



**ROWE**  
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DESIGN

# LOCAL STRUCTURE PLAN

PRECINCT 2A – PICTON INDUSTRIAL PARK  
SOUTHERN PRECINCT

## DOCUMENT CONTROL

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This structure plan is prepared under the provisions of the Shire of Dardanup Local Planning Scheme No. 3.

IT IS CERTIFIED THAT THIS STRUCTURE PLAN WAS APPROVED BY RESOLUTION OF THE WESTERN AUSTRALIAN PLANNING COMMISSION ON: **25 AUGUST 2021**

Signed for and on behalf of the Western Australian Planning Commission



an officer of the Commission duly authorised by the Commission pursuant to Section 16 of *the Planning and Development Act 2005* for that purpose, in the presence of:



Witness

26 AUGUST 2021

Date

25 AUGUST 2031

Date of Expiry

## ▲ TABLE OF AMENDMENTS

AMENDMENT NO.	SUMMARY OF THE AMENDMENT	AMENDMENT TYPE	DATE APPROVED BY WAPC

## EXECUTIVE SUMMARY

Rowe Group act for the owners of Lots 103 and 110 Harris Road and Lot 436 Martin-Pelusey, Picton East and have been engaged to prepare a Local Structure Plan over the land.

The land is located south of South Western Highway and southeast of the Picton Railway marshalling yards. It is within the planned expansion of the Picton Industrial Area, within the Shire of Dardanup.

The need for this Local Structure Plan (LSP) is outlined in the *Picton Industrial Park Southern Precinct District Structure Plan* (Western Australia Planning Commission (WAPC), 2017). The area is commonly referred to as the 'Picton South DSP' area. The Picton South DSP identifies four precincts within which local structure planning should be undertaken in order to guide future subdivision and development.

The land the subject of this local structure plan comprises the eastern part of the Picton South DSP Precinct 2. For clarity this LSP area is referred to as Precinct 2A. As the land is removed from the balance of the DSP Precinct 2 area by an existing rail loop alignment and adjoining DSP identified public open space, it is logical that the remainder of Precinct 2 be the subject of a separate 'Precinct 2B' LSP. Access, servicing and development timing for 2A and 2B will occur independent of each other while respecting the intentions of the overarching Picton South DSP.

The LSP area is zoned 'Industrial Deferred' in the Greater Bunbury Region Scheme (GBRS) and 'General Farming' in the Shire of Dardanup Town Planning Scheme No.3 (TPS3). A request for the 'Lifting of Industrial Deferred' under the GBRS to 'Industrial' zone, together with concurrent rezoning under TPS3 to 'Development' zone have been prepared and accompany this LSP as a separately prepared document.

Preparation of this LSP was delayed for some time by planning for the Bunbury Outer Ring Road (BORR). The LSP lies immediately west of Martin-Pelusey Road and the former BORR alignment. Given final resolution of the BORR route by Main Roads Western Australian (MRWA) and its reflection in documentation released by the WAPC, this LSP can now be progressed.

Since the initial preparation of the Precinct 2A LSP, the WAPC has declared a Planning Control Area (PCA) for the Bunbury Outer Ring Road (BORR) and related road network. GBRS PCA1 – Bunbury Outer Ring Road, Primary Regional Road (PRR) was gazetted during May 2020 and published on the Department of Planning Land's and Heritage (DPLH) website on Friday 22 May 2020.

This originally proposed Precinct 2A Local Structure Plan already accommodated the PCA1 area as gazetted and was designed based on the related road network plans. Notwithstanding the PCA1 area does not encompass the full width of the PRR on Martin-Pelusey Road the balance of the PRR is recognised in the LSP as being retained.

The key elements guiding formulation of the LSP are:

- Integrated land use and access;
- Connected road structure linking to the wider local road network and Bunbury Outer Ring Road (BORR) and Bunbury Port;
- Identified areas of vegetation recognised;

- Integrated design and delivery with a detailed Local Water Management Strategy (LWMS);
- Management of on-site wastewater to avoid detrimental impacts on environment and wastewater, pending the longer-term viable servicing of the land with reticulated sewer; and
- Facilitation of industrial land use and development for a wide variety of general industrial land uses and supporting uses.

The Structure Plan is summarised in the following table:

## STRUCTURE PLAN SUMMARY

ITEM	DATA	SECTION NUMBER REFERENCED IN PART 2 OF REPORT
Total area covered by the Structure Plan	73 hectares	2
Land Requirement (Martin Pelusey Road Widening – Lot 544)	2.1 hectares	3.1.1
Primary Regional Road Reserve (Subject to Review)	2.44 hectares	
Area of each land use proposed:		
Industrial	68.45 hectares	5
Commercial	0 hectares	
Total estimated lot yield <i>(Based on indicative concept plan and subject to detailed design)</i>	37 lots	5.3
Estimated area and percentage of public open space given over to:		
- Local parks	3.95 hectares, 5.41%	5.2

*Note: All information and areas are approximate only and are subject to survey and detailed design.*

Consistent with the Shire of Dardanup TPS3 this Local Structure Plan has been prepared for adoption by the Shire and endorsement by the Western Australian Planning Commission (WAPC).

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## ▲ TECHNICAL APPENDICES

APPENDIX NUMBER	DOCUMENT TITLE	NATURE OF DOCUMENT	REFERRAL/APPROVAL AGENCY	APPROVAL STATUS AND MODIFICATIONS
1	Certificates of Title	Supporting	-	
2	Clause 53 Certificates	Supporting	-	
3	Environmental Assessment and Management Strategy	Supporting	Department of Biodiversity, Conservation and Attractions	
4	Bushfire Management Plan	Approval Required	Department of Fire and Emergency Services, and Local Government	
5	Local Water Management Strategy	Approval Required	Department of Water and Environmental Regulation, and Local Government	
6	Transport Impact Assessment	Supporting	Main Roads WA / Shire of Dardanup	
7	Engineering Servicing Report	Supporting	-	
8	Planning Framework – Schedule of Assessment in relation to the <i>Picton Industrial Park Southern Precinct DSP</i>	Supporting	-	



# PART ONE

IMPLEMENTATION



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# 1. STRUCTURE PLAN AREA

This Local Structure Plan (LSP) applies to Lots 436, 103 and 110 being the land generally bounded by Martin-Pelusey Road, Harris Road, Columbas Drive and the southwest railway line. The LSP area is contained within the inner edge of the line denoting the Structure Plan boundary on the Structure Plan map (Refer Plan 1 situated at the end of Part 1 of this Structure Plan report).

# 2. OPERATION

In accordance with Schedule 2, Part 4 of the Planning and Development (Local Planning Schemes) Regulations 2015, this Structure Plan shall come into operation when it is approved by the Western Australian Planning Commission (WAPC) pursuant to Schedule 2, Part 4, Clause 22 of the Regulations.

The Local Structure Plan is intended to guide subdivision, development and use of the land within the Structure Plan area.

# 3. STAGING

The proposed development is considered likely to be constructed in a number of stages (yet to be determined). It is anticipated that the landowners will commence with an application for subdivision or development (and implementation thereof) as soon as possible following endorsement of this Structure Plan.

# 4. STRUCTURE PLAN COMPONENTS

## 4.1 REPORT STRUCTURE

Part One of this document comprises the Local Structure Plan (LSP) map and guiding provisions.

Part Two provides appropriate background documentation that both demonstrates the appropriateness of the LSP content and also its design.

## 4.2 BACKGROUND TECHNICAL REPORTS

This LSP also incorporates related technical reports. These reports have directly informed the design and documentation of the LSP and include:

- ▲ Traffic Impact Assessment (Uloth, 2019)
- ▲ Local Water Management Strategy *ver G* (Emerge, February 2021)
- ▲ Infrastructure Servicing Review (Wood & Grieve, 2019)
- ▲ Environmental Assessment Management Strategy *ver C* (Emerge, February 2021)
- ▲ Bushfire Management Plan *ver C* (Emerge, February 2021)



## 5. RELATIONSHIP TO TOWN PLANNING SCHEME NO.3

The Precinct 2A Local Structure Plan has been prepared in accordance with Clause 3.1.5.7 of TPS 3 and Part 4 of the Deemed Provisions which form Schedule A to TPS 3.

## 6. SUBDIVISION & DEVELOPMENT REQUIREMENTS

Land use, subdivision, and development shall be generally in accordance with the Local Structure Plan.

### 6.1 LOT DESIGN AND LAYOUT

A minimum of 1ha applies where no connection to reticulated sewer can be provided.

### 6.2 PRIOR TO SUBDIVISION

Prior to or associated with any application for subdivision, the Western Australian Planning Commission will require the following:

- ▲ A demonstration of how the requirements included in the Environmental Assessment Management Strategy have or will be met;
- ▲ Site suitability for on-site wastewater disposal is to be demonstrated via a site-specific 'Site and Soil Evaluation Report' at the site and lot level, undertaken in accordance with Australia New Zealand Standard 1547 to the satisfaction of Department of Health;
- ▲ Site suitability for on-site wastewater disposal is to demonstrate that the proposal complies with the Government Sewerage Policy and achieves a minimum 1.5m clearance from winter ground water level for on-site effluent disposal;
- ▲ A road safety audit being conducted for the proposed road network for Lot 110 relating to the connections onto Martin-Pelusey Road and Harris Road.

### 6.3 CONDITIONS OF SUBDIVISION

The Western Australian Planning Commission may impose conditions of subdivision requiring:

- ▲ The preparation and implementation of an Urban Water Management Plan as approved by the local government in consultation with the Department of Water and Environmental Regulation;
- ▲ Lots being filled where required or in accordance with the approved Urban Water Management Plan;
- ▲ Lots being connected to roadside drainage infrastructure.

## 7. OTHER REQUIREMENTS

### 7.1 LOCAL WATER MANAGEMENT STRATEGY

A Local Water Management Strategy ('LWMS') has been prepared to support this LSP and has been developed in accordance with *Better Urban Water Management* (WAPC, 2008). The LWMS design



objectives seek to deliver best practice outcomes using a water sensitive design approach, including detailed management approaches for:

- ▲ Water supply and water conservation
- ▲ Stormwater quantity and quality management
- ▲ Groundwater level and quality management
- ▲ Wastewater servicing

The LWMS is subject to more detailed development in the future through Urban Water Management Plans ('UWMPs'). Subdivision and development of land within the LSP area should be in accordance with the principles of the LWMS and subsequent UWMPs. It is acknowledged that this detailed design may result in refinement to the final size, location and configuration of identified drainage areas, notwithstanding the principles and modelling of the LWMS are still to be met.

## 7.2 WASTEWATER MANAGEMENT

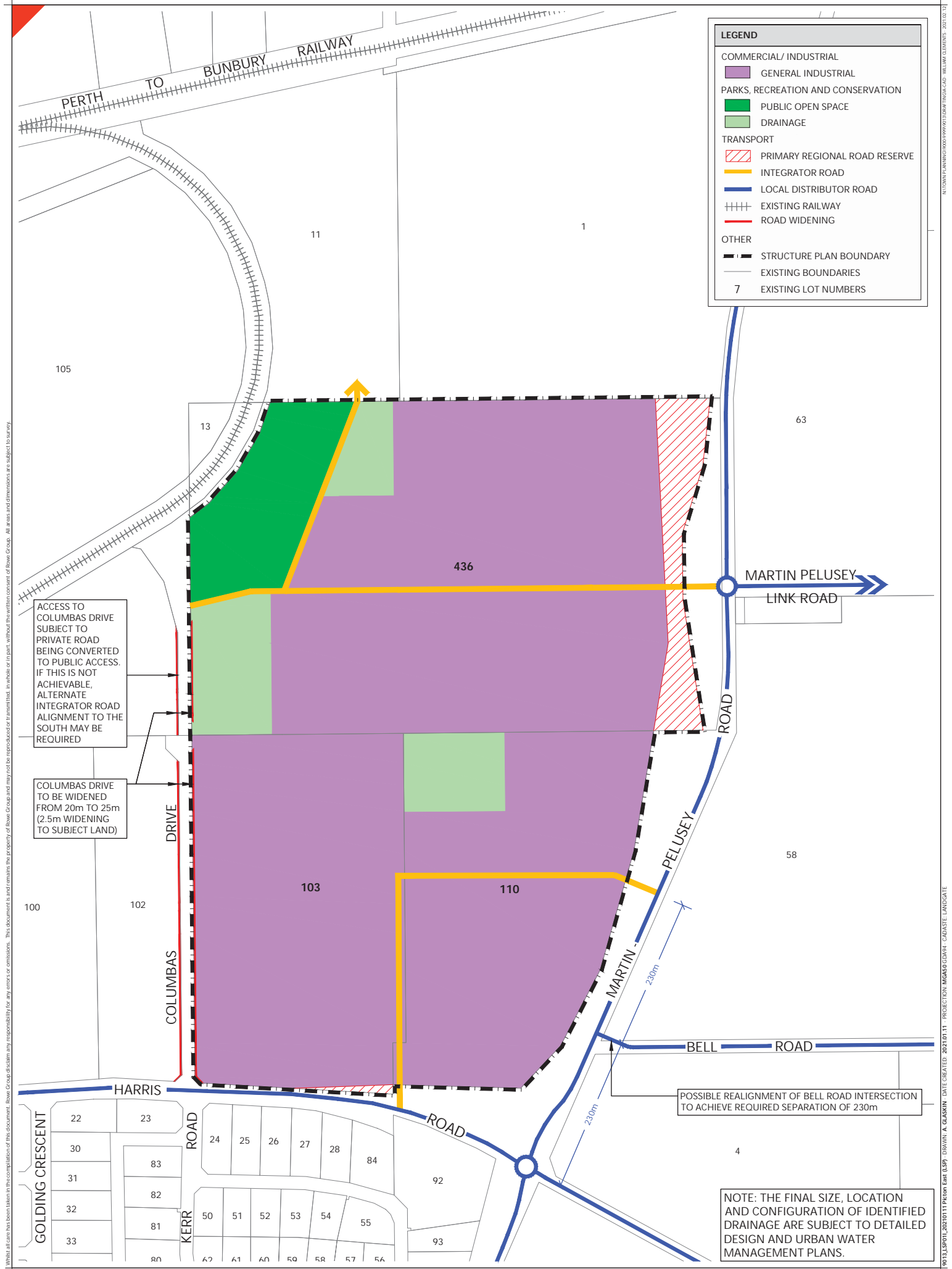
Wastewater management for land within this LSP area is subject to guidance provided within the associated LWMS. Until such time as the LSP area is serviced by reticulated sewer, wastewater management focuses on providing on-site domestic and industrial wastewater service in a manner that avoids detrimental impacts on the environment and water resources. This will be undertaken in line with the requirements of the *Government Sewerage Policy* (DPLH, 2019), *Australian Standard AS/NZS 1547:2012 Onsite Domestic Wastewater Management* (Standards Australia and Standards New Zealand, 2012) and *Water Quality Protection Note 51: Industrial Wastewater Management and Disposal* (DoW, 2009).

The LWMS demonstrates that the site is capable of being developed by following the recommendations detailed in the LWMS report. Subdivision and development within the LSP area should be undertaken having regard to these recommendations, including the requirements for Site and Soil Evaluation as outlined.

## 7.3 BUSHFIRE MANAGEMENT PLAN

This Local Structure Plan is supported by a Bushfire Management Plan ('BMP'). Any subdivision and development within the LSP area should be undertaken having regard to the BMP and its recommendations.





**LEGEND**

COMMERCIAL/ INDUSTRIAL

- GENERAL INDUSTRIAL

PARKS, RECREATION AND CONSERVATION

- PUBLIC OPEN SPACE
- DRAINAGE

TRANSPORT

- PRIMARY REGIONAL ROAD RESERVE
- INTEGRATOR ROAD
- LOCAL DISTRIBUTOR ROAD
- EXISTING RAILWAY
- ROAD WIDENING

OTHER

- STRUCTURE PLAN BOUNDARY
- EXISTING BOUNDARIES
- EXISTING LOT NUMBERS

ACCESS TO COLUMBAS DRIVE SUBJECT TO PRIVATE ROAD BEING CONVERTED TO PUBLIC ACCESS. IF THIS IS NOT ACHIEVABLE, ALTERNATE INTEGRATOR ROAD ALIGNMENT TO THE SOUTH MAY BE REQUIRED

COLUMBAS DRIVE TO BE WIDENED FROM 20m TO 25m (2.5m WIDENING TO SUBJECT LAND)

POSSIBLE REALIGNMENT OF BELL ROAD INTERSECTION TO ACHIEVE REQUIRED SEPARATION OF 230m

NOTE: THE FINAL SIZE, LOCATION AND CONFIGURATION OF IDENTIFIED DRAINAGE ARE SUBJECT TO DETAILED DESIGN AND URBAN WATER MANAGEMENT PLANS.

**LOCAL STRUCTURE PLAN**  
 LOTS 103, 110 AND 436  
 PICTON EAST

0 125 m  
 SCALE @ A3: 1:5000  
 9013-LSP-01-I



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K:\TOWN PLANNING\9013\9013\_LSP\9013\_LSP\_01\_I.dwg - CADASTRE - LANDGATE - PROJECTION: MGA84 - DATE CREATED: 2021.01.11 - DRAWN: A. GLASNIK - DATE CREATED: 2021.01.11 - PROJECTION: MGA84 - CADASTRE - LANDGATE





# PART TWO

EXPLANATORY SECTION



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# 1. PLANNING BACKGROUND

## 1.1 INTRODUCTION AND PURPOSE

Rowe Group act for the owners of Lots 103 and 110 Harris Road and Lot 436 Martin-Pelusey Road, Picton East ('the subject land') and have been engaged to prepare a Local Structure Plan over the land.

The need for this Local Structure Plan (LSP) is outlined in the *Picton Industrial Park Southern Precinct District Structure Plan* (WAPC, 2017). The area is commonly referred to as the 'Picton South DSP' area. The Picton South DSP identifies four precincts within which local structure planning should be undertaken in order to guide future subdivision and development:

- ▲ Precinct 1 comprises land north of the rail line, located between South Western Highway and the rail;
- ▲ Precinct 2 comprises land within the railway marshalling yards rail loop, together with land immediately west of the rail loop;
- ▲ Precinct 3 comprises land generally adjacent to the Ferguson River and south of Harris Road;
- ▲ Precinct 4 comprises land south of Harris Road centred around Golding Crescent and already subdivided into smaller allotments.

The land the subject of this local structure plan comprises the south eastern portion of the Picton South DSP Precinct 2. For clarity this proposed LSP area is referred to as Precinct 2A on the basis it comprises one of three such precincts:

- ▲ Precinct 2A comprises three adjoining landholdings with frontage to Columbas Drive and Harris Road that will be developed independent of the remaining Precinct 2 area and are not impacted by South Western Highway, the Picton Marshalling Yards rail loop or other issues prevalent in the balance of Precinct 2;
- ▲ Precinct 2B comprises Lots 11 and 1 immediately north of 2A and, while adjoining, will be subject to separate access, servicing and development arrangements following final determination of Martin-Pelusey Road and South Western Highway access arrangements;
- ▲ Precinct 2C comprising the balance of the Precinct 2 area north of Harris Road and west of Columbas Drive.

The Precinct 2A approach ensures future planning of surrounding properties can be undertaken by landowners as and when required. This LSP has due regard to site and context surrounds while proposing formal adoption of this LSP over Precinct 2A only.

The LSP area is zoned 'Industrial Deferred' in the Greater Bunbury Region Scheme (GBRS). A request for the 'Lifting of Industrial Deferred' under the GBRS to 'Industrial' zone, together with a request for concurrent rezoning under the Shire of Dardanup TPS3 to 'Development' zone have been prepared and accompany this LSP proposal as a separate document.



The key elements guiding formulation of the LSP are:

- ▲ Integrated land use and access;
- ▲ Connected road structure linking to the wider local road network and Bunbury Outer Ring Road (BORR) and Bunbury Port;
- ▲ Identified areas of vegetation recognised;
- ▲ Integrated design and delivery with a detailed Local Water Management Strategy (LWMS);
- ▲ Management of on-site wastewater to avoid detrimental impacts on environment and groundwater, pending the longer-term viable servicing of the land with reticulated sewer; and
- ▲ Facilitation of industrial land use and development for a wide variety of general industrial land uses and supporting uses.

## 1.2 PROJECT TEAM

The following multi-disciplinary project team has been engaged by the proponent to progress the preparation of the Structure Plan:

- ▲ Rowe Group – Town Planning and Urban Design
- ▲ Emerge – Environment, Bushfire Planning and Urban Water Management
- ▲ Stantec (Formerly Wood & Grieve) – Engineering and Servicing
- ▲ Uloth & Associates – Traffic and Transport Analysis



## 2. DESCRIPTION OF SITE

### 2.1 LOCATION

The subject land is located to the east of Picton, an established industrial area to the east of the Greater Bunbury region. The land lies south of South Western Highway and southeast of the Picton Railway marshalling yards. It is within the planned expansion of the Picton Industrial Area, within the Shire of Dardanup.

The land the subject of Local Structure Plan Precinct 2A is located within the Picton South area and comprises three (3) lots generally bounded by Martin-Pelusey Road to the east, Harris Road to the south, Columbas Drive to the west and abuts Lots 11 and 1 to the north.

The land is located within the Shire of Dardanup and lies approximately 12 km southeast of the Bunbury CBD.

**Refer Figure 1 – Regional Location and Figure 2 – Local Location**

### 2.2 AREA AND LAND USE

The Precinct 2A LSP area comprises approximately 73.129 ha. The land is currently used for general farming and grazing purposes. Lot 110 also supports a timber sales operation on the southern portion of the lot.

A 132 kV power line traverses the LSP area from west to east crossing generally at the common boundary of Lot 436 and 103 and extending through Lot 110 before crossing Martin-Pelusey Road. A low voltage line extending from this southward crosses Lot 103. Easements associated with the lines are evident on Lots 436 and 103. No easements are evident on Lot 110.

Small farm drains and dams occur across the site ultimately linking to the East Picton Main Drain managed by the Water Corporation west of the site.

**Refer Figure 3 – Site Plan**





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9013\_FIG04C\_20210111 Picton East (Regional Location) - DRAWN: ADAM GLASKIN - DATE CREATED: 2021.01.11 - PROJECTION: MGA50 GDA94 - CADASTRE: LANDGATE - N:\TOWN PLANNING\9000-9999\9013\DRAWING\GA-CAD - ADAM GLASKIN - 2021.01.11

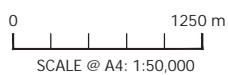


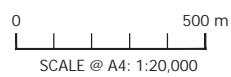
FIGURE 1  
REGIONAL LOCATION PLAN



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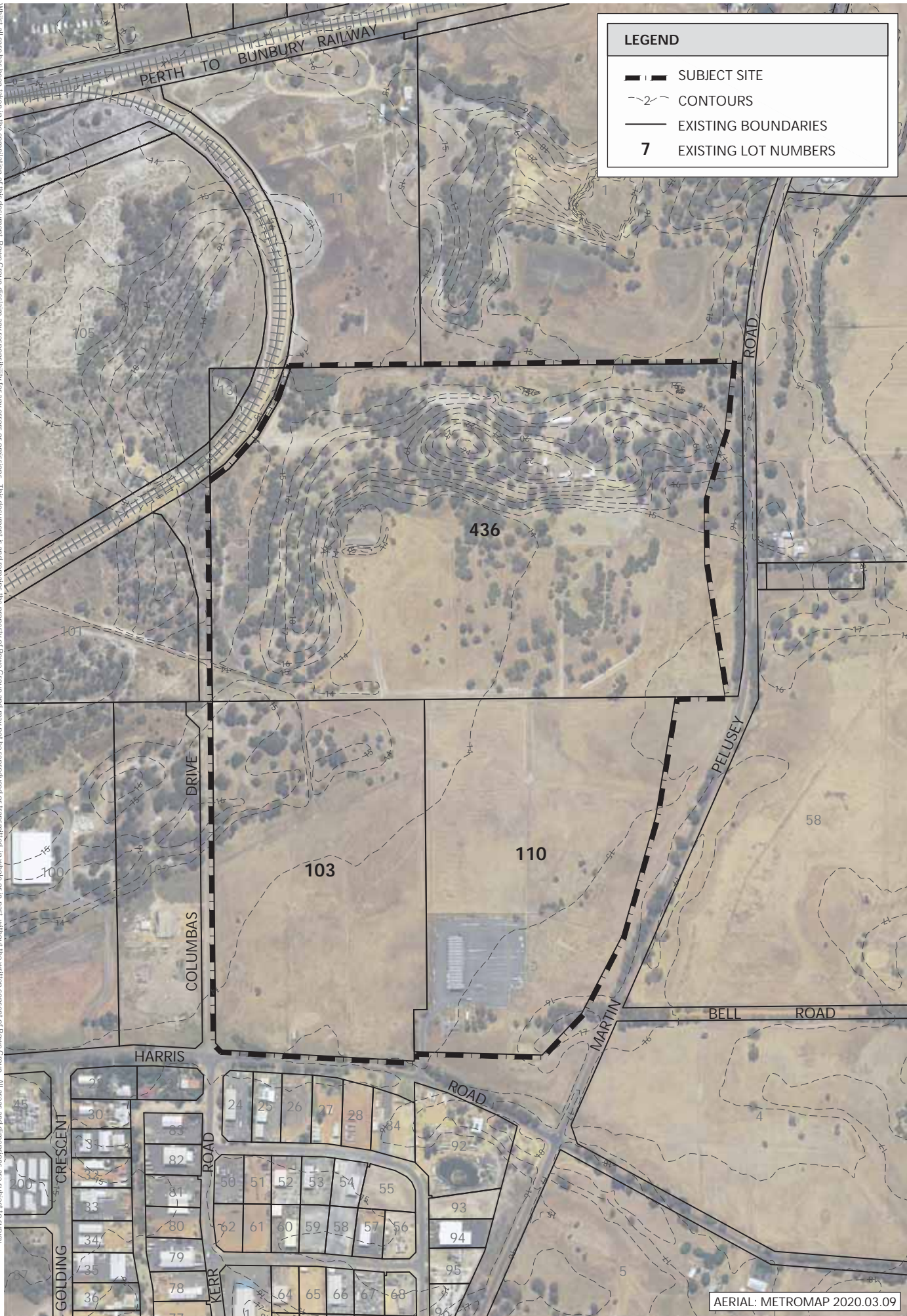
N:\TOWN PLANNING\9000-9999\9013\DRAWING\GAK-CAD - ADAM GLASKIN - 2021.01.12

9013\_FIG05C\_20200111 Picton East (Local Location) - DRAWN: ADAM GLASKIN - DATE CREATED: 2021.01.11 - PROJECTION: MGA50 GDA94 - CADASTRE: LANDGATE - AERIAL: NEARMAP 20190530



**FIGURE 2**  
**LOCAL LOCATION**

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N:\TOWN PLANNING\9000-9999\9013\DRAWING\GA-CAD - ADAM GLASKIN - 2021.01.12  
9013\_FIG06C\_20200111 Picton East (Site Plan) - DRAWN: ADAM GLASKIN - DATE CREATED: 2021.01.11 - PROJECTION: MGA50 GDA94 - CADASTRE: LANDGATE - AERIAL: NEARMAP 20191009



0 187.5 m  
SCALE @ A4: 1:7500



FIGURE 3  
SITE PLAN

## 2.3 LEGAL DESCRIPTION AND OWNERSHIP

The details of each land parcel are included within the table below.

LOT	LANDOWNER	VOLUME / FOLIO	AREA (HA)
Lot 436 Martin-Pelusey Road	Harris Road Pty Ltd	2044 / 266	37.101
Lot 103 cnr Columbas Dr & Harris Rd	Harris Road Pty Ltd	2152 / 572	17.076
Lot 110 Harris Rd	Westim Pty Ltd	2741 / 234	16.811
		<b>Total:</b>	<b>70.988</b>

**Table 1: Lot Details.**

Copies of the Certificate of Title are included within Appendix 1 to this report.





## 3. PLANNING FRAMEWORK

### 3.1 ZONING AND RESERVATIONS

#### 3.1.1 GREATER BUNBURY REGION SCHEME

The Greater Bunbury Region Scheme (GBRS) guides land use and provides the statutory framework for the zoning and reservation of land within the Greater Bunbury Region.

The subject land is predominantly zoned 'Industrial Deferred' under the GBRS with a portion of the eastern edge of Lot 436 reserved for Primary Regional Road (PRR) where it fronts Martin-Pelusey Road. This eastern strip of reserve of Lot 436 was reflected in the GBRS to accommodate the now superseded alignment for the Bunbury Outer Ring Road (BORR). This PRR as originally planned and reserved is nevertheless required to be maintained. The relationship of the LSP to Martin-Pelusey Road in this location is addressed in this LSP and the Traffic Impact Assessment (TIA) appended.

Copies of the Clause 53 Certificate for the land are included within Appendix 2 to this report.

A separate report has been prepared to accompany this LSP which outlines the zoning of the land under the GBRS and formally requests both lifting of industrial deferred and concurrent rezoning under the Shire of Dardanup Town Planning Scheme No.3 (TPS3).

The progression of this LSP, incorporating land use, traffic, servicing, water, environment and bushfire considerations and demonstrates the appropriateness of the lifting of 'Industrial Deferred'.

#### **Refer Figure 4 GBRS Zoning Plan.**

Since the initial preparation of the Precinct 2A LSP, the WAPC has declared a Planning Control Area (PCA) for the Bunbury Outer Ring Road (BORR) and related road network. GBRS PCA1 – Bunbury Outer Ring Road, Primary Regional Road was gazetted during May 2020 and published on the Department of Planning Land's and Heritage (DPLH) website on Friday 22 May 2020.

This proposed Precinct 2A Local Structure Plan already accommodates the PCA1 area as gazetted and was designed based on the related road network plans. The LSP also recognises the balance of the PRR and the expectation that it is to be retained.

#### 3.1.2 SHIRE OF DARDANUP TPS3

The subject land is zoned 'General Farming' under TPS3, along with the above-mentioned portion of land reserved for PRR associated with the former BORR alignment.

As noted above, this LSP is accompanied by an associated report requesting the 'Lifting of Industrial Deferred' over the land. The lifting request will be followed by a subsequent, separate request to the Shire to amend TPS3 from 'General Farming' to 'Development' Zone.

The aim of the 'Development' Zone is to facilitate the planning of land through a comprehensive Structure Plan in accordance with Clause 3.15.7 of TPS3 and the Deemed Provisions.

#### **Refer Figure 5 TPS 3 Zoning Plan.**



## 3.2 REGIONAL PLANS AND STRATEGIES

### 3.2.1 INDUSTRY 2030

The *Industry 2030: Greater Bunbury Industrial Land and Port Access Planning Final Report* (WAPC, 2000) documented the outcome of community consultation and related technical studies. These studies included the *Preston Industrial Park Land Use and Port Access Study*. The report included an 'Interim Strategy Plan' which identified the subject land as 'Secondary General Industry Precinct' and 'Transitional Industry Precinct'. The plan was, as its title indicates, intended as an interim guide pending more detailed technical investigations regarding traffic, environmental and water management considerations. Notwithstanding, the Industry 2030 report highlights the subject land's identification for general industrial.

### 3.2.2 GREATER BUNBURY STRATEGY

The *Greater Bunbury Strategy Final Report* (WAPC, 2013) was prepared to guide urban, industrial and regional land use planning; and associated infrastructure delivery in the Greater Bunbury sub-region in the short, medium and long terms. The Strategy provides for land use requirements to accommodate growth of the region's population from 84,000 to over 150,000.

The Strategy includes a 'Sub-regional Structure Plan 2013'. The land the subject of this LSP is identified as 'Industrial Expansion' in the Structure Plan.

### 3.2.3 SOUTH WEST REGIONAL PLANNING & INFRASTRUCTURE FRAMEWORK

The *South West Regional Planning and Infrastructure Framework - Parts A and B* (WAPC, 2015) provide the overall strategic context for land use planning in the South West Region of Western Australia.

In relation to Strategic Industrial Areas, section 6.8.3 of Part A recognises that, through the *Greater Bunbury Strategy*, the WAPC has planned additional industrial areas to accommodate general industry in the Greater Bunbury Area including the Preston Industrial Park. The subject land is within this area.

## 3.3 DISTRICT PLANS

### 3.3.1 PICTON INDUSTRIAL PARK SOUTHERN PRECINCT DISTRICT STRUCTURE PLAN

The Picton Industrial Park Southern Precinct is located to the east of Picton, the existing industrial area within the eastern part of Greater Bunbury. The *Picton Industrial Park Southern Precinct District Structure Plan* (WAPC, 2018) ('the Picton South DSP') outlines the key planning considerations for development of the area. As outlined above, the Picton South DSP represents the latest DSP for the wider Preston Industrial Park covering approximately 2950 hectares originally identified in the *Industry 2030* report.

The Picton South DSP provides a high-level guide to the planning requirements for the area, for industrial use, together with associated infrastructure and designations for regional open space and other reserves. It is relevant to note that the DSP indicates "*The former Office of the Environmental Protection Authority (OEPA), now part of the Department of Water and Environmental Regulation, previously provided advice and guidance on the environmental issues associated with*



remnant vegetation within the Preston Industrial Park (EPA, 2008) and identified key areas for retention. These are reflected in the DSP." (piii).

The land the subject of this DSP lies within the Picton South DSP and a number of elements within the DSP are worth noting:

- ▲ the subject land is identified as 'General Industry';
- ▲ the DSP recognises the final BORR alignment has moved southeast of Martin-Pelusey Road and Martin-Pelusey Road is shown as an 'Integrator Road';
- ▲ Harris Road is shown as a 'Local Distributor Road';
- ▲ Columbas Road is shown as a 'Local Distributor Road' and shown as indicatively extending west across the existing railway marshalling yards rail loop before turning south to again cross the rail loop and intersect Harris Road;
- ▲ Public Open Space areas to the west of Columbas Road are also identified.

The Picton South DSP identified four precincts within which more detailed structure planning should occur. These range in size from Precinct 1 (29 hectares) to Precinct 2 (347 hectares). Subdivision and development requirements are outlined within the DSP for each precinct.

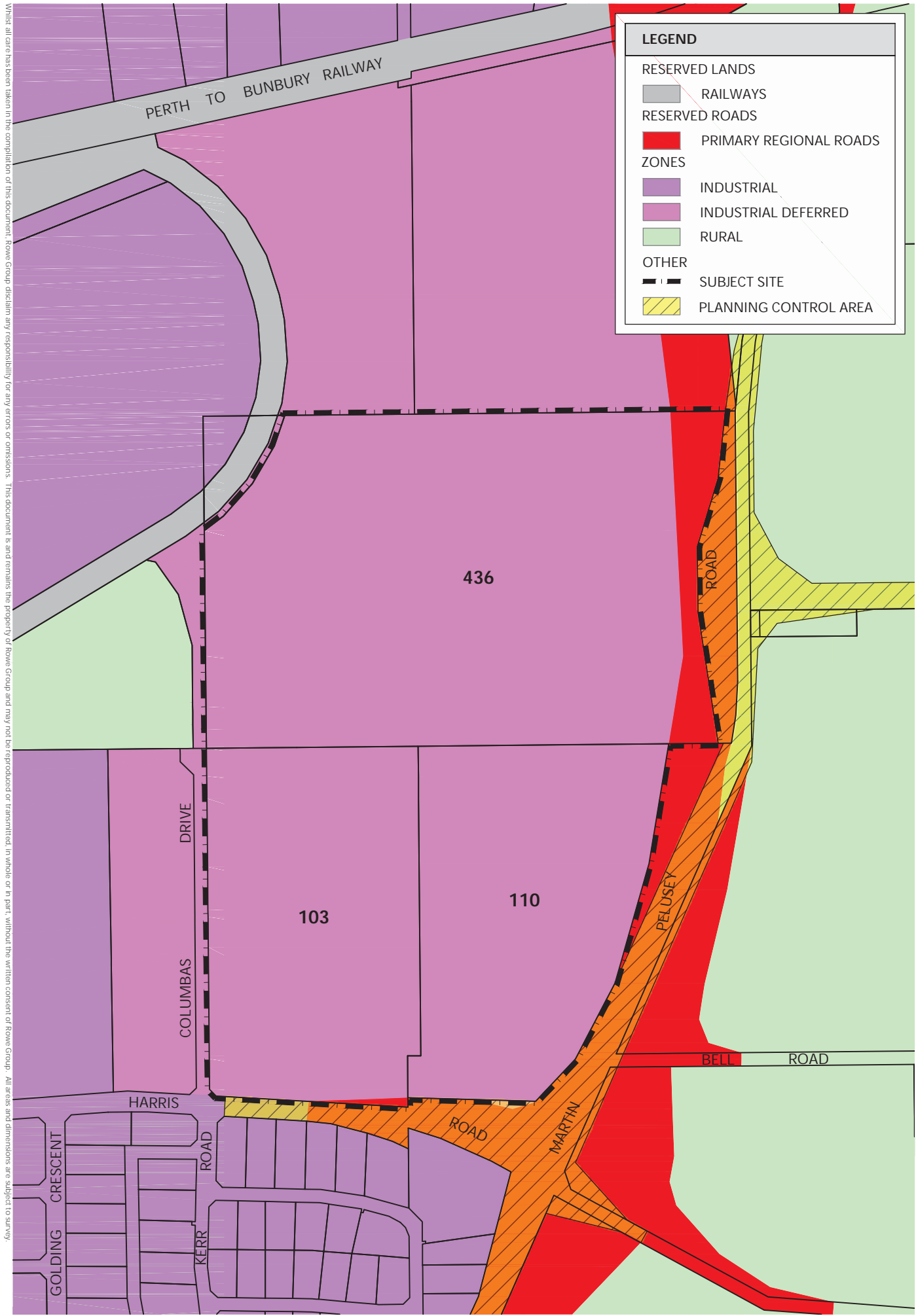
The land the subject of this Local Structure Plan is located within Precinct 2 of the DSP. Given the significant size of the precinct, this Local Structure Plan further divides Precinct 2 into more manageable local planning precincts, while responding to the elements outlined in the Picton South DSP. A detailed assessment of this LSP against DSP elements comprises Appendix 8.

### 3.4 WATERLOO INDUSTRIAL PARK DISTRICT STRUCTURE PLAN

The *Waterloo Industrial Park District Structure Plan* (WAPC, 2020) was adopted by the WAPC in February 2020. The DSP includes a 'Regional Context of Waterloo Industrial Park' Plan, identifying the Preston Industrial Park Southern Precinct (the Picton South DSP area including the subject land), the Waterloo Industrial Park DSP area east of the subject land, and the Wanju urban residential DSP area to the north east of the subject land.

The Waterloo Industrial DSP is directly relevant to the subject land and this LSP as it facilitates the delivery of an integrated local road network. The local road network will provide much-needed connectivity to the newly endorsed BORR alignment east of the Waterloo DSP boundary.

**Refer Figure 6 – Location Context for Picton Industrial Park Southern Precinct.**



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9013\_FIG07C\_20210111 Picton East (GBRS ZONING) : DRAWN: ADAM GLASKIN : DATE CREATED: 2021.01.11 : PROJECTION: MGA50 GDA94 : CADASTRE: LANDGATE : MAP DATA: DPLH

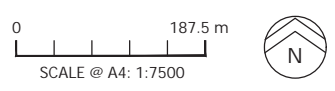
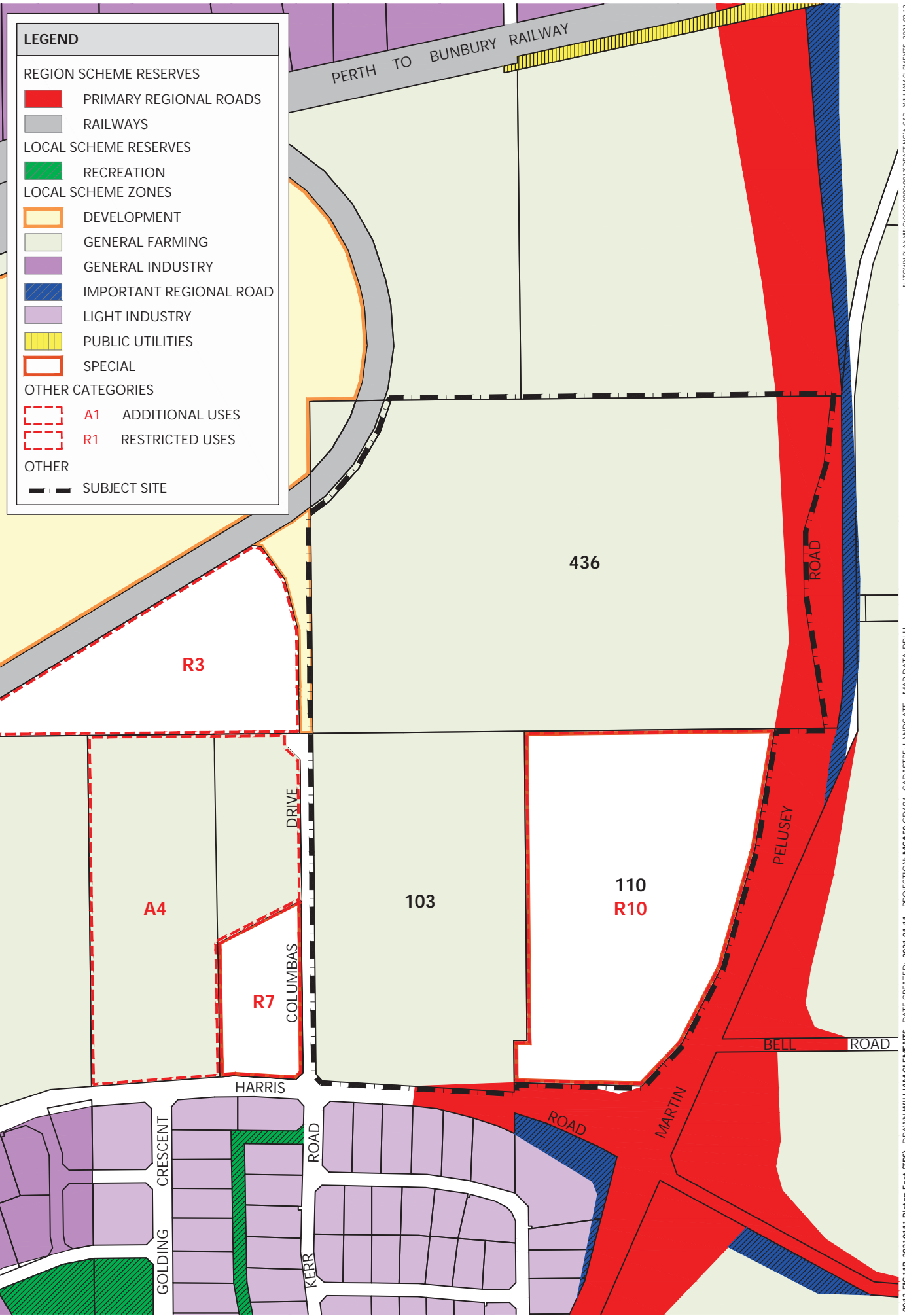
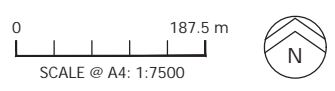


FIGURE 4  
GREATER BUNBURY REGION SCHEME ZONING

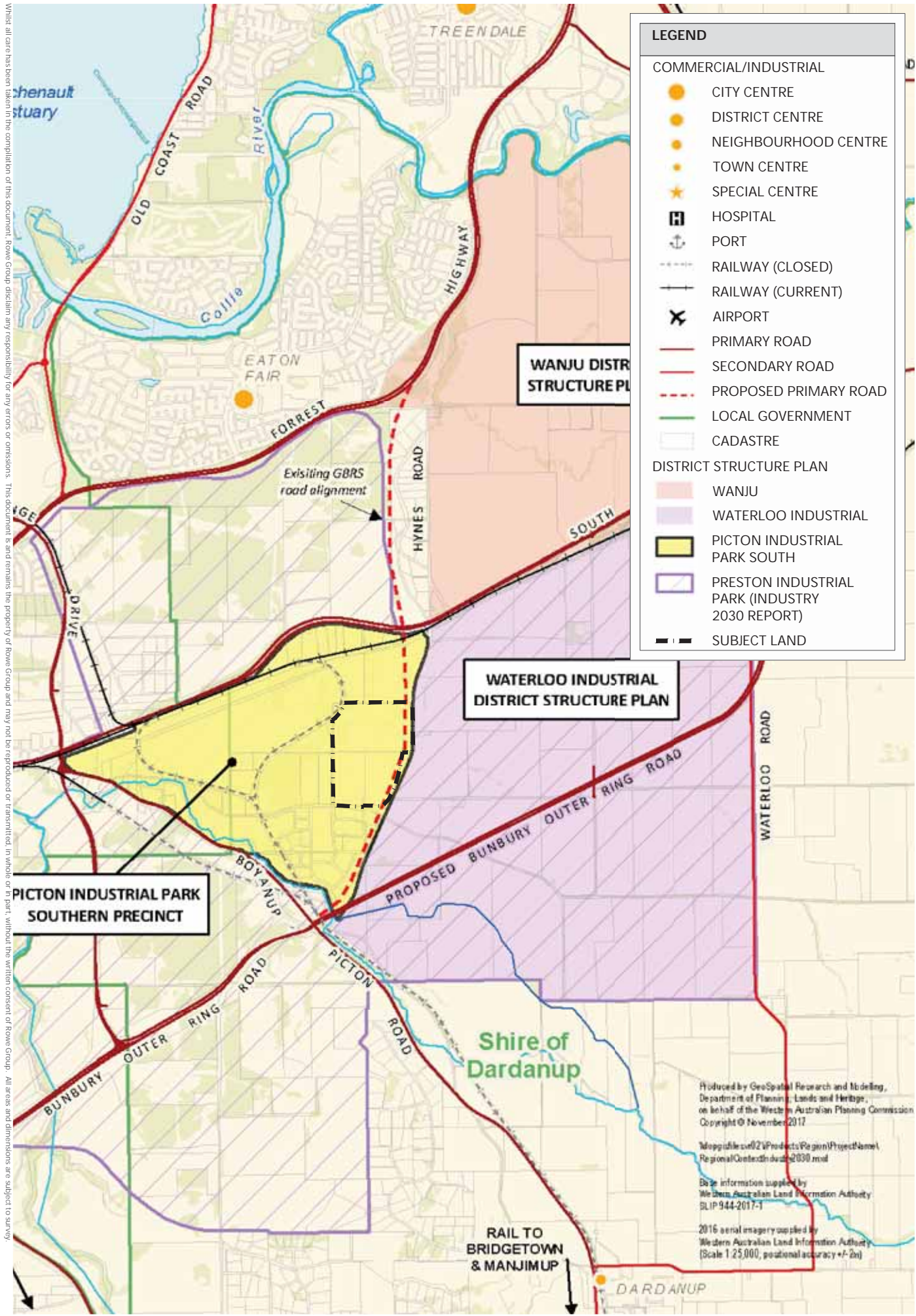
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9013.FIG11B\_20210111 Picton East (TPS) - DRAWN: WILLIAM CLEMENTS - DATE CREATED: 2021.01.11 - PROJECTION: MGA50 GDA94 - CADASTRE: LANDGATE - MAP DATA: DPLH



**FIGURE 5**  
**SHIRE OF DARDANUP TOWN PLANNING SCHEME No. 3 ZONING**



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9013.FIG09A\_20190814 Picton East (Picton Industrial Context) - DRAWN: ADAM GLASKIN - DATE CREATED: 2019.08.14 - PROJECTION: MGA50 GDA94 - MAP DATA: DPLH

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Data information supplied by  
 Western Australian Land Information Authority  
 SLIP 944-2017-1

2016 aerial imagery supplied by  
 Western Australian Land Information Authority  
 (Scale 1:25,000, positional accuracy +/- 2m)



FIGURE 6  
 LOCATION CONTEXT FOR PICTON INDUSTRIAL PARK SOUTHERN PRECINCT

## 3.5 OTHER DISTRICT STRUCTURE PLANS

Other District Structure Plans of relevance to this LSP are:

- ▲ *Preston Industrial Park (Northern Precinct) Structure Plan* (WAPC, 2009): Also known as the Picton North District Structure Plan, this DSP recognises the anticipated southern expansion of the Preston Industrial Park into what encompasses the Picton South DSP area and including the subject land;
- ▲ *Wanju District Structure Plan* (WAPC, 2020): endorsed by the WAPC in March, this document sets out the key planning parameters for new urban development northeast of the land the subject of this structure plan. As one of three newly developing areas (the subject land and surrounds as Picton South, the Waterloo Industrial DSP and Wanju) it is directly connected through the regional and district road networks now established and will provide long term housing choice to workers within the industrial areas. The area is connected to and accesses the subject land via Martin-Pelusey Road;

## 3.6 STATE PLANNING POLICIES

### 3.6.1 STATE PLANNING POLICY 3.7 - PLANNING IN BUSHFIRE PRONE AREAS

SPP3.7 and the WAPC's associated Guidelines provide guidance on the management of bushfire risk within bushfire prone areas throughout Western Australia. The policy is relevant to this LSP given a portion of the LSP area, and land adjoining, are identified as bushfire prone.

In response to the policy obligations of SPP3.7 a Bushfire Management Plan (BMP) has been prepared which considers the site context surrounding, the current, and the post-development circumstances for bushfire risk. This is discussed further in the report and the BMP is appended.

### 3.6.2 DRAFT STATE PLANNING POLICY 4.1- INDUSTRIAL INTERFACE

The draft SPP 4.1 Industrial Interface Policy was released by the WAPC in November 2017 and remains in draft following completion of advertising in February 2018. It is intended to replace earlier versions of the policy released in 2009 and 2007.

The Local Structure Plan accords with SPP4.1 by:

- ▲ recognising regional and district level planning endorsed in the Picton South DSP;
- ▲ proposing an appropriate mix of industrial development that does not include heavy or noxious industry; and
- ▲ adequately providing for the access and servicing of subdivision and development.

In the context that the subject land, the broader Picton South DSP area, and the adjoining Waterloo Industrial Park DSP area are identified for General Industry, there are no interface implications to be considered in the context of SPP4.1.



### 3.6.3 STATE PLANNING POLICY 5.4 – ROAD AND RAIL NOISE

This policy became operational in September 2019 and replaces the earlier SPP 5.4 released in 2009. The policy seeks to minimise the adverse impact of road and rail noise on noise-sensitive land use and / or development within specified distances.

The policy references noise sensitive land uses as being determined by a local planning scheme or structure plan that is occupied or designed for occupation or use for residential purposes, caravan park, camping ground, education, childcare, hospital, or place of worship.

While the proposed LSP and the surrounding Picton South DSP area lie in proximity to both regional road and rail infrastructure, no sensitive land uses are proposed within this LSP. In addition, the subject land does not lie within the prescribed distances to such infrastructure.

The Local Structure Plan accords with SPP4.1 by:

- ▲ recognising regional and district level planning endorsed in the Picton South DSP;
- ▲ proposing an appropriate mix of industrial development that does not include heavy or noxious industry; and
- ▲ adequately providing for the access and servicing of subdivision and development.

## 3.7 OTHER GOVERNMENT POLICIES, APPROVALS AND DECISIONS

- ▲ *Government Sewerage Policy (2019)*: this policy sets the State Government's position on how sewerage services are to be provided in W.A. through the planning and development of land.

The Policy defines sewage sensitive areas as, inter alia, estuary catchments on the Swan and Scott Coastal Plains. The DPLH online policy mapping shows the land the subject of this LSP as lying within estuary catchment. Notwithstanding this, both the Picton South DSP, and Waterloo Industrial Park DSP acknowledge that reticulated sewer is not currently available to the locality.

Industrial development within the proposed LSP will be serviced by appropriately sited on-site wastewater treatment systems. The type, size, siting and use of aerobic treatment units will be determined at the time of individual development.

- ▲ *Development Control Policy 4.1 – Industrial Subdivision (DC4.1)* is an operational policy of the WAPC and provides guidance on matters considered by the WAPC when determining applications of industrial subdivision. The design of the LSP has taken into account future requirements under DC4.1.

## 3.8 PRE-LODGEMENT CONSULTATION

As part of the preparation of this LSP, consultation was undertaken with representatives of:

- ▲ Department of Planning, Lands & Heritage (DPLH)
- ▲ Shire of Dardanup





▲ Main Roads Western Australia

The document has been finalised having regard to matters identified during those meetings and subsequent discussions.



## 4. SITE ATTRIBUTES

The following provides a summary of site conditions and constraints. The structure plan is accompanied by more detailed technical reports referenced in each section of Part 4.

An Environmental Assessment and Management Strategy (EAMS), a Local Water Management Strategy (LWMS) and a Bushfire Management Plan (BMP) have been completed by Emerge and are included as Appendices. Similarly, a Transport Assessment Report by Uloth & Associates and an Engineering Servicing Report by Wood & Grieve are also appended to this LSP.

### 4.1 TOPOGRAHPY & SOILS

#### 4.1.1 TOPOGRAPHY

The majority of the southern portion of the subject site is relatively flat at approximately RL13m AHD to RL14m AHD. An elevated area exists in the northern area of the subject site (extending parallel to the northern and western boundaries and lies at RL16m AHD to RL22m AHD). The flatter areas of the site are generally clear of vegetation, with the elevated area supporting greater vegetation. The site is underlain by fine to medium grained sands with clayey sands of the Guildford Formation at depth. Yellow Bassendean sands are located in the areas of higher elevation.

#### 4.1.2 SOILS

Regional mapping and previous soil investigation undertaken on site in 2010 (reviewed in the EAMS appended to this report) confirm the site comprises of Guildford formation alluvial sandy clay, Bassendean sand and thin Bassendean sand over Guidford formation.

#### 4.1.3 ACID SULFATE SOILS

The Department of Water and Environmental Regulation Acid Sulphate Soil Risk Mapping identifies the subject site as having a "moderate to low" Acid Sulphate Soils (ASS) risk. This is consistent with the broader surrounding area which is similarly moderate to low. Review of the risk of ASS would be undertaken at detailed subdivision design and development to review the need for any further investigation.

#### 4.1.4 POTENTIAL CONTAMINATION

The DWER Contaminated Sites Database does not list the subject site as being a known or suspected contaminated site. The EAMS notes that there are also no locally listed sites that would impact this LSP. Historic agricultural use of the land is considered unlikely to raise significant risk of contamination.

### 4.2 VEGETATION, FLORA & FAUNA

The EAMS completed by Emerge to inform this LSP concludes that there are no significant environmental constraints to industrial development of the subject site.

The EAMS is included as Appendix 3.



## 4.2.1 VEGETATION & FLORA

Given historic clearing and associated agricultural land uses, vegetation and flora within the site has been significantly modified, with all areas of remnant native vegetation on the subject site categorised as 'completed degraded'.

No threatened ecological communities (TECs) were identified within the site, nor are any likely to occur given the degraded nature of vegetation within the LSP area. The EAMS also notes that no threatened or priority flora species have been identified within the site, nor are any likely to occur for the same reasons.

Notwithstanding the above, the EAMS does encourage the consideration of tree retention opportunities (in addition to areas of public open space) as part of future detailed design and development. Where finished earthworks levels permit this should be considered.

## 4.2.2 FAUNA

The EAMS prepared to accompany this LSP notes that a number of conservation significant fauna species were identified as utilising vegetation within the site, including the western ringtail possum and the three black cockatoo species (Carnaby's, Baudin's and the forest red-tailed cockatoo). In addition to the retention of vegetation as proposed within open space, other retention opportunities should therefore be considered at detailed design stage. This may require site specific fauna investigations.

## 4.2.3 ECOLOGICAL LINKAGES AND ENVIRONMENTALLY SENSITIVE AREAS

The EAMS notes that no mapped ecological linkages, identified through the South West Biodiversity Project, occur within the subject site. The nearest is located approximately 870m west of the subject site and will not be affected by this LSP.

Environmentally sensitive areas (ESAs) as prescribed under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* are identified to protect native vegetation values around significant threatened or scheduled flora, vegetation communities or ecosystems. No ESAs occur within or are in proximity to the subject site.

## 4.3 HERITAGE

### 4.3.1 INDIGENOUS HERITAGE

A search of the subject site using the Department of Aboriginal Affairs ('DAA') Aboriginal Heritage Inquiry System identified there are no Registered Aboriginal Heritage Sites within the subject site. An 'Other Heritage Plan' is identified approximately 20m to the south of the subject site, being Site ID 18886 Bunbury Bypass Archaeological Site 3.

Importantly, the subject land lies within an area where heritage surveys have been completed and, given the extent of previous surveys the EAMS notes that it is unlikely any Aboriginal heritage sites exist within the site.



### 4.3.2 EUROPEAN HERITAGE

The EAMS completed searches of the Australian Heritage Database, the State Heritage Office database and the Shire of Dardannup Local Government Inventory and notes that there are no registered heritage sites within the LSP area.

## 4.4 WATER MANAGEMENT

A Local Water Management Strategy (LWMS) has been prepared by Emerge to accompany the structure plan. A summary of existing conditions is provided below.

### 4.4.1 GROUNDWATER

The EAMS notes that groundwater monitoring undertaken shows a depth to maximum groundwater level ranged from 0.05 m to 3.4m below natural surface. Seasonal fluctuations indicate a variance from 0.25m to 2.7m. Monitoring indicates groundwater flows are generally from the southeast to the northwest corner of the subject site.

### 4.4.2 SURFACE WATER

Small farm drains and dams occur across the site and ultimately contribute to a major drain that is currently managed by the Water Corporation. These drains ultimately discharge into the Ferguson River before entering the Preston River. Pre-development surface runoff modelling determined that the majority of the site is located within a catchment that discharges beneath the railway loop to the west of the site at a rate of 0.96 m<sup>3</sup>/s in the 1% average exceedance probability (AEP) rainfall event. A small portion of the site discharges north into a trapped low point.

### 4.4.3 WETLANDS

Wetlands are areas which are permanently, seasonally or intermittently waterlogged or inundated with water. Naturally occurring wetland features are common across the Swan Coastal Plain and can contain fresh or salty water, which may be flowing or still. The EAMS review of geomorphic wetlands within the LSP area indicates that there are several multiple use wetlands. Multiple Use Wetlands (MUWs) contain few wetland attributes but still provide hydrological functions. Use, development and management can be reviewed through this LSP process and has been considered in the hydrological review undertaken as part of the Local Water Management Strategy (LWMS) appended.

### 4.4.4 PUBLIC DRINKING WATER SOURCE AREAS

The site is not located within a PDSWA and there are no wellhead protection zones where public drinking water is extracted either within or in proximity to the subject site.

## 4.5 BUSHFIRE MANAGEMENT

The LSP area is located within a Department of Fire and Emergency Services (DFES) Bushfire Prone Area (2018). A Bushfire Management Plan (BMP) has been prepared in accordance with the *Guidelines for Planning in Bushfire Prone Areas* (WAPC 2018) (the 'Guidelines').

The BMP is included as Appendix 4.



The BMP considers the bushfire hazards surrounding the subject site and the associated bushfire risk is readily manageable through standard management responses. On implementation of the proposed management measures, the subject site will be able to be developed with a manageable level of bushfire risk while maintaining full compliance with the relevant controls.

From a bushfire hazard management perspective, the key issues and the responses identified in the BMP that are likely to require management include:

- ▲ **Location:** all proposed buildings can be located in an area subject to a low or moderate bushfire hazard, given buildings will be located within areas identified as low threat in accordance with Clause 2.2.3.2(e) of AS 3959.
- ▲ **Siting and Design:** all future built form can be sited within the proposed development so that BAL-29 or less can be achieved based on the proposed local structure plan and separation to nearby hazards through the location of public roads and/or through the use of in-lot setbacks. The development areas adjoining the northern, western and southern boundaries of the site are likely to include areas subject to a BAL rating of BAL-FZ, however the future lots can be suitably sized to accommodate built form that will not be exposed to a BAL rating exceeding BAL-29. The proposed public open space in the north-western corner of the site is intended to be revegetated and will therefore be considered a bushfire hazard. However suitable separation from this area can be provided based on the proposed road layout and use of in-lot setbacks.
- ▲ **Vehicular Access:** appropriate vehicle access can be provided, with the proposed development connecting to the existing public road network including Martin-Pelusey Road immediately east of the site, Harris Road immediately south of the site, Columbas Drive to the west of the site, and future industrial development to the north of the site. The site will have two connections to Martin-Pelusey Road which is a major regional connector road and provides egress opportunities to the north and south, including to South Western Highway and Boyanup-Picton Road.
- ▲ **Water:** the development will be provided with a permanent and reticulated water supply to support onsite firefighting requirements.

## 5. LAND USE AND SUBDIVISION REQUIREMENTS

### 5.1 LAND USE

This Precinct 2A – LSP sets out land use, open space, environmental, servicing, bushfire and movement considerations. The LSP provides for General Industrial use over the full extent of the LSP area and is to be serviced by road connections linking Martin-Pelusey Road to Columbas Drive and to Harris Road.

**Refer Plan 1 – Local Structure Plan Map and the Structure Plan Summary Table.**

### 5.2 PUBLIC OPEN SPACE & DRAINAGE

The proposed LSP identifies one (1) area of public open space and three (3) areas for drainage in response to identified environmental attributes and the Local Water Management Strategy (LWMS). These are additional to the Picton South DSP and reflect the EAMS and LWMS prepared for this LSP.

Based on the indicative Concept Plan appended to this LSP, the following are included:

- ▲ Public Open Space – the northwest corner of Lot 436 is identified for a public open space area comprising 3.95ha. The designation of POS in this location provides for the retention of vegetation, while acting as an extension of already identified open space land to the immediate southwest outside this LSP area.
- ▲ Drainage – 9426m<sup>2</sup> – the northwest corner of Lot 436 is identified for Drainage in accordance with LWMS modelling (LWMS Detention Area 1).
- ▲ Drainage (2.23ha) – the western end of Lot 436 is identified for Drainage in accordance with LWMS modelling (LWMS Detention Area 2).
- ▲ Drainage – 1.48ha – the northwest corner of Lot 110 is identified for Drainage in accordance with LWMS modelling for Lot 110 (LWMS Detention Area 3).

The location and size of drainage locations are in response to the LWMS modelling contained in the Appendix 5 to this report. The drainage site sizing and shape allows for appropriate basin size accommodation and landscaping treatments to occur. All drainage is subject to detailed design which would occur at the subsequent subdivision stage and in conjunction with conditions of subdivision approval including the need for preparation of an Urban Water Management Plan (UWMP). This may result in adjustment to the size, shape and location of drainage where required.

### 5.3 GENERAL INDUSTRIAL

The Structure Plan provides for development of the land for General Industrial use, consistent with the Picton South DSP. The full range of uses permissible under the Shire of Dardanup TPS 3 General Industry zone are to be accommodated. Achieving the full range of uses will be



influenced by servicing availability and the ability to accommodate in the absence of reticulated sewer.

Development requirements within the Local Structure Plan area will be in accordance with the normal guidance provisions of TPS3 and approval requirements imposed by the Shire at the time. Ultimately this could include an approved DCP encompassing the subject land and surrounds.

To the south west of the LSP area in Golding Crescent there are a number of dwellings that, although zoned Industrial, still need to be considered in future development applications within the LSP area. Future development applications should consider the need to address separation distances where required in accordance with the Environment Protection Authority Environmental Assessment Guideline 3 'Guidance for the Assessment of Environmental Factors No 3 – Separation Distances between Industrial and Sensitive Land Uses.'

#### **Refer Figure 7 - Concept Plan**

For the purposes of lot yield estimating, the indicative Concept Plan shows a range of potential industrial lots across Lots 436, 103 and 110. The proposed layout is served by a logical, robust local road network design to accommodate industrial development.

The Concept Plan is shown for explanatory purposes only and is subject to further review and detailed design at subdivision stage.

## **5.4 MOVEMENT NETWORKS**

Uloth & Associates have completed a comprehensive review of the road network, access and transport considerations for the subject site. The review has considered the proposed LSP as well as the Concept Plan for the subject site.

#### **Refer Appendix 6 – Transport Impact Assessment.**

### **5.4.1 RAIL NETWORK**

The Wood & Grieve Engineering Servicing report appended to this LSP notes that Arc Infrastructure operate the rail line that runs to the northwest of the subject site. The rail line forms part of the Boyanup Loop near Picton Junction and services the South West Region. There are no plans to widen the rail requirements in this locality. The rail line currently operates 24 / 7. The planned general industrial development of the subject site under this LSP is entirely compatible with the rail line operation as no sensitive land uses (residential etc) are contemplated.

Future road planning for land inside the rail loop, west of the subject site, will need to consider the extension of Columbas Drive across the rail loop and any of Arc Infrastructure's requirements at that time. This LSP does not include the future rail crossing location. The design of Columbas Drive immediately adjoining the LSP is discussed as part of the proposed road network discussion below.



## 5.4.2 EXISTING ROAD NETWORK

The Uloth review notes that the Main Roads WA (MRWA) functional road hierarchy shows the wider existing road network comprises of Forrest Highway, South Western Highway, Boyanup-Picton Road, Willinge Drive and Bunbury Outer Ring Road as Primary Distributor Roads in the vicinity of the proposed LSP. Martin-Pelusey Road and Hynes Road are Regional Distributor Roads. Harris Road is classified as a Local Distributor Road, with other neighbouring roads (including Columbas Drive, Kerr Road and Golding Crescent) classified as Access Roads.

## 5.4.3 REGIONAL ROAD NETWORK PLANNING

The Uloth review examines the existing regional road network, and the subsequent review occurring as a result of the final Bunbury Outer Ring Road (BORR) alignment. The review notes that there is no planned connection to the BORR at Martin-Pelusey Road or Boyanup Picton Road. There will be a connection from Martin-Pelusey Road to Boyanup-Picton Road. A new east-west link road is also proposed from Martin-Pelusey Road to Wireless Road in order to provide local access to and from the BORR.

The Uloth review considers this and the related district road network planning within the BORR as part of its movement analysis of this LSP.

## 5.4.4 PROPOSED ROAD NETWORK

The Uloth review determines that the LSP area could generate a total of 7,800 vehicle trips per day on an average weekday, based on the indicative Concept Plan lot yield. The review considers that 55% of traffic flows will be to/from the west via Harris Road, with 25% to/from the north via Martin-Pelusey Road. A further 15% will be to/from the east via the new east-west link to Wireless Road and 5% from the south.

The review by Uloth finds that Harris Road be classified as a 'District Distributor B' road (or Integrator B using the Liveable Neighbourhoods terminology), as should Golding Crescent and its extension to the south-east side of the BORR (in the long term). Columbas Drive and other 'internal distributor' roads within the Picton Industrial Park Southern Precinct will only need to be 'Local Distributor' roads (with maximum volumes of approximately 7,000 vehicles per day).

Key design considerations from the Uloth review accommodated within the LSP are:

- ▲ The appropriate sizing of all subdivision roads to 'Local Distributor' (25m road reserve) and local internal roads (20m road reserve);
- ▲ Widening of Columbas Drive to 25m road reserve through a 2.5m road widening on either side;
- ▲ Appropriate spacing of intersections along Martin-Pelusey Road and Harris Road for proposed access roads. This includes 230m spacing separation of intersections along Martin-Pelusey Road, and retention of Golding Crescent as full movement.
- ▲ The proposed roads abutting Lot 110 in the south east corner of the LSP area that access Harris Road and Martin-Pelusey Road may be identified as left in/left out either at the time of construction or at some time in the future depending on the traffic requirements at that time.





## 5.5 WATER MANAGEMENT

A Local Water Management Strategy ('LWMS') has been prepared by Emerge in support of this LSP and is provided as Appendix 5.

The LWMS consider the matters of relevant to the subject site as identified in the District Water Management Strategy (DWMS) prepared by Calibre (2017) including:

- ▲ Drainage management (on lot and off lot detention, treatment and flows)
- ▲ Groundwater (inflows, treatment, water quality, subsoil drainage and discharge)
- ▲ Sustainable water servicing (rainwater storage and use, potable water, sewer or ATU usage, waterwise landscaping)
- ▲ Water dependent ecosystem management (bioretention and detention systems to provide wetland habitat, water quality improvement)
- ▲ Fill Management (use of subsoil drainage, swales to minimise groundwater impact and manage fill requirements).

### 5.5.1 LOCAL WATER MANAGEMENT STRATEGY

The LWMS design objectives seek to deliver best practice outcomes using a water sensitive urban design approach, including detailed management approaches for:

- Water and wastewater servicing
- Water conservation
- Stormwater quantity and quality management
- Groundwater level and quality management.

The overall approach to water supply is a reticulated network for potable uses with groundwater available for non-potable uses within the lots. No ongoing water use is proposed for the estate itself and water efficiency measures (e.g. waterwise gardening (WWG)) will be promoted to lot owners to reduce water requirements. All lots will install a secondary treatment system (i.e. an aerobic treatment unit (ATU)) for the management of waste from buildings/site offices and any wastewater produced from industrial processes will be required to be treated appropriately on lot.

Stormwater management focuses on treating runoff from the small rainfall event as close to source as possible within lots and road reserves to mimic the existing hydrological regime. Detention structures are also required to maintain pre-development peak flow rates for minor and major events. Detention locations are identified within the LWMS and are reflected in the LSP. The use of roadside swales to capture and treat runoff from road reserves is also recognised in the LWMS. These would ultimately be designed at the detailed subdivision stage.

Groundwater management focuses on creating controlled groundwater levels (CGL) through a combination of maintaining existing inverts, creating roadside swales and subsoil drains. The inverts of these will maintain CGLs across the site, which will be set in accordance with *Water resource considerations when controlling groundwater levels in urban development* (DoW 2013).



Required clearances to the CGL will be achieved by utilising imported fill. Non-structural measures (e.g. education) have been proposed to ensure both stormwater and groundwater quality outcomes are met.

This LWMS demonstrates that the site is capable of being developed by following the recommendations detailed in the report.

In accordance with the processes defined under *Better Urban Water Management (WAPC)* an Urban Water Management Plan (UWMP) will also be required to be prepared and implemented at the time of subdivision. The UWMP will refine and implement the proposed drainage network/system, as identified under the LWMS.

## 5.6 INFRASTRUCTURE COORDINATION, SERVICING AND STAGING

The following provides a summary of the infrastructure and servicing for the Structure Plan area. Further information is contained within the Engineering Services Report prepared by Wood & Grieve at Appendix 7.

### 5.6.1 WATER

The proposed subdivision falls into an area currently licensed and operated by Aqwest. Provision of reticulated water as will be a condition of subdivision and / or development approval.

Aqwest have advised that an existing DN300 water main within the Harris Road reserve has capacity to service the subject site without need for any network upgrades.

### 5.6.2 WASTEWATER RETICULATION

No sewerage infrastructure exists within proximity to the subject site, with the nearest gravity sewer being over 3km to the northwest. Water Corporation long term sewer planning indicates the site grades into two future wastewater pump station (WWPS) catchment areas with the southern boundary of Lot 436 generally forming the catchment area boundary. The two proposed WWPSs are not currently planned to be constructed in the next 5 years.

A high-level review by Stantec (formerly Wood & Grieve) civil engineers suggests that an interim wastewater servicing solution could be in the order of \$7.5-8M, with ultimate design possibly in the order of \$35M. These are high-level estimates only but confirm that short term servicing of the land with reticulated sewer is not viable. Particularly given that this LSP is intended to facilitate development which will occur over the longer term.

Notwithstanding the horizon for sewer planning, the rezoning and structure planning of the land can still progress and will ultimately provide impetus for that sewer planning to occur. In the interim, development on site will be subject to detailed site assessment at subdivision and development stage to demonstrate suitability for alternate treatment units (ATUs). This is already the case for the nearby industrial land, south of Harris Road at Golding Crescent. Connection to reticulated sewer would then be necessary as it becomes available. Both the EAMS and LWMS prepared to accompany this LSP consider the matter further and a summary is provided below regarding wastewater management and site and soil evaluation.



### 5.6.3 WASTEWATER MANAGEMENT

Acknowledging the site is planned, but is not currently, serviced by reticulated sewer the consideration of both domestic (office use) and industrial wastewater has been considered in the EAMS accompanying this LSP.

- ▲ **On-site effluent disposal:** As a minimum alternate treatment units (ATUs) will be required to manage domestic wastewater requirements (including general office needs such as toilets, sinks, showers). The ATU, its siting, and sizing will be required to meet Department of Health requirements and a site's ability to accommodate. This is discussed further in the EAMS; and
- ▲ **Industrial wastewater management:** Wastewater resulting from industrial processes occurring as part of any future development will need to be treated appropriately on-site, captured and removed to a licenced treatment facility. These obligations are discussed further in the EAMS and are typical obligations for industrial development throughout WA. It is expected that normal conditions of development will apply at the time any specific and use and development is proposed.

However, if a reticulated sewerage service is provided in the future there is an expectation that lots will be connected to this service.

### 5.6.4 SITE AND SOIL EVALUATION

A site and soil evaluation has been undertaken in accordance with the requirements of Appendix C of AS 1547 (Standards of Australia and Standards of New Zealand 2012). Section 8.2.1 of the LWMS appended to this LSP document further outlines the site elements and associated description.

Based on this evaluation the site has been classified into two area given the suitability of existing conditions for on-site sewage disposal. They comprise areas that 'require little modification to be suitable' and areas that 'require modification to be suitable'.

Management of on-site sewage disposal within both identified areas is discussed in detail within Section 8.2.2 of the LWMS appended to this LSP under 'Sewage Management'. This section provides detailed guidance to inform further development of the land including minimum lot sizes, appropriate treatment technology and systems and performance criteria.

Management and compliance criteria are also outlined within the LWMS appended to this LSP. These elements will inform future development of the land in accordance with this LSP and the LWMS. It is anticipated that, in accordance with AS 1547 more detailed Site and Soil Evaluation reporting will be required to accompany or as conditions of development approval on the land.

### 5.6.5 POWER

Western power requires that commercial/industrial lots are provided with 200kVa/ha power supplies. There is sufficient capacity in the Picton zone substation to accommodate the likely demand from the LSP area.



No high voltage (HV) take-off points are currently provided in the surrounding area, likely meaning that lines will need to be constructed to the point of subdivision. This would be determined at the detailed design and development stage and is not an impediment to the LSP's progression.

A 132 kV power line traverses the LSP area from west to east crossing generally at the common boundary of Lot 436 and 103 and extending through Lot 110 before crossing Martin-Pelusey Road. A low voltage line extending from this southward crosses Lot 103. Easements associated with the lines are evident on Lots 436 and 103. No easements are evident on Lot 110. While the existing power lines corridors do not align with the future road reserves identified in the Concept Plan, and may need to be relocated, the need for this can be considered at the detailed design stage when final local road and lot layouts are determined.

### 5.6.6 GAS

ATCO Gas operates a reticulated gas network adjacent the subject site. The DN110 pressure main with Harris Road has the capacity to service the proposed development.

Department of Mines, Industry Regulation and Safety (MIRS) confirm that the LSP area overlaps an investigation corridor for the proposed extension of the Dampier to Bunbury Natural Gas Pipeline (DBNGP). It is noted that the corridor has been aligned with the former Bunbury Outer Ring Road (BORR) reservation alignment. The intention to relocate the DBNGP investigation corridor to align with the new BORR route is currently unknown.

While acknowledging the existence of the corridor as an investigation area, the timing of any investigation in this location or elsewhere is currently unclear. Further the timing of any subsequent works and future planning is unknown. This proposed LSP acknowledges the extent of the former BORR reservation, within which the gas investigation corridor lies and, in that context, it is not an impediment to the immediate progression of this LSP. It is anticipated that further dialogue with DMIRS will occur as this LSP is progressed.

### 5.6.7 TELECOMMUNICATIONS

Telecommunications are expected to be provided by NBN Co, Telstra or similar broadband provider. Broadband services are available in Harris and Martin-Pelusey Roads and are able to be extended to service the future subdivision and development.

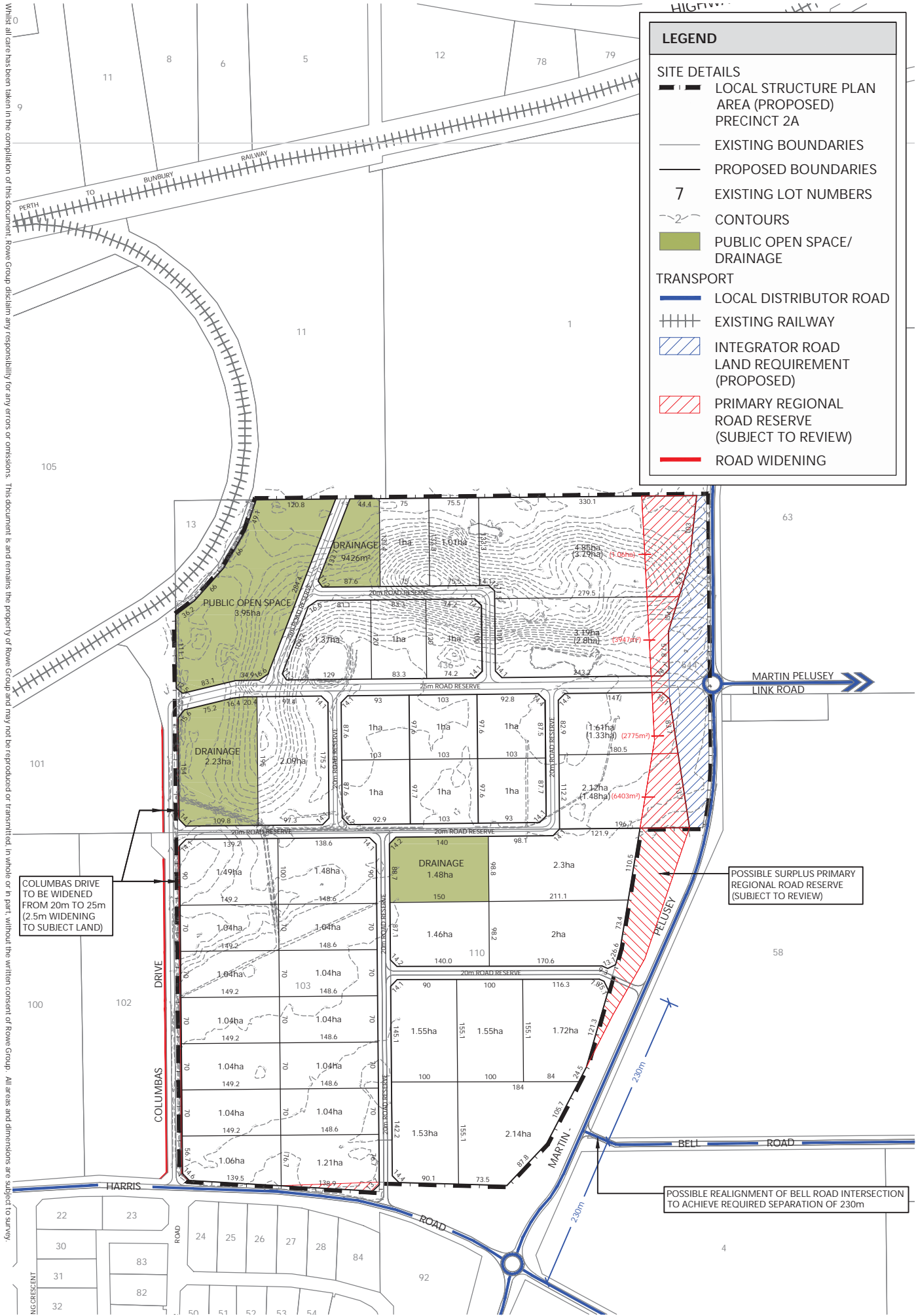
### 5.6.8 EARTHWORKS & STAGING

Detailed design and development of the subject site will ultimately be influenced by landowner expectations and market demand. Detailed design of finished road and lot levels will be undertaken following this LSP to inform any application for subdivision. Staging of development is expected to generally occur from Martin-Pelusey Road west.

## 5.7 SUMMARY OF ASESMENT IN RELATION TO DSP

To assist in the review of this LSP a *Schedule of LSP Assessment in relation to the Picton Industrial Park Southern Precinct DSP* comprises Appendix 8. The appendix summarises the above report content in a form referencing various DSP matters identified.





**LEGEND**

**SITE DETAILS**

- LOCAL STRUCTURE PLAN AREA (PROPOSED) PRECINCT 2A
- EXISTING BOUNDARIES
- PROPOSED BOUNDARIES
- EXISTING LOT NUMBERS
- CONTOURS
- PUBLIC OPEN SPACE/ DRAINAGE

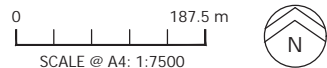
**TRANSPORT**

- LOCAL DISTRIBUTOR ROAD
- EXISTING RAILWAY
- INTEGRATOR ROAD LAND REQUIREMENT (PROPOSED)
- PRIMARY REGIONAL ROAD RESERVE (SUBJECT TO REVIEW)
- ROAD WIDENING

COLUMBAS DRIVE TO BE WIDENED FROM 20m TO 25m (2.5m WIDENING TO SUBJECT LAND)

POSSIBLE SURPLUS PRIMARY REGIONAL ROAD RESERVE (SUBJECT TO REVIEW)

POSSIBLE REALIGNMENT OF BELL ROAD INTERSECTION TO ACHIEVE REQUIRED SEPARATION OF 230m



**FIGURE 7**  
CONCEPT PLAN (MINIMUM 1HA LOTS)

WHIST all data has been taken in the compilation of this document. Rowe Group disclaim any responsibility for any errors or omissions. This document is and remains the property of Rowe Group and may not be reproduced or transmitted in whole or in part, without the written consent of Rowe Group. All areas and dimensions are subject to survey.

9013.FIG1614D\_20210315 Picton East (PCA Area) - DRAWN: WILLIAM CLEMENTS - DATE CREATED: 2021.03.15 - PROJECTION: MGA50 GDA94 - CADASTRE: LANDGATE - TOWN PLANNING 9006-9999/9013/DRAFTING/CA-D - WILLIAM CLEMENTS - 2021.03.15



# APPENDIX 1

CERTIFICATES OF TITLE



**ROWE**  
GROUP  
DESIGN

WESTERN



AUSTRALIA

REGISTER NUMBER <b>103/D96575</b>	
DUPLICATE EDITION <b>2</b>	DATE DUPLICATE ISSUED <b>20/9/2011</b>

**RECORD OF CERTIFICATE OF TITLE**  
UNDER THE TRANSFER OF LAND ACT 1893

VOLUME **2152** FOLIO **572**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.



REGISTRAR OF TITLES

**LAND DESCRIPTION:**

LOT 103 ON DIAGRAM 96575

**REGISTERED PROPRIETOR:**  
(FIRST SCHEDULE)

HARRIS RD PTY LTD OF SUITE 2, MAJESTIC RISE, 16 MOREAU MEWS, APPLECROSS  
(T K315375 ) REGISTERED 22/8/2007

**LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:**  
(SECOND SCHEDULE)

1. F810521 EASEMENT TO ELECTRICITY CORPORATION. SEE SKETCH ON VOL 2152 FOL 572. REGISTERED 20/2/1995.
2. EASEMENT BURDEN CREATED UNDER SECTION 27A OF T. P. & D. ACT - SEE DIAGRAM 96575.
3. L732578 MORTGAGE TO COMMONWEALTH BANK OF AUSTRALIA REGISTERED 13/9/2011.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.  
\* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.  
Lot as described in the land description may be a lot or location.

-----END OF CERTIFICATE OF TITLE-----

**STATEMENTS:**

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: 2152-572 (103/D96575)  
 PREVIOUS TITLE: 2044-265  
 PROPERTY STREET ADDRESS: NO STREET ADDRESS INFORMATION AVAILABLE.  
 LOCAL GOVERNMENT AUTHORITY: SHIRE OF DARDANUP

WESTERN



AUSTRALIA

REGISTER NUMBER <b>603/DP246179</b>	
DUPLICATE EDITION <b>2</b>	DATE DUPLICATE ISSUED <b>20/9/2011</b>

**RECORD OF CERTIFICATE OF TITLE**  
UNDER THE TRANSFER OF LAND ACT 1893

VOLUME **2044** FOLIO **266**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.



REGISTRAR OF TITLES

**LAND DESCRIPTION:**

LOT 603 ON DEPOSITED PLAN 246179

**REGISTERED PROPRIETOR:**  
(FIRST SCHEDULE)

HARRIS RD PTY LTD OF SUITE 2, MAJESTIC RISE, 16 MOREAU MEWS, APPLECROSS  
(T K315375 ) REGISTERED 22/8/2007

**LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:**  
(SECOND SCHEDULE)

1. THE LAND THE SUBJECT OF THIS CERTIFICATE OF TITLE EXCLUDES ALL PORTIONS OF THE LOT DESCRIBED ABOVE EXCEPT THAT PORTION SHOWN IN THE SKETCH OF THE SUPERSEDED PAPER VERSION OF THIS TITLE.
2. F810521 EASEMENT TO ELECTRICITY CORPORATION. SEE SKETCH ON VOL 2044 FOL 266. REGISTERED 20/2/1995.
3. L732578 MORTGAGE TO COMMONWEALTH BANK OF AUSTRALIA REGISTERED 13/9/2011.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.  
\* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.  
Lot as described in the land description may be a lot or location.

-----END OF CERTIFICATE OF TITLE-----

**STATEMENTS:**

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: 2044-266 (603/DP246179)  
 PREVIOUS TITLE: 1667-877  
 PROPERTY STREET ADDRESS: 96 MARTIN-PELUSEY RD, PICTON EAST.  
 LOCAL GOVERNMENT AUTHORITY: SHIRE OF DARDANUP

NOTE 1: A000001A LAND PARCEL IDENTIFIER OF WELLINGTON LOCATION 603 (OR THE PART THEREOF) ON SUPERSEDED PAPER CERTIFICATE OF TITLE CHANGED TO LOT 603 ON DEPOSITED PLAN 246179 ON 23-SEP-02 TO ENABLE ISSUE OF A DIGITAL CERTIFICATE OF TITLE.

END OF PAGE 1 - CONTINUED OVER



RECORD OF CERTIFICATE OF TITLE

REGISTER NUMBER: 603/DP246179

VOLUME/FOLIO: 2044-266

PAGE 2

NOTE 2:

THE ABOVE NOTE MAY NOT BE SHOWN ON THE SUPERSEDED PAPER CERTIFICATE OF TITLE OR ON THE CURRENT EDITION OF DUPLICATE CERTIFICATE OF TITLE.

WESTERN



AUSTRALIA

REGISTER NUMBER <b>110/DP61589</b>	
DUPLICATE EDITION <b>N/A</b>	DATE DUPLICATE ISSUED <b>N/A</b>

**RECORD OF CERTIFICATE OF TITLE**  
UNDER THE TRANSFER OF LAND ACT 1893

VOLUME **2741** FOLIO **234**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.



REGISTRAR OF TITLES

**LAND DESCRIPTION:**

LOT 110 ON DEPOSITED PLAN 61589

**REGISTERED PROPRIETOR:**  
(FIRST SCHEDULE)

WESTIM PTY LTD OF 57 TRIUMPH AVENUE, WANGARA

(AF L379582 ) REGISTERED 21/7/2010

**LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:**  
(SECOND SCHEDULE)

1. \*J720704 MORTGAGE TO NATIONAL AUSTRALIA BANK LTD REGISTERED 1/5/2006.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.  
 \* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.  
 Lot as described in the land description may be a lot or location.

-----END OF CERTIFICATE OF TITLE-----

**STATEMENTS:**

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: DP61589  
 PREVIOUS TITLE: 1441-327  
 PROPERTY STREET ADDRESS: NO STREET ADDRESS INFORMATION AVAILABLE.  
 LOCAL GOVERNMENT AUTHORITY: SHIRE OF DARDANUP

NOTE 1: L379582 THIS LOT/TITLE CREATED AFTER PORTION OF THE LAND TAKEN FROM THE FORMER LOT WITHOUT PRODUCTION OF THE DUPLICATE TITLE BY TAKING ORDER L379582. CURRENT DUPLICATE FOR THE WITHIN LAND IS STILL VOL.1441 FOL.327 EDITION 2.



# APPENDIX 2

CLAUSE 54 CERTIFICATES



**ROWE**  
GROUP  
DESIGN



Enquiries: Trevor Servaas (08) 6551 9110  
Our Ref: 53 / 59715541  
Your Ref: 9013

GREG ROWE PTY LTD  
LEVEL 3, 369 NEWCASTLE STREET  
NORTHBRIDGE  
6007 WA

Dear Sir/Madam

**CERTIFICATE UNDER CLAUSE 53 OF THE GREATER BUNBURY REGION SCHEME  
ISSUED BY THE WESTERN AUSTRALIAN PLANNING COMMISSION**

In reply to your request, please find enclosed  
Certificate Number: 59715541

It is advised that the enclosed Certificate has been prepared to conform with the current Statutory requirements (as at the date of signature) of the Greater Bunbury Region Scheme

Yours faithfully,

A handwritten signature in black ink, appearing to read "S Fagan".

Ms Sam Fagan  
Secretary  
Western Australian Planning Commission

14 August 2019





# Greater Bunbury Region Scheme

Form 5

## Scheme Certificate

In accordance with clause 53 of the

Greater Bunbury Region Scheme the following information relates to:

Certificate:  
59715541

Receipt:  
None

Date:  
14/08/2019

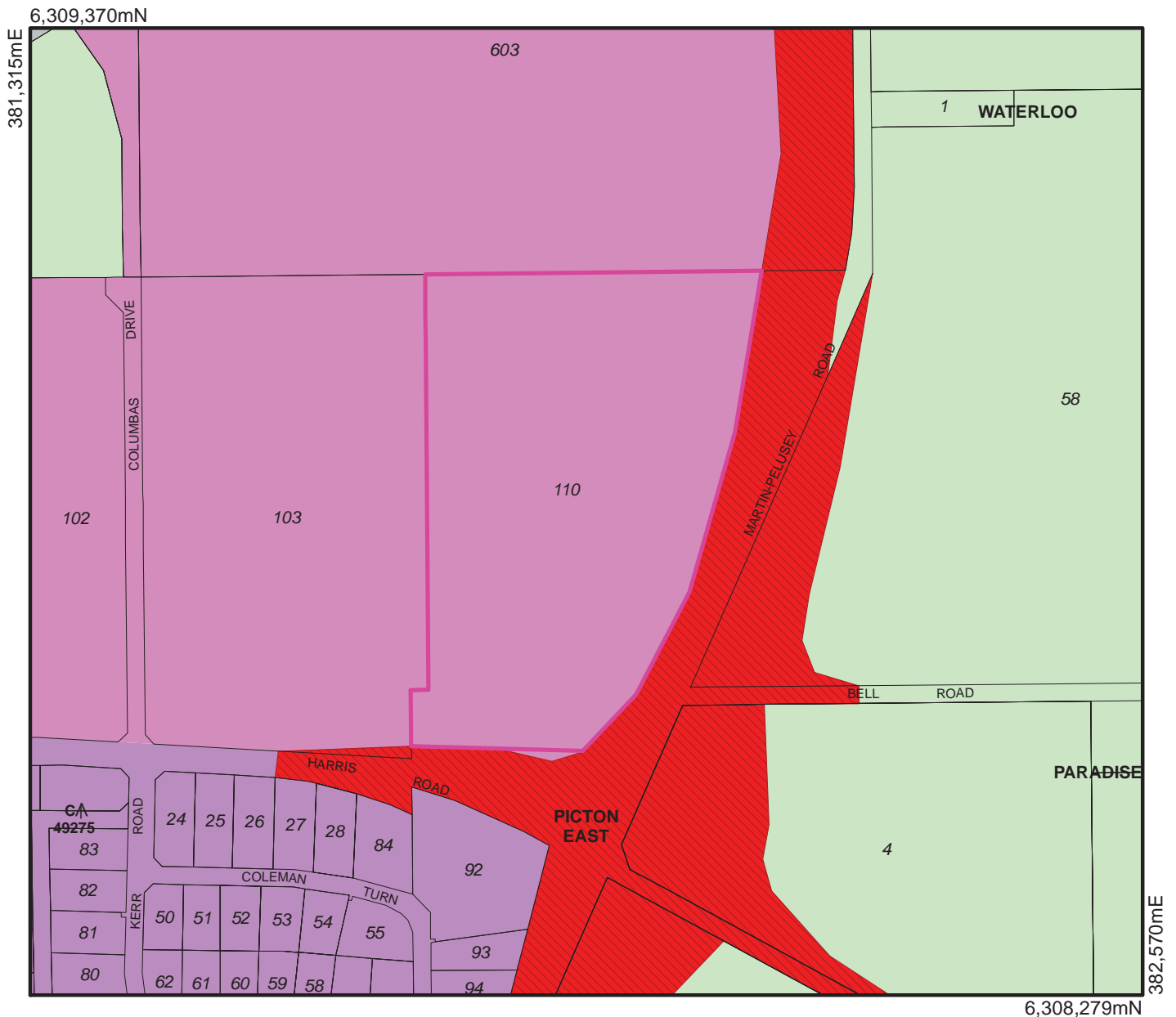
Location:

Certificate of Title: Vol: 2741 Folio:234

Deposited Plan: 61589

Legend for reserved land and zones

- |   |                          |   |                        |   |          |
|---|--------------------------|---|------------------------|---|----------|
|  | Environmental conditions |  | Industrial deferred    |  | Railways |
|  | Industrial               |  | Primary regional roads |  | Rural    |



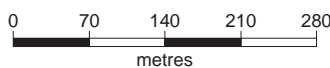
This certificate relates only to the provisions of the:

Greater Bunbury Region Scheme

and does not claim to indicate the land use allocation under any local government provision.

Produced by Data Analytics,  
Department of Planning, Lands and Heritage, Perth WA.

Base information supplied by:  
Western Australian Land Information Authority SLIP 1096-2018-1



Coordinates based on MGA Zone 50 (GDA 94)  
All dimensions are in metres  
Subject to survey

Ms Sam Fagan  
Secretary  
Western Australian Planning Commission



Enquiries: Trevor Servaas (08) 6551 9110  
Our Ref: 53 / 59683025  
Your Ref: 9013

GREG ROWE PTY LTD  
LEVEL 3, 369 NEWCASTLE STREET  
NORTHBRIDGE  
6007 WA

Dear Sir/Madam

**CERTIFICATE UNDER CLAUSE 53 OF THE GREATER BUNBURY REGION SCHEME  
ISSUED BY THE WESTERN AUSTRALIAN PLANNING COMMISSION**

In reply to your request, please find enclosed  
Certificate Number: 59683025

It is advised that the enclosed Certificate has been prepared to conform with the current Statutory requirements (as at the date of signature) of the Greater Bunbury Region Scheme

Yours faithfully,

A handwritten signature in black ink, appearing to read "S Fagan".

Ms Sam Fagan  
Secretary  
Western Australian Planning Commission

5 August 2019





# Scheme Certificate

In accordance with clause 53 of the

Greater Bunbury Region Scheme the following information relates to:

Certificate:  
59683025

Receipt:  
None

Date:  
6/08/2019

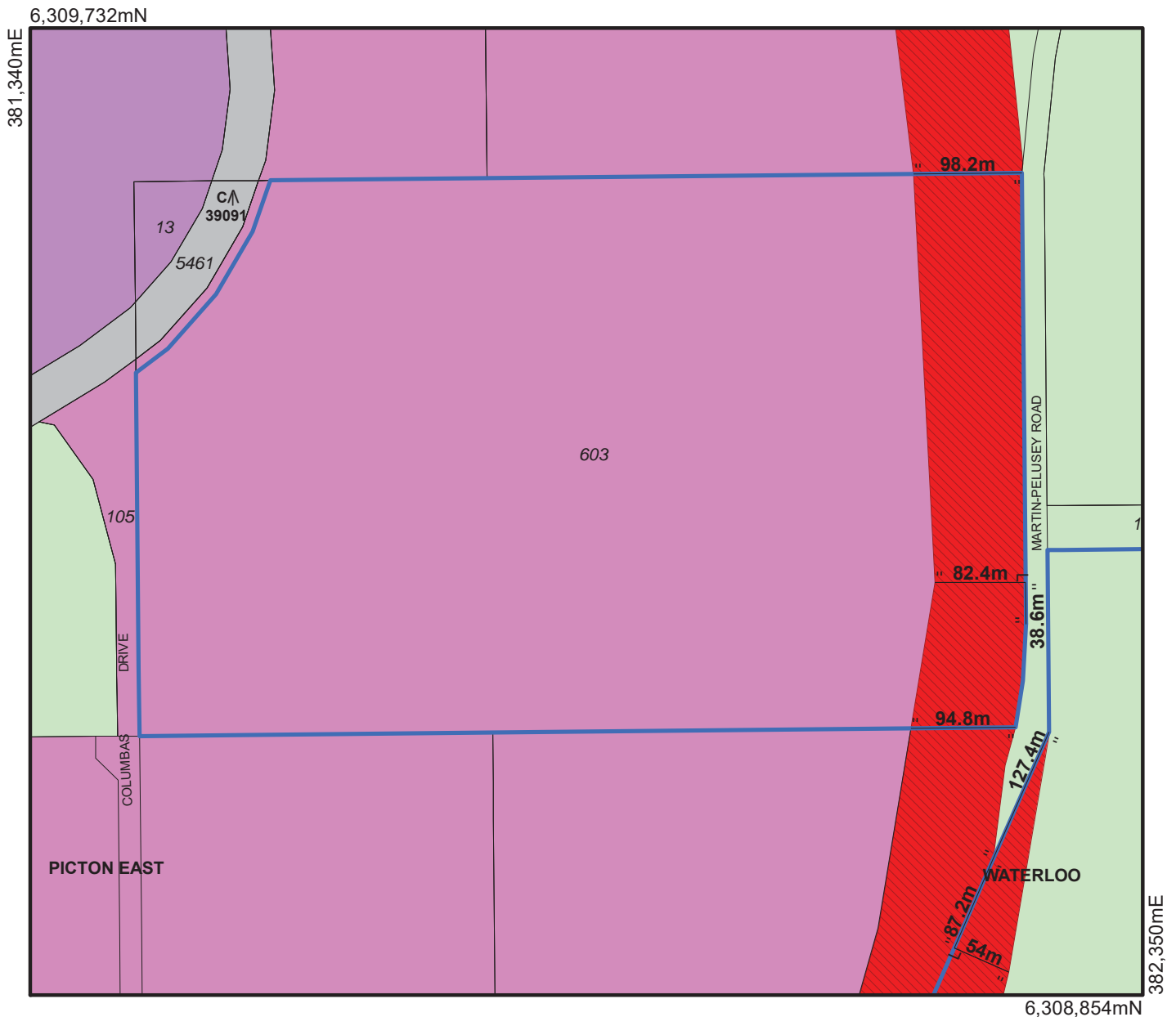
Location: Martin-Pelusey Rd, Picton East

Certificate of Title: Vol: 2044 Folio:266

Deposited Plan: 246179

Legend for reserved land and zones

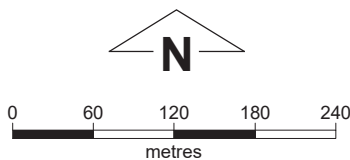
- Environmental conditions
- Industrial deferred
- Railways
- Industrial
- Primary regional roads
- Rural



This certificate relates only to the provisions of the:  
 Greater Bunbury Region Scheme  
 and does not claim to indicate the land use allocation under  
 any local government provision.

