3 Section 4.4.1	To allow for provision of services, paths and landscaping
Footpath Width				
Principal Shared Paths	2.5-4.0m for Regional/Principal Bicycle Network Path	3.0m Principal Shared Path adopted for Options 1, 2, 3, 5 & 6 4.0m Principal Shared Path adopted for Option 4	Austroads Guide to Road Design Part 6A Table 5.2	
Shared Paths	2.0-3.0m for Local Access Path	2.5m Shared Path adopted	Austroads Guide to Road Design Part 6A Table 5.2	
Cyclist clearance from trafficable lane				
60km/h posted speed	1.0m min. 1.5m preferred		MRWA Supplement to Austroads Guide to Road Design Part 6A Section 5.5.2	
70 – 80km/h posted speed	1.5m min. 2.0m preferred		MRWA Supplement to Austroads Guide to Road	

Parameter	Minimum Design Values from Standards/Guidelines	Minimum Design Values Adopted	Reference	Comment
			Design Part 6A Section 5.5.2	
Cut verge batter slope	1:3 (V:H) desirable max.	As per standards/guidelines	Austroads Guide to Road Design Part 3 Table 4.11	Suitable protections with lower severity index values will be provided where un-recoverable batters are located within the clear zone, at detailed design stage; assumes earth batter
Fill verge batter slope	1:4 (V:H) absolute max.	As per standards/guidelines	Austroads Guide to Road Design Part 3 Table 4.11	Suitable protections with lower severity index values will be provided where un-recoverable batters are located within the clear zone, at detailed design stage; assumes earth batter

5.4 Road and Rail Interactions

The alignment of the proposed transit corridor (refer **Section 2.3.3**) was included in the ORR model, to inform the horizontal alignment of adjacent roads, where appropriate, and road over rail interactions. At the locations where there is a clear road over rail interaction the road alignment has been lifted as much as practicable with due consideration of other engineering, environmental & heritage constraints. Standard vertical buffer has been assumed, as per Public Transport Authority Standard Drawings (refer **Appendix C**).

A key change since the Arup transit corridor study (*East Wanneroo District Rail Alignment – Land Reservation Study*, 2018) is the realignment of Franklin Road to the western side of the transit corridor. Consequently, the road and rail corridors have been adjusted to accommodate the realignment which will necessitate further transit corridor design development and coordination with future road design development across the study area.

5.5 Concept Design

5.5.1 Typical Design Parameters

The minimum design parameters adopted in the concept design are presented in the following tables, stating the minimum design requirements, relevant standards and/or guidelines, and any further comments or justifications for the adopted parameters.

Table 5-3 Stopping Sight Distance Design Criteria

Parameter	Minimum Design Values Adopted	Reference	Comment
Object height	0.2m	Austroads Guide to Road Design Part 3 Section 5.2	Object cut-off height for stationary object on road
Driver eye height	1.1m	Austroads Guide to Road Design Part 3 Section 5.2.1	Height of eye of driver for passenger car
Reaction time	2.0s	Austroads Guide to Road Design Part 3 Section 5.2.2	
Coefficient of deceleration	0.36	MRWA Austroads Supplement Part 3 Section 5.1	

Table 5-4 Horizontal Alignment Design Criteria

Parameter	Minimum Design Values from Standards/Guidelines	Minimum Design Values Adopted	Reference	Comment
Desirable minimum horizontal curve radius – 3% Superelevation			MRWA Supplement to Austroads Guide to Road Design Part 3 Section 7	
60km/h design speed	105m des. min.	All ORRs to meet minimum		
70km/h design speed	143m des. min.	All ORRs to meet minimum		

80km/h design speed	187m des. min.	All ORRs to meet minimum		

Table 5-5 Vertical Alignment Design Criteria

Parameter	Minimum Design Values from Standards/Guidelines	Minimum Design Values Adopted	Reference	Comment
Maximum vertical grade	8% max.	All ORRs to meet minimum	MRWA HVS Route Assessment Guidelines Table 7	Grade limit for RAV 2-6 category vehicles
Minimum vertical grade	0.5% min.	All ORRs to meet minimum	Austroads Guide to Road Design Part 3 Section 8.5.6	To allow for draining of road surface
Crest curve K value			MRWA Supplement to Austroads Guide to Road Design Part 3 Section 8	Based on adopted stopping sight distance criteria
60km/h design speed	6.8 min.	All ORRs to meet minimum		
70km/h design speed	19.1 min.	All ORRs to meet minimum		
80km/h design speed	29.3 min.	All ORRs to meet minimum		
Sag curve K value			MRWA Supplement to Austroads Guide to Road Design Part 3 Section 8	Urban and rural roads (headlight criteria govern)
60km/h design speed	12 abs. min.	All ORRs to meet minimum		
70km/h design speed	16 abs. min.	All ORRs to meet minimum		
80km/h design speed	21 abs. min.	All ORRs to meet minimum		

5.5.2 Other Design Assumptions

For the purposes of the Other Regional Road network concept design, a number of assumptions are made in addition to the presented design parameters and constraints:

- Horizontal Alignment tie-ins:
  - Whiteman Yanchep Highway western approaches, as designed by MRWA for Elliot Road and Lakeview Road are treated as fixed positions, with minor alignment changes away from interchanges due to change of ORR designations;
  - Flynn Road horizontal alignment (by MRWA) treated as fixed;
  - Neaves Road horizontal alignment (by others) treated as fixed;
  - Franklin Road / Lenore Road intersection location with Elliot Road is treated as fixed, to avoid impacting adjacent residents to the west as a result of proposed intersection upgrades; and
  - Existing Ocean Reef Road intersections with Lenore Road, Badgerup Road and Sydney Road are treated as fixed.
- Vertical alignment tie-ins:
  - Whiteman Yanchep Highway western approaches, as designed by MRWA for Elliot Road and Lakeview Road are treated as fixed positions, with minor alignment changes away from interchanges due to change of ORR designations;
  - Flynn Road vertical alignment (by MRWA) has been modified with minor changes to accommodate the proposed intersection treatment;
  - Neaves Road vertical alignment (by others) has not been provided, and as such a preliminary vertical alignment has been modelled;
  - Neaves Road and Franklin Road to tie-in via intersection;
  - Franklin Road / Lenore Road intersection with Elliot Road are treated as fixed; and
  - Ocean Reef Road intersections with Lenore Road, Badgerup Road and Sydney Road are treated as fixed.
- Passenger rail is assumed to dive under road design level without requiring road level lifts when interacting with ORRs. PTA reference drawings are provided in **Appendix C**;
- Minimum 1.5m embankments to be provided to the top of road level for drainage purposes where the groundwater table is at, or above, natural ground level;
- Swale, roadside table drain and retention basin designs are not included within this scope;
- Cut / fill volumes along the ORR alignments are balanced as much as practicable. Lakeview Road requires significant cut (up to maximum of 5m) to ensure safe tie-in to Whiteman Yanchep Highway approach
- Neighbourhood connector roads are to have space to accommodate dedicated left turn pockets and median breaks; and
- Pre-deflections for roundabouts within the EWDSP area have been excluded as posted speeds do not warrant this treatment.
- The Standard Restricted Access Vehicle (RAV) Route Assessment Guidelines provided by the Heavy Vehicle Services branch of MRWA has been referred to set minimum and maximum grades. Given the planning nature of the study, the cross-sections do not account for any lane widening that may be required to accommodate tracking of heavy vehicles. The design vehicle along Lakeview Road within the industrial area (intersections excluded) is expected to be up to a RAV 7 combination vehicle (refer **Figure 5-2**). Flynn Drive intersection with Franklin Road accommodates through traffic along Flynn Drive up to a RAV 7 combination design vehicle to service Neerabup Industrial Estate.

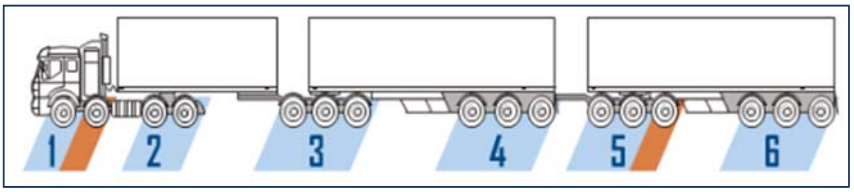


Figure 5-2 RAV Category 7 Vehicle Combination Diagram (Main Roads Heavy Vehicle Services, 2018)

6 Concept Design

With consideration of the constraints and design requirements set out in previous sections of this report, a planning concept design has been developed to provide an indication of the land protection requirements to realise the EWDSP ORR transport network.

The Other Regional Road network typical cross-sections adopted in the planning design concept are presented in **Appendix B**, with **Sketch01** displaying the locations and extents of each cross-section within the road network and the concept road design across the study area.

7 Conclusions & Recommendations

This study has been undertaken to review and provide updated road concept plans for the ORR regional movement network in East Wanneroo, in coordination with the proposed EWDSP, such that the ORR reserves are protected in the MRS to guide future planning within the study area. The concept design has been developed through consideration of known and investigated constraints, proposed land uses, future public transport and servicing planning and forecast traffic volumes.

The concept design development aims to avoid areas of environmental significance whilst minimising impacts to existing identified sites, using the existing road reserves wherever possible. Ultimately, the extent of the transport network proposed will require global land protections as a result of widenings, extensions and realignments of proposed ORRs.