Produced by Data Analytics,  
 Department of Planning, Lands and Heritage, Perth WA.

Base information supplied by:  
 Western Australian Land Information Authority SLIP 1096-2018-1



Coordinates based on MGA Zone 50 (GDA 94)  
 All dimensions are in metres  
 Subject to survey

Ms Sam Fagan  
 Secretary  
 Western Australian Planning Commission



GOVERNMENT OF WESTERN AUSTRALIA

**MINISTER FOR THE ENVIRONMENT; SCIENCE**

Statement No.

000697

**STATEMENT THAT A SCHEME MAY BE IMPLEMENTED  
(PURSUANT TO THE PROVISIONS OF DIVISION 3 OF PART IV OF THE  
ENVIRONMENTAL PROTECTION ACT 1986)**

**GREATER BUNBURY REGION SCHEME**

**Scheme Purpose:** To guide and regulate the use and development of land and to make provisions for regional infrastructure and regional open space within the Greater Bunbury Region.

**Responsible Authority:** Western Australian Planning Commission

**Responsible Authority Address:** 469 Wellington Street, PERTH WA 6000

**Assessment Number:** 1048

**Report of the Environmental Protection Authority:** Bulletin 1108

Subject to the following conditions, there is no known environmental reason why the Greater Bunbury Region Scheme to which the above report of the Environmental Protection Authority relates should not be implemented:

**1 Additional Land to be Reserved**

1-1 All or portions of the following sites shall be reserved for conservation, in accordance with the requirements set out in Attachment 1 of the Minister for the Environment's "Statement that a Scheme may be Implemented" No. 000697 published on (date):

- 1) Reserve 35061 Paris Road, Australind - Decommissioned Wastewater Treatment Plant
- 2) Reserve 31012 Harewoods Road, Dalyellup
- 3) Foreshore adjoining Port Installations Reserve
- 4) Twin Rivers - Pt Lot 211 Barnes Avenue, Australind
- 5) College Grove - Lot 1000 Bussell Highway
- 6) Pt Loc 632 Parade Road, Glen Padden
- 7) Reserve 670 North Boyanup Road, Davenport
- 8) Picton Waters - Environmental Protection Policy Lake on portion of Lots 40-44 Jeffery Road, Picton
- 9) Pt Lot 1 North Boyanup Road, Davenport
- 10) Lot 317 Harewoods Road, Dalyellup
- 11) Lot 1, Dalyellup Boulevard, Dalyellup

Published on

31 OCT 2005



## **2 Realignment of Primary Regional Roads Reserves**

2-1 Portions of the following Primary Regional Roads Reserves shall be realigned, in accordance with the requirements set out in Attachment 1 of the Minister for the Environment's "Statement that a Scheme may be Implemented" No. 000697 published on (date):

- 1) Port Access Road
- 2) Bunbury Outer Ring Road

## **CONDITIONS TO BE INCORPORATED INTO THE SCHEME BY INSERTION OF PROVISIONS IN SCHEME TEXT**

### **3 Management Plans**

3-1 The following Environmental Management Plans may be required in accordance with the specifications set out in Attachment 1 in the Minister for the Environment's "Statement that a Scheme may be Implemented" No. 000697 published on (insert date), and shall be subsequently implemented in accordance with the provisions of the Management Plans, to the satisfaction of the Western Australian Planning Commission:

- 1) Environmental Management Plans for schemes, subdivisions and developments which impact on Regional Open Space in the scheme, Crown conservation or nature reserves, a National Park or bushland, waterways, wetlands or other land that may be part of an ecological linkage;
- 2) Environmental Management Plans for industrial development within the Kemerton Industrial Area and Special Control Area No. 2;
- 3) Drainage, Nutrient and Water Management Plans in areas where the Average Maximum Groundwater Level is less than 1.2 metres below the natural ground surface or where any proposed off-site drainage could lead to degradation of wetlands or waterways; and
- 4) Acid Sulfate Soil Management Plans where the presence of acid sulphate soils is confirmed or there is likely to be a significant risk of disturbing acid sulphate soils.

### **4 Biological Survey**

4-1 As part of a scheme amendment or application to subdivide or develop land which has the potential to impact on regionally significant native remnant vegetation or native fauna, the Western Australian Planning Commission or local government, as the case requires, may require a biological survey, including a search for Declared Rare Flora and Fauna, Priority Flora, Threatened Flora Communities and Threatened Fauna, to be undertaken.

The biological survey shall be undertaken to the satisfaction of the Western Australian Planning Commission or local government, as the case requires, having due regard for advice from relevant government agencies, and shall be taken into account when considering the rezoning and subsequent subdivision and development applications.

## **5 Provision of Environmental Offsets**

- 5-1 Prior to construction of the Port Access Road and Bunbury Outer Ring Road, an environmental offset strategy shall be prepared to mitigate unavoidable impacts on wetlands and native vegetation associated with the Port Access Road and Bunbury Outer Ring Road to the satisfaction of the Western Australian Planning Commission on advice of the Environmental Protection Authority. With respect to the Port Access Road, the strategy shall include a foreshore management plan for the Ferguson River in the vicinity of the road. With respect to the Bunbury Outer Ring Road, the strategy shall include rehabilitation of the strip of land adjacent to the road in the vicinity of Lot 15 North Boyanup Road (South Western Highway) and design of the intersection with the Australind Bypass to minimize impacts on environmental values of the area.

Dr Judy Edwards MLA  
MINISTER FOR THE ENVIRONMENT; SCIENCE

31 OCT 2005

**STATEMENT THAT A SCHEME MAY BE IMPLEMENTED –  
GREATER BUNBURY REGION SCHEME**

**SPECIFICATIONS FOR ENVIRONMENTAL MANAGEMENT PLANS,  
ADDITIONAL LAND TO BE RESERVED AND REALIGNMENT OF PRIMARY  
REGIONAL ROAD RESERVES**

**1 Environmental Management Plans for Schemes, Subdivisions and Developments**

1-1 Prior to amending local town planning schemes, or finally approving subdivisions or developments (whichever is sooner), the Western Australian Planning Commission or local government, as the case requires, may require an Environmental Management Plan to be prepared and implemented to achieve the objective of managing the potential impacts of the proposed subdivision or development on the following:

- 1) land which is reserved as Regional Open Space in the Scheme;
- 2) a Crown conservation or nature reserve;
- 3) a National Park; or
- 4) bushland, waterway, wetland or land that may be part of an ecological linkage.

The Environmental Management Plan shall include:

- i) a description of existing environmental values, and the identification of the environmental outcome to be achieved through the implementation of the Plan;
- ii) clear delineation of boundaries of significant areas to be protected;
- iii) fire management;
- iv) drainage and nutrient management;
- v) management of access and rehabilitation;
- vi) vegetation and/or wetland mitigation strategies;
- vii) a program for implementation;
- viii) allocation of responsibilities and identification of timing and duration of implementation;
- ix) provision for routine monitoring of environmental values; and
- x) provision of details of contingency plans in the event that the monitoring surveys indicate that the development is having or has had an adverse impact upon environmental values.

1-2 Environmental Management Plans required by condition 1-1 shall be prepared to the satisfaction of the Western Australian Planning Commission or local government, as the case requires, having due regard for advice from relevant government agencies and shall be implemented in accordance with a program defined in the Environmental Management Plan.

## **2 Environmental Management Plans for Industrial Development within the Kemerton Industrial Area and Special Control Area No. 2**

2-1 Prior to approving subdivision or development within the Kemerton Industrial Area and the Special Control Area No. 2, the Western Australian Planning Commission or local government, as the case requires, may require an Environmental Management Plan to be prepared and implemented to achieve the objective of managing the potential impacts of the proposed development.

The Environmental Management Plan shall include:

- 1) a description of existing environmental values (including vegetation, fauna and wetlands) and the identification of the environmental outcome to be achieved through the implementation of this Plan;
- 2) management of potential impacts on visual amenity;
- 3) clear delineation of significant areas to be protected;
- 4) a program for implementation;
- 5) allocation of responsibilities and identification of timing and duration of implementation;
- 6) provision for routine monitoring of environmental values; and
- 7) provision of details of contingency plans in the event that the monitoring surveys indicate that the subdivision or development is having or has had an adverse impact upon environmental values.

2-2 An Environmental Management Plan required by condition 2-1 shall be prepared to the satisfaction of the Western Australian Planning Commission or local government, as the case requires, having due regard for advice from relevant government agencies and shall be implemented in accordance with a program defined in the Environmental Management Plan.

## **3 Drainage, Nutrient and Water Management Plans**

3-1 Prior to amending local town planning schemes, or finally approving subdivision or developments (including those for intensive horticulture), whichever is sooner, in areas where the Average Maximum Groundwater Level is less than 1.2 metres below the natural ground surface, or where any proposed off-site drainage could lead to degradation of wetlands or waterways, the Western Australian Planning Commission or local government, as the case requires, may require a Drainage, Nutrient and Water Management Plan to be prepared and implemented.

- 3-2 A Drainage, Nutrient and Water Management Plan, if required, shall ensure that there is no net increase in nitrogen export to the Leschenault Estuary as a result of development within the Greater Bunbury Region.
- 3-3 The Drainage, Nutrient and Water Management Plan shall be prepared to the satisfaction of the Western Australian Planning Commission or local government, as the case requires, having due regard for advice from relevant government agencies, and shall be implemented in accordance with a program defined in the Drainage, Nutrient and Water Management Plan.

#### **4 Acid Sulfate Soil Management Plans**

- 4-1 Prior to amending local town planning schemes, or finally approving subdivisions or development, the Western Australian Planning Commission or local government, as the case requires, may require a Preliminary Acid Sulfate Soils Assessment to be prepared where there is likely to be a significant risk of disturbing acid sulfate soils.
- 4-2 Where the presence of acid sulfate soils is confirmed, an Acid Sulphate Soil Management Plan shall be prepared to the satisfaction of the Western Australian Planning Commission or local government, as the case requires, having due regard for advice from relevant government agencies and implemented in accordance with a program defined in the Acid Sulphate Soil Management Plan.

#### **5 Additional Land to be Reserved**

##### **5-1 Reserve 35061 Paris Road, Australind - Decommissioned Wastewater Treatment Plant**

Land shall be reserved for conservation purposes to protect the integrity, function and environmental value of the bushland on the northern and western portions of Reserve 35061 Paris Road, Australind, to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation and complementary purposes.

##### **5-2 Reserve 31012 Harewoods Road, Dalyellup**

Land shall be reserved for conservation purposes to protect the integrity, function and environmental value of the bushland on the northern portion of Reserve 31012 Harewoods Road, Dalyellup to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority and shall only be used for conservation, landscape and recreational purposes.

##### **5-3 Foreshore adjoining Port Installations Reserve**

Land shall be reserved for conservation purposes to protect the integrity, function and environmental value of the foreshore adjacent to the Port Installations Reserve to the requirements of the Western Australian Planning Commission on advice of the

Environmental Protection Authority and shall only be used for conservation and complementary purposes.

**5-4 Twin Rivers - Pt Lot 211 Barnes Avenue, Australind**

A portion of Pt Lot 211 Barnes Avenue as detailed in the Minister for the Environment's determination of appeals relating to the Environmental Protection Authority's report and recommendations on the Scheme, dated 30 November 2004, shall be reserved for conservation purposes to protect the integrity, function and environmental values of the land to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation and complementary purposes.

**5-5 Picton Waters – Environmental Protection Policy Lake on Portion of Lots 40-44 Jeffery Road, Picton**

Land shall be reserved for conservation purposes to protect the integrity, function and environmental value of the wetland on Lots 40-44 Jeffery Road, Picton, to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation and complementary purposes. The land requirements shall include an appropriate buffer to protect the core wetland.

**5-6 College Grove – Lot 1000 Bussell Highway**

A portion of Lot 1000, Bussell Highway, as detailed in the Minister for the Environment's determination of appeals relating to the Environmental Protection Authority's report and recommendations on the Scheme, dated 30 November 2004, shall be reserved for conservation purposes to protect the integrity, function and environmental values of the land to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation and complementary purposes.

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Land shall be reserved for conservation purposes to protect the integrity, function and environmental value of the bushland on Pt Loc 632 Parade Road, Glen Padden, to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation and complementary purposes.

**5-8 Reserve 670 North Boyanup Road, Davenport**

Land shall be reserved for conservation purposes to protect the integrity, function and environmental value of the bushland on Reserve 670 North Boyanup Road, Davenport to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation and complementary purposes.

**5-9 Pt Lot 1 North Boyanup Road, Davenport**

Land shall be reserved for conservation purposes to provide an appropriate buffer to the Preston River on Pt Lot 1, North Boyanup Road, Davenport to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation and complementary purposes.

**5-10 Lot 317 Harewoods Road, Dalyellup**

Lot 317 Harewoods Road, Dalyellup shall be reserved for conservation purposes to protect the integrity, function and environmental value of the bushland on the land to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation and complementary purposes.

**5-11 Lot 1 Dalyellup Boulevard, Dalyellup**

Lot 1 Dalyellup Boulevard, Dalyellup shall be reserved for conservation purposes to protect the integrity, function and environmental values of the land to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority and shall only be used for conservation and complementary purposes.

**6 Realignment of Primary Regional Roads Reserves**

**6-1 Port Access Road**

The Port Access Road Primary Regional Roads Reserve shall be realigned in accordance with the Minister for the Environment's determination of appeals relating to the Environmental Protection Authority's report and recommendations on the Scheme, dated 30 November 2004.

**6-2 Bunbury Outer Ring Road**

The Bunbury Outer Ring Road Primary Regional Roads Reserve shall be realigned in accordance with the Minister for the Environment's determination of appeals relating to the Environmental Protection Authority's report and recommendations on the Scheme, dated 30 November 2004.



Enquiries: Trevor Servaas (08) 6551 9110  
Our Ref: 53 / 59715584  
Your Ref: 9013

GREG ROWE PTY LTD  
LEVEL 3, 369 NEWCASTLE STREET  
NORTHBRIDGE  
6007 WA

Dear Sir/Madam

**CERTIFICATE UNDER CLAUSE 53 OF THE GREATER BUNBURY REGION SCHEME  
ISSUED BY THE WESTERN AUSTRALIAN PLANNING COMMISSION**

In reply to your request, please find enclosed  
Certificate Number: 59715584

It is advised that the enclosed Certificate has been prepared to conform with the current Statutory requirements (as at the date of signature) of the Greater Bunbury Region Scheme

Yours faithfully,

A handwritten signature in black ink, appearing to read "S Fagan".

Ms Sam Fagan  
Secretary  
Western Australian Planning Commission

14 August 2019







# Scheme Certificate

In accordance with clause 53 of the

Greater Bunbury Region Scheme the following information relates to:

Certificate:  
59715584

Receipt:  
None

Date:  
14/08/2019

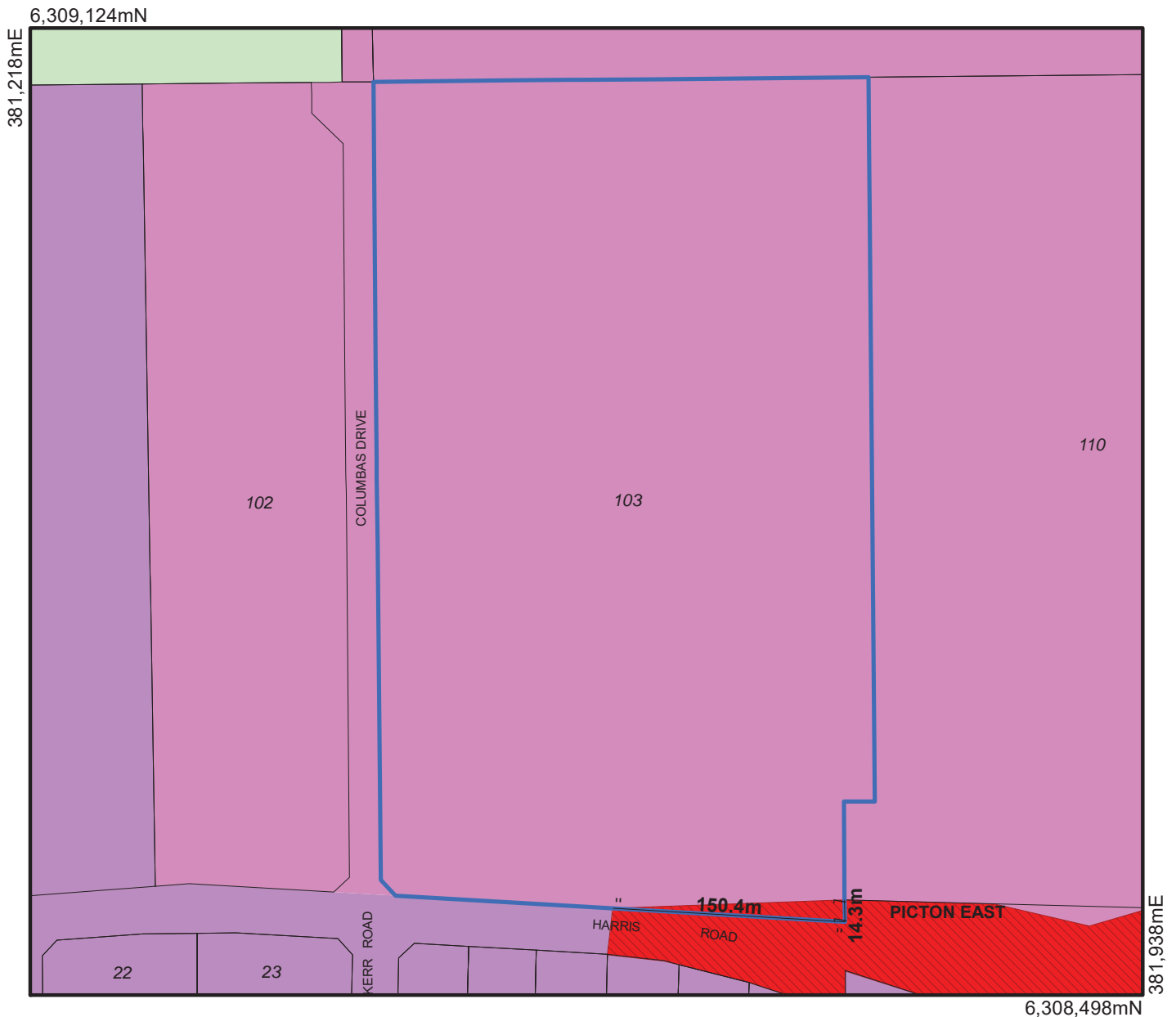
Location:

Certificate of Title: Vol: 2152 Folio:572

Diagram: 96575

Legend for reserved land and zones

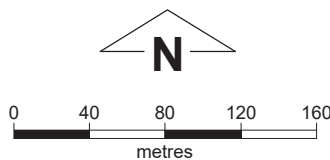
- Environmental conditions
- Industrial deferred
- Rural
- Industrial
- Primary regional roads



This certificate relates only to the provisions of the:  
Greater Bunbury Region Scheme  
and does not claim to indicate the land use allocation under any local government provision.

Produced by Data Analytics,  
Department of Planning, Lands and Heritage, Perth WA.

Base information supplied by:  
Western Australian Land Information Authority SLIP 1096-2018-1



Coordinates based on MGA Zone 50 (GDA 94)  
All dimensions are in metres  
Subject to survey

Ms Sam Fagan  
Secretary  
Western Australian Planning Commission



GOVERNMENT OF WESTERN AUSTRALIA

**MINISTER FOR THE ENVIRONMENT; SCIENCE**

Statement No.

000697

**STATEMENT THAT A SCHEME MAY BE IMPLEMENTED  
(PURSUANT TO THE PROVISIONS OF DIVISION 3 OF PART IV OF THE  
ENVIRONMENTAL PROTECTION ACT 1986)**

**GREATER BUNBURY REGION SCHEME**

**Scheme Purpose:** To guide and regulate the use and development of land and to make provisions for regional infrastructure and regional open space within the Greater Bunbury Region.

**Responsible Authority:** Western Australian Planning Commission

**Responsible Authority Address:** 469 Wellington Street, PERTH WA 6000

**Assessment Number:** 1048

**Report of the Environmental Protection Authority:** Bulletin 1108

Subject to the following conditions, there is no known environmental reason why the Greater Bunbury Region Scheme to which the above report of the Environmental Protection Authority relates should not be implemented:

**1 Additional Land to be Reserved**

1-1 All or portions of the following sites shall be reserved for conservation, in accordance with the requirements set out in Attachment 1 of the Minister for the Environment's "Statement that a Scheme may be Implemented" No. 000697 published on (date):

- 1) Reserve 35061 Paris Road, Australind - Decommissioned Wastewater Treatment Plant
- 2) Reserve 31012 Harewoods Road, Dalyellup
- 3) Foreshore adjoining Port Installations Reserve
- 4) Twin Rivers - Pt Lot 211 Barnes Avenue, Australind
- 5) College Grove - Lot 1000 Bussell Highway
- 6) Pt Loc 632 Parade Road, Glen Padden
- 7) Reserve 670 North Boyanup Road, Davenport
- 8) Picton Waters - Environmental Protection Policy Lake on portion of Lots 40-44 Jeffery Road, Picton
- 9) Pt Lot 1 North Boyanup Road, Davenport
- 10) Lot 317 Harewoods Road, Dalyellup
- 11) Lot 1, Dalyellup Boulevard, Dalyellup

Published on

31 OCT 2005

## **2 Realignment of Primary Regional Roads Reserves**

2-1 Portions of the following Primary Regional Roads Reserves shall be realigned, in accordance with the requirements set out in Attachment 1 of the Minister for the Environment's "Statement that a Scheme may be Implemented" No. 000697 published on (date):

- 1) Port Access Road
- 2) Bunbury Outer Ring Road

## **CONDITIONS TO BE INCORPORATED INTO THE SCHEME BY INSERTION OF PROVISIONS IN SCHEME TEXT**

### **3 Management Plans**

3-1 The following Environmental Management Plans may be required in accordance with the specifications set out in Attachment 1 in the Minister for the Environment's "Statement that a Scheme may be Implemented" No. 000697 published on (insert date), and shall be subsequently implemented in accordance with the provisions of the Management Plans, to the satisfaction of the Western Australian Planning Commission:

- 1) Environmental Management Plans for schemes, subdivisions and developments which impact on Regional Open Space in the scheme, Crown conservation or nature reserves, a National Park or bushland, waterways, wetlands or other land that may be part of an ecological linkage;
- 2) Environmental Management Plans for industrial development within the Kemerton Industrial Area and Special Control Area No. 2;
- 3) Drainage, Nutrient and Water Management Plans in areas where the Average Maximum Groundwater Level is less than 1.2 metres below the natural ground surface or where any proposed off-site drainage could lead to degradation of wetlands or waterways; and
- 4) Acid Sulfate Soil Management Plans where the presence of acid sulphate soils is confirmed or there is likely to be a significant risk of disturbing acid sulphate soils.

### **4 Biological Survey**

4-1 As part of a scheme amendment or application to subdivide or develop land which has the potential to impact on regionally significant native remnant vegetation or native fauna, the Western Australian Planning Commission or local government, as the case requires, may require a biological survey, including a search for Declared Rare Flora and Fauna, Priority Flora, Threatened Flora Communities and Threatened Fauna, to be undertaken.

The biological survey shall be undertaken to the satisfaction of the Western Australian Planning Commission or local government, as the case requires, having due regard for advice from relevant government agencies, and shall be taken into account when considering the rezoning and subsequent subdivision and development applications.

## **5 Provision of Environmental Offsets**

- 5-1 Prior to construction of the Port Access Road and Bunbury Outer Ring Road, an environmental offset strategy shall be prepared to mitigate unavoidable impacts on wetlands and native vegetation associated with the Port Access Road and Bunbury Outer Ring Road to the satisfaction of the Western Australian Planning Commission on advice of the Environmental Protection Authority. With respect to the Port Access Road, the strategy shall include a foreshore management plan for the Ferguson River in the vicinity of the road. With respect to the Bunbury Outer Ring Road, the strategy shall include rehabilitation of the strip of land adjacent to the road in the vicinity of Lot 15 North Boyanup Road (South Western Highway) and design of the intersection with the Australind Bypass to minimize impacts on environmental values of the area.

Dr Judy Edwards MLA  
MINISTER FOR THE ENVIRONMENT; SCIENCE

31 OCT 2005

**STATEMENT THAT A SCHEME MAY BE IMPLEMENTED –  
GREATER BUNBURY REGION SCHEME**

**SPECIFICATIONS FOR ENVIRONMENTAL MANAGEMENT PLANS,  
ADDITIONAL LAND TO BE RESERVED AND REALIGNMENT OF PRIMARY  
REGIONAL ROAD RESERVES**

**1 Environmental Management Plans for Schemes, Subdivisions and Developments**

1-1 Prior to amending local town planning schemes, or finally approving subdivisions or developments (whichever is sooner), the Western Australian Planning Commission or local government, as the case requires, may require an Environmental Management Plan to be prepared and implemented to achieve the objective of managing the potential impacts of the proposed subdivision or development on the following:

- 1) land which is reserved as Regional Open Space in the Scheme;
- 2) a Crown conservation or nature reserve;
- 3) a National Park; or
- 4) bushland, waterway, wetland or land that may be part of an ecological linkage.

The Environmental Management Plan shall include:

- i) a description of existing environmental values, and the identification of the environmental outcome to be achieved through the implementation of the Plan;
- ii) clear delineation of boundaries of significant areas to be protected;
- iii) fire management;
- iv) drainage and nutrient management;
- v) management of access and rehabilitation;
- vi) vegetation and/or wetland mitigation strategies;
- vii) a program for implementation;
- viii) allocation of responsibilities and identification of timing and duration of implementation;
- ix) provision for routine monitoring of environmental values; and
- x) provision of details of contingency plans in the event that the monitoring surveys indicate that the development is having or has had an adverse impact upon environmental values.

1-2 Environmental Management Plans required by condition 1-1 shall be prepared to the satisfaction of the Western Australian Planning Commission or local government, as the case requires, having due regard for advice from relevant government agencies and shall be implemented in accordance with a program defined in the Environmental Management Plan.

## **2 Environmental Management Plans for Industrial Development within the Kemerton Industrial Area and Special Control Area No. 2**

2-1 Prior to approving subdivision or development within the Kemerton Industrial Area and the Special Control Area No. 2, the Western Australian Planning Commission or local government, as the case requires, may require an Environmental Management Plan to be prepared and implemented to achieve the objective of managing the potential impacts of the proposed development.

The Environmental Management Plan shall include:

- 1) a description of existing environmental values (including vegetation, fauna and wetlands) and the identification of the environmental outcome to be achieved through the implementation of this Plan;
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- 7) provision of details of contingency plans in the event that the monitoring surveys indicate that the subdivision or development is having or has had an adverse impact upon environmental values.

2-2 An Environmental Management Plan required by condition 2-1 shall be prepared to the satisfaction of the Western Australian Planning Commission or local government, as the case requires, having due regard for advice from relevant government agencies and shall be implemented in accordance with a program defined in the Environmental Management Plan.

## **3 Drainage, Nutrient and Water Management Plans**

3-1 Prior to amending local town planning schemes, or finally approving subdivision or developments (including those for intensive horticulture), whichever is sooner, in areas where the Average Maximum Groundwater Level is less than 1.2 metres below the natural ground surface, or where any proposed off-site drainage could lead to degradation of wetlands or waterways, the Western Australian Planning Commission or local government, as the case requires, may require a Drainage, Nutrient and Water Management Plan to be prepared and implemented.

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- 3-3 The Drainage, Nutrient and Water Management Plan shall be prepared to the satisfaction of the Western Australian Planning Commission or local government, as the case requires, having due regard for advice from relevant government agencies, and shall be implemented in accordance with a program defined in the Drainage, Nutrient and Water Management Plan.

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- 4-1 Prior to amending local town planning schemes, or finally approving subdivisions or development, the Western Australian Planning Commission or local government, as the case requires, may require a Preliminary Acid Sulfate Soils Assessment to be prepared where there is likely to be a significant risk of disturbing acid sulfate soils.
- 4-2 Where the presence of acid sulfate soils is confirmed, an Acid Sulphate Soil Management Plan shall be prepared to the satisfaction of the Western Australian Planning Commission or local government, as the case requires, having due regard for advice from relevant government agencies and implemented in accordance with a program defined in the Acid Sulphate Soil Management Plan.

#### **5 Additional Land to be Reserved**

##### **5-1 Reserve 35061 Paris Road, Australind - Decommissioned Wastewater Treatment Plant**

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A portion of Pt Lot 211 Barnes Avenue as detailed in the Minister for the Environment's determination of appeals relating to the Environmental Protection Authority's report and recommendations on the Scheme, dated 30 November 2004, shall be reserved for conservation purposes to protect the integrity, function and environmental values of the land to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation and complementary purposes.

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**5-9 Pt Lot 1 North Boyanup Road, Davenport**

Land shall be reserved for conservation purposes to provide an appropriate buffer to the Preston River on Pt Lot 1, North Boyanup Road, Davenport to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation and complementary purposes.

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Lot 317 Harewoods Road, Dalyellup shall be reserved for conservation purposes to protect the integrity, function and environmental value of the bushland on the land to the requirements of the Western Australian Planning Commission on advice of the Environmental Protection Authority, and shall only be used for conservation and complementary purposes.

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**6-1 Port Access Road**

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**6-2 Bunbury Outer Ring Road**

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# APPENDIX 3

ENVIRONMENTAL ASSESSMENT AND MANAGEMENT  
STRATEGY



**ROWE**  
GROUP  
DESIGN

# Environmental Assessment and Management Strategy

Local Structure Plan, Lots 103, 110 and 436,  
Picton East

Project No: EP12-039(03)

**Prepared for Harris Road Pty Ltd  
January 2021**

# Environmental Assessment and Management Strategy

Local Structure Plan, Lots 103, 110 and 436, Picton East



## Document Control

<b>Doc name:</b> Environmental Assessment and Management Strategy Local Structure Plan, Lots 103, 110 and 436, Picton East					
<b>Doc no.:</b> EP12-039(03)—015C					
Version	Date	Author		Reviewer	
1	November 2019	Heidi Becker	HPB	Kirsten Knox	KK
	Report issued to client for review.				
A	January 2020	Kirsten Knox	KK	Kirsten Knox	KK
	Amended to include further detail on environmental assessment methodology and clarification on retention of vegetation and fauna habitat.				
B	May 2020	Heidi Becker	HPB	Kirsten Knox	KK
	Updated to address various agency comments provided as part of review of the structure plan.				
C	January 2021	Heidi Becker	HPB	Kirsten Knox	KK
	Updated to address minor change to site boundary.				

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# Environmental Assessment and Management Strategy

Local Structure Plan, Lots 103, 110 and 436, Picton East



## Executive Summary

This *Environmental Assessment and Management Strategy* (EAMS) has been prepared on behalf of Harris Road Pty Ltd (the proponent) for Lots 103, 110 and 436, Picton East within the Shire of Dardanup, herein referred to as 'the site'. Rowe Group, on behalf of the proponent, have prepared the Lots 103, 110 and 436, Picton East Local Structure Plan, which is intended to guide the future industrial development of the site.

This EAMS has been prepared to address the requirements of the Western Australian Planning Commission's (WAPC) *Structure Plan Framework* (WAPC 2015b) to support the preparation and implementation of the structure plan. This report provides a synthesis of information from a range of sources regarding the environmental features, attributes and values of the site.

The site comprises a total area of approximately 73 hectares (ha) and is located within the Shire of Dardanup. It is bounded by Martin-Pelusey Road to the east, undeveloped industrial land to the north, a freight railway to the north-west, Columbas Drive to the west and Harris Road and existing industrial land uses to the south.

The relevant environmental attributes and values of the site are summarised as follows:

- The majority of the site has been historically cleared or modified to allow for agricultural activities, primarily grazing.
- Topography across the site ranges from 12.0 m Australian Height Datum (AHD) to 23.0 m AHD along the western and northern boundaries of the site.
- The entire site is classified as having a 'moderate to low risk' of acid sulfate soils (ASS) occurring within 3 m of the natural soil surface. Site specific investigations (Strategen 2010) undertaken within a portion of the site did not detect potential for ASS as part of field sampling.
- Given historic clearing and associated agricultural land uses, flora and vegetation within the site has been significantly modified, with all areas containing remnant native vegetation in the site identified as being in 'completely degraded'.
- No threatened ecological communities (TECs) were identified within the site, nor are any likely to occur based on the degraded nature of vegetation within the site (Ekologica Pty Ltd 2009).
- No threatened or priority flora species have been identified within the site, nor are any likely to occur based on the degraded nature of vegetation within the site (Ekologica Pty Ltd 2009).
- A number of conservation significant fauna species were identified as utilising vegetation within the site including western ringtail possum and the three black cockatoo species (Carnaby's, Baudin's and forest red-tailed) (Harewood 2009).
- Based on the *Geomorphic Wetlands of the Swan Coastal Plain* (DBCA 2019a) dataset, three multiple use wetlands (MUW) were identified within the site.
- No registered Aboriginal or non-indigenous heritage sites were mapped within the site. One Other Heritage Place is identified 20 m south of the site.
- Areas of bushfire hazard have been identified both within and outside the site, associated with the proposed public open space within the north-west corner of the site, and existing private landholdings surrounding the site.

# Environmental Assessment and Management Strategy

Local Structure Plan, Lots 103, 110 and 436, Picton East



The structure plan design has responded to site-specific environmental considerations where necessary and possible, including retention of existing vegetation within an area of public open space (which is in addition to the conservation significant areas identified by the EPA (2008) and DPLH (2018), but was identified for retention in the LSP due to the habitat values); and accommodation of stormwater within drainage reserves.

As part of future development, a number of environmental attributes/values will require management to minimise potential impacts in accordance with the relevant federal, state and local requirements. The key requirements of future management for the site as part of subdivision and/or future development are summarised as follows:

- **Acid sulfate soils:** it is possible that future investigations and management considerations will be required at subdivision, particularly if services are likely to be installed below the permanent groundwater table.
- **Native vegetation:** ensuring a road interface is provided between the public open space area containing retained remnant vegetation (to ensure lots do not directly back onto this area), and confirming tree retention opportunities (in addition to the area of public open space proposed to retain remnant vegetation) in consideration of final development design and bulk earthworks requirements, and protection vegetation proposed for retention as part of works. Where clearing of native vegetation is proposed, clearing will need to be undertaken in accordance with a valid exemption or a clearing permit will need to be attained pursuant to Part V of the *Environmental Protection Act 1986*.
- **Native fauna:** confirming tree retention (i.e. fauna habitat) retention opportunities (in addition to the area of public open space proposed to retain remnant vegetation) in consideration of the final development design and bulk earthworks requirements. Fauna management protocols will likely need to be implemented prior to and during clearing activities, particularly with regard to western ringtail possums.
- **Hydrology:** stormwater management requirements to be implemented as outlined within the Local Water Management Strategy (LWMS), and will include preparation of an Urban Water Management Plan (UWMP) for each stage of future subdivision. Spatial provision will need to be made for the drainage reserves at subdivision to accommodate stormwater.
- **Wastewater:** Requirement to design and install appropriate onsite wastewater disposal, likely to be in the form of aerobic treatment units (ATUs) for domestic effluent and storage/treatment of industrial process wastewater.
- **Social surroundings:** Each future industrial land use will need to ensure they are able to provide appropriate separation between themselves and any nearby sensitive land uses. The only sensitive land uses that may be located within the vicinity of the site will be existing rural residences that have not been converted to industrial development (in line with the broader zoning for the area).
- **Bushfire risks:** Provision of appropriate separation between future built form and bushfire hazards will need to be accommodated as part of subdivision design (and proposed location of the integrator roads has demonstrated this can be achieved); and drainage and road reserves will be designed and maintained to low threat (in order to not be a hazard). Vehicle access will also need to accommodate access to at least two destinations. This will be addressed as part of

# Environmental Assessment and Management Strategy

Local Structure Plan, Lots 103, 110 and 436, Picton East



future bushfire management plans supporting subdivision and/or development approval, whichever is applicable.

Overall, the environmental attributes and values of the site can be accommodated within the structure plan design, or can be managed appropriately through the future subdivision and development phases in line with the relevant state and local government legislation, policies and guidelines and best management practices.

# Environmental Assessment and Management Strategy

Local Structure Plan, Lots 103, 110 and 436, Picton East



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### Appendix A

Lots 103, 110 and 436 Picton East Local Structure Plan (Rowe Group 2020)

### Appendix B

Preliminary Acid Sulphate Soil Investigation (Strategen 2010)

### Appendix C

Flora, vegetation and fauna assessment methodology (Emerge Associates 2020)

### Appendix D

Level 1 flora and vegetation survey (Ekologica Pty Ltd 2009)

### Appendix E

Terrestrial Fauna Survey (Level 1) (Harewood G. 2009)

### Appendix F

Groundwater Levels and Quality Monitoring Report (TME 2012)

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## List of Abbreviations

Table A1: Abbreviations – General terms

General terms	
AHD	Australian Height Datum
AHIS	Aboriginal Heritage Inquiry System
ANZECC	Australian and New Zealand Environment and Conservation Council (
ASS	Acid Sulfate Soil
ASSDMP	Acid Sulfate Soil and Dewatering Management Plan
BBC	Baudin's black cockatoo
CBC	Carnaby's black cockatoo
DBH	Diameter at Breast Height
EAMS	Environmental Assessment and Management Strategy
ESA	Environmentally sensitive area
FRTBC	Forest red-tailed black cockatoo
IBRA	Interim Biogeographic Regionalisation of Australia
LWMS	Local Water Management Strategy
PEC	Priority ecological community
PF	Priority flora
PDWSA	Public drinking water source area
TEC	Threatened ecological community
TF	Threatened flora
UWMP	Urban Water Management Plan

Table A2: Abbreviations – Legislation and policies

Legislation and policies	
AH Act	<i>Aboriginal Heritage Act 1972</i>
BC Act	<i>Biodiversity Conservation Act 2016</i>
EP Act	<i>Environmental Protection Act 1986</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>

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*Table A3: Abbreviations – Organisations*

Organisations	
DAWE	Department of Agriculture, Water and Environment (federal)
DBCA	Department of Biodiversity Conservation and Attractions
DoEE	Department of Environment and Energy (now known as Department of Agriculture, Water and Environment)
DoH	Department of Health
DoW	Department of Water (now known as Department of Water and Environmental Regulation)
DPAW	Department of Parks and Wildlife (now known as Department of Biodiversity Conservation and Attractions)
DPLH	Department of Planning, Lands and Heritage
DWER	Department of Water and Environmental Regulation
EPA	Environmental Protection Authority
WAPC	Western Australian Planning Commission

*Table A4: Abbreviations – Planning and building terms*

Planning and building terms	
GBRS	Greater Bunbury Region Scheme
LSP	Local Structure Plan
TPS	Town Planning Scheme

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## 1 Introduction

### 1.1 Background

Harris Road Pty Ltd (the proponent) are in the process of preparing a local structure plan for Lots 103, 110 and 436, Picton East (herein referred to as 'the site'), to support future industrial development, as shown in the structure plan in **Appendix A**. The site is shown in **Figure 1** and consists of an area approximately 71 ha and is located within the Shire of Dardanup. It is bounded by Martin-Pelusey Road to the east, undeveloped industrial-zoned land to the north, a freight railway to the north-west, Columbas Drive to the west and Harris Road and existing industrial land uses to the south.

The site is currently zoned 'Industrial Deferred' under the Greater Bunbury Region Scheme (GBRS), as shown in **Figure 2**. Lots 103 and 436 are zoned 'General Farming' and Lot 110 is zoned 'Restricted Use 10' (for timber sales and storage) under Shire of Dardanup Town Planning Scheme No. 3 (TPS 3).

### 1.2 Purpose of this report

The purpose of this Environmental Assessment and Management Strategy (EAMS) is to provide a synthesis of information regarding the environmental values and attributes of the site. Specifically, this report:

- Identifies the existing environmental values and attributes of the site (**Section 2**)
- Discusses the land use and environmental planning context for the structure plan area (**Section 3**)
- Discusses how the structure plan layout responds to the existing environmental features and values, and future environmental management requirements as part of the future planning and development process (**Section 4**)
- Provides an implementation framework for future environmental management requirements as part of the future planning and development process (**Section 5**)

The EAMS is the key supporting environmental document for the structure plan, to ultimately facilitate consideration of relevant environmental issues by the local government and various state government agencies and authorities. It is consistent with the requirements for environmental reporting as outlined in the Western Australian Planning Commission's (WAPC's) *Structure Plan Framework* (WAPC 2015b).

It is relevant to note, that as part of preparation of the structure plan, the *Industrial estates, precincts and industrial developments Scoping Tool: Public Health Considerations* (DoH 2016) has also been considered. This document covers a range of issues, many of which are not applicable to structure planning, and will be the responsibility of a range of government departments, local government and future industrial operators to consider and/or address as development within the site progresses.

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## 1.3 Assessment scope

Emerge Associates (Emerge) was engaged to undertake this environmental assessment to document the existing environmental attributes and values of the site and ensure that any relevant environmental values can be accommodated within the structure plan, and/or managed through future stages of planning and development of the site. This involved utilising a range of information sources including local and regional reports, databases, mapping and site-specific investigations, including:

- Various publicly available databases and information sources
- *Picton Industrial Park Southern Precinct District Structure Plan (DPLH 2018)*
- *Waterloo Industrial Park District Structure Plan (draft) (WAPC 2019)*
- *Shire of Dardanup Local Biodiversity Strategy Discussion Paper (draft) (Ironbark Environmental & Eco Logical Australia 2009)*
- *Local Structure Plan Lot 105 Columbas Drive, Picton (RPS 2010)*
- *Terrestrial Fauna Survey (Level 1) of Lots 1, 2, 11, 102-104 and 603 Picton (East) (Harewood 2009)*
- *Preliminary Acid Sulphate Soil Investigation, Picton East (Strategen 2010)*
- *Report for Preston South, Eastern Precinct – Environmental Assessment for Potential Land Development (GHD 2011)*
- *Report on a Level 1 flora and vegetation survey at various lots at Picton East (Ekologica Pty Ltd 2009)*
- Various environmental investigations associated with the Bunbury Outer Ring Road EPBC Act referral.

In addition to the above, Emerge have conducted a number of site-specific investigations (outlined further below), as well as a comprehensive desktop review of the available information on environmental conditions within and surrounding the site. The investigations undertaken by Emerge include:

- *Bushfire Management Plan (Emerge Associates 2020a)*
- *Local Water Management Strategy (Emerge Associates 2020b)*

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## 2 Existing Environment

### 2.1 General location and site context

The site is located on the Swan Coastal Plain (SCP) in the Shire of Dardanup and is situated approximately 10 km south-east of the Bunbury town centre. The site is generally located in an area that has historically supported a mixture of agricultural land uses, however is transitioning to industrial land uses.

Based on publicly available aerial imagery, prior to 1996, a majority of the remnant vegetation in the southern half of the site was removed, with patches of remnant trees remaining in the northern half of the site. The site is currently used for predominantly grazing purposes, with a timber saleyard located within Lot 110, in the southern portion of the site.

### 2.2 Landform and soils

#### 2.2.1 Topography

The site ranges from 12.0 m Australian Height Datum (AHD) to 23.0 m AHD. The higher elevations and steeper slopes are located along the western and northern boundaries of the site. The lowest areas are generally consistent with the existing drainage channels and farm dams. Topographic contours across the site are shown in **Figure 3**.

#### 2.2.2 Landform, soils and geology

The surface geology associated with the site is dominated by undifferentiated consolidated Cainozoic sedimentary rocks; sandstone, limestone, conglomerate and siltstone. Regional mapping by Gozzard (1981) indicated the site is underlain by the Guildford formation, consisting of clay, silt, sand and gravels, with some Bassendean Sand outcrops and includes the following types (as shown in **Figure 4**):

- Qpa – Guildford formation: mainly alluvial sandy clay
- QPb – Bassendean Sand: low rounded dunes
- Qpb/Qpa – thin bassendean sand over Guildford formation.

As part of soil investigations undertaken historically by Strategen (2010), the following was observed:

- In the low-lying areas of the site, soils were observed to be light brown or yellow brown to grey brown in colour, consisting of fine to medium grained sands, with clayey sands below depths of 1 m.
- In the higher areas/northern ridge (associated with sample location BH4), soils were observed to be yellow sand to the maximum installation depth of 2.25 m.

The sample locations from the investigation are shown in **Figure 4**, and the results generally align with the regional mapping.

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### 2.2.3 Acid sulfate soils

Acid sulfate soils (ASS) is the name commonly given to naturally occurring soils and sediment containing iron sulphide (iron pyrite) materials. In their natural state, ASS are generally present in waterlogged and/or anoxic conditions and do not present any risk to the environment. ASS can pose issues when oxidised, producing sulphuric acid, which can present a range of risks for the surrounding environment, infrastructure and human health.

The Department of Water and Environment Regulation (DWER) provides broad-scale mapping indicating areas of potential ASS risk (DWER 2019). A review of the DWER mapping indicates that the site is classified as having a 'moderate to low risk' of ASS occurring within 3 m of the natural soil.

A Preliminary Acid Sulfate Soil Investigation undertaken for the site (Strategen (2010) and attached in **Appendix B** found that based on the field tests, the potential for ASS was not detected within the sample locations in the site (BH4 and BH9, shown in **Figure 4**). Sample locations to the north and east of the site did show potential for ASS to occur, however further investigations would need to be undertaken to understand if management would be required.

## 2.3 Biodiversity and natural area assets

### 2.3.1 Flora and vegetation

#### 2.3.1.1 Regional context

Native vegetation can be described and mapped at different scales or units in order to illustrate general patterns in its distribution. At a continental scale the *Interim Biogeographic Regionalisation of Australia* (IBRA) divides the Swan Coastal Plain into two floristic subregions, the Perth Plateau and the Dandaragan Plateau (Environment Australia 2000).

Vegetation complex mapping undertaken by Heddle *et al.* (1980) which uses a combination of landform, soil and rainfall parameters, indicate the site, for the major part, is within the Guildford Complex, with the north-west corner of the site located within the Southern River Complex.

The Guildford Complex is described as an open forest to tall open forest of *Corymbia calophylla* – *Eucalyptus wandoo* – *Eucalyptus marginata* and woodland of *Eucalyptus wandoo* (with rare occurrences of *Eucalyptus lane-poolei*). Minor components include *Eucalyptus rudis* and *Melaleuca raphiophylla* (Heddle *et al* 1980).

The Southern River Complex is described as open woodland of *Corymbia calophylla* - *Eucalyptus marginata* - *Banksia* spp. with fringing woodland of *Eucalyptus rudis* - *Melaleuca raphiophylla* along creek beds (Heddle *et al* 1980).



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### 2.3.1.2 Site specific surveys and investigations

A level 1 flora and vegetation survey was carried out in October 2009 for the Picton East industrial park area (including Lots 1, 2, 11, 103, 603, 102 and 104) by Ekologica Pty Ltd (2009), and included the site. Due to the time that has elapsed since this survey was completed, Emerge Associates have undertaken a detailed review of the survey outcomes as well as a database review and a reconnaissance site visit in November 2019 to support preparation of the LSP. This was to ensure that all relevant conservation significant values, particularly those pursuant to the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *Biodiversity Conservation Act 2016* (BC Act) were appropriately considered.

The assessment methodology for the flora, vegetation and fauna values within the site is outlined further in **Appendix C**.

### 2.3.1.3 Vegetation units

The flora and vegetation survey undertaken by Ekologica Pty Ltd (2009), identified 44 species of native flora within the broader survey area, noting that non-native species were not recorded as these had been comprehensively covered in the surveys undertaken to support the *Advice on areas of conservation significance in the Preston Industrial Park* (EPA 2008). A copy of the flora and vegetation survey is provided in **Appendix C**.

Four vegetation units were identified within the survey area by Ekologica Pty Ltd (2009), with only three of these units identified within the site. A description of the vegetation units identified within the site has been provided in **Table 1** and is also shown in **Plate 1**.

Table 1: Vegetation units identified by Ekologica Pty Ltd (2009) within the site

Unit no.	Vegetation unit	Description
2	<i>Melaleuca</i> woodland/shrubland	Woodland or tall shrubland of <i>Melaleuca raphiophylla</i> or <i>M.preissiana</i> over shrubland of <i>M. lateritia</i> and/or <i>M. teretifolia</i> .
3	JMA parkland	Woodland to open woodland of Jarrah, Marri and <i>Agonis flexuosa</i> over pasture species and weeds.
4	Plantation	Mixed plantings of eucalypts and other species with scattered original tree species.

The reconnaissance site visit by Emerge Associates in November 2019 confirmed that the vegetation observed within the site appears to largely align with the vegetation units identified within the previous survey (Ekologica Pty Ltd (2009), noting that:

- The area identified as a plantation has since been removed and now consists of paddock grasses. No updated aerials were available showing this.
- Within the *Melaleuca* woodland/shrubland unit in the northern central portion of the site (see **Plate 1**) some *Eucalyptus rudis* (flooded gum) individuals were observed in addition to the *Melaleuca* species.

Photos of the vegetation observed within the site as part of the reconnaissance site visit has been included in **Plate 2** and **Plate 3**.

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Plate 1: Excerpt from the level 1 flora and vegetation survey (Ekologica Pty Ltd 2009), showing the vegetation units identified within the site. The approximate site boundary is shown in yellow outline.

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*Plate 2: Example of 'JMA Parkland' vegetation unit, taken during the reconnaissance site visit November 2019.*



*Plate 3: Example of 'Melaleuca woodland/shrubland' vegetation unit with Eucalyptus rudis (flooded gum) in foreground.*

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### 2.3.1.4 Vegetation condition

Vegetation condition within the site was assessed by Ekologica Pty Ltd (2009) using methods from Keighery (1994) which is still a relevant method for assessing vegetation condition.

Ekologica Pty Ltd (2009) found that due to the long history of grazing and partial clearing most of the native species (particularly ground covers, and mid storey species) had been replaced by pasture species and annual and perennial weeds associated with agriculture. Areas where native vegetation have been identified within the site (associated with overstorey species such as *Eucalyptus marginata*, *Agonis flexuosa* and *Corymbia calophylla*) have been assessed as 'completely degraded' condition (Ekologica Pty Ltd 2009), and is shown in **Plate 4**.

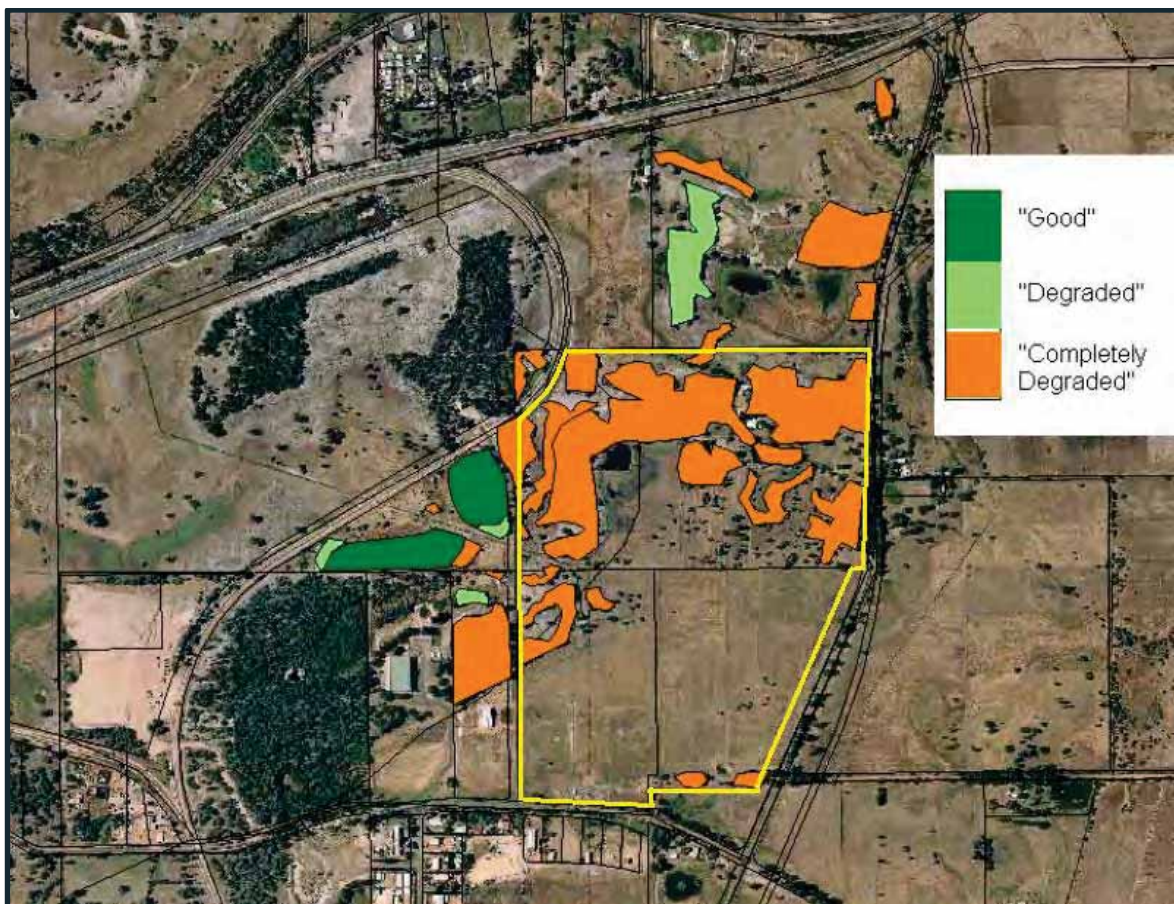


Plate 4: Excerpt from the Level 1 flora and vegetation survey (Ekologica Pty Ltd 2009) showing vegetation condition based on the method of Keighery (1994). The approximate site boundary is shown in yellow outline.

The reconnaissance site visit by Emerge Associates in November 2019 confirmed that the vegetation condition generally aligned with that documented in the Ekologica Pty Ltd (2009) survey.

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### 2.3.1.5 Threatened and priority ecological communities

Generally, ecological communities can be described as vegetation communities that are assemblages of species that occur together in a particular type of habitat. An ecological community's structure, composition and distribution are determined by a range of environmental factors. 'Threatened ecological communities' (TECs) are ecological communities that are recognised as rare or under threat and therefore warrant special protection.

Selected TECs are afforded statutory protection at a Commonwealth level under the EPBC Act. TECs listed under the EPBC Act are categorised as either 'critically endangered', 'endangered' or 'vulnerable'. Any action likely to have a significant impact on a TEC listed under the EPBC Act (either critically endangered or endangered TECs) requires approval from the Commonwealth Minister for the Environment.

Within Western Australia TECs are determined by the Western Australian Threatened Ecological Communities Scientific Advisory Committee (WATECSAC) and endorsed by the State Minister for the Environment. The WATECSAC is an independent group comprised of representatives from organisations including tertiary institutions, the Western Australian Museum and DBCA. The TECs endorsed by the State Minister are published by DBCA (DBCA 2018). TECs are afforded direct statutory protection at a State level under the BC Act and Biodiversity Conservation Regulations 2018 (BC regulations). Ecological communities are listed under Section 27(1) and 33 of the BC Act (although at the time this report was prepared no TECs had been formerly listed).

Their significance is also acknowledged through other state environmental approval processes such as 'environmental impact assessment' pursuant to Part IV of the *Environmental Protection Act 1986* (EP Act) and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*.

Section 43 of the BC Act requires that an occurrence of a threatened species or threatened ecological community is reported to DBCA where the occurrence has been identified as part of field work completed:

- as part of an assessment under Part IV of the *Environmental Protection Act 1986*; or
- in relation to an application for a clearing permit under the *Environmental Protection Act 1986* section 51E(1)(d).

Penalties apply to individuals and organisations that fail to provide accurate reports of threatened species or communities.

The *Biodiversity Conservation Regulations 2018* (BC Regulations 2018) came into effect on January 1 2019. The BC Regulations include provisions for licencing, charges, penalties and other provisions associated with the BC Act.

An ecological community under consideration for listing as a TEC in Western Australia, but which does not yet meet survey criteria or has not been adequately defined, or which is rare but not currently threatened, is referred to as a 'priority ecological community' (PEC). Whilst PECs are not afforded statutory protection in Western Australia, they are considered during the approval process.

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The level 1 flora and vegetation survey (Ekologica Pty Ltd 2009) identified four TECs occurring within 10 km of the survey area. Given the time that has elapsed since the flora and vegetation survey was completed, the results of the survey have been compared to the status and current known locations of TECs and PECs within 10 km of the site.

TECs and PECs were searched for using the publicly available *Weed and native flora dataset* (Keighery *et al.* 2012), *Protected Matters Search Tool* (Department of Environment and Energy (DoEE) 2018) and Department of Biodiversity Conservation Attraction (DBCAs) *NatureMap* (DBCAs 2019c) and current lists of threatened and priority ecological communities (DBCAs 2018; DBCAs 2019a). These search results indicate that five TECs or PECs were identified as potentially occurring within 10 km of the site and are listed in **Table 2**. Within **Table 2**, Emerge Associates have indicated whether the flora and vegetation survey (Ekologica Pty Ltd 2009) considered the TECs or PECs identified as potentially occurring within the site.

*Table 2: TECs and PECs potentially occurring within 10 km of the site based on relevant database searches and indication of whether these were considered within the Ekologica Pty Ltd (2009) survey.*

TECs and PECs identified based upon database searches	Considered as part of previous survey (Ekologica Pty Ltd 2009)	Potential to occur within the site based on habitat preferences
Threatened ecological community (TEC) (state or federally listed)		
Banksia woodlands of the Swan Coastal Plain (SCP)	-	Yes
Clay Pans of the SCP, including the state listed communities: <ul style="list-style-type: none"> <li>• Herb rich shrublands in clay pans (SCP08 – SCP community type 8)</li> <li>• Dense shrublands on clay flats (SCP09 – SCP community type 9).</li> </ul>	✓	Yes
<i>Corymbia calophylla</i> – <i>Xanthorrhoea preissii</i> woodlands and shrublands of the SCP (EPBC Act)	✓	Yes
<i>Corymbia calophylla</i> woodlands on heavy soils of the southern Swan Coastal Plain (State)	-	Yes
Shrublands on calcareous silts of the SCP (State)	✓	Yes
Subtropical and temperate coastal saltmarsh (EPBC Act)	-	No
Tuart ( <i>Eucalyptus gomphocephala</i> ) woodlands and forests of the SCP (EPBC Act)	-	Yes
Priority ecological community (PEC) (state listed)		
Banksia dominated woodlands of the Swan Coastal Plain IBRA region (Priority 3) (associated with the Banksia Woodlands of the Swan Coastal Plain TEC)	-	Yes
Low lying <i>Banksia attenuata</i> woodlands or shrublands ('floristic community type 21c') (Priority 3) (associated with the Banksia Woodlands of the Swan Coastal Plain TEC)	✓	Yes
Southern <i>Banksia attenuata</i> woodlands ('community type 21b') (Priority 3) (associated with the Banksia Woodlands of the Swan Coastal Plain TEC)	✓	Yes

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Table 2: TECs and PECs potentially occurring within 10 km of the site based on relevant database searches and indication of whether these were considered within the Ekologica Pty Ltd (2009) survey. (continued)

TECs and PECs identified based upon database searches	Considered as part of previous survey (Ekologica Pty Ltd 2009)	Potential to occur within the site based on habitat preferences
Priority ecological community (PEC) (state listed) (continued)		
Southern <i>Eucalyptus gomphocephala</i> - <i>Agonis flexuosa</i> woodlands (associated with the Banksia Woodlands of the Swan Coastal Plain TEC)	-	No
Quindalup <i>Eucalyptus gomphocephala</i> and/or <i>Agonis flexuosa</i> woodlands	-	No

The flora and vegetation survey (Ekologica Pty Ltd 2009) did not identify any TECs or PECs as occurring within the site. It is relevant to note that as part of the *Advice on areas of conservation significance in the Preston Industrial Park* (EPA 2008), the EPA also did not identify any TECs as occurring within the study area (including the site).

As outlined within **Appendix C**, since the flora and vegetation survey (Ekologica Pty Ltd 2009) was completed, new TECs and PECs have been listed, in particular the 'Subtropical and temperate coastal saltmarsh' TEC, 'Banksia woodlands of the SCP' TEC and the 'Tuart woodlands and forests of the SCP' TEC. The reconnaissance site visit was undertaken to confirm the presence of key indicator species or features that would indicate these (or the other identified) communities may be present within the site.

The outcomes of the reconnaissance site visit (outlined in **Appendix C**) and review of existing site-specific data indicate the:

- Banksia woodland of the Swan Coastal Plain TEC is not likely to be present given no Banksia sp. are present within the site.
- *Corymbia calophylla* woodlands on heavy soils of the southern Swan Coastal Plain TEC is not likely to occur given relevant indicator species are not present.
- Subtropical and temperate coastal saltmarsh TEC is not likely to be present given suitable habitat relevant to this community is not present within the site.
- Tuart woodland and forest of the Swan Coastal Plain TEC is not likely to be present given no tuarts were observed within the site.

Therefore, based on the observations from the visit and data collected during the previous flora and vegetation survey, none of the TECs or PECs listed in **Table 2** are likely to occur within the site.

### 2.3.1.6 Significant flora

Certain flora species that are considered to be rare or under threat warrant special protection under Commonwealth and/or State legislation. At a Commonwealth level, flora species may be listed as 'threatened' pursuant to the EPBC Act and any action likely to have a significant impact on a listed threatened species requires approval from the Commonwealth Minister for the Environment.

In Western Australia flora species may also be classed as 'threatened' under the BC Act. It is an offence to 'take' or 'disturb' threatened flora listed under the BC Act without Ministerial approval.

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Section 5(1)1 of the Act defines to take as including “... to gather, pluck, cut, pull up, destroy, dig up, remove, harvest or damage flora by any means” or to cause or permit the same to be done.

A search was conducted for threatened and priority flora within a 5 km radius of the site using the *Protected Matters Search Tool* (DoEE 2019b), *NatureMap* (DBCA 2019b) and searches conducted for the Bunbury Outer Ring Road (BORR Team 2019). A total of 8 threatened and 24 priority flora species were identified as occurring or potentially occurring in the wider local area. It is important to note that these searches do not take into account the types and condition of habitat occurring in the site, but are based on the proximity of the site to known occurrence of significant species.

*Table 3: Threatened and priority flora occurring within 5 km of the site based on relevant database searches and indication of whether these were also considered within the previous survey (Ekologica Pty Ltd 2009)*

Threatened and priority flora species based upon database searches	Conservation status		Species considered as part of previous survey (Ekologica Pty Ltd 2009)
	State	Federal	
<i>Austrostipa jacobiana</i>	Critically endangered	Critically endangered	-
<i>Caladenia huegelii</i>	Critically endangered	Endangered	-
<i>Drakaea elastica</i>	Critically endangered	Endangered	-
<i>Austrostipa bronwenae</i>	Endangered	Endangered	-
<i>Drakaea micrantha</i>	Endangered	Vulnerable	-
<i>Diuris drummondii</i> (Tall Donkey Orchid)	Vulnerable	Vulnerable	✓
<i>Diuris micrantha</i>	Vulnerable	Vulnerable	
<i>Eleocharis keigheryi</i>	Vulnerable	Vulnerable	-
<i>Synaphea odocoileops</i>	Priority 1	-	-
<i>Craspedia sp. Waterloo</i> (G.J. Keighery 13724)	Priority 2	-	-
<i>Grevillea rosieri</i>	Priority 2	-	-
<i>Leptomeria furtiva</i>	Priority 2	-	-
<i>Leucopogon sp. Busselton</i> (D. Cooper 243)	Priority 2	-	-
<i>Schoenus loliac</i>	Priority 2	-	-
<i>Angianthus drummondii</i>	Priority 3	-	-
<i>Carex tereticaulis</i>	Priority 3	-	✓
<i>Chamaescilla gibsonii</i>	Priority 3	-	✓
<i>Dillwynia dillwynioides</i>	Priority 3	-	-
<i>Lasiopetatum membranaceum</i>	Priority 3	-	✓
<i>Platysace ramosissima</i>	Priority 3	-	-
<i>Schoenus benthamii</i>	Priority 3	-	-
<i>Schoenus capilifolius</i>	Priority 3	-	✓



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Table 3: Threatened and priority flora occurring within 5 km of the site based on relevant database searches and indication of whether these were also considered within the previous survey (Ekologica Pty Ltd 2009) (continued)

Threatened and priority flora species based upon database searches	Conservation status		Species considered as part of previous survey (Ekologica Pty Ltd 2009)
	State	Federal	
<i>Verdicordia attenuata</i>	Priority 3	-	✓
<i>Acacia flagelliformis</i>	Priority 4	-	✓
<i>Acacia semitrullata</i>	Priority 4	-	-
<i>Aponogeton hexatepatus</i> (Stalked Water Ribbons)	Priority 4	-	✓
<i>Caladenia speciose</i>	Priority 4	-	-
<i>Eucalyptus rudis subsp. cratyantha</i>	Priority 4	-	-
<i>Ornduffia submersa</i>	Priority 4	-	-
<i>Pultenaea skinneri</i>	Priority 4	-	✓
<i>Rumex drummondii</i>	Priority 4	-	-
<i>Styloidium longitubum</i> (Jumping Jacks)	Priority 4	-	-

The flora survey undertaken by Ekologica Pty Ltd (2009) did not record any threatened or priority flora species within the site.

Based on the reconnaissance site visit which confirmed the highly disturbed nature of the site as a result of historical clearing and long-term use of the site for agricultural (predominantly grazing) purposes, it is considered highly unlikely that any occurrences of threatened or priority flora species would be found within the site.

## 2.3.2 Ecological linkages

Ecological linkages are linear landscape elements that allow the movement of fauna, flora and genetic material between areas of remnant habitat. The movement of fauna and the exchange of genetic material between vegetation remnants improve the viability of those remnants by allowing greater access to breeding partners and food sources, refuge from disturbances such as fire and maintenance of genetic diversity of plant communities and populations. Ecological linkages are ideally continuous or near-continuous as the more fractured a linkage is, the less ease flora and fauna have in moving within the corridor (Alan Tingay and Associates 1998).

The Perth Biodiversity Project, supported by the Western Australia Local Government Association (WALGA), have identified and mapped regional ecological linkages within the Perth Metropolitan Region (WALGA and PBP 2004). The study was extended beyond the Perth Metropolitan Region through the South West Biodiversity Project, resulting in the identification and mapping of the South West regional ecological linkages (Molloy *et al.* 2009).

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There are no mapped ecological linkages within the site. One regional ecological linkage (no. 215) is mapped approximately 870 m west of the site, extending in a north-south direction. The facilitation of this ecological linkage is considered as part of the vegetation retention within the *Picton Industrial Park Southern Precinct District Structure Plan* (DPLH 2018)

### 2.3.3 Environmentally sensitive areas

'Environmentally sensitive areas' (ESAs) are prescribed under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* and have been identified to protect native vegetation values of areas surrounding significant, threatened or scheduled flora, vegetation communities or ecosystems. Exemptions under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* do not apply within ESAs. However, exemptions under Schedule 6 of the EP Act still apply, including any clearing in accordance with a subdivision approval under the *Planning and Development Act 2005* (a recognised exemption under the Schedule 6 of the EP Act).

No ESAs occur within or in close proximity to the site based upon a review of the *Clearing Regulations – Environmentally Sensitive Areas* dataset (DWER 2017).

### 2.3.4 Local biodiversity strategy

A *Local Biodiversity Strategy Discussion Paper* (Ironbark Environmental & Eco Logical Australia 2009) has been prepared for the Shire of Dardanup, to identify significant natural areas and determine how these areas could be protected as part of future development. Areas of remnant vegetation within the site have been identified as part of a 'Local Natural Area'. As part of ongoing management, the *Local Biodiversity Strategy Discussion Paper* (Ironbark Environmental & Eco Logical Australia 2009) recommends that the Shire of Dardanup Local Planning Scheme make provision for the protection of the 'Subdivision/Rezoning Areas' and 'Restoration and Enhancement Areas' identified by the EPA (2008) in *Advice on areas of conservation significance in the Preston Industrial Park*.

None of the areas recommended by the EPA (2008) for protection or enhancement are identified within the site. Considerations around biodiversity values are discussed further in **Section 4.2**.

### 2.3.5 Terrestrial fauna

A level 1 fauna survey was carried out by qualified zoologist Greg Harewood in December 2009 for the Picton East industrial park area (including Lots 1, 2, 11, 103, 603, 102 and 104). The survey included a targeted western ringtail possum survey in addition to a targeted black cockatoo habitat assessment in accordance with the technical guidance relevant at the time of the survey. A copy of the fauna assessment is provided in **Appendix D** and the outcomes summarised in the section below.

As outlined further above, due to the time that has elapsed since the survey was completed, Emerge Associates have undertaken a detailed review of the survey outcomes as well as a database review and a reconnaissance site visit in November 2019 to support preparation of the LSP. This was to ensure that all relevant conservation significant values, particularly those pursuant to the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *Biodiversity Conservation Act 2016* (BC Act) were appropriately considered. The assessment methodology applied to the preparation of the EAMS is outlined further in **Appendix D**.

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### 2.3.5.1 Species of conservation significance

Certain fauna species that are considered to be rare or under threat warrant special protection under state and/or federal legislation. At a federal level, fauna species may be listed as 'threatened' pursuant to the EPBC Act and any action likely to have a significant impact on a listed threatened species requires approval from the Commonwealth Minister for the Environment.

In Western Australia, fauna taxa may be classed as 'specially protected' under the BC Act which is enforced by DBCA. Specially protected fauna species are listed under Schedules 1 to 7 according to their conservation status. It is an offence to 'take' or 'disturb' threatened fauna without Ministerial approval.

Fauna species that do not currently meet the criteria for listing as threatened but are potentially rare or threatened may be added to the DBCA's *Priority Fauna List*. These species are classified into 'priority' levels based on threat. Whilst priority species are not under direct statutory protection, they are considered during State approval processes.

To understand the extent of significant fauna species that are likely to occur within the local area, searches were undertaken of the DBCA's NatureMap database (DBCA 2019c) and the DoEE Protected Matters database (DoEE 2019b). It is important to note that these searches do not take into account the types and condition of fauna habitat occurring on the site, but are based on the proximity of the site to known occurrence of significant species. The conservation significant fauna species identified as potentially occurring within the site and the current conservation status are listed below in **Table 4**.

**Table 4** also indicates whether any of the species listed below were identified during the level 1 fauna survey, the potential for suitable habitat to be present within the site and the potential impact of the proposed development on the habitat. It is relevant to note, that where a species was not identified and/or discussed within the level 1 fauna survey (Harewood 2009), the potential for suitable habitat to be present within the site has been based on desktop assessment of the habitat requirements and a consideration of site conditions observed during the reconnaissance site visit.

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Table 4: Conservation fauna known to occur within the vicinity of the site based upon database searches and fauna identified during the Level 1 fauna survey (Harewood 2009) Conservation codes are outlined within Harewood (2009).

Species		Conservation status		Habitat present in site ((Harewood 2009) and desktop search)	Potential impact on habitat ((Harewood 2009 and desktop review))	Species identified utilising the broader survey area (Harewood 2009)
Common name	Scientific name	State	Federal			
Australasian Bittern	<i>Botaurus poiciloptilus</i>	EN	EN	No	None	-
Red Knot	<i>Calidris canutus</i>	EN	EN & MI	No	None	-
Curlew Sandpiper	<i>Calidris ferruginea</i>	CR	CR & MI	No	None	-
Forest Red-tailed Black Cockatoo	<i>Calyptorhynchus banksia naso</i>	VU	VU	Yes	Loss of low value foraging and potential breeding habitat	✓
Baudin's Cockatoo	<i>Calyptorhynchus baudinii</i>	EN	EN	Yes	Loss of low value foraging and potential breeding habitat	✓
Carnaby's cockatoo	<i>Calyptorhynchus latirostris</i>	EN	EN	Yes	Loss of low value foraging and potential breeding habitat	✓
Eastern Curlew	<i>Numenius madagascariensis</i>	CR	CR & MI	No	None	-
Australian Painted-snipe	<i>Rostratula australis</i>	EN	EN	No	None	-
Australian Fairy Tern	<i>Sternula nereis nereis</i>	VU	VU	No	None	-
Balston's Pygmy Perch	<i>Nannatherina balstoni</i>	VU	VU	No	None	-
Chudtich	<i>Dasyurus geoffroii</i>	VU	VU	No	None	-
Western Ringtail Possum	<i>Pseudocheirus occidentalis</i>	CR	CR	Yes	Loss of foraging, refuge and dispersal habitat	✓
Fork-tailed Swift	<i>Apus pacificus</i>	MI	MI	Yes	None	-
Grey wagtail	<i>Motacilla cinerea</i>	MI	MI	No	None	-
Common Sandpiper	<i>Actitis hypoleucos</i>	MI	MI	No	None	-

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Table 4: Conservation fauna known to occur within the vicinity of the site based upon database searches and fauna identified during the Level 1 fauna survey (Harewood 2009) Conservation codes are outlined within Harewood (2009). (continued)

Species		Conservation status		Habitat present in site ((Harewood 2009 and desktop search))	Potential impact on habitat ((Harewood 2009 and desktop review))	Species identified utilising the broader survey area (Harewood 2009)
Common name	Scientific name	State	Federal			
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	MI	MI	Yes (flooded paddocks)	None	-
Pectoral Sandpiper	<i>Calidris melanotos</i>	MI	MI	No	None	-
Osprey	<i>Pandion haliaetus</i>	S5	MI	No	None	-
Cattle Egret	<i>Ardea ibis</i>	S4	MI	Yes (flooded paddocks)	Loss of some degraded foraging habitat	-
Great Egret	<i>Ardea alba</i>	S4	MI	Yes (flooded paddocks)	Loss of some degraded foraging habitat	✓
White-bellied sea eagle	<i>Haliaeetus leucogaster</i>	S3	MI	No	None	-
Rainbow Bee-eater	<i>Merops ornatus</i>	MI	MI	Yes	Loss of potential breeding habitat	✓
Painted snipe	<i>Rostratula benghalensis (sensu lato)</i>	EN	EN	Potentially	None	-

Six fauna species of conservation significance were identified as utilising the survey area as part of the level 1 fauna survey (Harewood 2009), including:

- **Western ringtail possum.** the presence of western ringtail possum throughout the survey area (including the site) was identified through scats and dreys, with the location of these observations shown in **Plate 5** and **Plate 6**. The remnant vegetation in the north-western portion of the site contained a number of dreys as well as scats, and linked with areas of use identified outside the site. It is possible that the evidence observed may be the result of transient individuals temporarily residing in the area as opposed to a viable resident population (Harewood 2009). Protection of habitat values is considered further in **Section 4.3**.
- **Three black cockatoo species.** foraging evidence by the three black cockatoo species (Carnaby's, Baudin's and forest red-tailed) was identified within the survey area in the form of chewed marri nuts with three FRTBC's also observed during the survey. A number of trees with hollows were identified within the survey area (including at least one with a large hollow in the western portion of the site) that may possibly be suitable for nesting (i.e. a large enough hollow), although no evidence of actual breeding was observed at the time (Harewood 2009). No roosting trees were identified as part of the survey (Harewood 2009). Protection of habitat values is considered further in **Section 4.3**.

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- **Great Egret.** A Great Egret was observed in the broader survey area; however, it is unlikely to breed in the area and the site is unlikely to provide significant habitat.
- **Rainbow Bee-eater.** A Rainbow Bee-eater was observed foraging and roosting within the broader survey area during the survey period, with the potential to breed in some areas based on the identified characteristics. This species is widespread and therefore development of the site is unlikely to significantly impact the species.

Other species of conservation significance identified as having habitat present, including the fork tailed-swift, sharp-tailed sandpiper, pectoral sandpiper and cattle egret, are unlikely to breed in the site and the site is unlikely to provide significant habitat. Therefore, development is unlikely to impact these species.

Overall, while fauna species of conservation significance were identified utilising the site, the site is considered to have overall low biodiversity value from a fauna perspective due to the degraded nature of the vegetation (i.e. completely degraded) and associated habitat (Harewood 2009), and this was supported by observations during the 2019 reconnaissance site visit.

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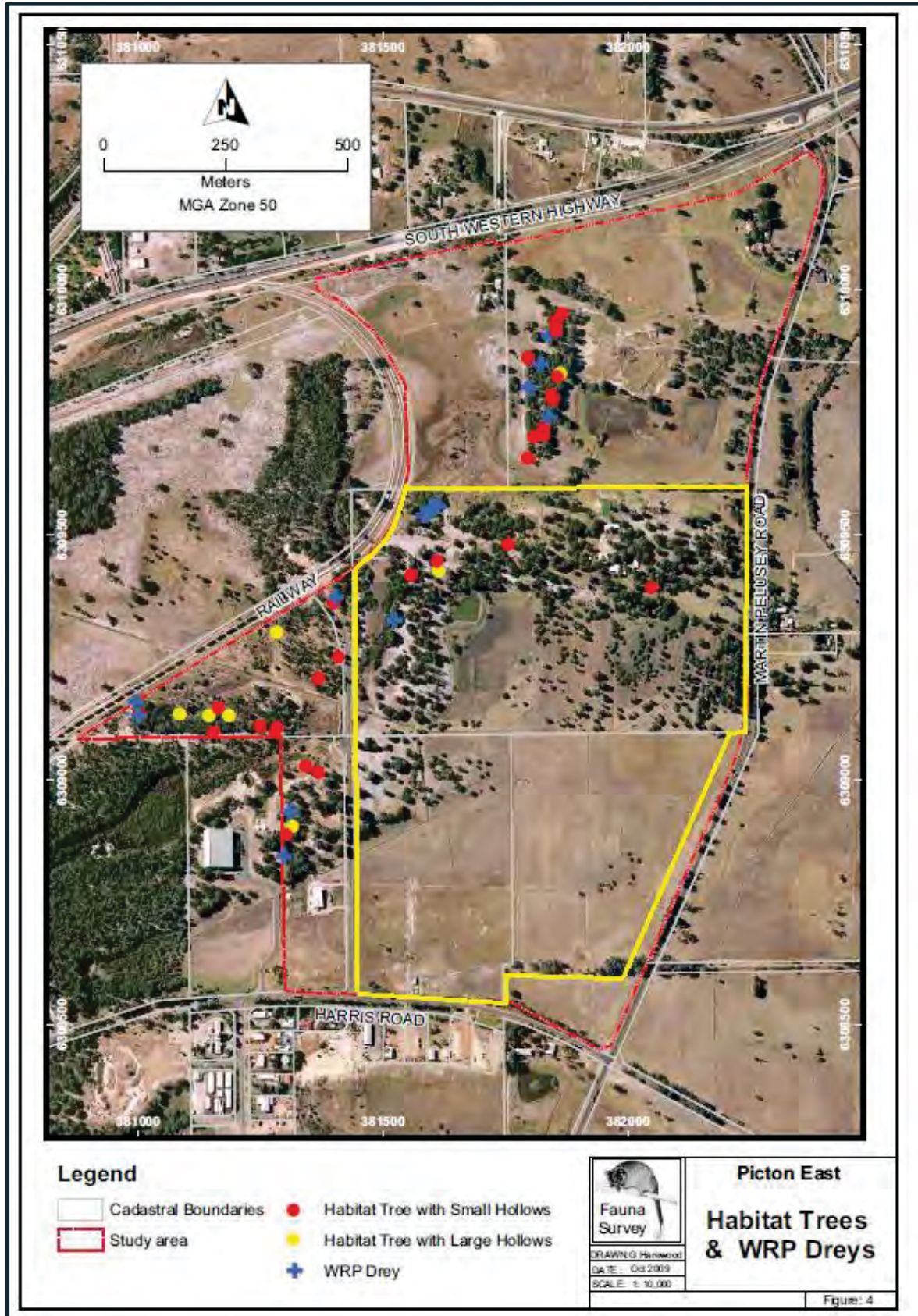


Plate 5: Excerpt from the Level 1 fauna survey (Harewood 2009) showing the location of habitat trees and western ringtail possum dreys. The approximate site boundary is shown in yellow outline.

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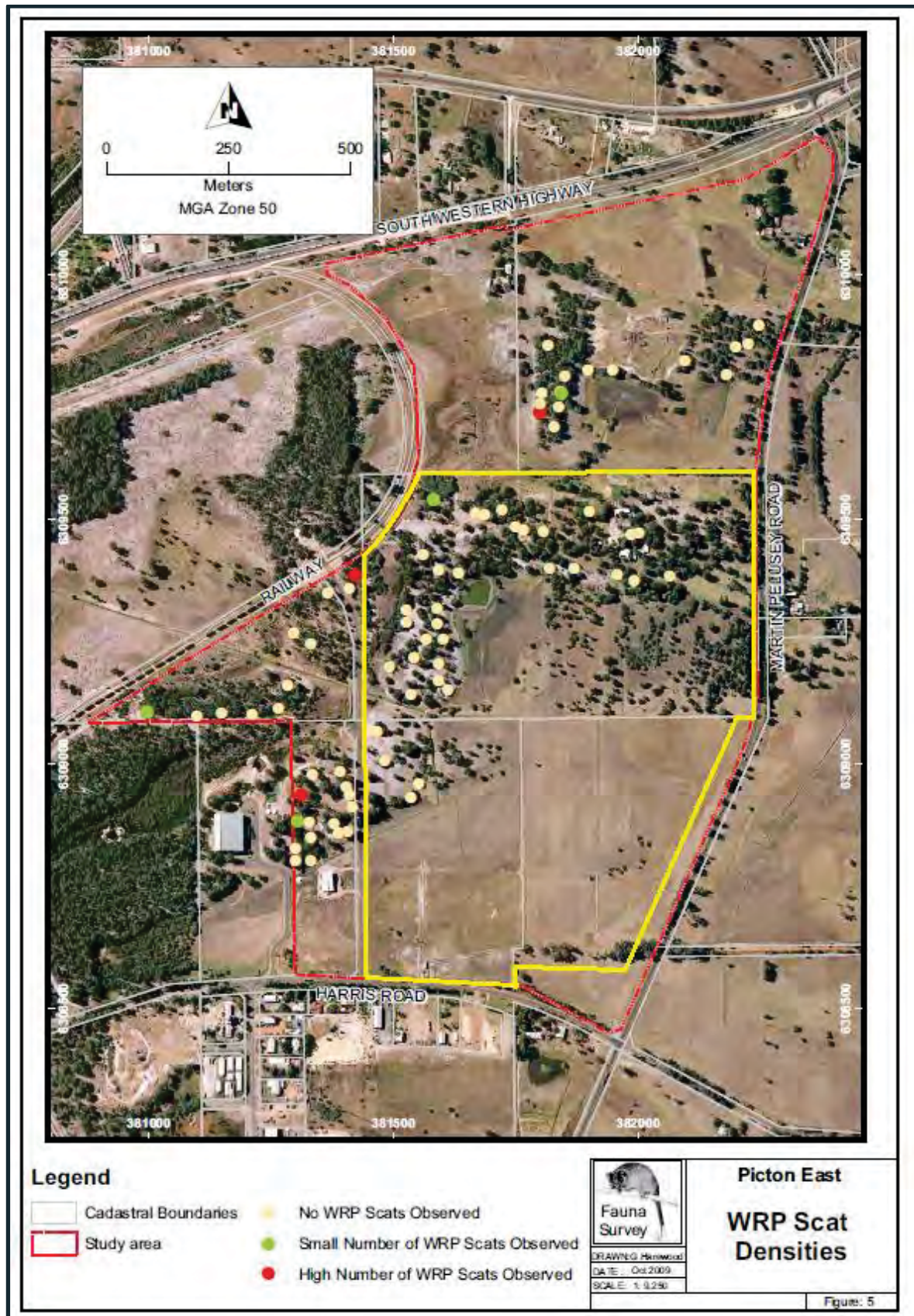


Plate 6: Excerpt from the Level 1 fauna survey (Harewood 2009) showing western ringtail possum scat densities. The approximate site boundary is shown in yellow outline.



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## 2.4 Hydrology

### 2.4.1 Groundwater

Information on the regional groundwater resources obtained from the *Water Register* (DWER 2019c) indicates that the site is underlain by a multi-layered aquifer system comprised of the Perth – Superficial Swan, Perth – Leederville and Perth – Yarragadee South resources.

Groundwater level monitoring was carried out by TME (2012) between October 2010 and December 2012 at nine monitoring bores installed within Lot 103 and Lot 436 as shown in **Figure 3**. This monitoring program captured two winter peaks and one summer low. The monitoring indicated that depth to groundwater from the natural surface over 2011 and 2012 ranged from 0.05 m to 3.4 m, with seasonal fluctuation across the bores ranging from 0.25 m to 2.7 m (TME 2012). The monitoring indicated the groundwater generally flowed from the south-east to the north-west corner of the site (TME 2012).

Measured maximum groundwater level (MGL) occurred in August 2011 in seven bores and in September 2011 in two bores. The depth to MGL at each bore ranged from 0.05 m to 0.9 m below natural surface (TME 2012). MGL contours across the site are shown on **Figure 3**.

Given the date of the pre-development monitoring program. Groundwater levels within the bores was measured again on the 22<sup>nd</sup> August 2019 (Emerge Associates 2020b). While Bore 8 was destroyed, depth to groundwater at the other bores ranged from 0.06 to 1.1 m below natural surface. These are generally consistent with winter groundwater levels measured in 2011 and 2012, but are still lower than the MGL measured in 2011. Therefore, the MGL contours derived from data collected in 2011-2012 are still valid and are shown in **Figure 3**.

Groundwater is generally close to the surface and consequently, groundwater quality is a reasonable indicator of likely surface water quality. Groundwater monitoring of the nine bores by TME (2012) included sampling for physio-chemical parameters in situ and laboratory analysis of nutrient, metal and salinity concentrations. Measured groundwater quality is provided in **Appendix F**. The analysis of groundwater found that Total Nitrogen (TN) and Total Phosphorus (TP) levels beneath Lot 103 and Lot 436 exceeded ANZECC and ARMCANZ (2000) default trigger values for slightly disturbed ecosystems in the south-west coast, however is not unexpected given the historic agricultural land uses within the site (TME 2012).

### 2.4.2 Surface water

The site is located within the Leschenault Estuary Catchment, which is included within the *Leschenault Estuary Water Quality Improvement Plan* (DoW 2012).

Small farm drains and dams occur across the site and ultimately contribute to the East Picton Main Drain located to the west of the site, which is currently managed by the Water Corporation. Indicative mapping of these features from the *Hydrography linear* dataset (DWER 2019b) are shown in **Figure 5**. This dataset does not capture all of the existing farm drains or dams located across the site.

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The site either discharges directly into East Picton Sub Drain C, or into a tributary (East Picton Sub-Section D and East Picton Sub-Section E). The site then ultimately discharges to the East Picton Main Drain and then the Ferguson River before entering the Preston River. The Ferguson River is located approximately 900 m south of the site.

Related to the above, the site is also identified as a 'sewerage sensitive area' given it is located as part of an 'estuary catchment on the Swan Coastal Plain', with the Preston River forming part of the catchment for the Leschenault Inlet/Estuary (approximately 5 km north-west of the site).

## 2.4.3 Wetlands

Wetlands are areas which are permanently, seasonally or intermittently waterlogged or inundated with water. Naturally occurring wetland features are common across the Swan Coastal Plain and can contain fresh or salty water, which may be flowing or still. Wetlands can be further categorised based on their hydrological characteristics and physical structure.

The location, mapped boundaries and management categories of wetlands across the Swan Coastal Plain were originally identified in the *Wetlands of the Swan Coastal Plain: Wetland Mapping, Classification and Evaluation* (Hill et al. 1996). This information was subsequently converted into the publicly available *Geomorphic Wetlands of the Swan Coastal Plain* database, which is maintained by the Department of Biodiversity, Conservation and Attractions (DBCA). The management categories of wetlands are conservation, resource enhancement and multiple use, and are detailed in **Table 2**.

Table 5: *Geomorphic Wetlands of the Swan Coastal Plain management categories (Hill et al. 1996)*

Management category	Description of wetland	Management objectives
Conservation (CCW)	Support high levels of attributes	Preserve wetland attributes and functions through reservation in national parks, crown reserves and state-owned land. Protection provided under environmental protection policies.
Resource Enhancement (REW)	Partly modified but still supporting substantial functions and attributes	Restore wetland through maintenance and enhancement of wetland functions and attributes. Protection via crown reserves, state or local government owned land, environmental protection policies and sustainable management on private properties.
Multiple Use (MUW)	Few wetland attributes but still provide important hydrological functions	Use, development and management considered in the context of water, town and environmental planning through land care.

A review of the *Geomorphic Wetlands on the Swan Coastal Plain* dataset (DBCA 2019b) indicates that there are a number of geomorphic wetlands within the site. The geomorphic wetlands are shown in **Figure 5**. These wetlands are identified as multiple use wetlands and include UFI #14329, UFI #1554, and UFI #1555.

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### 2.4.4 Public drinking water source areas

Public drinking water source areas (PDWSAs) are proclaimed by the Department of Water and Environmentally Regulation (DWER) to protect identified drinking water sources, including surface water and groundwater sources (DoW 2009b). They are proclaimed under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* or the *Country Areas Water Supply Act 1947* as Water Reserves, Catchment Areas or Underground Water Pollution Control Areas. PDWSAs provide the population with the majority of its drinking water supplies and can be vulnerable to contamination from a range of land uses. Once an area is identified as a PDWSA, consideration needs to be given to the intended land use and associated activities to ensure that they are appropriate in meeting the water protection quality objectives of the area.

The site is not located within a PDSWA nor are there any wellhead protection zones (where public drinking water is extracted from) in the vicinity of the site.

## 2.5 Heritage

### 2.5.1 Indigenous heritage

The Aboriginal Heritage Inquiry System (AHIS) is maintained pursuant to Section 38 of the *Aboriginal Heritage Act 1972* (AHA) by the Department of Planning, Lands and Heritage, containing information on Registered Aboriginal Heritages Sites and Other Heritage Places throughout Western Australia.

In accordance with the *Aboriginal Heritage Due Diligence Guidelines* (DAA 2013), a search of the AHIS online database (DAA 2015) was undertaken. No Registered Aboriginal Heritage Sites have been identified within the site. Approximately 20 m to the south of the site is an identified 'Other Heritage Place' Site ID 18886 Bunbury Bypass Archaeological Site 3.

The site falls within an area where a number of heritage surveys have been completed, including:

- Survey area 19390 (1) –Bunbury Bypass Road
- Survey area 104608 (1) – Bunbury Wellington Regional Planning Study: Aboriginal Heritage and Planning Survey: working paper no. 6.
- Survey area 20283 (1) – an addendum to a desktop preliminary Aboriginal heritage survey for Water Corporations proposed development of the Yarragadee aquifer extending to the Blackwood groundwater area.

Based on extent of disturbance (i.e. clearing and cultivation of the land) and the extent of previous surveys completed within the area, it is unlikely any Aboriginal heritage sites exist within the site. However, it is important to note that if during construction Aboriginal artefacts or sites are uncovered, these are protected under the AHA and works should cease and a suitably qualified expert should be brought in to survey the potential site. If required, based on the outcomes of the survey, permission under the AHA to manage and disturb sites should be sought.

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### 2.5.2 Non-Indigenous heritage

A desktop search of the Australian Heritage Database (Department of the Environment 2019), the State Heritage Office database (Heritage Council 2019) and the Shire of Dardanup Local Government Inventory (Shire of Dardanup 2003) indicated there are no registered heritage sites within the site.

## 2.6 Other land use considerations

### 2.6.1 Historic and existing land uses

Based on a review of publicly available historic aerial imagery (Landgate 2019), the majority of the site was historically cleared of native vegetation prior to 1996 and has largely been used for agricultural purposes. Minimal regrowth of native vegetation has occurred within the site since clearing occurred.

The northern portion of the site contains a number of existing buildings and sheds, with the majority of the land predominately used for agricultural purposes including grazing and plantations, while a timber saleyard currently operates within Lot 110 (and is likely to remain in the future).

### 2.6.2 Potential site contamination

A review of the DWER *Contaminated Sites Database* indicates that the site is not registered as a contaminated site pursuant to the *Contaminated Sites Act 2003*, nor are other registered sites located nearby. In addition, a review of the Department of Defence Unexploded Ordnance (UXO) search tool did not identify any potential risk of UXO occurring within the site. Historic agricultural land uses, primarily low-intensity activities such as grazing, and plantations, are considered unlikely to raise any significant contamination risk concerns for the site.

### 2.6.3 Surrounding land uses

The site forms part of the Picton Industrial Park Southern Precinct area (DPLH 2018) while the Waterloo Industrial District Structure Plan (WAPC 2019) is located immediately to the east of Martin-Pelusey Road, with the Wanju District Structure Plan (prepared to support residential development) further to the north. The site forms part of a larger industrial area that has been earmarked for development since the mid 1990's (EPA 2008) and is zoned 'general industry', which could include a range of industrial land uses including service stations, storage and transport depots as an example.

The current land uses and zoning surrounding the site include:

- Land zoned 'industrial deferred' under the GBRS to the north of the site and is currently used for agricultural purposes.
- Land immediately to the north-west zoned 'railway' and is currently used as a freight line.
- Areas to the west zoned 'industrial' and 'rural', with Columbas Drive located immediately to the west of the site, and current agricultural land uses further west.
- Land zoned 'industrial' to the south, with existing industrial land uses operating immediately south of Harris Road.
- Land zoned 'primary regional roads' immediately to the east of the site associated with the previous proposed alignment of the Bunbury Outer Ring Road. The land to the east of Martin

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Pelusey Road is currently used for agricultural purposes, however is zoned for future industrial land use (as part of the Waterloo Industrial District Structure Plan (WAPC 2019)).

Based on the existing and future proposed industrial development surrounding the site, there are no land uses identified surrounding the site that would be considered 'sensitive land uses' and therefore incompatible with the proposed future industrial development within the site. The existing residences within the vicinity of the site are expected to be removed as industrial development progresses.

## 2.7 Bushfire hazards

The site and surrounding areas have been identified as bushfire prone under the *Map of Bush Fire Prone Areas* (OBRM 2019), as shown in **Plate 7**.

The identification of bushfire prone areas within any portion of the site requires a further assessment of the bushfire hazard implications on development proposed within the site to be undertaken in accordance with *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7) (WAPC 2015a) and the *Guidelines for Planning in Bushfire Prone Areas Version 1.3* (the Guidelines) (WAPC and DFES 2017). This has been addressed through the preparation of a Bushfire Management Plan (BMP) (Emerge Associates 2020a).

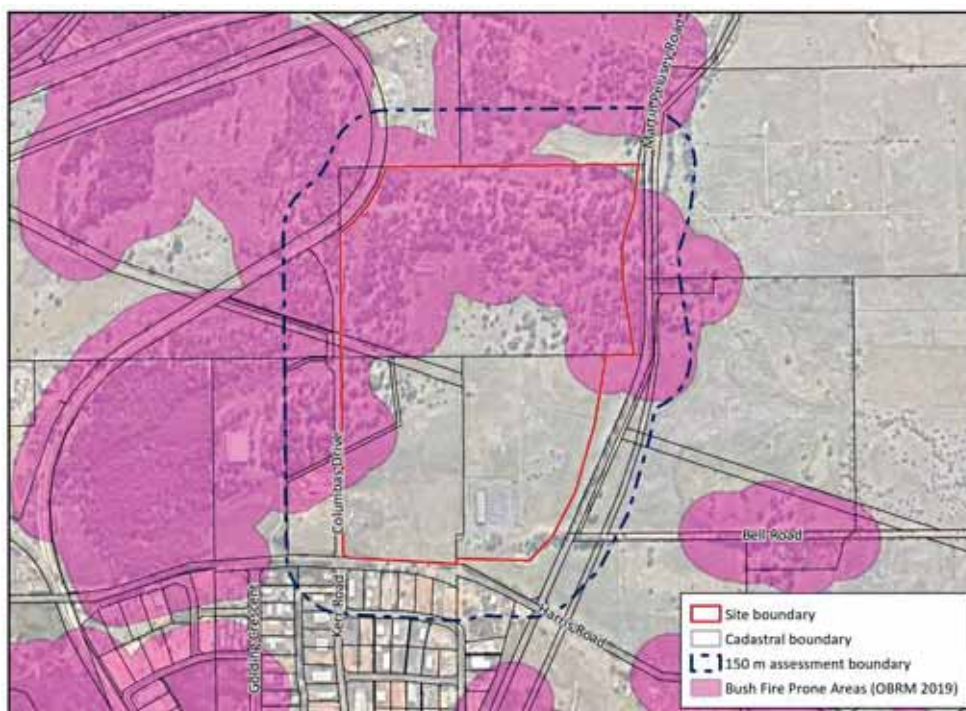


Plate 7: Areas within and surrounding the site identified as 'bushfire prone areas' (as indicated in purple) under the state-wide *Map of Bush Fire Prone Areas* (OBRM 2019).

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All areas within the site and surrounding 150 m have been assessed for the presence of bushfire prone vegetation which has been classified as per Table 2.5 of *Australian Standard 3959-2018 Construction of buildings in bushfire prone areas (AS 3959)* (Standards Australia 2018) to determine the associated bushfire hazard rating levels in accordance with the Guidelines. The pre-development vegetation classifications are shown in **Figure 6**.

The bushfire hazards (associated with areas of ‘classified’ vegetation) likely to affect development within the site are largely associated with areas of:

- Existing forest vegetation to the north-west of the site, as well as an area of proposed public open space in the north-west corner of the site which is currently a ‘woodland’ classification by will be revegetated as part of the proposed development and will be revegetated to a forest classification.
- Woodland vegetation within private landholdings surrounding the site to the east, west and north.
- Scrub vegetation located to the north-west of the site.
- Grassland vegetation largely associated with private landholdings to the east, south, west and north of the site.

All vegetation except the areas of forest vegetation are associated with areas proposed for future industrial development, so are likely to be removed in the long-term.

## 2.8 Summary of relevant environmental factors

**Table 6** provides a summary of the environmental values/factors that have been investigated for the site and outlines those that will require further specific consideration as part of future development within the site, and if applicable these are discussed further in **Section 4**.

*Table 6: Relevant environmental values/factors and considerations for the site.*

Environmental value/factor	Relevant considerations
Landform and soils	Regional ASS risk mapping indicates the site is located within an area identified as having a ‘moderate to low’ risk of ASS occurring within 3 m of the natural soil surface. The previous investigation (Strategen 2010) undertaken for the site did not detect potential for ASS within the site as part of field sampling, however the sampling was not extensive and this factor requires further consideration and is addressed in <b>Section 4.1</b> .
Flora and vegetation	No conservation significant flora and vegetation values have been identified within the site. However, the retention of native vegetation values within the site is a relevant consideration and is addressed further in <b>Section 4.2</b> .
Ecological linkages	No ecological linkages have been identified within the site. Maintaining linkages with vegetation values surrounding the site is considered in <b>Section 4.2</b> , and no further specific consideration of this factor is provided as part of this EAMS.
Environmentally sensitive areas (ESAs)	There are no ESAs mapped as being present within the site. Development within the site is not proposed to impact on any identified ESAs, and accordingly no further consideration of this factor is required as part of this EAMS.
Terrestrial fauna	The proposed development has the potential to impact conservation significant fauna species. Protection and management of these species and associated habitat is addressed further in <b>Section 4.3</b> .

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Table 6: Relevant environmental values/factors and considerations for the site.

Environmental value/ factor	Relevant considerations
Groundwater	Depth to MGL ranges between 0.05 m in the south-west and 0.9 m in the northern portion of the site. Management of groundwater is considered as part of the Local Water Management Strategy (LWMS) (Emerge Associates 2020b) and is discussed further in <b>Section 4.4</b> .
Surface water	The site either discharges directly into East Picton Sub Drain C, or into a tributary (East Picton Sub-Section D and East Picton Sub-Section E). The site then ultimately discharges to the East Picton Main Drain and then the Ferguson River before entering the Preston River. Management of stormwater will be a consideration for future development and is discussed further in the LWMS and <b>Section 4.4</b> .
Wetlands	A number of multiple use wetlands (Unique Feature Identifier (UFI) 14329, 1554, and 1555) have been identified within the site. The presence of multiple use wetlands within the site does not require a specific spatial response as part of the structure plan as this management category contains few wetland attributes and is suitable for development if hydrological considerations are addressed appropriately. The standard urban water management process (applied through the planning process) will address the hydrological considerations and are considered in <b>Section 4.4</b> .
PDWSAs	The site is not located within a PDSWA nor are there any wellhead protection zones in the vicinity of the site, and accordingly no further consideration of this factor is required as part of this EAMS.
Aboriginal heritage	No further specific consideration for Aboriginal heritage is detailed within this EAMS. While no Aboriginal sites were identified within the site, it is important to note that if during construction Aboriginal artefacts or sites are uncovered, these are protected under the AHA and works should cease and a suitably qualified expert should be brought in to survey the potential site. If required, based on the outcomes of the survey, permission under the AHA to manage and disturb sites should be sought.
Non-indigenous heritage	No non-indigenous heritage values have been identified within, or in close proximity to the site and therefore no further consideration of this factor is provided as part of this EAMS.
Historic and existing land uses	The site has historically been used for a range of agricultural land uses, including grazing and plantations, with Lot 110 currently used as a timber saleyard. No further consideration of this factor is provided as part of this EAMS.
Potential site contamination	No registered contaminated sites were identified within or in proximity to the site, and previous land uses are not likely to have resulted in contamination. No further consideration of this factor is required as part of this EAMS.
Surrounding land uses	Given the site is located within a broader area that will be subject to future industrial development, it is unlikely that industrial activities within the site will result in noise, odour, air emission of amenity impacts on sensitive land uses. No further consideration of this factor is provided as part of the EAMS. Where industrial land uses are likely to have noise, odour or air emission impacts, these will be largely associated with activities that are prescribed pursuant to Part V of the EP Act and can be managed appropriately through this process. .
Bushfire hazard	Classified vegetation has been identified within the site and surrounds. Management of bushfire hazards is further considered in the BMP and <b>Section 4.6</b> .

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## 3 Planning Framework and Proposal

### 3.1 Historic planning and environmental assessment context

The site is located in the Preston Industrial area, an area that has been planned for industrial development since the mid 1990's within a number of planning strategies, including the *Bunbury Wellington Plan* (WAPC 1995), *Industry 2030-Greater Bunbury Industrial Land and Port Access Planning* (WAPC 2000), *Picton Industrial Park Southern Precinct District Structure Plan* (DPLH 2018) and the *Waterloo Industrial District Structure Plan* (WAPC 2019). The preparation of these planning strategies has been based on strategic advice (pursuant to Section 16(e) of the EP Act) provided by the Environmental Protection Authority (EPA) and in particular *Bulletin 1282 Advice on areas of conservation significance in the Preston Industrial Park* (EPA 2008).

This advice specifically considered the remnant native vegetation values in this area and identified areas within the Preston Industrial Park area for retention and protection, including rezoning. The northern and western portion of the site were identified as part of 'Investigation Area 6', which included degraded and completely degraded condition vegetation of the Guildford and Southern River complexes, as well as habitat for threatened fauna species. However, while identified as part of an Investigation Area, none of the vegetation within the site was recommended for retention. Areas recommended for retention by the EPA are located immediately to the north-west and west of the site, as shown in **Figure 7**.

In addition to the consideration of native vegetation values, the EPA also indicated the following would need to be considered as part of future planning and development:

- Wetland buffers, where conservation category or resource enhancement wetlands are identified.
- Air quality, associated with emissions from industrial development. While air emissions will need to be considered, this will need to be addressed by individual industrial developments and can be managed through Part V of the EP Act.
- Noise, associated with industrial activities. Given the site is located within an area surrounded by future industrial development, noise impacts on sensitive land uses is unlikely to be a significant consideration and/or will be managed through individual industrial developments approvals pursuant to Part V of the EP Act.
- Water quality and quantity. This is considered through the preparation of the Local Water Management Strategy (LWMS) (Emerge Associates 2020b) and discussed in **Section 4.4**.
- Flood way mapping. No waterways or rivers are located in close proximity to the site, and stormwater management is considered within the LWMS (Emerge Associates 2020b) and discussed in **Section 4.4**.
- Solid and liquid waste disposal. Management of wastewater effluent disposal and industrial process wastewater is considered within the LWMS (Emerge Associates 2020b) and discussed in **Section 4.4**. Solid and liquid waste will also need to be addressed by individual industries in accordance with approvals pursuant to Part V of the EP Act.
- Acid sulfate soils. The site is identified as having a low to moderate risk of ASS and is considered further in **Section 4.1**.



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- Requirement for construction materials, and in particular fill material to provide separation to groundwater. This has been considered as part of the LWMS (Emerge Associates 2020b) and in determining separation between finished floor levels and groundwater.
- Development priority, and progressing appropriate structure planning. The structure plan for the site has been prepared in consideration of the Department of Planning, Lands and Heritage development priorities and connects with existing development that has been progressed since the EPA's advice was prepared.

## 3.2 Picton Industrial Park Southern Precinct District Structure Plan

The DPLH and Western Australian Planning Commission (WAPC) prepared the *Picton Industrial Park Southern Precinct District Structure Plan* (2018) to support the development of the land in accordance with the industrial zoning under the Greater Bunbury Region Scheme and the broader Preston Industrial Park. As part of the DSP, it was the following would need to be considered as part of future development:

- Fauna habitat surveys to identify habitat for the western ringtail possum and red-tailed black cockatoos, and management plans where appropriate. Previous survey work (Harewood 2009) has identified use of remnant vegetation within the site by these species and is considered further in **Section 4**.
- Management plans for wetlands and remnant vegetation to be developed concurrently with any bushfire management plans. No wetlands of conservation significance are identified within the site or nearby and no areas of remnant vegetation were identified for retention within the site as part of the DSP, however the BMP (Emerge Associates 2020a) has been prepared in consideration of the outlined requirements. This is considered further in **Section 4**.
- Fill and draining of the land at the subdivision stage is to demonstrate that retained vegetation will be protected where possible and not impact upon water quantity and quality of wetlands. This is considered further in **Section 4** and the LWMS (Emerge Associates 2020b).
- A bushfire risk assessment/management plan is to be developed and must take into account the long-term revegetation outcomes associated with any wetlands and remnant vegetation management plans and the Ferguson River foreshore management plan. This has been considered as part of the BMP prepared for the site.
- A local water management strategy for local structure plan areas must be prepared to the satisfaction of the Department of Water and Environmental Regulation, in consultation with the local authorities, Department of Biodiversity, Conservation and Attractions and Water Corporation. An LWMS has been prepared for the site and is discussed in **Section 4** (and provided separately as part of the LSP).
- No industrial lots are permitted to directly back onto areas of remnant vegetation, wetlands or the Ferguson River. Sufficient setback should be provided between all new development abutting native remnant vegetation, taking account of any revegetation and/or changes to buffers/foreshores as a result of development of management plans for remnant vegetation, wetlands or the Ferguson River. This has been considered as part of preparing the LSP and is discussed in **Section 4**.

The LSP design and how the above requirements have been (or will be) addressed as part of future development is considered further in **Section 4**.

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### 3.3 Proposed local structure plan

The proposed structure plan for the site will facilitate the future subdivision and development of the site for industrial purposes and is provided in **Appendix A**.

The structure plan is intended to support:

- A number of industrial lots ranging in size from approximately 1 ha to 4.06 ha, with an approximate overall yield of 37 lots.
- An area of public open space approximately 3.9 ha in size in the north-west corner of the site that will be revegetated.
- Approximately 4.7 ha of drainage reserves, located across a number of different areas.
- An interconnected road network, including three 25 m integrator road reserves, and a number of 20 m wide local access roads.

### 3.4 Future planning approval process

Subject to approval and endorsement of the structure plan by the Shire of Dardanup and WAPC, industrial development of the site would be progressed through subdivision and/or development approvals (collectively referred to as 'future planning stages'). The key environmental values and attributes that require further consideration as part of future planning stages have been outlined in **Table 6** and **Section 4** of this report and include:

- Acid sulfate soils, and management during construction.
- Native vegetation, including retention, protection and enhancement of identified vegetation.
- Native fauna, including protection and retention of fauna habitat and management of fauna during construction.
- Hydrology (in particular stormwater) and wastewater.
- Social surroundings, and in particular the requirement for industrial land uses to achieve appropriate separation from any nearby sensitive land uses.
- Bushfire risks, and provision of appropriate setbacks.

The WAPC can impose conditions on subdivision applications to ensure subdivision incorporates all the appropriate environmental management measures. These conditions are usually determined in accordance with WAPC's *Model Subdivision Conditions Schedule 2019* and include those relating to environmental considerations. It is envisaged that there would be future subdivision conditions applied for any subdivision within the site, that would deal with environmental, hydrological and bushfire related requirements.

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### 4 Environmental Assessment and Management Strategy

This section outlines spatial layout considerations that should be accommodated within the structure plan to respond to environmental attributes and values within the site, as well as any future environmental management requirements that will need to be accommodated within future planning and development stages. Only those environmental values and attributes that require specific consideration based on their presence within the site, and/or the applicable legislation and policy requirements have been included in this section.

#### 4.1 Acid sulfate soils

##### 4.1.1 Policy framework, site context and management objectives

The Department of Water and Environmental Regulation (DWER), through the WAPC, ensures ASS are adequately managed during the land use planning and development process. The objective of the DWER's ASS policy framework is to manage ASS appropriately to prevent the release of metals, nutrients and acidity into the soil and groundwater system that may adversely affect the natural and built environment and human health.

The regional mapping produced by DWER indicates that the site is located within an area identified as 'moderate – low' threat of ASS occurring within 3 m of the natural soil surface. A limited field sampling program undertaken within the site (Strategen 2010) did not detect the potential for ASS within the samples taken from the site.

The principal management objective for acid sulfate soils within the site is to ensure that any future development that may disturb acid sulfate soils is appropriately managed to avoid impacts on the environment.

##### 4.1.2 Structure plan layout considerations for acid sulfate soils

ASS management does not require any spatial consideration within the structure plan, and any ASS risk can be appropriately managed through future development planning.

##### 4.1.3 Future acid sulfate soils management requirements

While the risk of ASS is 'moderate to low' within the site, ASS is only likely to be a consideration if excavation (primarily for services) extends below the permanent groundwater table. It is possible, depending upon the extent of fill within the site and location of services, that excavation could occur below the permanent groundwater table and if this is the case, additional ASS investigations may be required and could include the preparation of an Acid Sulfate Soils and Dewatering Management Plan.

The WAPC can include a standard condition on subdivision applications (model subdivision condition EN8 (WAPC and DPLH 2019)), which states:

*An acid sulphate soils self-assessment form and, if required as a result of the self-assessment an acid sulphate soils report and an acid sulphate soils management plan shall be submitted to and approved*

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*by the Department of Water and Environmental Regulation (DWER) before any subdivision works or development are commenced. Where an acid sulphate soil management plan is required to be submitted, all subdivision works shall be carried out in accordance with the approved management plan (Department of Water and Environmental Regulation).*

The requirement for further ASS management will be confirmed in accordance with any subdivision conditions and/or as part of future development once detailed design has progressed.

## 4.2 Flora and vegetation

### 4.2.1 Policy framework, site context and management objectives

In the context of environmental impact assessment, the EPA objective for flora and vegetation is ‘to protect flora and vegetation so that biological diversity and ecological integrity are maintained’ (EPA 2016a). Where a proposal may potentially impact upon flora and vegetation values, the following mitigation hierarchy should be applied to minimise potential impacts:

1. **Avoid** impacts
2. **Minimise** impacts
3. **Offset** impacts.

The vegetation across the majority of the site is in a ‘completely degraded’ condition, dominated by non-native grasses and weeds, with areas of native overstorey vegetation including *Corymbia calophylla*, *Eucalyptus marginata*, *Agonis flexuosa* and *Melaleuca* sp. No vegetation within the site has been identified as containing conservation significant values (i.e. TEC or threatened flora) based on the site-specific investigations, including the reconnaissance site visit. Furthermore, no areas within the site have been identified by the EPA (2008) or within the *Picton Industrial Park Southern Precinct District Structure Plan* (DPLH 2018) for retention or as a strategic ecological linkage.

The objective for future management of flora and vegetation within the site will be principally focused around maximising the retention of vegetation in public open space and opportunistically retaining paddock trees in road reserves and/or potentially lots.

### 4.2.2 Structure plan layout considerations for flora and vegetation

A portion of the remnant vegetation in the north-west corner of the site was identified to contain fauna habitat values, namely western ringtail dreys and potential black cockatoo nesting hollows. This area of vegetation is shown in **Figure 7** and is proposed to be protected and retained as part of public open space. It is not proposed to contain any drainage in order to minimise alteration of existing ground levels to enable the protection of vegetation (i.e. the drainage reserves are separate areas).

This area of public open space is located immediately adjacent to areas recommended for long-term retention to the west and north-west of the site as part of the EPA strategic advice (EPA 2008) *Picton Industrial Park Southern Precinct District Structure Plan* (DPLH 2018), and therefore contributes to the conservation of regionally significant vegetation values, even though no vegetation was recommended for retention within the site.

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In order to ensure industrial lots do not back directly onto areas of retained remnant vegetation (as per the requirements of the *Picton Industrial Park Southern Precinct District Structure Plan* (DPLH 2018)), a road interface is proposed between the area of public open space containing remnant native vegetation and the future industrial lots, as shown in **Figure 7**.

Existing individual paddock trees may be identified for retention within lots and/or as part of road reserves, however will need to respond to site constraints such as level changes (i.e. the provision or removal of fill) and health/longevity considerations.

## 4.2.3 Future flora and vegetation management requirements

The remnant vegetation proposed to be retained within the public open space (as shown in **Figure 7**) will be protected and enhanced as part of future development, to improve the biodiversity values of the area (which is largely trees over paddock grasses) and improve ecological linkages across the landscape. The specific plant species and revegetation program will be confirmed as part of future detailed design through the subdivision process, as will any management measures to ensure protection of this vegetation as part of construction activities.

Any additional opportunities to retain the existing paddock trees within the site (that are outside the identified area of vegetation retention in **Figure 7**) will be considered as part of the detailed civil design process, to determine if it is possible and practical based on drainage requirements, fill material, location of road reserves and land requirements for incoming industrial development.

It is expected that a number of future subdivision approval conditions will ensure protection of the proposed area of remnant vegetation, including model subdivision condition EN2 and EN4 (WAPC and DPLH 2019), which requires:

*EN2 - Measures being taken to ensure the identification and protection of any vegetation on the site worthy of retention that is not impacted by subdivisional works, prior to commencement of subdivisional works. (Local Government)*

*EN4 - Measures being taken to ensure vegetation within the proposed Regional Open Space Reserve as identified in the plan dated [INSERT VALUE], is protected prior to the commencement of subdivisional works. (Local Government)*

Should bulk earthworks or any other works be commenced within the site that requires clearing of native vegetation before subdivision approvals are gained, a clearing permit pursuant to Part V of the EP Act will be required. Otherwise, subdivision approval and associated authorised subdivision works will provide an exemption from the requirements for a clearing permit.

## 4.3 Native fauna

### 4.3.1 Policy framework, site context and management objectives

In the context of environmental impact assessment, the EPA's objective for terrestrial fauna is 'to protect fauna so that biological diversity and ecological integrity are maintained' (EPA 2016b). The application of the mitigation hierarchy should be applied to avoid or minimise impacts to terrestrial fauna where possible.

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The EPBC Act also provides protection for listed ‘threatened’ species, including western ringtail possums and black cockatoos, which may potentially use habitat within the site. Any proposed action which is considered likely to result in a ‘significant’ impact upon these species, which are identified as Matters of National Environmental Significance (MNES), should be referred to the Commonwealth Department of Agriculture, Water and Environment (DAWE).

While conservation significant fauna species have been identified as utilising habitat within the site, particularly western ring tail possum and the three black cockatoo species, the site is considered to have low biodiversity value from a fauna perspective due to the degraded nature of the vegetation (i.e. trees over paddock grasses). As outlined within **Section 4.2**, no areas within the site have been identified by the EPA (2008) or within the *Picton Industrial Park Southern Precinct District Structure Plan* (DPLH 2018) for retention or as a strategic ecological linkage.

The management objective for fauna within the site will be principally focused around maximising retention of existing vegetation values within public open space, the retention of paddock trees where appropriate and ensuring development works are undertaken in a manner that minimises harm to native fauna.

## 4.3.2 Structure plan layout considerations for terrestrial fauna

Spatial consideration has been given to the areas of remnant vegetation located within the north-west corner of the site (see **Figure 7**), with this area proposed to be retained and protected within public open space and revegetated. This area was identified to contain the majority of conservation significant habitat, with a number of potential nesting hollows for black cockatoo species observed in this area. This is in addition to the areas recommended for retention and protection by the EPA (2008) and within *Picton Industrial Park Southern Precinct District Structure Plan* (DPLH 2018), as shown in **Figure 7**. As outlined above, this area of public open space is located immediately adjacent to areas recommended for long-term retention to the west and north-west of the site as part of the EPA strategic advice (EPA 2008), and therefore contributes to the conservation of regionally significant vegetation values.

As outlined in **Section 4.2**, no drainage is proposed within the public open space proposed to support the retention of remnant vegetation, and in order to ensure industrial lots do not back directly onto areas of retained remnant vegetation (as per the requirements of the *Picton Industrial Park Southern Precinct District Structure Plan* (DPLH 2018)), a road interface is proposed between the area of public open space containing remnant native vegetation and the future industrial lots, as shown in **Figure 7**.

Existing individual paddock trees may be identified for retention within lots and/or as part of road reserves, however will need to respond to site constraints such as level changes (i.e. the provision or removal of fill) and health/longevity considerations.

## 4.3.3 Future terrestrial fauna management requirements

Conservation significant species (including western ringtail possum and the three black cockatoo species) were identified as utilising habitat within the site, and the proponent will need to consider their potential obligations pursuant to the EPBC Act prior to vegetation being cleared within the site. This can be addressed separately to the LSP (prior to physical disturbance of remnant vegetation) and therefore obligations pursuant to the EPBC Act are not considered further as part of this EAMS.

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The location of the proposed public open space within the site, associated with the protection of remnant vegetation values, will retain and protect areas identified to contain habitat values through the site-specific investigations, and is located adjacent to other areas of remnant vegetation recommended for retention by the EPA (2008) and the *Picton Industrial Park Southern Precinct District Structure Plan* (DPLH 2018), see **Figure 7**.

The area of public open space proposed to support the retention of remnant vegetation is proposed to be revegetated which will enhance its fauna habitat values and the ecological linkage function, particularly for western ringtail possum. Where possible, the revegetation should consider opportunities to utilise black cockatoo food plants, specifically *Eucalyptus*, *Corymbia*, *Banksia*, *Hakea* and *Allocasuarina* species. The final selection of species should be determined in consultation with the Shire of Dardanup and DBCA and can be resolved through the standard subdivision process. In addition to this, and as previously outlined within **Section 4.2**, paddock trees outside the area of public open space will be opportunistically retained where possible and practical.

Some areas of remnant vegetation will be modified or removed as part of the proposed development and fauna may be disturbed as part of this process. Management of fauna as part of the detailed design and construction for the proposed development will be based on minimising harm to fauna (in particular western ringtail possums) through the preparation and implementation of a fauna management plan. Measures to be implemented may include:

- Bunting/flagging of trees to be retained so that it is clear which trees are to be avoided.
- Undertaking preclearing inspections of tree/vegetation proposed for removal/modification. This may include a trapping and relocation program for western ringtail possums.
- Using a fauna spotter during demolition and clearing works to avoid impacts to fauna wherever possible and to rescue trans-locatable fauna that are disturbed during clearing works to assist them to disperse safely or capture them for later translocation as appropriate.
- Application of correct fauna handling procedures to reduce stress on any captured animals.

It is likely that this will be a condition of future subdivision approval, based on application of model subdivision condition EN1 (WAPC and DPLH 2019), which requires:

*EN1 - Prior to the commencement of subdivisional works a foreshore/ environmental/ bushland/ tree/wetland/wildlife protection [DELETE AS APPLICABLE] management plan for [INSERT VALUE] is to be prepared and approved to ensure the protection and management of the sites environmental assets with satisfactory arrangements being made for the implementation of the approved plan. (Department of Water and Environmental Regulation) OR (Local Government) OR (Department of Biodiversity, Conservation and Attractions) [DELETE AS APPLICABLE]*

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### 4.4 Hydrology

#### 4.4.1 Policy framework, site context and management objectives

In the context of environmental impact assessment, the EPA's objective for inland waters is 'to maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected' (EPA 2018).

In addition, the *State Water Strategy for Western Australia* (Government of WA 2003) and *Better Urban Water Management* (WAPC 2008) endorses the promotion of integrated water cycle management and application of water sensitive urban design (WSUD) principles to provide improvements in the management of stormwater, and to increase the efficient use of other existing water supplies. Of particular relevance to the wetland habitat that occurs outside of the site is the *Better Urban Water Management* criteria for ecological protection, which requires development to maintain or restore desirable environmental flows and/or hydrological cycles.

Based on the values identified and the requirements of the *Picton Industrial Park Southern Precinct District Structure Plan* (DPLH 2018), the principal management objective for hydrology in the site will be to ensure that groundwater and surface water is appropriately infiltrated and treated to not impact on the broader area.

#### 4.4.2 Structure plan layout considerations for hydrology

In accordance with the Local Water Management Strategy (LWMS) (Emerge Associates 2020b) that has been prepared for the site, the structure plan has accommodated flood mitigation, flow management and treatment of surface water by providing appropriately sized road and drainage reserves to convey and store stormwater.

#### 4.4.3 Future management requirements

The LWMS provides a framework for the future delivery of a best practice approach to integrated water cycle management utilising water sensitive urban design (WSUD) principles and provides for the management of groundwater and surface water within the site. It has been prepared in accordance with relevant DWER requirements and considers the site-specific values. The LWMS will be a key document guiding future development and can be referred to for further detail, particularly with regard to determined water management criteria and water quality management objectives.

The WAPC can include a standard condition on subdivision applications (model subdivision condition D2 (WAPC and DPLH 2019)), requiring the preparation of an Urban Water Management Plan (UWMP) which states:

*Prior to the commencement of subdivisional works, an urban water management plan is to be prepared and approved, in consultation with the Department of Water and Environmental Regulation, consistent with any approved Local Water Management Strategy. (Local Government).*



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Generally, an UWMP will address the following considerations:

- The detailed drainage design based on civil designs
- Imported fill specifications and requirements
- Implementation of water conservation strategies
- Non-structural water quality improvement measures
- Management and maintenance requirements
- Construction period management strategy
- Monitoring and evaluation program.

## 4.5 Wastewater management

### 4.5.1 Policy framework, site context and management objectives

Effluent or domestic wastewater is derived from bathrooms, kitchens, laundries and toilets. It contains human waste (containing pathogens), paper, soap, detergent residues and food scraps (DoW 2010). Industrial wastewater refers to any liquid, solid or gaseous refuse from a business, industry, warehouse or manufacturing premises other than domestic sewage, stormwater, or unpolluted water. Industrial wastewater may include contaminated stormwater, cooling water, process waters and wash-down waters (DoW 2009b).

The *Government Sewerage Policy* (DPLH 2019) provides a best practice approach to the provision of onsite effluent treatment and disposal in WA and should be undertaken in accordance with *Australian/New Zealand Standard 1547 On-site domestic wastewater management* (Standards Australia and Standards New Zealand 2012) (AS 1547)). Any onsite industrial wastewater treatment should be undertaken in accordance with *Water Quality Protection Note 51: Industrial wastewater management and disposal* (DoW 2009a).

It is understood that no existing reticulated sewerage network is located in close proximity to the site. The Water Corporation has advised that the site is within two future wastewater pump station catchment areas, though neither are planned to be constructed within the next five years (WGE 2019). As such, it is anticipated that reticulated sewer will not be available for the site in the near future (WGE 2019). Accordingly, onsite effluent management will be required.

The site is located within a sewage sensitive area (specifically within the estuary catchments on the Swan and Scott Coastal Plains) (DPLH 2019c). Therefore, irrespective of the design process outlined in AS 1547, all lots will be required to install a secondary treatment system (i.e. an ATU) for the management of domestic wastewater consistent with the *Government Sewerage Policy* (DPLH 2019) to ensure discharge is of sufficient quality to protect downstream environments.

The principle management objective for wastewater is to enable the onsite treatment and disposal of both domestic and industrial wastewater without endangering public health or the environment.

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### 4.5.2 Structure plan layout considerations for wastewater

In accordance with the Local Water Management Strategy (LWMS) (Emerge Associates 2020b) that has been prepared for the site, the structure plan is able to accommodate onsite wastewater management by providing for appropriately sized lots and relevant separation requirements as part of future development. A concept plan has been included with the structure plan to demonstrate how this may work. Spatial consideration for the management of domestic and industrial wastewater within each individual lot will be required as part of subdivision and development approval.

### 4.5.3 Future management requirements

The LWMS provides a framework for future delivery of a best practice management approach to integrated water cycle management including management of wastewater. It has been prepared in accordance with the relevant requirements of the *Government Sewerage Policy* (DPLH 2019) and *AS/NZs 1547 On-site domestic wastewater management* (Standards Australia and Standards New Zealand 2012). The LWMS is a key document guiding future development and can be referred to for future detail, particularly with regard to wastewater management design criteria for the site and management measures required to ensure these design criteria and other relevant requirements will be met.

While the site and soil evaluation completed to support the LWMS indicates that portions of the site may not be able to support onsite effluent disposal (based on current conditions), particularly with regard to achieving separation to groundwater, it will be possible to satisfy onsite effluent disposal requirements through future management measures in accordance with AS 1547 (as outlined within the LWMS (Emerge Associates 2020b)).

As mentioned in **Section 4.4.3**, a standard condition of subdivision applications is the requirement for an UWMP to be prepared. It is expected this will include a more detailed site and soil evaluation utilising the detailed design information that will be available at this stage. The site and soil evaluation will be prepared in accordance with Appendix C of *AS/NZs 1547 On-site domestic wastewater management* (Standards Australia and Standards New Zealand 2012) and the requirements of the *Government Sewerage Policy* (DPLH 2019). Additional site-specific investigations may be required to inform the site and soil evaluation at either subdivision or development approval, including a geotechnical investigation. Further detail on this is provided in the LWMS (Emerge Associates 2020b).

The site and soil evaluation will need to determine the capacity of the subdivision area to contain sewage on-site, select and size treatment/onsite sewage management systems (including land application area), define adequate locations for these systems, and identify management and monitoring options, which in turn may affect the subdivision layout. This determination will likely be based on general land uses assumptions, given the specific industrial land uses are unlikely to be known at the time of subdivision. As per the *Government Sewerage Policy* (DPLH 2019) if lots less than 1 ha are proposed within a sewage sensitive area further demonstration and justification will be required.

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At the development approval stage, a site and soil evaluation for individual lots will be required to be prepared in accordance with Appendix D of *AS/NZs 1547 On-site domestic wastewater management* (Standards Australia and Standards New Zealand 2012) and in line with the requirements of the *Government Sewerage Policy* (DPLH 2019). The site and soil evaluation at development approval will need to determine the capacity of the lot to contain sewage on-site and gather sufficient lot use (including loading) and site and soil information (including any proposed earthworks, construction or landscaping activity) for the selection and design of the on-site management system. This will include more detail on the design specifications of ATUs, the land application system and area, siting considerations (e.g. location of WSUD measures, separation to groundwater) etc)). Lot owners will be informed of these requirements prior to the purchase of lots.

A summary of the primary considerations for general building and industrial wastewater has been provided below.

## General building wastewater

Given the site is located within a sewage sensitive area, as a minimum ATUs will be required to be installed to manage domestic wastewater. It is assumed that domestic wastewater requirements will be consistent with general office uses (i.e. toilets, sinks, showers etc.) with wastewater loading rates consistent with those stipulated in Table 2 of the Department of Health Western Australia (DoH) *Supplement to Regulation 29 and Schedule 9 - Wastewater system loading rates* (DoH 2019a, or as updated). DoH approved systems, as listed in the *Approved secondary treatment systems* (DoH 2019b, or as updated) will be utilised and installation will be carried out in line with the *Code of Practice for the Design, Manufacture, Installation and Operation of Aerobic Treatment Units* (DoH 2015) or where larger systems are required designs will be assessed and approved by DoH on a case by case basis.

ATUs are an advanced alternative to conventional septic tanks which provide improved quality of effluent treatment. ATUs differ from conventional septic tanks in that the wastewater is treated with oxygen to assist in the breakdown of bacteria into fine organic material. The effluent is then treated with chlorine to reduce the number of bacteria in the final effluent. The final treated effluent can then be disposed of within dedicated irrigation areas. The irrigation areas should:

- Be sized appropriately depending upon the size of the ATU system and number of people serviced.
- Include buffer areas (to be determined as a part of site-specific assessment) and fencing between the irrigation area and areas of human use. These buffer areas may be reduced by use of subsurface dripper irrigation systems.
- Include warning signs advising that effluent is being used and is not suitable for human contact or consumption.
- Be accessible for maintenance.
- Be planted out with salt and nutrient resistant plants to avoid pooling or run off of effluent.

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In addition to the requirements for irrigation disposal areas, a number of factors must be considered prior to the installation of ATUs on the site. These are outlined in the *Code of Practice for the Design, Manufacture, Installation and Operation of Aerobic Treatment Units* (DoH 2015). An ATU should be at least:

- 1.2 m from any lot boundaries or buildings.
- 1.8 m from the irrigation disposal area.
- 6 m from any well, bore (not used for drinking water purposes), dam, watercourse, drain or subsoil drain.

### Industrial process wastewater

Any wastewater produced on lots from industrial processes (additional to general building/domestic wastewater effluent) will be required to be treated appropriately on lot. Where appropriate treatment is not achievable on lot, either due to the volumes or contaminants contained therein, industrial process wastewater will need to be captured and removed from site to an appropriate treatment facility. This approach is consistent with industrial sites across Western Australia, even where deep sewer connection is provided.

Any onsite industrial wastewater treatment plants associated with specific lot uses should be designed and constructed in accordance with *Water Quality Protection Note 51: Industrial wastewater management and disposal* (DoW 2009a). The recommendations relating to the design and construction of industrial lots include, but are not limited to:

- Manage stormwater runoff effectively, in accordance with an approved UWMP.
- Industrial wastewater and the materials used for its treatment should be stored and used within weatherproof, chemically resistant or sealed containment compounds. Compounds should be built using low permeability materials, have chemically resistant or sealed surfaces, and be capable of storing at least 110% of the volume of the largest contained fluid storage vessel, plus 25% of the volume of all other containers within the compound.
- Containment compounds should effectively capture leaking tank contents, contaminated stormwater, jetting fluids and residues from equipment misuse.
- Contaminated fluids should be disposed of by draining into an internal collection sump for appropriate treatment, recovery or offsite disposal at an approved site.
- Fuelling facilities for vehicles, and machinery used for the treatment and disposal of wastewater should be constructed and operated to drain any spillage into holding tanks or well-maintained fuel recovery systems.
- Fuels, solvents, explosives and dangerous goods should be controlled and stored in accordance with the *Dangerous Goods Safety Act 2004*.

For prescribed premises, industrial process wastewater will be managed through the works approval and licence process pursuant to Part V of the EP Act. For other industry that may not be subject to Part V of the EP Act, development approval will need to address industrial process wastewater and/or demonstrate that any proposed wastewater management system can appropriately address the volumes and type of wastewater without impacting the environment. This is a typical requirement of development approval for industrial development.

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### 4.6 Social surroundings

#### 4.6.1 Policy framework, site context and management objectives

In the context of environmental impact assessment, the EPA's objective for social surroundings is 'to protect social surroundings from significant harm' (EPA 2016c) which includes impacts on sensitive land uses from nearby industrial operations.

EPA Guideline No. 3 *Guidance for the Assessment of Environmental Factors No 3 – Separation Distances between Industrial and Sensitive Land Uses* (EPA 2005) provides guidance on the generic separation distances between specific industry and sensitive land uses to avoid or minimise the potential for land use conflict. Land uses that could be potentially sensitive to emissions from industrial development include residential developments, hospitals, hotels, motels, hostels, caravan parks, schools, nursing homes, child care facilities, playgrounds and retail outlets as an example (EPA 2005). It is however noted that these are generic separation distances vary depending upon the type of industrial land use and can also be varied based on the proposed industrial development and associated operation, with EPA and DWER, as part of administering requirements under Part IV and Part V of the EP Act, considering separation from sensitive land uses on a merit and case-by-case basis.

As already outlined, the site forms part of a larger industrial area that has been earmarked for development since the mid 1990's (EPA 2008) and is zoned 'general industry'. It forms part of the Picton Industrial Park Southern Precinct area (DPLH 2018) while the Waterloo Industrial District Structure Plan (WAPC 2019) is located immediately to the east of Martin-Pelusey Road.

Based on the existing and future proposed industrial development surrounding the site, there are no land uses identified surrounding the site that would be considered 'sensitive land uses' and therefore it is unlikely that industrial activities within the site will result in noise, odour, air emission of amenity impacts on sensitive land uses. Where existing residences are currently located within the vicinity of the site, it is expected that these will be removed as industrial development progresses in the broader area and potential temporary impacts can be managed as part of future stages of the planning process.

The principle management objective for social surroundings associated with the site is to ensure that future industrial development can satisfy relevant separation distances (if applicable) to minimise impacts on sensitive land uses.

#### 4.6.2 Structure plan layout considerations for social surroundings

The structure plan is appropriately located in a broader area that is zoned for industrial development (and/or proposed to support future industrial development i.e. Waterloo Industrial Area), with existing industrial land uses located immediately south of Harris Road and also further west. No specific spatial response is required as part of the structure plan to support minimising impacts on sensitive land uses.

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### 4.6.3 Future social surrounding management requirements

Given the future specific industrial land uses likely to operate within the site are unlikely to be known at the time of subdivision (typically land uses would only be known after the lots are sold), no specific management is likely to apply as part of subdivision.

As part of future detailed design stages (i.e. development approval) it will be the responsibility of the incoming industrial land use and operator to ensure/demonstrate that any sensitive land uses (i.e. current existing residences that have not yet been removed as part of industrial development) that may exist at the time of development are appropriately considered, which may include accommodating separation in accordance with EPA Guideline No. 3 *Guidance for the Assessment of Environmental Factors No 3 – Separation Distances between Industrial and Sensitive Land Uses* (EPA 2005) or through advice provided by the EPA and/or DWER, based on the specific industrial use and proposed operation and management of the facility.

In addition, it is highly likely that where industrial land uses are likely to have noise, odour or air emission impacts that could detrimentally impact the social surroundings, these will be largely associated with activities that are prescribed pursuant to Part V of the EP Act and can be managed through the works approval and licence process.

## 4.7 Bushfire management

### 4.7.1 Policy framework, site context and management objectives

*State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP3.7) (WAPC 2015a) stipulates that any development proposal which occurs partly or wholly within a designated bushfire prone area is required to be accompanied by a bushfire management plan (BMP). The preparation of a BMP is required to incorporate the following tasks:

- Classification of existing vegetation types and effective slope within the site and surrounding 150 m, in accordance with *Australia Standard 3959-2018 Construction of buildings in bushfire-prone areas* (AS 3959) (Standards Australia 2018).
- Assessment of bushfire hazard levels within the site and surrounding 150 m, in accordance with the *Guidelines for Planning in Bushfire Prone Areas* (WAPC and DFES 2017).
- Completion of an indicative Bushfire Attack Level (BAL) assessment and preparation of an associated BAL contour plan.
- Assessment of the structure plan design against the bushfire protection criteria, in accordance with the *Guidelines for Planning in Bushfire Prone Areas* (WAPC and DFES 2017).

Policy objective 5.4 of SPP 3.7 specifies that development is required to:

*'achieve an appropriate balance between bushfire risk management measures and biodiversity conservation values, environmental protection and biodiversity management and landscape amenity'.*

This policy objective ensures that future development appropriately considers the bushfire risks, and provides appropriate separation from any identified risks without negatively impacting existing environmental values.

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The external hazards surrounding the site have been assumed to remain in their current state and will remain a bushfire hazard to the site, even though in the long term some of these hazards will be removed permanently as industrial development progresses. In addition to the hazards external to the site, retained vegetation within the proposed public open space in the north-west of the site will be a bushfire hazard to future development within the site. The bushfire hazard assessment has considered potential changes to the existing vegetation (i.e. when it is revegetated as part of future development) when considering any required setbacks and management measures, as per the requirements of the *Picton Industrial Park Southern Precinct District Structure Plan* (DPLH 2018).

The principal management objective for the bushfire risk to the site is to ensure that the risk to future people, property and infrastructure is appropriately minimised without negatively impacting on environmental values within or surrounding the site.

## 4.7.2 Structure plan layout considerations for bushfire management

In accordance with the BMP (Emerge Associates 2020a) prepared for the site, the structure plan has provided an appropriate spatial response to bushfire risk through:

- Ensuring future development areas will be able to accommodate the separation necessary to ensure built form is able to achieve a bushfire attack level (BAL) rating of BAL-29 or less without requiring clearing or modification of vegetation in areas where remnant vegetation is proposed to be retained. This has been achieved through the location of proposed roads and drainage areas between future lots and areas of bushfire hazard and/or providing lots of an appropriate size to accommodate necessary separation.
- An integrated internal road network that connects with the existing external public road network and provides access to multiple destinations, supporting appropriate emergency evacuation and response.

## 4.7.3 Future bushfire management requirements

The BMP (Emerge Associates 2020a) demonstrates that SPP 3.7 and the bushfire protection criteria (outlined within the Guidelines (WAPC and DFES 2017)) can be satisfied through an 'acceptable solution' approach. Going forward and based on satisfying the bushfire protection criteria, detailed design and construction will need to consider the following:

- *Element 1 Location*: all future built form should be located in an area subject to a low or moderate bushfire hazard, and should achieve a BAL rating of BAL-29 or less.
- *Element 2 Siting and Design*: provision of appropriate separation to ensure future built form can achieve a BAL rating of BAL-29 or less. This can be achieved through the location of road and drainage reserves (assuming these will be designed and managed to achieve low threat in accordance with Section 2.2.3.2 of AS 3959), and /or provision of appropriately sized lots enabling in-lot setbacks.
- *Element 3 Vehicular Access*: provision of an integrated road network that provides access to at least two different destinations, with roads to comply with the technical requirements outlined in Table 6 of Appendix Four in the Guidelines (WAPC & DFES 2017), including roads with a trafficable surface width of at least 6 m. If development is staged, temporary turn-around areas and/or temporary emergency access ways may be required.

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- *Element 4 Water:* the site is located within the current reticulated water supply network and therefore, will be provided with a permanent and secure reticulated water supply, which is to be installed in accordance with the Aqwest specifications. Additional fire-fighting infrastructure may be required on individual lots, including the installation of tanks and pumps given the potential water pressure may not be sufficient for fire-fighting purposes, but can be confirmed at the development approval stage.

A revised BMP may be required to support future subdivision applications, particularly if vegetation management assumptions are different, or the development layout is significantly different to that assessed as part of the BMP (Emerge Associates 2020a). The BMP will need to respond to the subdivision design (and/or stage of development).

It is likely that the WAPC will include a standard condition on subdivision applications (model subdivision condition F1 (WAPC and DPLH 2019)) which states:

*Information is to be provided to demonstrate that the measures contained in the bushfire management plan [NAME/DATE] that address the following [LIST AS REQUIRED] have been implemented during subdivisional works. This information should include a notice of 'Certification by Bushfire Consultant'.*

It is possible that future industrial land uses within the site may be considered high risk land use in accordance with Clause 6.6 of SPP 3.7 (WAPC 2015a), including (but not limited to) uses such as service stations, bulk storage of hazardous materials and fuel depots. If high risk land uses are proposed within the site and are located within a designated bushfire prone area, the associated development application for the proposed use will likely need to be supported by a bushfire management plan and risk management plan for the specific proposed use, to demonstrate risks can be appropriately managed to minimise the potential for bushfires to be exacerbated.



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## 5 Implementation Framework

A summary of how the structure plan responds to the environmental values and attributes within the site is provided in **Table 7**. The table also outlines the future management likely to be required as part of the subdivision and development process.

*Table 7: Environmental management framework implementation table*

Factor	Structure plan phase (completed)	Subdivision phase	Part of development works
Acid sulfate soils	<ul style="list-style-type: none"> <li>Consider ASS Risk mapping as prepared by DWER. No spatial response in LSP required.</li> </ul>	<ul style="list-style-type: none"> <li>If required, completion of the ASS self-assessment form (as prepared by the DPLH).</li> <li>If required, preparation of an Acid Sulfate Soil and Dewatering Management Plan.</li> </ul>	<ul style="list-style-type: none"> <li>If required, implementation of an Acid Sulfate Soil and Dewatering Management Plan.</li> </ul>
Native vegetation	<ul style="list-style-type: none"> <li>Assessment of flora and vegetation values and preliminary consideration of potential retention opportunities.</li> <li>Provision for public open space to retain vegetation in the north-west portion of the site.</li> </ul>	<ul style="list-style-type: none"> <li>Undertake detailed analysis of final subdivision layout and engineering design to determine tree retention opportunities.</li> <li>Provision for public open space in the north-west portion of the site to retain identified vegetation (or as agreed).</li> <li>Provision for road network around perimeter of retained remnant vegetation (see <b>Figure 7</b>) to ensure no lots directly back onto retained remnant vegetation.</li> <li>Consideration of potential requirement for Clearing Permit if clearing undertaken prior to subdivision approval.</li> </ul>	<ul style="list-style-type: none"> <li>Ensure areas of retention (both public open space and trees in road reserves etc.) are protected, accommodate these as part of construction and landscaping works.</li> <li>Undertake revegetation work as required.</li> </ul>
Native fauna	<ul style="list-style-type: none"> <li>Assessment of fauna habitat and preliminary consideration of potential retention opportunities.</li> <li>Provision for public open space to retain vegetation in the north-west portion of the site.</li> </ul>	<ul style="list-style-type: none"> <li>Undertake detailed analysis of final subdivision layout and engineering design to determine further potential tree retention opportunities.</li> <li>Provision for public open space in the north-west portion of the site to retain identified vegetation (or as agreed).</li> <li>Provision for road network around perimeter of retained remnant vegetation (see <b>Figure 7</b>) to ensure no lots directly back onto retained remnant vegetation.</li> </ul>	<ul style="list-style-type: none"> <li>Ensure areas of retention are protected, accommodate these as part of construction and landscaping works.</li> <li>Implement pre-clearance checks and/or management plan requirements to ensure fauna is managed appropriately to minimise harm.</li> <li>If required, obtain and implement licences pursuant to the <i>Biodiversity Conservation Act 2016</i> to disturb/relocate fauna prior to works commencing.</li> </ul>
Hydrology	<ul style="list-style-type: none"> <li>Preparation of a Local Water Management Strategy.</li> <li>Spatial providing for drainage reserves to accommodate stormwater.</li> </ul>	<ul style="list-style-type: none"> <li>Preparation of an Urban Water Management Plan.</li> <li>Provision for drainage reserves.</li> </ul>	<ul style="list-style-type: none"> <li>Implementation of the UWMP.</li> <li>Design and implementation of drainage reserves/management features as per the requirements of the UWMP.</li> </ul>

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Table 7: Environmental management framework implementation table (continued)

Factor	Structure plan phase (completed)	Subdivision phase	Part of development works
Wastewater	<ul style="list-style-type: none"> <li>• Preparation of a Local Water Management Strategy.</li> <li>• Preparation of a structure plan level site and soil evaluation.</li> <li>• Identification of likely sewage disposal requirements</li> </ul>	<ul style="list-style-type: none"> <li>• Preparation of an Urban Water Management Plan.</li> <li>• Preparation of a subdivision level site and soil evaluation</li> </ul>	<ul style="list-style-type: none"> <li>• Implementation of the UWMP.</li> <li>• Preparation of a detailed design level site and soil evaluation.</li> <li>• Application for wastewater disposal as part of development approvals.</li> <li>• Implementation of wastewater treatment and disposal in accordance with relevant approvals.</li> </ul>
Social surroundings	<ul style="list-style-type: none"> <li>• Understand presence of sensitive land uses and consider future development requirements. As the site is located in a broader area identified for industrial development, sensitive land uses are unlikely to be impacted.</li> </ul>	<ul style="list-style-type: none"> <li>• None, given the types of industrial land uses likely to operate within the site will not be known.</li> </ul>	<ul style="list-style-type: none"> <li>• Where required, demonstrate appropriate separation is provided between industrial development and existing residences that have not yet been removed to minimise potential noise, odour and air emission impacts.</li> </ul>
Bushfire risk	<ul style="list-style-type: none"> <li>• Preparation of a Bushfire Management Plan.</li> <li>• Provision for road and drainage reserves and appropriately sized development areas to accommodate setbacks to achieve BAL-29 or less.</li> <li>• Provision for a road network that connects the site to the public road network and provides access to at least two destinations.</li> </ul>	<ul style="list-style-type: none"> <li>• Complete detailed BAL assessment to determine the separation requirements necessary to achieve BAL-29 or less and confirm subdivision layout can accommodate this.</li> <li>• Provision for an appropriate road network that provides access to at least two destinations.</li> <li>• If required, prepare an updated BMP to support the subdivision application.</li> </ul>	<ul style="list-style-type: none"> <li>• Drainage reserves and road reserves to be designed and maintained as low threat in accordance with Clause 2.2.3.2(f) of AS 3959.</li> <li>• If industrial land use is likely to be considered 'high risk' (as per Clause 6.6 of SPP 3.7), development approval to be supported by a BMP and risk management plan.</li> </ul>

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## 6 Conclusions

This EAMS has been prepared on behalf of the proponent for to support the Local Structure Plan (Rowe Group 2019) prepared for Lots 103, 110 and 436, Picton East, to guide the proposed industrial development within the site. This EAMS has been prepared to support the structure plan, together with:

- *Bushfire Management Plan* (Emerge Associates 2020a)
- *Local Water Management Strategy* (Emerge Associates 2020b)

The structure plan design has responded to site-specific environmental considerations where necessary and possible, including accommodation of stormwater within drainage reserves consistent with the LWMS; retaining existing vegetation within an area of public open space in the north-west corner of the site (which is in addition to the conservation significant areas identified by the EPA (2008) and DPLH & WAPC (2018), but was identified for retention in the LSP due to the habitat values); and providing appropriate separation between future built form and areas of bushfire hazard within and external to the site.

This document provides an outline of the management requirements that will need to be considered as part of future subdivision and development stages. The key management considerations are summarised as follows.

- **Acid sulfate soils:** it is possible that future investigations and management considerations will be required at subdivision, particularly if services are likely to be installed below the permanent groundwater table.
- **Native vegetation:** ensuring a road interface is provided between the public open space area containing retained remnant vegetation (to ensure lots do not directly back onto this area), and confirming tree retention opportunities (in addition to the area of public open space proposed to retain remnant vegetation, shown in **Figure 7**) in consideration of final development design and bulk earthworks requirements, and protection vegetation proposed for retention as part of works. Where clearing of native vegetation is proposed, clearing will need to be undertaken in accordance with a valid exemption or a clearing permit will need to be attained pursuant to Part V of the *Environmental Protection Act 1986*.
- **Native fauna:** confirming tree retention (i.e. fauna habitat) retention opportunities (in addition to the area of public open space proposed to retain remnant vegetation, shown in **Figure 7**) in consideration of the final development design and bulk earthworks requirements. Fauna management protocols will likely need to be implemented prior to and during clearing activities, particularly with regard to western ringtail possums.
- **Hydrology:** stormwater management requirements to be implemented as outlined within the Local Water Management Strategy (LWMS), and will include preparation of an Urban Water Management Plan (UWMP) for each stage of future subdivision. Spatial provision will need to be made for the drainage reserves at subdivision to accommodate stormwater.
- **Wastewater:** Requirement to design and install appropriate onsite wastewater disposal, likely to be in the form of aerobic treatment units (ATUs) for domestic effluent and storage/treatment of industrial process wastewater.

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- **Social surroundings:** Each future industrial land use will need to ensure they are able to provide appropriate separation between themselves and any nearby sensitive land uses. The only sensitive land uses that may be located within the vicinity of the site will be existing rural residences that have not been converted to industrial development (in line with the broader zoning for the area).
- **Bushfire risks:** Provision of appropriate separation between future built form and bushfire hazards will need to be accommodated as part of subdivision design (and proposed location of the integrator roads has demonstrated this can be achieved); and drainage and road reserves will be designed and maintained to low threat (in order to not be a hazard). Vehicle access will also need to accommodate access to at least two destinations. This will be addressed as part of future bushfire management plans supporting subdivision and/or development approval, whichever is applicable.

Overall, the environmental attributes and values of the site can be accommodated through the structure plan design, or can be managed appropriately through the future subdivision and development phases in line with the relevant state and local government legislation, policies and guidelines and best management practices.

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Local Structure Plan, Lots 103, 110 and 436, Picton East



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# Environmental Assessment and Management Strategy

Local Structure Plan, Lots 103, 110 and 436, Picton East



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# Figures



*Figure 1: Location Plan*

*Figure 2: Greater Bunbury Region Scheme Zoning*

*Figure 3: Topographic Contours and Maximum Groundwater Level Contours*

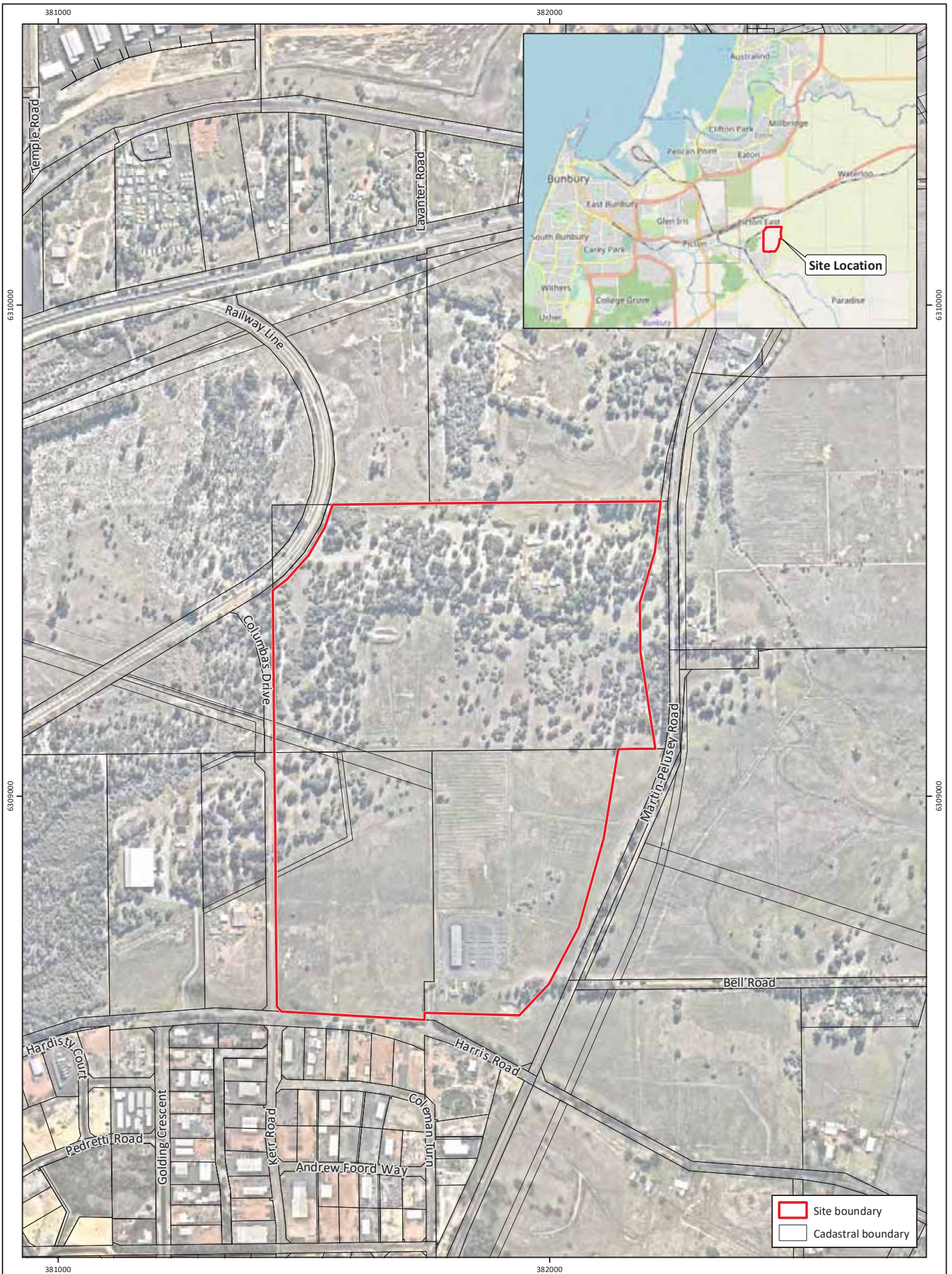
*Figure 4: Geological Mapping*

*Figure 5: Geomorphic Wetlands and Hydrological Features*

*Figure 6: Existing Site Conditions – AS 3959 Vegetation Classifications*

*Figure 7: Areas of Retained Remnant Vegetation*



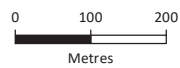


**Figure 1: Location Plan**

**Project:** Environmental Assessment and Management Strategy  
Local Structure Plan, Lots 103, 110 and 436 Picton East

**Client:** Harris Road Pty Ltd

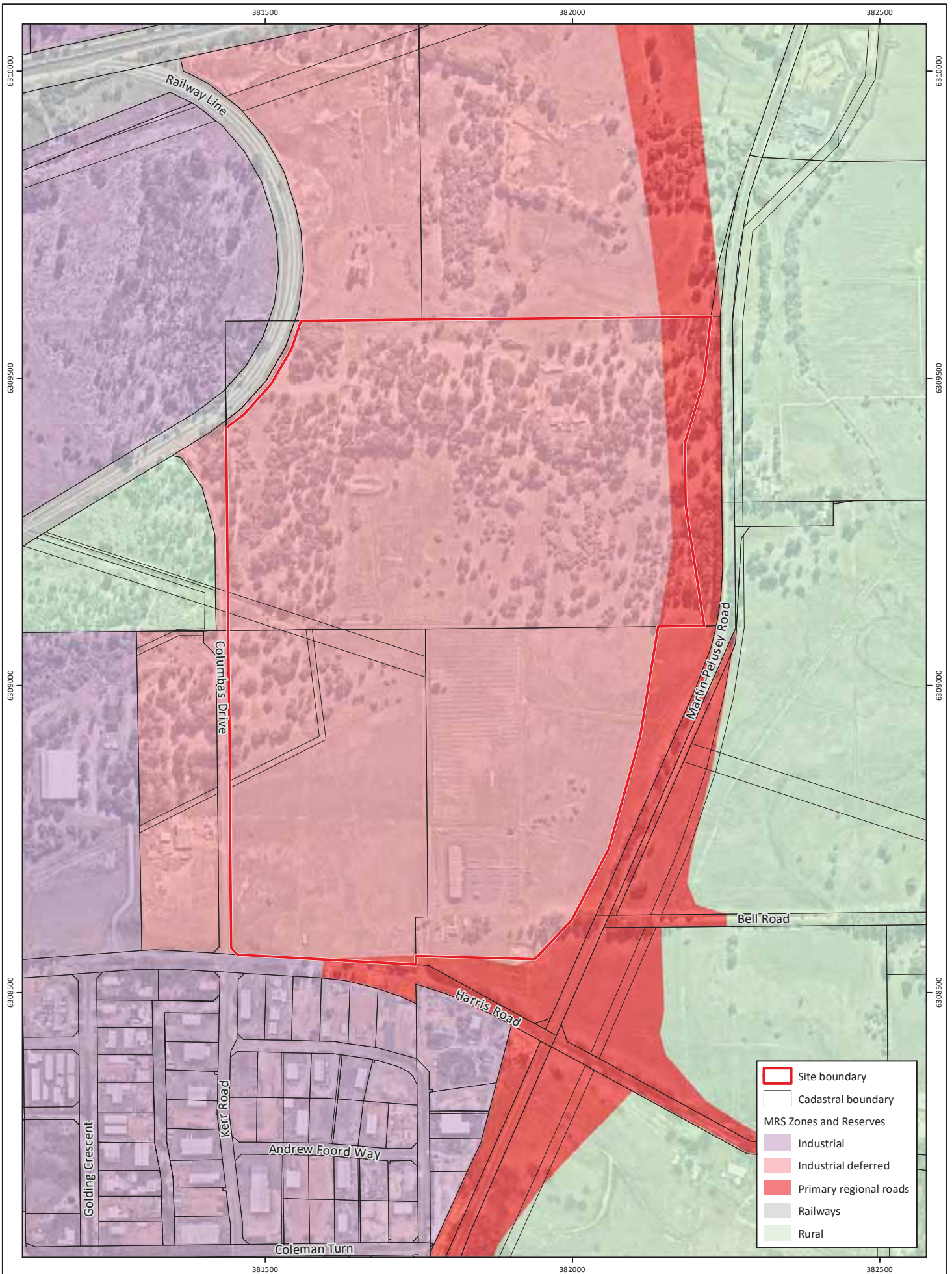
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**Drawn:** GAR  
**Date:** 25/01/2021  
**Checked:** HPB  
**Approved:** KK  
**Date:** 25/01/2021



Scale: 1:10,000@A4  
GDA 1994 MGA Zone 50







**Figure 2: Greater Bunbury Region Scheme Zoning**

**Project:** Environmental Assessment and Management Strategy  
Local Structure Plan, Lots 103, 110 and 436 Picton East  
**Client:** Harris Road Pty Ltd

**Plan Number:** EP12-039(03)--F29a  
**Drawn:** GAR  
**Date:** 25/01/2021  
**Checked:** HPB  
**Approved:** KK  
**Date:** 25/01/2021

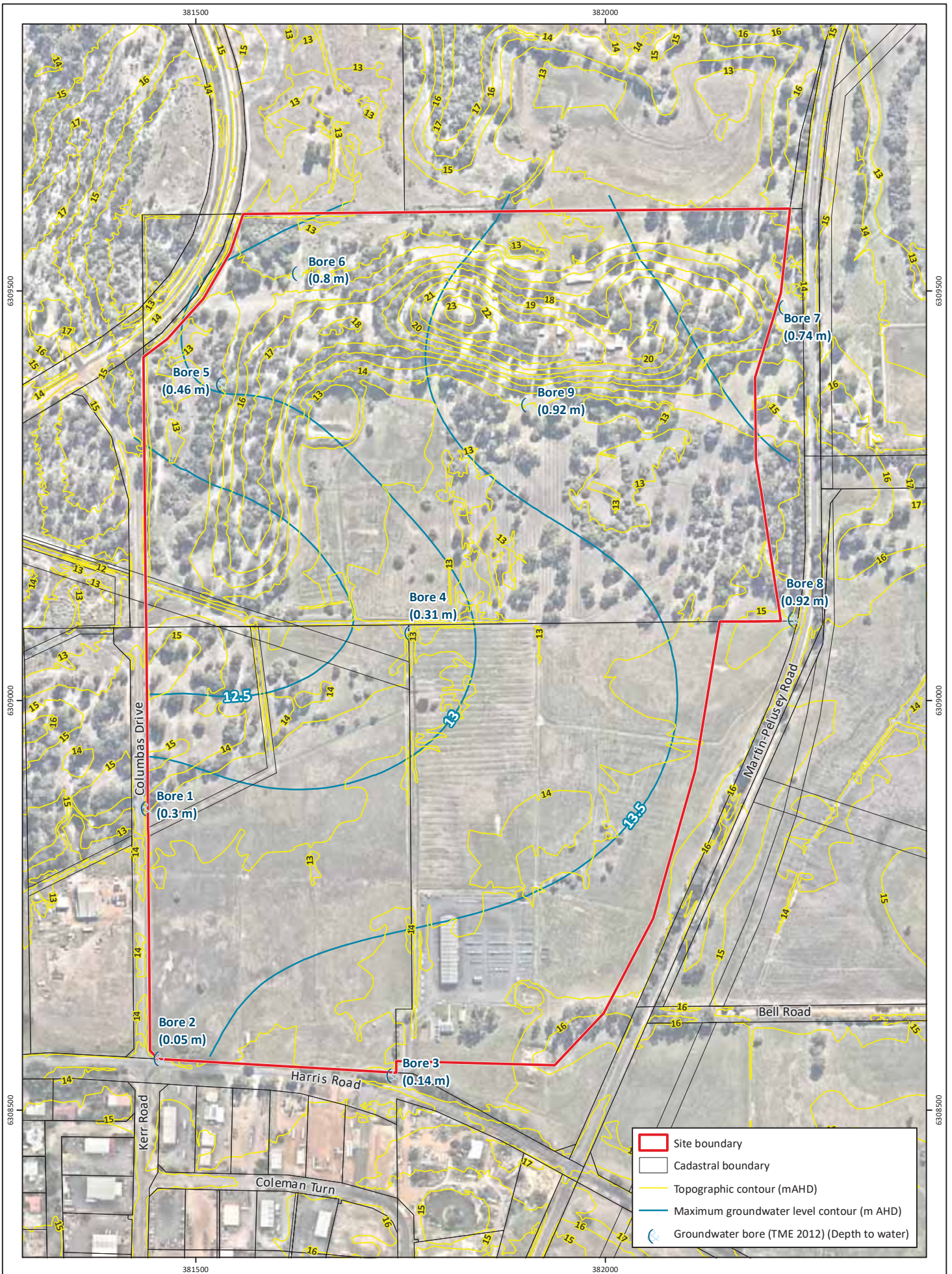


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GDA 1994 MGA Zone 50



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**Figure 3: Topographic and Maximum Groundwater Contours**

**Project:** Environmental Assessment and Management Strategy  
Local Structure Plan, Lots 103, 110 and 436 Picton East  
**Client:** Harris Road Pty Ltd

**Plan Number:** EP12-039(03)-F30a  
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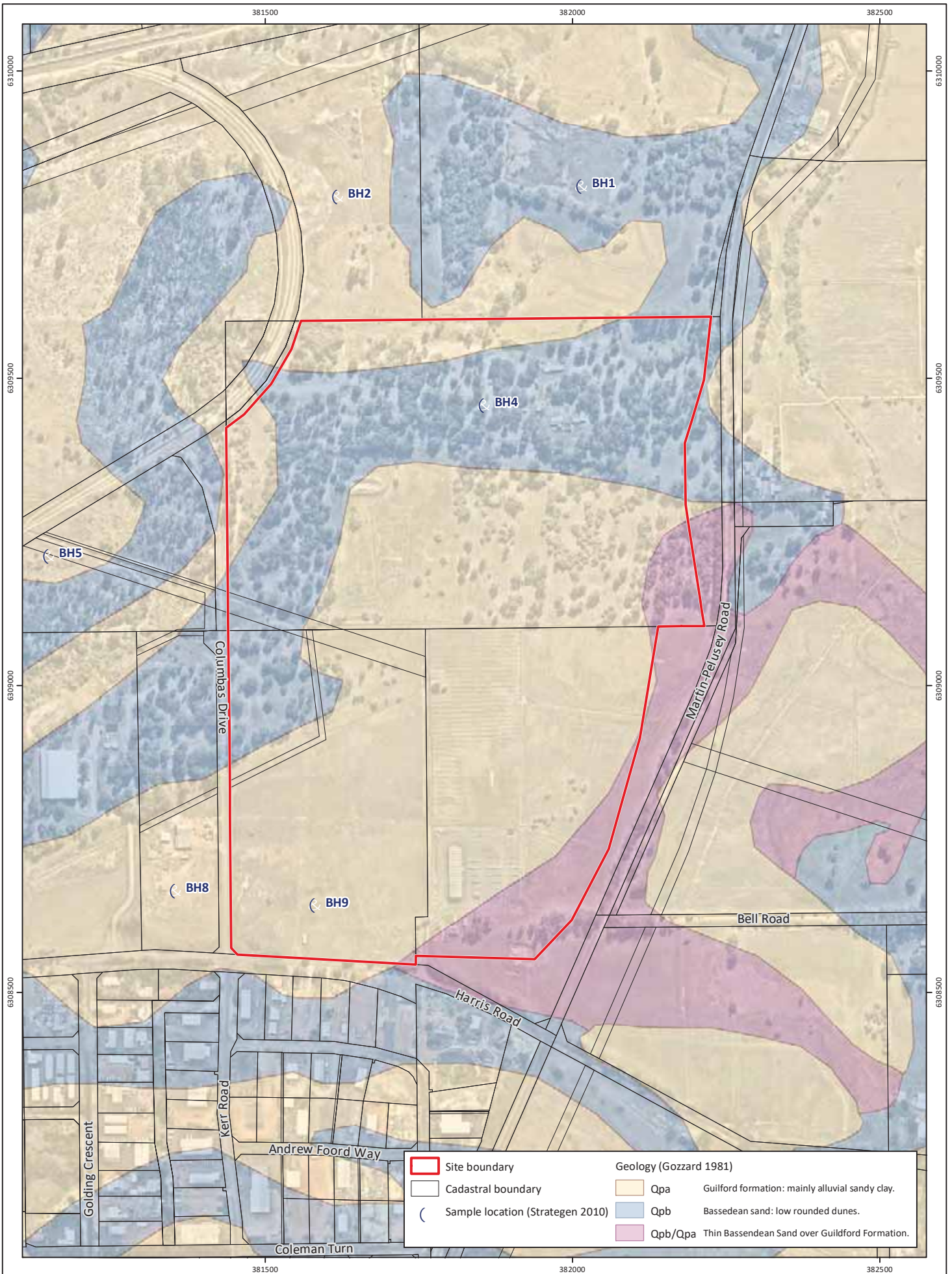


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GDA 1994 MGA Zone 50









**Figure 4: Geological Mapping**

**Project:** Environmental Assessment and Management Strategy  
Local Structure Plan, Lots 103, 110 and 436 Picton East

**Client:** Harris Road Pty Ltd

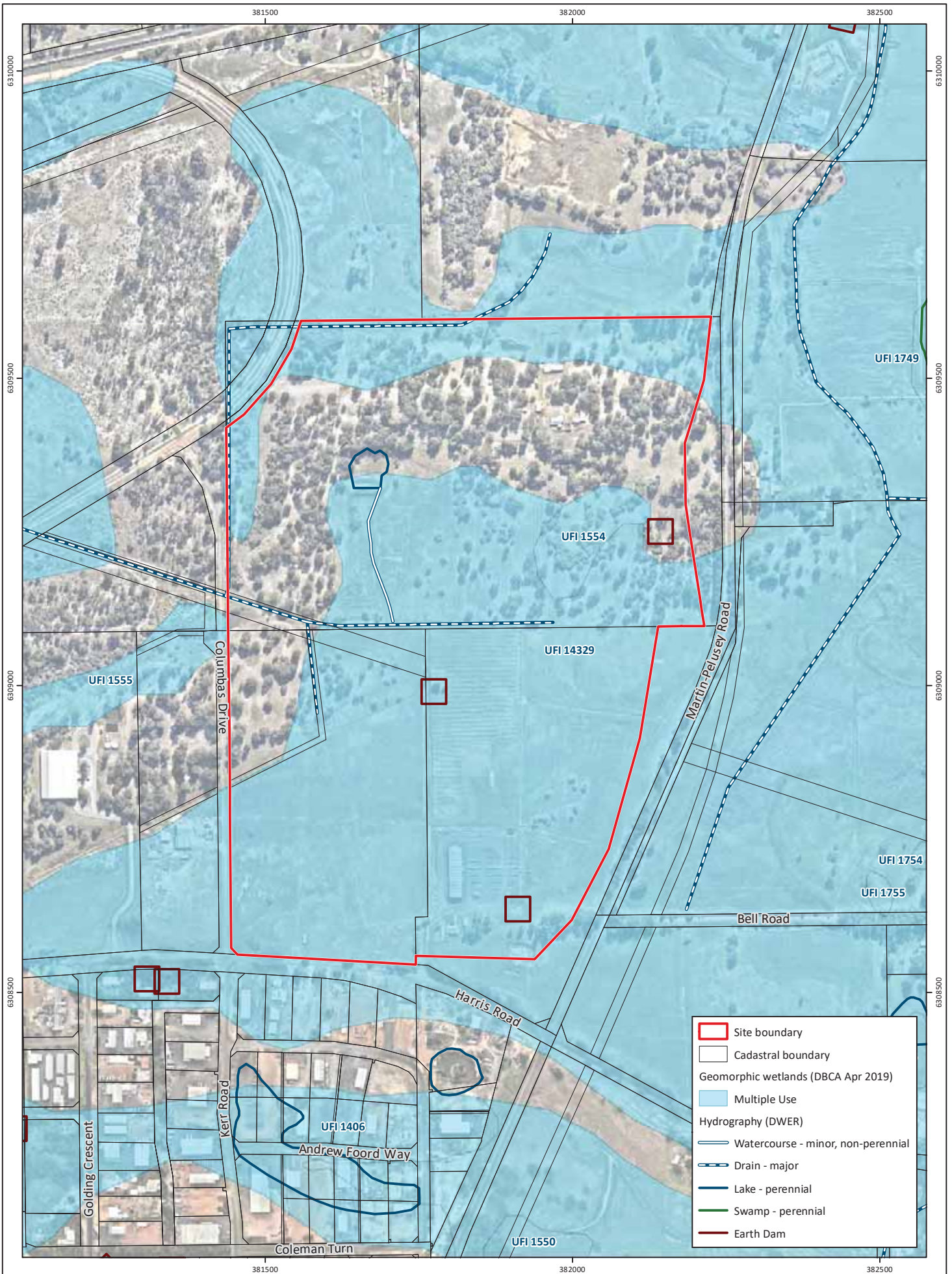
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**Drawn:** GAR  
**Date:** 25/01/2021  
**Checked:** HPB  
**Approved:** KK  
**Date:** 25/01/2021



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Metres  
Scale: 1:8,000@A4  
GDA 1994 MGA Zone 50







**Figure 5: Geomorphic Wetlands and Hydrological Features**

**Project:** Environmental Assessment and Management Strategy  
Local Structure Plan, Lots 103, 110 and 436 Picton East

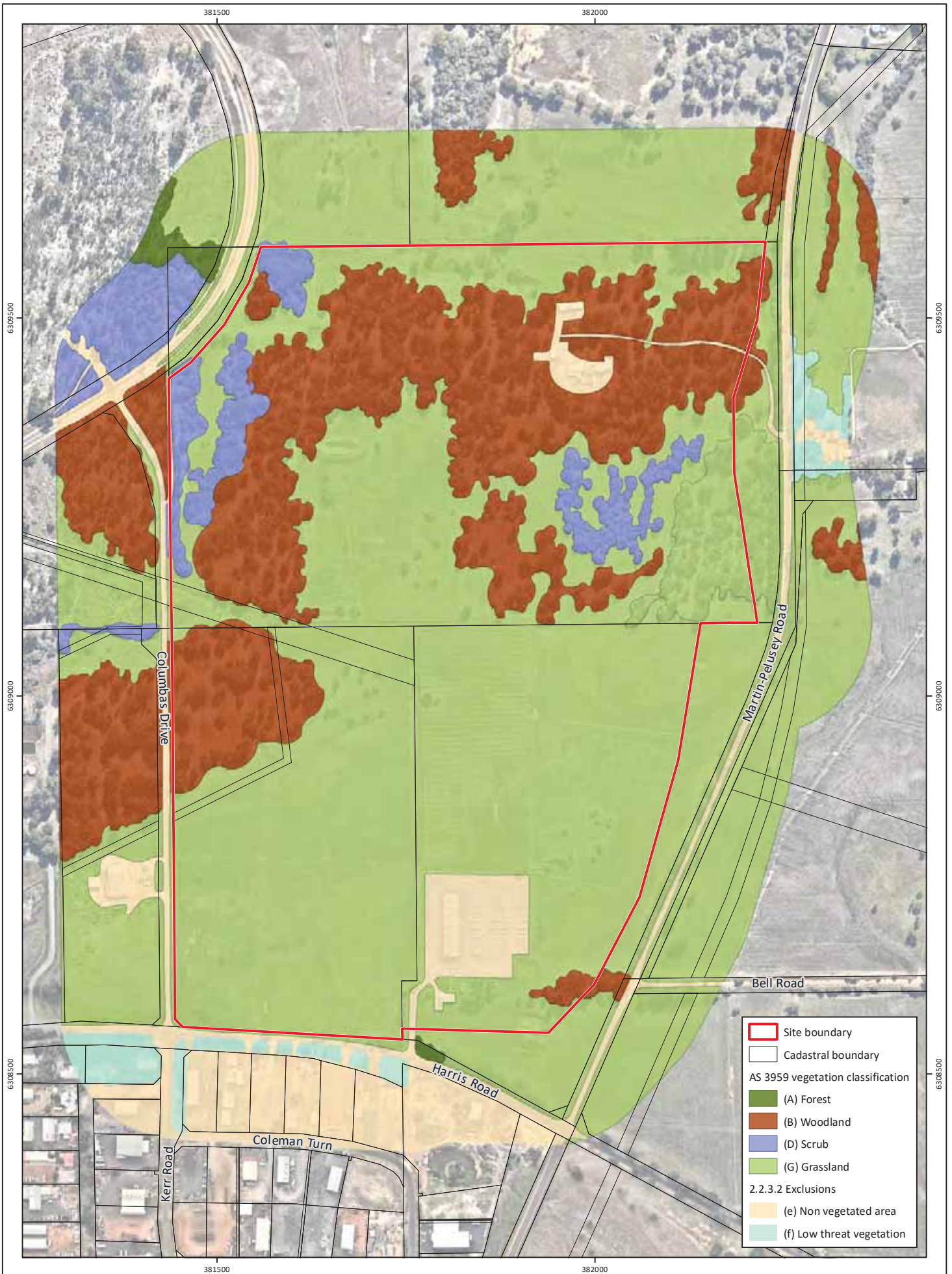
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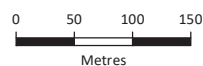


**Figure 6: Existing Site Conditions – AS 3959 Vegetation Classifications**

**Project:** Environmental Assessment and Management Strategy  
Local Structure Plan, Lots 103, 110 and 436 Picton East

**Client:** Harris Road Pty Ltd

**Plan Number:** EP12-039(03)--F33a  
**Drawn:** GAR  
**Date:** 25/01/2021  
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**Approved:** KK  
**Date:** 25/01/2021

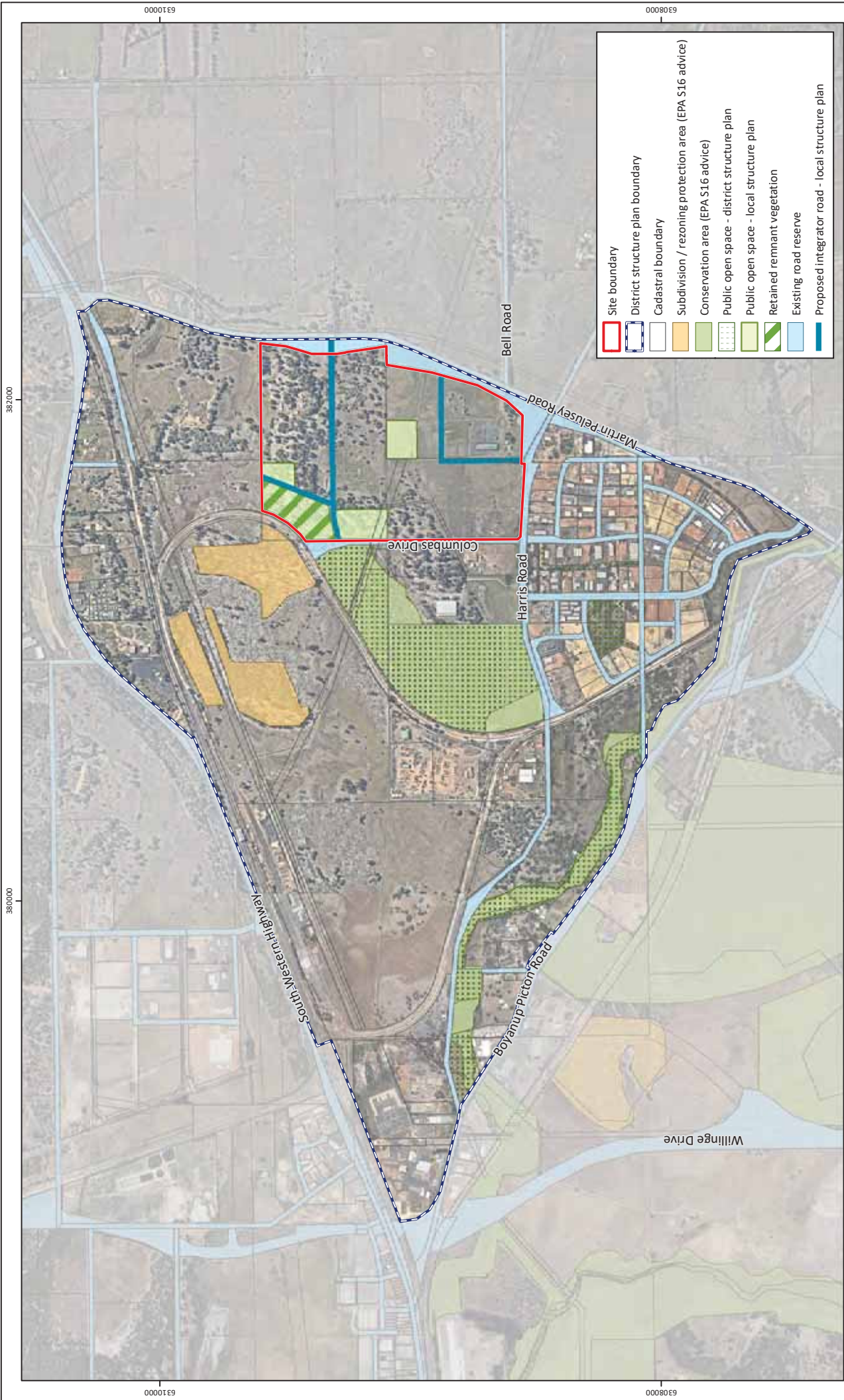


**Scale:** 1:6,500@A4  
GDA 1994 MGA Zone 50



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**Figure 7: Areas of Retained Remnant Vegetation**

**Project:** Environmental Assessment and Management Strategy  
Local Structure Plan, Lots 103, 110 and 436 Picton East  
**Client:** Harris Road Pty Ltd

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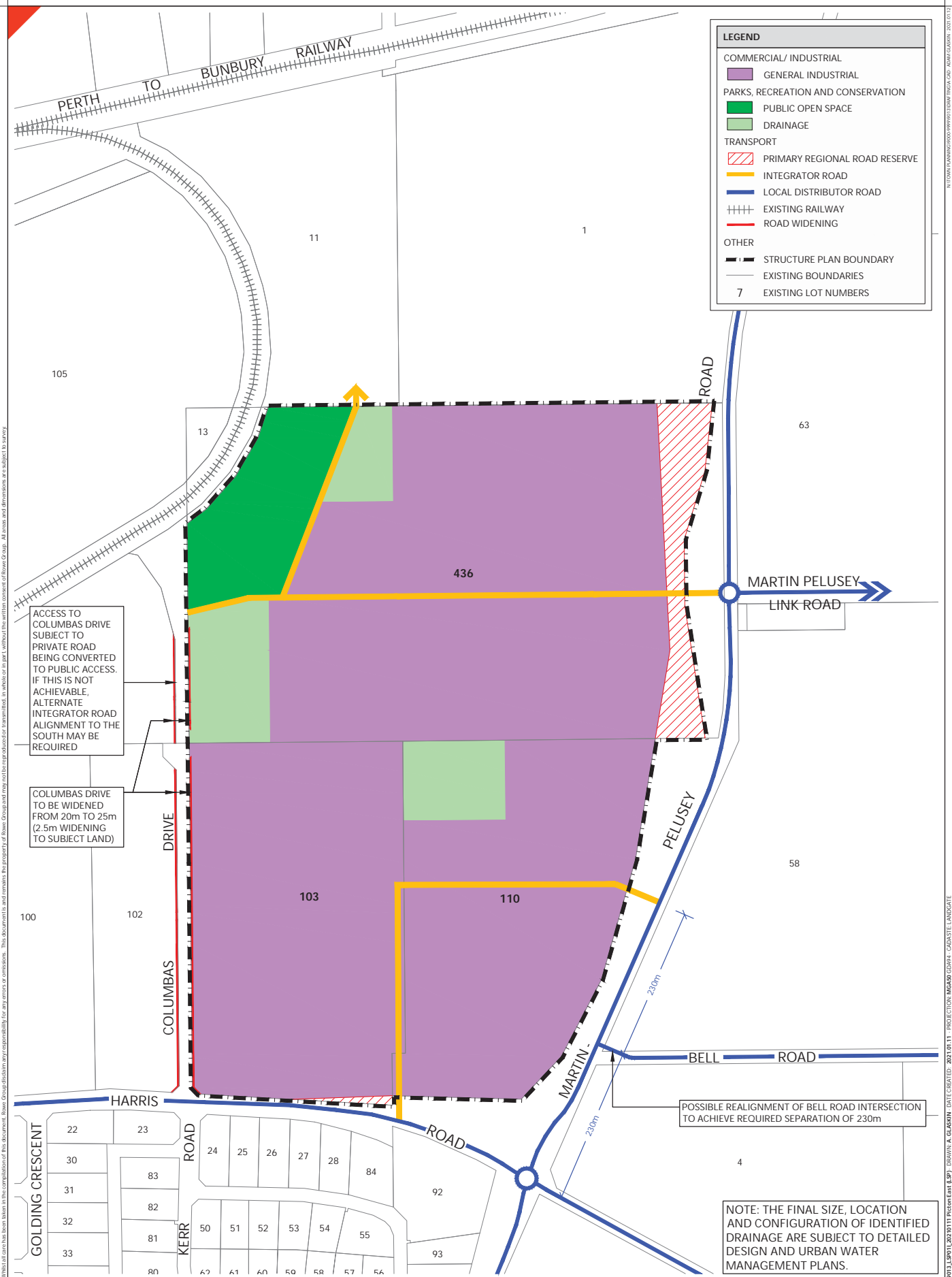


# Appendix A

Lots 103, 110 and 436 Picton East Local Structure Plan (Rowe Group 2020)







LEGEND	
COMMERCIAL/ INDUSTRIAL	
	GENERAL INDUSTRIAL
PARKS, RECREATION AND CONSERVATION	
	PUBLIC OPEN SPACE
	DRAINAGE
TRANSPORT	
	PRIMARY REGIONAL ROAD RESERVE
	INTEGRATOR ROAD
	LOCAL DISTRIBUTOR ROAD
	EXISTING RAILWAY
	ROAD WIDENING
OTHER	
	STRUCTURE PLAN BOUNDARY
	EXISTING BOUNDARIES
	EXISTING LOT NUMBERS

ACCESS TO COLUMBAS DRIVE SUBJECT TO PRIVATE ROAD BEING CONVERTED TO PUBLIC ACCESS. IF THIS IS NOT ACHIEVABLE, ALTERNATE INTEGRATOR ROAD ALIGNMENT TO THE SOUTH MAY BE REQUIRED

COLUMBAS DRIVE TO BE WIDENED FROM 20m TO 25m (2.5m WIDENING TO SUBJECT LAND)

POSSIBLE REALIGNMENT OF BELL ROAD INTERSECTION TO ACHIEVE REQUIRED SEPARATION OF 230m

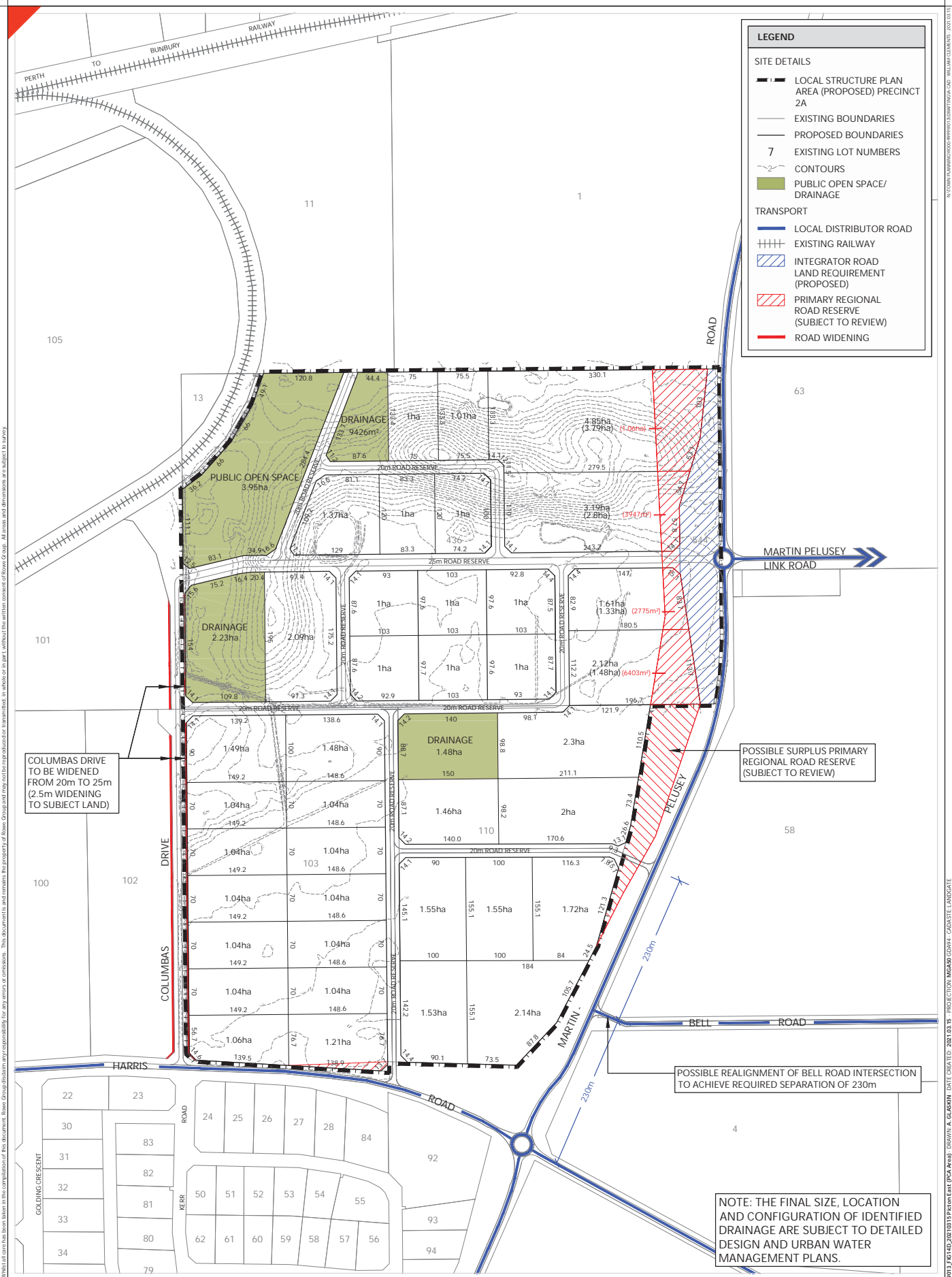
NOTE: THE FINAL SIZE, LOCATION AND CONFIGURATION OF IDENTIFIED DRAINAGE ARE SUBJECT TO DETAILED DESIGN AND URBAN WATER MANAGEMENT PLANS.

**LOCAL STRUCTURE PLAN**  
 LOTS 103, 110 AND 436  
 PICTON EAST



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9013-LSP-01-I (202111) Picton East (LSP) DRAWN: A. GLASBY DATE CREATED: 2021.01.11 PROJECTION: NGAD83 GDA94 CANADIAN DATUM CANADIAN LANGRANT



**CONCEPT PLAN (MINIMUM 1HA LOTS)**  
 LOTS 103, 110, 436 AND 544  
 PICTON EAST



0 125 m  
 SCALE @ A3: 1:5000  
 9013-FIG-14-D



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PROJECT: 9013-FIG-14-D (Picton East) (PCA Area) DRAWN: A. GLASPER DATE CREATED: 2022.03.15 PROJECTION: MGA94/GDA94 CAWASSEL LANDGATE

# Appendix B

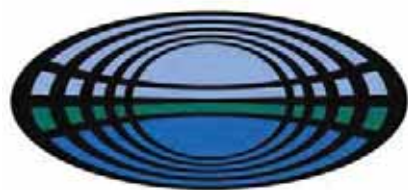
Preliminary Acid Sulphate Soil Investigation (Strategen 2010)





# Preliminary Acid Sulphate Soil Investigation

Picton East, Shire of Dardanup,  
WA



strategen

Prepared for  
TME Group  
by Strategen

May 2010





# **Preliminary Acid Sulphate Soil Investigation**

Picton South – Eastern Sector – Shire of  
Dardanup, WA

Strategen is a trading name of  
Strategen Environmental Consultants Pty Ltd  
Suite 7, 643 Newcastle Street Leederville WA  
ACN: 056 190 419

May 2010

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### **Client: TME Group**

Report	Version	Prepared by	Reviewed by	Submitted to Client	
				Copies	Date
Draft Report	V1	ZC/DD	AP	1	19/5/2010
Final Report	Final	ZC/DD	AP	1	31/5/2010

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1.1.2 Lot descriptions	2
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2. South West Chemical Services – Field Test Results



## 1. INTRODUCTION

The following report is a Preliminary Acid Sulphate Soil (ASS) Investigation undertaken for a land parcel (the study area) known as the Picton South site (eastern sector), which is bordered by Martin Pelusey Road, Harris Road, Columbas Drive, a section of disused railway line to the south west and the Perth to Bunbury railway line, and is located in the Shire of Dardanup, WA. The study area is proposed to be developed for light commercial use and will incorporate access roads and other services. Strategen was appointed by TME Group to undertake the investigation in order to develop an understanding of any potential ASS issues associated with excavations that may be undertaken within the study area, particularly in association with the provision of power and deep sewage services and stormwater management.

South West Chemical Services (SWCS) was sub-contracted by Strategen to carry out the Preliminary ASS field work, which was conducted on 12 May 2010. Previous investigations carried out to the south west of the study area, opposite Lot 200 Harris Road, showed some evidence of Potential Acid Sulphate Soils (PASS<sup>1</sup>) in a low lying area. In addition, some evidence of Actual Acid Sulphate Soils (AASS<sup>2</sup>) was observed in the upper soil layers and towards the Ferguson River at Lot 51 Martin Pelusey Rd, located to the south of the study area.

### 1.1 OVERVIEW OF STUDY AREA

The study area, as illustrated in Figure 2, comprises approximately 140 ha of low lying land split into seven lots, the majority of which has been cleared for grazing and industrial purposes. Some small pockets of lightly treed, native vegetation have been retained in slightly elevated areas associated with sandy soils. The surface levels range from 12 to 25 m Australian Height Datum (AHD).

#### 1.1.1 Geology and soils

Geological maps for the study area show the site to be underlain by the Guildford Formation, consisting of clay, silt, sand and gravels, with the Bassendean Sands outcropping in some areas. Both the Pinjarra and Bassendean soil systems dominate the study area (Figure 1 – Department of Agriculture 2003). The Pinjarra P2 phase consists of flat to very gently undulating plains with poor to imperfectly drained, deep alkaline mottled, yellow duplex soil, which generally consist of shallow pale sand to sandy loam over clay (Department of Agriculture 2003). The Bassendean B1a phase consists of extremely low to very low relief dunes, undulating sandplain and discrete sand rises where soils are deep bleached grey sands with an intensely coloured yellow B horizon occurring within 1 m of the surface with marri and jarrah vegetation dominating the system (Department of Agriculture 2003).

---

<sup>1</sup> Potential acid sulphate soils (PASS) are soils or sediments which contain iron sulphides and/or other sulphidic minerals that have not been oxidised or exposed to air (DoE 2006).

<sup>2</sup> Actual acid sulphate soils (AASS) are soils or sediments which contain iron sulphides and/or other sulphidic minerals that have previously undergone some oxidation to produce sulphuric acid (DoE 2006).