At this level of development, changes are expected as more information becomes available and other stakeholders progress their planning as a result of the outcomes of the EWDSP and updates to the MRS.

Recommended actions to progress the development of the road network concept include:

- Public Comprehensive Community Consultation on supporting land development, amenity, environmental and heritage considerations;
- Progression of engineering design development with detailed base data;
  - Detailed site survey (including topography, rail corridor & engineering service locations); and
  - Groundwater monitoring.
- Development of a District Water Management Strategy and Local Water Management Strategies to determine stormwater drainage whilst protecting natural watercourses within, and adjacent to, the study area;
- Commissioning of additional site-specific environmental assessments, mapping and reporting to confirm the values of priority areas identified in the Environmental Assessment Study;
- Confirmation of PTA rapid transit routes for buses;
- Confirmation of the proposed transit line alignment and stations, including development timing and coordination with the proposed road network;
- Key intersection preliminary design development and associated comprehensive traffic modelling;
- Confirmation of existing and future service planning requirements;
  - Site-specific protection requirements for existing water, gas, communications and power infrastructure;
  - Coordination of utilities network expansion (water, sewer, gas, communications and power) with project execution timing; and
  - Coordination and staging of service relocations, as required;
- Coordination of road upgrade timing with adjacent land use developments for optimisation of access and earthworks across the study area.

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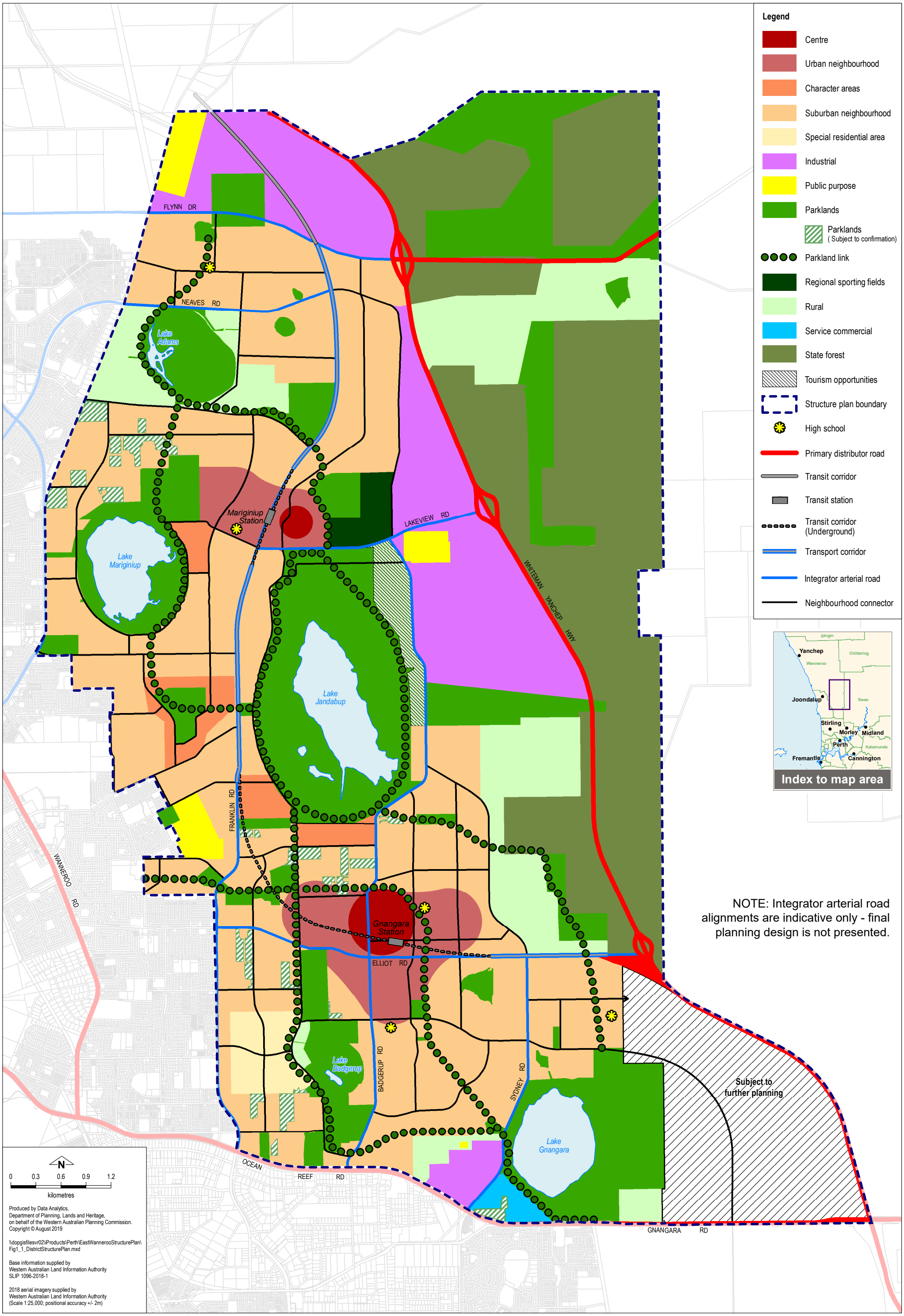
APPENDIX

A

DRAFT EAST WANNEROO DISTRICT STRUCTURE PLAN

Figure 1.1 Draft District Structure Plan



East Wanneroo District Structure Plan

APPENDIX

B

TYPICAL ROAD CROSS SECTIONS

NORTH

LEGEND:

- CROSS SECTION - 1
- CROSS SECTION - 2
- CROSS SECTION - 3
- CROSS SECTION - 4
- CROSS SECTION - 5
- CROSS SECTION - 6
- ROAD OUTSIDE STUDY AREA
- NEIGHBOURHOOD CONNECTOR ROADS
- TRANSIT CORRIDOR
- WHITEMAN - YANCHEP HIGHWAY

FLYNN DR

NEAVES RD

LAKE ADAMS

MARIGINIUP STATION

LAKEVIEW RD

MARIGINIUP LAKE

JANDABUP LAKE

HAWKINS RD

FRANKLIN RD

ASHBY ST

GNANGARA STATION

STONEY RD

ELLIOT RD

LAKE BADGERUP

BADGERUP RD

SYDNEY RD

SUBJECT TO FURTHER PLANNING

GNANGARA LAKE

OCEAN REEF RD

GNANGARA RD

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CROSS-SECTION OVERLAY

SCALE: NTS

DATE PLOTTED: 11 September 2019 10:50 AM BY : CRAIG BENFIELD
CAD File: Y:\CW1016300_Department_of_Planning_Road_Planning_Study_East_Wanneroo_DSP\5_Technical\Civil\CAD\CW1016300-SKE 001.dwg

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ROAD PLANNING STUDY FOR THE
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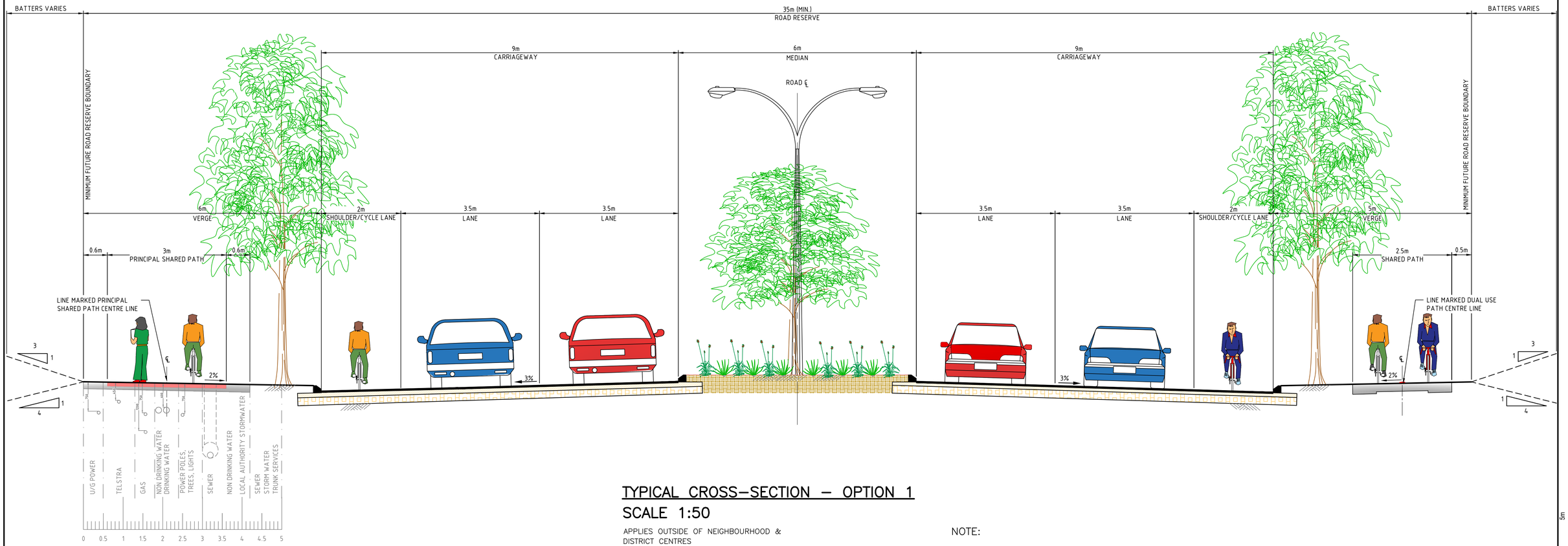
TYPICAL ROAD CROSS-SECTION LOCALITY PLAN

Date	Scale	Size
01.07.2019	NTS	A1

SKETCH 01 (Drawing Number)

A (Revision)



TYPICAL CROSS–SECTION – OPTION 1

SCALE 1:50

APPLIES OUTSIDE OF NEIGHBOURHOOD & DISTRICT CENTRES

- LENORE ROAD – FRANKLIN ROAD
- SYDNEY ROAD
- HAWKINS ROAD
- ELLIOT ROAD
- BADGERUP ROAD
- LAKEVIEW ROAD

NOTE:

1. CENTRAL MEDIAN TO BE LANDSCAPED WITH MATURE TREES, TREES TO BE OFFSET TO POWERPOLE LOCATIONS.
2. MEDIAN WIDTH SUFFICIENT FOR TURNING POCKETS, AS REQUIRED.
3. VERGE AND MEDIAN LANDSCAPING TO CITY OF WANNEROO SPECIFICATIONS.