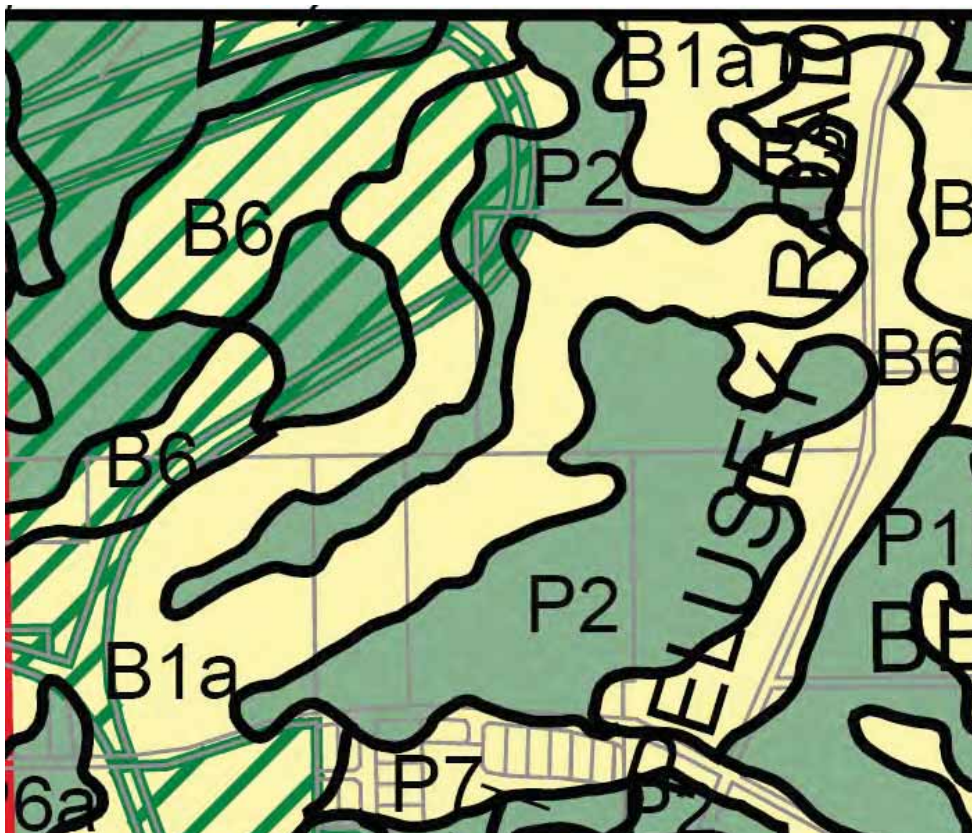


Figure 1 Soil map units within the study area

According to Western Australian Planning Commission (WAPC) Planning Bulletin 64, the site is in an area with a moderate to low risk of AASS and PASS occurring generally at depths greater than 3 m (Appendix 1).

### 1.1.2 Lot descriptions

The study area consists of 7 lots, comprising of:

**Lot 1** – 31.6 ha of low-lying, predominantly cleared land used for horse breeding, with some moderate sized pockets of native vegetation. Part of the Lot appears to be an old sand extraction site and it has a highly modified upper soil layer consisting of predominantly fill material and builder’s rubble.

**Lot 11** – 11.9 ha of low-lying, predominantly cleared land used for horse breeding and training.

**Lot 603** – 39.2 ha consisting of a small, cleared, low-lying area, as well as a large, slightly elevated ridge of remnant native vegetation on sandy soil.

**Lot 103** – 17.1 ha of predominantly cleared, low-lying land with a small pocket of native vegetation to the north-west.

**Lot 2** – 21.2 ha of almost entirely cleared, low-lying land, occupied in part by a shed used for industrial purposes.

**Lot 102** – 6.3 ha of predominantly low-lying land with a slight ridge containing small amounts of vegetation.

**Lot 104** – 8.6 ha of predominantly vegetated, low-lying land with areas containing piles of construction rubble.

## 1.2 SCOPE OF INVESTIGATION

Strategen commissioned South West Chemical Services to undertake the field work component of the Preliminary ASS Assessment of the study area. The intent of the preliminary assessment was to undertake the boring of 10 holes at pre-determined locations on the Lots using a hand auger to the depth of 2.5 m (Figure 2). Bore hole locations were considered representative of the varying elevations, soils and land types within the study area, as well as focussing on areas with a potentially higher risk of ASS. At each of the bored holes, samples were to be collected for analyses at 0.25 m vertical intervals in accordance with the Department of Environment and Conservation (DEC) *Identification and Investigation of acid sulphate soils and acidic landscapes* Guidelines (DEC 2009).

As the study area comprises approximately 140 ha, the Preliminary ASS Assessment does not constitute a full assessment in accordance with DEC Guidelines, but is intended to give an indication as to whether ASS may exist on the site. A full site assessment would entail a total of 280 holes across the full site (i.e. two holes per hectare).



Figure 2 Lot numbers and location of auger holes within the study area

## 2. SOIL SAMPLING

A site visit to undertake the Preliminary ASS investigation was conducted on 12 May 2010. During the initial work it became obvious that it would not be possible to complete 10 sample holes using a hand auger due to the nature of the soils at the study site. A total of six auger holes were sampled to varying depths and soil observations were made (Table 1).

Table 1 Soil observations during hand augering

Hole No.	Lot No.	Observations
8	102	Significant groundwater observed at just less than 1 m below ground level followed by a hard hand auger impenetrable layer at 1 m. The soils generally were light brown or yellow brown of fine to medium grained sands.
9	103	Gave similar results to hole 8 with water observed at 1 m. While no refusal was encountered, the large quantity of groundwater made sample collection at greater than 1.5 m impossible. The soils were generally light brown to grey/brown of fine to medium grained sands to 1 m with clayey sands at lower depths.
5	104	Located near the disused railway line, refusal was experienced at 1 m. No groundwater was encountered but the soil and gravel was damp. The soils were generally brown to yellow /brown sands and gravel.
4	603	Attempted near the maximum elevation of the sand hill that runs across the site roughly from east to west. Samples were collected to a depth of 2.25 m as the dry sand around that depth kept collapsing into the hole and were difficult to retrieve. The soil was very dry yellow sand to the depth of 2.25 m.
2	11	Samples were yielded to a depth of 2.25 m, with groundwater encountered at 1.25 m. Samples could not be collected below 2.25 m as it became increasingly difficult to remove the hand auger. The soils consisted of light brown sand to 0.5 m followed by blue/green/grey sands to 2 m. The sample collected at 2.25 m was grey clay.
1	1	The area appeared to be an old sand extraction site consisting of fill material and builder's rubble. Sampling could not be achieved at 0.25 m due to the presence of coarse builder's rubble. A further sample site was selected but samples could only be achieved to 0.5 m. The sampled soil appeared to be a dark brown sandy top soil.

It was determined that sampling the remaining four auger holes (hole numbers 3, 6, 7 and 10) would not yield sufficiently different results to those already encountered. This was because the location of holes 7 and 10 appeared to be similar in elevation and appearance to the areas sampled at holes 8 and 9, and it was likely that groundwater would be encountered. Similarly the locations of holes 3 and 6 appeared to be similar in elevation and appearance to the areas sampled at holes 4 and 5.

Samples from each of the six auger holes were collected at 0.25 m vertical intervals and immediately placed in sealed bags on ice. The samples were then transported to the SWCS laboratory and were immediately tested for field pH ( $pH_f$ ) and oxidised field pH ( $pH_{fox}$ ). The samples were then dried for 48 hours at 85°C for preservation and storage. The generally negative results from the field test conducted on the six completed holes confirmed the decision not to proceed with further sampling of the remaining four holes.



### 3. SOIL TEST RESULTS

#### 3.1 FIELD TESTING

Details of the field test results are presented in Appendix 2. The field test results were assessed using the following criteria:

- (a)  $\text{pH}_f$  less than 4
- (b)  $\text{pH}_{\text{fox}}$  less than 4 and/or
- (c) the change in pH was greater than 2 (where the resultant  $\text{pH}_{\text{fox}}$  was less than 4) and/or
- (d) there was a strong reaction following addition of hydrogen peroxide.

The key findings from the field test results were:

- of the 36 samples tested, there were no samples where the  $\text{pH}_f$  was 4.0 or less
- of the 36 samples there were two (2) samples where the  $\text{pH}_{\text{fox}}$  was 4 or less
- of the 36 samples there were no samples that gave a change in pH > 2 units with the  $\text{pH}_{\text{fox}} < 4.0$
- 1 sample gave a High reaction with the addition of Hydrogen Peroxide
- 3 samples gave an Extreme reaction with gas evolution and heat with the addition of Hydrogen Peroxide
- There appears to be no indication of the presence of PASS at all levels in the samples processed
- There may be an indication of Actual Acid Sulphate soils in samples collected from hole 2, hole 5 and hole 8.

#### 3.2 DETAILED LABORATORY TESTING AND ASSESSMENT

No full laboratory assessment has been carried out at this stage.

#### 4. CONCLUSIONS

Results of the field tests indicate a potential for AASS, particularly in the vicinity of holes 2 and 8 (Lots 11 and 102). Samples exposed to gas evolution and heat with the addition of hydrogen peroxide produced an extreme reaction in three samples at depths of 1.75 – 2.25 m for hole 2, and a high reaction in one sample at a depth of 0.75 m for hole 8. In addition, potential for AASS may also occur in the vicinity of hole 5 (Lot 104), where two surface samples (0.25 – 0.5 m) experienced a  $\text{pH}_{\text{fox}}$  of 4 or less. However, there appears to be no indication of the presence of PASS at all levels in the samples processed from these holes.

The overall results of the Preliminary ASS Investigation are limited due to the low number of samples collected using a hand auger. This outcome is the result of the soil types encountered within the study area and the presence of groundwater close to the surface in some locations. In the event that any future studies are undertaken, more accurate results at depth may be obtained using equipment such as Geoprobe boring or an excavator.

For a thorough indication of the potential for ASS within the study area, a more detailed investigation that follows full DEC guidelines is recommended for areas where field tests indicated a potential for ASS (in the vicinity of holes 2, 8 and 5), as well as areas of similar soil characteristics that weren't sampled during the site investigation. To obtain a detailed assessment of ASS potential within the entire study area, a full investigation aligning with DEC requirements (i.e. two holes per hectare across the entire site) would need to be undertaken.

## 5. REFERENCES

Department of Agriculture WA (2003), *AgMaps Land Profiler*, Sheet 1 – Shire of Capel, CD-ROM, Government of Western Australia.

Department of Environment and Conservation (January 2009), *DRAFT Treatment and management of soils and water in acid sulphate soil landscapes*, Acid Sulphate Soils Guideline Series, Government of Western Australia.

Department of Environment and Conservation (May 2009), *Identification and Investigation of acid sulphate soils and acidic landscapes*, Acid Sulphate Soils Guideline Series, Government of Western Australia.

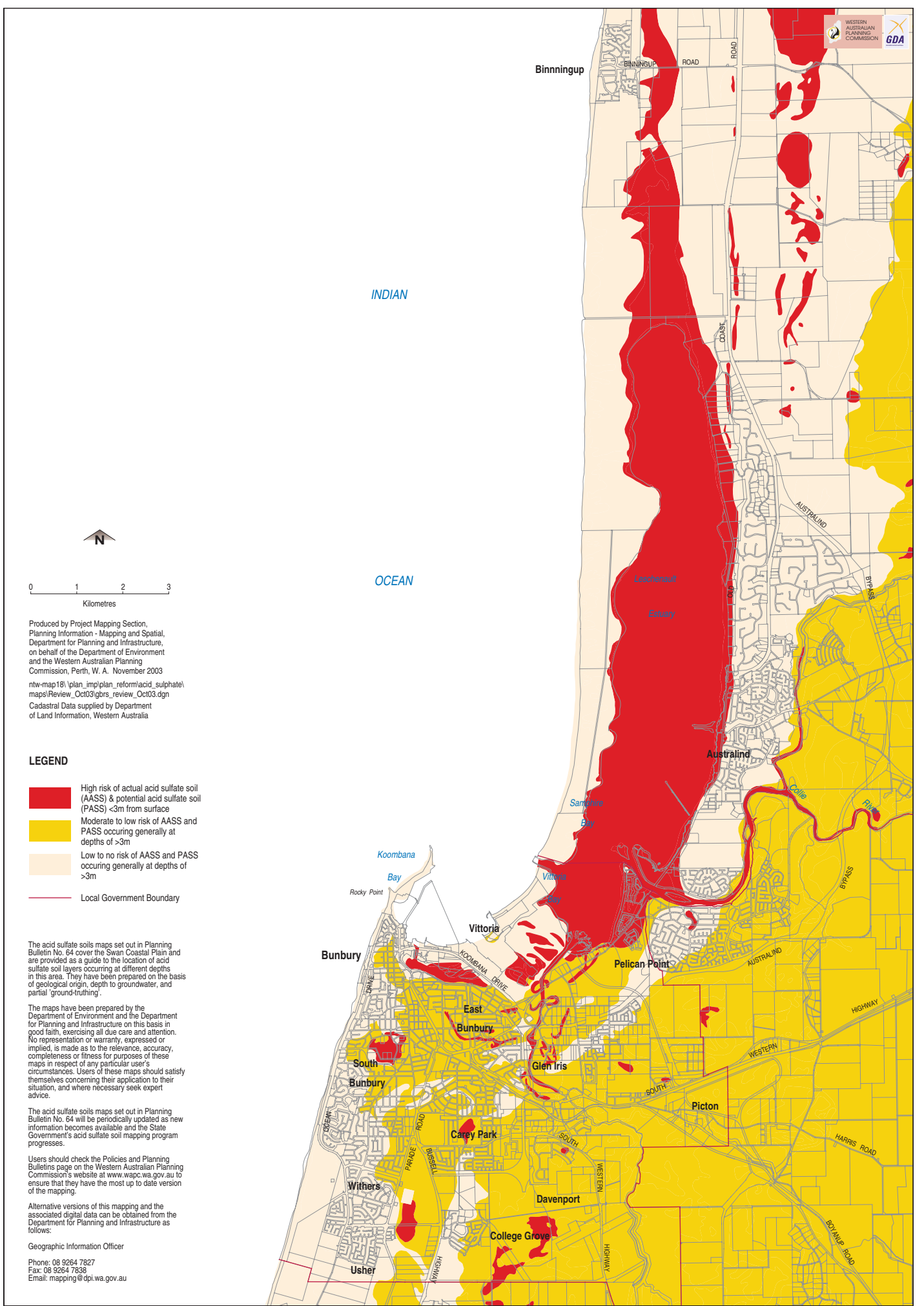
Queensland Department of Natural Resources, Mines and Energy (Qld NRM&E) (June 2004), *Acid Sulphate Soils, Laboratory Methods Guidelines*, Version 2.1 – Joint project of Queensland Acid Sulphate Soils Investigation Team (QASSIT), Southern Cross University (SCU), National Committee for Acid Sulphate Soils (NatCASS), Queensland Acid Sulphate Soils Management Advisory Committee (QASSMAC) and New South Wales Acid Sulphate Soils Management Advisory Committee (ASSMAC).

Western Australian Planning Commission (November 2003), *Acid Sulfate Soils*, Planning Bulletin Number 64, Figure 8: Australind – Bunbury Acid Sulfate Soils, Western Australia.



**Appendix 1  
Planning Bulletin  
Number 64: Australind –  
Bunbury Acid Sulphate  
Soils**





INDIAN

OCEAN



0 1 2 3  
Kilometres

Produced by Project Mapping Section,  
Planning Information - Mapping and Spatial,  
Department for Planning and Infrastructure,  
on behalf of the Department of Environment  
and the Western Australian Planning  
Commission, Perth, W. A. November 2003  
ntw-map18\plan\_imp\plan\_reform\acid\_sulphatel  
maps\Review\_Oct03\gbrs\_review\_Oct03.dgn  
Cadastral Data supplied by Department  
of Land Information, Western Australia

**LEGEND**

- High risk of actual acid sulfate soil (AASS) & potential acid sulfate soil (PASS) <3m from surface
- Moderate to low risk of AASS and PASS occurring generally at depths of >3m
- Low to no risk of AASS and PASS occurring generally at depths of >3m
- Local Government Boundary

The acid sulfate soils maps set out in Planning Bulletin No. 64 cover the Swan Coastal Plain and are provided as a guide to the location of acid sulfate soil layers occurring at different depths in this area. They have been prepared on the basis of geological origin, depth to groundwater, and partial ground-truthing.

The maps have been prepared by the Department of Environment and the Department for Planning and Infrastructure on this basis in good faith, exercising all due care and attention. No representation or warranty, expressed or implied, is made as to the relevance, accuracy, completeness or fitness for purposes of these maps in respect of any particular user's circumstances. Users of these maps should satisfy themselves concerning their application to their situation, and where necessary seek expert advice.

The acid sulfate soils maps set out in Planning Bulletin No. 64 will be periodically updated as new information becomes available and the State Government's acid sulfate soil mapping program progresses.

Users should check the Policies and Planning Bulletins page on the Western Australian Planning Commission's website at [www.wapc.wa.gov.au](http://www.wapc.wa.gov.au) to ensure that they have the most up to date version of the mapping.

Alternative versions of this mapping and the associated digital data can be obtained from the Department for Planning and Infrastructure as follows:

Geographic Information Officer  
Phone: 08 9264 7827  
Fax: 08 9264 7838  
Email: [mapping@dpi.wa.gov.au](mailto:mapping@dpi.wa.gov.au)

Figure 8: Australind - Bunbury Acid Sulfate Soils





**Appendix 2  
South West Chemical  
Services – Field Test  
Results**



## Certificate of Analysis

Client Name:	Strategen Attn: Roger Banks		
Address:	PO Box 287, Bunbury, WA 6231		
Phone No:	9792 4797	Fax:	9792 4708
Lab No:	4918	Email:	r.banks@strategen.com.au
Date samples received:	12/05/10	Report date:	14/05/10

**Sample details:** 36 Soil samples collected David Dodds and Zac Cockerill from 6 bore holes drilled using a hand auger at a site near the corner Harris Rd and Martin Pelusey Rd Dardanup, WA  
The site is in an area of Moderate to Low risk of ASS occurring within 3 m of the natural soil surface.  
Hole 1 Location GPS coordinates 50H 0382014 6309818 depth to 0.5 m  
Hole 2 Location GPS coordinates 50H 0381617 6309801 depth to 2.25 m  
Hole 4 Location GPS coordinates 50H 0381856 6309461 depth to 2.25 m  
Hole 5 Location GPS coordinates 50H 0381146 6309216 depth to 1.0 m  
Hole 8 Location GPS coordinates 50H 0381353 6308671 depth to 1.5 m  
Hole 9 Location GPS coordinates 50H 0381580 6308647 depth to 1.5 m  
Samples were immediately placed on ice and transferred to refrigerated storage.  
A portion of the sample was removed for Field pH ( $pH_f$ ) and oxidised Field pH ( $pH_{fox}$ ), the remainder has been preserved by drying for 48 hours at 85°C

**Scope of Work:** Acid Sulphate Soils Field Tests  $pH_f$ ,  $pH_{FOX}$ , Reaction rating, Fizz test  
Preservation of retained samples, Interpretation of results.

**Test Methods:** Acid Sulphate Soils Laboratory Methods Guidelines Version 2.1 Section H:Field Tests June 2004, Queensland Government, Natural Resources, Mines and Energy.  
Draft Identification & Investigation of Acid Sulphate Soils, prepared by Land & Water Quality Branch, DoE, WA May 2006  
 $pH$  tested using Eutech WP pHScan BNC with Ionode Intermediate Junction  $pH$  combination electrode IJ48F calibrated according to manufacturer's instructions.

### Test Results:

The field test results were assessed using the following criteria

- $pH_f$  less than 4
- $pH_{fox}$  less than 4 and /or
- the change in  $pH$  was greater than 2 (where the resultant  $pH_{fox}$  was less than 4) and/or
- there was a strong reaction following addition of hydrogen peroxide

Results meeting these criteria have been highlighted.

Of the 36 samples tested, there were no samples where the  $pH_f$  was 4.0 or less

Of the 36 samples there were 2 sample where the  $pH_{fox}$  was 4 or less

Of the 36 samples there were no samples that gave a change in  $pH > 2$  units with the  $pH_{fox} < 4.0$

1 sample gave a High reaction with the addition of Hydrogen Peroxide, 3 samples gave an Extreme reaction with gas evolution and heat with the addition of Hydrogen Peroxide.

*'Actual acid sulphate soils (AASS) are soils or sediments which contain iron sulphides and/or other sulphidic minerals that have previously undergone some oxidation to produce sulphuric acid.'* (DoE 2006)

*'Potential acid sulphate soils (PASS) are soils or sediments which contain iron sulphides and/or other sulphidic minerals that have not been oxidised or exposed to air.'* (DoE 2006)

There appears to be a no indication of the presence Potential Acid Sulphate soils at all levels in the samples processed.

There may be an indication of Actual Acid Sulphate soils in the samples collected from Hole 2 at 250 mm depth, Hole 5 at 250 mm and 500 mm depth.

All samples are being dried at 85°C for 48 hours.

If you have any further questions relating to this report and its interpretation please telephone South West Chemical Services on 08 9721 7170

David Dodds

Dip.App.Chem. A.G.Inst.Tech

Lab No: 4918  
 Hole No: Bore Hole 1  
 Hole Depth: 0.50 metre

Date Sampled: 12/05/10  
 Location: 0382014E  
 6309818N

Hole ID	Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
1	0.25	fine dark brown sandy top soil	7.45	5.85	1.60	L	N
	0.50	orange brown fine to med grained sand	7.95	6.15	1.80	M	XX

Reaction Rating N = none L = low M = medium H = high X = extreme V = volcanic  
 N - no visible or audible reaction, X - slight reaction, XX - moderate reaction, XXX - high reaction, XXXX - vigorous reaction, gas evolution, heat generation

Lab No: 4918  
 Hole No: Bore Hole 2  
 Hole Depth: 2.25 metre

Date Sampled: 12/05/10  
 Location: 0381617E  
 6309801N

Hole ID	Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
				pH <sub>H2O2</sub> =4.95			
2	0.25	light brown fine to medium grained sand	4.95	4.40	0.55	L	N
	0.50	light brown fine to medium grained sand	5.85	4.90	0.95	L	N
	0.75	blue/grey/green and brown sand - damp	6.75	5.05	1.70	N	N
	1.00	blue/grey/green and brown sand + gravel - damp	6.75	4.75	2.00	N	N
	1.25	blue/grey/green sand - wet	6.95	6.05	0.90	L	N
	1.50	blue/green/yellow sand - wet	7.55	6.80	0.75	L	N
	1.75	blue/green/grey sand - wet	7.65	7.95	-0.30	X	N
	2.00	blue/green/grey sand - wet	7.65	7.90	-0.25	X	N
	2.25	grey clay	6.90	7.50	-0.60	X	N

Reaction Rating N = none L = low M = medium H = high X = extreme V = volcanic

N - no visible or audible reaction, X - slight reaction, XX - moderate reaction, XXX - high reaction, XXXX - Vigorous reaction, gas evolution, heat generation

Lab No: 4918  
 Hole No: Bore Hole 4  
 Hole Depth: 2.25 metre

Date Sampled: 12/05/10  
 Location: 0381856E  
 6309461N

Hole ID	Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
4	0.25	brown/yellow fine sand	7.00	5.40	1.60	L	N
	0.50	yellow fine to med grained sand	7.20	5.35	1.85	L	N
	0.75	yellow fine to med grained sand	7.30	5.30	2.00	L	N
	1.00	yellow fine to med grained sand	7.25	5.25	2.00	L	N
	1.25	yellow fine to med grained sand	7.20	5.30	1.90	N	N
	1.50	yellow fine to med grained sand	7.30	5.25	2.05	L	N
	1.75	yellow fine to med grained sand	7.40	5.25	2.15	L	N
	2.00	yellow fine to med grained sand	7.35	5.25	2.10	L	N
	2.25	yellow fine to med grained sand	7.40	5.25	2.15	L	N

Reaction Rating N = none L = low M = medium H = high X = extreme V = volcanic  
 N - no visible or audible reaction, X - slight reaction, XX - moderate reaction, XXX - high reaction, XXXX - Vigorous reaction, gas evolution, heat generation

Lab No: 4918  
 Hole No: Bore Hole 5  
 Hole Depth: 1.00 metre

Date Sampled: 12/05/10  
 Location: 0381146E  
 6309216N

Hole ID	Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
5	0.25	dark brown silty sand	4.60	pH <sub>H2O2</sub> =4.95 4.00	0.60	L	N
	0.50	brown fine to med grained sand + gravel	4.95	3.90	1.05	N	N
	0.75	yellow/brown fine to med grained sand + gravel - damp	5.95	5.05	0.90	L	N
	1.00	yellow/brown fine to med grained sand + gravel - damp	6.30	5.15	1.15	N	N

Reaction Rating N = none L = low M = medium H = high X = extreme V = volcanic  
 N - no visible or audible reaction, X - slight reaction, XX - moderate reaction, XXX - high reaction, XXXX - Vigorous reaction, gas evolution, heat generation



Lab No: 4918  
 Hole No: Bore Hole 8  
 Hole Depth: 1.50 metre

Date Sampled: 12/05/10  
 Location: 0381353E  
 6308671N

Hole ID	Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
8	0.25	light brown fine – medium grained sand	5.70	4.25	1.45	L	N
	0.50	light brown fine to medium grained sand	6.55	5.50	1.05	N	N
	0.75	light brown/yellow fine to medium grained sand - damp	7.10	6.60	0.50	H	N
	1.00	brown/yellow fine – medium grained clayey sand - wet	7.40	6.95	0.45	M	N
	1.25	brown/yellow fine – medium grained clayey sand - wet	7.40	6.35	1.05	L	N
	1.50	brown/yellow/grey sand - wet	7.20	6.30	0.90	L	N

Reaction Rating N = none L = low M = medium H = high X = extreme V = volcanic

N - no visible or audible reaction, X – slight reaction, XX – moderate reaction, XXX – high reaction, XXXX – Vigorous reaction, gas evolution, heat generation

Lab No: 4918  
 Hole No: Bore Hole 9  
 Hole Depth: 1.50 metre

Date Sampled: 12/05/10  
 Location: 0381580E  
 6308647N

Hole ID	Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
9	0.25	light brown/grey fine – medium grained sand	6.20	4.75	1.75	N	N
	0.50	grey/brown fine to medium grained sand	7.00	5.30	1.70	L	N
	0.75	brown fine to medium grained sand - damp	6.95	5.50	1.45	L	N
	1.00	grey/brown fine – medium grained sand - damp	6.65	5.35	1.30	N	N
	1.25	orange/brown fine – medium grained clayey sand - wet	5.70	4.50	1.20	L	X
	1.50	grey clayey sand - wet	6.50	4.75	1.75	L	N

Reaction Rating N = none L = low M = medium H = high X = extreme V = volcanic

N - no visible or audible reaction, X – slight reaction, XX – moderate reaction, XXX – high reaction, XXXX – Vigorous reaction, gas evolution, heat generation

# Appendix C

Flora, vegetation and fauna assessment methodology (Emerge Associates 2020)





## TECHNICAL MEMORANDUM

### Flora, Vegetation and Fauna Assessment Methodology

<b>PROJECT NUMBER</b>	EP12-039(03)	<b>DOC. NUMBER</b>	EP12-039(03)—017b KK
<b>PROJECT</b>	Local Structure Plan Lots 103, 110 and 436, Picton East	<b>CLIENT</b>	Harris Road Pty Ltd
<b>AUTHOR</b>	KK	<b>REVIEWER</b>	KK
<b>VERSION</b>	B	<b>DATE</b>	January 2021

## 1 OVERVIEW

This technical memorandum has been prepared to document the assessment of environmental values (particularly with regard to conservation significant flora, vegetation and fauna values) that has informed the preparation of the Local Structure Plan (LSP) for Lot 103, 110 and 436 Picton East (herein referred to as ‘the site’).

## 2 INFORMATION USED TO ASSESS VALUES

As part of determining the environmental values relevant to the site, Emerge Associates have considered a range of investigations undertaken for the site and surrounds, and also completed a reconnaissance site visit in November 2019 to understand whether the observed values reflected the documented environmental values and determine if additional investigations were required to support the LSP. This review and site visit were particularly relevant given that a number of new conservation significant values (such as ‘*Banksia woodlands of the Swan Coastal Plain*’ threatened ecological community (TEC) and ‘*tuart woodland and forest of the Swan Coastal Plain*’ TEC) have been identified since some of the investigations were completed.

This is discussed in the following sections.

### 2.1 Review of existing information

Over the last 10 to 15 years, a number of investigations have been undertaken specific to the site, but also the broader Preston Industrial Area (which the site forms part of) that have considered the flora, vegetation and fauna values that may require protection and/or management as part of the industrial development within the region. These investigations and the associated outcomes were reviewed in detail as part of undertaking the environmental assessment for the site and include:

- *Advice on areas of conservation significance in the Preston Industrial Park* (EPA 2008)
- *Report on a Level 1 flora and vegetation survey at various lots at Picton East* (Ekologica Pty Ltd 2009)
- *Terrestrial Fauna Survey (Level 1) of Lots 1, 2, 11, 102-104 and 603 Picton (East)* (Harewood 2009)
- *Shire of Dardanup Local Biodiversity Strategy Discussion Paper (draft)* (Ironbark Environmental & Eco Logical Australia 2009)
- *Report for Preston South, Eastern Precinct – Environmental Assessment for Potential Land Development* (GHD 2011)
- *Picton Industrial Park Southern Precinct District Structure Plan* (DPLH 2018)

# Flora, Vegetation and Fauna Assessment Methodology

Local Structure Plan Lots 103, 110 and 436, Picton East



In addition to the above, recent environmental investigations associated with the assessment of the Bunbury Outer Ring Road pursuant to the state *Environmental Protection Act 1986* and federal *Environment Protection and Biodiversity Conservation Act 1999* (released in 2019) were reviewed for context and information on conservation significant environmental values that may be relevant for the site.

## 2.2 Review of federal and state databases

To determine if current conservation significant values relevant to the site and surrounds had been considered as part of the existing detailed investigations, a review of the following datasets was undertaken:

- *Weed and native flora dataset* (Keighery *et al.* 2012)
- *Protected Matters Search Tool* (Department of Environment and Energy (DoEE) 2018)
- Threatened and priority ecological community lists (Department of Biodiversity Conservation Attraction (DBCA) 2018 and 2019a)
- *NatureMap* (DBCA 2019b).

This review identified that a number of conservation significant values (particularly threatened ecological communities (TECs) may not have been considered as part of the previous investigations, and therefore further work may be required. These values included:

- Banksia woodland of the Swan Coastal Plain TEC
- Tuart woodland and forest of the Swan Coastal Plain TEC
- Subtropical and temperate coastal saltmarsh TEC. This TEC is not relevant to the site as suitable habitat is not present.

## 2.3 Site assessment

In order to understand if the vegetation values within the site had changed compared to those previously assessed (particularly as part of the flora and vegetation survey (Ekologica Pty Ltd 2009)) and/or if values not previously considered conservation significant (and therefore would not have been assessed) were present within the site, an environmental scientist from Emerge Associates completed a reconnaissance site visit in November 2019.

The purpose of this site assessment was to confirm the findings of the previous survey(s) and understand if any additional flora, vegetation or fauna values may be relevant (based on the characteristics observed and outcomes of the database searches) and if additional investigations would be required to support preparation of the LSP.

The site visit included a detailed walkover of the site observing vegetation present, and searching for characteristics that may indicate the:

- Vegetation condition had changed compared to the Ecological Pty Ltd (2009) survey. Vegetation condition is a good indicator of level of disturbance, and where areas are highly disturbed, conservation significant flora values are typically less likely to occur.
- Presence of any *Banksia* sp., as if *Banksia* sp. were present this would indicate that the *Banksia woodlands of the Swan Coastal Plain* TEC may be present

# Flora, Vegetation and Fauna Assessment Methodology

Local Structure Plan Lots 103, 110 and 436, Picton East



- Presence of *Eucalyptus gomphocephala* (Tuart) individuals, as if tuart were present this would indicate that the *Tuart woodlands and forest of the Swan Coastal Plain* TEC may be present.

### 3 OUTCOMES OF REVIEW AND SITE VISIT

The outcomes of the database review indicated that additional conservation significant values pursuant to the federal EPBC Act and state *Biodiversity Conservation Act 2016* (BC Act) had the potential to occur in the site and that these were not assessed as part of the previous site-specific flora and vegetation survey (Ekologica Pty Ltd 2009). No new fauna species were identified compared to those previously considered as part of the fauna survey (Harewood 2009).

However, the site assessment indicated that no additional conservation significant values were likely to occur within the site and that the vegetation values had not changed compared to the flora and vegetation survey (Ekologica Pty Ltd 2009). In particular:

- Vegetation condition did not appear to have changed compared to the outcomes of the flora and vegetation survey (Ekologica Pty Ltd 2009). The vegetation within the site was composed of overstorey species over paddock grasses. No understorey species were observed.
- No *Banksia* sp. were present within the site. Accordingly, the *Banksia woodlands of the Swan Coastal Plain* TEC is unlikely to be present.
- No tuart trees were present within the site. Accordingly, the *Tuart woodlands and forest of the Swan Coastal Plain* TEC is unlikely to be present.
- No new conservation significant fauna species were identified compared to those previously assessed.

On this basis, the environmental values relevant to the LSP (and assessment for the Environmental Assessment and Management Strategy (EAMS)) have been considered based on a review of current databases and the outcomes of the previous environmental investigations and recent reconnaissance site assessment undertaken by Emerge Associates (2019).

Additional investigations may be required to support a detailed consideration of potential obligations pursuant to the federal EPBC Act, and in particular potential impacts on habitat for the three black cockatoo species and western ringtail possum. This will be addressed prior to physical disturbance of remnant vegetation within the site, but is not required to support preparation of the LSP.

# Flora, Vegetation and Fauna Assessment Methodology

Local Structure Plan Lots 103, 110 and 436, Picton East



## 4 REFERENCES

### 4.1 General references

Department of Biodiversity, Conservation and Attractions (DBCA) 2018, *List of Threatened Ecological Communities endorsed by the Western Australian Minister for Environment*, 28 June 2018

Department of Biodiversity, Conservation and Attractions (DBCA) 2019a, *Priority Ecological Communities for Western Australia Version 28*, 17 January 2019

Department of Planning, Lands and Heritage, (DPLH) 2018, *Picton Industrial Park Southern Precinct - Districts Structure Plan*, Perth.

Ekologica Pty Ltd 2009, *Report on a Level 1 flora and vegetation survey of various lots at Picton East*.

Environmental Protection Authority (EPA) 2008, *Advice on areas of conservation significance in the Preston Industrial Park: Advice of the Environmental Protection Authority to the Minister for the Environment under Section 16(e) of the Environmental Protection Act 1986*, EPA, Perth

GHD 2011, *Report for Preston South, Eastern Precinct - Environmental Assessment for Potential Land Development*.

Harewood, G. 2009, *Terrestrial Fauna Survey (Level 1) of Lots 1, 2, 11, 102-104 and 603 Picton (East)*, 1.

Ironbark Environmental & Eco Logical Australia 2009, *Shire of Dardanup Local Biodiversity Discussion Paper (draft)*.

Keighery, B. J., Keighery, G. J., Longman, V. M. and Clarke, K. A. 2012, *Weed and Native Flora Data for the Swan Coastal Plain*, Departments of Environmental Protection and Conservation and Land Management, Western Australia.

Molloy, S., Wood, J., Hall, S., Wallrodt, S. and Whisson, G. 2009, *South West Regional Ecological Linkages Technical Report*, Western Australian Local Government Association and Department of Environment and Conservation, Perth.

### 4.2 Online references

Department of Biodiversity, Conservation and Attractions (DBCA) 2019b, *NatureMap*, viewed November 2019, <<https://naturemap.dbca.wa.gov.au/>>.

Department of Environment and Energy (DoEE) 2019, *Protected Matters Search Tool*, viewed November 2019, <<https://www.environment.gov.au/epbc/protected-matters-search-tool>>.



# Appendix D

Level 1 flora and vegetation survey (Ekologica Pty Ltd 2009)







Date: 22<sup>nd</sup> December 2009

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Report on a Level 1 flora  
and vegetation survey of  
various lots at Picton East

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Prepared for *Strategen*

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*By Russell Smith, Ekologica Pty Ltd*  
PO Box 207 Bunbury, WA, 6231

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## SUMMARY

A Level 1 flora survey (EPA, 2004) was carried out in October 2009 on approximately 33 ha of remnant vegetation in an area comprised of 7 lots (Lots 1, 2, 11, 103, 603, 102 and 104), totaling about 135 ha, in the proposed Picton East industrial park near Bunbury.

A total of 46 species of native flora was found within the remnant vegetation of the Study area, which is a very low number reflecting the long history of agriculture in the area. No Declared Rare or Priority List flora, or other flora of conservation significance was found. The remnant vegetation of the Study Area was mapped as four units, one of these consisting predominantly of planted species. The vegetation units were similar to units previously derived for the Study Area.

Vegetation condition was predominantly "Completely Degraded" (79%) with 9% (3 ha) in "Degraded" condition and only 12% (4 ha) in "Good" condition.

The remnant vegetation within the Study area has been classified as 1b or 1c by the South West Ecological Linkages project, which reflect the level of its proximity to a regional linkage axis line. The nearest edge of vegetation classed as 1b is up to 100 m from vegetation that touches or is less than 100 m from the axis line, and that classed as 1c is up to 100 m from vegetation classed as 1b.

## INTRODUCTION

### 1.1. *Background*

A Level 1 Flora Survey<sup>1</sup> was conducted on an area of land, comprised of 7 lots (Lots 1, 2, 11, 103, 603, 102 and 104), totaling about 135 ha, of which about 33 ha consists of remnant vegetation in the proposed Picton East industrial park. The survey was carried out between 19<sup>th</sup> and X October 2009. The Study Area is within the area identified by the Western Australian Planning Commission (WAPC) for the future development of the Preston Industrial Park (Environmental Protection Authority, 2008).

### 1.2. *Regional Setting and Soils*

The study area lies 9 km ESE of the Bunbury CBD adjacent to the South West Highway. It lies near the junction of the Pinjarra and Bassendean soil landscape zones (Schoknecht *et al*, 2004). To the east lie the relatively fertile soils of the Pinjarra Plain System and to the west the leached, infertile soils of the Bassendean Dune System (Seddon, 1972, Bolland, 1998).



Figure 1. The Study Area in relation to the city of Bunbury.

<sup>1</sup> EPA (2004). Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia. Guidance for the Assessment of Environmental Factors, No. 51. Environmental Protection Authority of Western Australia.

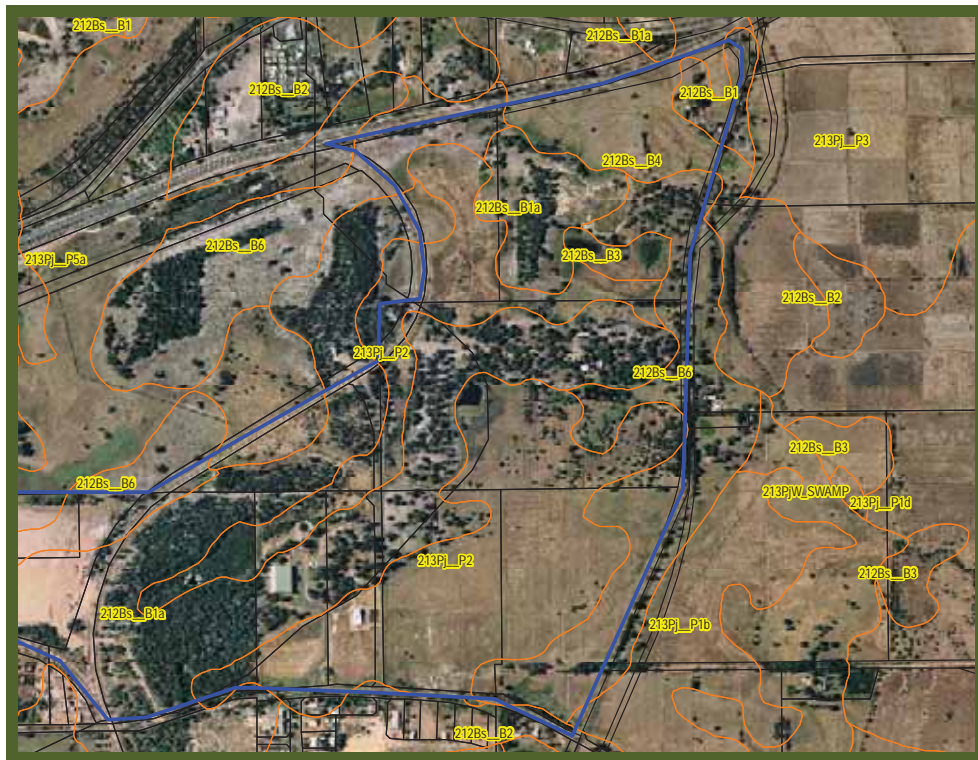


Figure 2. The soil mapping units of the Study Area.

Within the Study Area the soils are a mixture of Bassendean Dune and Pinjarra Plain soils (Fig. 2) with Bassendean soils generally occupying the low sandy ridges and the Pinjarra soils being found in the shallow depressions, or swales. The soil mapping units found within the Study Area are described in Table 1. Most of the remnant vegetation remaining within the Study Area is situated on the Bassendean soils, with the more fertile Pinjarra soils having been long ago cleared for agriculture.

### 1.3. *Vegetation and Threatened Ecological Communities*

#### 1.3.1. **Vegetation of the Study Area**

The vegetation and flora of the Study Area has been investigated as part of a number of studies done as part of those carried out for the Preston Industrial Park (see references in EPA, 2008). Vegetation mapping by Smith (1974) at 1:250,000 scale shows the vegetation of the Study Area as: "Medium woodland; jarrah, marri & wandoo" occurring in the Pinjarra vegetation system of Beard (1981) and "Mosaic: Medium forest; jarrah-marri / Low woodland; *Banksia* / Low forest; teatree (*Melaleuca* spp.)" for the Bassendean System (corresponding with the Pinjarra Plain and Bassendean Dune soils respectively). Heddl *et al.* (1980) mapped the vegetation complexes of the System 6 area, which includes the Study Area. Two of these occur within the Study Area, these being:

Southern River Vegetation Complex: Open woodland of *E. calophylla* - *E. marginata* - *Banksia* species with fringing woodland of *E. rudis* - *M. raphiophylla* along creek beds.

Guildford Vegetation Complex: A mixture of open forest to tall open forest of *Corymbia calophylla* – *Eucalyptus wandoo* – *Eucalyptus marginata* and woodland of *Eucalyptus wandoo*. Minor components include *Eucalyptus rudis* – *Melaleuca raphiophylla*

Perth Bioplan mapping (unpublished) and Connell, Wagner and Ecoscape (2007) mapping of the vegetation within the Preston Industrial Park cited by EPA (2008) has not been sighted for this study.

Soil Mapping Unit	Mapping Unit Name	Description
Pj__P2	Pinjarra P2 phase	Flat to very gently undulating plain with deep alkaline mottled yellow duplex soils which generally consist of shallow pale sand to sandy loam over clay.
Bs__B1	Bassendean B1 phase	Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2 m.
Bs__B1a	Bassendean B1a phase	Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands with an intensely coloured yellow B horizon occurring within 1 m of the surface.
Bs__B3	Bassendean B3 phase	Closed depressions and poorly defined stream channels with moderately deep, poorly to very poorly drained bleached sands with an iron-organic pan, or clay subsoil. Surfaces are dark grey sand or sandy loam.
Bs__B4	Bassendean B4 phase	Broad poorly drained sandplain with deep grey siliceous sands or bleached sands, underlain at depths generally greater than 1.5 m by clay or less frequently a strong iron-organic hardpan.
Bs__B6	Bassendean B6 phase	Sandplain and broad extremely low rises with imperfectly drained deep or very deep grey siliceous sands.

Table 1. The soil mapping units found within the Study Area (From Barnesby, B.A. and Proulx-Nixon, M.E., 2000).

### 1.3.2. Threatened Ecological Communities

An ecological community is a naturally occurring biological assemblage that occurs in a particular type of habitat. The scale at which ecological communities are defined will often depend on the level of detail in the information source, therefore no particular scale is specified (DEC, 2007a).



A threatened ecological community (TEC) is one which is found to fit into one of the following categories; “presumed totally destroyed”, “critically endangered”, “endangered” or “vulnerable”.

Possible threatened ecological communities that do not meet survey criteria are added to DEC’s Priority Ecological Community Lists under Priorities 1, 2 and 3. Ecological Communities that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. The threatened ecological communities of the Swan Coastal Plain mainly derive from the survey of Gibson *et al.* (1994).

There are several Threatened (TECs) known to occur within a 10 km radius of the study area. These are listed in Table 2.

Soil-landscape system	Threatened Ecological Community Type and Name (from Gibson <i>et al.</i> , 1994)	Status <sup>2</sup>
Pinjarra	SCP3c “ <i>Corymbia calophylla</i> - <i>Xanthorrhoea preissii</i> woodlands and shrublands, Swan Coastal Plain”	CR
Pinjarra	SCP08 “Herb rich shrublands in clay pans, Swan Coastal Plain”	VU
Pinjarra/Bassendean	SCP09 “Dense shrublands on clay flats, Swan Coastal Plain”	VU
Spearwood	SCP019 Shrublands on calcareous silts of the Swan Coastal Plain	CR*

Table 2. Threatened Ecological Communities occurring within 10 km of the Study Area at Picton East. (\*: recommended to be upgraded from “VU”).

Priority Ecological Communities that occur within 10 km of the Study area include “Low lying *Banksia attenuata* woodlands or shrublands” (‘floristic community type SCP21c’) and “Southern *Banksia attenuata* woodlands (‘floristic community type SCP21b’)", both of which are classified as Priority 3.

No Threatened Ecological Communities are known to occur within the Preston Industrial Park Area (which includes the Study Area) (EPA, 2008). However, the EPA report did acknowledge that vegetation is considered to be of regional significance at vegetation complex level. Of the four vegetation complexes within the Preston Industrial Park, the Guildford vegetation complex (Hedde *et al.*, 1980) is considered of highest conservation significance because it falls below the 10% target for retention.

Vegetation of the Southern River Complex, which is characterized by being in the transition between the Pinjarra Plain and the Bassendean Dunes, and which supports communities associated with the Bassendean Dunes but contains pockets of alluvial and colluvial soils which support plant communities characteristic of the Pinjarra Plain is also below the EPA’s target

<sup>2</sup> VU = “Vulnerable”, EN = “Endangered”, CR = “Critically endangered”.

level of native vegetation retention of at least 30% of the pre-clearing extent of the ecological communities on the Swan Coastal Plain.

### ***1.3.3. Declared Rare and Priority Flora***

Species of flora and fauna are defined as Declared Rare or Priority conservation status where their populations are restricted geographically or threatened by local processes. The Department of Environment and Conservation recognizes these threats of extinction and consequently applies regulations towards population and species protection. Declared Rare Flora species are gazetted under subsection 2 of section 23F of the Wildlife Conservation Act (1950) and therefore it is an offence to “take” or damage rare flora without Ministerial approval. Section 23F of the Wildlife Conservation Act (1950-1980) defines “to take” as “... to gather, pick, cut, pull up, destroy, dig up, remove or injure the flora or to cause or permit the same to be done by any means.

Priority Flora are under consideration for declaration as ‘rare flora’, but are in urgent need of further survey (Priority One to Three) or require monitoring every 5-10 years (Priority Four). Table 3 presents the definitions of Declared Rare and the four Priority ratings under the Wildlife Conservation Act (1950) as extracted from Atkins (2008) and Department of Environment and Conservation (DEC 2009b, 2009c). Threatened or Priority flora occurring within 10 km of the Study Area are listed in Table 4.

## **2. OBJECTIVES**

The objectives of the flora and vegetation survey for the study area were to:

- conduct an assessment of flora and vegetation values within the study area, building on existing studies in the adjacent area;
- conduct a review of other literature to summarize the values of flora and vegetation significance in the project area;
- review the documented flora and vegetation of significance, based on DEC records (databases);
- conduct a field assessment to:
  - identify the vascular flora species present;
  - determine the presence or absence of Declared Rare Flora (DRF), Priority or Significant Species;
  - define and spatially map vegetation communities;
  - define and spatially map vegetation condition;
- prepare a report that summarizes the findings of the desktop and field assessments

Conservation Code	Category
R	"Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection and have been gazetted as such."
P1	"Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey."
P2	Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey."
P3	"Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (ie. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora', but are in need of further survey."
P4	"Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years."

Table 3. Definitions of declared rare and priority list flora

Species	Priority
<i>Acacia flagelliformis</i>	4
<i>Anthotium junciforme</i>	4
<i>Aponogeton hexatepalus</i>	4
<i>Caladenia speciosa</i>	4
<i>Carex tereticaulis</i>	1
<i>Chamaescilla gibsonii</i>	3
<i>Diuris drummondii</i>	DRF
<i>Lasiopetalum membranaceum</i>	3
<i>Pultenaea skinneri</i>	4
<i>Rhodanthe pyrethrum</i>	3
<i>Schoenus capillifolius</i>	3
<i>Trichocline</i> sp. Treeton (B.J. Keighery & N. Gibson 564)	2
<i>Verticordia attenuata</i>	3
<i>Villarsia submersa</i>	4

Table 4. Declared rare and Priority List flora occurring with the Preston Industrial Park (EPA, 2008) or known to occur with 5 km of the Study Area (DEC, 2009b)

### 3. METHODS

The areas of remnant vegetation within the Study Area were traversed on foot on 19<sup>th</sup> and 20<sup>th</sup> October 2009. At representative locations a listing of all native vascular flora was made within an approximately 20 m radius. Notes were also taken of surface soil type, and vegetation condition using the method of Keighery (1994) (Table 5).

SCORE	DESCRIPTION
<b>Pristine (1)</b>	Pristine or nearly so, no obvious signs of disturbance.
<b>Excellent (2)</b>	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
<b>Very Good (3)</b>	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
<b>Good (4)</b>	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
<b>Degraded (5)</b>	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
<b>Completely Degraded (6)</b>	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as "parkland cleared" with the flora comprising weed or crop species with isolated native trees or shrubs.

Table 5. The native vegetation condition rating scale of Keighery (1994).

### 4. RESULTS AND DISCUSSION

#### 4.1. Flora

Only 44 species of native flora were recorded from within the Study Area (Appendix A). Non-native species were generally not recorded, these having been comprehensively covered in previous surveys within the Preston Industrial Park Area (see references in EPA, 2008). This number of native species is far lower than would be expected in 33 ha of the original vegetation. No Declared Rare or Priority List flora, or other flora of conservation significance was found.

## 4.2. Vegetation units

Four vegetation units were identified within the Study Area (Table 6; Figure 3; Appendix B), however one of these, Vegetation Unit 4, is predominantly comprised of planted non-local species. There was sufficient variation in the other vegetation units to suggest that originally others may have been identifiable, however, loss of species has simplified the composition to the extent that only three are now recognizable. This accords with the survey carried out by the DEC (2007) and reported in EPA (2008), which identified three vegetation units within Investigation Area 6 (contained within the present Study Area). While they are described somewhat differently, the DEC (2007) vegetation units correspond closely with vegetation Units identified by this survey.

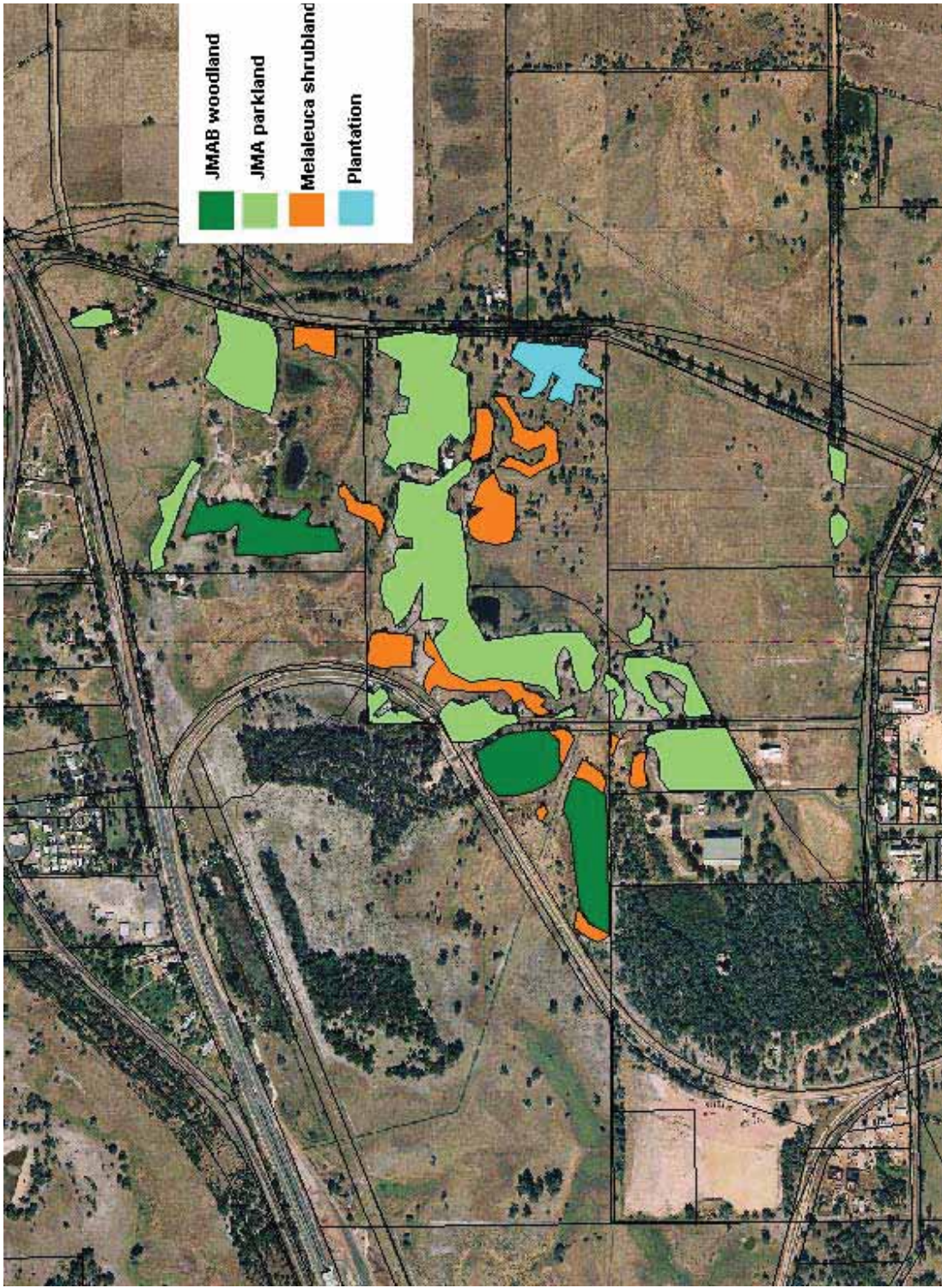
Species occurring within each of the vegetation Units are listed in Appendix 1. It is difficult because of their present paucity of native species to reliably assign the vegetation units identified in this study to the floristic community types described by Gibson *et al.* (1994) in the "Floristic Survey of the Swan Coastal Plain", except for Vegetation Unit 1, which probably belongs to the "Central *Banksia attenuata-Eucalyptus marginata* woodlands" (SCP 21a) floristic community type. None of the vegetation units corresponds with any Threatened or Priority Ecological Community.

As can be seen from Table 6 Vegetation Units 1 and 2 occur within areas mapped as "Southern River complex" by Heddle *et al.* (1980) and Vegetation Unit 2 within areas mapped as "Southern River Complex" or "Guildford Complex".

Unit Number	Vegetation Unit	Description	Vegetation Complex (Heddle <i>et al.</i> , 1980)
1	JMAB woodland	Woodland of Jarrah and Marri over low woodland of <i>Agonis flexuosa</i> , <i>Banksia attenuata</i> and <i>Banksia ilicifolia</i> woodland over shrubland	Southern River
2	<i>Melaleuca</i> woodland/ shrubland	Woodland or tall shrubland of <i>Melaleuca raphiophylla</i> or <i>M. preissiana</i> over a shrubland of <i>M. lateritia</i> and/or <i>M. teretifolia</i>	Southern River/Guildford
3	JMA parkland	Woodland to open woodland of Jarrah, Marri and <i>Agonis flexuosa</i> over pasture species and weeds	Southern River
4	Plantation	Mixed plantings of eucalypts and other species with scattered original tree species.	[Guildford]

Table 6. Vegetation Units identified within the Study Area described using the structural categories of Specht (1970).

Figure 3. Vegetation Units within the Study Area



### **4.3. *Vegetation Condition***

Because of a long history of grazing as well as partial clearing and the application of fertilizers most of the native species (particularly shrub and herbaceous species) within the remnant vegetation of the Study Area have been replaced by pasture species and annual and perennial weeds associated with agriculture. This is particularly so on the heavier and more fertile soils of the lower lying areas. Seventy nine percent (26 ha) of the remnant vegetation was judged to be in "Completely Degraded" condition, 9% (3 ha) in "Degraded" condition and only 12% (4 ha) in "Good" condition (Fig. 4).

### **4.4. *Significance of the vegetation***

Except for the area of Vegetation Unit 1 given a condition rating of "Fair to Good" the remnant vegetation of the Study Area has a low level of integrity in terms of the proportion of the original species remaining. This is particularly the case with regard to Vegetation Unit 3, which consists almost entirely of woodland or open woodland of jarrah, marri and *Agonis flexuosa* over an annual herbaceous understorey of pasture species. However, the many large trees, some with hollows, represent roosting and feeding resources for bird species. The EPA (2008) has assessed the vegetation within the Study Area as regionally significant because of the potential for used by the red-tailed Black Cockatoo, a Schedule 1 species and because the remnant vegetation represents degraded examples of the "Southern River" and "Guildford" vegetation complexes which have only 20% and 5% respectively of their original area remaining on the Swan Coastal Plain (EPA, 2008).

However, the vegetation in those areas mapped as Guildford in the Study Area (the *Melaleuca* shrubland community) has few of its original species left and has been assessed as completely degraded. Floristically it has little value as a representative of the Guildford Complex. There may be, however, opportunities to construct a partially rehabilitated linkage using remnants of this vegetation in the Study Area. This subject is addressed in Section 5, below.

### **4.5. *Linkages***

The South West Regional Linkages report (Molloy *et al.*, 2009) has identified some of the vegetation in the Study Area as belonging to 1b "proximity value" (in the south west part of Lot 104) and the rest as belonging to 1c. The meanings of these proximity values are;

- 1b, the vegetation is a patch with an edge touching or <100m from a natural area selected in 1a
- 1c, a patch with an edge touching or <100m from a natural area selected in 1b.

Vegetation classified as 1a is a patch with an edge touching or <100m from a linkage, ecological linkages being;

*“a series of (both contiguous and non-contiguous) patches which, by virtue of their proximity to each other, act as stepping stones of habitat which facilitate the maintenance of ecological processes and the movement of organisms within, and across, a landscape”.*

The report by Molloy *et al.* (2009) states that “In applying proximity analysis to land use planning it must be understood that 1b and 1c [...] level patches are not part of the core linkage (1a level patches), therefore their value in maintaining a linkage’s ecological function will (generally) not be as great”.

## 5. Conclusions and recommendations

As mentioned above, there is less than 5% of the pre-European extent remaining of the Guildford vegetation complex and only 20% of the Southern River Complex. Therefore even though both of these vegetation complexes are currently in a degraded condition it is important to conserve as much as possible of these vegetation types and to take steps, where practicable, to restore areas of vegetation within both the vegetation complexes.

As the exact nature of any proposed development in the Study Area is unknown to the author at this juncture the following generalized recommendations are presented and should be incorporated into the planning process where possible.

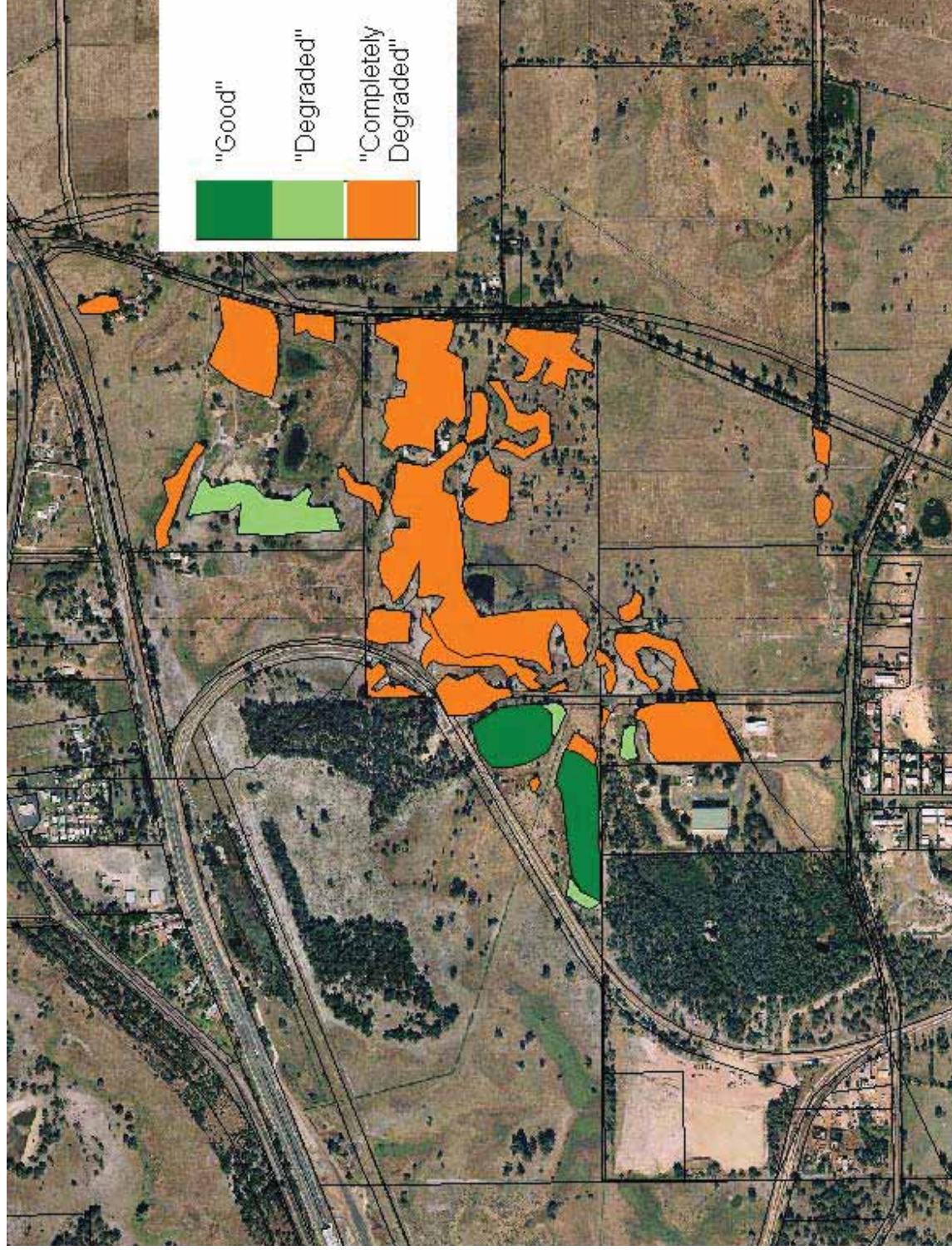
Aim to reduce the impact on the existing remnant Flora much as possible. It is recommended that:

- Planning for development recognizes that some clearing of the remnant vegetation will occur however steps should be taken where possible, aim to retain and protect as much remnant vegetation on site. In particular the best quality woodland habitat as identified in EPA Bulletin 1282 (EPA 2008) should be a priority for protection (part recommendation Area E – Lot 104),
- Rehabilitated and Landscaped areas should be re-vegetated with local seed stock. The final selection of suitable species should be carried out after liaison with suitable qualified botanist with knowledge of both the Southern River and Guildford vegetation complex to ascertain which species are most suitable for the area,
- Any rehabilitation undertaken on the site should have regard to the vegetated corridors outlined in the GBRs and the recent recommendation from Malloy 2009,
- During site works areas requiring clearing should be clearly marked and access to other areas restricted to prevent accidental clearing of areas to be retained,
- All staff working on site should be made aware that native flora is highly susceptible to dieback disease caused by the soil-borne pathogen *Phytophthora cinnamomi* and



personnel working on the project should be instructed in dieback hygiene practices and a Dieback Management plan should be prepared for the site.

Figure 4. Vegetation condition within the Study Area using the method of Keighery (1994).



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## Appendix A. List of locally native flora found within each vegetation unit in the Study Area at Picton East

FAMILY_NAME	LATIN NAME	1	2	3	4
Colchicaceae	<i>Burchardia congesta</i>	+			
Cyperaceae	<i>Gahnia trifida</i>		+		
	<i>Lepidosperma leptostachyum</i>	+			
	<i>Lepidosperma longitudinale</i>		+		
	<i>Lepidosperma squamatum</i>	+			
	<i>Mesomelaena tetragona</i>	+			
	<i>Tetraria octandra</i>	+			
Dasyogonaceae	<i>Dasyogon bromeliifolius</i>	+			
Dilleniaceae	<i>Hibbertia hypericoides</i>	+			
Droseraceae	<i>Drosera pallida</i>	+			
Epacridaceae	<i>Leucopogon conostephioides</i>	+			
	<i>Leucopogon propinquus</i>	+			
Haemodoraceae	<i>Conostylis aculeata</i>	+			
Hemerocallidaceae	<i>Thysanotus manglesianus</i>	+			
Iridaceae	<i>Patersonia occidentalis</i>	+			
Juncaceae	<i>Juncus pallidus</i>		+		
Lauraceae	<i>Cassytha racemosa</i>		+		
Mimosaceae	<i>Acacia pulchella</i>	+			
Myrtaceae	<i>Agonis flexuosa</i>	+	+	+	
	<i>Corymbia calophylla</i>	+	+	+	+
	<i>Eucalyptus marginata</i>	+		+	+
	<i>Kunzea glabrescens</i>	+	+	+	
	<i>Melaleuca lateritia</i>		+		
	<i>Melaleuca preissiana</i>		+		+
	<i>Melaleuca rhapsiophylla</i>		+		
	<i>Melaleuca teretifolia</i>		+		
Orchidaceae	<i>Microtis media</i>	+			
	<i>Thelymitra crinita</i>	+			
Papilionaceae	<i>Daviesia incrassata</i>	+			
	<i>Daviesia physodes</i>	+			
	<i>Hardenbergia comptoniana</i>	+			
	<i>Jacksonia furcellata</i>	+			
	<i>Kennedia prostrata</i>	+			
Proteaceae	<i>Banksia attenuata</i>	+			
	<i>Banksia dallanneyi</i>	+			
	<i>Banksia ilicifolia</i>	+			
	<i>Banksia littoralis</i>		+		
	<i>Xylomelum occidentale</i>	+		+	

FAMILY_NAME	LATIN NAME	1	2	3	4
Restionaceae	<i>Desmodus fasciculatus</i>	+			
	<i>Hypolaena exsulca</i>	+			
	<i>Loxocarya cinerea</i>	+			
	<i>Meeboldina scariosa</i>		+		
Rubiaceae	<i>Opercularia hispidula</i>	+			
Xanthorrhoeaceae	<i>Xanthorrhoea brunonis</i>	+			
<b>Number of native species</b>		<b>34</b>	<b>13</b>	<b>5</b>	<b>3</b>

## Appendix B: Photographs taken in the Vegetation Units identified in the Study Area

	<p><b>Vegetation Unit 1.</b></p> <p>Woodland of Jarrah and Marri over low woodland of <i>Agonis flexuosa</i>, <i>Banksia attenuata</i> and <i>Banksia ilicifolia</i> woodland over shrubland</p>
	<p><b>Vegetation Unit 2.</b></p> <p>Woodland or tall shrubland of <i>Melaleuca raphiophylla</i> or <i>M. preissiana</i> over a shrubland of <i>M. lateritia</i> and <i>M. teretifolia</i></p>
	<p><b>Vegetation Unit 3.</b></p> <p>Woodland to open woodland of Jarrah, Marri and <i>Agonis flexuosa</i> over pasture species and weeds</p>

Note: Vegetation Unit 4, which is comprised mainly of planted species is not illustrated.





# Appendix E

Terrestrial Fauna Survey (Level 1) (Harewood G. 2009)





# Terrestrial Fauna Survey

(Level 1)

of

Lots 1, 2, 11, 102-104 & 603

Picton (East)

December 2009

*Version 1*

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FIGURE 2: Study Area - Air Photo

FIGURE 3: Fauna Habitats

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FIGURE 5: WRP Scat Densities

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TABLE 1: Summary of Potential Vertebrate Species

TABLE 2: Listed Threatened, Migratory and Priority Fauna Species Potentially Occurring in Study Area

## **PLATES**

- PLATE 1: Cleared pasture with scattered trees – Lot 2.
- PLATE 2: Low open woodland dominated by Banksia with various densities of Jarrah, Marri and Peppermint over very open low shrubland and grassland – Lot 104.
- PLATE 3: Open woodland of Jarrah and Marri over low open woodland of Peppermint over grassland – Lot 603.
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- APPENDIX A: Conservation Categories
- APPENDIX B: Habitat Tree Coordinates
- APPENDIX C: Fauna Observed or Potentially in Study Area
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## **DISCLAIMER**

This fauna assessment report (“the report”) has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Greg Harewood (“the Author”). In some circumstances the scope of services may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints. In accordance with the scope of services, the Author has relied upon the data and has conducted environmental field monitoring and/or testing in the preparation of the report. The nature and extent of monitoring and/or testing conducted is described in the report.

The conclusions are based upon field data and the environmental monitoring and/or testing carried out over a limited period of time and are therefore merely indicative of the environmental condition of the site at the time of preparing the report. Also it should be recognised that site conditions, can change with time.

Within the limitations imposed by the scope of services, the field assessment and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, expressed or implied, is made.

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## EXECUTIVE SUMMARY

This report details the results of a fauna assessment of Lots 1, 2, 11, 102-104 & 603 located in East Picton (the study area). The site is located about 9 km south east of the Bunbury CBD and has an area of approximately 145 ha, most of which is cleared/partially cleared farmland (Figures 1 & 2).

It is understood that the information obtained as part of the fauna assessment reported on here will be used, in conjunction with the other studies, to facilitate the controlled and guided development of the subject site with the principal aim of minimising environmental impacts.

The extent of the broadly defined fauna habitats within the study area are shown in Figure 3 with a description of each given below.

1. **Cleared pasture with widely scattered trees:** Totally cleared or partly cleared with significant areas of bare sand in addition to sparse groundcover dominated by a mixture of introduced pasture grasses, clovers, weeds. There are scattered small groves and individual emergent trees including Peppermint *Agonis flexuosa*, Jarrah *Eucalyptus marginata*, Marri *Corymbia calophylla* and Paperbark *Melaleuca* sp.
2. **Open Woodland to Low Open Woodland of Jarrah, Marri, Banksia and Peppermint over grassland, open shrubland and shrubland.** Variable densities of Jarrah, Marri, Banksia and Peppermint along with associated species such as *Nuytsia floribunda* and *Xylomelum occidentale*. Considerable variation in ground cover and understory density with some areas having little or no native groundcover due to grazing/fire and others have a relatively dense low shrubland to shrubland of native species.
3. **Open Woodland to Low Open Woodland of Jarrah, Marri, and Peppermint over grassland.** Variable densities of Jarrah, Marri, and Peppermint along with associated species such as *Nuytsia floribunda* and *Xylomelum occidentale*. Little or no native groundcover due to clearing and ongoing grazing.
4. **Low Open Woodland to tall shrubland of Melaleuca:** Associated with the low lying areas most of which are seasonally inundated/waterlogged during wetter months of the year. Dominant species include *Melaleuca raphiophylla*, *M. preissiana* and *M. teretifolia*.
5. **Planted Non-endemic Eucalypts:** Some areas have been planted with various non-endemic eucalypts.
6. **Dams/areas of seasonal inundation:** Several manmade dams have been dug to provide water for livestock. Considerable sections of the cleared pasture areas are also inundated during the wetter months of the year.



Plates 1 to 6 illustrate the nature of fauna habitats existing within the study area.

During the course of the opportunistic fauna assessment the location of “habitat” trees were noted. In total 34 habitat trees were observed. The location of each tree observed is show in Figure 4. Seven of the trees recorded contained large hollows with entrances that appeared from ground level to be possibly of a size suitable for black cockatoos to enter.

The results of the opportunistic fauna survey are summarised in Table 1 and listed in Appendix C. A total of 45 native fauna species were observed (or positively identified from foraging evidence, scats, tracks, skeletons or calls) within the study area during the reconnaissance surveys carried out on the 19<sup>th</sup> of October 2009.

In summary, six vertebrate fauna species of conservation significance (listed on state or federal threatened species lists or DEC priority species) were positively identified as utilising the study area for some purpose during the Level 1 reconnaissance survey, these being:

- *Calyptorhynchus baudinii* Baudin`s Cockatoo - S1 (WAWC Act), Vulnerable (EPBC Act)  
Foraging evidence observed during the survey period (chewed Marri nuts and Banksia cones, grubbing on marri tree trunks). A number of hollow trees present in the study area are possibly suitable for nesting though no evidence of actual breeding observed.
- *Calyptorhynchus latirostris* Carnaby`s Cockatoo – S1 (WAWC Act), Endangered (EPBC Act)  
Foraging evidence observed during survey period (chewed Marri nuts and Banksia cones). A number of hollow trees present in the study area are possibly suitable for nesting though no evidence of actual breeding observed.
- *Calyptorhynchus banksii naso* Forest Red-tailed Black Cockatoo – S1 (WAWC Act), Vulnerable (EPBC Act)  
Three individuals were observed foraging during survey period. Other foraging evidence also observed (chewed Marri nuts). A number of hollow trees present in the study area are possibly suitable for nesting though no evidence of actual breeding observed.
- *Ardea alba* Great Egret – Migratory (EPBC Act)  
Observed within a section of the flooded pasture during the survey period. Unlikely to breed on site. .
- *Merops ornatus* Rainbow Bee-eater – Migratory (EPBC Act)  
Common seasonal visitor to south west. Observed foraging and roosting in the study area during the survey period. Possibly breeds in some sections of the study area.
- *Pseudocheirus occidentalis* Western Ringtail Possum - S1 (WAWC Act), Vulnerable (EPBC Act)  
Appears to be present in low numbers in some sections of the study area. Evidence observed (dreys and scats) is possibly the result of transient

individuals temporality residing in the area as opposed to a viable resident population.

Four species of conservation significance may possibly utilise the study area for some purpose at times but their current status on site and/or in the general area is difficult to determine because they were not sighted during the survey period or evidence of use of the study area was not found. Note: Habitat for some species onsite, while considered possibly suitable, may be marginal in extent/quality and species listed below may only visit the area for short periods or as rare/uncommon vagrants:

- *Ardea ibis* Cattle Egret – Migratory (*EPBC Act*)  
May visit flooded pasture areas during wetter months of year. Unlikely to breed on site.
- *Apus pacificus* Fork-tailed Swift – Migratory (*EPBC Act*)  
Rare seasonal visitor. May forage in area but very unlikely to roost.
- *Falco peregrinus* Peregrine Falcon - S4  
Study site may form part of larger home range.
- *Falsistrellus mackenziei* Western False Pipistrelle - P4 (DEC Priority Species)  
Status in the area difficult to determine. May at least forage on site.

Of most significance is the presence on site of black cockatoo and Western Ringtail Possum habitat. Potential impacts on these species and/or their habitat will need to be addressed during the planning process and where reasonable and practical planning should aim to retain/protect and enhance habitat so that they can persist and/or continue to utilise the site. The conservation of as much vegetation as possible will simplify any referral or assessment process required under the *EPBC Act*. Where impacts cannot be avoided, every attempt to minimise impacts should be made. The recommendations made in section 7.2 are provided to facilitate this.

If the clearing of vegetation (including black cockatoo and WRP habitat) is unavoidable the DEWHA will typically request onsite mitigation through revegetation and retention of key habitat as part of the approval process. Currently a ratio of 4:1 is seen as a minimum requirement for offsetting cockatoo foraging habitat loss by way of plantings (i.e. 4ha for every 1ha lost). For WRPs the ratio is 3:1. Offsetting the loss of cockatoo breeding habitat by plantings is generally viewed by DEWHA as needing to be higher (in the region of 10:1).

The actual impact on fauna and fauna habitat and likely obligations under the *EPBC Act* should be re-assessed when development plans are finalised.

## **1. INTRODUCTION**

This report details the results of a fauna assessment of Lots 1, 2, 11, 102-104 & 603 located in East Picton (the study area). The site is located about 9 km south east of the Bunbury CBD in south west Western Australia and is centred at approximately 33.347702°S and 115.729507°E (Figures 1 & 2). The study site has an area of approximately 145 ha most of which is cleared/partly cleared farmland.

## **2. DEVELOPMENT PROPOSAL**

No final development proposal currently exists for the site. The fauna survey forms part of a series of investigations which will be used to assess environmental opportunities and constraints for that will be used for future planning and development at the site. It is understood that the information obtained as part of the fauna assessment reported on here will be used, in conjunction with the other studies, to facilitate the controlled and guided development of the subject site with the principal aim of minimising environmental impacts.

## **3. SCOPE OF WORKS**

The scope of works is to conduct a “fauna survey”. To achieve this, the following will be carried out:

1. Level 1 Fauna Survey (to EPA standard) including targeted searches for evidence of Western Ringtail Possums (WRP) and Black Cockatoo foraging/nesting/roosting;
2. Significant Tree Survey (including potential black cockatoo nest hollows); and
3. Report summarising results with management/planning recommendations

This survey report has been prepared for use in the EPA’s (Environmental Protection Authority’s) Environmental Impact Assessment (EIA) process (if required) and is considered suitable for this purpose.

## 4. METHODOLOGY

### 4.1 FAUNA INVENTORY

#### 4.1.1 Potential Fauna

A list of all vertebrate fauna potentially occurring within the study area was compiled from searches the Department of Environment and Conservation's (DEC's) Threatened Fauna and 'NatureMap' database (joint DEC and Western Australian Museum (WAM) data), the Department of the Environment, Water, Heritage and the Arts (DEWHA) Commonwealth Environment Protection and Biodiversity Conservation database, Birds Australia's 'Birddata' database, published and unpublished reports and specialist books detailing fauna of the general area.

Taxonomy and nomenclature for fauna species used in this report generally follow Aplin and Smith (2001) for amphibians and reptiles, How *et al.* (2001) for mammals and Johnstone (2001) for birds. Some names, including common names recommended for national and international use by Christidis and Boles (1994) for birds, are also used. Common names for reptiles and amphibians come from a variety of sources and are not necessarily generally accepted. Sources include Van Dyk & Strahan (2008), Bush *et al* (2007), Wilson and Swan (2008), Bush *et al* (2002), Tyler *et al.* (2000) and Glauret (1961).

#### 4.1.2 Fauna of Conservation Significance

The conservation significance of fauna species has been assessed using data from the following sources:

- *Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*. Administered by the Australian Government Department of the Environment, Water, Heritage and the Arts (DEWHA);
- *Western Australian Wildlife Conservation Act 1950 (WAWC Act)*. Administered by the Western Australian Department of Environment and Conservation (DEC);
- Red List produced by the Species Survival Commission (SSC) of the World Conservation Union (also known as the IUCN Red List - the acronym derived from its former name of the International Union for Conservation of Nature and Natural Resources). The Red List has no legislative power in Australia but is used as a framework for State and Commonwealth categories and criteria; and the
- DEC Priority Fauna list. A non-legislative list maintained by the DEC for management purposes.

The *EPBC Act* also requires the compilation of a list of migratory species that are recognised under international treaties including the:

- Japan Australia Migratory Bird Agreement 1981 (JAMBA);
- China Australia Migratory Bird Agreement 1998 (CAMBA);
- Republic of Korea-Australia Migratory Bird Agreement 2007 (ROKAMBA); and
- Bonn Convention 1979 (The Convention on the Conservation of Migratory Species of Wild Animals).

(Note - Species listed under JAMBA are also protected under Schedule 3 of the *WAWC Act*.)

All migratory bird species listed in the annexes to these bilateral agreements are protected in Australia as matters of national environmental significance under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

The conservation status of all the vertebrate fauna species listed as occurring or possibly occurring in the vicinity of the study area has been assessed using the most recent lists published in accordance with the above-mentioned Acts, International Agreements and DEC's priority fauna list. The status of each species as defined in the above mentioned acts is indicated in the fauna listings of this report. A full listing of conservation codes are held in Appendix A.

#### **4.1.3 Other Species of Significance**

A number of other species not listed in official lists can also be considered of regional conservation significance. These include species that have a restricted range, those that occur in breeding colonies and those at the limit of their range.

While not classified as rare, threatened or vulnerable under any State or Commonwealth legislation, a number of bird species have been listed as of significance on the Swan Coastal portion of the Perth Metropolitan Region (Bush Forever - Government of Western Australia 1998 and 2000). The bird species are often referred to as Bush Forever Decreaser Species. The three categories used for birds within the Bush Forever documents are:

- Habitat specialists with reduced distribution on the Swan Coastal Plain (code Bh)
- Wide ranging Species with reduced population's on the Swan Coastal Plain. (code Bp)
- Extinct in the Perth region (code Be)

The presence of Bush Forever species should be taken into consideration when determining an areas fauna values. Bush Forever decreaser species are indicated as such within the species list held in Appendix C.

## **4.2 SITE RECONNAISSANCE SURVEY**

### **4.2.1 Opportunistic Fauna Observations**

Opportunistic observations of fauna species was made during a 5 hour daytime survey of the site. This included a series of close spaced transects across the site while searching under logs, rocks, leaf litter and observations of bird species with binoculars.

As the area has the potential to be utilised by WRPs and/or black cockatoos additional effort was made to determine if these species are utilising the site and to what degree so that their potential presence can be taken into consideration for planning and management:

The targeted assessments were be carried out concurrent with the Level 1 survey and included:

- Specific observations to locate and record WRP dreys (and other potential daytime refuges), scats and individual WRPs;
- Specific observation of foraging and roosting evidence left by any of the three federally listed black cockatoos species; and
- Determination of the amount and quality of potential WRP and black cockatoo habitat on site.

No targeted WRP night time surveys were considered warranted at this stage. If the presence of the WRP is confirmed and the proposed development is likely to have some impact additional surveys may be required/requested by regulatory authorities as part of the approval process.

### **4.2.2 Fauna Habitat Assessment**

A habitat assessment was carried out specifically targeting the likely habitats of listed (under the relevant Federal and State Acts) threatened vertebrate species potentially occurring in the study area. The aim of the habitat assessment was to determine if it was likely that any of the threatened species would be utilising the areas that will be impacted on as a consequence of the development proposal proceeding in its current form.

The initial phase of the assessment involved the review of available information on the habitats of the threatened species listed as possibly occurring in the area. During the field survey the habitat within the study area was assessed and specific elements searched for to determine the potential that any of the listed threatened species maybe utilising the area and its significance to them. In addition the habitat information obtained was used to aid in the compilation of a potential fauna list.

The vegetation communities present have been used as the basis for a classification into broad fauna habitats. In addition details on specific habitat components such as significant trees with hollows, loose bark, fallen hollow logs, and the amount of leaf litter were noted if present.

Quality of habitat with respect to WRPs and black cockatoos was specifically noted.

#### **4.2.3 Habitat Tree Assessment**

During the course of the opportunist and habitat assessment observations of “habitat” trees were recorded using a GPS. The aim of the survey was to document the presence of trees containing hollows suitable for fauna to use. For the purposes of this study a “habitat” tree “was defined as

**“Generally any tree which is alive or dead that contains one or more visible hollows (cavities within the trunk or branches) suitable for the occupation of hollow-dependent fauna as nesting, roosting and/or denning sites. Hollows that had an entrance greater than about 12cm in diameter and would allow the entry of a black cockatoo were recorded as a “potential cockatoo nest hollow”.**

The assessment of hollows was conducted from ground level. Because it is impossible to determine all the characteristics of hollows that are favoured by fauna species, the assessment of suitability was based entirely on the size of each hollow’s entrance, though other factors such as orientation and position (relative to ground level) was also taken into consideration. The main aim of the habitat tree assessment was to determine if any trees on site contained hollows suitable for black cockatoos to use as nest hollows.

#### **4.3 LOCAL CONSERVATION SIGNIFICANCE OF THE STUDY AREA**

The local (sub-regional) significance of the study area has been determined by applying site specific criteria such as:

- Fauna species and/or habitat present that is poorly represented in the general study area;
- Fauna habitat within the general study area supporting species of conservation or other significance;
- Fauna habitat in better condition than other similar locations in general study area.

#### **4.4 VALUE OF THE STUDY AREA AS A WILDLIFE CORRIDOR**

Corridors of native vegetation can be very important for the dispersal of species in otherwise cleared landscapes. Any areas of remnant vegetation making up

part of a linkage is therefore of great value by facilitating the movement of species that cannot utilise cleared/developed land. Linkage with adjacent bushland areas has been identified as a natural attribute of high priority in the assessment of an areas regional significance.

During the field survey and by examination of plans and air photos of the study area, the value of the site as a corridor/ecological linkage between any reserves, conservation areas or other significant areas of remnant bush was assessed.

## **5. SURVEY CONSTRAINTS**

The assessment reported on here has included a desktop analysis and a site reconnaissance survey that included opportunistic fauna observations over a total of about eight hours. No seasonal sampling has been conducted.

Fauna species are indicated as potentially present within this report based on there being suitable (quality and extent) habitat within the study area. With respect to opportunistic observations, the possibility exists that certain species may not have been detected during field investigations due to:

- seasonal inactivity during field survey;
- species present within micro habitats not surveyed;
- cryptic species able to avoid detection;
- transient wide-ranging species not present during survey period.

The lack of observational data on some species should therefore not be taken as necessarily indicating that a species is absent from the site.

In recognition of survey limitations a precautionary approach has been adopted for this assessment. Any fauna species that would possibly occur within the study area as identified through ecological databases, publications, discussions with local experts/residents and the habitat knowledge of the Author has been assumed to potentially occur in the study area.

Field survey work was carried out by Greg Harewood (B.Sc. Zoology) on the 19<sup>th</sup> October, 2009.

## **6. RESULTS**

### **6.1 REGIONAL BIOLOGICAL CONTEXT**

The project area is situated within the south west margin of the Swan Coastal Plain. The Swan Coastal Plain Bioregion (SWA) is classified as part of the



Interim Biogeographical Regionalisation for Australia. The SWA bioregion is described as being a:

*“Low lying coastal plain mainly covered with Woodlands. It is dominated by Banksia or Tuart on sandy soils, Casuarina obesa on outwash plains, and paperbark in swampy areas. In the east, the plain rises to duricrusted Mesozoic sediments dominated by Jarrah Woodland. Warm Mediterranean. Three phases of marine sand dune development provide relief.*

*The outwash plains, once dominated by Casuarina obesa – Marri Woodlands and Melaleuca shrublands, are extensive only in the south.”* (Thackway and Cresswell, 1996; IBRA, 2000).

The study area lies within a section of the Bassendean Dunes System and the Guilford Formation. In this area the Bassendean Dunes consist of extremely low to very low relief dunes with, deep, bleached grey sands. The Guilford formation, represent by low lying areas within the study area consists of poorly drained flats with shallow pale sand to sandy loam over clay (Agmap 2003).

Broadscale mapping by Beard (Beard 1991) shows the general area, prior to disturbance, to have consisted of a mosaic of medium forest (Jarrah-Marri), low woodland (Banksia and Jarrah-Banksia) and Low forest (Melaleuca spp).

Vegetation complexes were defined in relation to landform and soil units for the Swan Coastal Plain by Heddle *et al.* (1980). A total of 15 vegetation complexes were described for the Greater Bunbury Region (GBR - WAPC 2000). Of these the Southern River Complex and the Guildford Complex are mapped as originally comprising the vegetation units present within the study area.

The Southern River Complex is described as being an open woodland of Marri *Corymbia calophylla*, Jarrah *Eucalyptus marginata* and *Banksia* species with fringing woodlands of Flooded Gum *Eucalyptus rudis* and Swamp Paperbark *Melaleuca raphiophylla* along creek beds.

The Guildford Complex is described as a mixture of open forest to tall open forest of Marri *Corymbia calophylla* – Wandoo *Eucalyptus wandoo* – Jarrah *Eucalyptus marginata* and woodlands of Wandoo *Eucalyptus wandoo*. Minor components include Flooded Gum *Eucalyptus rudis* and Swamp Paperbark *Melaleuca raphiophylla* (Heddle *et al.* 1980)

## **6.2 FAUNA HABITAT ASSESSMENT**

### **6.2.1 Fauna Habitats**

The broad scale fauna habitats within the study area are based on vegetation structure. The study area has been subject to a significant amount of historical disturbance such as extensive clearing, construction of fire breaks and access

tracks, construction of dams and ongoing livestock grazing. These impacts have reduced the sites overall value to fauna by reducing or altering habitat quality and biodiversity values to a significant degree.

The extent of the broadly defined fauna habitats within the study area are shown in Figure 3 with a description of each given below. Additional information of the vegetation units present within the study area can be found in the botanical report (ekologica 2009).

7. **Cleared pasture with widely scattered trees:** Totally cleared or partly cleared with significant areas of bare sand in addition to sparse groundcover dominated by a mixture of introduced pasture grasses, clovers, weeds. There are scattered small groves and individual emergent trees including Peppermint *Agonis flexuosa*, Jarrah *Eucalyptus marginata*, Marri *Corymbia calophylla* and Paperbark *Melaleuca* sp.
8. **Open Woodland to Low Open Woodland of Jarrah, Marri, Banksia and Peppermint over grassland, open shrubland and shrubland.** Variable densities of Jarrah, Marri, Banksia and Peppermint along with associated species such as *Nuytsia floribunda* and *Xylomelum occidentale*. Considerable variation in ground cover and understory density with some areas having little or no native groundcover due to grazing/fire and others have a relatively dense low shrubland to shrubland of native species.
9. **Open Woodland to Low Open Woodland of Jarrah, Marri, and Peppermint over grassland.** Variable densities of Jarrah, Marri, and Peppermint along with associated species such as *Nuytsia floribunda* and *Xylomelum occidentale*. Little or no native groundcover due to clearing and ongoing grazing.
10. **Low Open Woodland to tall shrubland of Melaleuca:** Associated with the low lying areas most of which are seasonally inundated/waterlogged during wetter months of the year. Dominant species include *Melaleuca raphiophylla*, *M. preissiana* and *M. teretifolia*.
11. **Planted Non-endemic Eucalypts:** Some areas have been planted with various non-endemic eucalypts.
12. **Dams/areas of seasonal inundation:** Several manmade dams have been dug to provide water for livestock. Considerable sections of the cleared pasture areas are also inundated during the wetter months of the year.

Plates 1 to 6 illustrate the nature of fauna habitats existing within the study area.

## **6.2.2 Habitat Tree Assessment**

During the course of the opportunistic fauna assessment the location of “habitat” trees were noted. In total 34 habitat trees were observed. The location of each tree observed is shown in Figure 4. Seven of the trees recorded contained large hollows with entrances that appeared from ground level to be possibly of a size suitable for black cockatoos to enter.

Hollows are an important resource as many fauna species are obligated to utilise them for day to day refuge and as breeding sites. In this area of the south west, hollows have the potential to be used by a range of fauna including, but not limited to, the three Black Cockatoo species, Common Brushtail Possums, Brush-tailed Phascogales, Galahs, Regent Parrots, Australian Ringneck Parrots, Red-capped Parrots, Western Rosellas, Elegant Parrots, Boobook Owls, Australian Owlet-nightjars, Sacred Kingfishers, Striated Pardalotes and Tree Martins.

It should be noted that if the project is referred to the federal Department of Environment, Water, Heritage and the Arts (DEWHA) additional information on the habitat trees, in particular those that represent potential breeding habitat to black cockatoos maybe required to better define potential impacts of any proposed development. Currently the DEWHA regard a woodland stand (in this area Jarrah or Marri trees) of an area greater than 0.5ha and containing more than three trees with a diameter at breast height (DBH) of greater than 500mm as significant breeding habitat, irrespective of the presence or absence of any actual hollows suitable for black cockatoos to use.

## **6.3 FAUNA INVENTORY**

### **6.3.1 Opportunistic Fauna Surveys**

The results of the opportunistic fauna survey are summarised in Table 1 and listed in Appendix C. A total of 45 native fauna species were observed (or positively identified from foraging evidence, scats, tracks, skeletons or calls) within the study area during the reconnaissance surveys carried out on the 19<sup>th</sup> of October 2009. Four introduced species were also observed (includes livestock).

Evidence of four listed threatened species was observed (all three species of black cockatoo – foraging evidence, Forest Red-tailed Black Cockatoo – three individuals observed, Western Ringtail Possum – scats and dreys). Two migratory species were observed (Rainbow Bee-eater and Great Egret). No evidence of DEC priority species was sighted.

### 6.3.2 Western Ringtail Possum Survey

Daytime observations for dreys, scats and WRPs were carried out as part of the opportunistic fauna survey conducted on the 19<sup>th</sup> October 2009.

The day time survey results are shown in Figure 4. In total fourteen dreys were found. WRPs will use hollows in preference to building dreys and therefore some of the 27 habitat trees identified also represent potential daytime refuge sites.

WRP scats were found to uncommon and difficult to find, suggesting the presence of a sparse, very low density population (Figure 5).

The results suggest that the species is present in low numbers in some sections of the study area. The evidence observed (dreys and scats) is possibly the results of transient individuals moving through the area as opposed to a viable resident population. Irrespective of current population levels substantial areas of the remnant vegetation on site must be regarded as potential habitat that may be considered important for recovery of the species in the long term by regulatory authorities.

### 6.3.3 Potential Fauna

Table 1 summarises the numbers of potential species based on vertebrate class considered likely to be present in the study area. A complete list of vertebrate fauna possibly inhabiting or frequenting the study area is held in Appendix C. The results of a DEC Threatened fauna database search and the *EPBC Act* database are held in Appendix D.

Details on specially protected and priority species expected and/or listed as potentially occurring in the general area are given in Table 2 and Appendix E.

Not all species listed in existing databases and publications as potentially occurring within the study area (i.e. *EPBC Act's* Threatened Fauna and Migratory species lists, DEC's Threatened Fauna Database and various publications) are shown in the expected listing in Appendix C. Some species have been excluded from this list based largely on the lack of suitable habitat at the study site (e.g. whales, offshore seabirds) and in the general area or known local extinction even if suitable habitat is present (e.g. Malleefowl).

Despite the omission of some species it should be noted that the list provided is still very likely an over estimation of the fauna species utilising the site (either on a regular or infrequent basis) as a result of the precautionary approach adopted for the assessment.

**Table 1: Summary of Potential Fauna Species (As listed in Appendix C)**

Group	Total number of potential species	Potential number of specially protected species	Potential number of migratory species	Potential number of priority species	Number of species observed October 09
Amphibians	7	0	0	0	1
Reptiles	20	0	0	0	2
Birds	91 <sup>5</sup>	4	4	0	39
Non-Volant Mammals	11 <sup>8</sup>	1	0	0	7 <sup>4</sup>
Volant Mammals (Bats)	8	0	0	1	0
Total	137 <sup>13</sup>	5	4	1	49 <sup>4</sup>

Superscript = number of introduced species included in total.

### 6.3.4 Fauna of Conservation Significance

A review of EPBC Act's threatened fauna list, DEC's Threatened Fauna Database and Priority List and scientific publications identified about 25 specially protected, priority or migratory fauna species as potentially occurring in the general vicinity of the study area. Most of those species that have no potential whatsoever, under normal circumstances, to utilise the site for any purpose are not listed or discussed despite appearing in the DEC or EPBC Act database searches (Appendix D). Species have been omitted from the potential list (Appendix C) for the site principally due to lack of suitable habitat on site or known local extinction. A brief account of these species with details on their distribution and habitat preference and potential impact are shown in Table 2. Additional details on significant species that potentially utilise the study site are given in Appendix E.

In summary, six vertebrate fauna species of conservation significance (listed on state or federal threatened species lists or DEC priority species) were positively identified as utilising the study area for some purpose during the Level 1 reconnaissance survey, these being:

- Calyptorhynchus baudinii* Baudin's Cockatoo - S1 (WAWC Act), Vulnerable (EPBC Act)  
 Foraging evidence observed during the survey period (chewed Marri nuts and Banksia cones, grubbing on marri tree trunks). A number of hollow trees present in the study area are possibly suitable for nesting though no evidence of actual breeding observed.

- *Calyptorhynchus latirostris* Carnaby's Cockatoo – S1 (WAWC Act), Endangered (EPBC Act)  
Foraging evidence observed during survey period (chewed Marri nuts and Banksia cones). A number of hollow trees present in the study area are possibly suitable for nesting though no evidence of actual breeding observed.
- *Calyptorhynchus banksii naso* Forest Red-tailed Black Cockatoo – S1 (WAWC Act), Vulnerable (EPBC Act)  
Three individuals were observed foraging during survey period. Other foraging evidence also observed (chewed Marri nuts). A number of hollow trees present in the study area are possibly suitable for nesting though no evidence of actual breeding observed.
- *Ardea alba* Great Egret – Migratory (EPBC Act)  
Observed within a section of the flooded pasture during the survey period. Unlikely to breed on site. .
- *Merops ornatus* Rainbow Bee-eater – Migratory (EPBC Act)  
Common seasonal visitor to south west. Observed foraging and roosting in the study area during the survey period. Possibly breeds in some sections of the study area.
- *Pseudocheirus occidentalis* Western Ringtail Possum - S1 (WAWC Act), Vulnerable (EPBC Act)  
Appears to be present in low numbers in some sections of the study area. Evidence observed (dreys and scats) is possibly the result of transient individuals temporally residing in the area as opposed to a viable resident population.

Four species of conservation significance may possibly utilise the study area for some purpose at times but their current status on site and/or in the general area is difficult to determine because they were not sighted during the survey period or evidence of use of the study area was not found. Note: Habitat for some species onsite, while considered possibly suitable, may be marginal in extent/quality and species listed below may only visit the area for short periods or as rare/uncommon vagrants:

- *Ardea ibis* Cattle Egret – Migratory (EPBC Act)  
May visit flooded pasture areas during wetter months of year. Unlikely to breed on site.
- *Apus pacificus* Fork-tailed Swift – Migratory (EPBC Act)  
Rare seasonal visitor. May forage in area but very unlikely to roost.
- *Falco peregrinus* Peregrine Falcon - S4  
Study site may form part of larger home range.
- *Falsistrellus mackenziei* Western False Pipistrelle - P4 (DEC Priority Species)  
Status in the area difficult to determine. May at least forage on site.

Species of conservation significance that, while possibly present in the general area (e.g. various lakes, estuaries, beaches or larger reserves in the general area), are not listed as potential species due to known localised extinction (and no subsequent recruitment from adjoining areas) and/or lack of suitable habitat and/or the presence of feral predators:

- *Burhinus grallarius* Bush Stone Curlew - P4 (DEC Priority Species)  
Regionally extinct. Majority of the habitat in the study area is unsuitable due to lack of daytime shelter required by this species.
- *Psophodes nigrogularis nigrogularis* Western Whipbird (western heath subsp) - S1 (WAWC Act), Endangered (EPBC Act)  
Regionally extinct. Habitat in the study area is unsuitable for this species due to lack of dense midstorey vegetation.
- *Botaurus poiciloptilus* Australasian Bittern – S1 (WAWC Act)  
Habitat on site is unsuitable for this species.
- *Ixobrychus flavicollis* Black Bittern – P2 (DEC Priority Species)  
Habitat on site is unsuitable for this species.
- *Ixobrychus minutus* Little Bittern – P4 (DEC Priority Species)  
Habitat on site is unsuitable for this species.
- *Haliaeetus leucogaster* White-bellied Sea-Eagle – Migratory (EPBC Act)  
Unsuitable habitat. May fly over occasionally.
- *Charadrius rubricollis* Hooded Plover – P4 (DEC Priority Species)  
Unsuitable habitat.
- *Ninox connivens connivens* Barking Owl – P2 (DEC Priority Species)  
Habitat appears very marginal for this species and it is unlikely to be specifically attracted to the site.
- *Tyto novaehollandiae* Masked Owl – P3 (DEC Priority Species)  
Habitat appears very marginal for this species and it is unlikely to be specifically attracted to the site.
- *Phascogale tapoatafa ssp* Southern Brush-tailed Phascogale - S1 (WAWC Act)  
Status in the area is difficult to determine. Better quality vegetation present to the west of the study area (Lot 200) maybe suitable, though the total area of the remnant would limit the long term viability of a population. Limited suitable habitat within the study area is marginal and would be unlikely to support a population of this species.
- *Isoodon obesulus fusciventer* Southern Brown Bandicoot – P5 (DEC Priority Species)  
There is very limited areas of suitable habitat for this species to persist within the study area (dense groundcover) and it is unlikely that a population could exist on site.

- *Dasyurus geoffroii* Chuditch - S1 (WAWC Act), Vulnerable (EPBC Act)  
Locally extinct. Transient individuals may very rarely be present but the area is too small and of a quality too poor to maintain a population of this species.
- *Setonix brachyurus* Quokka – S1 (WAWC Act), Vulnerable (EPBC Act)  
Locally extinct. Only known population on the coastal plain is located just south of Bunbury.
- *Macropus irma* Western Brush Wallaby – P4 (DEC Priority Species)  
Locally extinct. Habitat within the study area is unsuitable for this species.
- *Hydromys chrysogaster* Water Rat – P4 (DEC Priority Species)  
Unsuitable/very marginal habitat. Habitat within the study area is unsuitable for this species due to a lack of permanent water.

### 6.3.5 Other Species of Significance

Thirteen of the bird species that potentially frequent or occur in the study area are noted as Bush Forever Decreaser Species in the Perth metropolitan region (seven species were sighted/identified as having used the site during the site survey). Decreaser species are a significant issue in biodiversity conservation in the Perth section of the Coastal Plain as there have been marked reductions in range and population levels of many sedentary bird species as a consequence of disturbance and land clearing (Dell & Hyder-Griffiths 2002).

## 6.4 LOCAL CONSERVATION SIGNIFICANCE OF THE STUDY AREA

Coastal areas in south west western Australia have been altered substantially since European settlement in the 1830's and a variety of environmental factors, in particular habitat fragmentation and fire, will continue to threaten many species of fauna with local extinction (How *et al* 1987). As the local development of land progresses the significance of any remnant vegetation increases.

The results of this fauna assessment shows the study site as a whole hosts (or potentially hosts) a range of fauna species some of which are of special conservation significance. Based on these findings remnant vegetation within the study area must be considered of local significance to fauna, a fact that has previously been recognised (EPA 2008). The majority of the study area however supports (or potentially supports) a significantly depleted fauna assemblage, a consequence of its very degraded state. Most of the fauna species utilising the site are common and widespread and are often found in similar degraded/very degraded habitat present in nearby areas of the Swan Coastal Plain.



Table 2: Listed Threatened, Migratory and Priority Fauna Species Potentially Occurring in Study Area.

Common Name/Species	Conservation Code				Actual Records or Listed as Potentially in General Area			Threatening Processes	Habitat Requirements	Habitat in Project Area/Qualify	Potential Impact on Habitat
	EPBC Act Status	WAWC Act Status	ICUN Status	DEC Priority Status	EPBC Act Database	DEC Database	Birds Aust. Data Base				
Western Whipbird <i>Psophodes nigrogularis nigrogularis</i>	EN	S1				Yes (1898)		Habitat loss and/or modification, changing fire regimes	Dense shrubland with an open overstorey, the structure of the vegetation being more important than the floristics. Nests found have been in dense bushes in heath adjacent to thickets.	No Species Locally Extinct	None
Hooded Plover <i>Charadrius rubricollis</i>			NT	P4		Yes		Vulnerable to disturbance of foraging and breeding activities on beaches	Broad sandy ocean beaches and bays, coastal and inland salt lakes.	No	None
Great Egret <i>Ardea alba</i>	Migratory (CAMBA, JAMBA)		LC		Yes		Yes	Loss of breeding habitat and declines in water quality	Wetlands, flooded pasture, dams, estuarine mudflats, mangroves and reefs	Yes	Loss of some degraded foraging habitat
Cattle Egret <i>Ardea ibis</i>	Migratory (CAMBA, JAMBA)		LC		Yes		Yes	Loss of breeding habitat and declines in water quality	Moist pastures with tall grasses, shallow open wetlands and margins, mudflats.	Yes	Loss of some degraded foraging habitat
White-bellied Sea Eagle <i>Haliaeetus leucogaster</i>	Migratory (CAMBA)		LC		Yes			Loss of breeding habitat and declines in water quality	Nests and forages near the coast over islands, reefs, headlands, beaches, bays, estuaries, mangroves, but will also live near seasonally flooded inland swamps, lagoons and floodplains, often far inland on large pools of major rivers. Established pairs usually sedentary, immatures dispersive. Builds a large stick nest, which is used for many seasons in succession.	No	None
Peregrine Falcon <i>Falco peregrinus</i>		S4	LC					Loss of breeding habitat	Diverse from rainforest to arid shrublands from coastal heath to alpine. Mainly about cliffs, along coasts rivers and ranges and about wooded watercourses and lakes. The species utilises the ledges, cliff faces and large hollows/broken spouts of trees for nesting. It will also occasionally use the abandoned nests of other birds of prey.	Yes	None Likely
Bush Stone Curlew <i>Burhinus grallarius</i>			NT	P4		Yes		Land clearing	Lightly wooded country (including partly cleared forests) near daytime shelter e.g. thickets or long grass.	No Species Locally Extinct	None
Australasian Bittern <i>Botaurus poiciloptilus</i>	VU	S1	EN					Land clearing (wetlands/swamps)	Freshwater wetlands, occasionally estuarine; prefers heavy vegetation such as beds of tall dense <i>Typha</i> , <i>Baumea</i> and sedges in freshwater swamps.	No	None
Black Bittern <i>Ixobrychus flavicollis</i>			LC	P2		Yes (1931)		Land clearing (wetlands/swamps)	Freshwater pools, swamps and lagoons, well screen with trees. Shelters in dense waterside vegetation.	No	None
Little Bittern <i>Ixobrychus minutus</i>			LC	P4				Land clearing (wetlands/swamps)	Dense beds of Freshwater pools, swamps and lagoons, well screen with trees. Shelters in dense beds of <i>Typha</i> , <i>Baumea</i> and tall rushes in freshwater swamps around lakes and along rivers.	No	None
Forest Red-tailed Black Cuckoo <i>Calyptrornis bairdii</i>	VU	S1	LC		Yes	Yes	Yes	Land clearing and logging.	This subspecies of the Red-tailed Black Cuckoo is restricted to the forests of the south-west. It requires tree hollows to nest and breed and is totally dependent on Jarrah-marri forest	Yes	Loss of foraging and breeding habitat
Baudin's Black-Cuckoo <i>Calyptrornis bairdii</i>	VU	S1	EN		Yes	Yes		Land clearing and illegal shooting	Heavily forested areas of the south-west, where it feeds on the seeds of eucalypts and various proteaceous species. It is a nomadic species. Breeding on the coastal plain mostly occurs in areas south of Mandurah during spring/summer, nesting in tree hollows (primarily Marri).	Yes	Loss of foraging and breeding habitat
Carnaby's Black-Cuckoo <i>Calyptrornis latirostris</i>	EN	S1	EN		Yes	Yes		Land clearing and illegal shooting	This species moves around in seasonal flocks to feeding areas in proteaceous scrubs and heaths and eucalypt woodlands as well as pine plantations. Breeding occurs in winter/spring mainly in eastern forest and where they can find mature hollow bearing trees to nest in though it appears this species is currently expanding its breeding range westward and south into the Jarrah – Marri forest of the Darling Scarp and into the Tuart forests of the Swan Coastal Plain including the region between Mandurah and Bunbury.	Yes	Loss of foraging and breeding habitat

Common Name/Species	Conservation Code				Actual Records or Listed as Potentially in General Area			Threatening Processes	Habitat Requirements	Habitat in Project Area/Quality	Potential Impact on Habitat
	EPBC Act Status	WAWC Act Status	ICUN Status	DEC Priority Status	EPBC Act Database	DEC Database	Birds Aust. Data Base				
Masked Owl <i>Tyto novaehollandiae</i>			LC	P3				Land clearing and logging	Roosts and nests in heavy forest, hunts over open woodlands and farmlands. Probably breeding in forested deep south west with some autumn-winter wanderings northwards	No Marginal	None
Barking Owl <i>Ninox connixens connixens</i>			LC	P2				Land clearing and logging	Dense vegetation, especially forest and thickets of waterside vegetation such as melaleucas. Roosts in tree hollows.	No	None
Fork-tailed Swift <i>Apus pacificus</i>	Migratory (CAMBA, JAMBA)		LC		Yes		None identified		Low to very high airspace over varied habitat from rainforest to semi desert.	Yes	None
Rainbow Bee-eater <i>Merops ornatus</i>	Migratory (JAMBA)		LC		Yes	Yes	Loss of roosting and breeding sites		Open Country, of woodlands, open forest, semi arid scrub, grasslands, clearings in heavier forest, farmlands. Common as a regular summer migrant to southern Australia (September to April) and breeds underground during this period in areas of suitable soft soil firm enough to support tunnel building.	Yes	Loss of breeding habitat
Western Ringtail Possum <i>Pseudocheirus occidentalis</i>	VU	S1	VU		Yes	Yes	Fox predation, Habitat loss and/or modification, changing fire regimes, damming		Western Ringtail Possums feed, rest and socialise in the canopy, primarily coastal peppermint woodlands and peppermint/uart associations. Inland, the largest known populations occur in the Upper Warren area east of Manjimup. In this area the Peppermint tree is naturally absent and Jarrah and Marri foliage constitutes the species staple diet. They require tree hollows and/or dense canopy for refuge and nesting.	Yes	Loss of foraging refuge and dispersal habitat
Chuditch <i>Dasyurus geoffroii</i>	VU	S1	VU		Yes	Yes	Competition from and predation by foxes and cats, land clearing, habitat alteration through removal of suitable den logs, poisoning, illegal shooting and road traffic.		This carnivorous marsupial occupies large home ranges, is highly mobile and appears to utilise bush remnant and corridors. Requires a medium sized hollow at or near ground level or will dig burrow under log or stump. Chuditch occur in a wide range of habitats but are more commonly found in woodland, forest and riparian vegetation.	No Species Locally Extinct	None
Southern Bush-tailed Phascogale <i>Phascogale tapoatafa</i>		S1	NT		Yes	Yes	Fox and cat predation, reduction in trees with suitable hollows and possibly altered fire regimes.		This arboreal marsupial occurs in forest and woodland, where suitable tree hollows are available. Requires small hollows. Prefers dense crown vegetation. Populations fluctuate dramatically in response to invertebrate prey abundance.	No Marginal	None
Quenda <i>Isodon obesulus fusciventris</i>			LC	P5			Fox predation and land clearing		This species prefers areas with dense understorey vegetation, particular around swamps and along watercourses that provide ample protection from predators.	No	None
Western Brush Wallaby <i>Macropus irma</i>			LC	P4		Yes	Fox predation.		The western brush wallaby prefers areas of forest and woodland supporting a dense shrub layer adjacent to small open areas.	No Species Locally Extinct	None
Quokka <i>Setonix brachyurus</i>	VU	S1	VU		Yes		Fox predation, altered fire regimes		Densely vegetated wetlands and tea-tree thickets along creek systems and dense heath on valley slopes. Peppermint and <i>Thomasia</i> species being dominant vegetation items in their diet	No Species Locally Extinct	None
Western False Pipstrelle <i>Falstrelia mackenziei</i>			NT	P4			Land clearing and logging.		This species of bat occurs in high jarrah forest and coastal woodlands. It roosts in small colonies in tree hollows and forages in the cathedral-like spaces between trees.	Yes Marginal	Loss of roosting habitat
WaterRat <i>Hydromys chrysogaster</i>			LC	P4	Yes		Fox predation and a decline in water quality.		Water rats occur along permanent watercourses where there are freshwater molluscs and crustaceans (its main prey), frogs, small mammals and water birds present. Requires healthy fresh (to brackish) water habitat containing diverse water and bank life.	No	None

## 6.5 VALUE OF THE STUDY AREA AS A WILDLIFE CORRIDOR

Linkage with adjacent bushland areas has been identified as a natural attribute of high priority in the assessment of a sites regional significance (EPA 2002a, Molly *et al* 2009). Two types of linked (or potentially linked) sequences of ecological communities were identified in the EPA's Strategy, vegetated sequences and river corridors. The vegetated sequences are further divided into two groups – those that link North-South predominantly along landforms and vegetation complexes; and those that link East-West across landform and vegetation complexes (EPA 2002a)

The Greater Bunbury Region (GBR) ecological linkages plan (Appendix 4, EPA 2003) shows the study area as being situated within the north south orientated McLarty/Kemerton/Twin Rivers/Preston River/Gwindinup linkage. Detailed analyses of potential ecological linkages recently completed for the south west (Molloy *et al* 2009) also shows the study area as being close to a regional ecological linkage.

Examination of air photos and observations made during the field reconnaissance survey shows the general area is largely cleared and the value of the remnant vegetation within the site relates more to its potential function as “stepping stones” rather than part of a continuous vegetated link. These “stepping stones” facilitate to a certain degree the maintenance of ecological processes and the movement of organisms within and across a landscape (Molloy *et al* 2009) and should if possible be maintained in the long term.

## 7. ECOLOGICAL IMPACTS AND MANAGEMENT

### 7.1 POTENTIAL IMPACTS

In general the most significant potential impacts to fauna of any development include:

- Loss of vegetation/fauna habitat that is used for foraging, breeding, roosting, or dispersal (includes loss of hollow bearing trees),
- Fragmentation of vegetation/fauna habitat which may restrict the movement of some fauna species,
- Modifications to surface hydrology, siltation of creek lines,
- Changes to fire regimes,
- Pollution (e.g. oil spills),

- Noise/Light,
- Spread of plant pathogens (e.g. dieback) and weeds,
- Potential increase in the number of predatory introduced species (e.g. domestic cats), and
- Death or injury of fauna during clearing and construction.

The exact nature of any development at the site is not finalised and therefore the exact magnitude of the impact of fauna and fauna habitat cannot be predicted. If any future development requires the clearing of vegetation then the loss or degradation of fauna habitat is likely to result. The impact on the significant species listed as potentially being present will vary depending on their current degree of utilisation/population densities and preferred habitat requirements (e.g. quantity and quality of potential foraging and breeding habitat that is affected).

Of most significance is the presence on site of black cockatoo and Western Ringtail Possum habitat. Potential impacts on these species and/or their habitat will need to be addressed during the planning process and where reasonable and practical planning should aim to retain/protect and enhance habitat so that they can persist and/or continue to utilise the site.

## 7.2 MINIMISING IMPACTS

As the exact nature of any proposed development is unknown to the author the following generalised recommendations are presented and should be incorporated into the planning process where possible. The recommendations aim to reduce the impact on fauna and fauna habitat as much as reasonable and practicable. It is recommended that:

- Planning for development should where possible aim to retain and protect as much remnant vegetation on site. In particular the best quality woodland habitat as identified in EPA Bulletin 1282 (EPA 2008) should be a priority for protection (part recommendation Area E – Lot 104).
- Landscaped areas should be revegetated with local seed stock that includes cockatoo food plants, specifically *Eucalyptus*, *Corymbia*, *Banksia*, *Hakea*, and *Allocasuarina*. The final selection of suitable species should be carried out after liaison with appropriate experts or local land care groups to ascertain which species are most suitable for the area.

- During site works areas requiring clearing should be clearly marked and access to other areas restricted to prevent accidental clearing of areas to be retained.
- No dead, standing or fallen timber should be removed unnecessarily. Logs (hollow or not) and other debris resulting from land clearing should be used to enhance fauna habitat in untouched and rehabilitated areas if possible.
- A Construction and Operations Fire Management Plan should be prepared to reduce the risk of unplanned fires and provide contingency measures to minimise any associated impacts. The plan will include a contingency and response plan in the event of any bushfires that commence as a result of the works on site.
- All staff working on site should be made aware that native fauna is protected. Personnel working on the project should not be allowed to bring firearms, other weapons or pets onsite.
- Native fauna injured during clearing or normal site operations should be taken to a designated veterinary clinic or a DEC nominated wildlife carer.
- Fuel storage facilities should be bunded.
- Any trenching required for services should be kept open for only as long as necessary and suitable escape ramps and bridging provided if the site is to be left unattended for extended periods. Significant sized trenches should be inspected for fauna immediately prior to filling.

Once detailed plans for the development of the study area are finalised the impact on fauna should be reviewed as site/species specific management plans may be required.

## **8. LEGISLATIVE OBLIGATIONS**

### **8.1 WILDLIFE CONSERVATION ACT 1950**

The objective of the *Wildlife Conservation Act 1950* is to provide for the protection of wildlife. The Act is administered by the Executive Director of the Department of Environment and Conservation, under the direction and control of the Minister for the Environment. Under section 14, "Protection of Fauna", of this Act, all fauna is wholly protected throughout the State at all times, unless declared by the Minister by notice in the Government Gazette. Under section 14(2)(ba) of The Act, Fauna Notices are made by the Minister for the Environment listing specially protected fauna.

Disturbance or destruction of any native fauna over and above that reasonably required for construction works and access is considered an offence under the Act and the developer should take the necessary steps to inform construction personnel of this fact. The developer should also, as part of their management plan implement procedures that will reduce the chances of wildlife being injured or killed during clearing and construction on the site.

## **8.2 COMMONWEALTH ENVIRONMENTAL PROTECTION & BIODIVERSITY CONSERVATION ACT 1999**

A number of fauna species known to or potentially present within the study area are listed under the federal *Environment Protection and Biodiversity Conservation Act (EPBC Act, 1999)*. The objective of the *EPBC Act* is to provide for the protection of the environment, especially those aspects that are of national significance, promote ecologically sustainable development, the conservation of biodiversity and a cooperative approach to the protection and management of the environment.

If an action (e.g. clearing of vegetation) is deemed to have a potential significant impact (as detailed in “Principal Significant Impact Guidelines 1.1” - DEW 2006) on listed species, a referral to the Department of Environment, Water, Heritage and the Arts (DEWHA) is required.

The results of the fauna assessment reported on here suggest that several species listed under the *EPBC Act* potentially utilise the study site to some degree and any the project should aim to avoid having a significant impact on any one of them. The conservation of as much vegetation as possible will simplify any referral or assessment process required under the *EPBC Act*. Where impacts cannot be avoided, every attempt to minimise impacts should be made. The recommendations made in section 7.2 are provided to facilitate this.

If the clearing of vegetation (including black cockatoo and WRP habitat) is unavoidable the DEWHA will typically request onsite mitigation through revegetation and retention of key habitat as part of the approval process. Currently a ratio of 4:1 is seen as a minimum requirement for offsetting cockatoo foraging habitat loss by way of plantings (i.e. 4ha for every 1ha lost). For WRPs the ratio is 3:1. Offsetting the loss of cockatoo breeding habitat by plantings is generally viewed by DEWHA as needing to be higher (in the region of 10:1).

Obligations under the *EPBC Act* should be re-assessed when development plans are finalised.

## 9. CONCLUSION

Potentially, 11 native mammals (includes eight bat species), 86 bird, 20 reptile and seven frog species could be expected to occur in or utilise at times, the study area. Thirteen introduced species could also occur. Of the 124 native animals that are listed as potentially occurring at the site, five are considered to be endangered/vulnerable or in need of special protection under state and/or federal law. In addition four migratory species may frequent the site at times and a single DEC priority species was identified as possibly present.

Planning of the proposal should take into account the potential presence of several species of conservation significance and impact on these species will need to be minimised so as to simplify any referral or assessment process required under the federal *EPBC Act* or the state administered EP Act. The recommendations made aim to reduce the impact on fauna and should be incorporated into the sites development plan where considered reasonable and practical.

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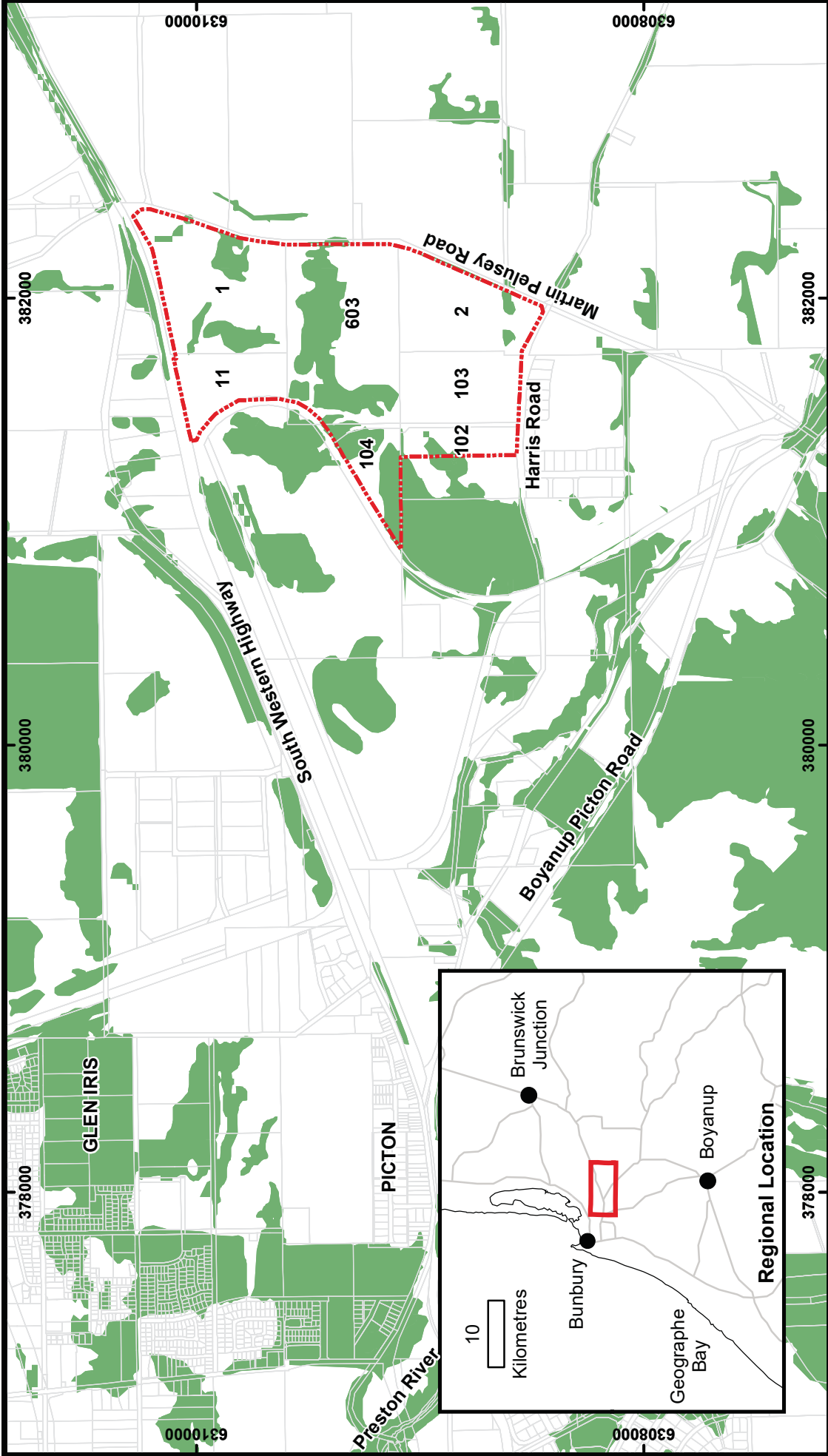
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# FIGURES

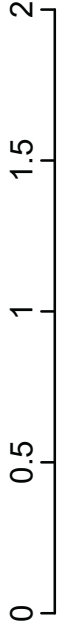


Fauna Survey

DRAWING: Harewood

DATE: Dec 2009




SCALE: 1:25,000



Kilometres

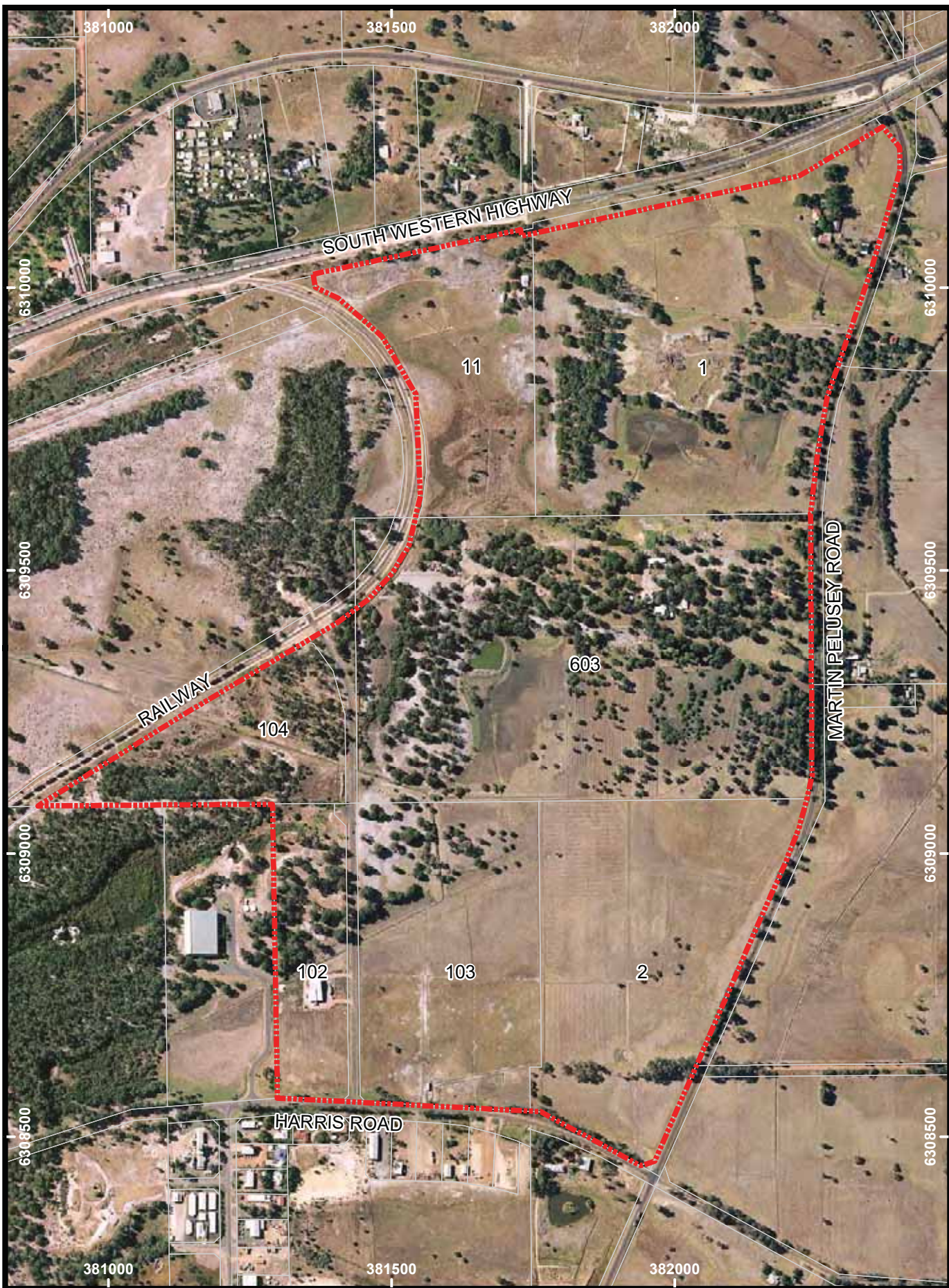
MGA Zone 50

**Legend**



-  Study area
-  Cadastral Boundaries (Existing)
-  Remnant Vegetation

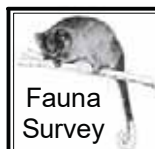
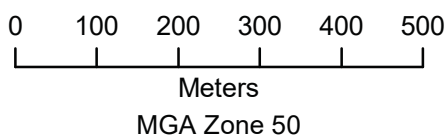
Picton East

**Study Area and Surrounds**



**Legend**

-  Cadastral Boundaries
-  Study area

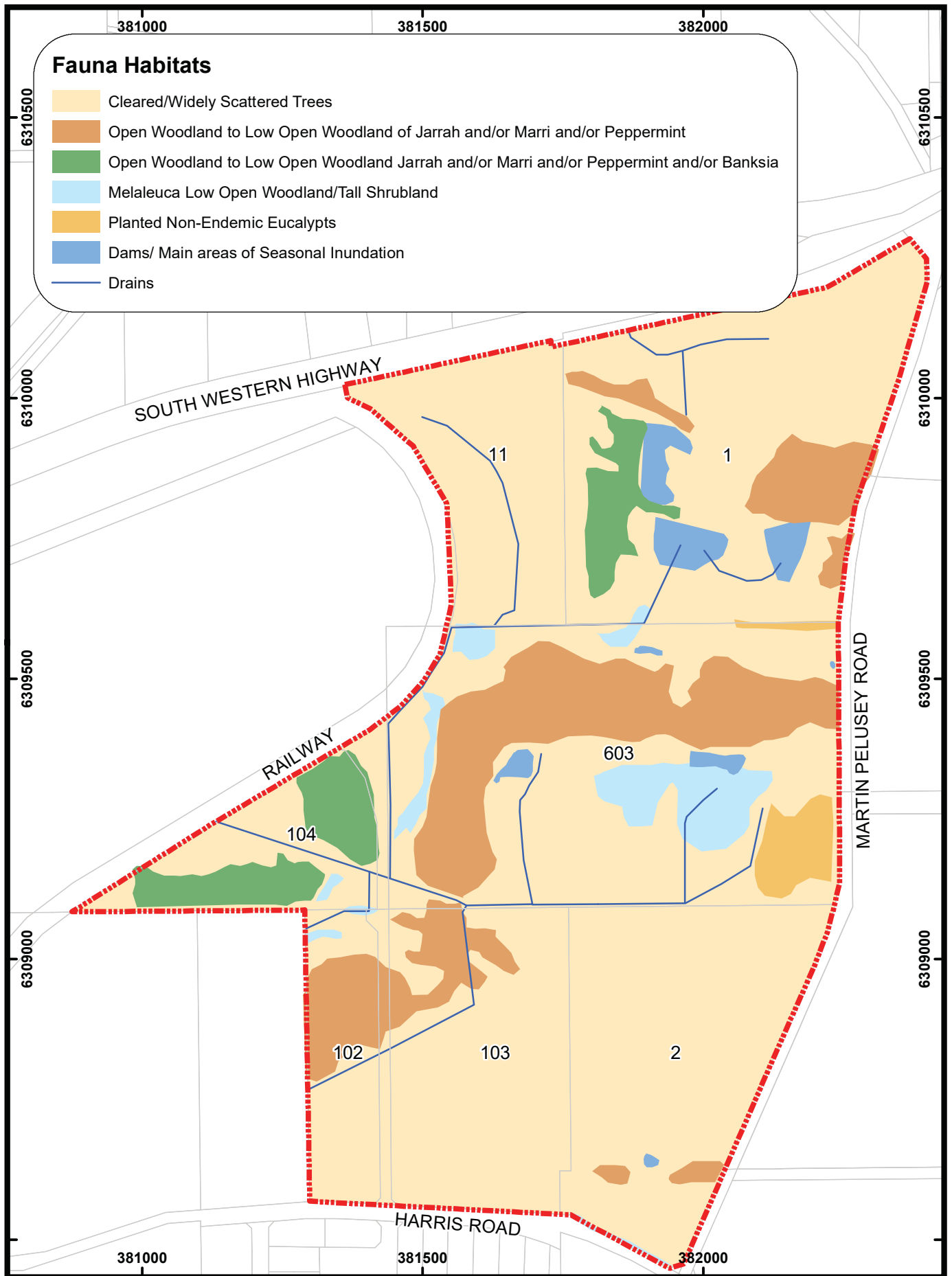


DRAWN: G Harewood  
 DATE: Dec 2009  
 SCALE: 1: 9,250

**Picton East**  
**Study Area**  
**Air Photo**

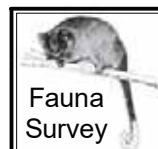
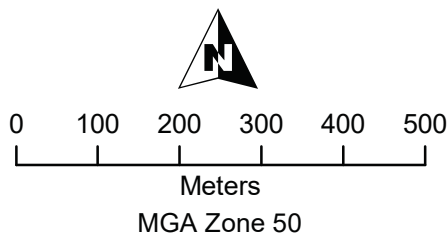
### Fauna Habitats

- Cleared/Widely Scattered Trees
- Open Woodland to Low Open Woodland of Jarrah and/or Marri and/or Peppermint
- Open Woodland to Low Open Woodland Jarrah and/or Marri and/or Peppermint and/or Banksia
- Melaleuca Low Open Woodland/Tall Shrubland
- Planted Non-Endemic Eucalypts
- Dams/ Main areas of Seasonal Inundation
- Drains



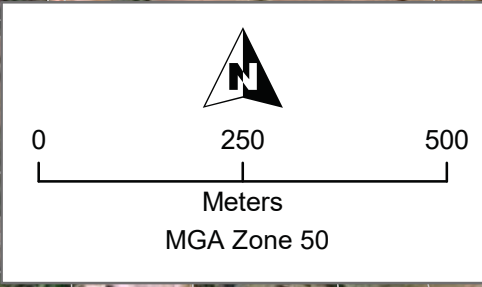
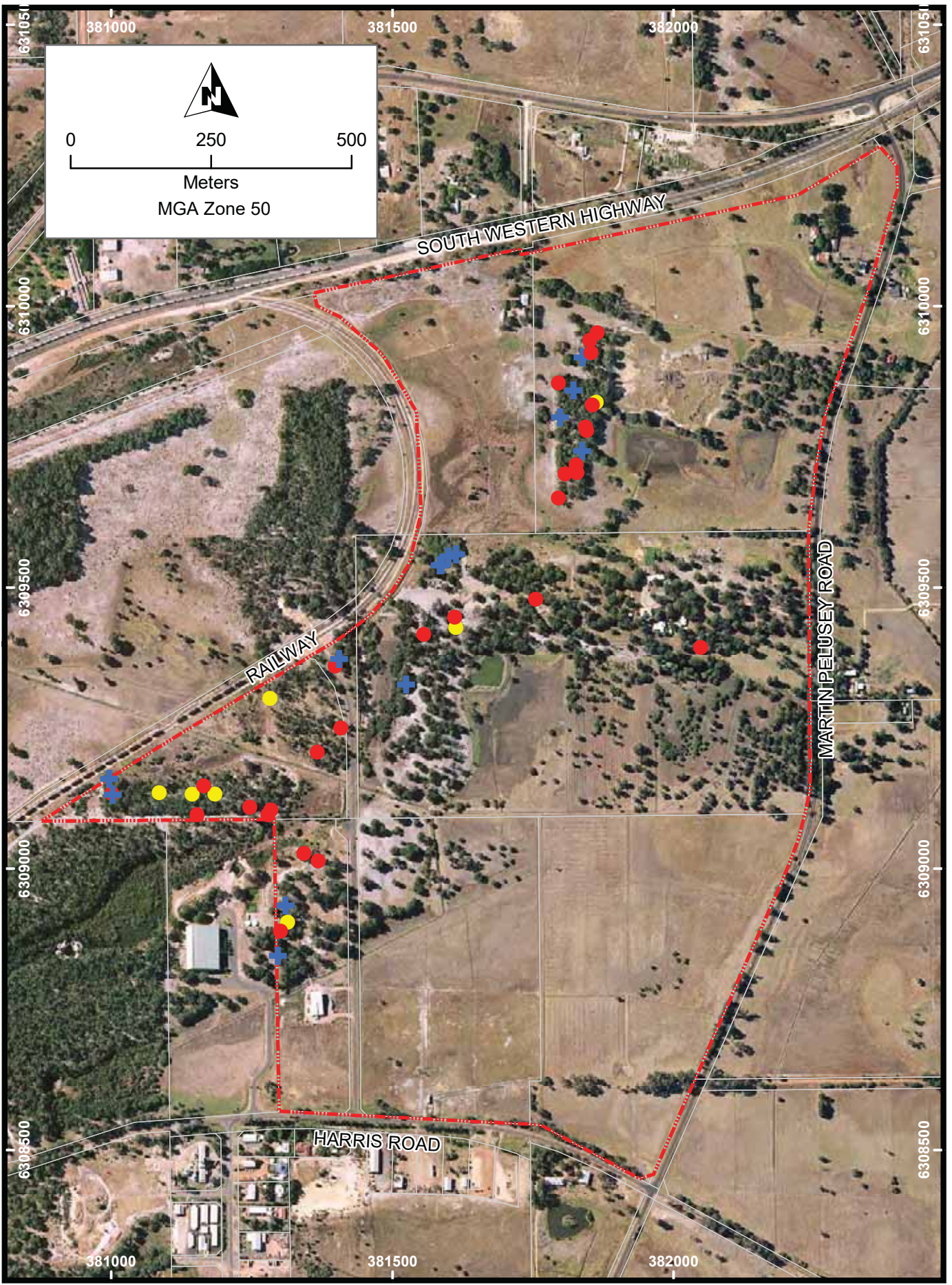
### Legend

- Cadastral Boundaries
- Study area



Fauna Survey  
 DRAWN: G Harewood  
 DATE: Dec 2009  
 SCALE: 1: 9,250

## Picton East Fauna Habitats



**Legend**

- Cadastral Boundaries
- Study area
- Habitat Tree with Small Hollows
- Habitat Tree with Large Hollows
- WRP Drey

**Fauna Survey**

DRAWN: G Harewood

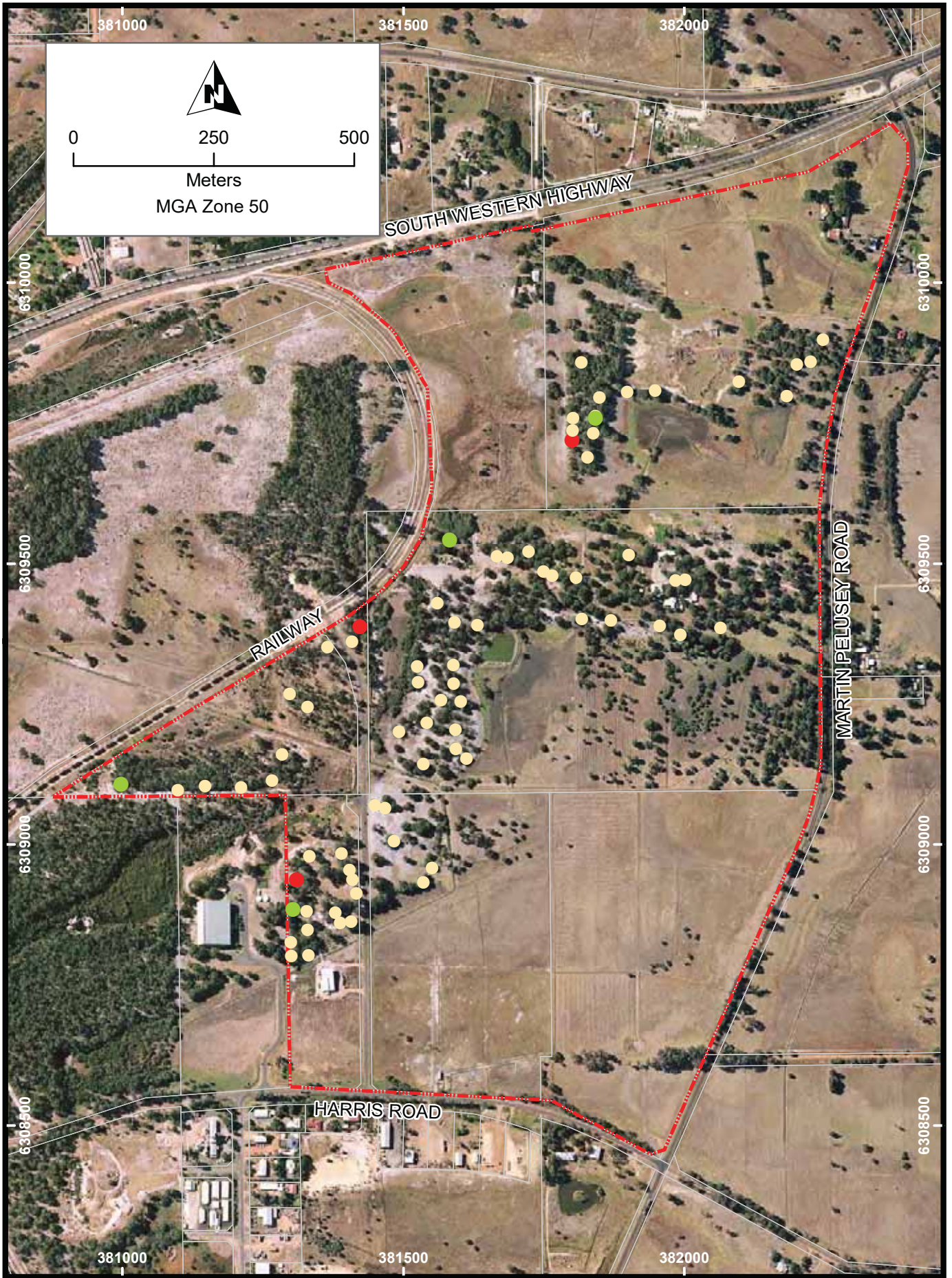
DATE: Oct 2009

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**Picton East**

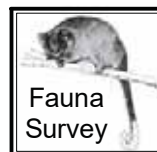
**Habitat Trees & WRP Dreys**





**Legend**

- Cadastral Boundaries
- Study area
- No WRP Scats Observed
- Small Number of WRP Scats Observed
- High Number of WRP Scats Observed



Fauna Survey  
DRAWN: G Harewood  
 DATE: Oct 2009  
 SCALE: 1: 9,250

**Picton East  
 WRP Scat  
 Densities**

# PLATES



Plate 1: Cleared pasture with scattered trees – Lot 2.



Plate 2: Low open woodland dominated by Banksia with various densities of Jarrah, Marri and Peppermint over very open low shrubland and grassland – Lot 104.



Plate 3: Open woodland of Jarrah and Marri over low open woodland of Peppermint over grassland – Lot 603.



Plate 4: Low open woodland of Melaleuca over seasonally inundated grassland – Lot 603.



Plate 5: Planted non-endemic Eucalypts – Lot 603.



Plate 6: Manmade Dam - Lot 603.

# **APPENDIX A**

## **CONSERVATION CATEGORIES**

## EPBC Act (1999) Threatened Fauna Categories

Category	Code	Description
Extinct	E	There is no reasonable doubt that the last member of the species has died.
*Extinct in the wild	EW	A species (a) is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
*Critically endangered	CE	A species is facing an extremely high risk of extinction in the wild in the immediate future.
*Endangered	EN	A species: (a) is not critically endangered; and (b) is facing a very high risk of extinction in the wild in the near future.
*Vulnerable	VU	A species (a) is not critically endangered or endangered; and (b) is facing a high risk of extinction in the wild in the medium-term future.
Conservation dependent	CD	A species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered
*Migratory	Migratory	(a) all migratory species that are: (i) native species; and (ii) from time to time included in the appendices to the Bonn Convention; and (b) all migratory species from time to time included in annexes established under JAMBA, CAMBA and ROKAMBA; and (c) all native species from time to time identified in a list established under, or an instrument made under, an international agreement approved by the Minister.
Marine	Ma	Species in the list established under s248 of the EPBC Act

Note: Only species in those categories marked with an asterisk are matters of national environmental significance under the EPBC Act.

### Western Australian Wildlife Conservation Act (1950) Threatened Fauna Categories

Category	Code	Description
Schedule 1	S1	Fauna which is rare or likely to become extinct
Schedule 2	S2	Fauna which is presumed extinct
Schedule 3	S3	Birds which are subject to an agreement between the governments of Australia and Japan (JAMBA) relating to the protection of migratory birds and birds in danger of extinction
Schedule 4	S4	Fauna that is otherwise in need of special protection

Note: The *WAWC Act* also uses the categories defined by the *EPBC Act* to further define the status of species in the S1 category.

### Western Australian DEC Priority Fauna Categories

Category	Code	Description
Priority 1	P1	Taxa with few, poorly known populations on threatened lands.
Priority 2	P2	Taxa with few, poorly known populations on conservation lands.
Priority 3	P3	Taxa with several, poorly known populations, some on conservation lands.
Priority 4	P4	Taxa in need of monitoring (Not currently threatened or in need of special protection, but could be if present circumstances change)
Priority 5	P5	Taxa in need of monitoring (Not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years)



## IUCN Red List Threatened Species Categories

Category	Code	Description
Extinct	EX	Taxa for which there is no reasonable doubt that the last individual has died.
Extinct in the Wild	EW	Taxa which is known only to survive in cultivation, in captivity or and as a naturalised population well outside its past range and it has not been recorded in known or expected habitat despite exhaustive survey over a time frame appropriate to its life cycle and form.
Critically Endangered	CR	Taxa facing an extremely high risk of extinction in the wild.
Endangered	EN	Taxa facing a very high risk of extinction in the wild.
Vulnerable	VU	Taxa facing a high risk of extinction in the wild.
Near Threatened	NT	Taxa which has been evaluated but does not qualify for CR, EN or VU now but is close to qualifying or likely to qualify in the near future.
Least Concern	LC	Taxa which has been evaluated but does not qualify for CR, EN, VU, or NT but is likely to qualify for NT in the near future.
Data Deficient	DD	Taxa for which there is inadequate information to make a direct or indirect assessment of its risk of extinction based on its distribution and/or population status.

A full list of categories and their meanings are available at:

[http://www.iucnredlist.org/info/categories\\_criteria2001#categories](http://www.iucnredlist.org/info/categories_criteria2001#categories)

# **APPENDIX B**

## **HABITAT TREE COORDINATES**

Habitat Trees Observed - Picton East

MGA

mN	mE	Description	Comments
6309013.543	381368.1255	Small hollow	bees
6309027.095	381342.8316	Small hollow	bees
6308889.263	381301.8665	Small hollow	
6309095.430	381278.7093	Small hollow	
6309105.116	381284.4912	Small hollow	
6309109.089	381246.7502	Small hollow	
6309096.101	381152.4456	Small hollow	
6309133.257	381001.9924	Small hollow	
6309147.263	381164.6898	Small hollow	
6309207.586	381366.3748	Small hollow	
6309250.973	381408.4975	Small hollow	
6309360.463	381398.9402	Small hollow	
6309447.140	381610.5469	Small hollow	
6309416.531	381555.8508	Small hollow	
6309479.397	381754.8785	Small hollow	
6309394.259	382048.6222	Small hollow	
6309823.655	381855.8548	Small hollow	
6309785.800	381843.4438	Small hollow	
6309778.613	381845.2346	Small hollow	
6309718.509	381827.0451	Small hollow	
6309704.295	381828.1490	Small hollow	bees
6309658.246	381795.8183	Small hollow	
6309702.563	381807.0705	Small hollow	
6309862.837	381795.1861	Small hollow	
6309917.709	381853.6200	Small hollow	
6309939.117	381851.3488	Small hollow	
6309953.140	381864.5157	Small hollow	
6308905.682	381314.2294	Large Hollow	
6309132.901	381184.5683	Large Hollow	
6309135.197	381085.1063	Large Hollow	
6309132.784	381144.2341	Large Hollow	
6309302.394	381282.5039	Large Hollow	
6309428.134	381613.4129	Large Hollow	
6309829.472	381862.7645	Large Hollow	

# **APPENDIX C**

**FAUNA OBSERVED OR POTENTIALLY IN STUDY AREA**

# Fauna Observed or Potentially in Study Area

Picton East - Picton, W.A.

33.347505°S 115.730545°E

Compiled by Greg Harewood - October 2009

Recorded (Sighted/Heard/Signs) = +

Class Family Species	Common Name	Conservation Status	Recorded October 2009
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## Amphibia

### Myobatrachidae

Ground or Burrowing Frogs

<i>Crinia georgiana</i>	Quacking Frog	LC	
<i>Crinia glauerti</i>	Clicking Frog	LC	+
<i>Crinia insignifera</i>	Squelching Froglet	LC	
<i>Heleioporus eyrei</i>	Moaning Frog	LC	
<i>Limnodynastes dorsalis</i>	Western Banjo Frog	LC	

### Hylidae

Tree or Water-Holding Frogs

<i>Litoria adelaidensis</i>	Slender Tree Frog	LC	
<i>Litoria moorei</i>	Motorbike Frog	LC	

## Reptilia

### Gekkonidae

Geckoes

<i>Christinus marmoratus</i>	Marbled Gecko		
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### Pygopodidae

Legless Lizards

<i>Lialis burtonis</i>	Burtens's Legless Lizard		
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### Agamidae

Dragon Lizards

<i>Pogona minor minor</i>	Western Bearded Dragon		
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### Varanidae

Monitor's or Goanna's

<i>Varanus gouldii</i>	Bungarra or Sand Monitor		
<i>Varanus rosenbergi</i>	Heath Monitor		

WAWC Act Status - S1 to S4, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, DEC Priority Status - P1 to P5, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions see Appendix and [www.iucnredlist.org/info/categories\\_criteria2001#categories](http://www.iucnredlist.org/info/categories_criteria2001#categories). LR=Low Risk, LC=Least Concern, DD=Data Deficient

Class Family Species	Common Name	Conservation Status	Recorded October 2009
<b>Scincidae</b>			
Skinks			
<i>Acritoscincus trilineatum</i>	South-western Cool Skink		
<i>Cryptoblepharus buchananii</i>	Fence Skink		+
<i>Ctenotus fallens</i>	West Coast Ctenotus		
<i>Ctenotus labillardieri</i>	Red-legged Ctenotus		
<i>Egernia kingii</i>	King's Skink		
<i>Egernia napoleonis</i>	South-western Crevice Egernia		
<i>Glaphyromorphus gracilipes</i>			
<i>Hemiergis peronii peronii</i>			
<i>Hemiergis quadrilineata</i>	Two-toed earless Skink		
<i>Lerista elegans</i>	West Coast Four-toed Lerista		
<i>Menetia greyii</i>	Dwarf Skink		
<i>Morethia lineoocellata</i>	West Coast Morethia		
<i>Tiliqua rugosa rugosa</i>	Western Bobtail		+
<b>Elapidae</b>			
Elapid Snakes			
<i>Notechis scutatus</i>	Tiger Snake		
<i>Pseudonaja affinis</i>	Dugite		
<b>Aves</b>			
<b>Casuariidae</b>			
Emus, Cassowaries			
<i>Dromaius novaehollandiae</i>	Emu	LC	+
<b>Phasianidae</b>			
Quails, Pheasants			
<i>Coturnix pectoralis</i>	Stubble Quail	LC	

WAWC Act Status - S1 to S4, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, DEC Priority Status - P1 to P5, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions see Appendix and [www.iucnredlist.org/info/categories\\_criteria2001#categories](http://www.iucnredlist.org/info/categories_criteria2001#categories). LR=Low Risk, LC=Least Concern, DD=Data Deficient

Class Family Species	Common Name	Conservation Status	Recorded October 2009
<b>Anatidae</b>			
Geese, Swans, Ducks			
<i>Anas gracilis</i>	Grey Teal	LC	+
<i>Anas platyrhynchos</i>	Mallard	Introduced	
<i>Anas superciliosa</i>	Pacific Black Duck	LC	+
<i>Chenonetta jubata</i>	Australian Wood Duck	LC	+
<i>Tadorna tadornoides</i>	Australian Shelduck	LC	+
<b>Podicipedidae</b>			
Grebes			
<i>Poliiocephalus poliocephalus</i>	Hoary-headed Grebe	LC	
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe	LC	+
<b>Ardeidae</b>			
Hérons, Egrets, Bitterns			
<i>Ardea alba</i>	Great Egret	Migratory CA JA	+
<i>Ardea ibis</i>	Cattle Egret	Migratory CA JA	
<i>Ardea novaehollandiae</i>	White-faced Heron	LC	+
<i>Ardea pacifica</i>	White-necked Heron	LC	+
<i>Nycticorax caledonicus</i>	Rufous Night Heron	LC	
<b>Threskiornithidae</b>			
Ibises, Spoonbills			
<i>Platalea flavipes</i>	Yellow-billed Spoonbill	LC	
<i>Threskiornis molucca</i>	Australian White Ibis	LC	+
<i>Threskiornis spinicollis</i>	Straw-necked Ibis	LC	+

WAWC Act Status - S1 to S4, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, DEC Priority Status - P1 to P5, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions see Appendix and [www.iucnredlist.org/info/categories\\_criteria2001#categories](http://www.iucnredlist.org/info/categories_criteria2001#categories). LR=Low Risk, LC=Least Concern, DD=Data Deficient

Class Family Species	Common Name	Conservation Status	Recorded October 2009
<b>Accipitridae</b>			
Kites, Goshawks, Eagles, Harriers			
<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk	LC	
<i>Accipiter fasciatus</i>	Brown Goshawk	LC	
<i>Aquila audax</i>	Wedge-tailed Eagle	LC	
<i>Aquila morphnoides</i>	Little Eagle	LC	
<i>Circus approximans</i>	Swamp Harrier	LC	
<i>Elanus caeruleus</i>	Black-shouldered Kite	LC	
<i>Haliastur sphenurus</i>	Whistling Kite	LC	
<b>Falconidae</b>			
Falcons			
<i>Falco berigora</i>	Brown Falcon	LC	
<i>Falco cenchroides</i>	Australian Kestrel	LC	+
<i>Falco longipennis</i>	Australian Hobby	LC	
<i>Falco peregrinus</i>	Peregrine Falcon	S4 LC	
<b>Rallidae</b>			
Rails, Crakes, Swamphens, Coots			
<i>Fulica atra</i>	Eurasian Coot	LC	+
<b>Columbidae</b>			
Pigeons, Doves			
<i>Columba livia</i>	Domestic Pigeon	Introduced	
<i>Ocyphaps lophotes</i>	Crested Pigeon	LC	
<i>Phaps chalcoptera</i>	Common Bronzewing	LC	+
<i>Streptopelia senegalensis</i>	Laughing Turtle-Dove	Introduced	

WAWC Act Status - S1 to S4, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, DEC Priority Status - P1 to P5, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions see Appendix and [www.iucnredlist.org/info/categories\\_criteria2001#categories](http://www.iucnredlist.org/info/categories_criteria2001#categories). LR=Low Risk, LC=Least Concern, DD=Data Deficient



Class Family Species	Common Name	Conservation Status	Recorded October 2009
<b>Psittacidae</b>			
Parrots			
<i>Cacatua roseicapilla</i>	Galah	LC	
<i>Cacatua sanguinea</i>	Little Corella	Introduced	
<i>Calyptorhynchus banksii naso</i>	Forest Red-tailed Black-Cockatoo	S1 VU VU Be LC	+
<i>Calyptorhynchus baudinii</i>	Baudin's Cockatoo	S1 EN Bp VU C2a(ii)	+
<i>Calyptorhynchus latirostris</i>	Carnaby's Cockatoo	S1 EN Bp EN A2bcd+3bcd	+
<i>Glossopsitta porphyrocephala</i>	Purple-crowned Lorikeet	LC	
<i>Neophema elegans</i>	Elegant Parrot	LC	
<i>Platycercus icterotis</i>	Western Rosella		
<i>Platycercus spurius</i>	Red-capped Parrot	LC	+
<i>Platycercus zonarius semitorquatus</i>	Twenty-eight Parrot	LC	+
<i>Polytelis anthopeplus</i>	Regent Parrot	LC	
<b>Cuculidae</b>			
Parasitic Cuckoos			
<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo	LC	
<i>Chrysococcyx basalis</i>	Horsfield's Bronze Cuckoo	LC	+
<i>Chrysococcyx lucidus</i>	Shining Bronze Cuckoo	LC	
<i>Cuculus pallidus</i>	Pallid Cuckoo	LC	
<b>Strigidae</b>			
Hawk Owls			
<i>Ninox novaeseelandiae</i>	Boobook Owl	LC	
<b>Tytonidae</b>			
Barn Owls			
<i>Tyto alba</i>	Barn Owl	LC	
<b>Podargidae</b>			
Frogmouths			
<i>Podargus strigoides</i>	Tawny Frogmouth	LC	
<b>Aegothelidae</b>			
Owlet-nightjars			
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar	LC	

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Class Family Species	Common Name	Conservation Status	Recorded October 2009
<b>Apodidae</b> Swifts, Swiftlets			
<i>Apus pacificus</i>	Fork-tailed Swift	Migratory CA JA LC	
<b>Halcyonidae</b> Tree Kingfishers			
<i>Dacelo novaeguinea</i>	Laughing Kookaburra	Introduced	
<i>Todiramphus sanctus</i>	Sacred Kingfisher	LC	+
<b>Meropidae</b> Bee-eaters			
<i>Merops ornatus</i>	Rainbow Bee-eater	Migratory JA LC	+
<b>Maluridae</b> Fairy Wrens, GrassWrens			
<i>Malurus splendens</i>	Splendid Fairy-wren	Bh LC	+
<b>Acanthizidae</b> Thornbills, Geryones, Fieldwrens & Whitefaces			
<i>Acanthiza apicalis</i>	Broad-tailed Thornbill	Bh LC	
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	Bh LC	+
<i>Acanthiza inornata</i>	Western Thornbill	Bh LC	
<i>Gerygone fusca</i>	Western Gerygone	LC	+
<i>Sericornis frontalis</i>	White-browed Scrubwren	Bh LC	+
<i>Smicrornis brevirostris</i>	Weebill	LC	
<b>Pardalotidae</b> Pardalotes			
<i>Pardalotus striatus</i>	Striated Pardalote	LC	+

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Class Family Species	Common Name	Conservation Status	Recorded October 2009
<b>Meliphagidae</b> Honeyeaters, Chats			
<i>Acanthorhynchus superciliosus</i>	Western Spinebill	LC	
<i>Anthochaera carunculata</i>	Red Wattlebird	LC	+
<i>Epthianura albifrons</i>	White-fronted Chat	LC	
<i>Lichenostomus virescens</i>	Singing Honeyeater	LC	
<i>Lichmera indistincta</i>	Brown Honeyeater	LC	+
<i>Phylidonyris nigra</i>	White-cheeked Honeyeater	Bp LC	
<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater	Bp LC	
<b>Neosittidae</b> Sitellas			
<i>Daphoenositta chrysoptera</i>	Varied Sittella	Bh LC	
<b>Pachycephalidae</b> Crested Shrike-tit, Crested Bellbird, Shrike Thrushes, Whistlers			
<i>Colluricincla harmonica</i>	Grey Shrike-thrush	LC	
<i>Pachycephala pectoralis</i>	Golden Whistler	Bh LC	+
<i>Pachycephala rufiventris</i>	Rufous Whistler	LC	+
<b>Dicruridae</b> Monarchs, Magpie Lark, Flycatchers, Fantails, Drongo			
<i>Grallina cyanoleuca</i>	Magpie-lark	LC	+
<i>Rhipidura fuliginosa</i>	Grey Fantail	LC	+
<i>Rhipidura leucophrys</i>	Willie Wagtail	LC	+
<b>Campephagidae</b> Cuckoo-shrikes, Trillers			
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	LC	+
<i>Lalage tricolor</i>	White-winged Triller	LC	
<b>Artamidae</b> Woodswallows, Butcherbirds, Currawongs			
<i>Artamus cinereus</i>	Black-faced Woodswallow	LC	
<i>Artamus cyanopterus</i>	Dusky Woodswallow	Bp LC	

WAWC Act Status - S1 to S4, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, DEC Priority Status - P1 to P5, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions see Appendix and [www.iucnredlist.org/info/categories\\_criteria2001#categories](http://www.iucnredlist.org/info/categories_criteria2001#categories). LR=Low Risk, LC=Least Concern, DD=Data Deficient

Class Family Species	Common Name	Conservation Status	Recorded October 2009
<b>Cracticidae</b>			
Currawongs, Magpies & Butcherbirds			
<i>Cracticus tibicen</i>	Australian Magpie	LC	+
<i>Cracticus torquatus</i>	Grey Butcherbird	LC	+
<b>Corvidae</b>			
Ravens, Crows			
<i>Corvus coronoides</i>	Australian Raven	LC	+
<b>Motacillidae</b>			
Old World Pipits, Wagtails			
<i>Motacilla alba</i>	White Wagtail	Migratory CA LC	+
<b>Dicaeidae</b>			
Flowerpeckers			
<i>Dicaeum hirundinaceum</i>	Mistletoebird	LC	
<b>Hirundinidae</b>			
Swallows, Martins			
<i>Hirundo neoxena</i>	Welcome Swallow	LC	+
<i>Hirundo nigricans</i>	Tree Martin	LC	
<b>Sylviidae</b>			
Old World Warblers			
<i>Cincloramphus cruralis</i>	Brown Songlark	LC	
<i>Cincloramphus mathewsi</i>	Rufous Songlark	LC	
<b>Zosteropidae</b>			
White-eyes			
<i>Zosterops lateralis</i>	Grey-breasted White-eye	LC	+
<b>Mammalia</b>			
<b>Phalangeridae</b>			
Brush-tail Possums, Cuscuses			
<i>Trichosurus vulpecula</i>	Common Brushtail Possum	LR/LC	+
<b>Pseudocheiridae</b>			
Ringtail Possums			
<i>Pseudocheirus occidentalis</i>	Western Ringtail Possum	S1 VU VU C2a	+
<b>Macropodidae</b>			
Kangaroos, Wallabies			
<i>Macropus fuliginosus</i>	Western Grey Kangaroo	LR/LC	+

WAWC Act Status - S1 to S4, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, DEC Priority Status - P1 to P5, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions see Appendix and [www.iucnredlist.org/info/categories\\_criteria2001#categories](http://www.iucnredlist.org/info/categories_criteria2001#categories). LR=Low Risk, LC=Least Concern, DD=Data Deficient

Class Family Species	Common Name	Conservation Status	Recorded October 2009
<b>Molossidae</b>			
Freetail Bats			
<i>Mormopterus planiceps</i>	Southern Freetail-bat	LR/LC	
<i>Tadarida australis</i>	White-striped Freetail-bat	LR/LC	
<b>Vespertilionidae</b>			
Ordinary Bats			
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	LR/LC	
<i>Chalinolobus morio</i>	Chocolate Wattled Bat	LR/LC	
<i>Falsistrellus mackenziei</i>	Western False Pipistrelle	P4 VU A2c	
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat	LR/LC	
<i>Nyctophilus gouldi</i>	Gould's Long-eared Bat	LR/LC	
<i>Vespadelus regulus</i>	Southern Forest Bat	LR/LC	
<b>Muridae</b>			
Rats, Mice			
<i>Mus musculus</i>	House Mouse	Introduced	
<i>Rattus rattus</i>	Black Rat	Introduced	
<b>Canidae</b>			
Dogs, Foxes			
<i>Vulpes vulpes</i>	Red Fox	Introduced	
<b>Felidae</b>			
Cats			
<i>Felis catus</i>	Cat	Introduced	
<b>Equidae</b>			
Horses			
<i>Equus caballus</i>	Horse	Introduced	+
<b>Bovidae</b>			
Horned Ruminants			
<i>Bos taurus</i>	European Cattle	Introduced	+
<i>Ovis aries</i>	Domestic Sheep	Introduced	+
<b>Leporidae</b>			
Rabbits, Hares			
<i>Oryctolagus cuniculus</i>	Rabbit	Introduced	+

WAWC Act Status - S1 to S4, EPBC Act Status - EN = Endangered, VU = Vulnerable, EX = Extinct, DEC Priority Status - P1 to P5, Int. Agmts - CA = CAMBA, JA = JAMBA, RK = ROKAMBA, Bush Forever Decreaser Species - Bh = habitat specialists, Bp = wide ranging species, Be = extinct in Perth Coastal Plain Region. IUCN Red List Category Definitions see Appendix and [www.iucnredlist.org/info/categories\\_criteria2001#categories](http://www.iucnredlist.org/info/categories_criteria2001#categories). LR=Low Risk, LC=Least Concern, DD=Data Deficient

# **APPENDIX D**

**DEC DATABASE SEARCH RESULTS & EPBC DATABASE SEARCH  
RESULTS**

33.2637°S 115.6131°E / 33.4432°S 115.8262°E

Picton area (plus ~10km buffer) #2857

\* *Date* *Certainty* *Seen* *Location Name* *Method***Schedule 1 - Fauna that is rare or is likely to become extinct*****Dasyurus geoffroii* Chuditch 1 records**

This carnivorous marsupial occupies large home ranges, is highly mobile and appears able to utilise bush remnants and corridors.

Date	Certainty	Seen	Location Name	Method
2000	1	1	Eaton/Pelican Point	Dead

***Phascogale tapoatafa* ssp. (WAM M434) Brush-tailed Phascogale, Wambenger 5 records**

This arboreal marsupial occurs in forest and woodland where suitable tree hollows are available. Populations fluctuate dramatically in response to invertebrate prey abundance.

Date	Certainty	Seen	Location Name	Method
1999	1	2	North Boyanup	Caught or trapped
2003	1	1	Glen Iris	Night sighting
2008	1	1	Bunbury	Dead
2008	1	1	College Grove	Night sighting
2008	1	1	Australind	Dead

***Pseudocheirus occidentalis* Western Ringtail Possum 22 records**

This species occurs in areas of forest and dense woodlands and requires tree hollows and/or dense canopy for refuge and nesting.

Date	Certainty	Seen	Location Name	Method
1998	1	1	Dalyellup	Night sighting
2003	1	1	Davenport	Day sighting
2005	1	1	Glen Iris/Vittoria	Dead
2006	1	1	Eaton	Day sighting
2006	1	1	Carey Park	Day sighting
2006	1	0	Millbridge/Waterloo	Dead
2006	2	1	Stratham	Dead
2006	1	2	Gelorup	Night sighting
2007	1	1	Eaton/Picton East	Dead
2007	1	2	Dardanup	Day sighting
2007	1	1	Waterloo	Day sighting
2007	1	3	Gelorup	Night sighting
2007	1	1	Eaton	Dead
2008	1	1	Bunbury	Dead
2008	1	1	Bunbury	Day sighting
2008	1	1	Gelorup	Dead
2008	1	1	Gelorup	Caught or trapped
2008	1	0	Gelorup	Definite signs
2008	1	1	Davenport	Dead
2008	1	1	Bunbury	Dead
2008	1	1	Glen Iris	Dead
2008	1	1	South Bunbury	Dead

***Diomedea exulans* Wandering Albatross 1 records**

This species is an occasional visitor to south and southwest coastal Western Australia. It breeds on subantarctic and antarctic islands.

Date	Certainty	Seen	Location Name	Method
1939	1	1	Bunbury	Dead

33.2637°S 115.6131°E / 33.4432°S 115.8262°E

Picton area (plus ~10km buffer) #2857

* Date	Certainty	Seen	Location Name	Method
<b><i>Macronectes giganteus</i></b> <b>Southern Giant Petrel</b> <b>1 records</b>				
2008	1	1	South Bunbury	Day sighting
<b><i>Thalassarche carteri</i></b> <b>Indian Yellow-nosed Albatross</b> <b>1 records</b>				
1939	1		Bunbury	Day sighting
<b><i>Thalassarche melanophrys</i></b> <b>Black-browed Albatross</b> <b>1 records</b>				
This species is an occasional visitor to south and southwest coastal Western Australia. It breeds on subantarctic and antarctic islands.				
1939	1		Bunbury	Day sighting
<b><i>Calyptorhynchus banksii naso</i></b> <b>Forest Red-tailed Black-Cockatoo</b> <b>2 records</b>				
This subspecies of the Red-tailed Black Cockatoo is restricted to the forests of the south-west. It requires tree hollows to nest and breed and is totally dependent on jarrah-marri forest.				
1999	1	3	"Green Patch"	Day sighting
2009	1	2	Eaton	Day sighting
<b><i>Calyptorhynchus baudinii</i></b> <b>Baudin's Black-Cockatoo</b> <b>3 records</b>				
This species is a seasonal visitor to the northern forests and adjacent eastern edge of the coastal plain, feeding on the seeds of eucalypts and various proteaceous species. It breeds in spring/summer in the southern forests, nesting in tree hollows (primarily in Marri).				
1939	2		Bunbury	Day sighting
1999	1	3	Bunbury	Day sighting
2008	1	6	Bunbury	Day sighting
<b><i>Calyptorhynchus latirostris</i></b> <b>Carnaby's Black-Cockatoo</b> <b>2 records</b>				
This species moves around seasonally in flocks to feeding areas in proteaceous scrubs and heaths and eucalypt woodlands as well as pine plantations. Breeding occurs in winter/spring, mainly in the eastern forests and wheatbelt where they can find mature hollow-bearing trees to nest in.				
1999	2	7	Bunbury	Day sighting
2003	1	1	Bunbury	Dead
<b><i>Psophodes nigrogularis nigrogularis</i></b> <b>Western Whipbird (western heath subsp)</b> <b>1 records</b>				
This subspecies is restricted to a small area east of Albany and inhabits areas of dense shrubland and coastal heath that is long unburnt.				
1898	1	0	Bunbury	Eggs
<b>Priority Three: Taxa with several, poorly known populations, some on conservation lands</b>				
<b><i>Ixobrychus flavicollis australis</i></b> <b>Black Bittern</b> <b>1 records</b>				
This species inhabits freshwater pools, swamps and lagoons, well screened with trees.				
1931	1		Picton	
<b>Priority Four: Taxa in need of monitoring</b>				
<b><i>Macropus irma</i></b> <b>Western Brush Wallaby</b> <b>3 records</b>				
This species occurs in areas of forest and woodland supporting a dense shrub layer.				
1986	1	1	Gelorup	
1999	1	1	Bunbury	Day sighting



33.2637°S 115.6131°E / 33.4432°S 115.8262°E

Picton area (plus ~10km buffer) #2857

* Date	Certainty	Seen	Location Name	Method
2008	1	1	Gelorup	Day sighting
<b><i>Hydromys chrysogaster</i> Water-rat, Rakali 2 records</b>				
This species occurs in waterways and wetlands that support its main prey items such as molluscs and crustaceans.				
1957	1	1	Bunbury	
1964	1	1	Bunbury	
<b><i>Burhinus grallarius</i> Bush Stonecurlew 1 records</b>				
A well camouflaged, ground nesting bird which prefers to 'freeze' rather than fly when disturbed. It inhabits lightly timbered open woodlands.				
1939	1		Bunbury	
<b><i>Charadrius rubricollis</i> Hooded Plover 1 records</b>				
This species frequents the margins and shallows of salt lakes, also along coastal beaches, where it forages for invertebrates along the water's edge.				
1998	1	85	Leschenault	Day sighting
<b><i>Numenius madagascariensis</i> Eastern Curlew 4 records</b>				
This species is a migratory visitor and has been observed on reef flats and sandy beaches along the West Australian coast and in coastal estuaries.				
1998	1	15	Leschenault	Day sighting
2000	1	7	Leschenault	
2001	1	7	Leschenault	
2004	1		Pelican Point	Day sighting
<b>Priority Five: Taxa in need of monitoring (conservation dependent)</b>				
<b><i>Isoodon obesulus fusciventer</i> Quenda 3 records</b>				
This species prefers areas with dense understorey vegetation, particularly around swamps and along watercourses, that provides ample protection from predators.				
1999	1	1	Bunbury	Dead
1999	2	0	Bunbury	Definite signs
2008	1	1	Gelorup	Day sighting

\* Information relating to any records provided for listed species:-

Date: date of recorded observation

Certainty (of correct species identification): 1=Very certain; 2=Moderately certain; and 3=Not sure.

Seen: Number of individuals observed.

Location Name: Name of reserve or nearest locality where observation was made

Method: Method or type of observation

## Protected Matters Search Tool

You are here: [Environment Home](#) > [EPBC Act](#) > [Search](#)

16 December 2009 19:29

# EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Information on the coverage of this report and qualifications on data supporting this report are contained in the [caveat](#) at the end of the report.

You may wish to print this report for reference before moving to other pages or websites.

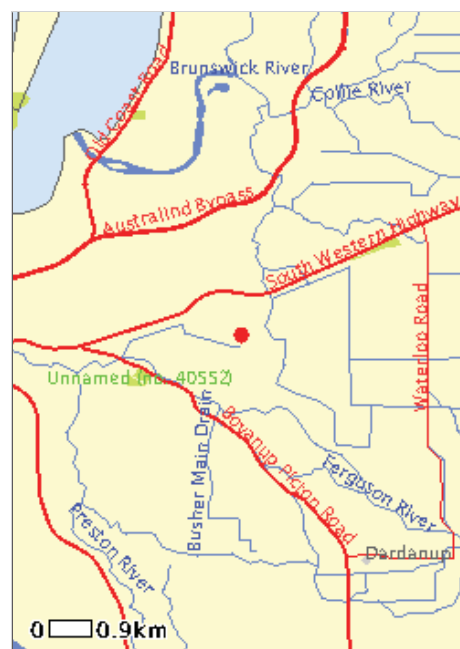
The Australian Natural Resources Atlas at <http://www.environment.gov.au/atlas> may provide further environmental information relevant to your selected area. Information about the EPBC Act including significance guidelines, forms and application process details can be found at <http://www.environment.gov.au/epbc/assessmentsapprovals/index.html>

**Search Type:** Point  
**Buffer:** 5 km  
**Coordinates:** -33.348528,115.729706



- Report Contents:** [Summary](#)  
[Details](#)
- [Matters of NES](#)
  - [Other matters protected by the EPBC Act](#)
  - [Extra Information](#)

[Caveat](#)  
[Acknowledgments](#)



This map may contain data which are  
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 (Geoscience Australia)  
 © PSMA Australia Limited

## Summary

### Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see <http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html>.

**World Heritage Properties:** None  
**National Heritage Places:** None  
**Wetlands of International Significance:  
 (Ramsar Sites)** None

<b>Commonwealth Marine Areas:</b>	None
<b><u>Threatened Ecological Communities:</u></b>	1
<b><u>Threatened Species:</u></b>	9
<b><u>Migratory Species:</u></b>	7

## Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage/index.html>.

Please note that the current dataset on Commonwealth land is not complete. Further information on Commonwealth land would need to be obtained from relevant sources including Commonwealth agencies, local agencies, and land tenure maps.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at <http://www.environment.gov.au/epbc/permits/index.html>.

<b><u>Commonwealth Lands:</u></b>	1
<b>Commonwealth Heritage Places:</b>	None
<b>Places on the RNE:</b>	None
<b><u>Listed Marine Species:</u></b>	5
<b>Whales and Other Cetaceans:</b>	None
<b>Critical Habitats:</b>	None
<b>Commonwealth Reserves:</b>	None

## Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

<b><u>State and Territory Reserves:</u></b>	1
<b>Other Commonwealth Reserves:</b>	None
<b>Regional Forest Agreements:</b>	None

## Details

### Matters of National Environmental Significance

Threatened Ecological Communities [ <a href="#">Dataset Information</a> ]	Status	Type of Presence
<a href="#">Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands of the Swan Coastal Plain</a>	Endangered	Community known to occur within area
Threatened Species [ <a href="#">Dataset Information</a> ]	Status	Type of Presence

**Birds**

<a href="#">Calyptorhynchus banksii naso</a> Forest Red-tailed Black-Cockatoo	Vulnerable	Species or species habitat may occur within area
<a href="#">Calyptorhynchus baudinii</a> Baudin's Black-Cockatoo, Long-billed Black-Cockatoo	Vulnerable	Breeding known to occur within area
<a href="#">Calyptorhynchus latirostris</a> Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo	Endangered	Breeding likely to occur within area

**Mammals**

<a href="#">Dasyurus geoffroii</a> Chuditch, Western Quoll	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Pseudocheirus occidentalis</a> Western Ringtail Possum	Vulnerable	Species or species habitat likely to occur within area
<a href="#">Setonix brachyurus</a> Quokka	Vulnerable	Species or species habitat may occur within area

**Ray-finned fishes**

<a href="#">Nannatherina balstoni</a> Balston's Pygmy Perch	Vulnerable	Species or species habitat may occur within area
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**Plants**

<a href="#">Darwinia sp. Muchea (B.J.Keighery 2458)</a> Muchea Bell	Critically Endangered	Species or species habitat likely to occur within area
<a href="#">Drakaea micrantha Hopper &amp; A.P.Brown nom. inval.</a> Dwarf Hammer-orchid	Vulnerable	Species or species habitat likely to occur within area
Migratory Species [ <a href="#">Dataset Information</a> ]	Status	Type of Presence

**Migratory Terrestrial Species****Birds**

<a href="#">Haliaeetus leucogaster</a> White-bellied Sea-Eagle	Migratory	Species or species habitat likely to occur within area
<a href="#">Merops ornatus</a> Rainbow Bee-eater	Migratory	Species or species habitat may occur within area

**Migratory Wetland Species****Birds**

<a href="#">Ardea alba</a> Great Egret, White Egret	Migratory	Breeding likely to occur within area
<a href="#">Ardea ibis</a> Cattle Egret	Migratory	Species or species habitat may occur within area

**Migratory Marine Birds**

<a href="#">Apus pacificus</a> Fork-tailed Swift	Migratory	Species or species habitat may occur within area
<a href="#">Ardea alba</a> Great Egret, White Egret	Migratory	Breeding likely to occur within area
<a href="#">Ardea ibis</a> Cattle Egret	Migratory	Species or species habitat may occur within area

**Other Matters Protected by the EPBC Act**

Listed Marine Species [ <a href="#">Dataset Information</a> ]	Status	Type of Presence
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**Birds**

<a href="#">Apus pacificus</a> Fork-tailed Swift	Listed - overfly marine area	Species or species habitat may occur within area
---	------------------------------	--

[Ardea alba](#)

Great Egret, White Egret

Listed -  
overfly  
marine  
area

Breeding likely to occur within area

[Ardea ibis](#)

Cattle Egret

Listed -  
overfly  
marine  
area

Species or species habitat may occur within area

[Haliaeetus leucogaster](#)

White-bellied Sea-Eagle

Listed

Species or species habitat likely to occur within area

[Merops ornatus](#)

Rainbow Bee-eater

Listed -  
overfly  
marine  
area

Species or species habitat may occur within area

Commonwealth Lands [ [Dataset Information](#) ]

Unknown

## Extra Information

State and Territory Reserves [ [Dataset Information](#) ]

Un-named (No. 46108) Nature Reserve, WA

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## Caveat

The information presented in this report has been provided by a range of data sources as [acknowledged](#) at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the *Environment Protection and Biodiversity Conservation Act 1999*. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under "type of presence". For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the [migratory](#) and [marine](#) provisions of the Act have been mapped.

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as [extinct or considered as vagrants](#)
- some species and ecological communities that have only recently been listed
- [some terrestrial species](#) that overfly the Commonwealth marine area
- migratory species that are very [widespread, vagrant, or only occur in small numbers](#).

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites;

- seals which have only been mapped for breeding sites near the Australian continent.

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

## Acknowledgments

This database has been compiled from a range of data sources. The Department acknowledges the following custodians who have contributed valuable data and advice:

- [New South Wales National Parks and Wildlife Service](#)
- [Department of Sustainability and Environment, Victoria](#)
- [Department of Primary Industries, Water and Environment, Tasmania](#)
- [Department of Environment and Heritage, South Australia Planning SA](#)
- [Parks and Wildlife Commission of the Northern Territory](#)
- [Environmental Protection Agency, Queensland](#)
- [Birds Australia](#)
- [Australian Bird and Bat Banding Scheme](#)
- [Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [Queensland Herbarium](#)
- [National Herbarium of NSW](#)
- [Royal Botanic Gardens and National Herbarium of Victoria](#)
- [Tasmanian Herbarium](#)
- [State Herbarium of South Australia](#)
- [Northern Territory Herbarium](#)
- [Western Australian Herbarium](#)
- [Australian National Herbarium, Atherton and Canberra](#)
- [University of New England](#)
- Other groups and individuals

[ANUcliM Version 1.8, Centre for Resource and Environmental Studies, Australian National University](#) was used extensively for the production of draft maps of species distribution. Environment Australia is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

[Department of the Environment, Water, Heritage and the Arts](#)

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Last updated: Thursday, 20-Nov-2008 14:17:56 EST

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# **APPENDIX E**

## **DETAILS OF SIGNIFICANT SPECIES**

### **Western Whipbird *Psophodes nigrogularis nigrogularis***

Status and Distribution: This subspecies of the Western Whipbird is classified as Schedule 1 under the *WAWC Act (1950)* and as Endangered under the *EPBC Act (1999)*. Originally found in South-west Western Australia along the west coast from Perth to Augusta and on the south coast from King Georges Sound east to at least Two People's Bay. Now restricted to a small area east of Albany between Mt Taylor and Cheyne Beach/Waychinicup R., notably Two People's Bay Nature Reserve and Mt Manypeaks.

Habitat: At Two Peoples Bay, the Western Whipbird occurs in dense shrubland with an open overstorey, the structure of the vegetation being more important than the floristics. All of the domed nests found have been in dense bushes in heath adjacent to thickets. On Mt Manypeaks, the subspecies also occurs in dense low mallee and shrubland. The birds feed mostly on or near the ground.

Likely presence in study area: Regionally extinct.

Potential impact of development: No impact on this species will occur as the result of development within the study area.

### **Hooded Plover *Charadrius rubricollis***

Status and Distribution: Listed as Priority 4 by DEC. In WA coastally west from Israelite Bay north to Jurien Bay and inland salt lakes more than 100km from the coast. In eastern Australia confined to suitable habitat from Jervis Bay (NSW) through Bass Strait and Tasmanian and west to Great Australian Bight in South Australia.

Habitat: Broad sandy ocean beaches and bays, coastal and inland salt lakes (Pizzey & Knight 2006).

Likely presence in study area: No suitable habitat.

Potential impact of development: No impact on this species will occur as the result of development within the study area.

### **Great Egret *Ardea alba***

Status and Distribution: This species of egret is listed as migratory under the *EPBC Act (1999)* and under international agreements to which Australia is a signatory. The Great Egret is common and very widespread in any suitable permanent or temporary habitat (Morcombe, 2003).



Species or species habitat listed as likely to occur in general area within EPBC database search.

Habitat: Wetlands, flooded pasture, dams, estuarine mudflats, mangroves and reefs (Morcombe 2003).

Likely presence in study area: Observed in flooded paster areas during the survey period. Likely to be a frequent visitor, in low numbers during wetter months of the year. Unlikely to breed onsite.

Potential impact of proposed development: Potential for the loss of some poor quality foraging habitat, however substantial areas of similar habitat are present in surrounding farmland and no significant impact on this species is anticipated.

### **Cattle Egret *Ardea ibis***

Status and Distribution: This species of egret is listed as migratory under the *EPBC Act 1999* and under international agreements to which Australia is a signatory. The Cattle Egret is common in the north sections of its range but is an irregular visitor to the better watered parts of the state (Johnstone and Storr 1998). The population is expanding (Morcombe 2003).

Species or species habitat listed as likely to occur in general area within EPBC database search.

Habitat: Moist pastures with tall grasses, shallow open wetlands and margins, mudflats (Morcombe 2003).

Likely presence in study area: Likely to be an infrequent visitor, in low numbers during wetter months of the year. Unlikely to breed onsite.

Potential impact of proposed development: Potential for the loss of some poor quality foraging habitat, however substantial areas of similar habitat are present in surrounding farmland and no significant impact on this species is anticipated.

### **White-bellied Sea Eagle *Haliaeetus leucogaster***

Status and Distribution: This species is listed as migratory under the *EPBC Act (1999)* and under international agreements to which Australia is a signatory. White-bellied sea eagles are moderately common to common on Kimberley and Pilbara islands, coasts and estuaries, on Bernier, Dorre and Dirk Hartog Is., in Houtman Abrolhos and in the Archipelago of the Recherche; rare to uncommon elsewhere (Johnstone and Storr 1998). Also found in New Guinea, Indonesia,

China, southeast Asia and India. Scarce near major coastal cities (Morcombe 2003).

Species or species habitat listed as likely to occur in general area within EPBC database search.

Habitat: They nest and forage usually near the coast over islands, reefs, headlands, beaches, bays, estuaries, mangroves, but will also live near seasonally flooded inland swamps, lagoons and floodplains, often far inland on large pools of major rivers. Established pairs usually sedentary, immatures dispersive (Morcombe 2003). White-bellied Sea-Eagles build a large stick nest, which is used for many seasons in succession.

Likely presence in study area: May fly over the site occasionally due to proximity to ocean and estuaries. Would however not be specifically attracted to the site as habitat unsuitable and is therefore not listed as a potential species.

Potential impact of proposed development: No impact on this species is anticipated.

#### **Peregrine Falcon *Falco perigrinus***

Status and Distribution: This species is listed as Schedule 4 under the *WAWC Act 1950*. Individuals of this species are uncommon/rare but wide ranging across Australia. Moderately common at higher levels of the Stirling Range, uncommon in hilly, north west Kimberley, Hamersley and Darling Ranges; rare or scarce elsewhere (Johnstone and Storr 1998).

Habitat: Diverse from rainforest to arid shrublands, from coastal heath to alpine (Morcombe 2003). Mainly about cliffs along coasts, rivers and ranges and about wooded watercourses and lakes (Johnstone and Storr 1998). The species utilises the ledges, cliff faces and large hollows/broken spouts of trees for nesting. It will also occasionally use the abandoned nests of other birds of prey.

Likely presence in study area: The species potentially utilises some sections of the study area as part of a much larger home range. No potential nest sites observed.

Potential impact of proposed development: No impact anticipated.

#### **Australasian Bittern *Botaurus poiciloptilus***

Status and Distribution: Classified as Schedule 1 under the *WAWC Act (1950)* and as Vulnerable under the *EPBC Act (1999)*. The species is uncommon to rare

(Morcombe, 2003), but locally common in wetter parts of south west (Johnstone and Storr 1998). Occurs north to Moora and east to Mt Arid (Johnstone and Storr 1998).

Habitat: Freshwater wetlands, occasionally estuarine; prefers heavy vegetation (Morcombe 2003) such as beds of tall dense *Typha*, *Baumea* and sedges in freshwater swamps (Johnstone and Storr 1998).

Likely presence in study area: No suitable habitat.

Potential impact of development: No impact on this species will occur as the result of development within the study area.

### **Black Bittern *Ixobrychus flavicollis***

Status and Distribution: Listed as Priority 2 by DEC. Occurs north to Yanchep and Northam and east to Albany (Johnstone and Storr 1998).

Habitat: Freshwater pools, swamps and lagoons, well screened with trees. Shelters in dense waterside vegetation (Johnstone and Storr 1998).

Likely presence in study area: No suitable habitat.

Potential impact of development: No impact on this species will occur as the result of development within the study area.

### **Little Bittern *Ixobrychus minutus***

Status and Distribution: Listed as Priority 4 by DEC. Occurs north to Moora and east to Two Peoples Bay; accidental or on migration further north and east and on Rottnest Island and central district (Condingup district) (Johnstone and Storr 1998).

Habitat: In south dense beds of Freshwater pools, swamps and lagoons, well screened with trees. Shelters in dense beds of *Typha*, *Baumea* and tall rushes in freshwater swamps around lakes and along rivers (Johnstone and Storr 1998).

Likely presence in study area: No suitable habitat.

Potential impact of development: No impact on this species will occur as the result of development within the study area.

**Bush Stone Curlew *Burhinus grallarius***

Status and Distribution: Listed as Priority 4 by DEC. Occurs over much of the western half of the state (and Kimberley) but rare to uncommon in the south of its range due to fox predation (Johnstone and Storr 1998).

Habitat: Lightly wooded country (including partly cleared forests) near daytime shelter e.g. thickets or long grass (Johnstone and Storr 1998).

Likely presence in study area: There is a single DEC database record from Bunbury 1939. No sightings since suggest the species is extinct in the general project area.

Likely presence in study area: Regionally extinct.

Potential impact of development: No impact on this species will occur as the result of development within the study area.



**Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso***

Status and Distribution: Listed as Scheduled 1 under the *WAWC Act (1950)* and as Vulnerable under the *EPBC Act (1999)*. Found in the humid and subhumid south west, mainly hilly interior, north to Gingin and east to Mt Helena, Christmas Tree Well, North Bannister, Mt Saddleback, Rock Gully and the upper King River (Johnstone and Storr 1998).

Habitat: Eucalypt forests, feeds on Marri, Jarrah, Blackbutt, Karri, Sheoak and Snottygobble. The Forest Red-tailed Black Cockatoo nests in the large hollows of Marri, Jarrah and Karri (Johnstone and Kirkby 1999). In Marri, the nest hollows of the Forest Red-tailed Black Cockatoo range from 8-14m above ground, the entrance is 12 – 41cm in diameter and the depth is one to five metres (Johnstone and Storr 1998).

Breeding commences in winter/spring. There are few records of breeding in the Forest Red-tailed Black Cockatoo (Johnstone and Storr 1998), but eggs are laid in October and November (Johnstone 1997; Johnstone and Storr 1998). Incubation period 29 – 31 days. Young fledge at 8 to 9 weeks (Simpson and Day 2004).

J	F	M	A	M	J	J	A	S	O	N	D

 Period in which breeding is most likely to commence  
 Period in which fledging/weening could extend through

Likely presence in study area: Three individuals were observed foraging during survey period. Other foraging evidence also observed (chewed Marri nuts). A number of hollow trees present in the study area are possibly suitable for nesting though no evidence of actual breeding observed.

Potential impact of development: Potential for the loss of foraging and breeding habitat. Significance of impact will depend on areas actually affected.



### **Baudin's Black- Cockatoo *Calyptorhynchus baudinii***

Status and Distribution: Listed as Scheduled 1 under the *WAWC Act (1950)* and as Vulnerable under the *EPBC Act (1999)*. Confined to the south-west of Western Australia, north to Gidgegannup, east to Mt Helena, Wandering, Quindanning, Kojonup, Frankland and King River and west to the eastern strip of the Swan Coastal Plain including West Midland, Byford, Nth Dandalup, Yarloop, Wokalup and Bunbury (Johnstone and Storr 1998). On the southern Swan Coastal Plain this cockatoo is in some areas resident but mainly a migrant moving from the deep south-west to the central and northern Darling Range. Between March and September most flocks move north and are concentrated in the northern parts of the Darling Range. During this period birds forage well out onto the southern Swan Coastal Plain to areas such as Harvey, Myalup, Bunbury, Capel, Dunsborough and Meelup. While generally more common in the Darling Range this species can also be common on parts of the southern Swan Coastal Plain especially in mid-August – September when flocks begin to return to their breeding quarters (Johnstone 2008).

Habitat: Mainly eucalypt forests where it feeds primarily on the Marri seeds, (Morcombe, 2003), Banksia, Hakeas and *Erodium* sp. Also strips bark from trees in search of beetle larvae (Johnstone and Storr 1998). This species of cockatoo nests in large tree hollows, 30–40 cm in diameter and more than 30 cm deep (Saunders 1974).

Baudin's Black-Cockatoo breeds in late winter and spring, from August to November or December (Gould 1972; Johnstone 1997; Saunders 1974; Saunders *et al.* 1985). Eggs laid in October (Johnstone and Storr 1998). Incubation is 28 – 30 days. Young fledge at 8 to 9 weeks (Simpson and Day 2004).

J	F	M	A	M	J	J	A	S	O	N	D

 Period in which breeding is most likely to commence  
 Period in which fledging/weening could extend througho

Likely presence in study area: Foraging evidence observed during the survey period (chewed Marri nuts and Banksia cones, grubbing on marri tree trunks). A number of hollow trees present in the study area are possibly suitable for nesting though no evidence of actual breeding observed.

Potential impact of development: Potential for the loss of foraging and breeding habitat. Significance of impact will depend on areas actually affected.

### **Carnaby's Black- Cockatoo *Calyptorhynchus latirostris***

Status and Distribution: Carnaby's Black Cockatoo is listed as Scheduled 1 under the *WAWC Act (1950)* and as Endangered under the *EPBC Act (1999)*. Confined to the south-west of Western Australia, north to the lower Murchison River and east to Nabawa, Wilroy, Waddi Forest, Nugadong, Manmanning, Durokoppin, Noongar (Moorine Rock), Lake Cronin, Ravensthorpe Range, head of Oldfield River, 20 km ESE of Condingup and Cape Arid; also casual on Rottnest Island (Johnstone and Storr 1998).

Habitat: Forests, woodlands, heathlands, farms; feeds on Banksia, Hakeas and Marri. Carnaby's Cockatoo has specific nesting site requirements. Nests are mostly in smoothed-barked eucalypts with the nest hollows ranging from 2.5 to 12m above the ground, an entrance from 23-30cm diameter and a depth of 0.1-2.5m (Johnstone and Storr, 1998).

Breeding occurs in winter/spring mainly in eastern forest and wheatbelt where they can find mature hollow bearing trees to nest in (Morcombe, 2003). Judging from records in the Storr-Johnstone Bird Data Bank, this species is currently expanding its breeding range westward and south into the Jarrah – Marri forest of the Darling Scarp and into the Tuart forests of the Swan Coastal Plain including the region between Mandurah and Bunbury. Carnaby's Black Cockatoo has been known to breed close to the town of Mandurah, as well as at Dawesville, Lake Clifton and Baldivis (pers. comm., Ron Johnstone, WA Museum) and there are small resident populations on the southern Swan Coastal Plain near Mandurah, Lake Clifton and near Bunbury. At each of these sites the birds forage in remnant vegetation and adjacent pine plantations (Johnstone 2008).

Carnaby's Black-Cockatoo lays eggs from July or August to October or November, with most clutches being laid in August and September (Saunders

1986). Birds in inland regions may begin laying up to three weeks earlier than those in coastal areas (Saunders 1977). The female incubates the eggs over a period of 28-29 days. The young depart the nest 10–12 weeks after hatching (Saunders 1977; Smith & Saunders 1986).

J	F	M	A	M	J	J	A	S	O	N	D

Period in which breeding is most likely to commence  
 Period in which fledging/weaning could extend through

Likely presence in study area: Foraging evidence observed during the survey period (chewed Marri nuts and Banksia cones). A number of hollow trees present in the study area are possibly suitable for nesting though no evidence of actual breeding observed.

Potential impact of development: Potential for the loss of foraging and breeding habitat. Significance of impact will depend on areas actually affected.

### **Barking Owl *Ninox connivens connivens***

Status and Distribution: Listed as Priority 2 by DEC. Found north to Perth (formerly) and east to Northam, Katanning and nearly to Bremer Bay. Declining in south west (Johnstone and Storr 1998).

Habitat: Dense vegetation, especially forest and thickets of waterside vegetation such as melaleucas (Johnstone and Storr 1998). Roosts in tree hollows.