SCALE: 0 1 2 3 4 5m @A1 SCALE 1:50

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DESIGN SPEEDS:

ALL ROADS:
POSTED SPEED LIMIT 70km/h
DESIGN SPEED 80km/h

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BASE INFORMATION SUPPLIED BY WESTERN AUSTRALIAN LAND INFORMATION AUTHORITY
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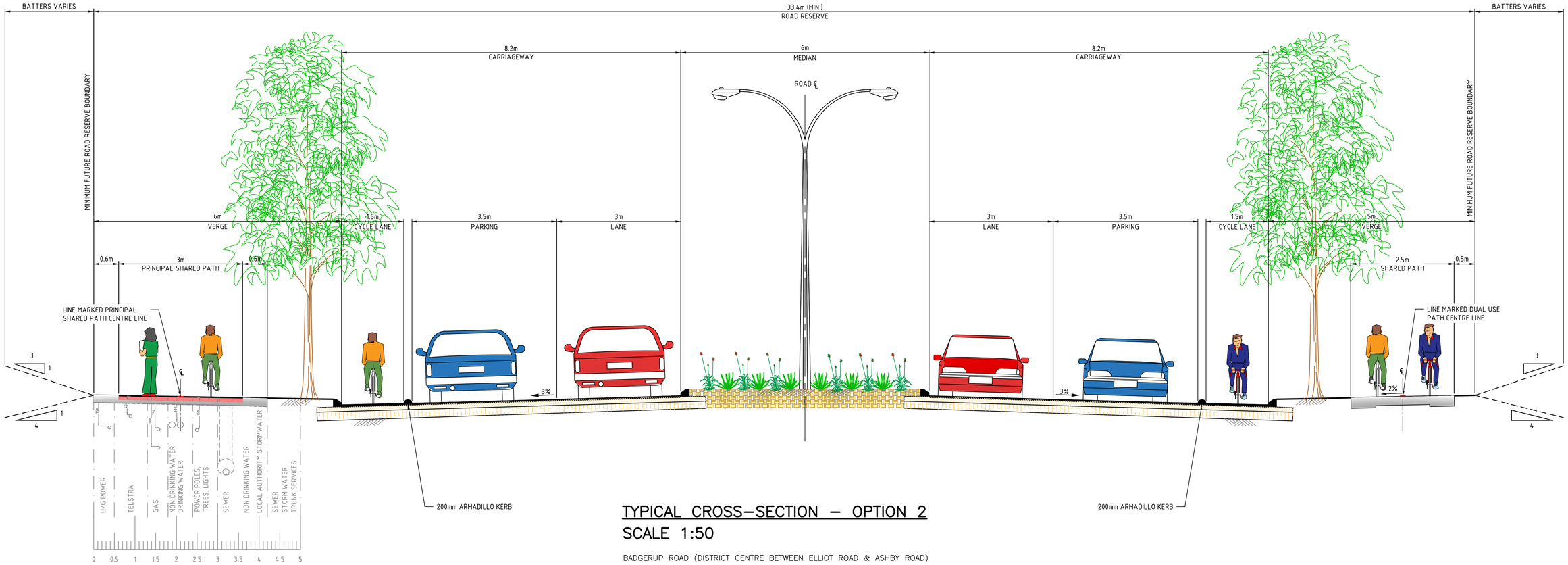
ROAD PLANNING STUDY FOR THE EAST WANNEROO DISTRICT STRUCTURE PLAN

TYPICAL CROSS SECTION

CITY OF WANNEROO

INFRASTRACTURE AND LAND USE COORDINATION

PLAN No.
1.7650



TYPICAL CROSS–SECTION – OPTION 2

SCALE 1:50

BADGERUP ROAD (DISTRICT CENTRE BETWEEN ELLIOT ROAD & ASHBY ROAD)

NOTE:

1. PUBLIC TRANSPORT RAPID TRANSIT ROUTE QUEUE JUMP FACILITY AT INTERSECTIONS.
2. STREETSCAPE TO BE DESIGNED TO PROVIDE MAXIMUM TREE CANOPY WHILST MAINTAINING SAFE ROAD AND PATH LIGHTING.
3. FREQUENT MEDIAN BREAKS TO BE PROVIDED TO FACILITATE SAFE PEDESTRIAN AND CYCLIST ROAD CROSSING.
4. CENTRAL MEDIAN TO BE LANDSCAPED WITH MATURE TREES, TREES TO BE OFFSET TO POWERPOLE LOCATIONS.
5. MEDIAN WIDTH SUFFICIENT FOR TURNING POCKETS, AS REQUIRED.
6. VERGE AND MEDIAN LANDSCAPING TO CITY OF WANNEROO SPECIFICATIONS.

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ROAD PLANNING STUDY FOR THE EAST WANNEROO DISTRICT STRUCTURE PLAN

TYPICAL CROSS SECTION

CITY OF WANNEROO

INFRASTRACTURE AND LAND USE COORDINATION

PLAN No.
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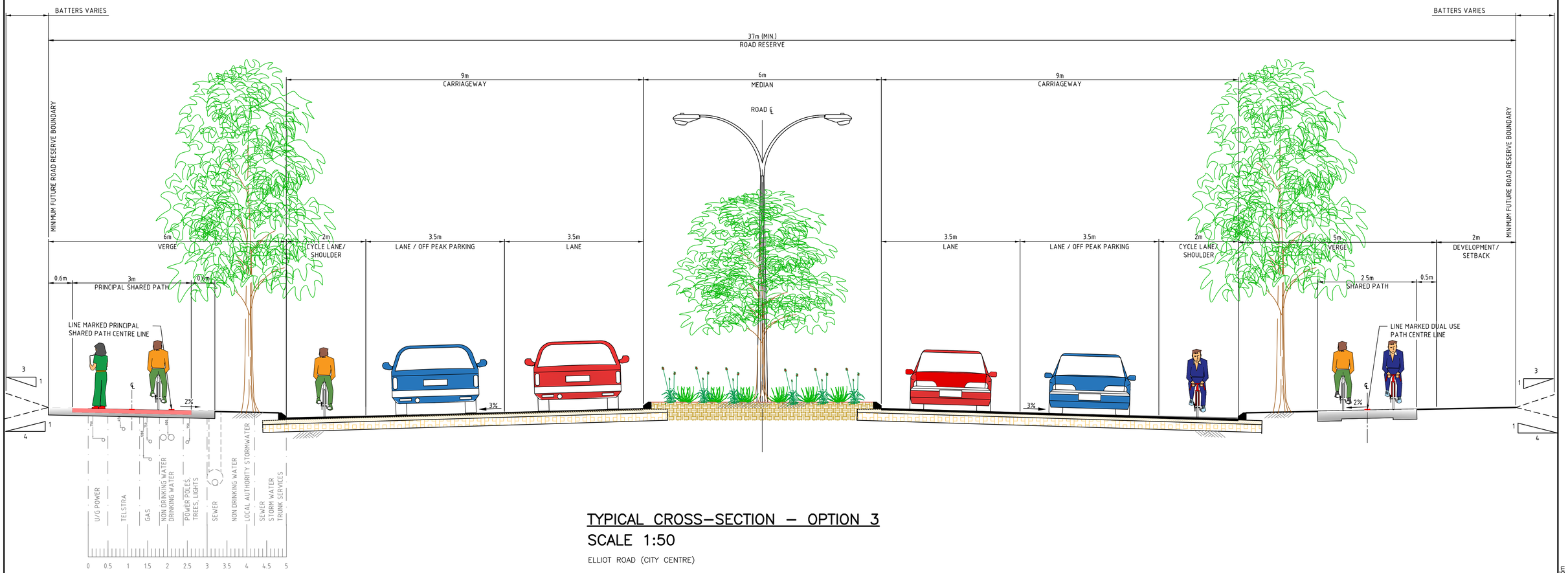

TYPICAL CROSS–SECTION – OPTION 3

SCALE 1:50

ELLIOT ROAD (CITY CENTRE)

NOTE:

1. STREETSCAPE TO BE DESIGNED TO PROVIDE MAXIMUM TREE CANOPY WHILST MAINTAINING SAFE ROAD AND PATH LIGHTING.
2. FREQUENT MEDIAN BREAKS TO BE PROVIDED TO FACILITATE SAFE PEDESTRIAN AND CYCLIST ROAD CROSSING.
3. CENTRAL MEDIAN TO BE LANDSCAPED WITH MATURE TREES, TREES TO BE OFFSET TO POWERPOLE LOCATIONS.
4. MEDIAN WIDTH SUFFICIENT FOR TURNING POCKETS, AS REQUIRED.
5. VERGE AND MEDIAN LANDSCAPING TO CITY OF WANNEROO SPECIFICATIONS.

SCALE: 0 1 2 3 4 5m @A1 SCALE 1:50

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ROAD PLANNING STUDY FOR THE EAST WANNEROO DISTRICT STRUCTURE PLAN

TYPICAL CROSS SECTION

CITY OF WANNEROO

INFRASTRACTURE AND LAND USE COORDINATION

PLAN No.
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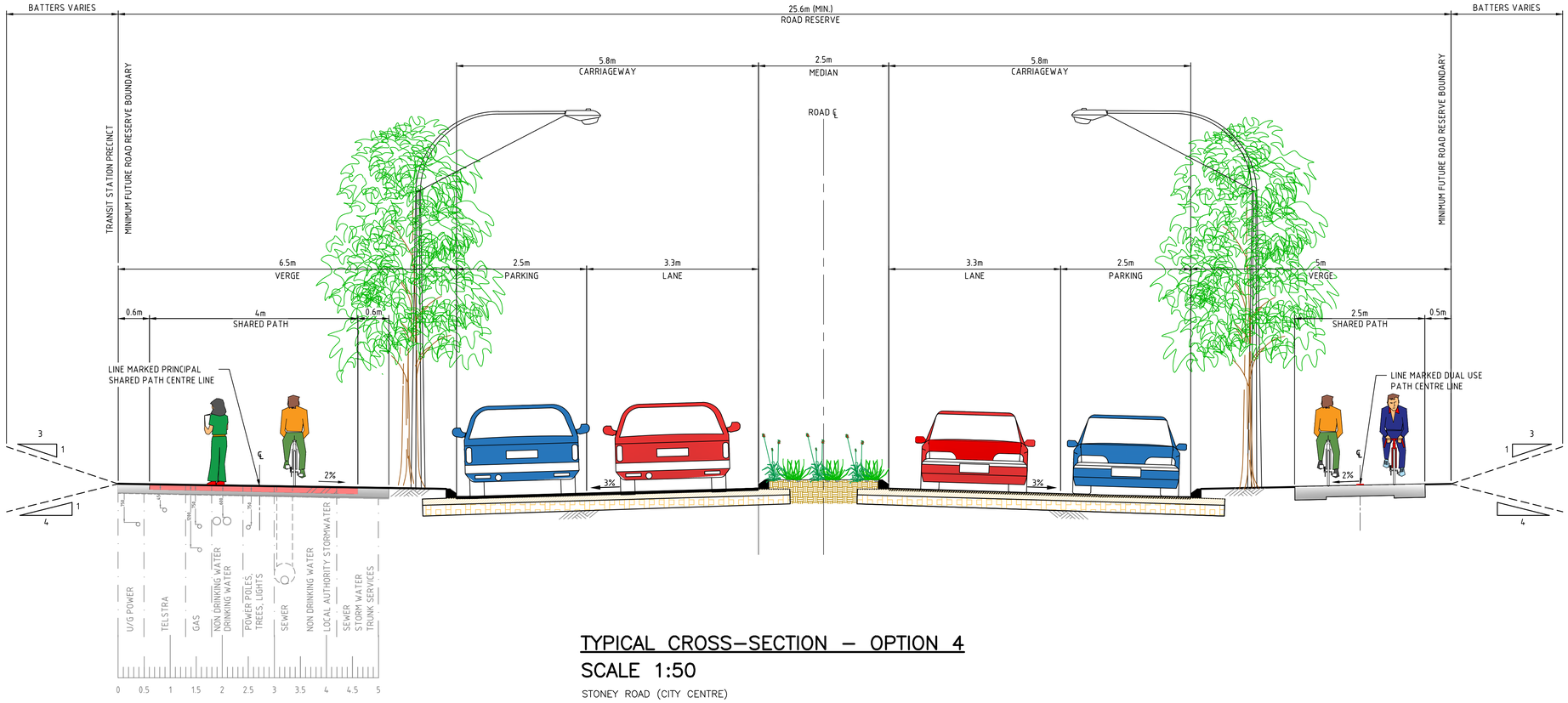

TYPICAL CROSS–SECTION – OPTION 4

SCALE 1:50

STONEY ROAD (CITY CENTRE)

NOTE:

1. TREES TO BE OFFSET WITH POWERPOLE LOCATIONS ON ROAD VERGE.
2. AT INTERSECTION WITH BADGERUP ROAD LANE WIDTHS INCREASE TO 2 x 3.5m AND PARKING REMOVED ON APPROACH AND EXIT.
3. STREETSCAPE TO BE DESIGNED TO PROVIDE MAXIMUM TREE CANOPY WHILST MAINTAINING SAFE ROAD AND PATH LIGHTING.
4. FREQUENT MEDIAN BREAKS TO BE PROVIDED TO FACILITATE SAFE PEDESTRIAN AND CYCLIST ROAD CROSSING.
5. VERGE AND MEDIAN LANDSCAPING TO CITY OF WANNEROO SPECIFICATIONS.

SCALE: 0 1 2 3 4 5m @A1 SCALE 1:50

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ROAD PLANNING STUDY FOR THE EAST WANNEROO DISTRICT STRUCTURE PLAN

TYPICAL CROSS SECTION

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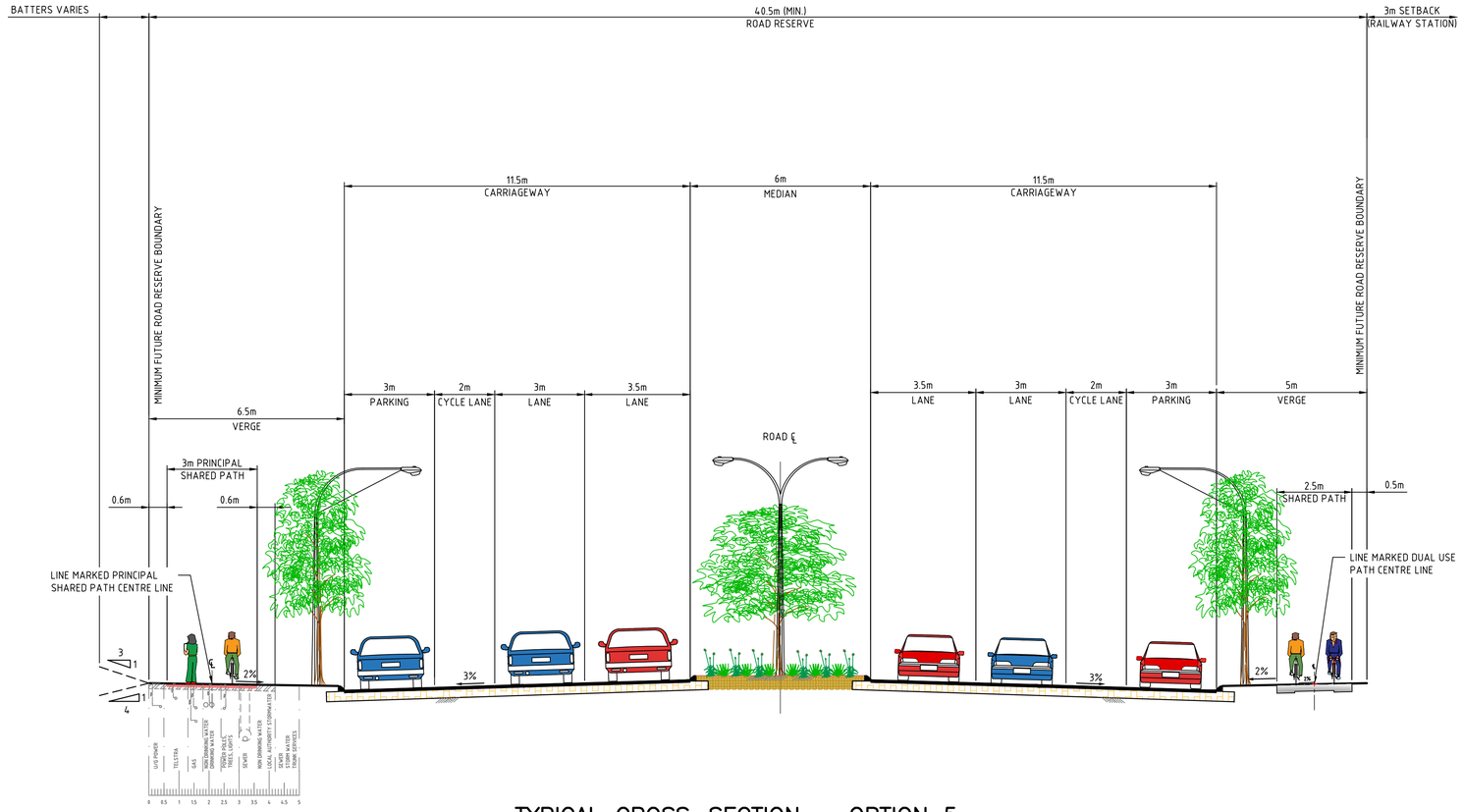