Likely presence in study area: Habitat appears very marginal for this species and it is unlikely to be specifically attracted to the site. Not listed as a potential species.

Potential impact of development: No impact on this species is anticipated.

### **Masked Owl *Tyto novaehollandae novaehollandae***

Status and Distribution: Listed as Priority 3 by DEC. Found north to Yanchep and east to Yealering, Gnowangerup and Albany, casual further north. Locally common in south west but generally uncommon (Johnstone and Storr 1998).

Habitat: Roosts and nests in heavy forest, hunts over open woodlands and farmlands (Morcombe, 2003). Probably breeding in forested deep south west with some autumn–winter wanderings northwards (Johnstone and Storr 1998).

Likely presence in study area: Habitat appears very marginal for this species and it is unlikely to be specifically attracted to the site. Not listed as a potential species.

Potential impact of development: No impact on this species is anticipated.

### **Fork-tailed Swift *Apus pacificus***

Status and Distribution: The Fork-tailed Swift is listed as migratory under the *EPBC Act 1999* and under international agreements to which Australia is a signatory. It is a summer migrant (Oct-Apr) to Australia (Morcombe 2003).

Habitat: Low to very high airspace over varied habitat from rainforest to semi desert (Morcombe 2003).

Likely presence in study area: It is potentially an occasional summer visitor to the study area but is entirely aerial and largely independent of terrestrial habitats.

Potential impact of development: No impact on this species is anticipated.

### **Rainbow Bee-eater *Merops ornatus***

Status and Distribution: This species is listed as migratory under the *EPBC Act (1999)* and under international agreements to which Australia is a signatory. The Rainbow Bee-eater is a common summer migrant to southern Australia but in the north they are resident (Morcombe 2003).

Habitat: Open Country, of woodlands, open forest, semi arid scrub, grasslands, clearings in heavier forest, farmlands (Morcombe 2003). Breeds underground in areas of suitable soft soil firm enough to support tunnel building.

Likely presence in study area: Observed foraging and roosting onsite. Some areas suitable for breeding.

Potential impact of development: Despite the potential for breeding no significant impact on this species is anticipated as individuals onsite are unlikely to represent a substantial proportion of the population. It can be expected to continue to utilise the area, as it does now, despite any future development.

### **Chuditch *Dasyurus geoffroii***

Status and Distribution: Listed as Scheduled 1 under the *WC Act (1950)* and as Vulnerable under the *EPBC Act (1999)*. Formerly occurred over nearly 70 per cent of Australia. The Chuditch now has a patchy distribution throughout the



Jarrah forest and mixed Karri/Marri/Jarrah forest of southwest Western Australia. Also occurs in very low numbers in the Midwest, Wheatbelt and South Coast Regions with records from Moora to the north, Yellowdine to the east and south to Hopetoun.

Habitat: Chuditch are known to have occupied a wide range of habitats from woodlands, dry sclerophyll (leafy) forests, riparian vegetation, beaches and deserts. Riparian vegetation appears to support higher densities of Chuditch, possibly because food supply is better or more reliable and better cover is offered by dense vegetation. Chuditch appear to utilise native vegetation along road sides in the wheatbelt (CALM 1994). The estimated home range of a male Chuditch is over 15 km<sup>2</sup> whilst that for females is 3-4 km<sup>2</sup> (Sorena and Soderquist 1995).

Likely presence in study area: Locally extinct. Habitat within the study area is not suitable for a population of this species to persist.

Potential impact of development: No impact on this species is anticipated.

**Southern Brush-tailed Phascogale *Phascogale tapoatafa tapoatafa***

Status and Distribution: Listed as Scheduled 1 under the *WAWC Act (1950)*. Present distribution is believed to have been reduced to approximately 50 per cent of its former range. Now known from Perth and south to Albany, west of Albany Highway. Occurs at low densities in the northern Jarrah forest. Highest densities occur in the Perup/Kingston area, Collie River valley, and near Margaret River and Busselton (DEC information pamphlet). Records are less common from wetter forests.

Habitat: This subspecies has been observed in dry sclerophyll forests and open woodlands that contain hollow-bearing trees but a sparse ground cover. A nocturnal carnivore relying on tree hollows as nest sites. The home range for a female Brush-tailed Phascogale is estimated at between 20 and 70 ha, whilst that for males is given as twice that of females. In addition, they tend to utilise a large number (approximately 20) of different nest sites throughout their range (Soderquist, 1995).

Likely presence in study area: Better quality vegetation present to the west of the study area (Lot 200) maybe suitable, though the total area of the remnant would limit the long term viability of a population. Limited suitable habitat within the study area is marginal and would be unlikely to support a population of this species.

Potential impact of development: No impact on this species is anticipated.

### **Quenda *Isoodon obesulus fusciventer***

Status and Distribution: Listed as Priority 5 by DEC. Widely distributed in the south west from near Cervantes north of Perth to east of Esperance, patchy distribution through the Jarrah and Karri forest and on the Swan Coastal Plain, and inland as far as Hyden. Has been translocated to Julimar State Forest, Hills Forest Mundaring, Tutanning Nature Reserve, Boyagin Nature Reserve, Dongolocking Nature Reserve, Leschenault Conservation Park, and Karakamia and Paruna Sanctuaries (DEC information pamphlet) and Nambung National Park (DEC pers. coms.)

Habitat: Dense scrubby, often swampy, vegetation with dense cover up to one metre high, often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover. Populations inhabiting Jarrah and Wandoo forests are usually associated with watercourses. Quendas can thrive in more open habitat subject to exotic predator control (DEC information pamphlet).

Likely presence in study area: There is very limited areas of suitable habitat for this species to persist within the study area (dense groundcover) and it is unlikely that a population could exist on site.

Potential impact of development: No impact on this species is anticipated.

### **Western Ringtail Possum *Pseudocheirus occidentalis***

Status and Distribution: Listed as Scheduled 1 under the *WAWC Act (1950)* and as Vulnerable under the *EPBC Act (1999)*. Common in suitable habitat (de Tores 2008). The highest densities of this species are recorded in Peppermint habitat near Busselton area; relatively high densities are found in Jarrah/Marri forest at Perup (de Tores 2008).

The Western Ringtail Possum has a restricted distribution in south-western Western Australia. Most known populations (natural and translocated) are now restricted to near coastal areas of the south west from the Dawesville area to the Waychinicup National Park. Inland, it is also known to be relatively common in a small part of the lower Collie River valley, the Perup Nature Reserve and surrounding forest blocks near Manjimup. It was recently recorded in stands of Peppermint near the Harvey River and in Jarrah/Marri forest near Collie; however, the long term persistence of the species in these areas is not confirmed (de Tores et al. 2004). The Western Ringtail was formerly more widespread: in the 1970s it was known from Casuarina woodlands in the wheatbelt near Pingelly (south-east of Perth), and it is thought to have once occurred throughout much of

south-western Western Australia (but not necessarily continuously distributed) (Maxwell et al. 1996; de Tores 2008).

The species is widespread and relatively common in vegetated remnants within the Swan Coastal Plain and along the Whicher Scarp between Bunbury and Busselton (G. Harewood per. obs.). Most northern known natural population is centred on the Binningup townsite.

Habitat: The Western Ringtail Possum was once located in a variety of habitats including Coastal Peppermint, Coastal Peppermint-Tuart, Jarrah-Marri associations, Sheoak woodland, and eucalypt woodland and mallee. Coastal populations mostly inhabit Peppermint-Tuart associations with highest densities in habitats with dense, relatively lush vegetation. In these areas the main determinants of suitable habitat for WRPs appears to be the presence of *Agonis flexuosa* either as the dominant tree or as an understorey component of Eucalypt forest or woodland (Jones *et al.* 1994a). Inland, the largest known populations occur in the Upper Warren area east of Manjimup (Wayne *et al.* 2005). In this area the peppermint tree is naturally absent and jarrah-marri associations constitute the species refuge and foraging habitat.

Likely presence in study area: Appears to be present in low numbers in some sections of the study area. Evidence observed (dreys and scats) is possibly the result of transient individuals temporally residing in the area as opposed to a viable resident population. Despite current population levels significant areas of remnant vegetation on site represents potential habitat that may be considered important for recovery of the species in the long term.

Potential impact of development: Potential for the loss of foraging, refuge and/or dispersal habitat. Significance of impact will depend on areas actually affected.

### **Quokka *Setonix brachyurus***

Status and Distribution: Listed as Scheduled 1 under the *WC Act* (1950) and as Vulnerable under the *EPBC Act* (1999). Rare and restricted in south west W.A. from south of Perth to Two Peoples Bay. The distribution of the Quokka includes Rottnest and Bald Islands, and at least 25 known sites on the mainland, including Two Peoples Bay Nature Reserve, Torndirrup National Park, Mt Manypeaks National Park, Walpole-Nornalup National Park, and various swamp areas through the south-west forests from Jarrahdale to Walpole.

Species or species habitat listed as likely to occur in general area within EPBC database search.

Habitat: Mainland populations of this species are currently restricted to densely vegetated coastal heaths, swamps, riverine habitats including tea-tree thickets on sandy soils along creek systems where they are less vulnerable to predation. The species is nocturnal

Likely presence in study area: No suitable habitat.

Potential impact of development: No impact on this species is anticipated.

### **Western Brush Wallaby *Macropus irma***

Status and Distribution: Listed as Priority 4 by DEC. The Western Brush Wallaby is distributed across the south-west of Western Australia from north of Kalbarri to Cape Arid (DEC information pamphlet).

Habitat: The species optimum habitat is open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets. It is also found in some areas of mallee and heathland, and is uncommon in karri forest (DEC information pamphlet).

Likely presence in study area: Locally extinct. Remnants within the study area are two small and isolated to support a population or even transient individuals of this species.

Potential impact of development: No impact on this species is anticipated.

### **Western False Pipistrelle *Falsistrellus mackenziei***

Status and Distribution: Listed as Priority 4 by DEC. Listed as vulnerable by the ICUN. Confined to south west W.A. south of Perth and east to the wheat belt. Most records from Karri forests but also recorded in wetter stands of jarrah and tuart and woodlands on the Swan Coastal Plain (Menkhorst and Knight 2001). Range appears to be contracting southwards, presumably due to drying climate.

Habitat: This species of bat occurs in high forest and coastal woodlands. It roosts in small colonies in tree hollows and forages at canopy level and in the cathedral-like spaces between trees.

Likely presence in study area: Status in the area difficult to determine. May at least forage on site.

Potential impact of development: Potential for the loss of roosting habitat (hollow trees).

**Water Rat *Hydromys chrysogaster***

Status and Distribution: Listed as Priority 4 by DEC. The water rat is widely distributed around Australia and its offshore islands, New Guinea and some adjacent islands. It occurs in fresh brackish water habitats in the south-west of Western Australia, but occurs in marine environments along the Pilbara coastline and offshore islands. Previous survey work in the south west suggested this species was relatively common and widespread though difficult to capture (Christensen *et al* 1985, How *et al* 1987).

Habitat: The water rat occupies habitat in the vicinity of permanent water, fresh, brackish or marine. Likely to occur in all major rivers and most of the larger streams as well as bodies of permanent water in the lower south west (Christensen *et al* 1985).

Likely presence in study area: This species is unlikely to persist onsite.

Potential impact of development: No impact on this species is anticipated.



# Appendix F

Groundwater Levels and Quality Monitoring Report (TME 2012)









# Groundwater Levels & Quality Monitoring Report

## Lot 103 Harris Road & 96 Martin Pelusey Road, Picton East



Research, Design & Delivery of  
Sustainable Development

## DOCUMENT QUALITY CONTROL

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15.03.2012

**CHECKED BY**  
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**DATE**  
21.03.2012

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### VERSION TABLE

<b>No.</b>	<b>Purpose</b>	<b>Date</b>
<b>1</b>	<b>Submission to client</b>	<b>21.03.2012</b>
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**TME Town Planning Management Engineering Pty Ltd**

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## EXECUTIVE SUMMARY

*TME Town Planning Management Engineering Pty Ltd* (TME) has prepared this report on behalf of Harris Road Pty Ltd for the proposed industrial development. The subject land consists of Lot 103 on Diagram 96575 Harris Road and Lot 603 on Plan 246179 (96) Martin Pelusey Road, Picton East (see *Figure 1*).

The subject land is located in an area that exhibits high groundwater levels, including Multiple Use wetlands. This necessitated the requirement for monitoring of the superficial groundwater level across the land as per advice provided by the Department of Water. The Department of Water also required monitoring of physical and chemical parameters of the groundwater on-site due to the risks involved with the industrial nature of the development, and the close proximity of the Ferguson River to the subject land.

TME monitored groundwater levels at 9 monitoring bore sites across the subject land with regular measurements between October 2010 and December 2011. Quarterly quality sampling was undertaken at all bores over a period of 14 months.

The rainfall from April to December 2011 was approximately within the 50<sup>th</sup> percentile or greater for the land. However May and July were lower, approximately 40<sup>th</sup> and 20<sup>th</sup> percentiles respectively. The total rainfall during this period was less than 10mm greater than the long term average total. This data suggest that 2011 was a representative year for the average rainfall at the subject land, which therefore suggests that the seasonal peak high groundwater levels measured would be close the average annual maximum groundwater level (AAMGL).

The quality sampling of the groundwater found that Total Nitrogen and Total Phosphorus levels on the subject land exceeded the ANZECC and Department of Water Swan Coastal Plain trigger values. These results were however not unexpected given the past agricultural land uses. Iron and Aluminium also had high concentrations, however this is typical of the natural soils on the Swan Coastal Plain.

The subject land's high seasonal groundwater levels were modelled at less than 1 metre below the surface level across the majority of the subject land.

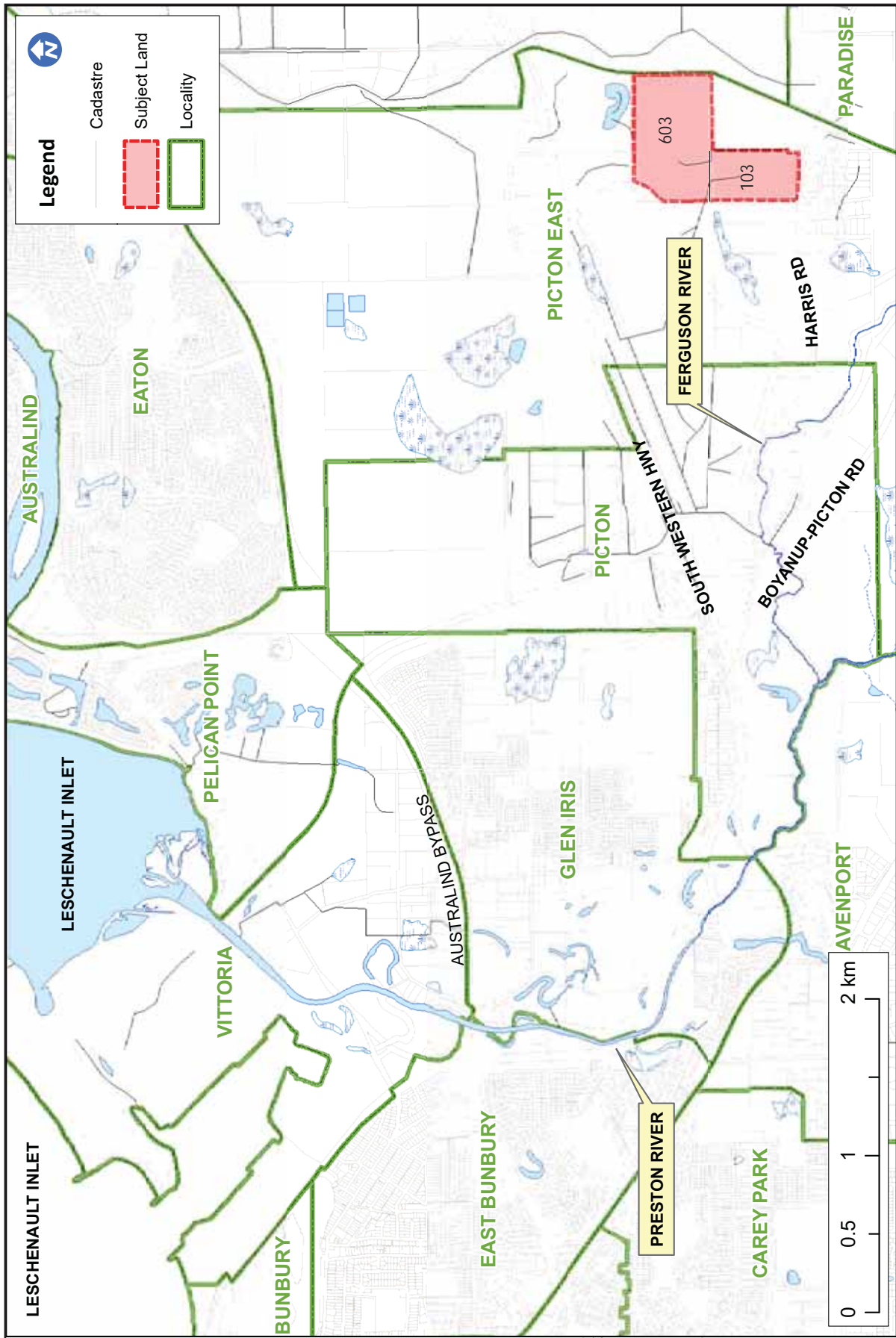


Figure 1 - Location Plan



## METHODOLOGY

In September 2010 9 water table monitoring bores were installed on the subject land and TME verified their installation (see *Figure 2* for locations). Monitoring bores were constructed to an average depth of 3m below the natural surface level. PVC casing pipes with slots were placed within the holes and the bottom of the pipe was capped. The monitoring bores were finished with free draining sand backfill and a bentonite plug.

TME monitored groundwater levels from October 2010 to December 2011. A total of 12 measurements were taken for each monitoring bore site during this period of time. All measurements were undertaken on the same day for every monitoring bore.

To obtain the measurement of the groundwater's level, an electrical sounder groundwater probe was lowered into the pipe until it signalled that it had reached the water table. The depth was recorded, and in the office the pipe height above the surface level was subtracted from the recorded measurement to ascertain the depth to the groundwater from the ground's surface.

Groundwater quality samples were taken from each of monitoring bores on 4 separate occasions in October 2010, April, October and December 2011. Physical and chemical parameters of the groundwater were tested. The physical parameters were measured in the field, and samples were taken and submitted to ALS Laboratory Group (NATA Accredited) for chemical analysis.

The physical and chemical parameters sampled from each of the monitoring bores are listed below. The trigger values used for analysis are shown in *Appendix 2*.

### *Physical Parameters*

- Temperature
- pH
- Conductivity
- Dissolved oxygen
- Oxidation reduction potential
- Salinity

### **Chemical Parameters**

- Alkalinity
- Nitrate-N
- Nitrite-N
- Ammonia-N
- Total Kjeldahl Nitrogen (TKN)
- Total Nitrogen (TN)
- Total Phosphorus (TP)
- Reactive Phosphorus
- Metals (Aluminium, Arsenic, Cadmium, Chromium, Copper, Lead, Manganese, Zinc and Iron)



Figure 2 - Monitoring Program and Groundwater Contour Plan



## RESULTS

### LEVELS

The general trend observed in the groundwater records across all bores was an increase in depths to groundwater (i.e. a lower groundwater table) between September and April or May, and a decrease in depths to groundwater (i.e. a rising groundwater table) between April or May and September (see *Figure 3*).

The following table (*Table 1*) summarises the highest seasonal groundwater levels (HSGL) and lowest seasonal groundwater levels (LSGL) recorded and the months when recorded, also the seasonal range of groundwater levels is included. All records within this report's tables are relative to the distance (in millimetres) of the water below the natural surface level measured at each monitoring bore.

For full details of recordings for each monitoring bore site please refer to *Appendix 1*.

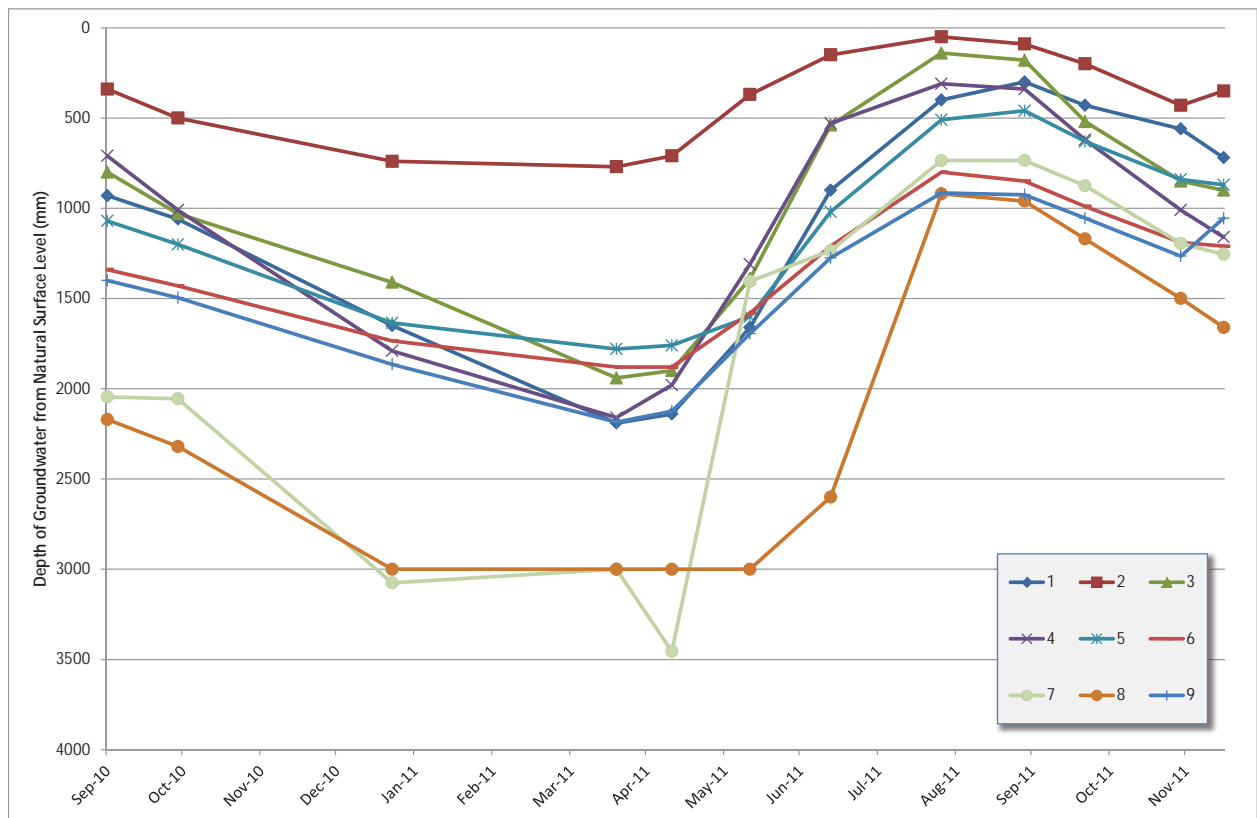


Figure 3 - Groundwater Hydrograph





Monitoring Bore No.	HSGL (mm)	Date(s) Recorded	LSGL (mm)	Date(s) Recorded	Range (mm)
1	300	Sep-11	2190	Apr-11	1890
2	50	Aug-11	770	Apr-11	720
3	140	Aug-11	1940	Apr-11	1800
4	310	Aug-11	2160	Apr-11	1850
5	460	Sep-11	1780	Apr-11	1320
6	80	Aug-11	1880	Apr to May-11	1080
7	735	Aug to Sep-11	DRY (>3000)	Apr-11	>2265
8	920	Aug-11	DRY (>3000)	Jan to Jun-11	>2080
9	915	Aug-11	2185	Apr-11	1270

*Table 1 - Summary of Groundwater Levels Monitoring Results*

The '>' recordings for the monitoring bores were made when no water was present within the bore's pipe when monitored. This meant that at the time of measurement, the groundwater level was lower than the base of the bore.

#### PHYSICAL PARAMETERS

The physical parameter results for the four sample runs for each monitoring bore are shown in *Appendix 3*. The sample records were compared to the Australian Drinking Water Guidelines (ADWG) and ANZECC Guidelines for south Western Australia.

The pH across the site was generally low (slightly acidic) with pH results predominantly between 5.01 and 6.71, which is generally below the ANZECC trigger value for surface waters in wetlands (7.0) and for the ADWG (aesthetic only) range of 6.5 to 8.

The dissolved oxygen saturated percentages were significantly less than the minimum value of 85%. These values however are based on surface water values, and are not an accurate in comparison to groundwater values, as there is minimal interaction to the atmosphere to oxygenate the water.

#### CHEMICAL PARAMETERS

##### *Total Nitrogen (TN)*

Each bore had at least one sample that exceeded the Swan Coastal Plain target value of 1.0mg/L. The concentrations ranged from 0.4 to 29.8mg/L. The majority of the nitrogen is comprised of Total Kjeldahl Nitrogen (TKN). Results are shown in *Table 2*.



Monitoring Bore	Total Nitrogen (mg/L)			
	26/10/2010	18/04/2011	21/10/2011	15/12/2011
1	0.6	1.2	8.0	4.8
2	5.0	4.4	2.4	3.0
3	6.8	4.5	3.9	2.5
4	0.8	0.4	4.2	1.3
5	6.5	1.5	3.0	1.6
6	6.3	9.2	1.4	4.9
7	1.6		7.4	3.0
8	2.2		7.2	3.3
9	4.3	29.8	11.0	3.9

*Table 2 – Total Nitrogen Sample Results.*

The yellow cell indicates that the value exceeds the Swan Coastal Plain trigger value (1.0mg/L), green cell indicates that the value exceeds the ANZECC wetland river trigger value (1.5mg/L), and orange cell indicated the value exceeds the ANZECC long-term irrigation trigger value (5.0mg/L).

*Total Phosphorus (TP)*

The sample results exceeded the Swan Coastal Plain target value of 0.1 mg/L for all runs at all bores, except for Bore 4's sample in April 2011. The TP ranged from 0.03 to 2.52mg/L. The results are shown in *Table 3*.

Monitoring Bore	Total Phosphorous (mg/L)			
	26/10/2010	18/04/2011	21/10/2011	15/12/2011
1	0.07	0.13	0.58	0.31
2	0.29	0.19	0.14	0.31
3	0.54	0.43	0.24	0.26
4	0.24	0.03	0.42	0.14
5	0.34	0.19	0.16	0.14
6	1.69	0.79	2.00	4.60
7	0.31		0.56	0.24
8	0.52		1.06	0.55
9	0.30	2.52	1.79	0.70

*Table 3 – Total Phosphorus Sample Results.*

The green cell indicates that the value exceeds the ANZECC wetland river trigger value (0.06mg/L), and the yellow cell indicates that the value exceeds the Swan Coastal Plain trigger value (0.1mg/L).



### Total Metals

From the results two metals are of note. Aluminium (Al) and Iron (Fe) regularly exceeded all trigger values (including short and long term irrigation). The maximum Aluminium recorded was at Bore 6, with a result of 146.0mg/L. This exceeds the short-term irrigation trigger value by 126mg/L. The lowest Aluminium record was 2.15mg/L at Bore 5, which is lower than the short-term (20mg/L) and long-term (5mg/L) irrigation trigger values

The other metal of note was Iron, with results regularly exceeding the short-term irrigation trigger value of 10mg/L. Bore 6 also recorded the highest Iron sample (146mg/L) in the same sampling period (18<sup>th</sup> April 2011), which is 136mg/L higher than the short-term irrigation trigger value. The lowest Iron record was 3.47mg/L at Bore 6 (6 months after recording the highest Iron value for the whole land).

The full results from the metal samples and remaining quality parameters tested are shown in *Appendix 4*.

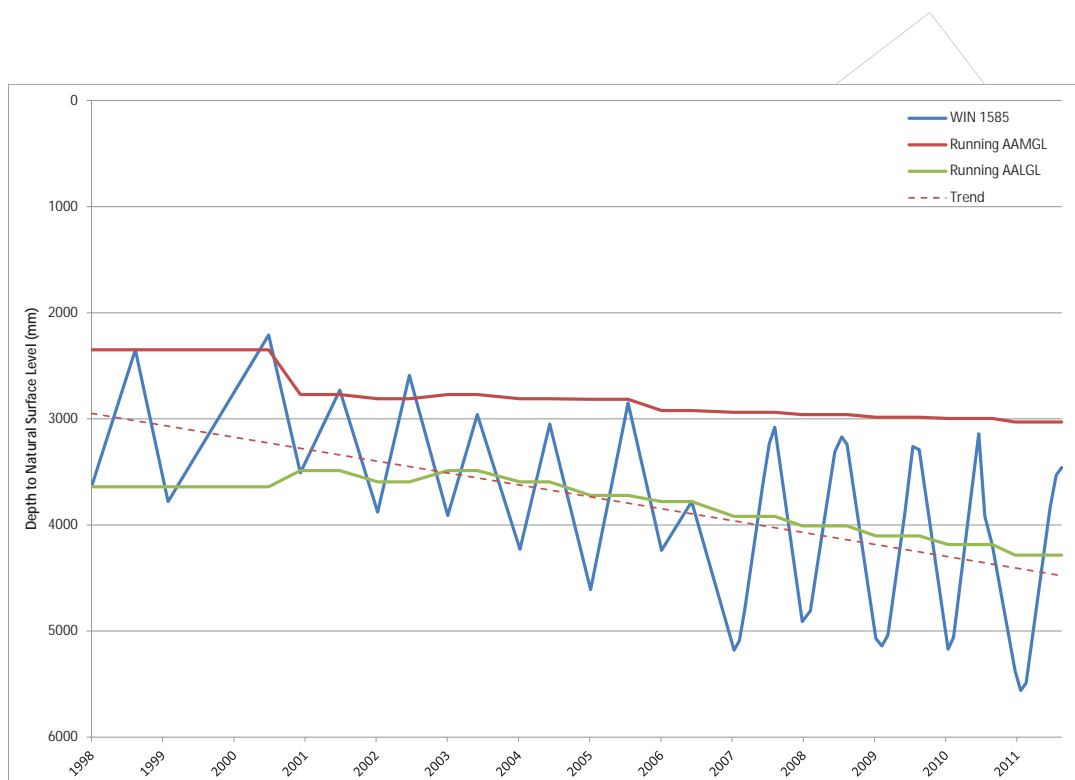


Figure 4 - DoW Bore (WIN 1585) Hydrograph



## DISCUSSION

### COMPARISON TO DEPARTMENT OF WATER MONITORING BORES

To ascertain the long-term water table patterns for the subject land a query of all the Department of Water (DoW) shallow groundwater monitoring bores within a 3km radius of the subject land was undertaken

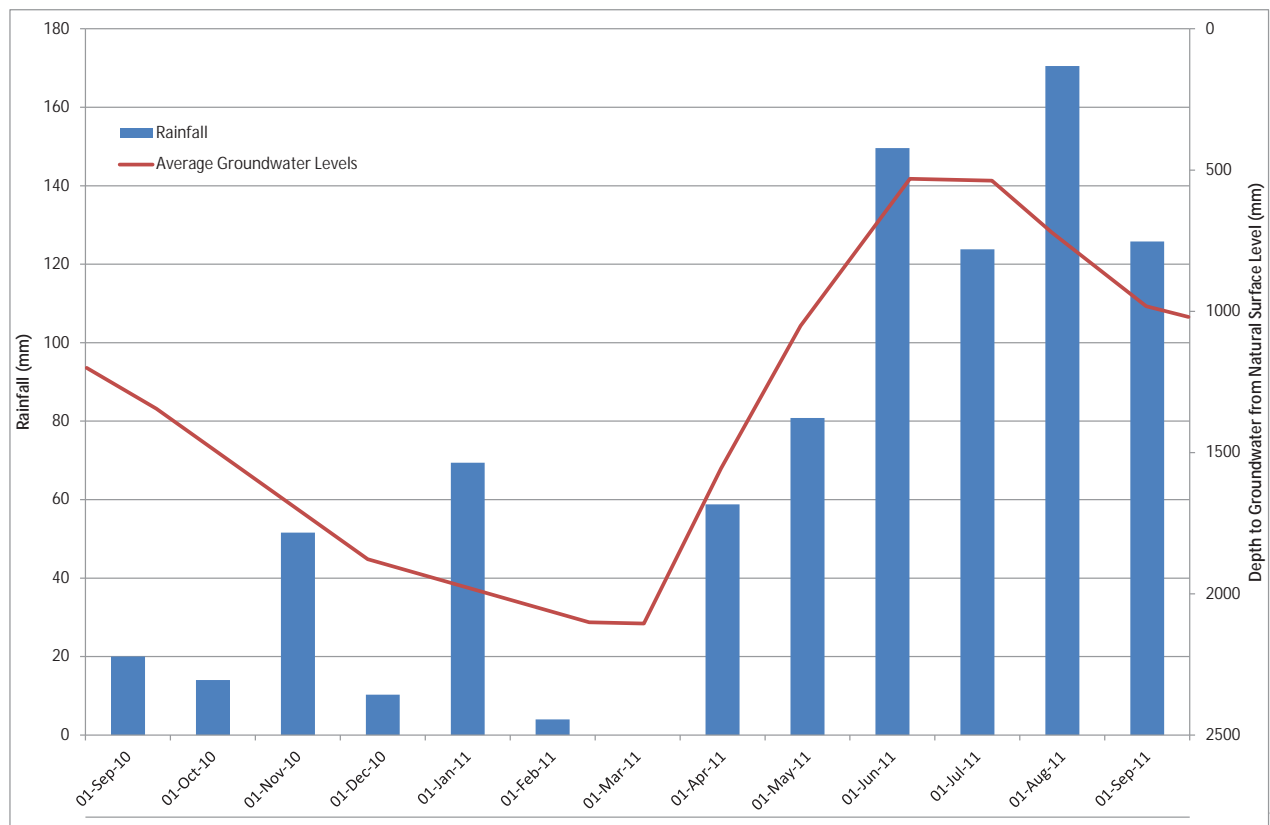


Figure 5 - Rainfall Hydrograph

by DoW on TME's behalf. Only one monitoring bores was determined to provide information considered marginally useful to compare with the subject land.

The monitoring bore shows a falling trend in the groundwater table since the commencement of records in 1998 (see Figure 4). The AAMGL at bore (WIN ID) 1585 has fallen over 650mm since 1998, and the 2011 highest peak level was 800mm deeper than the AAMGL in 1998. The AAMGL and average annual lowest groundwater level (AALGL) have steadily deepened since 1998.

The on-site drainage of surface water on the subject land, and the presence of groundwater at the surface across the majority suggest that comparisons with the DoW bore are not that useful. The DoW bore's AAMGL is around 3000mm below the natural ground surface, whilst the deepest seasonal high peak on the subject land was less than 1000mm below the natural surface. The majority of the bores were within 100mm of the surface. This suggests the DoW bore does not have a similar on-site drainage infrastructure or ponding of groundwater on the land as is evident at the subject land. The general trends observed in the DoW bore are the only real useful information available for comparison to the subject land.

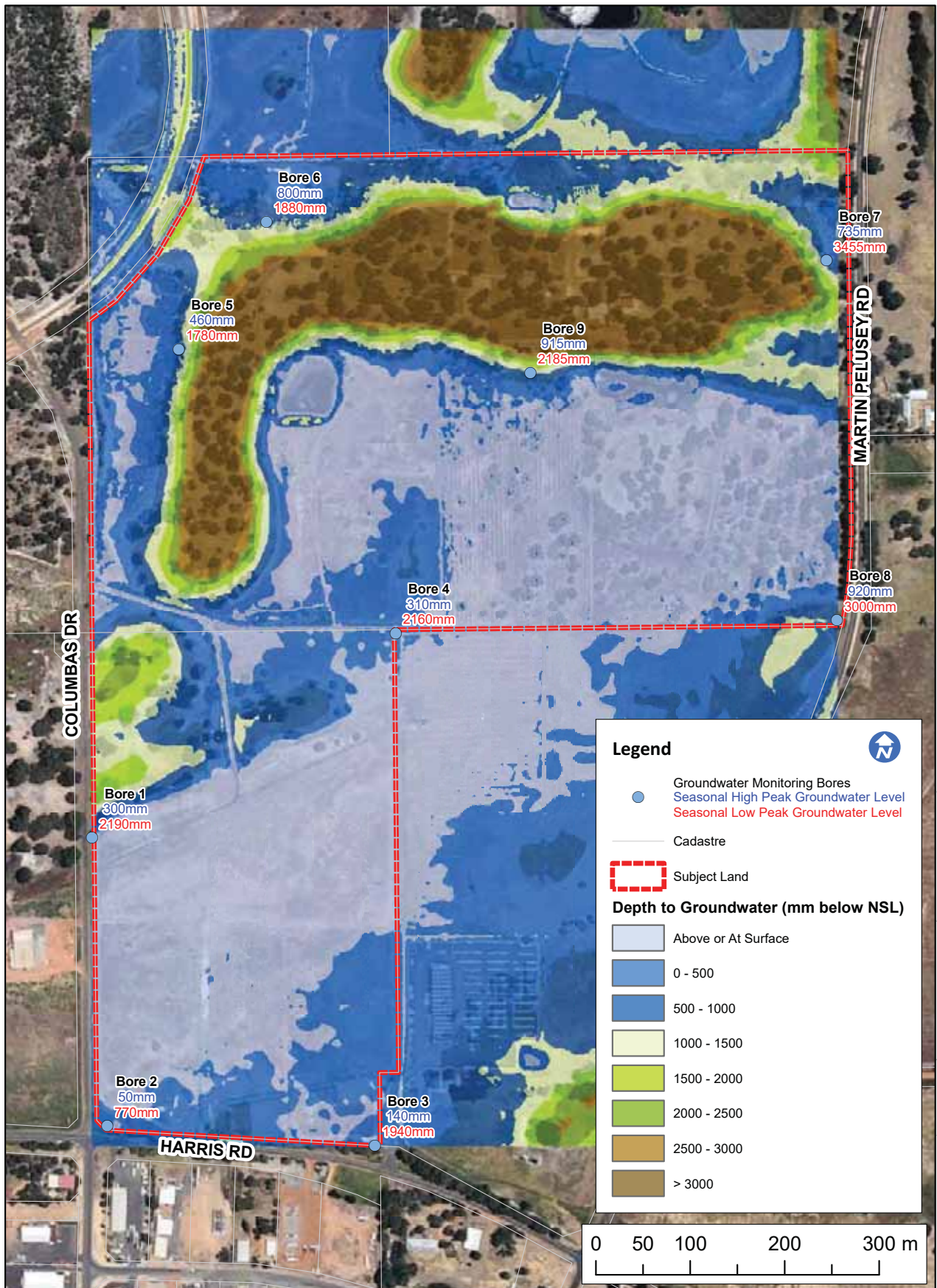


Figure 6 - Depth to Groundwater



### **COMPARISON TO RAINFALL PATTERNS**

The graph in *Figure 5* visually depicts a relationship between rainfall events and the water table level. The groundwater levels rose closer to the surface as rainfall increased. This implies that rainfall may directly recharge the shallow groundwater table at the site, and that there is little influence on the shallow water table from flows outside of the site.

### **DEPTH TO AVERAGE ANNUAL MAXIMUM GROUNDWATER LEVELS (AAMGL)**

The depth to the AAMGL across the subject land has been modelled in *Figure 6*. The depth to AAMGL for each bore was derived from modelling the groundwater contours for the site, and then subtracting the natural surface levels from these contours. There was no adjustment of the seasonal high peaks against the DoW bore because of the issues discussed in the last paragraph of the DoW comparison section, i.e. direct comparisons of the subject land and DoW bore were unrepresentative.

*Figure 8* shows that the groundwater depth is very shallow (less than 1m below natural surface level) for the majority of the subject land (shades of blue). It would be expected that groundwater levels may be shallower than modelled for the maximum groundwater levels (MGL). The ridge in the north is clearly visible in the model by the dark brown shading. This represents areas where the groundwater is greater than 3m below the natural surface level.

### **QUALITY**

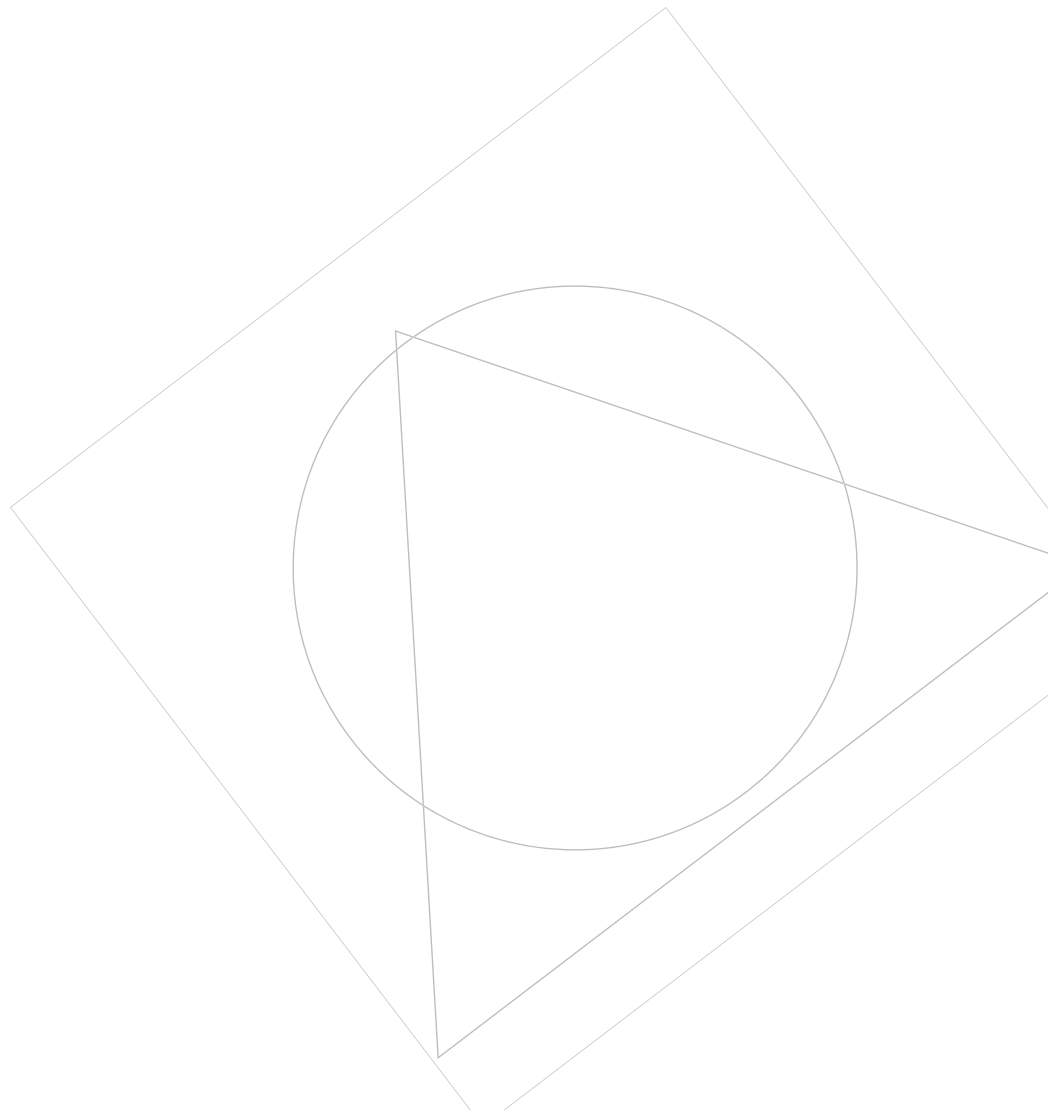
The high values of TN and TP within the groundwater were not unexpected given the past land use and presence of wetlands on the subject land. Sources of TN would include plant decay, animal wastes (especially from previous livestock grazing) and the use of fertilisers. The TP sources would primarily be from the agricultural practices on the land. Phosphorus and nitrogen in high concentrations (as recorded on the subject land) indicate the potential for algal growth and blooms in receiving water bodies, including the surrounding wetlands. The removal of stock and reduction of fertilisers on the land could assist in reducing TN and TP concentrations.

The sands on the Swan Coastal Plain are coated with both iron and aluminium oxides, and are the reason for the high concentrations of Aluminium and Iron recorded on the site. The high Iron and Aluminium concentrations in the groundwater may also suggest that these metals are coating the sand grains, which may increase the sands capacity to retain phosphorus. The Iron and Aluminium concentrations at each bore did at one stage exceed the guidelines for short and long term irrigation uses.

## **CONCLUSION**

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The results of this monitoring program should be utilised in any future studies and/or designs that require site specific information regarding groundwater levels (especially seasonal highs) and quality data. The results from 2011 provide a representative seasonal high level to model an maximum groundwater level for the subject land, which can be used for detailed designs.



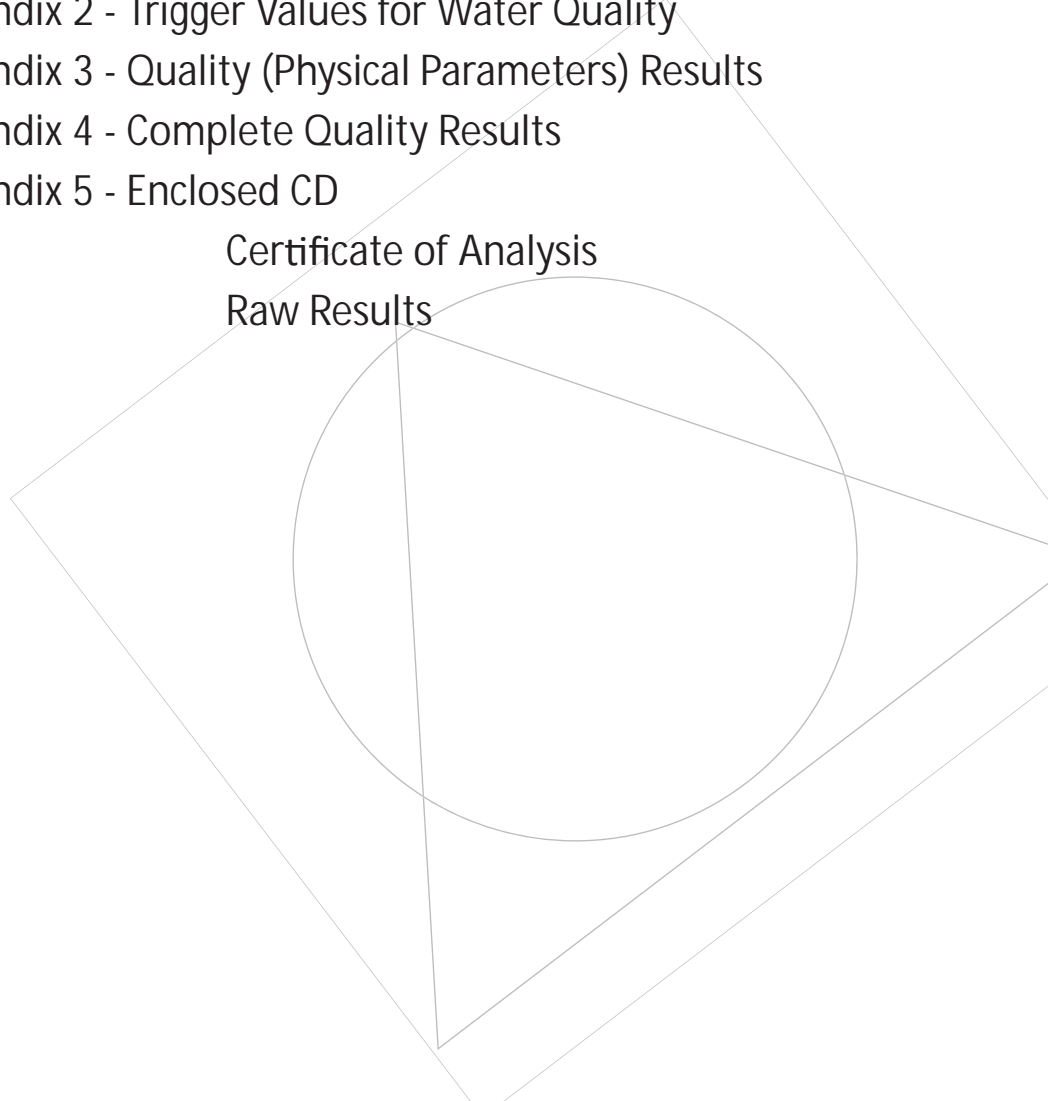


# APPENDICES

- Appendix 1 - Field Sheet Level Measurements
- Appendix 2 - Trigger Values for Water Quality
- Appendix 3 - Quality (Physical Parameters) Results
- Appendix 4 - Complete Quality Results
- Appendix 5 - Enclosed CD

Certificate of Analysis

Raw Results

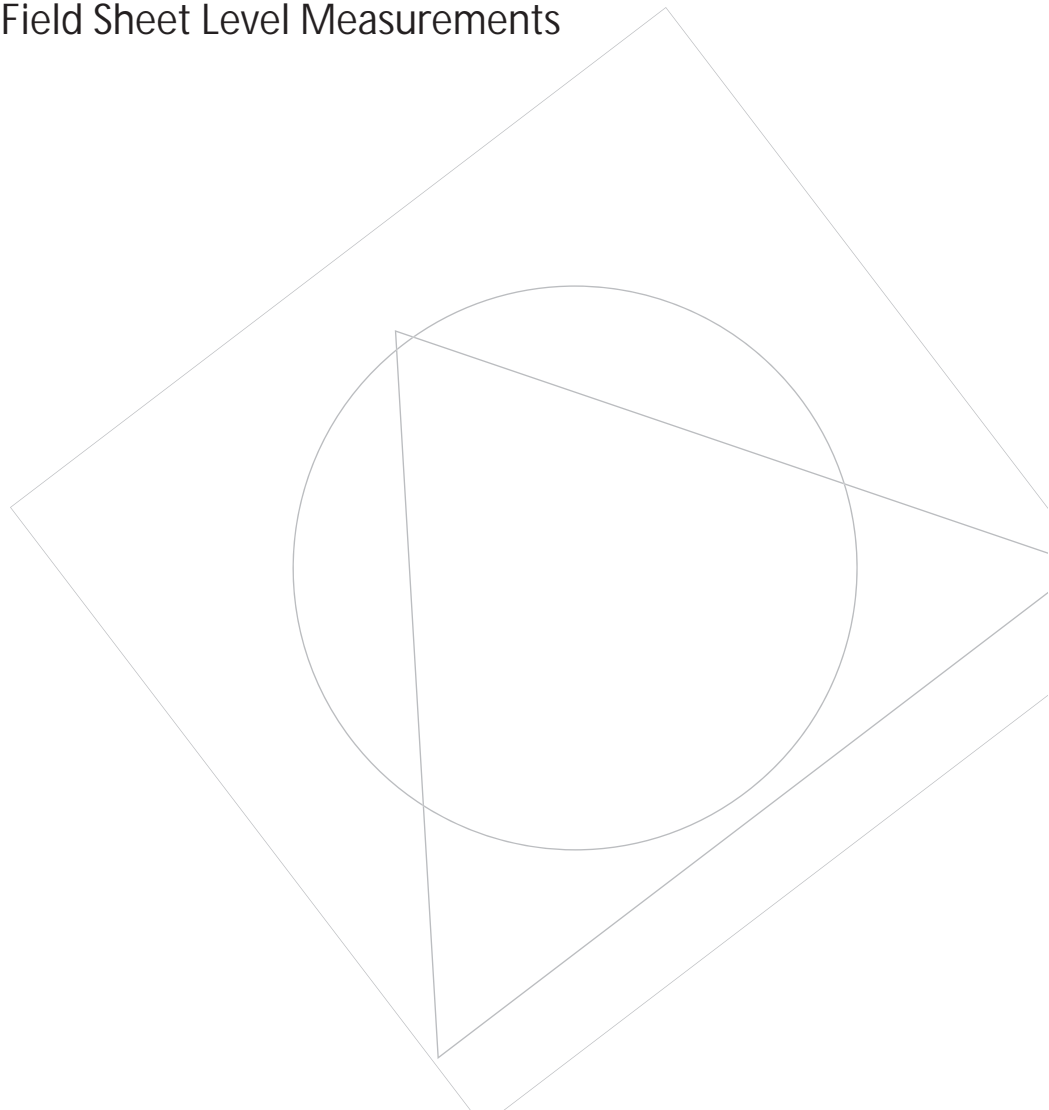






# APPENDIX 1

## Field Sheet Level Measurements



## TME Groundwater Monitoring Program - Field Sheets

**Project Name:** Harris Road Groundwater Monitoring

**Client:** Harris Road Pty Ltd

**Job No:** 10334

*Bore Number:* 1

*Eastings:* 381439.00

*Northings:* 6308872.00

*Height of TOC above Surface Level (mm):*

480

Date	Depth to Water (mm)	Groundwater Level (mm)	Comments
28/09/2010	1410	930	
26/10/2010	1540	1060	
19/01/2011	2130	1650	
18/04/2011	2670	2190	
10/05/2011	2620	2140	
10/06/2011	2140	1660	
12/07/2011	1380	900	
25/08/2011	880	400	
27/09/2011	780	300	
21/10/2011	910	430	
28/11/2011	1040	560	
15/12/2011	1200	720	

*Bore Number:* 2

*Eastings:* 381455.00

*Northings:* 6308567.00

*Height of TOC above Surface Level (mm):*

530

Date	Depth to Water (mm)	Groundwater Level (mm)	Comments
28/09/2010	870	340	
26/10/2010	1030	500	
19/01/2011	1270	740	
18/04/2011	1300	770	
10/05/2011	1240	710	
10/06/2011	900	370	
12/07/2011	680	150	
25/08/2011	580	50	
27/09/2011	620	90	
21/10/2011	730	200	
28/11/2011	960	430	
15/12/2011	880	350	

**Project Name:** Harris Road Groundwater Monitoring

**Client:** Harris Road Pty Ltd

**Job No:** 10334

**Bore Number:**

**Eastings:** 381739.00

**Northings:** 6308546.00

**Height of TOC above Surface Level (mm):** 440

Date	Depth to Water (mm)	Groundwater Level (mm)	Comments
28/09/2010	1240	800	
26/10/2010	1470	1030	
19/01/2011	1850	1410	
18/04/2011	2380	1940	
10/05/2011	2340	1900	
10/06/2011	1830	1390	
12/07/2011	980	540	
25/08/2011	580	140	
27/09/2011	620	180	
21/10/2011	960	520	
28/11/2011	1290	850	
15/12/2011	1340	900	

**Bore Number:**

**Eastings:** 381761.00

**Northings:** 6309089.00

**Height of TOC above Surface Level (mm):** 450

Date	Depth to Water (mm)	Groundwater Level (mm)	Comments
28/09/2010	1160	710	
26/10/2010	1460	1010	
19/01/2011	2240	1790	
18/04/2011	2610	2160	
10/05/2011	2430	1980	
10/06/2011	1760	1310	
12/07/2011	980	530	
25/08/2011	760	310	
27/09/2011	790	340	
21/10/2011	1070	620	
28/11/2011	1460	1010	
15/12/2011	1610	1160	

**Project Name:** Harris Road Groundwater Monitoring

**Client:** Harris Road Pty Ltd

**Job No:** 10334

**Bore Number:**

5
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**Eastings:** 381531.00

**Northings:** 6309390.00

**Height of TOC above Surface Level (mm):** 460

Date	Depth to Water (mm)	Groundwater Level (mm)	Comments
28/09/2010	1530	1070	
26/10/2010	1660	1200	
19/01/2011	2095	1635	
18/04/2011	2240	1780	
10/05/2011	2220	1760	
10/06/2011	2060	1600	
12/07/2011	1480	1020	
25/08/2011	970	510	
27/09/2011	920	460	
21/10/2011	1090	630	
28/11/2011	1300	840	
15/12/2011	1330	870	

**Bore Number:**

6
---

**Eastings:** 381624.00

**Northings:** 6309525.00

**Height of TOC above Surface Level (mm):** 480

Date	Depth to Water (mm)	Groundwater Level (mm)	Comments
28/09/2010	1820	1340	
26/10/2010	1910	1430	
19/01/2011	2215	1735	
18/04/2011	2360	1880	
10/05/2011	2360	1880	
10/06/2011	2060	1580	
12/07/2011	1690	1210	
25/08/2011	1280	800	
27/09/2011	1330	850	
21/10/2011	1470	990	
28/11/2011	1670	1190	
15/12/2011	1690	1210	

**Project Name:** Harris Road Groundwater Monitoring

**Client:** Harris Road Pty Ltd

**Job No:** 10334

**Bore Number:**

7
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**Eastings:** 382218.00

**Northings:** 6309484.00

**Height of TOC above Surface Level (mm):** 495

Date	Depth to Water (mm)	Groundwater Level (mm)	Comments
28/09/2010	2540	2045	
26/10/2010	2550	2055	
19/01/2011	3570	3075	
18/04/2011	NA	DRY	No water encountered
10/05/2011	3950	3455	
10/06/2011	1900	1405	
12/07/2011	1730	1235	
25/08/2011	1230	735	
27/09/2011	1230	735	
21/10/2011	1370	875	
28/11/2011	1690	1195	
15/12/2011	1750	1255	

**Bore Number:**

8
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**Eastings:** 382229.00

**Northings:** 6309103.00

**Height of TOC above Surface Level (mm):** 520

Date	Depth to Water (mm)	Groundwater Level (mm)	Comments
28/09/2010	2690	2170	
26/10/2010	2840	2320	
19/01/2011	NA	DRY	No water encountered
18/04/2011	NA	DRY	No water encountered
10/05/2011	NA	DRY	No water encountered
10/06/2011	NA	DRY	No water encountered
12/07/2011	3120	2600	
25/08/2011	1440	920	
27/09/2011	1480	960	
21/10/2011	1690	1170	
28/11/2011	2020	1500	
15/12/2011	2180	1660	

**Project Name:** Harris Road Groundwater Monitoring

**Client:** Harris Road Pty Ltd

**Job No:** 10334

**Bore Number:**

9
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**Eastings:** 381904.00

**Northings:** 6309365.00

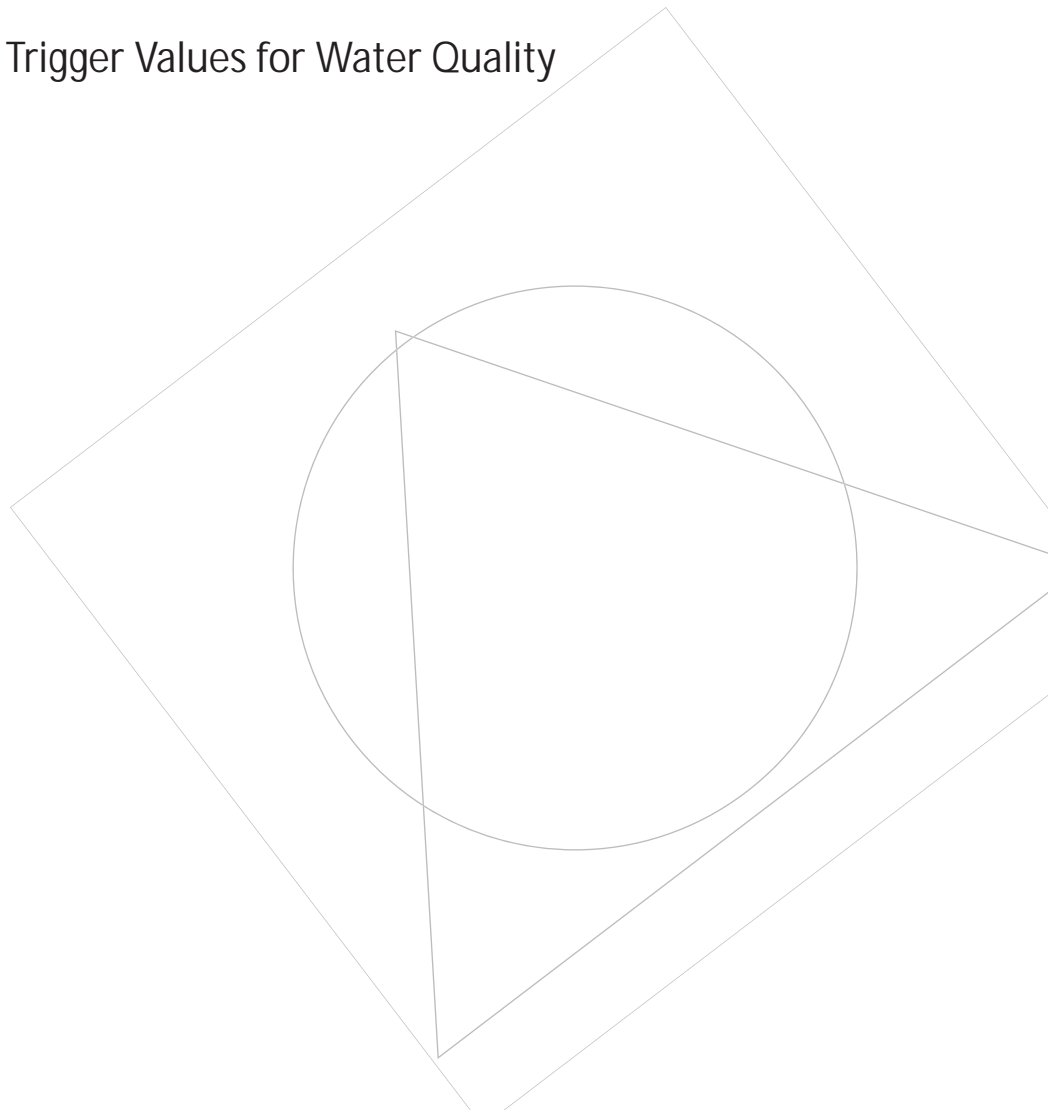
**Height of TOC above Surface Level (mm):** 525

Date	Depth to Water (mm)	Groundwater Level (mm)	Comments
28/09/2010	1925	1400	
26/10/2010	2020	1495	
19/01/2011	2390	1865	
18/04/2011	2710	2185	
10/05/2011	2650	2125	
10/06/2011	2220	1695	
12/07/2011	1800	1275	
25/08/2011	1440	915	
27/09/2011	1450	925	
21/10/2011	1580	1055	
28/11/2011	1790	1265	
15/12/2011	1580	1055	



# APPENDIX 2

Trigger Values for Water Quality



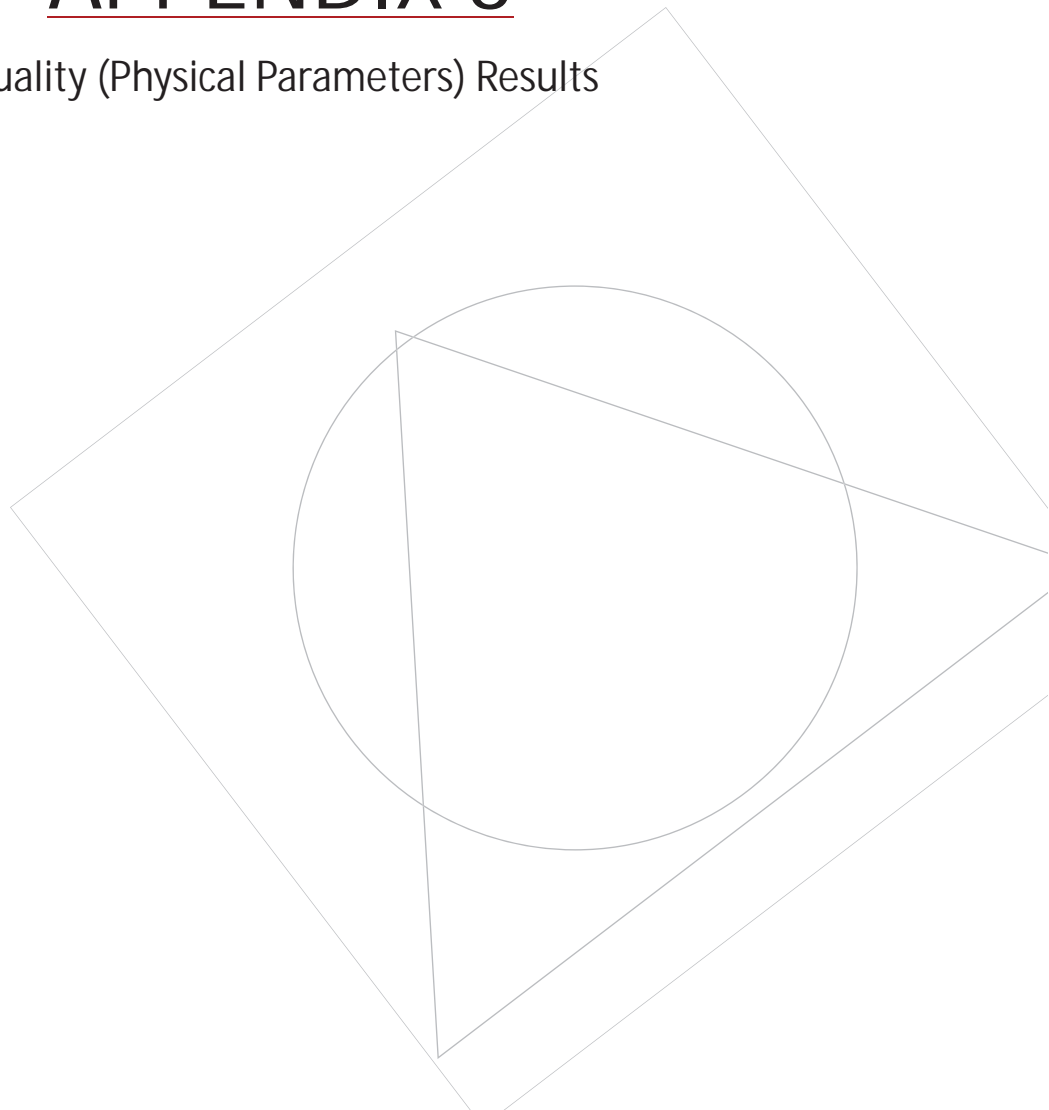
	ADWG (2004)		ANZECC (2000)		DoH (2006)		Swan Coastal Plain		ANZECC (2000)	
	Health	Aesthetic	Wetland	Non-Pot Gwater Use	WQIP	Long Term Irrigation	Short Term Irrigation			
TP	-	-	0.06	-	0.1	-	-			
FRP	-	-	0.03	-	-	-	-			
TN	-	-	1.5	-	1	5	-			
NO <sub>x</sub>	-	-	0.1	-	-	-	-			
Amonia (NH <sub>3</sub> )	-	0.5	0.9	5	-	-	-			
Nitrate	50	-	0.7	500	-	-	-			
Nitrite	3	-	-	30	-	-	-			
Ammonium (NH <sub>4</sub> )	-	-	0.04	5	-	-	-			
DO% (Sat)	-	85	90	120	-	-	-			
pH	-	6.5	7	8.5	-	6	8.5			
SPC (mS/cm)	-	-	0.3	1.5	-	-	-			
Sulfate (SO <sub>4</sub> )	500	250	-	5000	-	-	-			
Chloride	-	250	-	2500	-	-	-			
Aluminium	-	0.2	0.055	2	-	5	20			
Arsenic	0.007	-	0.024	0.07	-	0.1	2			
Cadmium	0.002	-	0.00002	0.02	-	0.01	0.05			
Chromium	0.05	-	-	0.5	-	0.1	1			
Copper	2	1	0.0014	20	-	0.2	5			
Iron	-	0.3	-	3	-	0.2	10			
Lead	0.001	-	0.0014	0.1	-	2	5			
Manganese	0.5	0.1	1.9	5	-	0.2	10			
Mercury (total)	0.001	-	0.0006	0.01	-	0.002	0.002			
Nickel	0.02	-	0.011	0.2	-	0.2	2			
Selenium (total)	0.01	-	0.011	0.1	-	0.02	0.05			
Zinc	-	3	0.008	30	-	2	5			





# APPENDIX 3

## Quality (Physical Parameters) Results



	Bore 1				Bore 2				Bore 3			
	26/10/2010	18/04/2011	21/10/2011	15/12/2011	26/10/2010	18/04/2011	21/10/2011	15/12/2011	26/10/2010	18/04/2011	21/10/2011	15/12/2011
Temperature (°C)	16.5	21.2	17.2	18.1	17.8	23.2	17.1	19.0	17.7	22.0	17.5	18.3
Conductivity SPC (mS/cm)	2.3140	2.0100	0.4200	2.1200	0.4221	0.4220	0.6700	1.5920	1.6290	3.0800	2.4000	3.3380
Dissolved Oxygen (ppm)	1.38	0.03	0.28	0.13	2.06	0.05	0.01	0.00	2.08	0.09	0.00	0.02
pH (scale)	6.07	5.86	5.42	5.94	6.71	6.41	6.30	5.90	6.64	6.00	6.22	6.24
Salinity (ppt)		1.11	0.20	1.09		0.21	0.33	0.81		1.71	1.24	1.76
Diss. Oxygen % (Saturated)	14.5	0.4	3.0	1.3	21.3	0.6	0.1	0.0	21.2	1.0	-0.2	0.2
ORP (mV)	24.8	-74.7	57.2	-186.5	-25.2	-156.6	-100.0	-150.5	103.2	58.0	54.0	-104.2

Table A

The green fill shown in the tables denotes the variable was outside of the ANZEC trigger value ranges for a wetland. However both these trigger values are based on surface water in wetlands and not groundwater in particular. The light green fill denotes the variable was less than the ADWG (aesthetic only) trigger value.

	Bore 4					Bore 5					Bore 6					
	26/10/2010	18/04/2011	21/10/2011	15/12/2011	26/10/2010	18/04/2011	21/10/2011	15/12/2011	26/10/2010	18/04/2011	21/10/2011	15/12/2011	26/10/2010	18/04/2011	21/10/2011	15/12/2011
Temperature (°C)	18.0	23.1	18.2	19.4	16.7	19.8	16.9	18.6	18.4	24.2	18.1	19.3				
Conductivity SPC (mS/cm)	2.9020	1.7500	2.2200	2.5260	0.5210	0.5600	0.5700	0.6300	0.7040	0.9600	0.4200	0.9070				
Dissolved Oxygen (ppm)	2.48	0.19	0.03	0.15	1.37	0.07	0.02	0.01	1.43	0.01	0.00	0.00				
pH (scale)	6.52	6.03	6.46	6.00	6.17	5.95	5.88	5.78	6.52	6.18	5.31	6.18				
Salinity (ppt)		0.92	1.14	1.31		0.30	0.29	0.31		0.49	0.20	0.45				
Diss. Oxygen % (Saturated)	26.3	2.2	0.3	1.6	13.5	0.9	0.4	0.1	16.2	0.2	-0.4	0.0				
ORP (mV)	125.5	-119.1	43.8	0.9	14.2	-141.4	-25.5	-96.6	22.2	-209.7	84.7	-124.0				

Table B

	Bore 7					Bore 8					Bore 9					
	26/10/2010	18/04/2011	21/10/2011	15/12/2011	26/10/2010	18/04/2011	21/10/2011	15/12/2011	26/10/2010	18/04/2011	21/10/2011	15/12/2011	26/10/2010	18/04/2011	21/10/2011	15/12/2011
Temperature (°C)	17.1		18.0	18.6	18.1		18.1	19.0	17.5	20.8	17.7	18.3				
Conductivity SPC (mS/cm)	1.5690		5.0200	1.2100	3.1210		0.1700	0.2420	1.0140	1.9000	1.2500	1.1270				
Dissolved Oxygen (ppm)	2.60		0.08	0.12	1.60		2.24	0.42	3.34	0.68	0.09	0.01				
pH (scale)	5.82		5.56	6.32	5.87		5.46	5.01	6.32	5.16	5.04	5.43				
Salinity (ppt)			0.24	0.60			0.08	0.12		1.06	0.63	0.56				
Diss. Oxygen % (Saturated)	28.0		0.9	1.3	16.2		23.8	4.3	35.1	7.7	1.0	0.1				
ORP (mV)	148.7		55.2	-187.2	60.5		79.9	-2.1	72.7	127.3	99.6	-14.5				

Table C



# APPENDIX 4

## Complete Quality Results



	Bore 1				Bore 2				Bore 3			
	26/10/2010	18/04/2011	21/10/2011	15/12/2011	26/10/2010	18/04/2011	21/10/2011	15/12/2011	26/10/2010	18/04/2011	21/10/2011	15/12/2011
OH <sup>-</sup> Alkalinity (mg/L, LOR = 1)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
CO <sub>3</sub> <sup>2-</sup> Alkalinity (mg/L, LOR = 1)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
HCO <sub>3</sub> <sup>-</sup> Alkalinity (mg/L, LOR = 1)	34	13	7	7	87	66	151	71	151	96	<1	163
Total Alkalinity (mg/L, LOR = 1)	34	13	7	7	87	66	151	71	151	96	<1	163
Aluminium (mg/L, LOR = 0.01)	2.20	5.71	21.90	10.40	25.60	23.80	5.09	9.77	29.20	42.00	22.10	27.80
Arsenic (mg/L, LOR = 0.001)	<0.001	<0.001	0.001	0.001	<0.001	0.002	0.001	0.002	<0.001	0.002	0.001	<0.001
Cadmium (mg/L, LOR = 0.0001)	<0.0001	0.0001	0.0002	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium (mg/L, LOR = 0.001)	0.003	0.01	0.021	0.015	0.049	0.01	0.008	0.018	0.049	0.06	0.037	0.042
Copper (mg/L, LOR = 0.001)	0.008	0.033	0.042	0.038	0.056	0.060	0.009	0.019	0.026	0.037	0.022	0.025
Lead (mg/L, LOR = 0.001)	0.002	0.012	0.036	0.012	0.050	0.057	0.008	0.018	0.018	0.026	0.019	0.019
Manganese (mg/L, LOR = 0.001)	0.074	0.029	0.043	0.023	0.057	0.036	0.252	0.050	0.132	0.268	0.087	0.176
Zinc (mg/L, LOR = 0.005)	0.030	0.081	0.096	0.062	0.030	0.050	0.025	0.023	0.050	0.041	0.021	0.050
Iron (mg/L, LOR = 0.05)	6.92	6.48	19.50	8.43	43.60	42.40	15.40	20.50	16.90	20.80	14.00	15.00
Ammonia (mg/L, LOR = 0.01)	0.22	0.11	0.04	<0.05	1.07	2.13	0.42	1.12	0.01	0.04	0.07	<0.05
Nitrite (mg/L, LOR = 0.01)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05	<0.01
Nitrate (mg/L, LOR = 0.01)	<0.01	<0.01	<0.01	0.04	0.01	0.01	<0.01	0.04	0.59	0.02	0.42	0.02
NO <sub>x</sub> (mg/L, LOR = 0.01)	<0.01	<0.01	<0.01	0.04	0.01	0.01	<0.01	0.04	0.59	0.02	0.47	0.02
TKN (mg/L, LOR = 0.1)	0.6	1.2	8.0	4.8	5.0	4.4	2.4	3.0	6.2	4.5	3.4	2.5
Total Nitrogen (mg/L, LOR = 0.1)	0.6	1.2	8.0	4.8	5.0	4.4	2.4	3.0	6.8	4.5	3.9	2.5
Reactive P (mg/L, LOR = 0.01)	<0.01	<0.01	0.02	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01
Total P (mg/L, LOR = 0.01)	0.07	0.13	0.58	0.31	0.29	0.19	0.14	0.31	0.54	0.43	0.24	0.26

Table D

Refer to Quality Trigger Values Key

ADWG (2004)		ANZECC (2000)	DoH (2006)	Swan Coastal Plain	ANZECC (2000)	
Health	Aesthetic	Wetland	Non-Pot Gwater Use	WQIP	Long Term Irrigation	Short Term Irrigation

	Bore 4				Bore 5				Bore 6			
	26/10/2010	18/04/2011	21/10/2011	15/12/2011	26/10/2010	18/04/2011	21/10/2011	15/12/2011	26/10/2010	18/04/2011	21/10/2011	15/12/2011
<b>OH<sup>-</sup> Alkalinity</b> (mg/L, LOR = 1)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
<b>CO<sub>3</sub><sup>2-</sup> Alkalinity</b> (mg/L, LOR = 1)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
<b>HCO<sub>3</sub><sup>-</sup> Alkalinity</b> (mg/L, LOR = 1)	60	61	85	68	31	37	<1	38	5	38	<1	39
<b>Total Alkalinity</b> (mg/L, LOR = 1)	60	61	85	68	31	37	<1	38	5	38	<1	39
<b>Aluminium</b> (mg/L, LOR = 0.01)	4.56	8.80	16.50	11.80	15.50	11.50	2.15	3.28	20.00	146.00	2.84	30.40
<b>Arsenic</b> (mg/L, LOR = 0.001)	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	<0.001	0.001	<0.001	0.066	0.002	0.031
<b>Cadmium</b> (mg/L, LOR = 0.0001)	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0010	<0.0001	<0.0001
<b>Chromium</b> (mg/L, LOR = 0.001)	0.013	0.02	0.032	0.024	0.017	0.01	0.002	0.003	0.017	0.09	0.002	0.023
<b>Copper</b> (mg/L, LOR = 0.001)	0.014	0.025	0.071	0.055	0.034	0.036	0.010	0.007	0.042	0.104	0.005	0.029
<b>Lead</b> (mg/L, LOR = 0.001)	0.007	0.011	0.022	0.012	0.029	0.024	0.007	0.006	0.022	0.120	0.003	0.021
<b>Manganese</b> (mg/L, LOR = 0.001)	0.086	0.043	0.119	0.041	0.094	0.055	0.063	0.061	0.047	0.088	0.031	0.044
<b>Zinc</b> (mg/L, LOR = 0.005)	0.028	0.051	0.067	0.038	0.049	0.044	0.016	0.012	0.058	<0.052	0.018	0.033
<b>Iron</b> (mg/L, LOR = 0.05)	10.90	17.30	23.60	19.40	25.70	17.40	30.50	37.80	21.60	114.00	3.47	31.20
<b>Ammonia</b> (mg/L, LOR = 0.01)	0.03	0.03	0.06	<0.05	0.21	0.23	0.07	0.06	0.11	0.25	0.05	0.11
<b>Nitrite</b> (mg/L, LOR = 0.01)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01
<b>Nitrate</b> (mg/L, LOR = 0.01)	0.17	0.03	<0.01	0.08	0.05	<0.01	<0.01	0.06	2.76	0.01	0.24	0.68
<b>NO<sub>x</sub></b> (mg/L, LOR = 0.01)	0.17	0.03	<0.01	0.08	0.05	<0.01	<0.01	0.06	2.77	0.01	0.24	0.68
<b>TKN</b> (mg/L, LOR = 0.1)	0.6	0.4	4.2	1.2	6.4	1.5	3.0	1.5	3.5	9.2	1.2	4.2
<b>Total Nitrogen</b> (mg/L, LOR = 0.1)	0.8	0.4	4.2	1.3	6.5	1.5	3.0	1.6	6.3	9.2	1.4	4.9
<b>Reactive P</b> (mg/L, LOR = 0.01)	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	1.64	0.05
<b>Total P</b> (mg/L, LOR = 0.01)	0.24	0.03	0.42	0.14	0.34	0.19	0.16	0.14	1.69	0.79	2.00	4.60

Table E

	Bore 7				Bore 8				Bore 9			
	26/10/2010	18/04/2011	21/10/2011	15/12/2011	26/10/2010	18/04/2011	21/10/2011	15/12/2011	26/10/2010	18/04/2011	21/10/2011	15/12/2011
OH <sup>-</sup> Alkalinity (mg/L, LOR = 1)	<1		<1	<1	<1		<1	<1	<1	<1	<1	<1
CO <sub>3</sub> <sup>2-</sup> Alkalinity (mg/L, LOR = 1)	<1		<1	<1	<1		<1	<1	<1	<1	<1	<1
HCO <sub>3</sub> <sup>-</sup> Alkalinity (mg/L, LOR = 1)	12		28	33	59		<1	10	55	<1	<1	21
Total Alkalinity (mg/L, LOR = 1)	12		28	33	59		<1	10	55	<1	<1	21
Aluminium (mg/L, LOR = 0.01)	23.80		15.00	11.70	8.30		28.20	20.30	11.60	31.80	23.30	20.20
Arsenic (mg/L, LOR = 0.001)	<0.001		0.001	<0.001	<0.001		0.001	<0.001	<0.001	0.011	0.002	0.002
Cadmium (mg/L, LOR = 0.0001)	<0.0001		0.0001	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001
Chromium (mg/L, LOR = 0.001)	0.041		0.018	0.018	0.019		0.052	0.040	0.018	0.06	0.022	0.021
Copper (mg/L, LOR = 0.001)	0.073		0.053	0.041	0.031		0.151	0.069	0.056	0.125	0.084	0.051
Lead (mg/L, LOR = 0.001)	0.022		0.029	0.012	0.010		0.068	0.035	0.019	0.073	0.025	0.014
Manganese (mg/L, LOR = 0.001)	0.075		0.074	0.032	0.205		0.075	0.044	0.084	0.193	0.121	0.094
Zinc (mg/L, LOR = 0.005)	0.180		0.026	0.022	0.055		0.046	0.031	0.033	0.061	0.018	0.033
Iron (mg/L, LOR = 0.05)	33.50		19.70	18.10	21.20		45.20	43.90	22.00	169.00	37.40	34.60
Ammonia (mg/L, LOR = 0.01)	0.05		0.01	0.10	0.05		0.02	<0.05	0.11	<0.10	0.07	0.06
Nitrite (mg/L, LOR = 0.01)	<0.01		<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrate (mg/L, LOR = 0.01)	0.13		<0.01	0.06	0.02		<0.01	0.03	<0.01	0.03	<0.01	0.04
NO <sub>x</sub> (mg/L, LOR = 0.01)	0.13		<0.01	0.06	0.02		<0.01	0.03	<0.01	0.03	<0.01	0.04
TKN (mg/L, LOR = 0.1)	1.5		7.4	2.9	2.2		7.2	3.3	4.3	29.8	11.0	3.9
Total Nitrogen (mg/L, LOR = 0.1)	1.6		7.4	3.0	2.2		7.2	3.3	4.3	29.8	11.0	3.9
Reactive P (mg/L, LOR = 0.01)	0.01		<0.01	<0.01	<0.01		0.03	<0.01	<0.01	<0.01	<0.01	<0.01
Total P (mg/L, LOR = 0.01)	0.31		0.56	0.24	0.52		1.06	0.55	0.30	2.52	1.79	0.70

Table F





# APPENDIX 5

C.D OF ATTACHMENTS:  
CERTIFICATE OF ANALYSIS  
RAW RESULTS





# APPENDIX 4

BUSHFIRE MANAGEMENT PLAN



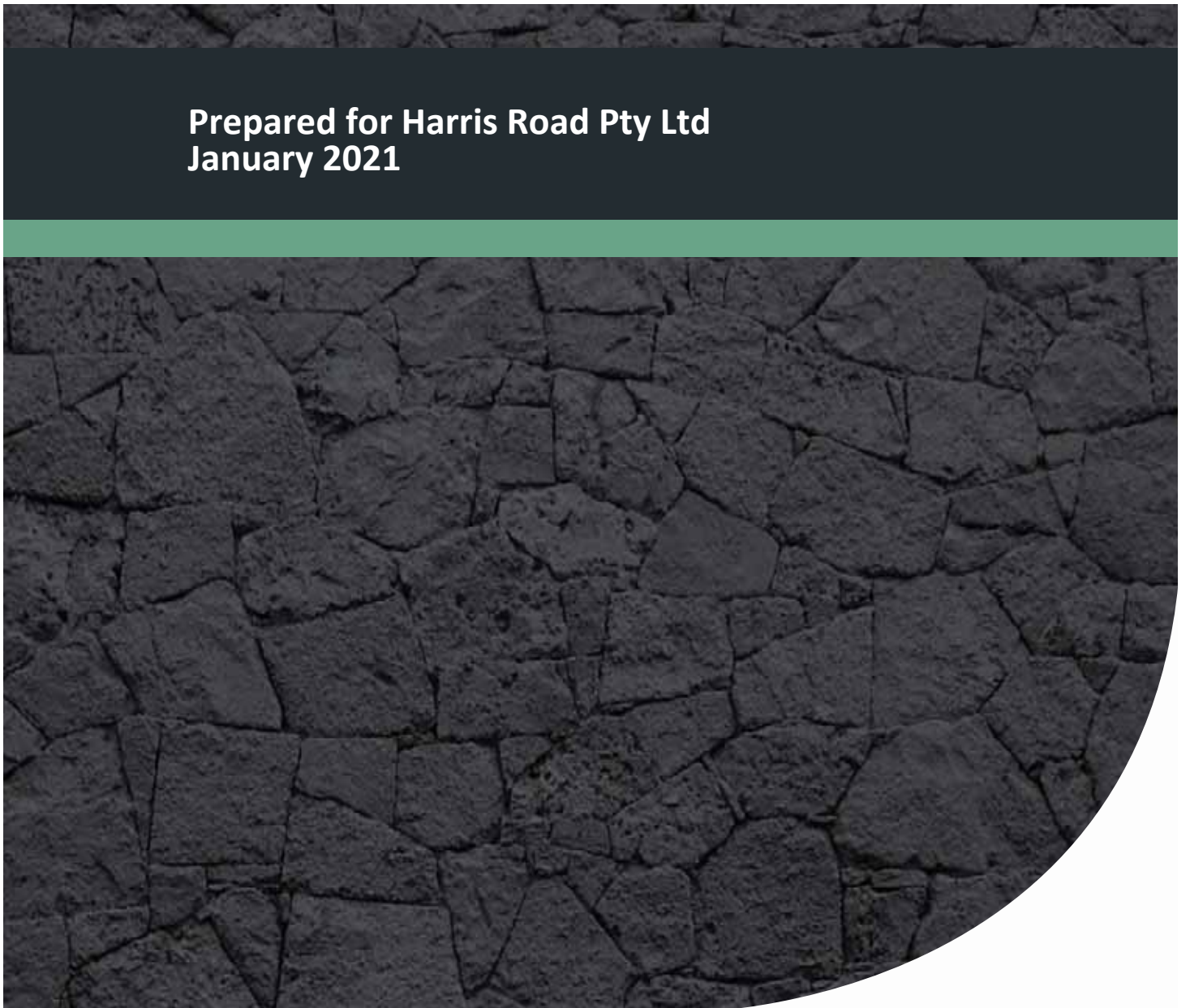
**ROWE**  
GROUP  
DESIGN

# Bushfire Management Plan

Local Structure Plan, Lots 103, 110 and 436,  
Picton East

Project No: EP12-039(02)

**Prepared for Harris Road Pty Ltd  
January 2021**



# Bushfire Management Plan

Local Structure Plan, Lots 103, 110 and 436, Picton East



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C	January 2021	Heidi Becker	HPB	Kirsten Knox	KK
				Anthony Rowe	AJR
Minor updates following change to site boundary.					

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This document has been prepared primarily to consider the layout of development and/or the appropriate building construction standards applicable to development, where relevant. The measures outlined are considered to be prudent minimum standards only based on the standards prescribed by the relevant authorities. The level of bushfire risk mitigation achieved will depend upon the actions of the landowner or occupiers of the land and is not the responsibility of the author. The relevant local government and fire authority (i.e. Department of Fire and Emergency Services or local bushfire brigade) should be approached for guidance on preparing for and responding to a bushfire.

Notwithstanding the precautions recommended in this document, it should always be remembered that bushfires burn under a wide range of conditions which can be unpredictable. An element of risk, no matter how small, will always remain. The objective of the Australian Standard AS 3959-2018 is to "prescribe particular construction details for buildings to reduce the risk of ignition from a bushfire while the front passes" (Standards Australia 2018). Building to the standards outlined in AS 3959 does not guarantee a building will survive a bushfire or that lives will not be lost.

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# Bushfire Management Plan

## Local Structure Plan, Lots 103, 110 and 436, Picton East



## Executive Summary

Harris Road Pty Ltd (the proponent) are in the process of preparing a local structure plan for Lots 103, 110 and 436, Picton East (herein referred to as ‘the site’) to support future industrial development within the site. The site is approximately 71 ha and is located within the Shire of Dardanup. It is bounded by Martin-Pelusey Road to the east, undeveloped industrial-zoned land to the north, a railway to the north-west, Columbas Drive to the west and Harris Road and existing land uses to the south. The site forms part of a larger area proposed for industrial land use including the broader Picton Industrial Park Southern Precinct District Structure Plan area (DPLH 2018) and Waterloo Industrial District Structure Plan (WAPC 2019) located to the east of Martin-Pelusey Road.

The site is currently identified as a ‘bushfire prone area’ under the state-wide *Map of Bush Fire Prone Areas* prepared by the Office of Bushfire Risk Management (OBRM 2019). The identification of the site within an area declared as bushfire prone necessitates that a further assessment of the determined bushfire risk affecting the site (in accordance with *Australian Standard 3959-2018 Construction of buildings in bushfire prone areas (AS 3959)*) and the satisfactory compliance of the proposal with the policy measures described in *State Planning Policy 3.7 Planning in Bushfire Prone Areas (SPP 3.7)* (WAPC 2015) and its associated *Guidelines for Planning in Bushfire Prone Areas Version 1.3* (the Guidelines) (WAPC and DFES 2017).

The purpose of SPP 3.7 and its policy intent is best summarised as preserving life and reducing the impact of bushfire on property and infrastructure through effective risk-based land use planning. Importantly, it is required by SPP 3.7 that the determining authority is to apply its consideration to the precautionary principle (clause 6.11 in SPP 3.7) and it must be satisfied that the intent of the policy measures have been met, before it issues an approval.

Pursuant to the policy measures outlined in SPP 3.7, this Bushfire Management Plan (BMP) examines the various responses to the identified bushfire risk (following development) that will make the ultimate use of the land suitable for its intended purpose. As part of this, a bushfire attack level (BAL) assessment has been undertaken to determine the associated bushfire risk, the applicable BAL ratings (if any), and in turn the building siting and construction response that will achieve compliance with the bushfire protection criteria and satisfy the precautionary principle.

As part of assessing the long-term bushfire risk to the site, the vegetation within 150 m of the site has been classified in accordance with AS 3959. The following bushfire hazards were identified in the post-development scenario:

- Forest (Class A) vegetation, associated with vegetation on the western side of the railway line (north-west of the site), as well as the area of public open space in the north-west of the site, which is proposed to be revegetated.
- Woodland (Class B) vegetation, associated with private landholdings surrounding the site to the east, west and north.
- Scrub (Class D) vegetation, located to the north-west and west of the site.
- Grassland (Class G) vegetation, largely associated with cleared private landholdings (largely used for agricultural purposes) to the east, south, west and north of the site.

# Bushfire Management Plan

## Local Structure Plan, Lots 103, 110 and 436, Picton East



Overall, the outcomes of this BMP demonstrate that as development progresses, it will be possible for the intent of the bushfire protection criteria outlined in the Guidelines to be satisfied through an acceptable solution approach. This includes:

- **Element 1 Location:** all proposed habitable buildings can be located in an area subject to a low or moderate bushfire hazard, given buildings will be located within areas identified as low threat in accordance with Clause 2.2.3.2(e) of AS 3959 and will be subject to a BAL rating of BAL-29 or less.
- **Element 2 Siting and Design:** all future built form can be sited within the proposed development so that BAL-29 or less can be achieved based on the proposed local structure plan and separation to nearby hazards through the location of public roads and/or through the use of in-lot setbacks. The development areas adjoining the northern, western and southern boundaries of the site are likely to include areas subject to a BAL rating of BAL-FZ, however the future lots can be suitably sized to accommodate built form that will not be exposed to a BAL rating exceeding BAL-29. The proposed public open space in the north-western corner of the site is intended to be revegetated and will therefore be considered a bushfire hazard. However suitable separation from this area can be provided based on the proposed road layout and use of in-lot setbacks.
- **Element 3 Vehicular Access:** appropriate vehicle access can be provided, with the proposed development connecting to the existing public road network including Martin-Pelusey Road immediately east of the site, Harris Road immediately south of the site, Columbas Drive to the west of the site, and future industrial development to the north of the site. The site will have two connections to Martin-Pelusey Road which is a major regional connector road and provides egress opportunities to the north and south, including to South Western Highway and Boyanup-Picton Road.
- **Element 4 Water:** the development will be provided with a permanent and reticulated water supply to support onsite firefighting requirements. It is possible that the water pressure within the reticulated network may not be sufficient to support fire-fighting, however this can be addressed through provision of tanks and pumps in future lots as part of development.

The management/mitigation measures to be implemented through this structure plan and future requirements as part of subdivision design have been outlined as part of this BMP and can be used to support future planning and development approval processes. Depending upon proposed staging, a revised BMP may be required to support future subdivision applications, in order to address the specific bushfire risk reduction measures applicable to future proposed lots, particularly if bushfire hazards are likely to be different to that outlined as part of this BMP.

# Bushfire Management Plan

Local Structure Plan, Lots 103, 110 and 436, Picton East



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# Bushfire Management Plan

Local Structure Plan, Lots 103, 110 and 436, Picton East



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## Appendices

### Appendix A

Proposed local structure plan (Rowe Group Design 2020)

### Appendix B

Additional photographs



# Bushfire Management Plan

Local Structure Plan, Lots 103, 110 and 436, Picton East



## List of Abbreviations

*Table A1: Abbreviations – General terms*

General terms	
AHD	Australian Height Datum
AS	Australian Standard
APZ	Asset Protection Zone
BAL	Bushfire Attack Level
BMP	Bushfire Management Plan
BPAD	Bushfire Planning and Design
EEP	Emergency Evacuation Plan
ESL	Emergency Services Levy
FDI	Fire Danger Index
FZ	Flame Zone

*Table A2: Abbreviations – Organisations*

Organisations	
DBCA	Department of Biodiversity Conservation and Attractions
DoW	Department of Water (now known as Department of Water and Environment Regulation)
DFES	Department of Fire and Emergency Services
DPLH	Department of Planning, Lands and Heritage
DWER	Department of Water and Environmental Regulation
OBRM	Office of Bushfire Risk Management
SES	State Emergency Services
WAPC	Western Australian Planning Commission

*Table A3: Abbreviations – Legislation and policies*

Legislation	
Guidelines	<i>Guidelines for Planning in Bushfire Prone Areas version 1.3 (WAPC and DFES 2017)</i>
SPP 3.7	<i>State Planning Policy 3.7 Planning in Bushfire Prone Areas (WAPC 2015)</i>

# Bushfire Management Plan

Local Structure Plan, Lots 103, 110 and 436, Picton East



Table A4: Abbreviations – Planning and building terms

Planning and building terms	
AS 3959	<i>Australian Standard 3959-2018 Construction of buildings in bushfire prone areas</i>
GBRS	Greater Bunbury Region Scheme
POS	Public Open Space
ROS	Regional Open Space
TPS	Town Planning Scheme

# Bushfire Management Plan

## Local Structure Plan, Lots 103, 110 and 436, Picton East



## 1 Introduction

### 1.1 Background

Harris Road Pty Ltd (the proponent) are in the process of preparing a local structure plan for Lots 103, 110 and 436, Picton East (herein referred to as ‘the site’), to support future industrial development, as shown in the structure plan in **Appendix A**. The site is shown in **Figure 1** and consists of an area approximately 71 ha and is located within the Shire of Dardanup. It is bounded by Martin-Pelusey Road to the east, undeveloped industrial-zoned land to the north, a railway to the north-west, Columbas Drive to the west and Harris Road and existing industrial land uses to the south.

The site is currently identified as a ‘bushfire prone area’ under the state-wide *Map of Bush Fire Prone Areas* prepared by the Office of Bushfire Risk Management (OBRM 2019) and is shown in **Plate 1** below. The identification of an area within a declared bushfire prone area necessitates further assessment of the bushfire risk and suitability of the proposed development to be undertaken in accordance with *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7) (WAPC 2015) and the *Guidelines for Planning in Bushfire Prone Areas Version 1.3* (the Guidelines) (WAPC and DFES 2017).

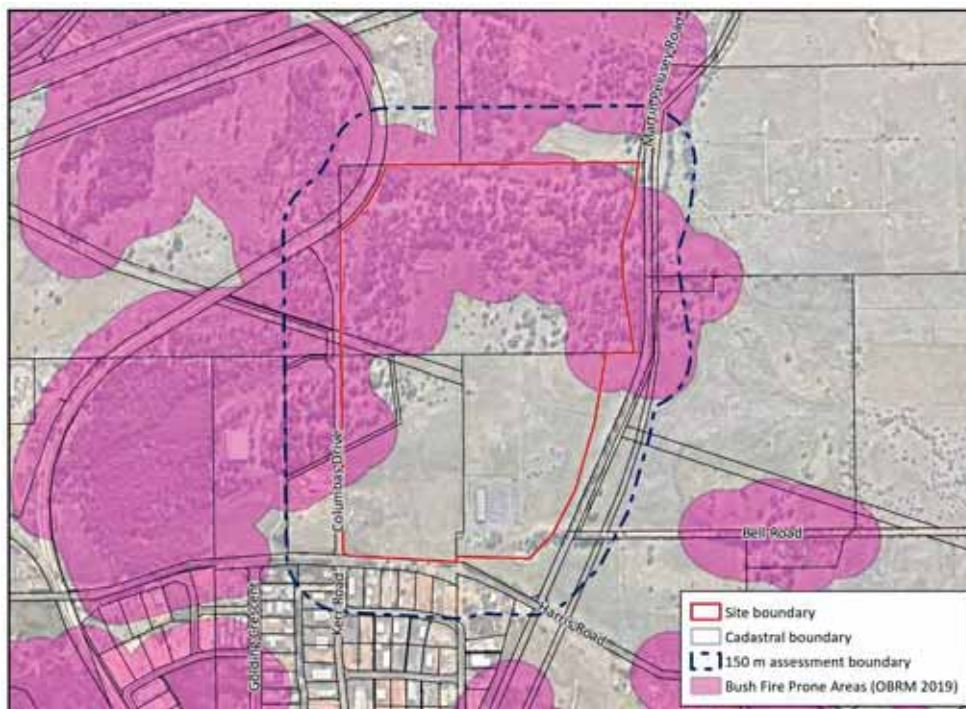


Plate 1: Areas within and surrounding the site identified as ‘bushfire prone areas’ (as indicated in purple) under the state-wide *Map of Bush Fire Prone Areas* (OBRM 2019).