TYPICAL CROSS–SECTION – OPTION 5

SCALE 1:100

FRANKLIN ROAD – DISTRICT CENTRE

NOTE:

1. STREETSCAPE TO BE DESIGNED TO PROVIDE MAXIMUM TREE CANOPY WHILST MAINTAINING SAFE ROAD AND PATH LIGHTING.
2. FREQUENT MEDIAN BREAKS TO BE PROVIDED TO FACILITATE SAFE PEDESTRIAN AND CYCLIST ROAD CROSSING.
3. CENTRAL MEDIAN TO BE LANDSCAPED WITH MATURE TREES, TREES TO BE OFFSET TO POWERPOLE LOCATIONS.
4. MEDIAN WIDTH SUFFICIENT FOR TURNING POCKETS, AS REQUIRED.
5. VERGE AND MEDIAN LANDSCAPING TO CITY OF WANNEROO SPECIFICATIONS.
6. PARKING LANE TO BE CONSIDERED FOR BUS, TAXI & RIDESHARE FACILITY. VEHICLE / PEDESTRIAN SEPARATION TO BE PROVIDED AT PEDESTRIAN / CYCLIST MEDIAN BREAK CROSSING (I.E. KERBED NIBS / BARRIERS)

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SCALE: 0 1 2 4 6 8 10m @A1 SCALE 1:100

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ROAD PLANNING STUDY FOR THE EAST WANNEROO DISTRICT STRUCTURE PLAN

TYPICAL CROSS SECTION

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CITY OF WANNEROO

INFRASTRACTURE AND LAND USE COORDINATION

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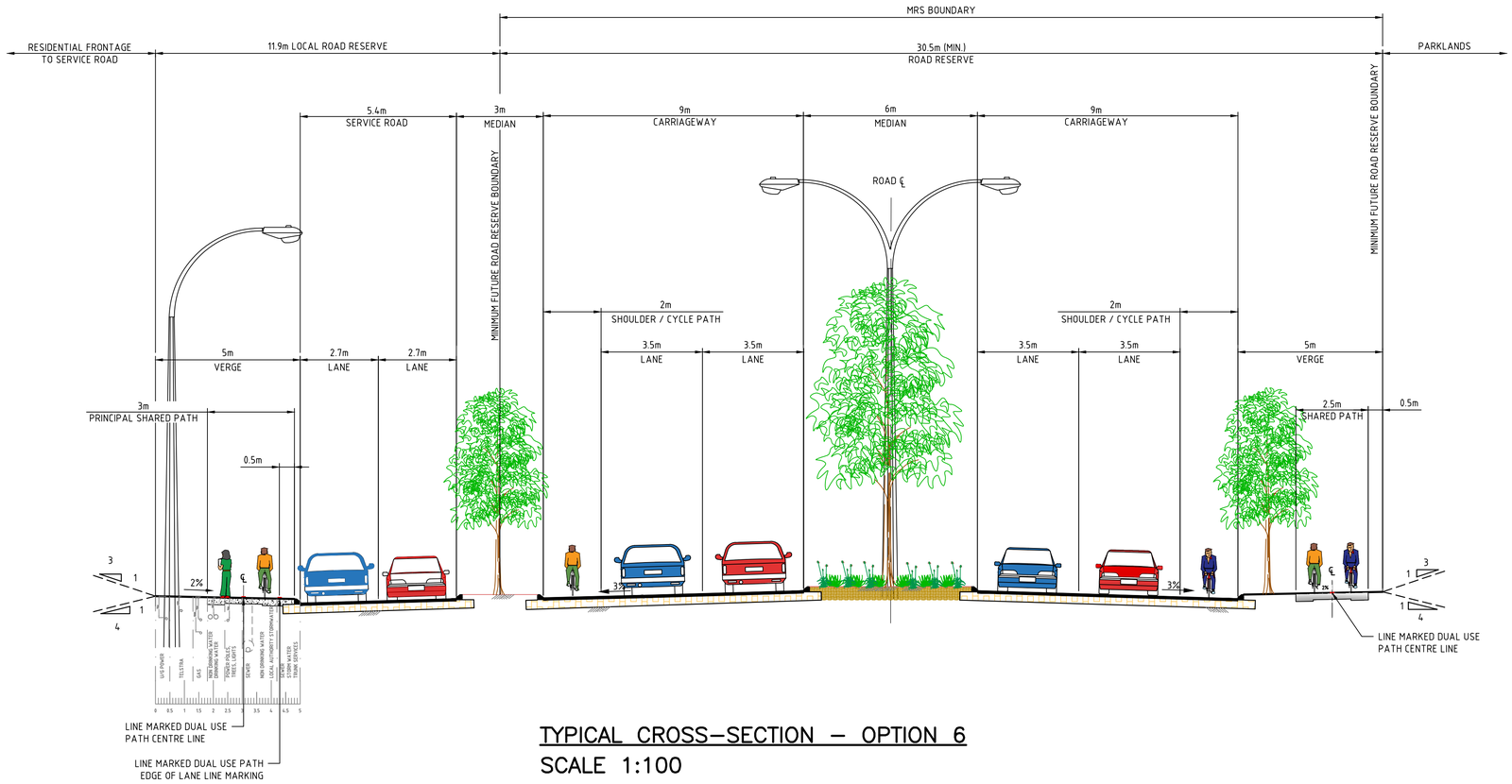

TYPICAL CROSS–SECTION – OPTION 6

SCALE 1:100

LAKEVIEW ROAD – DISTRICT CENTRE

NOTE:

1. STREETSCAPE TO BE DESIGNED TO PROVIDE MAXIMUM TREE CANOPY WHILST MAINTAINING SAFE ROAD AND PATH LIGHTING.
2. FREQUENT MEDIAN BREAKS TO BE PROVIDED TO FACILITATE SAFE PEDESTRIAN AND CYCLIST ROAD CROSSING.
3. CENTRAL MEDIAN TO BE LANDSCAPED WITH MATURE TREES, TREES TO BE OFFSET TO POWERPOLE LOCATIONS.
4. MEDIAN WIDTH SUFFICIENT FOR TURNING POCKETS, AS REQUIRED.
5. VERGE AND MEDIAN LANDSCAPING TO CITY OF WANNEROO SPECIFICATIONS.

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DESIGN SPEEDS:

LAKEVIEW ROAD
POSTED SPEED LIMIT 70km/h
DESIGN SPEED 80km/h
(SERVICE ROAD BY OTHERS)

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SCALE: 0 1 2 4 6 8 10m @A1
SCALE 1:100

BASE INFORMATION SUPPLIED BY WESTERN AUSTRALIAN LAND INFORMATION AUTHORITY
DATE OF AERIAL PHOTOGRAPHY: 2017

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FILENAME			
FILE REF :			

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SHEET SIZE
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ROAD PLANNING STUDY FOR THE EAST WANNEROO DISTRICT STRUCTURE PLAN

TYPICAL CROSS SECTION

.

CITY OF WANNEROO

INFRASTRACTURE AND LAND USE COORDINATION

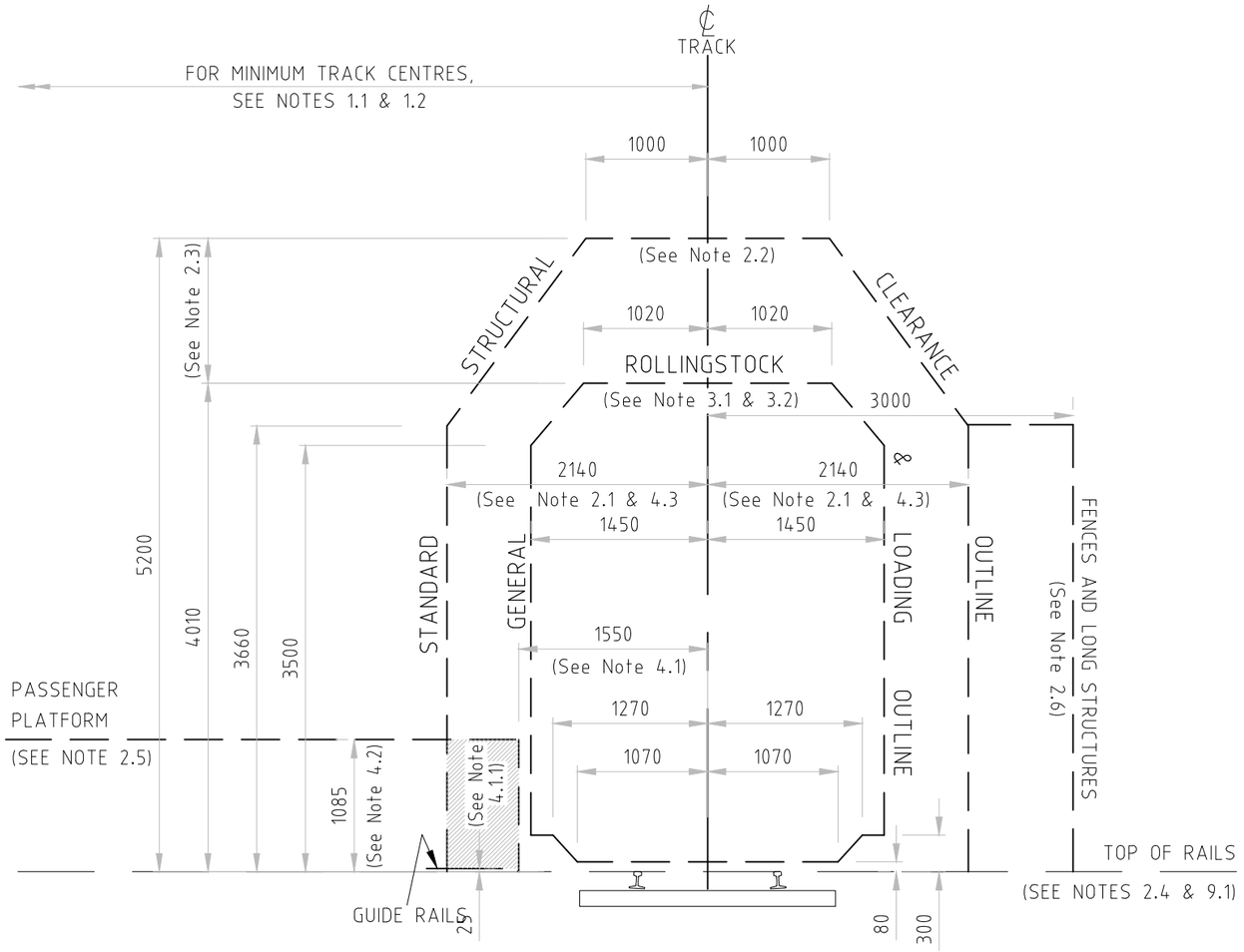
PLAN No.

1.7655

APPENDIX

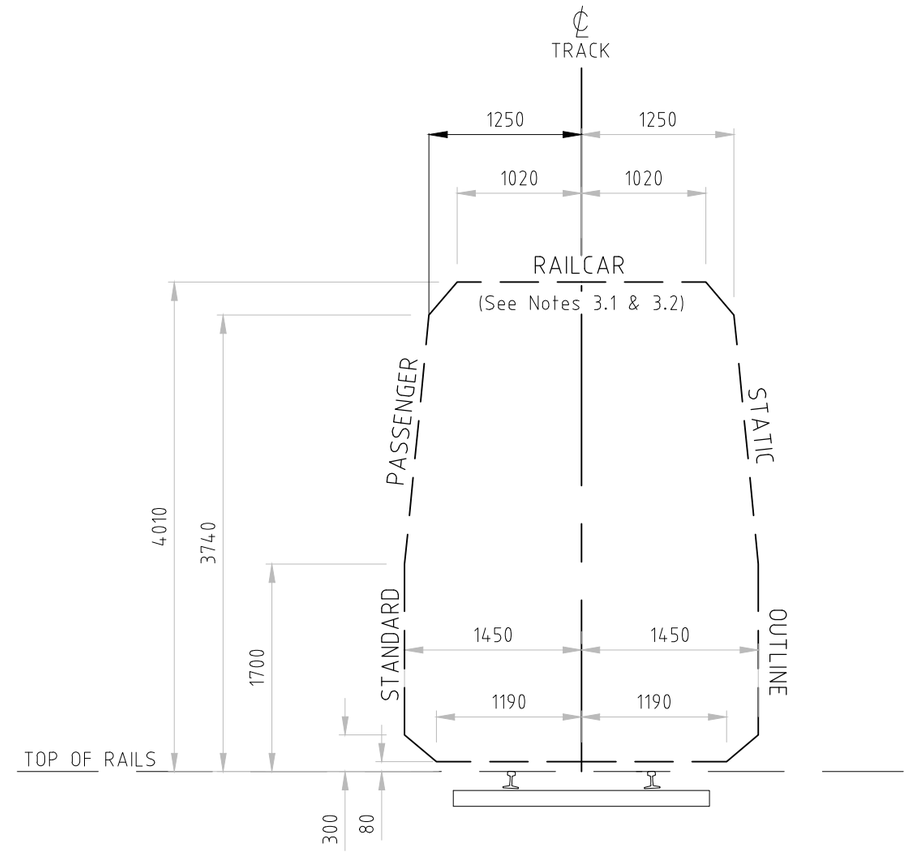
C

PTA REFERENCE DRAWINGS



STANDARD OUTLINES FOR STRUCTURAL CLEARANCE, ROLLINGSTOCK AND LOADING

(See Note 4.3)



STATIC OUTLINE FOR STANDARD PASSENGER RAILCARS

NOTES

1. All dimensions shown on this drawing are in mm.
2. For referenced notes refer drawing 00-C-04-0078
3. For Clearance and Rollingstock Outlines on Standard and Dual Gauge Lines refer drawing 00-C-04-0077
4. Supersedes Drawing 10-C-04-0042 (CE 82035/3 Sheet 1) (standard passenger outline changed at lower corner)

REV	DATE	AMENDMENT	DRN	REVD	APP
0	19.05.06	ISSUED FOR CONSTRUCTION	AWP	WPL	RH

ORIG SIZE A3 | CAD DRG PATHNAME G:\Cad\C Civil\04 Standards\00C040076_0.dwg

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XREF's

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General Manager Network & Infrastructure
Hugh Smith 25/05/06
Signature Date
General Manager Transperth Train Operations
Signature Date

SCALE : 1:50 (@ A3)
DATUM : HORIZONTAL: VERTICAL:
0 10 20 30 40 50 100 mm

DESIGNED W Parke
DRAWN A Paull
CHECKED W Parke
FILE No.

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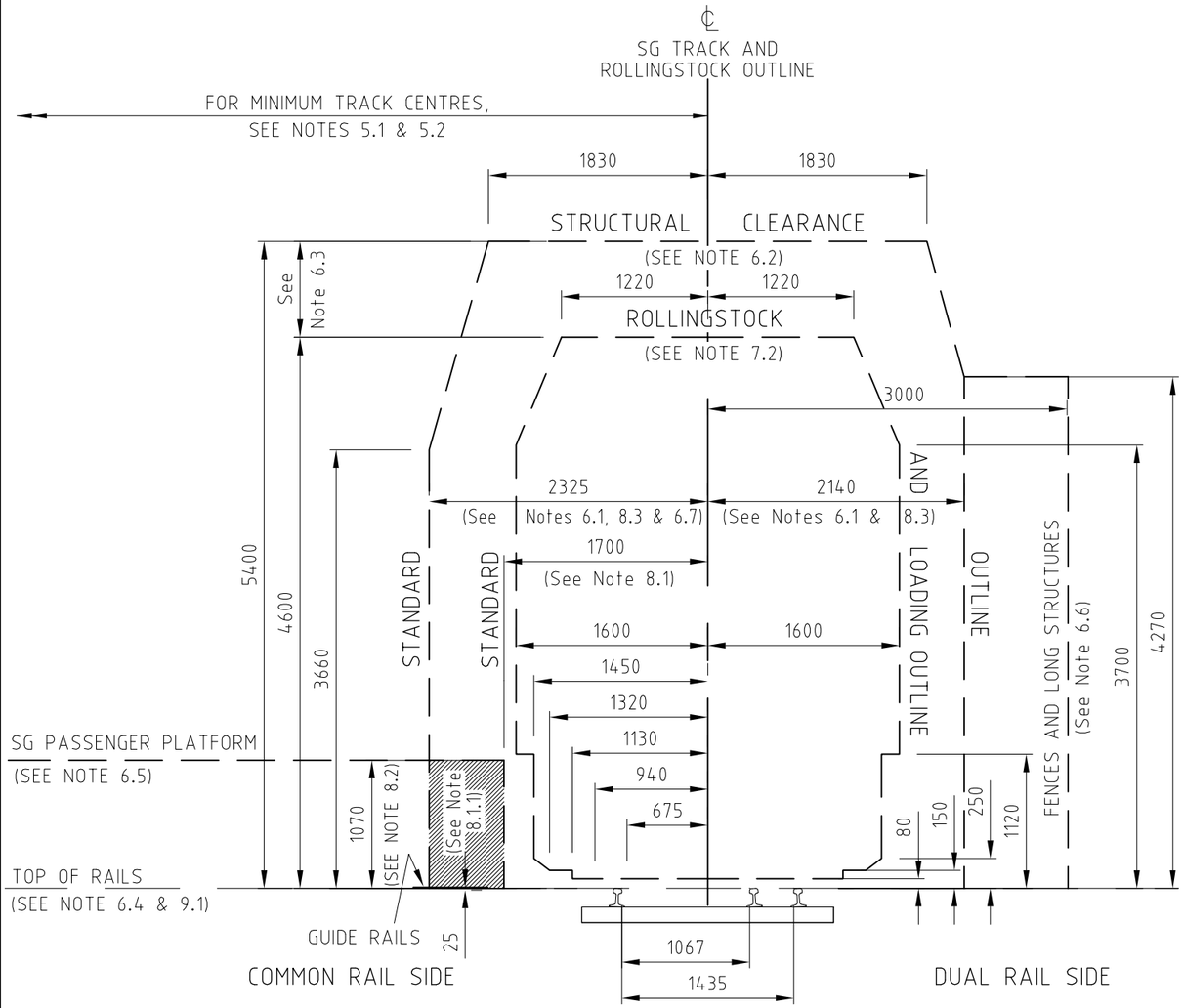
Peter Martinovich
Signature
22/05/06
Date