# Bushfire Management Plan

## Local Structure Plan, Lots 103, 110 and 436, Picton East



### 1.2 Aim of this report

The aim of this BMP is to assess bushfire hazards within the site and nearby areas and ensure that the threat posed by any identified hazards can be appropriately mitigated and managed and demonstrate satisfaction of clause 6.11 of SPP 3.7 the precautionary principle. It has been prepared to support the proposed structure plan for the site and addresses the requirements of SPP 3.7 (WAPC 2015), the Guidelines (WAPC and DFES 2017) and *Australian Standard 3959-2018 Construction of buildings in bushfire prone areas* (AS 3959) (Standards Australia 2009). The document provides an assessment of the general bushfire management strategies to be considered as part of the future industrial development within the site and includes:

- An assessment of the existing classified vegetation in the vicinity of the site (within 150 m) and consideration of bushfire hazards that will exist in the post-development scenario (**Section 3**).
- Commentary on how the future development can achieve the bushfire protection criteria outlined within the Guidelines (**Section 5**).
- An outline of the roles and responsibilities associated with implementing this BMP (see **Section 6**).

### 1.3 Statutory policy and framework

The following key legislation, policies and guidelines are relevant to the preparation of a bushfire management plan:

- *Fire and Emergency Services Act 1998*
- *Bush Fires Act 1954*
- *Planning and Development Act 2005* and associated regulations
- *Building Act 2011* and associated regulations
- *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (WAPC 2015)
- *Guidelines for Planning in Bushfire Prone Areas version 1.3* (WAPC and DFES 2017)
- *Australian Standard AS 3959 – 2018 Construction of buildings in bushfire prone areas* (Standards Australia 2009)

# Bushfire Management Plan

## Local Structure Plan, Lots 103, 110 and 436, Picton East



### 1.4 Description of the proposed development

The proposed structure plan for the site will facilitate the future subdivision and development of the site for industrial purposes and is provided in **Appendix A** and also includes a concept for future subdivision (although this is subject to change). The structure plan is intended to support:

- A number of industrial lots ranging in size from approximately 1 ha to 4.06 ha, with an approximate overall yield of 37 lots.
- An area of public open space 3.9 ha in size in the north-west corner of the site that will be revegetated.
- Approximately 4.7 ha of drainage reserves.
- An interconnected road network, including three 25 m integrator road reserves, and a number of 20 m wide local access roads.

The site is zoned 'Industrial deferred' under the Greater Bunbury Region Scheme (GBRS) and 'General farming' and 'Special' under the Shire of Dardanup Town Planning Scheme (TPS) No.3. The site is currently undergoing a GBRS amendment to lift the 'Industrial Deferred' zone (to move to an 'Industrial' zone) which will be supported through the approval of the local structure plan. The current GBRS zoning for the site and surrounds is shown in **Plate 2**. Under an 'Industrial' zoning, land uses will include those associated with supporting manufacturing industry, the storage and distribution of goods and associated uses, and may include service stations, storage and transport depots as an example.

More broadly, the site forms part of a larger industrial area and is located within the Picton Industrial Park Southern Precinct area and adjacent to the Waterloo Industrial District Structure Plan located to the east of Martin-Pelusey Road. A residential area, associated with the Wanju District Structure Plan area is located further north of the site.

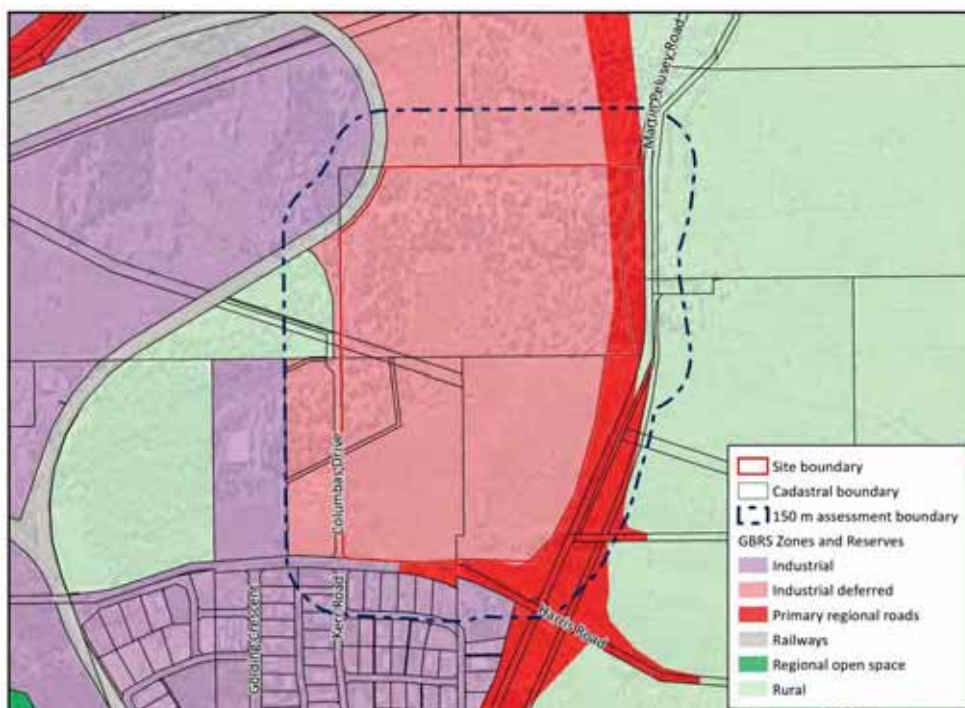
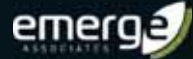


Plate 2: Existing GBRS zoning for the site and surrounds

# Bushfire Management Plan

## Local Structure Plan, Lots 103, 110 and 436, Picton East



### 1.5 Description of land characteristics

The site ranges from 12.0 m Australian Height Datum (AHD) to 23.0 m AHD. The higher elevations and steeper slopes are located along the western and northern boundaries of the site. The lowest areas are generally consistent with the existing drainage channels and farm dams. Topographic contours are shown in **Figure 1**. It is expected that the topography of the site will change as part of the proposed industrial development, with the higher areas likely to be reduced in height, while the lower areas will be increased, in order to accommodate drainage and servicing.

The southern portion of the site was historically cleared of a majority of native vegetation (prior to 1996, based on available historic aerial photography) to support agricultural purposes. The northern portion of the site contains a number of paddock grasses located around existing building and sheds.

The land uses surrounding the site (within 150 m) include:

- Immediately to the north of the site is land currently used for agricultural purposes (zoned for future industrial land use) and to the north-west is a freight railway.
- Columbas Drive immediately west of the site and current agricultural land uses further west (zoned for future industrial land use).
- Harris Road immediately to the south of the site, and existing industrial land uses further south.
- Martin-Pelusey Road immediately to the east of the site and current agricultural land uses further east (zoned for future industrial land use).

# Bushfire Management Plan

## Local Structure Plan, Lots 103, 110 and 436, Picton East



## 2 Environmental Considerations

In accordance with the Department of Planning, Lands and Heritage *Bushfire Management Plan – BAL Contour* template (2018), this BMP has considered whether there are any environmental values that may require specific consideration through either protection, retention or revegetation. To support this, a review of publicly available databases was undertaken, with particular reference to the Shared Location Information Platform (SLIP) databases. A number of site-specific environmental investigations and surveys have been undertaken to support the Picton Industrial Park Southern Precinct District Structure Plan (DPLH 2018), in addition to the proposed local structure plan for the site. These investigations include:

- *Report on a Level 1 flora and vegetation survey at various lots at Picton East* (Ekologica Pty Ltd 2009)
- *Terrestrial Fauna Survey (Level 1) of Lots 1, 2, 11, 102-104 and 603 Picton (East)* (Harewood 2009)
- *Environmental Assessment Management Strategy* (Emerge Associates 2019a)
- *Local Water Management Strategy* (Emerge Associates 2019b)

The *Environmental Assessment Management Strategy* (Emerge Associates 2019a) consolidates previous environmental reports and comments on new environmental considerations for the site.

A review of the site-specific environmental investigations and publicly available datasets identified a number of environmental values within and surrounding the site and are summarised in **Table 1**. A number of federal and state listed conservation significant fauna species (namely black cockatoo and western ringtail possums) were identified as utilising or having the potential to use areas of remnant vegetation (predominantly paddock trees within the site). Some areas of existing vegetation are proposed to be retained as part of development and are discussed further in **Section 2.2**.

*Table 1: Summary of potential environmental considerations that may be associated with the site (based on a search of the SLIP databases)*

Key environmental feature (information in brackets refers to mapping data source)	Yes / no / potentially occurring within the site	If yes / potentially, describe value that may be impacted
Conservation category wetlands and buffer (Geomorphic wetlands, Swan Coastal Plain (DBCA-019))	No	Not applicable. The majority of the site is mapped as a multiple use wetland and requires no specific protection and/or retention of values. A resource enhancement wetland is located approximately 350 m to the west of the site however no buffers for this wetland needs to be accommodated within the site.
RAMSAR wetlands (DBCA-010)	No	Not applicable. No RAMSAR sites are located within or nearby to the site.
Threatened and priority flora (Ekologica Pty Ltd 2009)	No	The site has been historically cleared of native vegetation for agricultural purposes and is now dominated by paddock grasses with scattered paddock trees. No Threatened or Priority flora were identified within the site (Ekologica Pty Ltd 2009).

# Bushfire Management Plan

Local Structure Plan, Lots 103, 110 and 436, Picton East



Table 1: Summary of potential environmental considerations that may be associated with the site (based on a search of the SLIP databases) (continued)

Key environmental feature (information in brackets refers to mapping data source)	Yes / no / potentially occurring within the site	If yes / potentially, describe value that may be impacted
Threatened and priority fauna (Harewood 2009)	Yes	Harewood (2009) identified a portion of vegetation within the northern half of the site as containing habitat for the western ringtail possum, through the identification of scats and dreys. Evidence of foraging from the three black cockatoo species were identified in the broader Picton area through the identification of chewed marri nuts and banksia cones.
Threatened ecological communities (TEC) (Ekologica Pty Ltd 2009)	No	Not applicable. The flora and vegetation survey did not identify any TECs (Ekologica Pty Ltd 2009) and based on the site inspection and review of available information no TECs listed since the flora and vegetation survey was completed are likely to occur. While no TECs are identified within the site, the vegetation has been identified as regionally significant by the EPA (EPA 2008), although has not been recommended for retention.
Bush Forever areas (DOP-071)	No	Not applicable.
Clearing regulations – Environmentally Sensitive Areas (DWER-046)	No	Not applicable. The site has not been identified as an Environmentally Sensitive Area (ESA).
Swan Bioplan Regionally Significant Natural Areas 2010 (DWER-070)	No	Not applicable.
Conservation Covenants Western Australia (DPIRD-023)	No	Not applicable.
Aboriginal heritage (DAA-001)	No	Not applicable. Approximately 20 m to the south of the site is an identified 'Other Heritage Place' Site ID 18886 Bunbury Bypass Archaeological Site 3.
Non-indigenous heritage (SHO-003)	No	Not applicable. No registered non-indigenous heritage sites were identified within or nearby to the site.

## 2.1 Native vegetation – modification and clearing

The vegetation within the proposed public open space, in the north-west corner of the site, is proposed to be retained in accordance with the structure plan. The majority of the remaining vegetation within the site will most likely be removed as part of the proposed industrial development or retained where possible in road reserves or lots as part of future subdivision (but modified to be considered low threat). Clearing of native vegetation needs to be in accordance with a clearing permit (pursuant to the EP Act) or a valid exemption. Clearing of native vegetation undertaken in accordance with addressing conditions associated with a subdivision approval, pursuant to the *Planning and Development Act 2005*, are exempt from requiring a clearing permit pursuant to Schedule 6 of the *Environmental Protection Act 1986* (where approved by a responsible authority).



## Bushfire Management Plan

Local Structure Plan, Lots 103, 110 and 436, Picton East



### 2.2 Revegetation and landscape plans

The existing vegetation within the proposed public open space in the north-west corner of the site is proposed to be retained and also revegetated with local native species to support the enhancement of fauna habitat and ecological linkages within the site. This area of public open space is located adjacent to areas of regionally significant vegetation outside the site that has been recommended for retention by the EPA (2008).

Within the remainder of the site road reserves and drainage reserves are proposed to be landscaped as part of the future development. These areas will be designed to achieve low threat vegetation in accordance with Section 2.2.3.2 of AS 3959. The management of the road and drainage reserves will be the responsibility of the proponent initially prior to handover to the Shire of Dardanup, with ongoing management currently proposed to include:

- Regular mowing/slashing of grass to a minimum of 100 mm in height or under the Shire of Dardanup's fire control notice less than 50 mm in height (where present).
- Irrigation of grass and garden beds (only temporary establishment irrigation is required prior to handover to the Shire of Dardanup).
- Regular removal of weeds and built up dead material (such as fallen branches, leaf litter etc.).
- Low pruning of trees (branches below 2 m in height removed where appropriate).
- Application/replacement of ground/surface covers such as mulch or non-flammable materials as required.

Given this area is proposed for industrial development, it is expected that in accordance with typical urban and industrial development standards, there will be a level of maintenance applied to the road reserves and drainage reserves in order to ensure their ongoing function and also to provide amenity to future workers in the area. It is possible that the Shire of Dardanup may require different standards to be satisfied within these areas from a vegetation management perspective, however this can be addressed as part of subdivision and development application if required and would significantly alter the outcomes of the assessment as part of this BMP.

## Bushfire Management Plan

Local Structure Plan, Lots 103, 110 and 436, Picton East



### 3 Bushfire Assessment Results

Bushfire risk for the site has been appropriately considered in the specific context of the Guidelines (WAPC and DFES 2017) and AS 3959. The Guidelines require the identification of the bushfire risk (using AS 3959) out to 150 m from the development site, but for determining the likely bushfire impact upon a building, a distance of 100 m is used. The objective of AS 3959 is to reduce the risk of ignition and loss of a building to bushfire. It provides a consistent method for determining a radiant heat level (radiant heat flux) as a primary consideration of bushfire attack on a building or object. It also prescribes simple national construction responses that can resist the determined radiant heat level at a given distance from the fire and are based on six Bushfire Attack Level (BAL) ratings: BAL-LOW, BAL-12.5, BAL-19, BAL-29, BAL-40 and BAL-FZ.

The building construction requirements outlined within AS 3959 only apply to Class 1, 2, 3 and 10a buildings, which are not generally associated with industrial development. Accordingly, higher building construction requirements in accordance with AS 3959 are unlikely to apply. However, development within the site will still be required to demonstrate built form achieves a BAL rating of BAL-29 or less (in accordance with SPP 3.7), and can satisfy the bushfire protection criteria, and accordingly is still relevant.

Two separate methods are outlined in AS 3959 for determining the impact of bushfire on dwellings and have been outlined below:

- **Method 1**, outlined in Section 2 and Appendix A of AS 3959, provides a basic assessment of radiant heat flux levels at various distances from classified vegetation (up to 100 m). This method assumes standard fuel loads for classified vegetation as outlined in AS 3959 and considers the effective slope beneath vegetation. This method can be used to determine appropriate setbacks to dwellings to achieve different levels of radiant heat exposure (i.e. BAL-12.5 to BAL-FZ).
- **Method 2**, outlined in Appendix B of AS 3959, provides access to the formula used to derive the Method 1 values. Where justified it enables the inputs used in Method 1 to be varied, to reflect true site conditions to provide a site-specific assessment of the radiant heat level at any given distance from the fire.

Not all vegetation is a classified bushfire risk. Vegetation and ground surfaces that are exempt from classification as a potential hazard is identified as low threat under Section 2.2.3.2 of AS 3959. Low threat vegetation includes the following:

- a) Vegetation of any type more than 100 m from the site.
- b) Single areas of vegetation less than 1 ha in area and not within 100 m of other areas of vegetation being classified.
- c) Multiple areas of vegetation less than 0.25 ha in area and not within 20 m of the site or each other.
- d) Strips of vegetation less than 20 m wide (measured perpendicular to the elevation exposed to the strip of vegetation) regardless of length and not within 20 m of the site or each other, or other areas of vegetation being classified.
- e) Non-vegetated areas, including waterways, roads, footpaths, buildings and rocky outcrops.

# Bushfire Management Plan

## Local Structure Plan, Lots 103, 110 and 436, Picton East



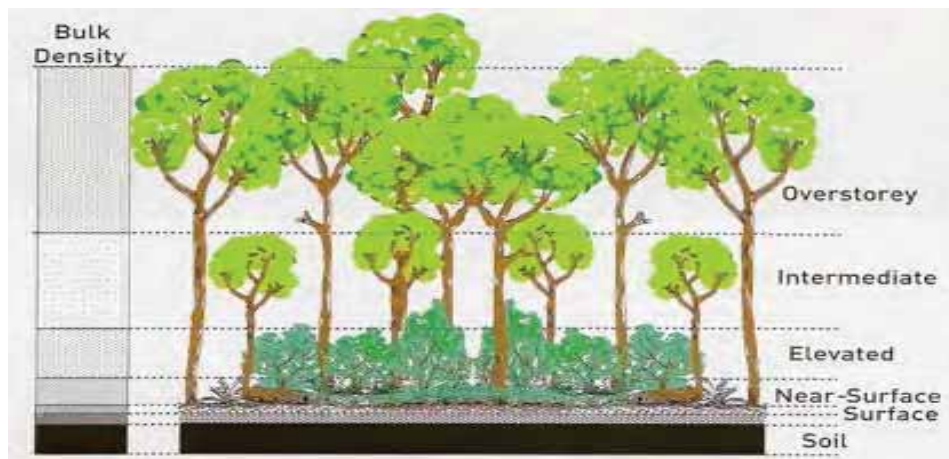
- f) Vegetation regarded as a low threat due to factors such as flammability, moisture content or fuel load. This includes grassland managed in a minimal fuel condition, mangroves and other saline wetlands, maintained lawns, golf courses (such as playing areas and fairways), maintained public reserves and parklands, sporting fields, vineyards, orchards, banana plantations, market gardens (and other non-curing crops), cultivated gardens, commercial nurseries, nature strips and wind breaks.

### 3.1 Bushfire attack level (BAL) assessment

In accordance with Appendix Five of the Guidelines, a method 1 BAL assessment has been undertaken to support the proposed structure plan for the site in order to understand appropriate setbacks based on the vegetation classification and effective slope, and to prepare the associated BAL contour plan.

#### 3.1.1 Assessment inputs

Assessing bushfire hazards takes into account the classes of vegetation within the site and surrounding area for a minimum of 150 m, in accordance with AS 3959. The assignment of vegetation classifications is based on an assessment of vegetation structure, which includes consideration of the various fuel layers of different vegetation types. For example, fuel layers in a typical forest environment can be broken-down into five segments as illustrated in **Plate 3** below. These defined fuel layers are considered when determining the classification of vegetation and associated bushfire hazard levels.



*Plate 3: The five fuel layers in a forest environment that could be associated with fire behaviour (Gould et al. 2007)*

An assessment of existing vegetation within the site and surrounding 150 m, as well as effective slope, was undertaken on 20<sup>th</sup> August 2019 in accordance with AS 3959 and the Guidelines.

**Table 2** outlines:

- The pre-development AS 3959 vegetation classifications (and associated photo locations), which are also shown in **Figure 2**. Additional photo locations not included in **Table 2** are provided in **Appendix B**.

## Bushfire Management Plan

Local Structure Plan, Lots 103, 110 and 436, Picton East



- The bushfire hazard ratings are shown in **Figure 3**.
- The post-development AS 3959 vegetation classifications, which are also shown in **Figure 4**.
- The effective slope for each area of classified vegetation present in the post-development scenario, which is also shown in **Figure 5**.

## Bushfire Management Plan

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Table 2: Vegetation classification, effective slope and future management

Pre-development (see Figure 2 and Figure 3)		Post development (see Figure 4 and Figure 5)	
Plot no.	AS 3959 classification and bushfire hazard rating	Site photo/s (location points shown in Figure 2)	Plot no. AS 3959 classification, effective slope and assumptions
1, 2	<p>An area of forest vegetation has been identified to the north-west of the site on the western side of the railway line (Plot 1) and within Harris Road reserve (Plot 2).</p> <p>These areas of vegetation are not managed and are associated with multiple fuel layers, including near-surface, understorey, elevated and overstorey.</p> <p><b>AS 3959 classification (Figure 2):</b> Forest (Class A)</p> <p><b>Bushfire hazard rating (Figure 3):</b> Extreme</p> <p><b>Photo points:</b> 20</p>	 <p><i>Photo location 20: forest vegetation in the background on the photo on the opposite side of the railway line, looking west.</i></p>	<p>1, 2</p> <p>The forest vegetation associated with Plot 1 is assumed to remain in its existing condition in the long term on the basis that the EPA has identified this area to be regionally significant and has recommended it be retained and protected as part of any future rezoning, subdivision or development (EPA 2008).</p> <p>The forest vegetation within Harris Road reserve (Plot 2) is expected to remain in its current condition.</p> <p>Therefore, the forest vegetation associated with both Plot 1 and Plot 2 is assumed to remain a bushfire hazard to future development.</p> <p><b>AS 3959 classification (Figure 4):</b> Forest (Class A)</p> <p><b>Effective slope (Figure 5):</b> Flat/upslope</p>

## Bushfire Management Plan

Local Structure Plan, Lots 103, 110 and 436, Picton East



Table 2: Vegetation classification, effective slope and future management (continued)

Pre-development (see Figure 2 and Figure 3)		Post development (see Figure 4 and Figure 5)		
Plot no.	AS 3959 classification and bushfire hazard rating	Site photo/s (location points shown in Figure 2)	Plot no.	
3	<p>Woodland vegetation has been identified throughout the site and is characterised by an overstorey of primarily <i>Agonis flexuosa</i>, with unmanaged understorey of grasslands and leaf litter fuel loads.</p> <p><b>AS 3959 classification (Figure 2):</b> Woodland (Class B)</p> <p><b>Bushfire hazard rating (Figure 3):</b> Extreme</p> <p><b>Photo points:</b> 7, 18, 23, 24, 28, 31</p>	 <p>Photo location 7: woodland vegetation within the site, looking south-east.</p>  <p>Photo location 23: woodland vegetation, looking east.</p>	 <p>Photo location 18: woodland vegetation in the northern portion of the site, looking south-east.</p>  <p>Photo location 28: woodland vegetation with a grassy understorey, looking north.</p>	<p>AS 3959 classification, effective slope and assumptions</p> <p>The majority of the site will be converted to non-vegetated areas in the form of buildings, hardstand areas, driveways and roads and is therefore considered to be low threat in accordance with (exclusion clause 2.2.3.2(e)). It is noted that some of these areas will contain managed grass, garden areas or verges in the future (as development is completed), however for ease of reference have been excluded as non-vegetated on the basis that these will form part of future lots.</p> <p><b>AS 3959 classification (Figure 4):</b> Non-vegetated (exclusion clause 2.2.3.2(e)).</p> <p><b>Effective slope (Figure 5):</b> Not applicable</p>

## Bushfire Management Plan

Local Structure Plan, Lots 103, 110 and 436, Picton East



Table 2: Vegetation classification, effective slope and future management (continued)

Pre-development (see Figure 2 and Figure 3)		Post development (see Figure 4 and Figure 5)	
Plot no.	AS 3959 classification and bushfire hazard rating	Site photo/s (location points shown in Figure 2)	Plot no. AS 3959 classification, effective slope and assumptions
3	Continued from above.	Continued from above.	<p>The north-west corner of the site will be converted to an area of public open space approximately 3.9 ha in size. This area is proposed to be revegetated with local native species to support the enhancement of fauna habitat and ecological linkages within the site. Based on the area being revegetated, the area of public open space has been assessed as forest vegetation in the post-development scenario based on multiple fuel layers being present, and will therefore be a hazard to future development within the site.</p> <p><b>AS 3959 classification (Figure 4):</b> Forest (Class A)</p> <p><b>Effective slope (Figure 5):</b> Downslope 0-5°C Flat/upslope</p>

# Bushfire Management Plan

Local Structure Plan, Lots 103, 110 and 436, Picton East



Table 2: Vegetation classification, effective slope and future management (continued)

Pre-development (see Figure 2 and Figure 3)		Post development (see Figure 4 and Figure 5)	
Plot no.	AS 3959 classification and bushfire hazard rating	Site photo/s (location points shown in Figure 2)	Plot no.
4-10	<p>Woodland vegetation has been identified outside the site in adjacent landholdings to the east, north and west of the site. These areas of vegetation have been subject to previous disturbance and contains a mix of overstorey species with a grass understorey and do not appear to be subject to management.</p> <p><b>AS 3959 classification (Figure 2):</b> Woodland (Class B)</p> <p><b>Bushfire hazard rating (Figure 3):</b> Extreme</p> <p><b>Photo points:</b> 6, 13, 14, 40</p>	 <p>Photo location 6: woodland vegetation in adjacent landholdings to the west of the site, looking west.</p>  <p>Photo location 13: woodland vegetation to the west of the site, looking north-west.</p>  <p>Photo location 14: woodland vegetation outside the site, looking south.</p>  <p>Photo location 40: woodland vegetation east of the site, looking west.</p>	<p>AS 3959 classification, effective slope and assumptions</p> <p>The majority of woodland vegetation located outside the site is situated in land that will be subject to future industrial development, however as the timing of development is unknown these areas have been assumed to remain a bushfire hazard.</p> <p><b>AS 3959 classification (Figure 4):</b> Woodland (Class B)</p> <p><b>Effective slope (Figure 5):</b> Flat/upslope</p>



# Bushfire Management Plan

Local Structure Plan, Lots 103, 110 and 436, Picton East



Table 2: Vegetation classification, effective slope and future management (continued)

Pre-development (see Figure 2 and Figure 3)		Post development (see Figure 4 and Figure 5)	
Plot no.	AS 3959 classification and bushfire hazard rating	Site photo/s (location points shown in Figure 2)	Plot no.
11	<p>Areas of scrub vegetation have been identified within the northern portion of the site. These areas of vegetation are associated with predominantly <i>Melaleuca</i> species that species with a canopy height of between 2 m and 6 m. These areas do not appear to be subject to any regular maintenance.</p> <p><b>AS 3959 classification (Figure 2):</b> Scrub (Class D)</p> <p><b>Bushfire hazard rating (Figure 3):</b> Extreme</p> <p><b>Photo points:</b> 12, 15, 16, 17, 21, 22, 42</p> <p>Continued below.</p>	 <p>Photo location 15: scrub vegetation within the site, looking south.</p>  <p>Photo location 17: scrub vegetation within the northern portion of the site, looking south.</p>  <p>Photo location 21: scrub vegetation in the north-west corner of the site, looking east.</p>  <p>Photo location 22: scrub vegetation, looking north-west.</p>	<p>AS 3959 classification, effective slope and assumptions</p> <p>The majority of the site will be converted to non-vegetated areas in the form of buildings, hardstand areas, driveways and roads and is therefore considered to be low threat in accordance with (exclusion clause 2.2.3.2(e)). It is noted that some of these areas will contain managed grass, garden areas or verges in the future (as development is completed), however for ease of reference have been excluded as non-vegetated on the basis that these will form part of future lots.</p> <p><b>AS 3959 classification (Figure 4):</b> Non-vegetated (exclusion clause 2.2.3.2(e)).</p> <p><b>Effective slope (Figure 5):</b> Not applicable</p>

## Bushfire Management Plan

Local Structure Plan, Lots 103, 110 and 436, Picton East



Table 2: Vegetation classification, effective slope and future management (continued)





Pre-development (see Figure 2 and Figure 3)		Post development (see Figure 4 and Figure 5)	
Plot no.	AS 3959 classification and bushfire hazard rating	Site photo/s (location points shown in Figure 2)	Plot no. AS 3959 classification, effective slope and assumptions
11	Continued from above.	Continued from above.	<p>The north-west corner of the site will be converted to an area of public open space approximately 3.9 ha in size. This area is proposed to be revegetated with local native species to support the enhancement of fauna habitat and ecological linkages within the site. Based on the area being revegetated, the area of public open space has been assessed as forest vegetation in the post-development scenario based on multiple fuel layers being present, and will therefore be a hazard to future development within the site.</p> <p><b>AS 3959 classification (Figure 4):</b> Forest (Class A)</p> <p><b>Effective slope (Figure 5):</b> Downslope 0-5°C Flat/upslope</p>

# Bushfire Management Plan

Local Structure Plan, Lots 103, 110 and 436, Picton East



Table 2: Vegetation classification, effective slope and future management (continued)

Pre-development (see Figure 2 and Figure 3)		Post development (see Figure 4 and Figure 5)	
Plot no.	AS 3959 classification and bushfire hazard rating	Site photo/s (location points shown in Figure 2)	Plot no.
12, 13	<p>Areas of scrub vegetation have been identified to the north-west and west of the site. These areas of vegetation are associated with predominately <i>Mealeuca</i> species with a canopy height of between 2 m and 4 m. These areas do not appear to be subject to any regular maintenance.</p> <p><b>AS 3959 classification (Figure 2):</b> Scrub (Class D)</p> <p><b>Bushfire hazard rating (Figure 3):</b> Extreme</p> <p><b>Photo points:</b> 8, 9, 10, 19</p>	 <p>Photo location 8: scrub vegetation to the west of the site, looking north-west.</p>  <p>Photo location 10: scrub vegetation, looking north.</p>	<p>AS 3959 classification, effective slope and assumptions</p> <p>The areas of scrub vegetation identified within Plot 13 is assumed to remain in its existing condition in the long term on the basis that the EPA has identified this area to be regionally significant and has recommended it be retained and protected as part of future rezoning, subdivision or development (EPA 2008).</p> <p>The area of scrub vegetation identified within Plot 12 is situated in land that will be subject to future industrial development, however as the timing of development is unknown these areas have been assumed to remain a bushfire hazard.</p> <p><b>AS 3959 classification (Figure 4):</b> Scrub (Class D)</p> <p><b>Effective slope (Figure 5):</b> Flat/upslope</p>
		 <p>Photo location 9: scrub vegetation, looking west.</p>  <p>Photo location 19: scrub vegetation in the background of the photo, looking west.</p>	

## Bushfire Management Plan

Local Structure Plan, Lots 103, 110 and 436, Picton East



Table 2: Vegetation classification, effective slope and future management (continued)

Pre-development (see Figure 2 and Figure 3)		Post development (see Figure 4 and Figure 5)	
Plot no.	AS 3959 classification and bushfire hazard rating	Site photo/s (location points shown in Figure 2)	Plot no.
14	<p>Grassland vegetation has been identified throughout the site, with the southern portion of the site predominately grassland. Paddock grasses within the site are subject to grazing by livestock however is not maintained less than 100 mm in height regularly and therefore has been identified as a bushfire hazard.</p> <p><b>AS 3959 classification (Figure 2):</b> Grassland (Class G)</p> <p><b>Bushfire hazard rating (Figure 3):</b> Moderate</p> <p><b>Photo points:</b> 5, 29, 35, 37</p>	 <p>Photo location 5: grassland vegetation in the southern portion of the site, looking east.</p>  <p>Photo location 29: grassland vegetation in the foreground of the photo, looking south-west.</p>  <p>Photo location 35: grassland vegetation in the central portion of the site, looking north-east.</p>  <p>Photo location 37: grassland vegetation within the site, looking north-east.</p>	<p>AS 3959 classification, effective slope and assumptions</p> <p>The majority of the site will be converted to non-vegetated areas in the form of buildings, hardstand areas, driveways and roads and is therefore considered to be low threat in accordance with (exclusion clause 2.2.3.2(e)). It is noted that some of these areas will contain managed grass, garden areas or verges in the future (as development is completed), however for ease of reference have been excluded as non-vegetated on the basis that these will form part of future lots.</p> <p><b>AS 3959 classification (Figure 4):</b> Non-vegetated (exclusion clause 2.2.3.2(e)).</p> <p><b>Effective slope (Figure 5):</b> Not applicable</p>

## Bushfire Management Plan

Local Structure Plan, Lots 103, 110 and 436, Picton East



Table 2: Vegetation classification, effective slope and future management (continued)


Pre-development (see Figure 2 and Figure 3)		Post development (see Figure 4 and Figure 5)	
Plot no.	AS 3959 classification and bushfire hazard rating	Site photo/s (location points shown in Figure 2)	Plot no.
14	Continued from above.	Continued from above.	<p>AS 3959 classification, effective slope and assumptions</p> <p>The north-west corner of the site will be converted to an area of public open space approximately 3.9 ha in size. This area is proposed to be revegetated with local native species to support the enhancement of fauna habitat and ecological linkages within the site. Based on the area being revegetated, the area of public open space has been assessed as forest vegetation in the post-development scenario based on multiple fuel layers being present, and will therefore be a hazard to future development within the site.</p> <p><b>AS 3959 classification (Figure 4):</b> Forest (Class A)</p> <p><b>Effective slope (Figure 5):</b> Downslope 0-5°C Flat/upslope</p>

## Bushfire Management Plan

Local Structure Plan, Lots 103, 110 and 436, Picton East



Table 2: Vegetation classification, effective slope and future management (continued)





Pre-development (see Figure 2 and Figure 3)		Post development (see Figure 4 and Figure 5)	
Plot no.	AS 3959 classification and bushfire hazard rating	Site photo/s (location points shown in Figure 2)	Plot no.
15-17	<p>Grassland vegetation has been identified in adjacent landholdings outside of the site to the south, east, north and west, and is associated with existing agricultural land uses an/or agricultural drains.</p> <p>The areas of paddock grasses outside the site may be subject to some management, but this appears to be intermittent and therefore has been identified as a bushfire hazard.</p> <p><b>AS 3959 classification (Figure 2):</b> Grassland (Class G)</p> <p><b>Bushfire hazard rating (Figure 3):</b> Moderate</p> <p><b>Photo points:</b> 3, 4, 11, 25, 30, 33, 34, 39, 41</p>	 <p>Photo location 11: areas of grassland vegetation to the west of the site, looking west.</p>  <p>Photo location 3: grassland vegetation in adjacent landholdings to the west of the site, looking west.</p>	<p>AS 3959 classification, effective slope and assumptions</p> <p>The majority of grassland vegetation located outside the site is situated in land that will be subject to future industrial development, however as the timing of development is unknown these areas have been assumed to remain a bushfire hazard.</p> <p><b>AS 3959 classification (Figure 4):</b> Grassland (Class G)</p> <p><b>Effective slope (Figure 5):</b> Flat/upslope</p>
		 <p>Photo location 34: grassland vegetation immediately east of the site, looking south.</p>  <p>Photo location 4: grassland vegetation within Columbas Drive road reserve, looking north.</p>	

# Bushfire Management Plan

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Table 2: Vegetation classification, effective slope and future management (continued)

Pre-development (see Figure 2 and Figure 3)		Post development (see Figure 4 and Figure 5)		
Plot no.	AS 3959 classification and bushfire hazard rating	Site photo/s (location points shown in Figure 2)	Plot no.	
18	<p>Non-vegetated areas such as roads, driveways, existing industrial buildings and hardstand areas, water bodies including dams and drains within and surrounding the site have been excluded in accordance with Clause 2.2.3.2(e) of AS 3959.</p> <p><b>AS 3959 classification (Figure 2):</b> Non-vegetated (exclusion clause 2.2.3.2(e))</p> <p><b>Bushfire hazard rating (Figure 3):</b> Low, however as required under the Guidelines, any areas within 100 m of moderate or extreme hazards would be considered moderate hazard, to reflect the potential increased risk.</p> <p><b>Photo points:</b> 2, 26, 27, 32, 36, 38</p>	 <p>Photo location 2: Columbus Drive immediately west of the site, looking north.</p>  <p>Photo location 36: rural drain within the central portion of the site, looking north-east.</p>	<p>18</p>  <p>Photo location 27: existing buildings and bare mineral earth within the northern portion of the site, looking east.</p>  <p>Photo location 38: existing industrial buildings within the southern portion of the site, looking east.</p>	<p>AS 3959 classification, effective slope and assumptions</p> <p>The existing maintenance regimes for all existing non-vegetated areas surrounding the site are assumed to continue in the long-term based on current land uses and management arrangements and will remain low threat.</p> <p>In addition, areas within the site that have been identified as non-vegetated will remain non-vegetated when converted to public roads and/or industrial lots as part of the proposed development of the site.</p> <p><b>AS 3959 classification (Figure 4):</b> Non-vegetated (exclusion clause 2.2.3.2(e))</p> <p><b>Effective slope (Figure 5):</b> Not applicable</p>

## Bushfire Management Plan

Local Structure Plan, Lots 103, 110 and 436, Picton East



Table 2: Vegetation classification, effective slope and future management (continued)

Pre-development (see Figure 2 and Figure 3)		Post development (see Figure 4 and Figure 5)	
Plot no.	AS 3959 classification and bushfire hazard rating	Site photo/s (location points shown in Figure 2)	Plot no.
19	<p>Surrounding the site, areas of low threat vegetation have been identified and are largely associated with either existing managed road verges and managed gardens/verges associated with surrounding industrial development.</p> <p><b>AS 3959 classification (Figure 2):</b> Low threat vegetation (exclusion clause 2.2.3.2(f))</p> <p><b>Bushfire hazard rating (Figure 3):</b> Low, however as required under the Guidelines, any areas within 100 m of moderate or extreme hazards would be considered moderate hazard, to reflect the potential increased risk.</p> <p><b>Photo points:</b> 1</p>	 <p><i>Photo location 1: low threat vegetation within the industrial area to the south of the site, looking east.</i></p>	<p>The maintenance regimes for all existing low-threat vegetation surrounding the site is assumed to continue in the long-term based on current land uses and management arrangements, in accordance with the requirements of the Shire of Dardanup fire control notice and community expectations.</p> <p><b>AS 3959 classification (Figure 4):</b> Low threat vegetation (exclusion clause 2.2.3.2(f))</p> <p><b>Effective slope (Figure 5):</b> Not applicable</p>



# Bushfire Management Plan

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### 3.1.1.1 Post development assumptions

The BAL assessment, to determine the predicated BAL ratings applicable to the site, has assumed the following:

- **Designated FDI:** 80
- **Flame temperature:** 1090 K
- **Vegetation classification:** forest (Class A), woodland (Class B), scrub (Class D) and grassland (Class G) vegetation identified within the post-development scenario, see **Figure 4**.
- **Effective slope beneath classified vegetation:** Downslope 0-5°C and flat/upslope (see **Figure 5**)
- **Setback distances:** as per Table 2.5 in AS 3959 with the relevant distances used to inform the BAL contour plan summarised in **Table 3** with the BAL contour provided in **Figure 6**.

In addition to the above, the following key assumptions have informed this assessment:

- The 3.9 ha of public open space, located in the north-west corner of the site, will be revegetated with local native species and has been classified as the forest (Class A) vegetation in the post-development scenario. No future management of this area has been assumed.
- The drainage reserves within the site will be managed to low threat in accordance with Section 2.2.3.2 of AS 3959. Management of the drainage reserves will be the responsibility of the proponent initially and the Shire of Dardanup following handover (usually two years).
- The remainder of the classified vegetation within the site will be removed or modified to achieve low threat in accordance with Section 2.2.3.2 of AS 3959. Management of low threat areas are may include (but is not limited to):
  - Removal of grassland vegetation and/or regular mowing/slashing of grass to less than 100mm in height.
  - Establishment irrigation of grass and garden beds
  - Regular maintenance including removal of weeds and dead material
  - Low pruning of trees
  - Application of ground covers such as mulch or non-flammable materials
- Areas of low threat vegetation outside of the site will continue to be managed and/or considered to achieve low threat (in accordance with Section 2.2.3.2 of AS 3959) based on the existing maintenance regimes, and/or as per the Shire of Dardanup's fire control notice.
- Classified vegetation that has been identified outside of the site has been assumed to remain in its current state (unless stated otherwise) and will therefore remain a bushfire hazard to development within the site. It is noted that large portions of the land surrounding the site are zoned for future industrial uses, and therefore are likely to be removed in the long-term and therefore this BMP has provided a conservative assessment of risk.

### 3.1.2 Assessment outputs

The BAL assessment completed for the site indicates that a BAL rating of BAL-29 or less can be achieved at future built form based on the indicated spatial layout for the structure plan (**Appendix A**). A portion of the development areas adjoining the northern, western and southern boundaries of the site are likely to be subject to a BAL rating of BAL-FZ, however future lots can be suitably sized to accommodate built form that will not be exposed to a BAL rating exceeding BAL-29. It is important to note that portions of the site have a BAL rating of BAL-FZ as a result of vegetation that will be subject to future industrial development. The proposed public open space in the north-western corner of the

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site is assumed to be a bushfire hazard, however suitable separation from this area can be provided based on the proposed road layout and if required in lot setbacks.

**Table 3** provides a summary of the setback distances necessary from classified vegetation to achieve the indicated BAL ratings, with the BAL Contour Plan (**Figure 6**) being a visual representation of these distances. The setback distances are based on the post-development classified vegetation (**Figure 4**), effective slope (**Figure 5**) and are taken from Table 2.5 of AS 3959.

*Table 3: Setback distances based on vegetation classification and effective slope and Table 2.5 of AS 3959, as determined by the method 1 BAL assessment*

Post development plot number (see Figure 4)	Vegetation classification (see Figure 4)	Effective slope (see Figure 5)	Distance to vegetation (from Table 2.5 of AS 3959)	BAL rating (see Figure 6)
Plot 1, 2, 20	Forest (Class A)	Flat/upslope	< 16 m	BAL-FZ
			16 - < 21 m	BAL-40
			21 - < 31 m	BAL-29
			31 - < 42 m	BAL-19
			42 - < 100 m	BAL-12.5
			> 100 m	BAL-LOW
Plot 21	Forest (Class A)	Downslope 0-5°C	< 20 m	BAL-FZ
			20 - < 27 m	BAL-40
			27 - < 37 m	BAL-29
			37 - < 50 m	BAL-19
			50 - < 100 m	BAL-12.5
			> 100 m	BAL-LOW
Plot 4-9	Woodland (Class B)	Flat/upslope	< 10 m	BAL-FZ
			10 - < 14 m	BAL-40
			14 - < 20 m	BAL-29
			20 - < 29 m	BAL-19
			29 - < 100 m	BAL-12.5
			> 100 m	BAL-LOW
Plot 12, 13	Scrub (Class D)	Flat/upslope	< 10 m	BAL-FZ
			10 - < 13 m	BAL-40
			13 - < 19 m	BAL-29
			19 - < 27 m	BAL-19
			27 - < 100 m	BAL-12.5
			> 100 m	BAL-LOW

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*Table 3: Setback distances based on vegetation classification and effective slope and Table 2.5 of AS 3959, as determined by the method 1 BAL assessment (continued)*

Post development plot number (see Figure 4)	Vegetation classification (see Figure 4)	Effective slope (see Figure 5)	Distance to vegetation (from Table 2.5 of AS 3959)	BAL rating (see Figure 6)
Plot 15-17	Grassland (Class G)	Flat/upslope	< 6 m	BAL-FZ
			6 - < 8 m	BAL-40
			8 - < 12 m	BAL-29
			12 - < 17 m	BAL-19
			17 - < 50 m	BAL-12.5
			> 50 m	BAL-LOW

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## 4 Identification of Bushfire Hazard Issues

From a bushfire hazard management perspective, the key issues that are likely to require management and/or consideration as part of future development within the site include:

- Provision of appropriate separation distance from permanent bushfire hazards within or surrounding the site (i.e. the public open space in the north-west corner of the site) to ensure a BAL rating of BAL-29 or less can be achieved at future built form. Consideration will also need to be given to providing appropriate separation from any temporary bushfire hazards (i.e. unmanaged vegetation within the site) that may exist as part of staged development.
- Ensuring that drainage reserves and road reserves are appropriately designed and managed to achieve low threat standards in accordance with AS 3959 and the requirements of the Shire of Dardanup.
- Provision of appropriate vehicular access to ensure that when development within the site is fully constructed, egress to at least two different destinations will be available to future workers and emergency personnel. The site is located immediately north of Harris Road, immediately east of Columbas Drive and west of Martin-Pelusey Road which provides egress to the north to South Western Highway and to the south to Boyanup-Picton Road. Temporary egress opportunities (including turn-around areas and emergency access ways) may need to be considered as part of staged development.
- Provision of appropriate water supply and associated infrastructure.

These issues are considered further in **Section 5**.

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## 5 Assessment Against the Bushfire Protection Criteria

This BMP provides an outline of the mitigation strategies that will ensure that as development progresses within the site, an acceptable solution and/or performance-based system of control can be adopted for each of the bushfire protection criteria detailed within Appendix Four of the Guidelines (WAPC and DFES 2017). The bushfire protection criteria identified in the Guidelines and addressed as part of this BMP are:

- Element 1: Location of the development
- Element 2: Siting and design of the development
- Element 3: Vehicular access
- Element 4: Water supply.

As part of future development, the intent of the bushfire protection criteria can be satisfied through acceptable solutions. A summary of how this can be achieved and an associated compliance statement for each has been provided in **Table 4**.

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Table 4: Summary of bushfire protection criteria and compliance statement

Bushfire protection criteria	Intent	Method of compliance		Proposed bushfire management strategies	Compliance statement
		Acceptable solution	Performance principle		
Element 1: Location	To ensure that strategic planning proposals, subdivision and development applications are located in areas with the least possible risk of bushfire to facilitate the protection of people, property and infrastructure.	A1.1 Development location Yes.	Development location N/A	It will be possible for all future habitable buildings to be located in an area of developable land <sup>1</sup> subject to a low or moderate bushfire hazard given buildings will be located within areas identified as low threat in accordance with Clause 2.2.3.2(e) or (f) of AS 3959. Appendix Two of the Guidelines (WAPC and DFES 2017) states that non-vegetated or low threat areas will be considered a 'low' hazard, except where within 100 m of a moderate or extreme hazard (associated with areas of classified vegetation), and in that case would be subject to a 'moderate' hazard.  As the site is proposed for industrial development, this typically includes subdivision with larger lots. Sufficient area will be available within future proposed lots to enable the 'developable land' (i.e. land that can accommodate a building) to achieve a BAL rating of BAL-29 or less. The proposed structure plan is therefore able to satisfy the acceptable solution.	Based on the outlined management measures and proposed layout, future development would be able to comply with and meet the intent of Element 1: Location.

<sup>1</sup> Position Statement: Planning in bushfire prone areas - Demonstrating Elements 1: Location and Element 2: Siting and design (DPLH 2019) has outlined that 'developable land' is "land that can accommodate a habitable dwelling and would not generally include areas of BAL-40 and/or BAL-FZ, areas within the local government setback and areas subject to environmental constraints".

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Table 4: Summary of bushfire protection criteria and compliance statement (continued)

Bushfire protection criteria	Intent	Method of compliance		Proposed bushfire management strategies	Compliance statement
		Acceptable solution	Performance principle		
Element 2: Siting and design	To ensure the siting and design of development minimises the level of bushfire impact.	A2.1 Asset Protection Zone Yes.	N/A	<p>Asset protection zones (APZ) around buildings are an important bushfire protection measure influencing the safety of people and property. An APZ is a low fuel area immediately surrounding a building and can include non-flammable features such as irrigated landscapes, gardens, driveways, public roads and managed public open space.</p> <p>Bushfire hazards likely to pose a risk to future development include classified vegetation within adjacent landholdings surrounding the site to the north, east, south and west as well as the proposed public open space within the north-western portion of the site. The vegetation within surrounding landholdings to the east of Martin Pelusey Road, west and north of the site are subject to future industrial development, however the timing of development is unknown.</p> <p>As outlined above, the outcomes of the BAL assessment (see <b>Figure 6</b>) indicates that there is sufficient space within the structure plan to enable future habitable buildings to be located in areas subject to a BAL rating of BAL-29 or less, with the majority of the future development areas likely to be subject to a BAL rating of BAL-LOW. Separation from bushfire hazards can be accommodated through the public road network and/or future lot sizes and in lot setbacks. Industrial lots are typically larger lots that will be able to accommodate any setbacks. Temporary bushfire hazards that may result from staged development have not been specifically considered as part of this BMP, however it will be possible for the proponent to maintain fuels within the structure plan to a low threat standard within 50 m of development stages.</p> <p>A portion of the development areas adjoining the eastern, western and southern boundaries of the site and nearby to the public open space may be subject to BAL-FZ and BAL-40, however future lots can be sized to accommodate built form, ensuring it doesn't exceed BAL-29 (this would also be the case for unmanaged drainage reserves). Vegetation to the west and north of the site is associated with future industrial development and will likely be removed in the long term, whilst the vegetation located immediately to the east of the site will be removed in the future as part of planned upgrades to Martin Pelusey Road.</p> <p>The construction standards pursuant to AS 3959 are unlikely to apply to industrial development within the site unless building classes include Class 1, 2, 3 or 10a buildings.</p> <p>Overall, the acceptable solution can be satisfied for all future habitable buildings.</p>	Based on the outlined management measures, future development would be able to comply with and meet the intent of Element 2: Siting and design. Separation to achieve BAL-29 or less at future habitable buildings is able to be achieved.



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Table 4: Summary of bushfire protection criteria and compliance statement (continued)

Bushfire protection criteria	Intent	Method of compliance		Proposed bushfire management strategies	Compliance statement
		Acceptable solution	Performance principle		
Element 3: Vehicular access	To ensure vehicular access serving a subdivision/development is available and safe during a bushfire event.	A3.1 Two access routes	N/A	The proposed development will have direct access to Martin-Pelusey Road (via at least two connections), which provides egress opportunities to the north and south, including South Western Highway to the north and Boyanup-Picton Road to the south. Martin Pelusey will also connect to the Bunbury Outer Ring Road (to be constructed in the future), a major regional connector.  The site will also connect to Harris Road to the south, and Columbas Drive to the west, and once development in adjacent landholdings progresses, connection to the north of the site will be available.	Based on the outlined management measures, future development would be able to comply with and meet the intent of Element 3: Vehicular access, in particular access to at least two different destinations via the existing road network and future internal road network.
		A3.2 Public road	N/A		
	Yes				

The proposed new public roads within the site, can and will comply with the minimum standards outlined in Appendix Four of the Guidelines (WAPC and DFES 2017) or as agreed with the Shire of Dardanup and includes a minimum 6 m-wide trafficable surface. An excerpt of the requirements (from Table 6 of Appendix Four the Guidelines) has been provided below. This can be accommodated through the subdivision process.

*Excerpt of Table 6 from Appendix Four of the Guidelines (WAPC & DFES 2017)*

TECHNICAL REQUIREMENTS	1	2	3	4	5
	Public road	Cul-de-sac	Private driveway	Emergency access way	Fire service access routes
Minimum trafficable surface (m)	6*	6	4	6*	6*
Horizontal clearance (m)	6	6	6	6	6
Vertical clearance (m)	4.5	N/A	4.5	4.5	4.5
Maximum grade <50 metres	1 in 10	1 in 10	1 in 10	1 in 10	1 in 10
Minimum weight capacity (t)	15	15	15	15	15
Maximum crossfall	1 in 33	1 in 33	1 in 33	1 in 33	1 in 33
Curves minimum inner radius (m)	8.5	8.5	8.5	8.5	8.5

\*Refer to E3.2 Public roads: Trafficable surface

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Table 4: Summary of bushfire protection criteria and compliance statement (continued)

Bushfire protection criteria	Intent	Method of compliance		Proposed bushfire management strategies	Compliance statement
		Acceptable solution	Performance principle		
Element 3: Vehicular access (continued from above)	Continued from above.	A3.3 Cul-de-sac (including dead-end-road)		As part of staging of development within the structure plan area, it is possible that one temporary dead-end road may be required within the site (as shown in <b>Figure 7</b> ). This is associated with the connection to future industrial development to the north of the site, which may not be progressed at the time of development. No lots will need to be serviced by this road and instead are serviced by the loop road network (hence it is a dead-end road), and a temporary turn-around area is unlikely to be required given the road reserve will be sufficiently wide enough (i.e. 25 m wide) to enable turning of emergency service vehicles.  If any temporary or permanent cul-de-sac/dead-end roads are required as part of future planning these will need to comply with Appendix Four of the Guidelines, including: <ul style="list-style-type: none"> <li>• Have a minimum 6 m-wide trafficable surface and support a minimum weight capacity of 15 tonnes.</li> <li>• Minimise the length of the cul-de-sac/dead-end road (with 200 m the indicated maximum length where no emergency access way is provided).</li> <li>• Provide turn-around areas with a minimum 17.5 m kerb-to-kerb.</li> </ul>	Continued from above.
		Yes (temporary)	N/A		
	A3.4 Battle-axe		If battle-axe properties are proposed as part of the development within the site, these will need to comply with Appendix Four of the Guidelines, including minimum width and length requirements and the provision of appropriate turn around areas.		
	Yes	N/A			
A3.5 Private driveway longer than 50 m		Due to the large lot sizes it is possible that private driveways longer than 50 m may be required as part of the development approval stage. If private driveways longer than 50 m in length are required, they will need to meet the minimum requirements outlined within Table 6 of Appendix Four of the Guidelines, including minimum horizontal and vertical clearance, overtaking bays (if required) and appropriate turn around areas. This can be confirmed at the development approval stage.			
	Yes	N/A			
A3.6 Emergency access way		Given the proposed structure plan layout provides for egress to at least two different destinations it is unlikely that permanent emergency access ways will be required as part of future development within the site. Temporary emergency access ways may be required as part of staged development to provide two egress points and if so, will need to comply with the requirements outlined within Table 6 of Appendix Four of the Guidelines, and as a minimum should have a 6 m-wide trafficable surface suitable for two-wheel drive vehicles.			
	Yes	N/A			

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Table 5: Summary of bushfire protection criteria and compliance statement

Bushfire protection criteria	Intent	Method of compliance		Proposed bushfire management strategies	Compliance statement
		Acceptable solution	Performance principle		
Element 3: Vehicular access (continued from above)	Continued from above.	A3.7 Fire service access routes (perimeter roads)		Not applicable. Future development within the site will be provided with appropriate vehicular access, as outlined above, and therefore fire service access routes are not required.	Continued from above
		N/A	N/A		
		A3.8 Firebreak width		Once development is progressed within the site, in accordance with the Shire of Dardanup fire control notice (or as specified by the Shire of Dardanup in accordance with Section 33 of the <i>Bush Fires Act 1954</i> ), firebreaks are unlikely to be required. Instead industrial zoned landholdings will be required to be managed clear of all flammable matter to a height of no greater than 50 mm.	
		Yes.	N/A		
Element 4: Water	To ensure water is available to the subdivision, development or land use to enable people, property and infrastructure to be defended from bushfire.	A4.1 Reticulated areas		Development is located within an Emergency Services Levy (ESL) Category 5 area, which indicates that bushfire events are responded to by the State Emergency Services (SES) if required and a bush fire brigade. Fire response services require ready access to an adequate water supply during bushfire emergencies.  The site will connect with a reticulated water supply and will include fire hydrants installed by the developer to meet the specifications of the relevant water authority (i.e. Aquwest) or the Water Corporation (Design Standard DS 63) and DFES. It is possible that the water pressure may not be sufficient to support fire-fighting requirements within individual lots, and as a result each lot may be required to install additional tank and pump infrastructure for fire-fighting purposes. This will be confirmed as part of future development stages and can be appropriately addressed as part of development approval.	Based on the outlined management measures, future development would be able to comply with Element 4: Water.
		Yes.	N/A		
		A4.2 Non-reticulated areas		Not applicable.	
		N/A	N/A		
		A4.3 Individual lots within non-reticulated areas (only for use if creating 1 additional lot and cannot be applied cumulatively)		Not applicable.	
		N/A	N/A		

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### 5.1 Additional management strategies

#### 5.1.1 Future approval considerations

The BAL assessment within this document is considered to be a conservative assessment of potential bushfire risk posed to future habitable buildings within the site based on the assumptions outlined in **Section 3** and will be a relevant consideration as part of future development to ensure a BAL rating of BAL-29 or less is achieved at future built form.

The measures to be implemented through this structure plan and associated future subdivision process have been outlined as part of this BMP and can be used to support future planning and development approval processes. A revised BMP may be required to support any future subdivision applications, particularly if the development layout is different to that outlined within this document, and will need to respond to the subdivision design (and/or stage of development).

No Class 1, 2 or 3 buildings are likely to be constructed within the site based on the typical built form associated with industrial development, and accordingly higher construction standards in accordance with AS 3959 are unlikely to apply.

#### 5.1.2 Landscape management

##### 5.1.2.1 Within the site

###### **Public open space**

The existing vegetation within the proposed public open space (located in the north-west corner of the site) will be retained and also revegetated with local native species to support the enhancement of fauna habitat and ecological linkages within the site. This area has been assumed to achieve a forest (Class A) classification, and no future management of this area has been assumed.

###### **Drainage reserves and road reserves**

Within the remainder of the site road reserves and drainage reserves are proposed to be landscaped as part of the future development. These areas will be designed to achieve low threat vegetation in accordance with Section 2.2.3.2 of AS 3959 The drainage reserves will need to be managed in line with the maintenance requirements associated with addressing *Vegetation Guidelines for Stormwater Biofilters in the South-west of Western Australia* (Monash University 2014), including removal of dead material and replacement of plants over time. The management of the landscaped areas will be the responsibility of the proponent initially prior to handover to the Shire of Dardanup, with ongoing management likely to include:

- Regular mowing/slashing of grass to a minimum of 100 mm in height or under the Shire of Dardanup's fire control notice less than 50 mm in height (where present).
- Irrigation of grass and garden beds (only temporary establishment irrigation is required prior to handover to the Shire of Dardanup).
- Regular removal of weeds and built up dead material (such as fallen branches, leaf litter etc.).
- Low pruning of trees (branches below 2 m in height removed where appropriate).

# Bushfire Management Plan

## Local Structure Plan, Lots 103, 110 and 436, Picton East



- Application/replacement of ground/surface covers such as mulch or non-flammable materials as required.

If the Shire of Dardanup indicate they will not or are unable to manage the drainage areas as per the typical development standards, given the industrial nature of the development and typical larger lots sizes associated with this type of development, the lots will be able to accommodate setbacks to ensure the future built form can achieve a BAL rating of BAL-29 or less. A revised BMP can be prepared to support the subdivision process, to confirm the required setbacks based on the proposed planting (likely to be at most a 'scrub' classification for the drainage areas) if the Shire of Dardanup indicate they will not manage the drainage areas to a low threat standard.

### **Future lots**

All lots within the site will be managed to a low threat standard by the proponent initially, and once sold this will be the responsibility of applicable landowners in accordance with the relevant BMP and Shire of Dardanup fire control notice (as published).

#### 5.1.2.2 Surrounding the site

##### **Within existing private landholdings**

Where indicated as low threat in **Figure 4**, it is assumed that the private landholdings surrounding the site will be managed by the applicable landowners in accordance with the Shire of Dardanup fire control notice (as published) and/or in accordance with existing maintenance regimes.

##### **Existing public road reserves**

Where road reserves surrounding the site have been identified as bushfire hazards, no future maintenance of these areas has been assumed.

#### 5.1.3 Shire of Dardanup fire control notice

The Shire of Dardanup releases a fire control notice annually (or as required) to provide a framework for bushfire management within the Shire. The Shire of Dardanup is able to enforce this order in accordance with Section 33 of the *Bush Fires Act 1954* and landowners will need to ensure compliance with the fire control notice, as published, or any directions provided by the Shire of Dardanup.

In particular, in accordance with the fire control notice, industrial areas must slash all flammable material/vegetation (except living trees) to a height of no greater than 50 mm and flammable material must be removed.

#### 5.1.4 Vulnerable or high-risk land uses

It is possible that future industrial land uses within the site may meet the definition of 'high-risk land uses' as provided in Clause 6.6 of SPP 3.7 and the Guidelines, however the specific presence of these land uses will not be known until after subdivision and future lots are sold. Therefore, policy measure 6.6 of SPP 3.7 is not applicable at this stage of the planning process and is also unlikely to be applicable at subdivision (given land uses will not be known).

# Bushfire Management Plan

## Local Structure Plan, Lots 103, 110 and 436, Picton East



However, in consideration of policy measure 6.6 of SPP 3.7, the proposed structure plan layout provides access for emergency evacuation and or response through the proposed public road network, which provide egress to the existing public road network surrounding the site. Industrial land uses typically have larger lots (particularly when compared to standard residential development), which means that future lots will have sufficient area to enable separation between surrounding bushfire hazards and future built form to be accommodated within individual lots if required.

As part of future planning stages, if a high-risk land uses are proposed, the requirements of policy measure 6.6 SPP 3.7 will need to be addressed, including the assessment of bushfire risk and/or the preparation of an emergency evacuation plan and/or risk management plan, largely as part of the development approval stage of the planning process.

### 5.1.5 Public education and preparedness

Community bushfire safety is a shared responsibility between individuals, the community, government and fire agencies. DFES has an extensive Community Bushfire Education Program including a range of publications, a website and Bushfire Ready Groups. The DFES publication '*Prepare. Act. Survive.*' (DFES 2014) provides excellent advice on preparing for and surviving the bushfire season. Other downloadable brochures are available from <http://www.dfes.wa.gov.au/safetyinformation/fire/bushfire/pages/publications.aspx>

The Shire of Dardanup provides bushfire safety advice to residents available from their website <https://www.dardanup.wa.gov.au/environment/fire-management/>. Professional, qualified consultants also offer bushfire safety advice and relevant services to workers and businesses in high risk areas in addition that that provided in this BMP.

In the case of a bushfire in the area, advice would be provided to future workers/businesses by DFES, the Department of Biodiversity Conservation and Attractions (DBCA) and/or the Shire of Dardanup on any specific recommendations with regard to responding to the bushfire, including evacuation if required. However, it is highly recommended that workers/businesses make themselves aware of their responsibilities with regard to preparing for and responding to a potential bushfire that may impact upon them, their property and their visitors at the time, regardless of the BAL rating the building is subject to.

## Bushfire Management Plan

Local Structure Plan, Lots 103, 110 and 436, Picton East



## 6 Responsibilities for Implementation and Management of Bushfire Measures

**Table 6** outlines the future responsibilities of the proponent (developer) and the Shire of Dardanup associated with implementing this BMP with reference to ongoing bushfire risk mitigation measures for existing land uses (through compliance with the Shire of Dardanup fire control notice) or future mitigation measures to be accommodated as part of the development process. These responsibilities will need to be considered as part of the subsequent development and implementation process.

*Table 6: Responsibilities for the implementation of this BMP*

Management action	Timing
<b>Developer/landowner</b>	
Provide a copy of this BMP to the relevant decision makers to support approval of the proposed local structure plan.	To support the structure plan approval process.
If required, prepare a new/revised BMP in accordance with SPP 3.7, the Guidelines and AS 3959 to support future subdivision applications, based on the proposed detailed layout and in consideration of existing bushfire hazards or those that will be present following development. In addition, if the assumptions regarding the treatment of the public open space, drainage and road reserves change as part of future detailed design stages, a revised BMP will be required.	To support each future subdivision application.
Where required, and based on the outcomes this BMP or subsequent BMP/s, make spatial provision within the subdivision layout/design to accommodate: <ul style="list-style-type: none"> <li>• A suitable road network that provides access to at least two different destinations which may include temporary emergency access ways depending upon staging of the subdivision. The trafficable surface of the public roads should be at least 6 m-wide and consider the minimum requirements of Appendix Four in the Guidelines (or as agreed with the Shire of Dardanup). The proposed structure plan currently supports this requirement.</li> <li>• If cul-de-sacs/dead-end roads, battle axe lots and private driveways longer than 50 m in length are proposed, ensure these meet the requirements outlined in Appendix Four of the Guidelines (if applying an acceptable solution), or as agreed with the Shire of Dardanup.</li> <li>• Ensure future habitable buildings are able to be located so that BAL-29 or less applies. Separation distances should be in accordance with the minimum distances outlined in <b>Table 3</b> of this BMP for the corresponding vegetation plot/classification, or as determined in subsequent BMPs/BAL assessments. This may include the provision of public roads and/or managed drainage reserves between built form and bushfire hazards, or by ensuring lots are an adequate depth or width to accommodate in-lot setbacks and ensure BAL-29 is not exceeded at future built form.</li> </ul>	To support each future subdivision application.
Comply with the Shire of Dardanup fire control order as required.	At all times, where applicable.
<b>Shire of Dardanup</b>	
Maintaining fuel loads in existing public road reserves and public open space (under their management) to appropriate standards to minimise fuel loads (as per current maintenance regimes).	Ongoing, as required.
Monitoring vegetation fuel loads in private landholdings against the requirements of the Shire's fire control order (and/or existing maintenance regimes outlined in this BMP) and liaising with relevant stakeholders to maintain fuel loads at minimal/appropriate fuel levels.	Ongoing, as required.



# Bushfire Management Plan

Local Structure Plan, Lots 103, 110 and 436, Picton East



## 7 Applicant Declaration

### 7.1 Accreditation

This BMP has been prepared by Emerge Associates who have been providing bushfire risk management advice for more than seven years, undertaking detailed bushfire assessments (and associated approvals) to support the land use development industry.

Anthony Rowe has reviewed this BMP and is a Fire Protection Association of Australia (FPAA) Level 3 Bushfire Planning and Design (BPAD) accredited practitioner (BPAD no. 36690) with over ten years' experience and is supported by a number of team members who have undertaken BPAD Level 1 and Level 2 training and are in the processing of gaining formal accreditation.

### 7.2 Declaration

I declare that the information provided is true and correct to the best of my knowledge.

Signature:

**Name:** Anthony Rowe

**Company:** Emerge Associates/Envision Bushfire Protection

**Date:** 28<sup>th</sup> January 2021

**BPAD Accreditation:** Level 3 BPAD no. 36690

Signature:

**Name:** Kirsten Knox

**Company:** Emerge Associates

**Date:** 28th January 2021

# Bushfire Management Plan

## Local Structure Plan, Lots 103, 110 and 436, Picton East



## 8 References

### 8.1 General references

Department of Fire and Emergency Services (DFES) 2014, *Prepare. Act. Survive.*, Perth. August 2014.

Department of Planning, Lands and Heritage (DPLH) 2018, *Picton Industrial Park Southern Precinct - Districts Structure Plan*, Perth.

Department of Planning, Lands and Heritage (DPLH) 2019, *Position Statement: Planning in bushfire prone areas - Demonstrating Element 1: Location and Element 2: Siting and design*, Western Australian Planning Commission.

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Environmental Protection Authority (EPA) 2008, *Advice on areas of conservation significance in the Preston Industrial Park*, Perth.

Harewood, G. 2009, *Terrestrial Fauna Survey (Level 1) of Lots 1, 2, 11, 102-104 and 603 Picton (East)*, Version 1.

Monash University 2014, *Vegetation Guidelines for Stormwater Biofilters within South-west of Western Australia* Melbourne.

Standards Australia 2009, *AS 3959-2009 Construction of buildings in bushfire-prone areas*, Sydney.

Western Australian Planning Commission (WAPC) 2015, *State Planning Policy 3.7 Planning in Bushfire Prone Areas*, Perth.

Western Australian Planning Commission (WAPC) 2019, *Waterloo Industrial Park District Structure Plan (draft)*, Perth.

Western Australian Planning Commission and Department of Fire and Emergency Services (WAPC and DFES) 2017, *Guidelines for Planning in Bushfire Prone Areas Version 1.3*, Western Australia. December 2017.

### 8.2 Online references

Department of Water 2008, *LIDAR derived 1 m elevation contours* dataset, Government of Western Australia.

Landgate 2019, *Locate V5*, viewed October 2019, <<https://maps.slip.wa.gov.au/landgate/locate/>>

## Bushfire Management Plan

Local Structure Plan, Lots 103, 110 and 436, Picton East



Office of Bushfire Risk Management (OBRM) 2019, *Map of Bush Fire Prone Areas*, viewed October 2019, <https://maps.slip.wa.gov.au/landgate/bushfireprone/>

# Bushfire Management Plan

Local Structure Plan, Lots 103, 110 and 436, Picton East



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# Figures



*Figure 1: Site Plan and Topographic Contours*

*Figure 2: Existing Site Conditions – AS 3959 Vegetation Classifications*

*Figure 3: Existing Site Conditions - Bushfire Hazard Rating*

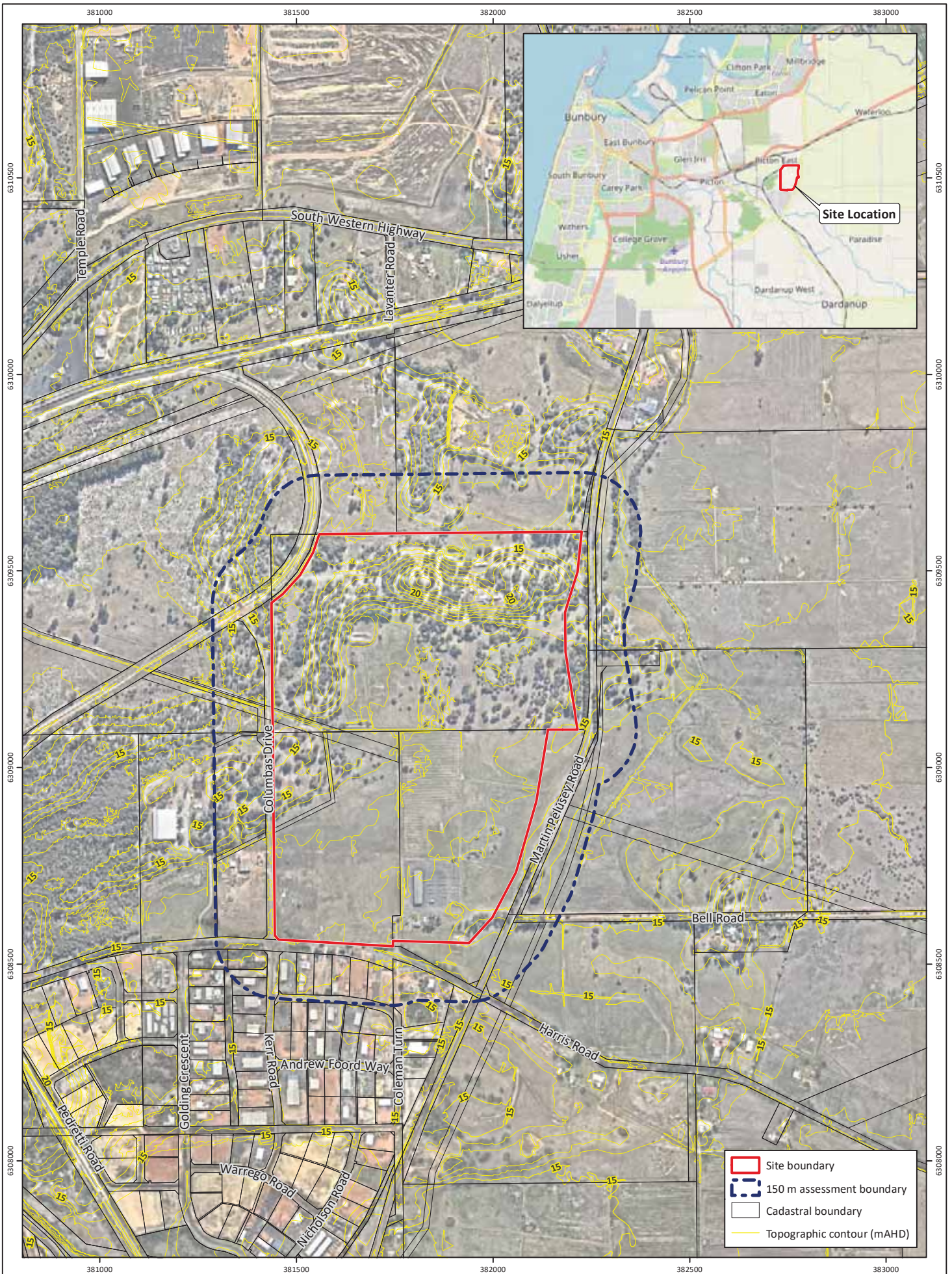
*Figure 4: Post Development Conditions-AS 3959 Vegetation Classifications*

*Figure 5: Post Development Conditions – Effective Slope*

*Figure 6: Bushfire Attack Level Contours*

*Figure 7: Vehicle Access Plan*





**Figure 1: Site Plan and Topographic Contours**

**Project:** Bushfire Management Plan  
Local Structure Plan, Lots 103, 110 and 436, Picton East

**Client:** Harris Road Pty Ltd

**Plan Number:** EP12-039(02)--F14a  
**Drawn:** GAR  
**Date:** 25/01/2021  
**Checked:** HPB  
**Approved:** KK  
**Date:** 25/01/2021

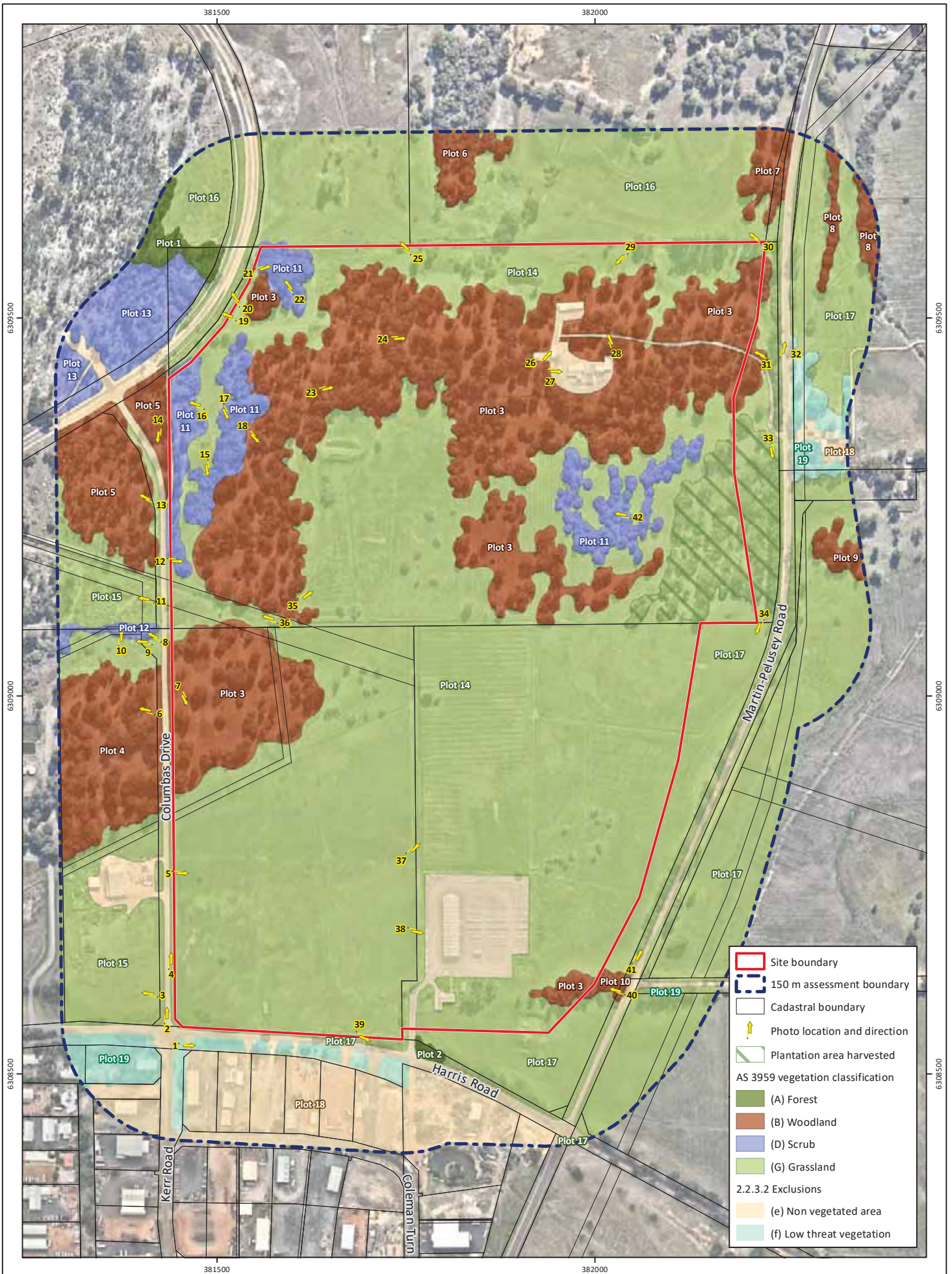
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GDA 1994 MGA Zone 50



While Emmerge Associates makes every attempt to ensure the accuracy and completeness of data, Emmerge accepts no responsibility for externally sourced data used



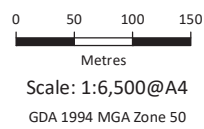




**Figure 2: Existing Site Conditions – AS 3959 Vegetation Classifications**

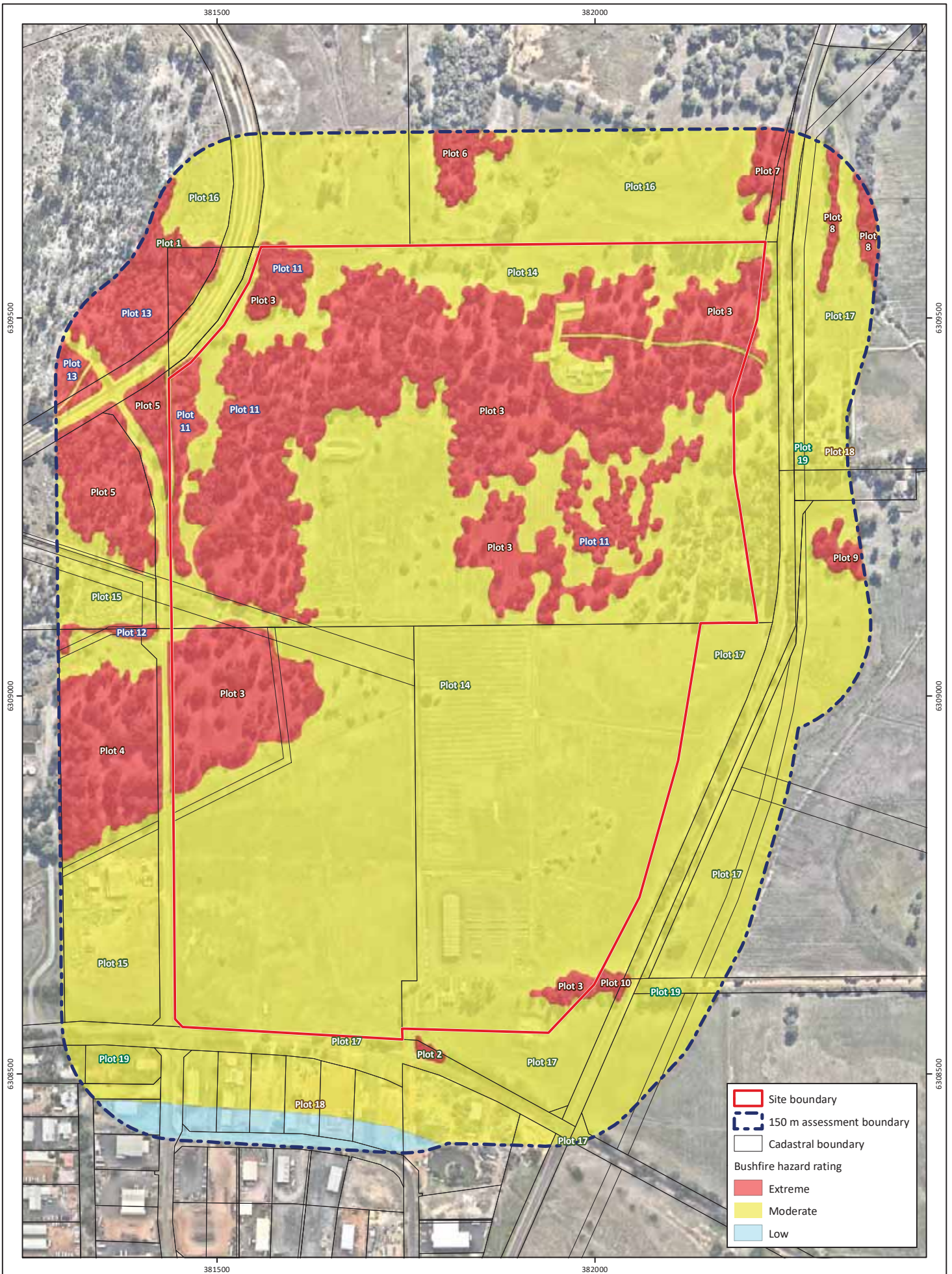
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Local Structure Plan, Lots 103, 110 and 436, Picton East  
**Client:** Harris Road Pty Ltd

**Plan Number:** EP12-039(02)--F15a  
**Drawn:** GAR  
**Date:** 25/01/2021  
**Checked:** HPB  
**Approved:** KK  
**Date:** 25/01/2021



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**Figure 3: Existing Site Conditions - Bushfire Hazard Rating**

**Project:** Bushfire Management Plan  
Local Structure Plan, Lots 103, 110 and 436, Picton East

**Client:** Harris Road Pty Ltd

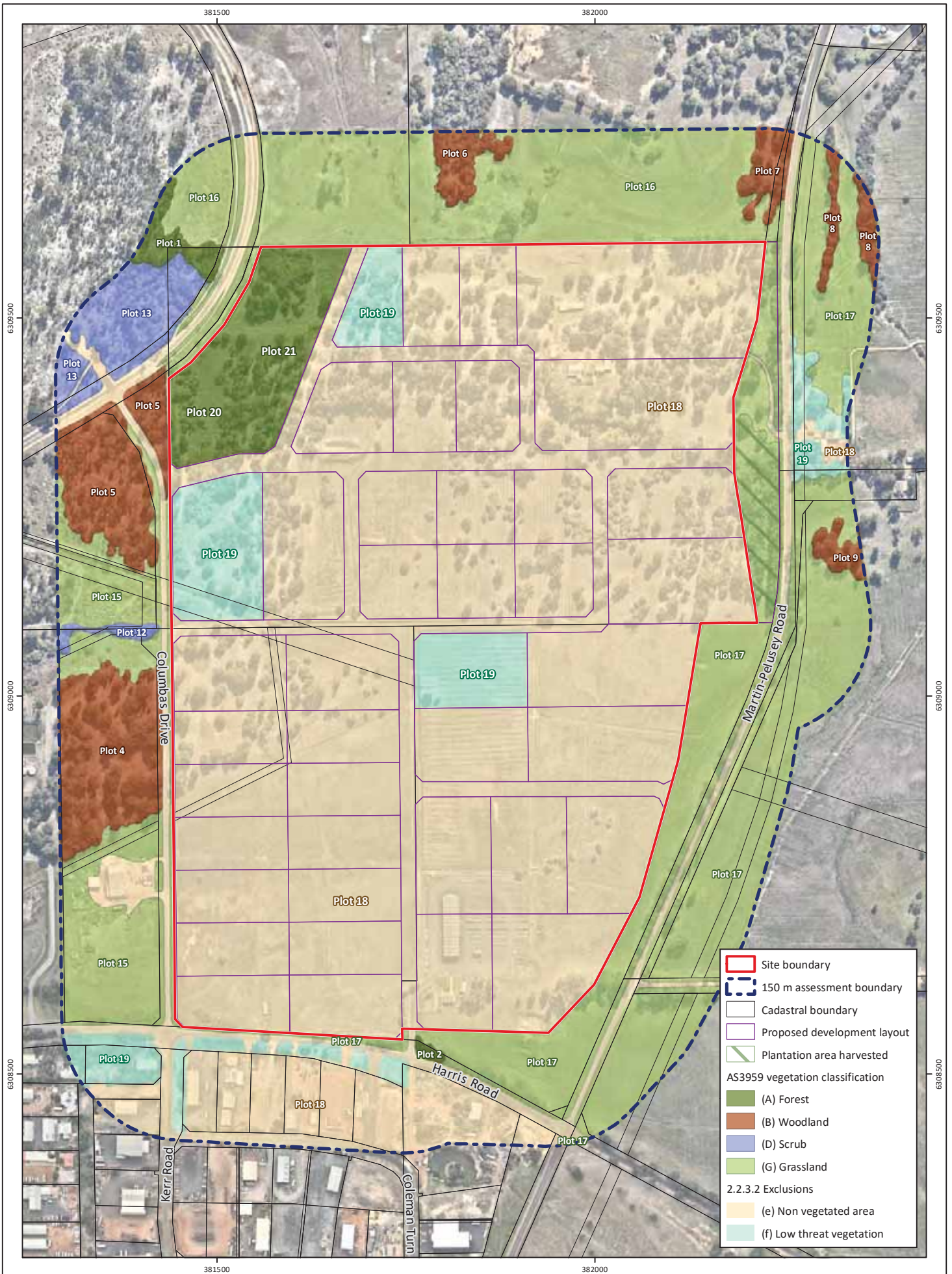
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**Drawn:** GAR  
**Date:** 25/01/2021  
**Checked:** HPB  
**Approved:** KK  
**Date:** 25/01/2021

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Scale: 1:6,500@A4  
GDA 1994 MGA Zone 50



While Emmerge Associates makes every attempt to ensure the accuracy and completeness of data, Emmerge accepts no responsibility for externally sourced data used





**Figure 4: Post Development Conditions – AS 3959 Vegetation Classifications**

**Project:** Bushfire Management Plan  
Local Structure Plan, Lots 103, 110 and 436, Picton East

**Client:** Harris Road Pty Ltd

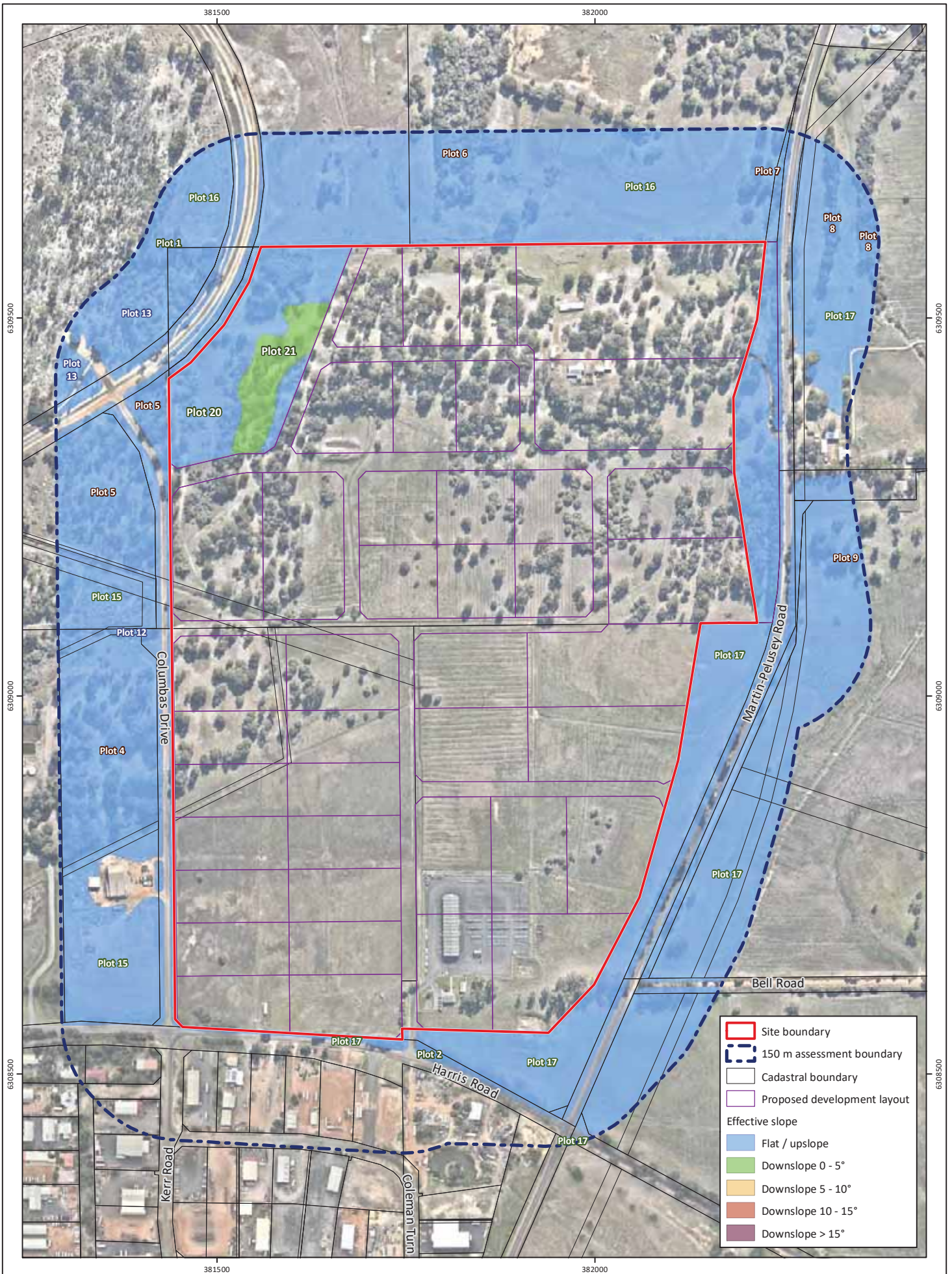
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Drawn: GAR  
Date: 25/01/2021  
Checked: HPB  
Approved: KK  
Date: 25/01/2021



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GDA 1994 MGA Zone 50







**Figure 5: Post Development Conditions – Effective Slope**

**Project:** Bushfire Management Plan  
Local Structure Plan, Lots 103, 110 and 436, Picton East

**Client:** Harris Road Pty Ltd

**Plan Number:** EP12-039(02)--F18b  
**Drawn:** GAR  
**Date:** 25/01/2021  
**Checked:** HPB  
**Approved:** KK  
**Date:** 25/01/2021

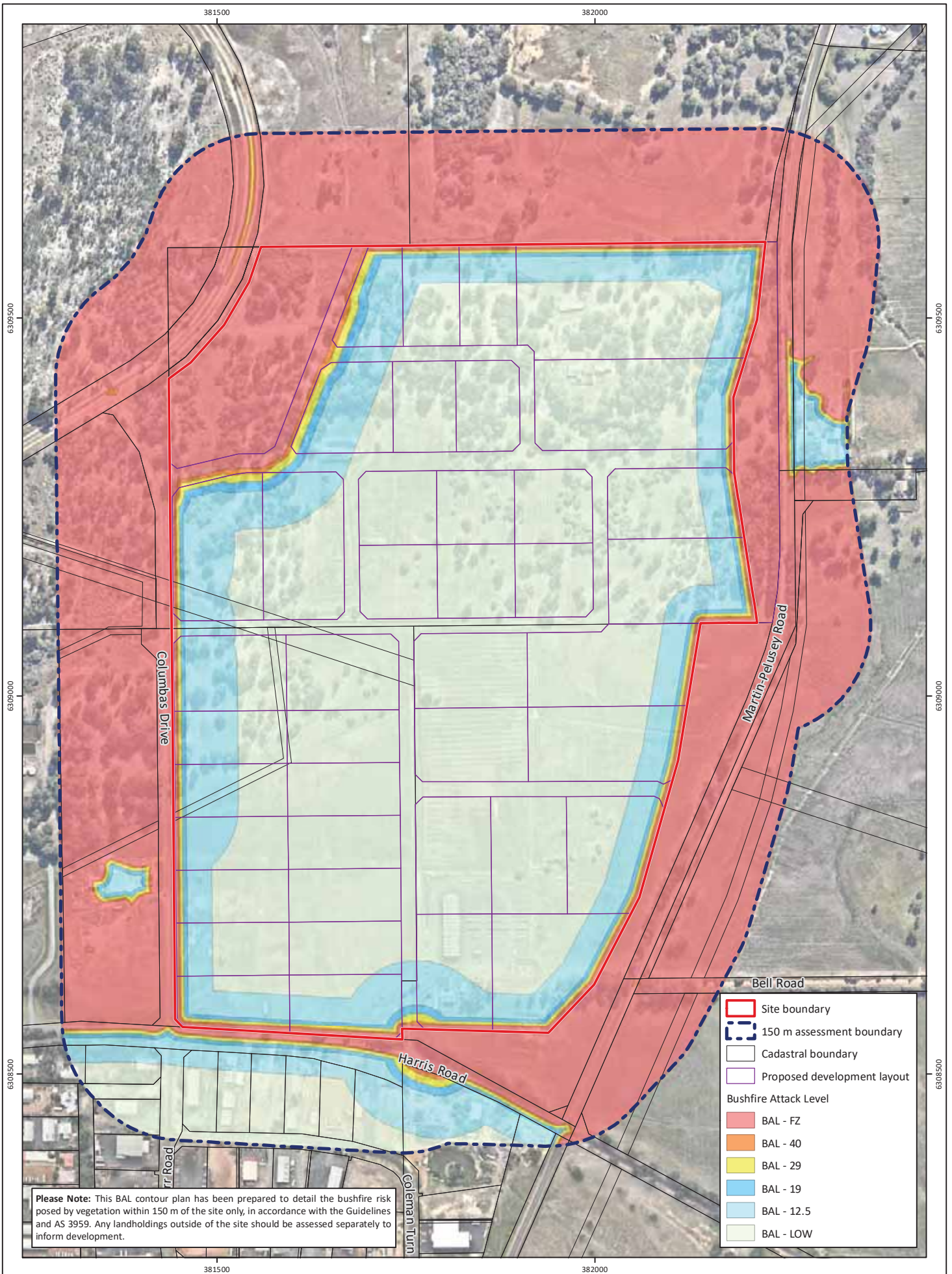
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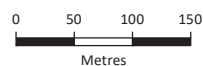






**Figure 6: Bushfire Attack Level Contours**

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Drawn: GAR  
Date: 25/01/2021  
Checked: HPB  
Approved: KK  
Date: 25/01/2021

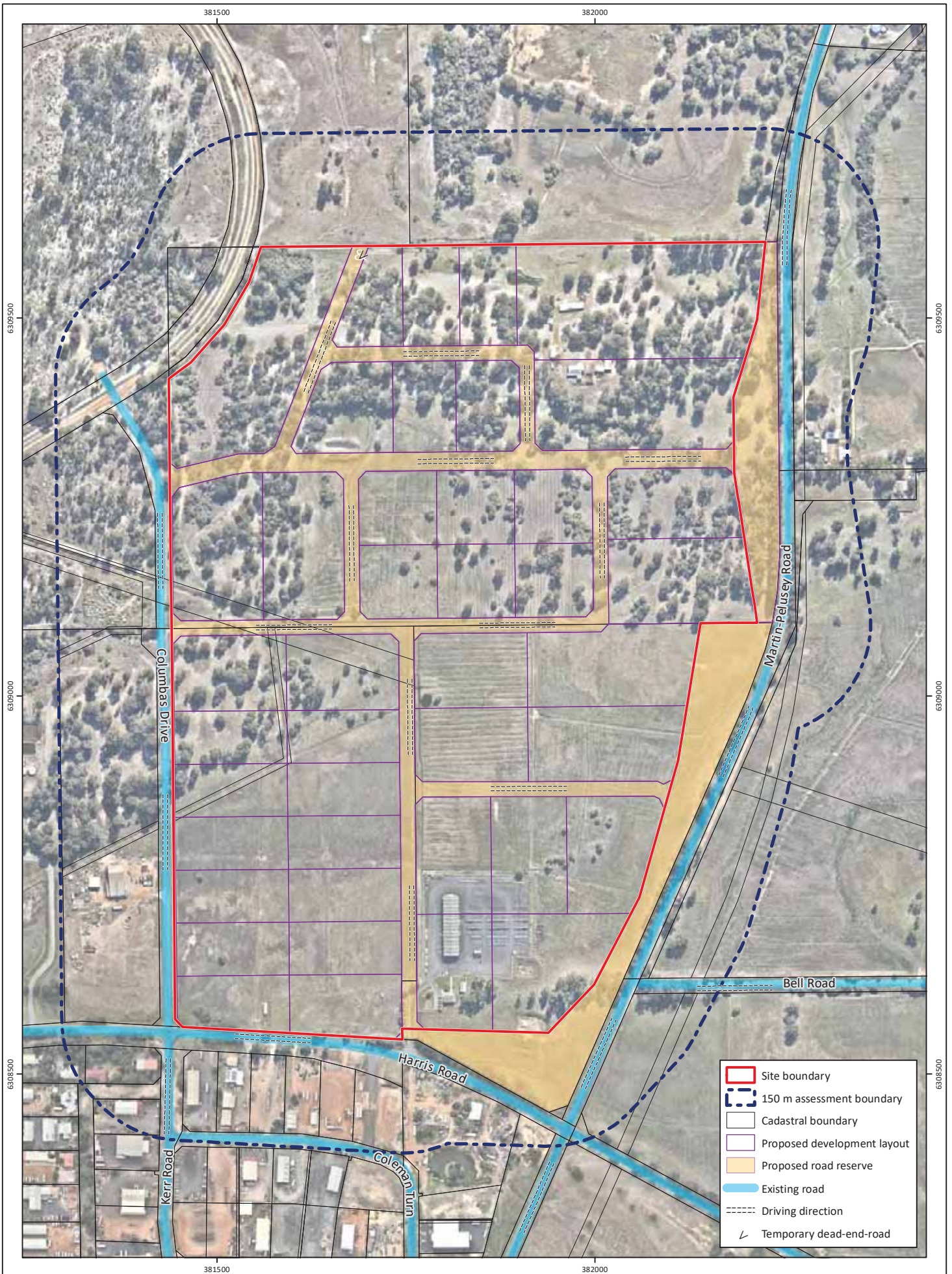


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**Project:** Bushfire Management Plan  
Local Structure Plan, Lots 103, 110 and 436, Picton East  
**Client:** Harris Road Pty Ltd

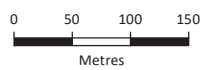




**Figure 7: Vehicle Access Plan**

**Project:** Bushfire Management Plan  
Local Structure Plan, Lots 103, 110 and 436, Picton East  
**Client:** Harris Road Pty Ltd

**Plan Number:** EP12-039(02)--F20c  
**Drawn:** GAR  
**Date:** 25/01/2021  
**Checked:** HPB  
**Approved:** KK  
**Date:** 25/01/2021



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GDA 1994 MGA Zone 50



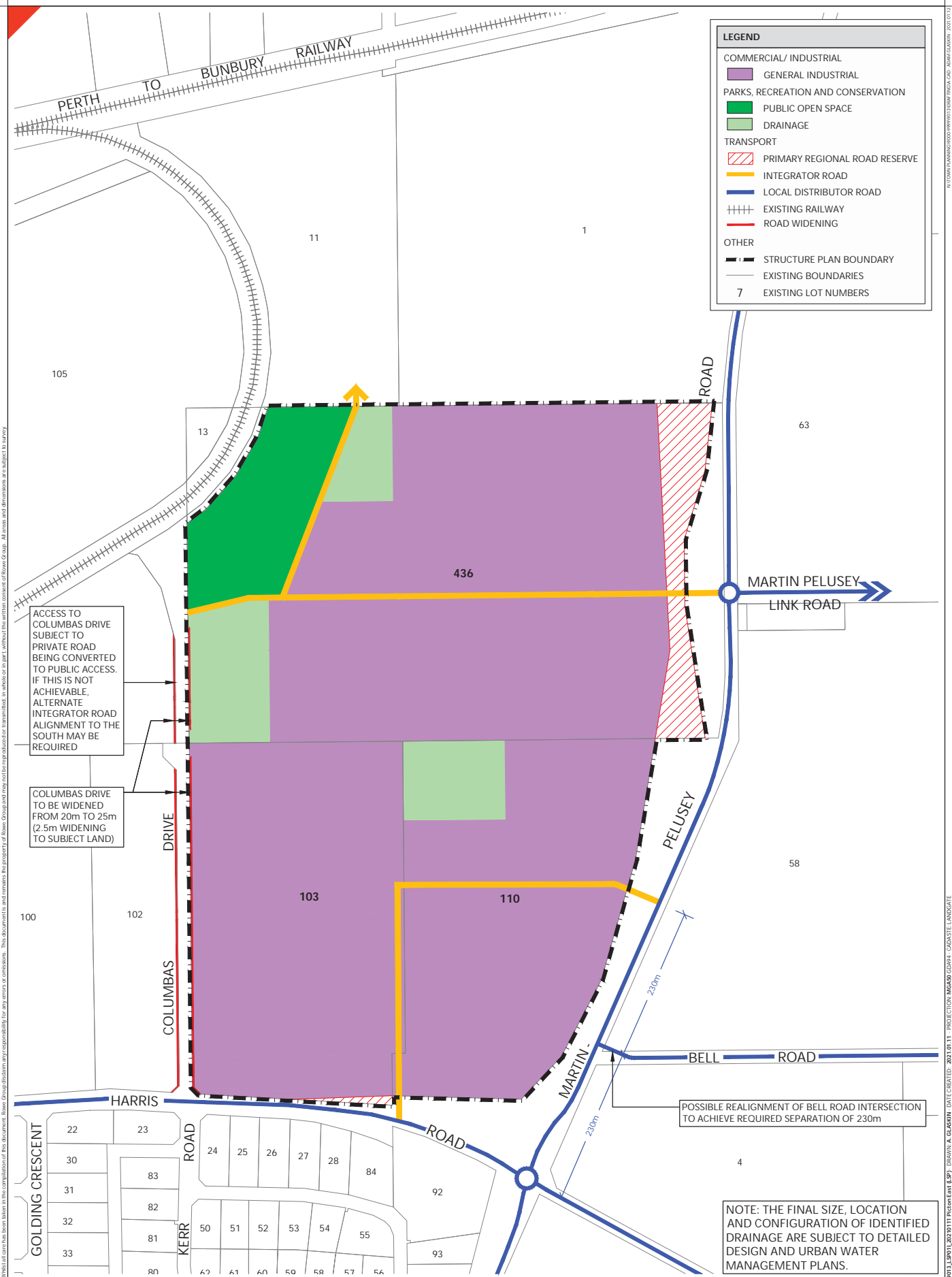


# Appendix A

Proposed local structure plan (Rowe Group Design 2020)







LEGEND	
COMMERCIAL/ INDUSTRIAL	
	GENERAL INDUSTRIAL
PARKS, RECREATION AND CONSERVATION	
	PUBLIC OPEN SPACE
	DRAINAGE
TRANSPORT	
	PRIMARY REGIONAL ROAD RESERVE
	INTEGRATOR ROAD
	LOCAL DISTRIBUTOR ROAD
	EXISTING RAILWAY
	ROAD WIDENING
OTHER	
	STRUCTURE PLAN BOUNDARY
	EXISTING BOUNDARIES
	EXISTING LOT NUMBERS

ACCESS TO COLUMBAS DRIVE SUBJECT TO PRIVATE ROAD BEING CONVERTED TO PUBLIC ACCESS. IF THIS IS NOT ACHIEVABLE, ALTERNATE INTEGRATOR ROAD ALIGNMENT TO THE SOUTH MAY BE REQUIRED

COLUMBAS DRIVE TO BE WIDENED FROM 20m TO 25m (2.5m WIDENING TO SUBJECT LAND)

POSSIBLE REALIGNMENT OF BELL ROAD INTERSECTION TO ACHIEVE REQUIRED SEPARATION OF 230m

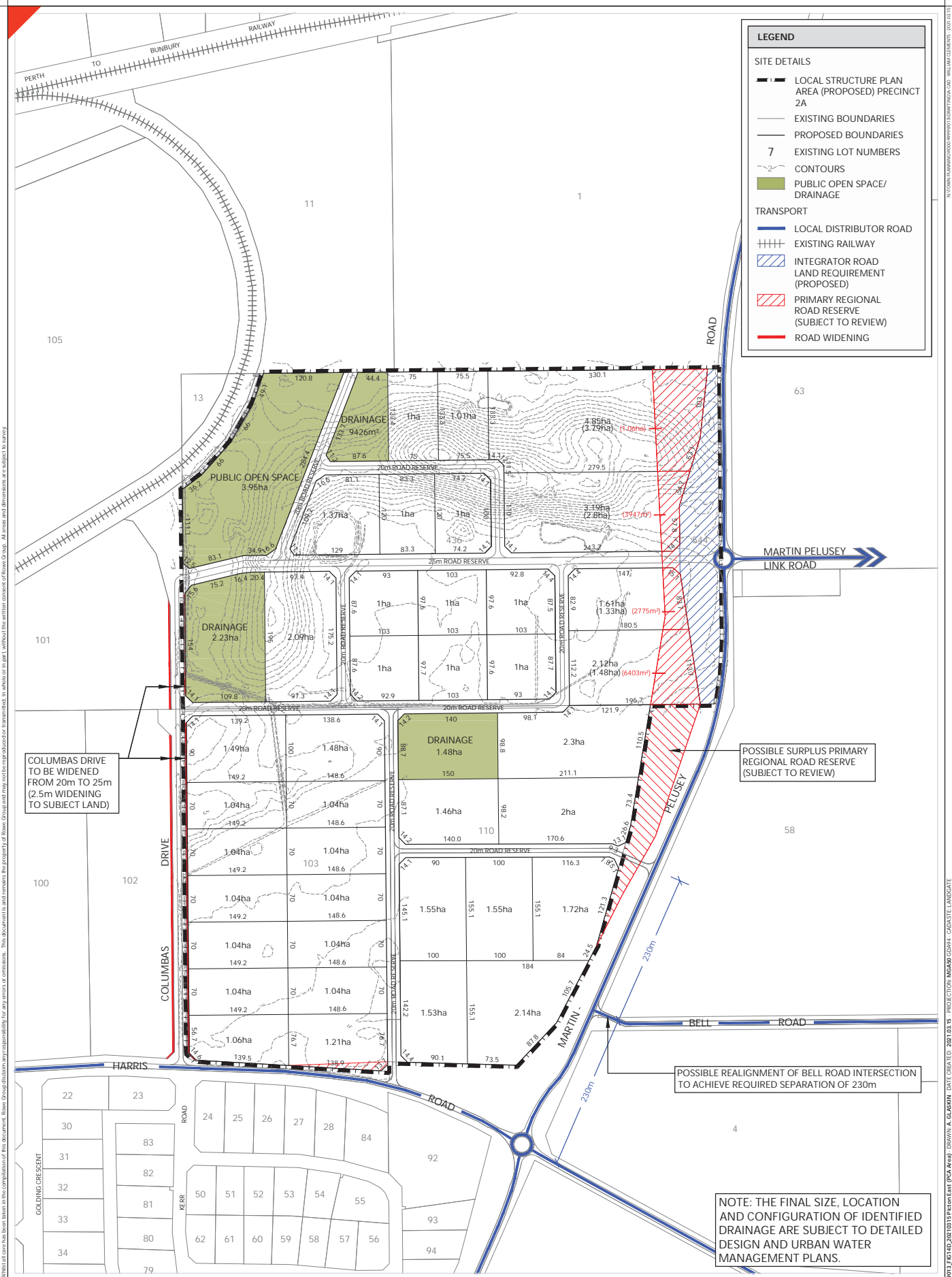
NOTE: THE FINAL SIZE, LOCATION AND CONFIGURATION OF IDENTIFIED DRAINAGE ARE SUBJECT TO DETAILED DESIGN AND URBAN WATER MANAGEMENT PLANS.