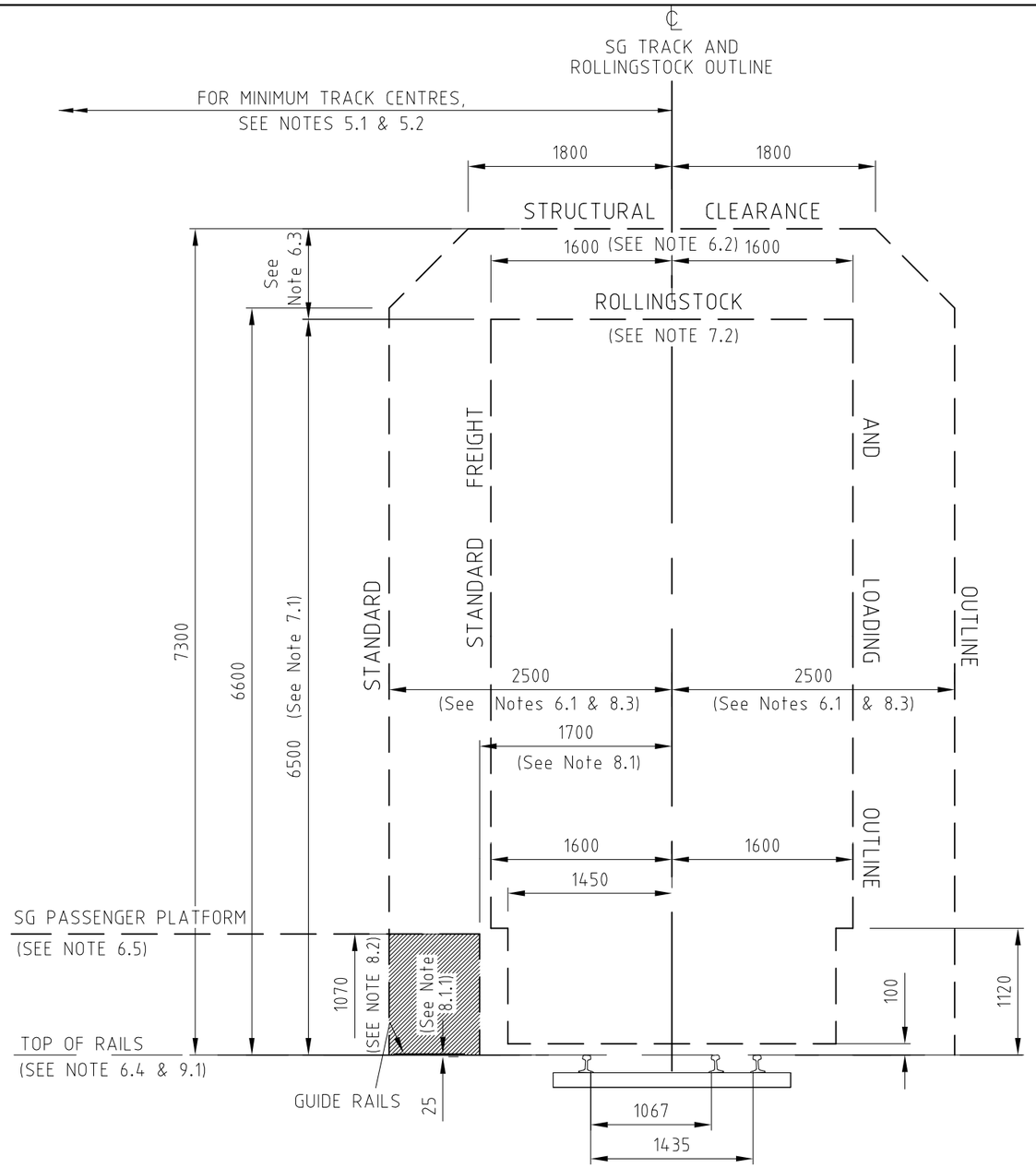
Public Transport Authority Government of Western Australia
NewMetroRail Making the Connection

STANDARDS FOR URBAN NETWORK
STRUCTURAL CLEARANCE AND ROLLING STOCK OUTLINES
NARROW GAUGE LINES

DRG No: 00-C-04-0076 REV 0



EAST PERTH - MIDLAND RAILWAY
DUAL GAUGE STRUCTURAL & STANDARD GAUGE ROLLINGSTOCK OUTLINES
(See Note 8.3)



NTH FREMANTLE - ROBB JETTY RAILWAY
STANDARD GAUGE OUTLINES
(See Note 7.1)

NOTES
1. All dimensions shown on this drawing are in mm.
2. For referenced notes refer drawing 00-C-04-0078
3. For Clearance and Rollingstock Outlines on Narrow Gauge Lines refer drawing 00-C-04-0076
4. Supersedes drawing 10-C-04-0043 (CE 82035/3 Sheet 2)

50 mm
AT ORIGINAL SCALE ONLY

REV	DATE	AMENDMENT	DRN	REVD	APP
0	19.05.06	ISSUED FOR CONSTRUCTION	AWP	WPS	RM

ORIG SIZE A3 | CAD DRG PATHNAME G:\Cad\00 Gen\C Civil\04 Standards\00C040077_0.dwg

GENERAL NOTES :
1. ALL ELECTRONIC COPIES OF THIS DRAWING SHOULD BE SUPPLIED WITH ELECTRONIC COPIES OF XREFERENCED DRAWINGS.

XREF's

ACCEPTED BY PTA
General Manager Network & Infrastructure
Hugh Smith 25/05/06
Signature Date
General Manager Transperth Train Operations
Signature Date

SCALE : 1:50 (@ A3)
DATUM : HORIZONTAL: VERTICAL:
0 10 20 30 40 50 100 mm

DESIGNED W Sarke
DRAWN A Paull
CHECKED W Sarke
FILE No.

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Peter Martinovich
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Public Transport Authority
Government of Western Australia
NewMetroRail Making the Connection

STANDARDS FOR URBAN NETWORK
STRUCTURAL CLEARANCE AND ROLLING STOCK OUTLINES
STANDARD AND DUAL GAUGE LINES

DRG No: 00-C-04-0077 REV 0

NARROW GAUGE LINES (See Sheet 1)

1. NOTES ON TRACK CENTRES

1.1 Desireable minimum track centres for tangent track.
1.1.1 Adjacent tracks with marginal masts 3700mm.
1.1.2 Central overhead traction masts 5200mm.

1.2 Minimum track centres in mm for curved track:

1.2.1 3700 or 5200 + $\frac{72250}{R}$ + 3(Ea1-Ea2) Where Ea1 is greater than Ea2

1.2.2 3700 or 5200 + $\frac{72250}{R}$ Where Ea2 is greater than Ea1

Ea1 = Cant in mm of Outer Track
Ea2 = Cant in mm of Inner Track
R = Radius in Metres

2. NOTES ON STRUCTURAL CLEARANCE OUTLINE

2.1 Minimum structural clearance of 2140mm to be increased by

$\frac{36125}{R}$ + 3Ea on the inside of a curve

Where R = Radius in metres Ea = Cant in mm
(no increase to outside of curve)

2.2 All new overhead structures are to be constructed with a minimum overhead clearance in accordance with the standard structural clearance outline except additional clearance shall be provided adjacent to and over platforms, and adjacent to level crossings where required for additional traction wire height. (See Note 2.3.)

2.3 Clearance for overhead traction power equipment to be in accordance with "The Design Supply Construction and Commissioning of 25 kvAC Traction Overhead Catenary Equipment" Doc. No. 8190-800-001.

2.4 Heights to be measured from high rail on curves.

2.5 Handrailing for staff safety and S & C equipment (Ref Drg ES-CE-143) can be built to platform clearances, vertically and horizontally.

2.6 Clearance outline to be increased for fences and long structures without refuges. Faces of masts carrying catenary systems to be located at 3100mm from track centreline.

3. NOTES ON ROLLINGSTOCK & LOADING OUTLINES

3.1 All new passenger rollingstock shall be built to the Urban Passenger Railcar Static Outline.

3.2 The maximum longitudinal dimensions for rollingstock and railcar outlines are:
i) Length over body 24 metres
ii) Bogie Centres 17 metres
iii) Bogie Centre to body end 3.5 metres
The values in Notes 1.2 and 2.1 are based upon these dimensions.

4. NOTES ON PLATFORMS AND STATION STRUCTURES

4.1 Platform Clearances

4.1.1 Platforms are a permanent infringement of the base operating standard.

4.1.2 On curves platform distance in mm from centre of track to be increased by:

4.1.2.1 Convex Platform Faces 4.1.2.2 Concave Platform Faces

$\frac{36125}{R}$ + Ea R = Radius in metres Ea = Cant in mm $\frac{36125}{R}$ - Ea

Note that concessions to these dimensions may be required for conformance to disability standard at door steps. See "Technical Instruction for the Determination of Station Platform Clearances on Curved Track", Doc No. 8140-400-001.

4.2 Platform heights on curves to be measured perpendicular to the plane of the designed cant. i.e. top of rails.

4.3 Station buildings, verandah posts, overhead masts, footbridge ramps on platforms etc are to meet the clearance requirements of "Architectural Design Guide for Stations" Doc. No. 8190-500-002.

Supersedes Drawing 10-C-04-0044 (CE 82035/3 sheet 3)

(Narrow gauge throw formulae amended to reflect 17 Metre bogie centres maximum)
(Minimum marginal mast track centres revised from 4000mm to 3700 mm)

STANDARD AND DUAL GAUGE LINES (See Sheet 2)

5. NOTES ON TRACK CENTRES

5.1 Minimum track centres for tangent track
5.1.1 Adjacent tracks 4000mm. NG to NG, SG to SG and NG to SG.
5.1.2 Central overhead traction masts:
Centres to provide for masts to be outside minimum structural clearance

5.2 Minimum track centres in mm for curved track
5.2.1 Passenger Rollingstock and Loading Outline

5.2.1.1 Tangent Centres + $\frac{83600}{R}$ + 3(Ea1-Ea2) Where Ea1 is greater than Ea2

5.2.1.2 Tangent Centres + $\frac{83600}{R}$ Where Ea2 is greater than Ea1

Ea1 = Cant in mm of Outer Track Ea2 = Cant in mm of Inner Track
R = Radius in Metres

5.2.2 Freight Rollingstock and Loading Outline

5.2.2.1 Tangent Centres + $\frac{83600}{R}$ + 4.5 (Ea1-Ea2) Where Ea1 is greater than Ea2

5.2.2.2 Tangent Centres + $\frac{83600}{R}$ Where Ea2 is greater than Ea1

6. NOTES ON STRUCTURAL CLEARANCE OUTLINE

6.1 Minimum structural clearance of 2140mm, 2325mm or 2500mm to be increased by

$\frac{41800}{R}$ + 3Ea or $\frac{41800}{R}$ + 4.5 Ea (Nth Fremantle-Robb Jetty) on the inside of a curve

Where R = Radius in metres
Ea = Cant in mm
(no increase to outside of curve)

6.2 All new overhead structures are to be constructed with a minimum overhead clearance in accordance with the standard structural clearance outline except between East Perth and Midland where additional clearance shall be provided adjacent to and over platforms and adjacent to level crossings when required for additional traction wire height. (See Note 6.3)

6.3 Clearance for overhead traction power equipment to be in accordance with "The Design Supply Construction and Commissioning of 25 kvAC Traction Overhead Catenary Equipment" Doc No. 8190-800-001.

6.4 Heights to be measured from high rail on curves.

6.5 Handrailing for staff safety and S & C equipment (Ref Drg ES-CE-143) can be built to platform clearances, vertically and horizontally.

6.6 Clearance outline to be increased for fences and long structures without refuges. Faces of masts carrying catenary systems to be located at 3100mm from track centreline.

6.7 On the common rail side the co-incident NG clearance outline governs.

7. NOTES ON ROLLINGSTOCK & LOADING OUTLINES

7.1 Current minimum wire height of 6200 on the North Fremantle to Fremantle Section preludes operation of vehicles to this outline height.

7.2 The maximum longitudinal dimensions for rollingstock and loading outlines are:
i) Length over body 25.9 metres
ii) Bogie Centres 18.3 metres
iii) Bogie Centre to body end 3.8 metres
The values in Notes 5.2 and 6.1 are based upon these dimensions.

8. NOTES ON PLATFORMS AND STATION STRUCTURES

8.1 Platform Clearances

8.1.1 Platforms are a permanent infringement of the base operating standard.

8.1.2 The platform clearance and platform height shown are for standard gauge track only. For dual gauge track, narrow gauge clearances govern. See Sheet 1 for narrow gauge clearances.

8.1.3 On curves platform distance in mm from centre of track to be increased by:

8.1.3.1 Convex Platform Faces 8.1.3.2 Concave Platform Faces

$\frac{41800}{R}$ + Ea R = Radius in metres Ea = Cant in mm $\frac{41800}{R}$ - Ea

Note that concessions to these dimensions may be required for conformance to disability standard at door steps. See "Technical Instruction for the Determination of Station Platform Clearances on Curved Track", Doc No. 8140-400-001.

8.2 Platform heights on curves to be measured perpendicular to the plane of the designed cant. i.e. top of rails.

8.3 Station buildings, verandah posts, overhead masts, footbridge ramps on platforms etc are to meet the clearance requirements of "Architectural Design Guide for Stations" Doc. No. 8190-500-002.

GENERAL NOTES (Sheets 1 and 2)

9. GENERAL NOTES

9.1 Top of rails for design will be 0 - 200mm above existing rail levels as specified by the General Manager Network and Infrastructure.

9.2 For special circumstances concessional structural clearances may be granted by the General Manager Network and Infrastructure and these shall comply with the general design procedures of the SG Code of Practice. Approved concessions shall be entered into the clearance register.

9.3 Third Party access. Procedures must be in accordance with the Railways (Access) Act 1998 and Railways (Access) Code 2000.

9.4 For Clearance and Rollingstock Outlines on Narrow Gauge Lines, refer 00-C-04-0076

9.5 For Clearance and Rollingstock Outlines on Standard and Dual Lines, refer 00-C-04-0077

REV	DATE	AMENDMENT	DRN	REVD	APP
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General Manager Transperth Train Operations
Signature Date

SCALE: NTS (@ A3)
DATUM : HORIZONTAL: VERTICAL:
0 10 20 30 40 50 100 mm

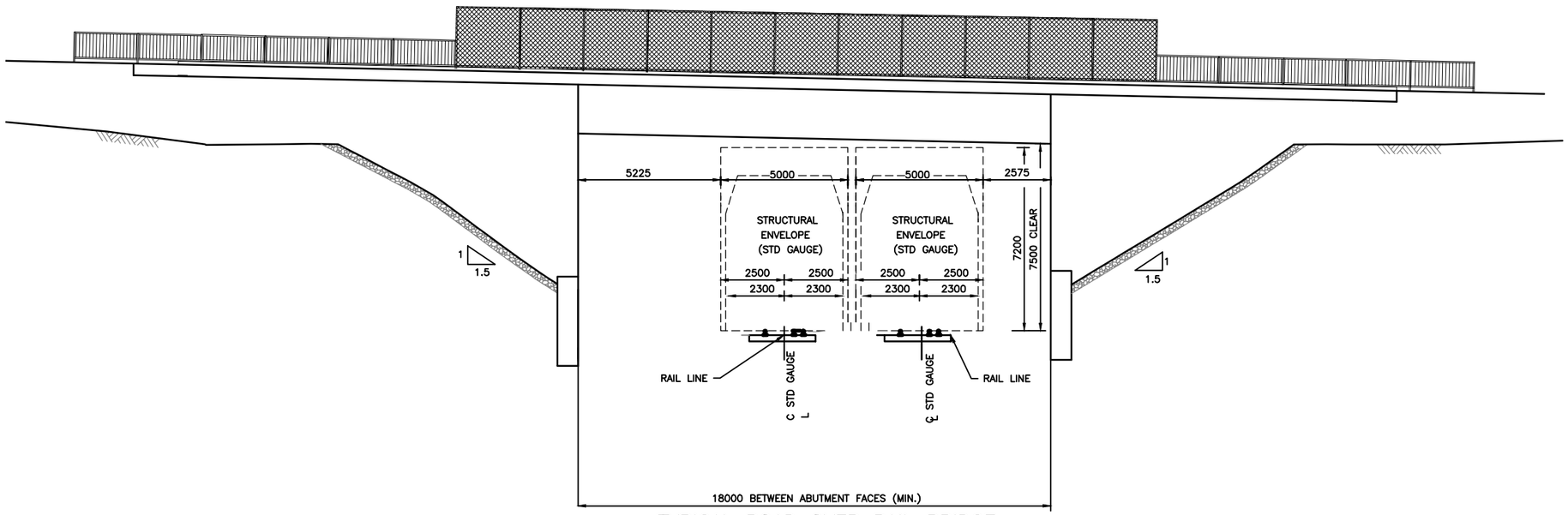
DESIGNED M Clarke
DRAWN A Paull
CHECKED M Clarke
FILE No.

APPROVED FOR ISSUE
Peter Martincevich
Signature
22/05/06
Date

Public Transport Authority Government of Western Australia
NewMetroRail Making the Connection

STANDARDS FOR URBAN NETWORK
STRUCTURAL CLEARANCE AND ROLLING STOCK OUTLINES
NOTES RELATING TO CLEARANCES

DRG No : 00-C-04-0078 REV 0



TYPICAL ROAD OVER RAIL BRIDGE
1:100

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DEPARTMENT OF PLANNING, LANDS AND HERITAGE
ROAD PLANNING STUDY FOR THE EAST WANNEROO DISTRICT PLAN

CROSS SECTION

Date	Scale	Size
11.09.2019	1:100	A1

SKETCH 02
Drawing Number

A
Revision

About Cardno

Cardno is a professional infrastructure and environmental services company, with expertise in the development and improvement of physical and social infrastructure for communities around the world. Cardno's team includes leading professionals who plan, design, manage and deliver sustainable projects and community programs. Cardno is an international company listed on the Australian Securities Exchange [ASX:CDD].

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