**LOCAL STRUCTURE PLAN**  
 LOTS 103, 110 AND 436  
 PICTON EAST



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9013-LSP-01-I (202111) Picton East (LSP) DRAWN: A. GLASWIN DATE CREATED: 2021.01.11 PROJECTION: NGAD83 GDA94 CANADIAN DATUM CANADIAN LANGSATE



**LEGEND**

**SITE DETAILS**

- LOCAL STRUCTURE PLAN AREA (PROPOSED) PRECINCT 2A
- EXISTING BOUNDARIES
- PROPOSED BOUNDARIES
- EXISTING LOT NUMBERS
- CONTOURS
- PUBLIC OPEN SPACE/ DRAINAGE

**TRANSPORT**

- LOCAL DISTRIBUTOR ROAD
- EXISTING RAILWAY
- INTEGRATOR ROAD LAND REQUIREMENT (PROPOSED)
- PRIMARY REGIONAL ROAD RESERVE (SUBJECT TO REVIEW)
- ROAD WIDENING

COLUMBAS DRIVE TO BE WIDENED FROM 20m TO 25m (2.5m WIDENING TO SUBJECT LAND)

POSSIBLE SURPLUS PRIMARY REGIONAL ROAD RESERVE (SUBJECT TO REVIEW)

POSSIBLE REALIGNMENT OF BELL ROAD INTERSECTION TO ACHIEVE REQUIRED SEPARATION OF 230m

NOTE: THE FINAL SIZE, LOCATION AND CONFIGURATION OF IDENTIFIED DRAINAGE ARE SUBJECT TO DETAILED DESIGN AND URBAN WATER MANAGEMENT PLANS.

**CONCEPT PLAN (MINIMUM 1HA LOTS)**  
 LOTS 103, 110, 436 AND 544  
 PICTON EAST



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9013-FIG-14-D\_20230315\_Picton East (PCA Area) DRAWN: A. GLASPER DATE CREATED: 2023.03.15 PROJECTION: MGA84/GDA94 CAWASSEL LANDGATE



# Appendix B

Additional photographs





# Bushfire Management Plan

Local Structure Plan, Lots 103, 110 and 436, Picton East



Table B1: Additional photo points organised by plot, as shown within Figure 2

## Plot 3

AS 3959 classification (Figure 2): Woodland (Class B)



Photo location 24: woodland vegetation within the site, looking east.



Photo location 31: woodland vegetation within the northern portion of the site, looking west.

## Plot 11

AS 3959 classification (Figure 2): Scrub (Class D)



Photo location 12: scrub vegetation along the western boundary of the site, looking east.



Photo location 16: scrub vegetation within the site, looking north-west.



Photo location 42: scrub vegetation within the central portion of the site, looking west.

**Bushfire Management Plan**  
 Local Structure Plan, Lots 103, 110 and 436, Picton East



*Table B1: Additional photo points organised by plot, as shown within Figure 2 (continued)*

Plot 15-17	
AS 3959 classification (Figure 2): Grassland (Class G)	
 <p><i>Photo location 25: grassland vegetation to the north of the site, looking north-west.</i></p>	 <p><i>Photo location 30: grassland vegetation within landholdings to the north of the site, looking north-west.</i></p>
 <p><i>Photo location 33: grassland vegetation within Martin Pelusey Road, with scattered trees.</i></p>	 <p><i>Photo location 39: grassland within Harris Road reserve with some Melaleuca sp. Present.</i></p>
 <p><i>Photo location 41: grassland vegetation along Martin-Pelusey Road, looking north.</i></p>	

# Bushfire Management Plan

Local Structure Plan, Lots 103, 110 and 436, Picton East



Table B1: Additional photo points organised by plot, as shown within Figure 2 (continued)

**Plot 18**

**AS 3959 classification (Figure 2): Non-vegetated (e)**



Photo location 26: existing water tanks and sheds within the site, looking north-east.



Photo location 32: Martin-Pelusey Road adjacent to the eastern boundary of the site, looking north.

# Bushfire Management Plan

Local Structure Plan, Lots 103, 110 and 436, Picton East



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# APPENDIX 5

LOCAL WATER MANAGEMENT STRATEGY



**ROWE**  
GROUP  
DESIGN

# Local Water Management Strategy

Local Structure Plan, Lots 103, 110 and 436,  
Picton East

Project No: EP12-039(01)

**Prepared for Harris Road Pty Ltd  
August 2021**





# Local Water Management Strategy

## Local Structure Plan, Lots 103, 110 and 436, Picton East



## Document Control

Doc name: Local Water Management Strategy Local Structure Plan, Lots 103, 110 and 436, Picton East					
Doc no.: EP12-039(01)—002I KT					
Version	Date	Author		Reviewer	
1	February 2014	Aisha Chalmers	ASC	David Coremans	DPC
	For review by project team				
A	March 2014	Aisha Chalmers	ASC	David Coremans	DPC
	For submission to SoD and DoW				
B	May 2014	Aisha Chalmers	ASC	David Coremans	DPC
	For submission to SoD and DoW				
C	May 2014	Aisha Chalmers	ASC	David Coremans	DPC
	For submission to SoD and DoW				
D	November 2019	Aisha Chalmers	ASC	David Coremans	DPC
	For project team review				
E	November 2019	Aisha Chalmers	ASC	David Coremans	DPC
	To accompany local structure plan submission				
F	May 2020	Aisha Chalmers	ASC	David Coremans	DPC
		Heidi Becker	HPB		
	Updated to address agency comments				
G	February 2021	April Irwin	AJI	Rachel Evans	RLE
	Updated to address agency comments				
H	May 2021	April Irwin	AJI	David Coremans	DPC
	Updated to address agency comments				
I	August 2021	Kirsten Knox	KK	Kirsten Knox	KK
	Minor text change to address SoD request				

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# Local Water Management Strategy

## Local Structure Plan, Lots 103, 110 and 436, Picton East



## Executive Summary

Harris Road Pty Ltd (the 'proponent') proposes to develop a portion of the Picton Industrial Park Southern Precinct within the Shire of Dardanup (SoD) for industrial purposes. Specifically Lots 103, 110 and 436 (referred to herein as 'the site'), which have existing frontages to Columbus Drive, Harris Road and Martin Pelusey Road, respectively.

The site covers appropriately 73 hectares (ha). The full range of land uses permissible under the SoD *Town Planning Scheme No. 3* (DPLH 2019b) 'General Industry' zone will be accommodated. The site is anticipated to include lots ranging in size from approximately 1 ha to 4.85 ha, with an overall yield of 37 lots. In addition to industrial lots, the development will include three 25 m wide integrator road reserves, 3.9 ha of public open space (POS), approximately 4.7 ha of drainage reserves, and local access roads.

This local water management strategy (LWMS) has been prepared to support the local structure plan and has been developed in accordance with *Better Urban Water Management* (WAPC 2008b) and other relevant policies and guidelines.

Water will be managed using an integrated water cycle management approach. The first step in applying integrated water cycle management is to understand the existing environment. In summary, the environmental investigations conducted to date indicate that:

- The site receives 726 mm of average annual rainfall with the majority of rainfall received in June to August.
- Topography of the site ranges from 12 m Australian height datum (AHD) to 23 m AHD, with lower areas generally consistent with existing drains and farm dams. The higher elevations are located along the western and northern boundaries of the site.
- The site is underlain by fine to medium grained sands with clayey sands of the Guildford Formation at depth. Yellow Bassendean sands are located in the areas of higher elevation.
- The site is in an area of moderate to low risk of acid sulfate soils (ASS) occurring within three metres of the natural surface. No potential for ASS was found within the site by a preliminary ASS investigation.
- Most of the site is listed as multiple use wetland.
- No natural waterways exist within the site, with only small farm drains and dams evident. These ultimately contribute to a major drain that is currently managed by the Water Corporation. These drains ultimately discharge into the Ferguson River before entering the Preston River.
- Pre-development surface runoff modelling determined that the majority of the site is located within a catchment that discharges beneath the railway to the west of the site at a rate of 0.96 m<sup>3</sup>/s in the 1% average exceedance probability (AEP) rainfall event. A small portion of the site discharges north into a trapped low point.
- Depth to maximum groundwater level (MGL) across the site ranges from just below the surface to approximately 8.5 m below the natural surface, however across the majority of the site MGL depth is within approximately 0.9 m of the natural surface.
- Total nitrogen and total phosphorus concentrations within groundwater beneath the site exceeded available guideline values.

# Local Water Management Strategy

## Local Structure Plan, Lots 103, 110 and 436, Picton East



- The *Government Sewerage Policy* indicates that the entire site is mapped as a sewage sensitive area associated with area 'A - Estuary catchments on the Swan and Coastal Plains'.
- The site has historically been used for agricultural purposes and general industry.

The LWMS design objectives seek to deliver best practice outcomes using a water sensitive urban design approach, including detailed management approaches for:

- Water supply and water conservation
- Stormwater quantity and quality management
- Groundwater level and quality management
- Wastewater servicing.

The overall approach to water supply is a reticulated network for potable uses. No ongoing water use is proposed for the estate itself and water efficiency measures (e.g. waterwise gardening (WWG)) will be promoted to lot owners to reduce water requirements.

Stormwater management focuses on treating runoff from the small rainfall event as close to source as possible within lots and road reserves to mimic the existing hydrological regime. Detention structures are also required to maintain pre-development peak flow rates for minor and major events.

Groundwater management focuses on creating controlled groundwater levels (CGL) through a combination of maintaining existing inverts, creating roadside swales and any subsoil drains within lots. The inverts of these will maintain CGLs across the site, which will be set in accordance with *Water resource considerations when controlling groundwater levels in urban development* (DoW 2013). Required clearances to the CGL will be achieved by utilising imported fill. Non-structural measures (e.g. education) have been proposed to ensure both stormwater and groundwater quality outcomes are met.

Wastewater management focuses on providing on-site domestic and industrial wastewater services in a manner that avoids any detrimental impacts on the environment and water resources. This will be undertaken in line with the requirements of the *Government Sewerage Policy* (DPLH 2019), *Australian Standard AS/NZS 1547:2012 Onsite Domestic Wastewater Management* (Standards Australia and Standards New Zealand 2012) and *Water Quality Protection Note 51: Industrial wastewater management and disposal* (DoW 2009).

The proposed design criteria and the manner in which they are proposed to be achieved are presented in **Table E 1**. This table provides a readily auditable summary of the required outcomes which can be used in the future detailed design stage to demonstrate that the agreed objectives for water management at the site have actually been achieved.

This LWMS demonstrates that the site is capable of being developed by following the recommendations detailed in the report.

## Local Water Management Strategy

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Table E 1 Water management criteria and compliance summary

Management aspect	Criteria number	Criteria description	Manner in which compliance will be achieved	Responsibility for implementation	Timing of implementation
Water supply and conservation	WC1	Ensure the efficient use of all water resources.	Lots will be provided with potable water through a reticulated network.	Developer	Detailed design and implementation
			Promotion of rainwater tanks, water efficient appliances and WWG principles for use within lots.	Developer	At point of sale
			Use of water efficient fittings and toilets within lots.	Lot owner	Lot construction
Stormwater management	SW1	Treat the small rainfall event as close to source as practicably possible.	No ongoing water use is proposed for the POS, drainage reserves or verges (including swales).	Developer	Landscape design and implementation
			Lots are required to provide 2 m <sup>3</sup> of storage for each 65 m <sup>2</sup> of impervious area through a combination of rainwater tanks, detention within carparks or hardstand, infiltration in landscaped areas, subsurface storage/soakwells and/or lot detention areas (LDAs).	Lot owner	Lot construction
	SW2	Maintain allowable (pre-development) peak flow rates and volumes up to the major rainfall event discharging from the development.	Swales within road verges will treat small event rainfall from the adjacent road bitumen.	Developer	Detailed design and implementation
			Lots are required to provide 2 m <sup>3</sup> of storage for each 65 m <sup>2</sup> of impervious area through a combination of rainwater tanks, detention within carparks or hardstand, infiltration in landscaped areas, subsurface storage/soakwells and/or LDAs.	Lot owner	Lot construction
			Swales and detention areas will detain the minor and major rainfall event runoff from road reserves to maintain allowable peak flow rates and volumes.	Developer	Detailed design and implementation
			Roadside swales and the existing swale along the railway line and Columbas Drive will convey upstream flows through the site towards the ultimate discharge location.	Developer	Detailed design and implementation

## Local Water Management Strategy

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Table E 1 Water management criteria and compliance summary (continued)

Management aspect	Criteria number	Criteria description	Manner in which compliance will be achieved	Responsibility for implementation	Timing of implementation
Stormwater management	SW4	Minor roads remain passable in the minor (10% AEP) rainfall event.	Minor roads remain passable in the minor rainfall event (i.e. 10% AEP).	Developer	Detailed design and implementation
	SW5	Finished floor levels should have a clearance from the major rainfall event top water level within detention areas of 300 mm.	Where necessary, lots are required to be filled, as a condition of subdivision (at subdivision). This will ensure finished flood levels of habitable buildings meet the required clearances.	Developer	Detailed design and implementation at subdivision
	SW6	Apply appropriate non-structural measures to reduce pollutant loads.	Street sweeping on a regular basis. No ongoing fertiliser use is proposed within the POS, drainage reserves and swales, as these are not proposed to require ongoing irrigation. Education of lot owners regarding fertiliser application and the use of nutrient absorbing vegetation within LDAs and landscaped areas.	Developer and then SoD Developer and then SoD Developer	Post-construction Post-construction At point of sale
Groundwater management	GW1	Existing inverts at discharge locations will be maintained.	Existing inverts at the ultimate discharge location beneath Columbas Drive will be maintained. Existing inverts within the existing swale located adjacent to the western boundary of the site (i.e. adjacent to the railway easement), and within existing roadside swales along Columbas Drive and Harris Road will also be maintained.	Developer	Detailed design and implementation
	GW2	Swales and subsoil drains will have free draining outlets.	Roadside swales and any subsoil drains will have free draining outlets and minimum grades of 1:750 and 1:500, respectively. This will determine the inverts of swales and subsoil drains and therefore the CGL across the site.	Developer	Detailed design and implementation

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Table E 1 Water management criteria and compliance summary (continued)

Management aspect	Criteria number	Criteria description	Manner in which compliance will be achieved	Responsibility for implementation	Timing of implementation	
Groundwater management	GW3	Mitigate the breeding of disease vector and nuisance insects within detention areas.	Detention areas will have a low flow outlet to ensure these dry out between rainfall events. Detention Area 1 will have an invert set at CGL (i.e. 13 m AHD). Detention Area 2 and 3 will have an invert set at the existing drain invert (i.e. 12.05 m AHD and 12.5 m AHD, respectively).	Developer	Detailed design and implementation	
			Education of lot owners regarding fertiliser use and nutrient absorbing vegetation species appropriate for use within lots.	Developer	At point of sale	
	GW4	Maintain or improve groundwater quality onsite.	No ongoing fertiliser use is proposed within the POS, drainage reserves and swales, as these are not proposed to require ongoing irrigation.	Developer	Developer	Landscape design and implementation
			Use of ATUs for the management of waste from buildings/site offices in accordance with relevant guidelines.	Lot owner	Lot owner	Lot construction
			Appropriate treatment and/or the capture and removal of wastewater from industrial processes from the lot.	Lot owner	Lot owner	Lot construction
			Utilising water sensitive urban design measures within each lot as is appropriate to the final industrial land use.	Lot owner	Lot owner	Lot construction
			Use of high phosphorous retention index soils (or similar) beneath LDAs and roadside swales, and surrounding subsoil drains.	Lot owner and developer	Lot owner and developer	Lot construction and detailed design and implementation
			Directing infiltrated stormwater and groundwater captured by subsoil drains into a vegetated roadside swale.	Developer	Developer	Detailed design and implementation

## Local Water Management Strategy

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Table E 1 Water management criteria and compliance summary (continued)

Management aspect	Criteria number	Criteria description	Manner in which compliance will be achieved	Responsibility for implementation	Timing of implementation	
Wastewater servicing	WW1	On-site sewage systems to be located at least 100 m from a drainage system that discharges directly into a waterway or significant wetland without treatment.	Discharges from the on-site sewage system will not connect directly to a natural waterway or significant wetland. Discharges from the lot will ultimately enter a treatment train system of roadside swales and detention areas before entering a major drain and eventually the Ferguson River. All roadside swales and detention areas within the site will provide treatment by utilise nutrient absorbing vegetation.	Developer and lot owner	Detailed design and implementation, and lot construction	
	WW2	On-site sewage systems are not to be located in any area subject to inundation and/or flooding in a 10 % AEP rainfall event.	Lot sewage systems will not be located in an area subject to inundation or flooding in a 10 % AEP event. Each lot will contain an LDA to treat and infiltrate runoff, and consequently, lot sewage systems will need to be located beyond the LDA.	Lot owner	Lot construction and detailed design	
	WW3	The discharge point of the on-site sewage system should be at least 1.5 m above the highest groundwater level.	The discharge point of lot sewage systems will be set at least 1.5 m above the highest groundwater level. Fill will be used to meet this clearance where necessary.	Lot owner	Lot owner	Lot construction and detailed design
	WW4	Ensure appropriate treatment of industrial wastewater within lots.	Wastewater from any industrial processes will be treated appropriately within the lot and not within the ATUs used for general sewage.	Lot owner	Lot owner	Lot construction and detailed design

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## Appendices

### **Appendix A**

Local Structure Plan and Concept Plan

### **Appendix B**

Preliminary Acid Sulphate Soil Investigation

### **Appendix C**

Surface Runoff Modelling from DWMS

### **Appendix D**

Lot 105 Columbas Drive, Picton East, Preliminary Servicing Strategies

### **Appendix E**

Groundwater Monitoring Results

### **Appendix F**

Groundwater Monitoring Report

### **Appendix G**

Modelling Assumptions Report

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## Abbreviation Tables

Table A1: Abbreviations – Organisations

Organisations	
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
BoM	Bureau of Meteorology
DBCA	Department of Biodiversity, Conservation and Attractions
DoH	Department of Health
DoP	Department of Planning (now DPLH)
DoW	Department of Water (now DWER)
DPLH	Department of Planning, Lands and Heritage
DWER	Department of Water and Environmental Regulation
EPA	Environmental Protection Authority
IPWEA	Institute of Public Works Engineering Australasia
MRWA	Main Road Western Australia
NWRC	National Water Reform Committee
WAPC	Western Australian Planning Commission
WGE	Wood & Grieve Engineers, now part of Stantec
WQPSC	Water Quality Policy Sub Committee

Table A2: Abbreviations – General terms

General terms	
AEP	Annual exceedance probability
AHD	Australian height datum
ASS	Acid sulfate soil
ATU	Aerobic treatment units
BUWM	Better urban water management
CAP	Contingency action plan
CGL	Controlled groundwater level
DA	Development application
DSP	District structure plan
DWMS	District water management strategy
EC	Electrical conductivity

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Table A2: Abbreviations – General terms (continued)

General terms	
GPT	Gross pollutant trap
LDA	Lot detention area
LSP	Local structure plan
LWMS	Local water management strategy
MGL	Maximum groundwater level
MUW	Multiple use wetland
NO <sub>2</sub>	Nitrite
NO <sub>3</sub>	Nitrate
NO <sub>x</sub>	Nitrate and nitrite
POS	Public open space
PRI	Phosphorous retention index
SSE	Site and soil evaluation
TKN	Total Kjeldahl Nitrogen
TN	Total nitrogen
TP	Total phosphorous
TPS	Town planning scheme
TWL	Top water level
UWMP	Urban water management plan
WA	Western Australia
WQIP	Water quality improvement plan
WSUD	Water sensitive urban design
WWG	Waterwise gardening

Table A3: Abbreviations – Units of measurement

General terms	
cm	Centimetre
m <sup>3</sup>	Cubic metre
m <sup>3</sup> /ha	Cubic metres per hectare
m <sup>3</sup> /s	Cubic metres per second
m <sup>3</sup> /s/ha	Cubic metres per second per hectare
ha	Hectare

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Table A3: Abbreviations – Units of measurement (continued)

General terms	
kL	Kilolitres
km	Kilometres
m	Metre
m AHD	Metres in relation to the Australian height datum
m/day	Metres per day
mg/L	Miligrams per litre
mm	Millimetre
%	Percentage
m <sup>2</sup>	Square metre

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## 1 Introduction

### 1.1 Background

Harris Road Pty Ltd (the proponent) proposes to develop a portion of the *Picton Industrial Park Southern Precinct - District Structure Plan (DSP)* (DPLH 2018) within the Shire of Dardanup (SoD) for industrial purposes. Specifically, Lots 103, 110 and 436 (referred to herein as 'the site'), which have existing frontages to Columbus Drive, Harris Road and Martin Pelusey Road, respectively. The location, aerial photography illustrating the current condition, and cadastral boundaries of the site are shown in **Figure 1**.

### 1.2 Town planning context

The site is currently zoned 'Industrial Deferred' under the *Greater Bunbury Region Scheme* (DPLH 2019a). Lots 103 and 436 are zoned 'General Farming' and Lot 110 is zoned 'Restricted Use 10' (for timber sales and storage) under *SoD Town Planning Scheme No. 3 (TPS 3)* (DPLH 2019b).

### 1.3 Purpose of this report

The proponent has prepared a local structure plan (LSP) to support and guide future development within the site. The LSP is provided in **Appendix A**. This Local Water Management Strategy (LWMS) details the water management approach to support the LSP, and has been developed in consideration of the policies listed in **Section 1.4** and the existing environment described in **Section 3**.

### 1.4 Policy framework

There are a number of State Government policies of relevance to the site. These policies include:

- *State Water Strategy* (Government of WA 2003b)
- *State Planning Policy 2.9 Water Resources* (WAPC 2006)
- *State Water Plan* (Government of WA 2007)
- *Guidance Statement No. 33: Environmental Guidance for Planning and Development* (EPA 2008)
- *Liveable Neighbourhoods* (WAPC 2009a)
- *Planning Bulletin No. 64: Acid Sulfate Soils (ASS)* (WAPC 2009b)
- *Government Sewerage Policy* (DPLH 2019).

In addition to the above policies, there are a number of published guidelines and standards available that provide direction regarding the water discharge characteristics that urbanised developments should aim to achieve. These are key inputs that relate either directly or indirectly to the site and include:

- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC and ARMCANZ 2000; WQPSC & NWRC 2018)
- *Australian Runoff Quality* (Engineers Australia 2006)
- *Stormwater Management Manual for WA* (DoW 2007b)

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- *Better Urban Water Management (BUWM) (WAPC 2008b)*
- *Interim: Development a LWMS (DoW 2008a)*
- *Leschenault Estuary Water Quality Improvement Plan (WQIP) (DoW 2012)*
- *Australian Standard AS/NZS 1547:2012 Onsite Domestic Wastewater Management (Standards Australia and Standards New Zealand 2012)*
- *Water resource considerations when controlling groundwater levels in urban developments (DoW 2013)*
- *Specification: Separation distances for groundwater controlled urban development (IPWEA 2016)*
- *Australian Rainfall and Runoff (Ball J et al. 2019)*
- *Decision Process for Stormwater Management in WA (DWER 2017)*
- *Policy No CP095 – Local Biodiversity (SoD 2018b)*
- *Policy No CP060 – Storm Water Discharge from Buildings (SoD 2018a).*

### 1.5 Previous studies

The District Water Management Strategy (DWMS) was prepared by Calibre (2017). The key water management strategies proposed in the DWMS are consistent with integrated water cycle management principles outlined in the reference documents described previously. Those of relevance to the site are:

- Drainage management
  - On lot and off lot detention systems, combined with treatment systems such as bioretention gardens will capture and treat stormwater flows. All flows leaving the site up to the 1% annual exceedance probability (AEP) event are generally to match the pre-development rate.
  - Lots will have a direct connection to the road network stormwater system, after storage is exceeded on the lot.
  - On lot storage is to be in accordance with the local authority guidelines.
  - All finished floor levels will be designed to maintain a clear separation of 300 mm between the habitable floor levels and the 1% AEP flood level, generated on site.
- Groundwater and ASS management strategy
  - Inflows to groundwater are to be treated through bioretention media and plants within the basins and swales, to improve the quality of water prior to it entering the groundwater.
  - A subsoil drainage system, interconnected with the swale network, will be used to control groundwater levels around buildings and roads.
  - All groundwater level management is to focus on fill minimisation.
  - Subsoil drainage systems are to incorporate amended filter media around them to treat groundwater prior to it entering the subsoil pipe.
  - All groundwater discharged from subsoil drains will be further treated through vegetation within the receiving drainage system.
  - An ASS investigation is required within each LSP area. ASS will be handled in accordance with an ASS management plan at subdivision stage.
- Sustainable water servicing
  - Industrial buildings are to be encouraged to incorporate rainwater storage devices where practical. These are to be plumbed to provide a source of internal and external non potable water.



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- All lots are to be connected to a potable reticulated water main to provide security of supply.
- Lots to be connected to mains sewer unless detailed planning shows a portion is suitable to dry industry or onsite effluent management, using alternative treatment units (ATUs).
- Non-potable water can come from a variety of sources including some stormwater harvesting and treated wastewater.
- Provision of awareness raising material on water saving measures to business developers.
- Landscaping on private lots to be in accordance with waterwise landscaping principles as directed by the local authority.
- Water dependent ecosystem management
  - New waterway habitat will be created within upgraded and new swales.
  - Bioretention systems and detention basins will provide riparian wetland habitat.
  - The water sensitive urban design (WSUD) elements used on site will treat stormwater and groundwater, improving the water quality prior to it entering downstream ecosystems.
- Fill management
  - Fill minimisation is to be a key consideration in all developments within the DSP area.
  - Utilisation of techniques such as a close network of subsoil drains and swales are to be investigated to minimise groundwater mounding and control groundwater rise.
  - Infrastructure that can be built within and on top of minimal fill are to be preferentially used to reduce fill requirements.

### 1.6 LWMS objectives

This LWMS has been developed in consideration of the objectives and principles detailed in *Better Urban Water Management* (WAPC 2008a) and the overarching DWMS (**Section 1.5**). It is intended to support the LSP, and is further based on the following major objectives:

- Provide a broad level water management framework to support future industrial development.
- Recognise and convey runoff from upstream catchments.
- Consider all potential water sources and all uses in water supply planning.
- Incorporate appropriate WSUD measures into the drainage systems that address the environmental and stormwater management issues identified.
- Manage risks to the underlying groundwater source appropriately.
- Minimise development construction costs.
- Minimise ongoing operation and maintenance costs for the land owners and SoD.
- Gain support from the SoD, DWER, Department of Health (DoH) and Water Corporation for the proposed method to manage water within the site and to mitigate potential impacts on downstream areas.

Detailed objectives for water management within the site are further discussed in **Section 4**.

## Local Water Management Strategy

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## 2 Proposed Development

The site is proposed to be developed for industrial uses. The full range of land uses permissible under the SoD TPS 3 (DPLH 2019b) 'General Industry' zone will be accommodated. The site is anticipated to include lots ranging in size from approximately 1 ha to 4.85 ha, with an overall yield of approximately 37 lots. In addition to industrial lots, the development will include three 25 m wide integrator road reserves, 3.9 ha of public open space (POS), approximately 4.7 ha of drainage reserves, and a number of 20 m wide local access roads (which are not required to be shown on the statutory LSP).

The POS is located where the greatest conservation protection values will be achieved. Drainage reserves are provided to integrate stormwater treatment and storage requirements into the development. Drainage reserves have been located based on post-development catchments identified within the site and the requirement for flows to be directed towards existing discharge points.

There are no natural waterways within the site, however small farm drains and dams occurring across the site. Runoff from the site ultimately contributes to a major drain that is currently managed by the Water Corporation. The site either discharges directly into East Picton Main Drain 711 or into a tributary (East Picton Sub-Section D 709 and East Picton Sub-Section E 710). Runoff from within the site will be maintained to pre-development conditions at these locations through the use of on lot treatment and detention, roadside swales and drainage reserves.

The LSP and a concept plan, as a guide to the site's development potential, are included in **Appendix A**.

# Local Water Management Strategy

## Local Structure Plan, Lots 103, 110 and 436, Picton East



### 3 Pre-development Environment

#### 3.1 Sources of information

The following sources of information were used to provide a broad regional environmental context for the site:

- *South West Rural Drainage, Run-off Map, 50098-1-2* (Public Works Department 1977)
- Geological mapping (Gozzard 1981)
- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC and ARMCANZ 2000; WQPSC & NWRC 2018)
- *Picton Industrial Park Southern Precinct - District Structure Plan* (DPLH 2018)
- *Weather and Climate Statistics Data: Bunbury* (BoM 2019)
- *Geomorphic Wetlands on the Swan Coastal Plain* dataset (DBCA 2019)
- ASS mapping (DWER 2019a)
- *Hydrography linear* dataset (DWER 2019b)
- *Water Register* (DWER 2019c).

In addition to the above information, site-specific investigations have been conducted. These have aimed at providing more detail to the existing regional information. The site-specific investigations include:

- Survey of Lots 103 and 436 Martin Pelusey Rd, Picton East in 2010
- *Groundwater Levels & Quality Monitoring Report: Lot 103 Harris Road & 96 Martin Pelusey Road* (TME 2012)
- *Preliminary Acid Sulphate Soil Investigation: Picton East, Shire of Dardanup, WA* (Strategen 2010)
- *LSP, Lots 103, 110 and 436, Picton East Bushfire Management Plan* (Emerge Associates 2019).

#### 3.2 Climate

The site experiences a dry Mediterranean climate of hot dry summers and cool wet winters. Long term climatic averages at the Bunbury station (Site No 009965) indicate that the site is located in an area of moderate rainfall, receiving 726 mm on average annually (BoM 2019) with the majority of rainfall received in June to August. The region experiences rainfall for 85 days annually (on average).

#### 3.3 Geotechnical conditions

##### 3.3.1 Topography

The site ranges from 12.0 m Australian Height Datum (AHD) to 23.0 m AHD. The higher elevations and steeper slopes are located along the western and northern boundaries of the site. The lowest areas are generally consistent with the existing drainage channels and farm dams (which are detailed in **Section 3.4.2**). Topographic contours across the site are shown in **Figure 2**.

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#### 3.3.2 Soils and geology

The surface geology is dominated by undifferentiated consolidated Cainozoic sedimentary rocks; sandstone, limestone, conglomerate and siltstone. The site is underlain by the Guildford formation, consisting of clay, silt, sand and gravels, with some Bassendean Sand outcrops. Geological mapping (Gozzard 1981) in **Figure 3** illustrates the following types:

- Qpa – Guildford formation: mainly alluvial sandy clay
- QPb – Bassendean Sand: low rounded dunes
- Qpb/Qpa – thin bassendean sand over Guildford formation.

Soils observed across low-lying areas of the site within boreholes installed by Strategen (2010) were light brown or yellow brown to grey brown in colour, consisting of fine to medium grained sands, with clayey sands below depths of 1 m. A borehole installed along the northern ridge (BH4) was observed to have yellow sand to the maximum installation depth of 2.25 m (Strategen 2010). The location of these boreholes is provided in **Figure 3** and the preliminary ASS report is provided in **Appendix B**.

#### 3.3.3 Acid sulfate soils

The site is in an area of moderate to low risk of ASS occurring within three metres of the natural surface (DWER 2019a). Strategen (2010) completed a preliminary ASS investigation in May 2010. The investigation found there was a potential for ASS in the vicinity of Lot 11 Martin Pelusey Road (BH2), Lot 102 Harris Road (BH8) and Lot 104 Columbas Drive (BH5). However, these are located beyond the site and no potential for ASS was found in BH4 or BH9. The preliminary ASS report is provided in **Appendix B**.

### 3.4 Surface water

#### 3.4.1 Wetlands

A review of the *Geomorphic Wetlands on the Swan Coastal Plain* dataset (DBCA 2019) indicates that there are a number of geomorphic wetlands on site. The geomorphic wetlands are shown in **Figure 4**.

Most of the site is listed as a Multiple Use Wetland (MUW) (UFI #14329). There is another small MUW wetland within the site (UFI #1554). There is a further MUW (UFI #1555) that interests the western boundary of the site.

#### 3.4.2 Existing hydrological features

There are no natural waterways within the site, however small farm drains and dams occur across the site. Runoff from the site ultimately contributes to a major drain that is currently managed by the Water Corporation. Indicative mapping of these features from the *Hydrography linear* dataset (DWER 2019b) are shown in **Figure 5**. This dataset does not capture all of the existing farm drains or dams located across the site.

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## Local Structure Plan, Lots 103, 110 and 436, Picton East



The site either discharges directly into East Picton Sub Drain C, or into a tributary (East Picton Sub-Section D and East Picton Sub-Section E). The site then ultimately discharges to the East Picton Main Drain and then the Ferguson River before entering the Preston River.

The main drains were originally installed by the Public Works Department to drain paddocks and prevent surface ponding over long periods of time, not for flood management purposes. The site is within an area where rural drains were sized to cater for 7.5 m<sup>3</sup>/s per 1,000 ha, but ultimately discharge into drains sized for 5 m<sup>3</sup>/s per 1,000 ha (Public Works Department 1977). The limited capacity of these drains must be considered when modifying the site from a rural to urban landscape.

### 3.4.2.1 Pre-development modelling

Pre-development surface runoff modelling for the broader Picton Industrial Park Southern Precinct was completed as part of the overarching DWMS (Calibre Consulting 2017).

The pre-development catchments (see **Appendix C**) show most of the site is located within Catchment G, which discharges towards the East Picton Main Drain in Catchment F at a prorata rate of 0.96 m<sup>3</sup>/s in the 1% AEP rainfall event. However, the approved *Lot 105 Columbas Drive, Picton East Preliminary Servicing Strategies* (DVN 2009) report proposed a water management strategy that controls flows into Catchment F (i.e. beneath the railway) to 1.16 m<sup>3</sup>/s in the 1% AEP rainfall event. As noted in the DWMS, this rate is slightly higher than the prorata rate determined by surface runoff modelling. A copy of the Lot 105 report is provided in **Appendix D** and allowable discharge rates from the site are discussed further in **Section 6.1**.

A small portion of the site is located within Catchment E (see **Appendix C**) and currently discharges north into an existing trapped low point (see **Figure 2**).

### 3.4.3 Surface water quality

There has been no surface water quality monitoring undertaken at the site. The site is located within the Leschenault Estuary Catchment, which is included within the *Leschenault Estuary WQIP* (DoW 2012). Monitoring within the Ferguson River Catchment measured an average concentration of 1.5 mg/L for total nitrogen (TN) and 0.1 mg/L for total phosphorous (TP). Target concentrations specified in the WQIP are 1 mg/L for TN and 0.1 mg/L for TP.

Results from groundwater level and quality monitoring are provided in **Section 3.5**. Groundwater is generally close to the surface and consequently, groundwater quality is a reasonable indicator of likely surface water quality.

## 3.5 Groundwater

### 3.5.1 Groundwater resources

Information on the regional groundwater resources obtained from the *Water Register* (DWER 2019c) indicates that the site is underlain by a multi-layered aquifer system comprised of the Perth – Superficial Swan, Perth – Leederville and Perth – Yarragadee South resources.

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A resource allocation report received by DWER on 21 August 2019 listed the following available volumes:

- Perth – Superficial Swan: 227,650 kL
- Perth – Leederville: 22,300 kL
- Perth – Yarragadee South: 107,000 kL.

Obtaining an allocation from the Perth-Leederville and Perth – Yarragadee South resources is unlikely due to the limited allocation available within the Bunbury management area and considering the existing license applications that are yet to be assessed. Allocation is available from the Perth – Surficial Swan resource, however this aquifer can at times be difficult to extract within the Bunbury management area. Therefore, reliance on groundwater within this area is not recommended by DWER.

There are no existing private bores within the site. A number of lots adjacent to the site (i.e. to the west of Columbas Drive, south of Harris Road and east of Martin-Pelusey Road) have existing licences for the Perth – Leederville aquifer and drawpoints mapped on the *Water Register* (DWER 2019c).

The site is not located within a public drinking water source area nor are there any wellhead protection zones in the vicinity of the site (DWER 2019d).

### 3.5.2 Groundwater levels

There are three DWER bores within a 3 km radius that have sufficient groundwater level data (WIN ID 1583, 1584 and 1585) to be utilised as reference bores. However, this data is not relevant to monitoring within the superficial aquifer, as they are drilled into the Yarragadee or Leederville aquifer. There are no DWER bores close to the site that have sufficient and relevant data to be utilised as reference bores. Consequently, maximum groundwater levels (MGL) across the site have been defined by the monitoring undertaken on site.

Groundwater level monitoring was carried out by TME between October 2010 and December 2012 at nine monitoring bores (shown in **Figure 2**) installed within Lot 103 and Lot 436. This monitoring program captured two winter peaks and one summer low (see **Plate 1** and data provided in **Appendix E**). The monitoring indicated that groundwater generally flowed from the south-east to the north-west corner of the site (TME 2012).

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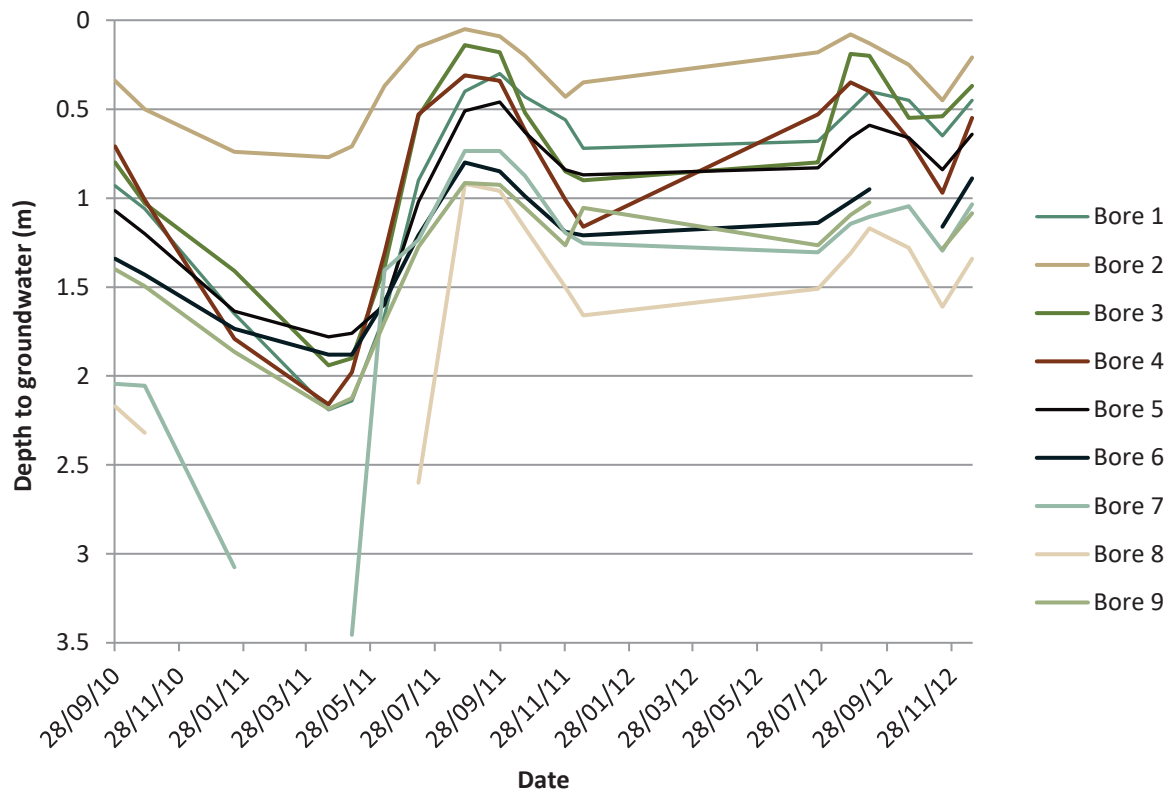


Plate 1: Depth to groundwater from natural surface (TME 2012)

**Plate 1** shows that depth to groundwater from the natural surface over 2011 and 2012 ranged from 0.05 m to 3.4 m, with the seasonal fluctuation across the bores ranging from 0.25 m to 2.7 m. Measured maximum groundwater level (MGL) occurred on the 25/08/2011 in seven bores and on the 27/09/2011 in two bores. Depth to MGL at each bore ranged from 0.05 m to 0.9 m below natural surface. MGL contours across the site are shown on **Figure 2**. The 2012 peak occurred in either August (three bores), September (four bores), or December (two bores).

Given the date of the pre-development monitoring program. Groundwater levels within the bores was measured again on 22/08/2019 (see data provided in **Appendix E**). While Bore 8 was destroyed, depth to groundwater at the other bores ranged from 0.06 to 1.1 m below natural surface. These are generally consistent with winter groundwater levels measured in 2011 and 2012, but are still lower than the MGL measured in 2011. Therefore, the MGL contours derived from data collected in 2011-2012 are still valid and are shown in **Figure 2**. The depth to MGL across the site ranges from just below the surface to approximately 8.5 m below the natural surface. However, as shown in **Figure 6**, depth to MGL across the majority of the site is within approximately 0.9 m of the natural surface.

### 3.5.3 Groundwater quality

Groundwater monitoring of the nine bores by TME included sampling of physio-chemical parameters in situ and laboratory analysis of nutrient, metal and salinity concentrations. Measured groundwater quality is summarised in **Table 1**, which details the parameters significant to, and managed within, this LWMS (i.e. physio-chemical parameters and nutrient concentrations). Groundwater quality monitoring results are provided in more detail in **Appendix E**.

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Table 1: Groundwater quality monitoring summary

Analytes	Bore 1	Bore 2	Bore 3	Bore 4	Bore 5	Bore 6	Bore 7	Bore 8	Bore 9
pH	5.82 (0.28)	6.33 (0.33)	6.28 (0.27)	6.25 (0.28)	5.95 (0.17)	6.05 (0.52)	5.90 (0.39)	5.45 (0.43)	5.49 (0.58)
Electrical conductivity (EC) (mS/cm)	1.72 0.87	0.78 (0.56)	2.61 (0.77)	2.35 (0.49)	0.57 (0.05)	0.75 (0.24)	2.60 (2.10)	1.18 (1.68)	1.32 (0.40)
Nitrite (NO <sub>2</sub> ) (mg/L, LOR = 0.01)	<0.01 (0)	<0.01 (0)	0.02 (0.02)	<0.01 (0)	<0.01 (0)	0.01 (0)	<0.01 (0)	<0.01 (0)	<0.01 (0)
Nitrate (NO <sub>3</sub> ) (mg/L, LOR = 0.01)	0.02 (0.02)	0.02 (0.01)	0.21 (0.27)	0.06 (0.07)	0.04 (0.02)	0.92 (1.26)	0.05 (0.06)	0.02 (0.01)	0.023 (0.015)
NOx (mg/L, LOR = 0.01)	0.02 (0.02)	0.02 (0.01)	0.22 (0.28)	0.06 (0.07)	0.04 (0.02)	0.93 (1.26)	0.05 (0.06)	0.02 (0.01)	0.023 (0.015)
Total Kjeldahl nitrogen (TKN) (mg/L, LOR = 0.1)	4.1 (3.2)	3.3 (1.3)	4.3 (1.4)	1.6 (1.5)	3.1 (2.0)	4.5 (3.4)	4.4 (2.7)	3.8 (2.3)	12.3 (12.1)
TN (mg/L, LOR = 0.1)	4.1 (3.2)	3.3 (1.3)	4.5 (1.6)	1.7 (1.5)	3.2 (2.0)	5.5 (3.2)	4.5 (2.6)	3.8 (2.3)	12.3 (12.1)
Reactive phosphorous (mg/L, LOR = 0.01)	0.01 (0)	<0.01 (0)	0.01 (0)	0.01 (0)	<0.01 (0)	0.43 (0.81)	0.01 (0)	0.015 (0.01)	<0.01 (0)
TP (mg/L, LOR = 0.01)	0.26 (0.20)	0.21 (0.08)	0.37 (0.12)	0.18 (0.15)	0.21 (0.08)	2.27 (1.64)	0.49 (0.28)	0.59 (0.35)	1.33 (1.01)

Values given are average and standard deviation. Derived from TME (2012) groundwater monitoring data.



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The analysis of groundwater found that TN and TP levels beneath Lot 103 and Lot 436 exceeded ANZECC and ARMCANZ (2000) default trigger values for slightly disturbed ecosystems in the south-west coast as well as the target concentrations for the Ferguson River (DoW 2012). The pH levels measured across all bores were generally low (slightly acidic), between 5.01 and 6.71, which is somewhat below the ANZECC and ARMCANZ (2000) trigger value for surface waters in 'lowland rivers' (i.e. 6.5). These results were not unexpected given past agricultural land uses in the region (TME 2012).

## 3.6 Sewage sensitive areas

Sewage sensitive areas are proclaimed under the *Government Sewerage Policy* (DPLH 2019) to protect groundwater and surface water systems. A review of the *Government Sewerage Policy* dataset (DPLH 2019c) indicates the entire site is identified as a sewage sensitive area and is associated with area 'A - Estuary catchments on the Swan and Scott Plains', as shown on **Figure 4**.

## 3.7 Current and historical land uses

The site has established rural land on its northern, western and eastern boundaries, with an industrial estate to the south. The land within this site is predominately used for rural purposes, with Lot 110 used for general industry.

## 3.8 Summary of existing environment

In summary, the environmental investigations conducted to date indicate that:

- The site receives 726 mm of average annual rainfall with the majority of rainfall received in June to August.
- Topography of the site ranges from 12 m AHD to 23 m AHD, with lower areas generally consistent with existing drains and farm dams. The higher elevations are located along the western and northern boundaries of the site.
- The site is underlain by fine to medium grained sands with clayey sands of the Guildford Formation at depth. Yellow Bassendean sands are located in the areas of higher elevation.
- The site is in an area of moderate to low risk of ASS occurring within three metres of the natural surface. No potential for ASS was found within the site by a preliminary ASS investigation.
- Most of the site is listed as MUW.
- No natural waterways exist within the site, with only small farm drains and dams present within the site, which ultimately contribute to a major drain that is currently managed by the Water Corporation. These drains ultimately discharge into the Ferguson River before entering the Preston River.
- Pre-development surface runoff modelling determined that the majority of the site is located within a catchment that discharges beneath the railway to the west of the site at a rate of 0.96 m<sup>3</sup>/s in the 1% AEP rainfall event. A small portion of the site discharges north into a trapped low point.

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- Depth to MGL across the site ranges from just below the surface to approximately 8.5 m below the natural surface. Depth to MGL across the majority of the site ranges from just below the surface to approximately 0.9 m below the natural surface.
- TN and TP concentrations within groundwater beneath the site exceeded available guideline values.
- The entire site is mapped as a sewage sensitive area associated with area 'A - Estuary catchments on the Swan and Coastal Plains'.
- The site has historically been used for agricultural purposes and general industry.

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## 4 Design Criteria and Objectives

This section outlines the objectives and design criteria that this LWMS and future Urban Water Management Plans (UWMP) must achieve. The water management strategy covers water supply, water consumption, stormwater management, groundwater management and wastewater management.

### 4.1 Integrated water cycle management

The *State Water Strategy* (Government of WA 2003a) and *Better Urban Water Management* (WAPC 2008a) endorse the promotion of integrated water cycle management and application of WSUD principles to provide improvements in the management of stormwater, and to increase the efficient use of other existing water supplies.

The key principles of integrated water cycle management include:

- Considering all water sources, including wastewater, stormwater and groundwater
- Integrating water and land use planning
- Allocating and using water sustainably and equitably
- Integrating water use with natural water processes
- Adopting a whole of catchment integration of natural resource use and management.

Integrated water cycle management addresses not only physical and environmental aspects of water resource use and planning, but also integrates other social and economic concerns. Management design objectives should therefore seek to deliver best practice outcomes in terms of:

- Water supply and water consumption
- Flood mitigation
- Stormwater quality management
- Groundwater management
- Wastewater servicing.

The first step in applying integrated water cycle management in urban catchments is to establish agreed environmental values for receiving environments. The existing environmental context of the site has been discussed in **Section 3** of this document. Guidance regarding environmental values and criteria is provided by a number of National and State policies and guidelines and site specific studies undertaken in and around the site. These were detailed in **Sections 1.4** and **3.1**.

The overall objective for preparing integrated water cycle management plans for proposed industrial developments is to minimise pollution and maintain an appropriate water balance. This objective is central to the water management approach for the LSP.

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### 4.2 Water supply and water conservation

The water supply and water conservation design criteria proposed are consistent with the guidelines presented in *Better Urban Water Management* (WAPC 2008a) and consultation with key stakeholders. This LWMS proposes the following criteria:

**Criteria WC1** Ensure the efficient use of all water resources.

The manner in which the above criteria will be achieved is further detailed in **Section 5**.

### 4.3 Stormwater management

The principle behind stormwater management at the site is to mimic the pre-development hydrological conditions. This principle and the guidance documents discussed in **Section 1.4** and **1.5** have guided the stormwater management criteria. This LWMS proposes the following stormwater design criteria:

**Criteria SW1** Treat the small rainfall event as close to source as practicably possible.

**Criteria SW2** Maintain allowable (pre-development) peak flow rates and volumes up to the major rainfall event discharging from the development.

**Criteria SW3** Provide conveyance of upstream flows through the development.

**Criteria SW4** Minor roads remain passable in the minor (10% AEP) rainfall event.

**Criteria SW5** Finished floor levels should have a clearance from the major rainfall event top water level (TWL) within detention areas of 300 mm.

**Criteria SW6** Apply appropriate non-structural measures to reduce pollutant loads.

The manner in which these objectives will be achieved is further detailed in **Section 6**.

### 4.4 Groundwater management

The principle behind the groundwater management strategy is to maintain the existing groundwater levels and quality. This LWMS proposes the following groundwater management criteria:

**Criteria GW1** Existing inverts at discharge locations will be maintained.

**Criteria GW2** Swales and subsoil drains will have free draining outlets.

**Criteria GW3** Mitigate the breeding of disease vector and nuisance insects within detention areas.

**Criteria GW4** Maintain or improve groundwater quality onsite.

The manner in which these objectives will be achieved is further detailed in **Section 7**.

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### 4.5 Wastewater servicing

The principle behind the wastewater management strategy for the site is to provide wastewater servicing for the development in a manner that avoids any detrimental impacts on the environment and water resources, and in line with the requirements of the *Government Sewerage Policy* (DPLH 2019) and relevant guidelines.

**Criteria WW1** On-site sewage systems to be located at least 100 m from a drainage system that discharges directly into a waterway or significant wetland without treatment.

**Criteria WW2** On-site sewage systems are not to be located in any area subject to inundation and/or flooding in a 10 % AEP rainfall event.

**Criteria WW3** The discharge point of the on-site sewage system should be at least 1.5 m above the highest measured groundwater level.

**Criteria WW4** Ensure appropriate treatment of industrial wastewater within lots.

The manner in which these objectives is achieved is further detailed in **Section 8**.

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## 5 Water Source Allocation, Infrastructure, Fit-for-purpose and Water Use

### 5.1 Water supply

#### 5.1.1 Potable water

The site is located within an area operated by Aqwest and there is an existing 300 mm diameter water main within Harris Road along the southern boundary of the site. This existing water main has the capacity to service the site and will need to be extended east towards the intersection with Martin Pelusey Road. Extension of the reticulated network will also be required to service lots within the site and will require approval from Aquest (WGE 2019).

#### 5.1.2 Non-potable water

As discussed in **Section 3.5.1**, it is likely that groundwater allocation will only be available from the Perth-Superficial Swan aquifer, though this resource can be difficult to access within this area. It is unlikely the site will need to rely on groundwater resources for non-potable needs as no ongoing irrigation across the estate is proposed (i.e. within areas of POS and drainage reserves).

### 5.2 Lot scale water use

Water efficient fittings and toilets are mandated through the building licence process. In order to ensure that water is used efficiently, lot owners will be encouraged to utilise rainwater tanks, water efficient appliances and employ waterwise gardening (WWG) principles across any landscaped areas within the lot. The following WWG measures will be used within the development:

- Improve soil with conditioner certified to Australian Standard AS4454 to a minimum depth of 300 mm for garden beds.
- Design and install any irrigation system according to best water efficient practices.
  - Control systems must be able to irrigate different zones with different irrigation rates.
  - Emitters must disperse coarse droplets or be subterranean.
  - Utilise subsoil irrigation where appropriate.
- Landscape with native, preferably endemic, species.
- Mulch garden beds to 100 mm with a product certified to Australian Standard AS4454.
- Minimise use of slow fertilisers and these are only to be utilised on initial planting.

Groundwater may be used on lots for irrigation of landscaping or other appropriate non-potable water uses. It is the lot owners responsibility to obtain a groundwater licence appropriate to the proposed use where necessary.

Given the large lot industrial uses the water savings achieved by the above measures are likely to be nominal.

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#### 5.3 Estate scale water use

Water will be required for temporary uses, being dust suppression and civil construction activities, or establishment irrigation of vegetation. As outlined within **Section 3.5.1**, given the limited availability and known extraction issues, groundwater is unlikely to be a reliable source of non-potable water for the site. Thus, if groundwater cannot be secured, the developer will need to import water for temporary uses.

Aside from the temporary requirements for non-potable water, no ongoing water use is proposed for the estate itself. The POS does not require irrigation as it is a natural conservation area. Drainage reserves and verges (including swales) are to be designed not to be irrigated in the long term by the SoD (J Reilly [SoD] 2019, *pers. comm.* 23 August). Any ongoing irrigation of verges can be undertaken at the discretion of the adjacent lot owner. Species selected for drainage reserves and swales should not require ongoing irrigation once established (i.e. be waterwise). Temporary establishment irrigation will occur prior to handover of the drainage reserves and swales to the SoD.

#### 5.4 Water conservation criteria compliance summary

A summary of the proposed water conservation design criteria, and how these are addressed within LSP is provided in **Table 2**.

Table 2: Water conservation compliance summary

Criteria number	Criteria description	Manner in which compliance will be achieved
WC1	Ensure the efficient use of all water resources.	Lots will be provided with potable water through a reticulated network.
		Promotion of rainwater tanks, water efficient appliances and WWG principles for use within lots.
		Use of water efficient fittings and toilets within lots.
		No ongoing water use is proposed for the POS, drainage reserves or verges (including swales).

## 6 Stormwater Management Strategy

The principle behind the stormwater management strategy for the site is to maintain the existing hydrology by matching allowable peak flow rates and volumes leaving the site. The stormwater management strategy consists of two distinct components:

- Lot drainage
- Development drainage.

Each component has been designed to achieve the objectives and criteria stated in **Section 4.3**. The sizing of each component has been determined using XPSTORM hydrological and hydraulic software. The modelling assumptions report provided in **Appendix G** presents the detailed methods and assumptions used to develop the model.

### 6.1 Allowable peak flow rates and indicative storage volumes

As discussed in **Section 3.4.2.1**, the approved *Lot 105 Columbas Drive, Picton East Preliminary Servicing Strategies* (DVN 2009) proposed that this development would convey flows through Lot 105 via an arterial 1050 mm diameter pipe. Further, that inflows to this pipe beneath the railway line will need to be restricted to 1.16 m<sup>3</sup>/s in the 1% AEP rainfall event. This was incorporated into the post-development surface runoff modelling completed in the overarching DWMS (Calibre Consulting 2017), which is provided in **Appendix C**.

The DWMS proposes that runoff from Catchments 3, 4 and 5 will achieve the allowable peak flow of 1.16 m<sup>3</sup>/s in the 1% AEP rainfall event. More specifically, that this will be achieved on a prorata basis to ensure that the treatment and detention of runoff is applied across the Picton Industrial Park Southern Precinct area equitably. As shown in Table 5 of the DWMS (see **Appendix C**), this equates to combined allowable peak flow rates in the 1% and 10% AEP rainfall events from Catchment 3 and 4 of 0.0065 m<sup>3</sup>/s/ha and 0.0058 m<sup>3</sup>/s/ha, respectively, and indicative combined storage volumes (in addition to detention provided within lots) in the 1% and 10% AEP rainfall events from Catchment 3 and 4 of 465 m<sup>3</sup>/ha and 300 m<sup>3</sup>/ha, respectively.

**Table 3** summarises the allowable peak flow rates and indicative storage volumes from the two catchments within the site. Note that Catchment 2 is the ultimate discharge location for the whole site, which encompasses Catchment 1, Catchment 2 and both upstream catchments. The upstream catchment boundaries are consistent to those described as Catchment 3 and 4 in the DWMS.

Allowable peak flow rates and indicative required storage volumes (in addition to detention provided within lots) are based upon the allowable peak flow rates and indicative storage requirements above (i.e. determined through post-development surface runoff modelling presented in the DWMS) and the post-development catchments for the site shown in **Figure 7**.



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Table 3: Allowable peak flow rates and indicative required storage volumes

Catchment	1% AEP allowable peak flow rate (m <sup>3</sup> /s)	1% AEP indicative required storage volume (m <sup>3</sup> )	10% AEP allowable peak flow rate (m <sup>3</sup> /s)	10% AEP indicative required storage volume (m <sup>3</sup> )
Catchment 1	0.07	4,980	0.06	3,290
Catchment 2	0.76	53,285	0.68	35,170

## 6.2 Lot drainage

All lots will be required to retain 2 m<sup>3</sup> of runoff for every 65 m<sup>2</sup> of hardstand or roof (i.e. impervious area) consistent with the SoD's *Policy No CP060 – Storm Water Discharge from Buildings* (SoD 2018a). Combining a number of WSUD strategies in a treatment train is the most effective manner in which to treat and retain catchment runoff, which can include:

- Rainwater tanks to retain runoff from roofs, which can be used for internal and external non-potable uses.
- Temporary inundation of car park or other hardstand areas to retain runoff prior to infiltration within another WSUD structure. A maximum flooding depth of 300 mm is recommended within car park areas.
- Waterwise landscaped areas to treat and infiltrate runoff.
- Subsurface soakage/soakwells to retain and infiltrate runoff.
- Vegetated lot detention areas (LDAs) to treat and infiltrate runoff. A layer of high phosphorus retention index (PRI) >10 soil or engineered media should be located beneath the invert of the LDA to provide treatment as runoff infiltrates (Payne et al. 2015).

The invert of subsurface soakage/soakwells must be at or above CGL or the low permeability layer. The invert of LDAs should be at or above CGL (discussed further in **Section 7.1**). For many lots across the site, runoff can be infiltrated into the existing sand and/or fill beneath the lot. It is understood that the site constraints within some lots (i.e. where there is a thin layer of sand over low permeability soil and/or shallow groundwater) may make infiltration difficult. A low flow discharge or subsoil connection point should be utilised to ensure that LDAs dry out and do not become inundated due to shallow groundwater.

To represent these lot drainage requirements, the post-development surface runoff model (see **Appendix G**) has assumed that lots are 90% impervious and 10% pervious, and will utilise LDAs with a capacity of 2 m<sup>3</sup> for every 65 m<sup>2</sup> of impervious area. The LDAs are nominally modelled to have 1:6 side slopes, maximum depth of 1 m, and a low infiltration rate of 2 m/day. When represented in this manner, the LDAs are approximately 5% of the total lot area.

Other WSUD and water quality treatment strategies (i.e. those which are industry specific) can be installed within each lot to treat runoff prior to it discharging from the lot. These are discussed in following sections.

The selection and design of lot WSUD and water quality treatment strategies are the responsibility of the lot owner and should be selected to suit individual site characteristics and the intended development of the lot. The design of lot drainage will be submitted to the SoD within a development application (DA).

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#### 6.2.1 Gross pollutant traps

Stormwater runoff can transport nutrients and gross pollutants to downstream water bodies. A gross pollutant trap (GPT) is considered a primary level treatment system, removing a proportion of these large pollutants and, in some cases, the smaller particles such as sediments and hydrocarbons. The pollutants captured in the GPT must be regularly removed to ensure the efficiency of the device.

GPTs are best suited to land uses with high gross pollutants such as commercial development, or for collecting gross pollutants during the construction phase of the development. These may be applicable to some lots within the site depending on the industrial use.

#### 6.2.2 Trash racks

Trash racks are usually permanent structures which intercept trash and other debris to protect the quality of water. Trash racks are generally constructed upstream of LDAs and require regular maintenance to remove debris and silt and ensure their ongoing efficiency. Trash racks can be incorporated in the design of GPTs.

#### 6.2.3 Grease and sediment traps

Certain industrial land uses can produce sediments and hydrocarbons to a level that cannot be treated by GPTs. Grease and sediment traps can be used as a secondary level treatment system to remove these smaller particles. Grease and sediment traps must be regularly maintained to ensure the efficiency of the device. These are more likely to be required where there is either a high vehicle/traffic load, or where vehicle servicing/maintenance is to be carried out onsite.

#### 6.2.4 Oil-water separators

Oil-water separators can be used to provide water quality treatment at a lot scale, particularly for small industrial or commercial lots where larger WSUD strategies are not feasible due to site constraints. There are a range of systems available which incorporate some combination of filtration media, hydrodynamic sediment removal, oil and grease removal, or screening to remove pollutants from stormwater.

Oil-water separators are best used in commercial, industrial and transportation type land uses i.e. areas that are expected to receive high sediment and hydrocarbon loadings, such as car parks and service stations.

### 6.3 Development drainage

The development is required to treat the small rainfall event, detain major event runoff to ensure that the post-development peak flows discharging from the development beneath Columbas Drive are consistent with the allowable peak flow rates outlined in **Section 6.1**, and convey runoff from catchment catchments. This will be achieved through the use of roadside swales and detention areas as discussed in the following sections.

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#### 6.3.1 Roadside swales

Treatment of stormwater runoff from road reserves will occur at source. Swales will be located within road verges to infiltrate and treat small event (first 15 mm) runoff from the adjacent road pavement as close to source as possible in order to mimic the pre-development hydrological regime.

Swales are proposed along the downstream side of the road located immediately adjacent to road pavement. The post-development surface runoff model has nominally assumed that swales will have 1:4 side slopes, a 1 m wide base, be 500 mm deep, and have an infiltration rate of 2 m/day (plus a 50% clogging factor). It is also assumed that 20% of the swale length shown in **Figure 7** will be required for cross-overs and therefore will not provide any treatment capacity.

Swales will be vegetated with reeds and rushes suitable for removing nutrients (Payne *et al.* 2015). A layer of high PRI >10 soil or engineered media should be located beneath the invert of the swale to provide treatment as runoff infiltrates towards the underlying lower permeability layer (Payne *et al.* 2015).

**Table 4** provides the volume that will be treated with the swale profile, and demonstrates that the required volume can be treated within swales located along a section of the road reserve. **Table 4** also provides the swale depths in frequent, minor and major runoff events. **Figure 8** illustrates the areas inundated by the small rainfall event.

*Table 4: Treatment of small event runoff and detention of minor and major event runoff within swales*

Rainfall event	Attribute	Catchment 1	Catchment 2
		Length of swale (m)	790
Small rainfall event (first 15 mm)	Volume (m <sup>3</sup> )	85	660
	Water depth (m)	0.08	0.16
Minor rainfall event (10% AEP)	Volume (m <sup>3</sup> )	755	2,065
	Water depth (m)	0.38	0.34
Major rainfall event (1% AEP)	Volume (m <sup>3</sup> )	860	2,810
	Water depth (m)	0.41	0.42

The swale profiles can be revised in the future to meet localised site and servicing requirements, provided that the treatment and detention volumes specified in this LWMS are achieved. While the roadside swales are modelled as 500 mm deep, only 400 mm has been utilised for detention of the major rainfall event. This extra capacity allows roadside drain inverts to act as groundwater controls (as outlined in **Section 7.1**) without compromising the surface runoff modelling results. Further storage could also be forced within the swales by introducing minor weir structures.

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#### 6.3.2 Detention areas

Surface runoff from road reserves and lots will be conveyed towards detention areas shown in **Figure 7** via the swales and overland flow. These detention areas are only required to detain infrequent and major event runoff, and are not intended to be inundated in response to small and frequent rainfall events. It is assumed that the capacities of swales (as provided in **Table 4**) are fully utilised prior to runoff entering downstream detention areas. Detention areas will be utilised to ensure that post-development peak flow rates discharging beneath Columbas Drive are consistent with the allowable peak flow rates outlined in **Section 6.1**.

The invert of detention areas can be set at CGL, on the underlying lower permeability layer or consistent with any existing invert (where relevant). Given these inverts, the surface runoff model has conservatively assumed that no infiltration will occur within detention areas. Low flow outlets will be required to ensure the detention areas dry out between rainfall events to prevent the creation of mosquito breeding habitat.

At this stage, it is broadly assumed the CGL will be set close to MGL where an existing invert is not proposed to be maintained (this is discussed further in **Section 7.1**). Therefore, Detention Area 1 will have an invert of approximately 13 m AHD. The invert of Detention Area 2 will be set at 12.05 m AHD, which is the invert of the existing culverts beneath Columbas Drive. Similarly, Detention Area 3 can be set at the invert of existing drains in this area, being 12.5 m AHD.

Depth of these detention areas must consider existing topographic contours within the proposed POS area (i.e. proposed to be located to the west and downstream of the detention area) and along Columbas Drive. Therefore, Detention Areas 1, 2 and 3 have maximum water depths of 500 mm, 950 mm and 500 mm, respectively. All detention areas are nominally assumed to have 1:6 side slopes. Depths and side slopes of detention areas can be revised in the future to meet localised site constraints, provided that the allowable peak flow rates (see **Table 6**) are achieved and design of the detention areas are supported by the SoD.

Discharge from detention areas can be controlled via a number of outlet options such as v-notch weir, low flow pipe and weir combinations etc. Detention Area 1 will discharge beneath the proposed road reserve towards an existing drain located along the eastern boundary of the existing railway and Columbas Drive (discussed further below in **Section 6.3.3**). It is assumed that the existing culverts beneath Columbas Drive will need to be realigned and/or upgraded to direct runoff from this existing swale and Detention Area 2 towards Picton Sub Drain C. Finally, runoff from Detention Area 3 will also be directed towards the ultimate discharge location. This can be achieved through a number of methods (potentially in combination) which should be determined when an earthworks plan is being developed, and can include:

- Overland flow onto the adjacent road reserve
- Discharge into an adjacent roadside swale via low flow outlet and/or overland flow
- Installation of an arterial pipe network that connects Detention Area 3 to the discharge location.

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The potential methods outlined above have not been assessed in detail (e.g. detailed civil designs). Nevertheless, the critical control points mapping provided in **Figure 11** shows that the invert of the roadside swale on the opposite side of the road (i.e. to the north) is approximately 12.5 m AHD, based on a survey of the existing drain in this location. Therefore, a low flow outlet set at minimum grades from Detention Area 3 is able to discharge into the roadside swale provided minimum grade and free flowing outlet conditions can be achieved. Alternatively, an arterial pipe network (~ 300 m long) could connect Detention Area 3 to Detention Area 2 with an average grade of approximately 1:670.

Resolution of how the hydraulics for Detention Area 3 are achieved will be determined during future design stages and compliance with criteria provided in supporting documentation (i.e. UWMP). The detailed design information that will be available at subdivision will be utilised to determine the most appropriate design solution.

The design of detention areas and finished lot levels will be such that adjacent habitable floor levels will be at least 300 mm above the TWL to ensure protection from flooding during extreme rainfall events.

The required detention volumes provided in **Table 5** can be revised in the future, provided that the allowable peak flows discharging from the site (shown in **Figure 7**) are maintained. The inundated areas for the minor and major rainfall events are shown in **Figure 9** and **Figure 10**, respectively.

*Table 5: Detention of minor and major event runoff within detention areas*

Detention area	Minor rainfall event (10% AEP)			Major rainfall event (1% AEP)		
	Volume (m <sup>3</sup> )	Max water depth (m)	Surface area (m <sup>2</sup> )	Volume (m <sup>3</sup> )	Max water depth (m)	Surface area (m <sup>2</sup> )
1	850	0.14	6,175	3,215	0.50	6,870
2	7,135	0.42	17,835	17,135	0.95	19,590
3	2,580	0.21	12,305	6,200	0.50	13,075

### 6.3.3 Existing swales

A number of existing swales will be maintained to ensure the stormwater management strategy functions as intended and to control groundwater levels (see **Section 7.1**). Key locations are referred to as critical control points and are shown in **Figure 11**, along with their inverts.

The existing swale located along the western boundary of the site from the north western corner adjacent to the railway and the proposed POS area to the ultimate discharge location beneath Columbas Drive is proposed to be retained. This swale will be utilised to convey runoff from the detention area within Catchment 1 towards the detention area within Catchment 2. It will also be utilised to convey runoff from future industrial development to the north of the site (i.e. from Catchment 3 US) through the site towards the ultimate discharge location.

Similarly, the existing roadside swales along Harris Road and Columbas Drive will be retained and improved (e.g. will nutrient removing vegetation). These will continue to convey runoff from upstream catchments and existing road reserves towards the ultimate discharge location.

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Finally, one of the existing farm drains can be retained given its location within a proposed road verge. It will be utilised to treat and convey runoff from the proposed road reserve towards Detention Area 2 and the ultimate discharge location.

### 6.4 Drainage design assessment

The post-development catchments, proposed WSUD strategies and the site's ultimate discharge location beneath Columbas Drive are shown in **Figure 7**. As detailed previously, the stormwater management strategy aims to match allowable peak flows leaving the site and required storage volumes in a minor and major rainfall event. **Table 6** compares the post-development peak flow rates from each catchment and the storage volumes provided within each catchment in a minor and major rainfall event to the allowable rates and volumes discussed in **Section 6.1** (and which were determined in the DWMS).

Post-development peak flow rates for the minor rainfall event are less than 10% of the allowable peak flow rates. This is due to the hydraulics of the stormwater management plan (e.g. sizing of low flow outlets and weirs); achieving the allowable peak flow rate in the major rainfall event results in a lower peak flow rate for the minor rainfall event.

Storage volumes required somewhat differ from those presented in the DWMS. Storage volume requirements determined through high level surface runoff modelling to support the DWMS (see **Appendix C**) have been refined to reflect the proposed LSP (e.g. catchment boundaries and land use areas) and utilised more detailed assumptions (e.g. modelling of LDAs). Modelling assumptions are discussed in **Appendix G**.

*Table 6: Allowable peak flow rates, indicative required storage volumes and post-development comparison*

Catchment	Scenario	1% AEP peak flow rate (m <sup>3</sup> /s)	1% AEP storage volume (m <sup>3</sup> )	10% AEP peak flow rate (m <sup>3</sup> /s)	10% AEP storage volume (m <sup>3</sup> )
Catchment 1	DWMS	0.07	4,980	0.06	3,290
	LWMS	0.07	4,075*	0.05	1,605*
Catchment 2	DWMS	0.76	53,285	0.68	35,170
	LWMS	0.77	55,600**	0.58	24,167**

\* Encompasses the volume provided by swales in Catchment 1 and Detention Area 1.

\*\* Encompasses the volume provided by swales and detention areas across the site, and estimated detention volumes required for upstream catchments. Estimated detention volumes to be required within upstream catchments are shown in **Figure 7**.

### 6.5 Structural and non-structural water quality measures

The structural measures proposed within the site provide both a storage and treatment function to stormwater runoff. A number of non-structural measures will also be implemented across the site to help reduce nutrient loads within stormwater that discharges from the development.

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These measures include:

- Education of lot owners regarding fertiliser use and nutrient absorbing vegetation species appropriate for use within lots.
- No ongoing fertiliser use is proposed within the POS, drainage reserves and swales, as these are not proposed to require ongoing irrigation.
- Utilising WSUD measures within each lot as is appropriate to the final industrial land use.
- Directing first flush stormwater to vegetated LDAs or roadside swales.
- Use of high PRI soils (or similar) beneath LDAs and roadside swales, and surrounding subsoil drains.
- Directing infiltrated stormwater and groundwater captured by subsoil drains into vegetated roadside swales.
- Directing all stormwater and groundwater captured by the proposed stormwater and groundwater management strategy into vegetated detention areas prior to discharge from site.

## 6.6 Stormwater criteria compliance summary

A summary of the proposed stormwater design criteria and how these are addressed is given within **Table 7**.

*Table 7: Stormwater management criteria compliance*

Criteria number	Criteria description	Manner in which compliance will be achieved
SW1	Treat the small rainfall event as close to source as practicably possible.	Lots are required to provide 2 m <sup>3</sup> of storage for each 65 m <sup>2</sup> of impervious area through a combination of rainwater tanks, detention within carparks or hardstand, infiltration in landscaped areas, subsurface storage/soakwells and/or LDAs.
		Swales within road verges will treat small event rainfall from the adjacent road bitumen.
SW2	Maintain allowable (pre-development) peak flow rates and volumes up to the major rainfall event discharging from the development.	Lots are required to provide 2 m <sup>3</sup> of storage for each 65 m <sup>2</sup> of impervious area through a combination of rainwater tanks, detention within carparks or hardstand, infiltration in landscaped areas, subsurface storage/soakwells and/or LDAs.
		Swales and detention areas will detain the minor and major rainfall event runoff from road reserves to maintain allowable peak flow rates and volumes.
SW3	Provide conveyance of upstream flows through the development.	Roadside swales and the existing swale along the railway line and Columbas Drive will convey upstream flows through the site towards the ultimate discharge location.
SW4	Minor roads remain passable in the minor (10% AEP) rainfall event.	Minor roads remain passable in the minor rainfall event (i.e. 10% AEP).
SW5	Finished floor levels should have a clearance from the major rainfall event TWL within detention areas of 300 mm.	Where necessary, lots are required to be filled, as a condition of subdivision (at subdivision). This will ensure finished flood levels of habitable buildings meet the required clearances.

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Table 7: Stormwater management criteria compliance (continued)

Criteria number	Criteria description	Manner in which compliance will be achieved
SW6	Apply appropriate non-structural measures to reduce pollutant loads.	Street sweeping on a regular basis.
		No ongoing fertiliser use is proposed within the POS, drainage reserves and swales, as these are not proposed to require ongoing irrigation.
		Education of lot owners regarding fertiliser application and the use of nutrient absorbing vegetation within LDAs and landscaped areas.



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## 7 Groundwater Management Strategy

The development drainage system has been designed to achieve the objectives and criteria stated in **Section 4.4**. The principle behind the groundwater management strategy for the site is to maintain the existing groundwater regime while achieving adequate separation from infrastructure.

### 7.1 Groundwater level management

Consistent with Criteria GW1, existing inverts at the discharge locations will be maintained. Specifically, this includes the ultimate discharge location beneath Columbas Drive and the existing swale located along the western boundary of the site (i.e. adjacent to Columbas Drive and the POS). The inverts of these existing critical control points are shown in **Figure 11**.

It is recommended that groundwater beneath road reserves be controlled by existing or proposed roadside swales and/or additional design measures implemented to ensure the appropriate level of serviceability is achieved. CGLs across the site should be set in accordance with the *Water resource considerations when controlling groundwater levels in urban development* (DoW 2013). CGL across the site can be set below MGL given there are no significant natural environments (e.g. conservation category or resource enhancement category wetlands, or the Ferguson River) within the vicinity of the site, as long as the proposed CGL is supported by an assessment of ASS risks. The extent to which this can occur will be controlled by the retention of the existing invert at the ultimate discharge location (i.e. beneath Columbas Drive), within the existing swale located adjacent to the western boundary of the site (i.e. adjacent to the railway easement), and within existing roadside swales along Columbas Drive and Harris Road. Consequently, the CGL at any point within the site will be set based on the existing discharge location and swale inverts (see **Figure 11**), plus minimum grades for swales and any subsoil drains and consideration of ASS risks.

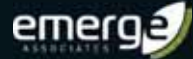
The management of groundwater levels within lots is the responsibility of the lot owner. Lot owners may elect to install subsoil drains to manage groundwater rise within their lot. These subsoil drains must be free draining by discharging into the adjacent roadside swale (which will be designed as part of subdivision and built by the developer) at least 150 mm above the swale invert. As discussed in **Section 6.2**, the invert of LDAs should be at or above CGL. A low flow discharge or subsoil connection point should be utilised to ensure that LDAs dry out between storm events and are not inundated due to shallow groundwater.

As specified in the *Government Sewerage Policy* (DPLH 2019), the discharge point of all ATUs within a sewage sensitive area are required to achieve a clearance to the highest groundwater level of 1.5 m (discussed further in **Section 8**). The highest groundwater level (i.e. MGL) is shown in **Figure 2** with depth to MGL shown in **Figure 6**.

If a lot owner elects to install subsoil drains to manage groundwater within their lot, the highest groundwater level would be the phreatic crest (i.e. mounding expected between subsoil drains), which will need to be determined on a lot by lot basis.

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The above requirements will be achieved through a combination of the following measures:

- Maintain existing invert at the ultimate discharge location beneath Columbas Drive. As discussed in **Section 6.3.2**, it is proposed that the existing culvert invert be maintained (though realignment of these culverts is anticipated).
- Maintain inverts of the existing swale located along the western boundary of the site (i.e. adjacent to Columbas Drive and the POS), the southern boundary (i.e. along Harris Road) and along the central east-west road (i.e. between Detention Area 2 and 3) to control groundwater.
- Detention areas will have inverts set at CGL or slightly above the existing drain invert. Detention areas will have a low flow outlet to ensure these dry out between rainfall events.
- Roadside swales will convey runoff from road reserves towards the detention areas (see **Section 6.3.1**) and will control groundwater beneath road reserves. These will have free draining outlets (at least 150 mm above the invert of the discharge point) and grades that do not result in scour or conversely, in extended ponding. Grades of swales should be determined by flow velocity, vegetation and proposed maintenance regime, infiltration and landform. It is generally recommended that swales be no flatter than 1:750 to provide sufficient detention, while minimising scour and extended ponding.
- Subsoil drains proposed within lots should also have free draining outlets (i.e. they should outlet into the roadside swale at least 150 mm above the swale invert). Generally, subsoil drains should be no flatter than 1:500, though subsoils with grades of 1:800 where the land is very flat have demonstrated to be successful (R Martin [WGE] 2019, *pers. comm.*, 7 November).
- Use of sand fill by both the developer and lot owners to ensure the stormwater and groundwater management system functions as intended and the required clearances and serviceability are achieved.

## 7.2 Drainage design assessment

The inverts of the existing existing critical control points are shown in **Figure 11**. This includes the drain at the ultimate discharge location beneath Columbas Drive and existing swales located along the western boundary, the southern boundary and along the central east-west road. Minimum inverts for roadside swales across the site (as shown in **Figure 11**) were determined based on the following assumptions:

- Roads are consistent with the indicative concept layout plan provided in **Appendix A**.
- Swales are graded no flatter than 1:750.
- CGL is conservatively set no lower than MGL or at the surface where **Figure 2** shows MGL to be at the surface.
- CGL adjacent to the POS area (where vegetation is to be retained) is no lower than 500 mm below existing surface.
- Consideration of existing levels along Columbas Drive, Harris Road and along the eastern boundary (as the ultimate design of Martin-Pelusey Road upgrade is unknown).

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The critical control points mapping illustrates how stormwater runoff from upstream catchments and across the site will be treated and conveyed towards the three detention areas and the ultimate discharge location in the west and therefore, how the stormwater management strategy will be achieved. It also shows how existing and proposed roadside swales will control groundwater beneath road reserves and provides inverts that subsoil drains within lots will need to discharge into.

### 7.3 Groundwater quality management

The main objective for the management of groundwater quality is to maintain or improve the existing groundwater quality. This can be achieved by treating surface runoff and any captured stormwater or groundwater in subsoils prior to infiltration. Treating this water via appropriate WSUD measures will reduce the total nutrient load that infiltrates from the development.

The reduction of nutrient load to the groundwater will be achieved by:

- Education of lot owners regarding fertiliser use and nutrient absorbing vegetation species appropriate for use within lots.
- No ongoing fertiliser use is proposed within the POS, drainage reserves and swales, as these are not proposed to require ongoing irrigation.
- Use of ATUs for the management of waste from buildings/site offices in accordance with relevant guidelines.
- Appropriate treatment and/or the capture and removal of wastewater from industrial processes from the lot.
- Utilising WSUD measures within each lot as is appropriate to the final industrial land use.
- Use of high PRI soils (or similar) beneath LDAs and roadside swales, and surrounding subsoil drains.
- Directing infiltrated stormwater and groundwater captured by subsoil drains into a vegetated roadside swale.

### 7.4 Groundwater criteria compliance summary

A summary of the proposed groundwater quantity design criteria and how these are addressed within the Picton East LSP area is provided in **Table 8**.

*Table 8: Groundwater criteria compliance summary*

Criteria number	Criteria description	Manner in which compliance will be achieved
GW1	Existing inverts at discharge locations will be maintained.	Existing inverts at the ultimate discharge location beneath Columbas Drive will be maintained. Existing inverts within the existing swale located adjacent to the western boundary of the site (i.e. adjacent to the railway easement), and within existing roadside swales along Columbas Drive and Harris Road will also be maintained.
GW2	Swales and subsoil drains will have free draining outlets.	Roadside swales and any subsoil drains will have free draining outlets and minimum grades of 1:750 and 1:500, respectively. This will determine the inverts of swales and subsoil drains and therefore the CGL across the site.

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Table 8: Groundwater criteria compliance summary (continued)

Criteria number	Criteria description	Manner in which compliance will be achieved
GW3	Mitigate the breeding of disease vector and nuisance insects within detention areas.	Detention areas will have a low flow outlet to ensure these dry out between rainfall events. Detention Area 1 will have an invert set at CGL (i.e. 13 m AHD). Detention Area 2 and 3 will have an invert set at the existing drain invert (i.e. 12.05 m AHD and 12.5 m AHD, respectively).
GW4	Maintain or improve groundwater quality onsite.	<p>Education of lot owners regarding fertiliser use and nutrient absorbing vegetation species appropriate for use within lots.</p> <p>No ongoing fertiliser use is proposed within the POS, drainage reserves and swales, as these are not proposed to require ongoing irrigation.</p> <p>Use of ATUs for the management of waste from buildings/site offices in accordance with relevant guidelines.</p> <p>Appropriate treatment and/or the capture and removal of wastewater from industrial processes from the lot.</p> <p>Utilising WSUD measures within each lot as is appropriate to the final industrial land use.</p> <p>Use of high PRI soils (or similar) beneath LDAs and roadside swales, and surrounding subsoil drains.</p> <p>Directing infiltrated stormwater and groundwater captured by subsoil drains into a vegetated roadside swale.</p>

## 8 Wastewater Servicing

Wastewater is defined under the *Water Service Act 2012* as sewage and does not include stormwater, surface water or groundwater of a type that is ordinarily drained from land as part of the provision of a drainage service. Sewage is defined in the *Government Sewerage Policy* (DPLH 2019) as any waste composed wholly or partly of liquid. Sewage then includes any wastewater discharged from households and businesses attributable to domestic use (i.e. toilet, bathroom, laundry and kitchen). The proposed management of wastewater produced from general buildings has been outlined in **Section 8.2**.

Industrial wastewater refers to any liquid, solid or gaseous refuse from a business, industry, warehouse or manufacturing premises other than domestic sewage, stormwater, or unpolluted water. Industrial wastewater may include contaminated stormwater, cooling water, process waters and wash-down waters. The management of wastewater from industrial processes is addressed separately from wastewater from general buildings and is discussed in **Section 8.3**.

The development wastewater system has been designed to achieve the objectives and criteria stated in **Section 4.5**. The principle behind the wastewater management strategy for the site is to provide wastewater servicing for the development in a manner that avoids any detrimental impacts on the environment and water resources, and in line with the requirements of the *Government Sewerage Policy* (DPLH 2019) and relevant guidelines.

### 8.1 Reticulated sewer

There is no existing reticulated sewer network located in close proximity to the site. The Water Corporation has advised that the site is within two future wastewater pump station catchment areas. The northern portion of the site will be serviced by a future pump station planned to be located near the northern boundary of the site. The southern portion will be serviced by a future pump station located to the south of the site. However, neither pump station is planned to be constructed as part of Water Corporation's program within the next five years.

It is understood that the infrastructure required to service the site would include internal gravity sewer, the two pump stations and over 18 km of pressure main or gravity sewer to the Bunbury wastewater treatment plant. The cost of this infrastructure is estimate to be over \$30 million (R Martin [Stantec] 2020, *pers. comm.* 14 May). As such, it is anticipated that reticulated sewer will not be available for the site in the near future (WGE 2019).

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## 8.2 On-site sewage disposal

Reticulated sewage will not be available within the site (as discussed above) and thus provision for the disposal of wastewater will need to be considered and accommodated on site, in line with the requirements of the *Government Sewerage Policy* (DPLH 2019) and other relevant guidelines. Proposed developments that will not be connected to reticulated sewer are required to prepare a site and soil evaluation (SSE) in accordance with *AS/NZs 1547 On-site domestic wastewater management* (AS 1547) (Standards Australia and Standards New Zealand 2012). To support an LSP, the LWMS should determine minimum lot sizes, identify appropriate treatment technology and onsite sewage management systems, and establish performance criteria, which are all informed by the SSE (DoH 2019).

### 8.2.1 Site and soil evaluation

**Section 1, Section 2** and **Section 3** of this LWMS outlines the relevant planning and environmental information for the site and has formed the desktop study component of the SSE. Whilst this is a desktop study, the information provided in **Section 3** has been informed by a number site specific investigations, including site visits for soil investigations and multiple groundwater monitoring events. In addition to the site-specific investigations outlined within **Section 3**, a number of general site visits have been undertaken.

A site and soil evaluation has been undertaken in accordance with the requirements of Appendix C of the AS 1547 (Standards Australia and Standards New Zealand 2012). **Table 9** discusses the existing site conditions in accordance with the elements outlined in Appendix C.

*Table 9: Site and soil evaluation as per Appendix C of AS/NZs 1547 (Standards Australia and Standards New Zealand 2012).*

Element	Site description
Terrain-soil combinations	Two broad terrain-soil combinations can be classified within the site, being: <ul style="list-style-type: none"> <li>• Dunal – as shown in <b>Figure 3</b> and outlined within <b>Section 3.3.2</b>, the northern portion of the site is classified as ‘Bassendean sand’ consisting of low rounded dunes.</li> <li>• Palusplain – the majority of the site is classified as a multiple use wetland (shown in <b>Figure 4</b>) and consists of low lying flat land that is seasonally waterlogged.</li> </ul>
Land surface shape	Due to the extent of the site, multiple land surface shapes can be classified throughout the site when topographic contours are considered on a finer scale (see <b>Figure 2</b> ). Broadly, the land surface shape of the northern portion of the site can be described as ‘linear planar – natural drainage less effective from crest, no spreading or acceleration’, ‘waning planar – progressively less well drained down slope, slows run-off, poor’, and ‘linear convergent’ where surface water is concentrated in a smaller area. The southern portion of the site generally flat.
Gradient	As per <b>Figure 2</b> and outlined within <b>Section 3.3.1</b> , the site ranges from 23 m AHD within the northern portion of the site dropping to 12 m AHD in the southern portion of the site. The higher elevations and steeper slopes are located along the western and northern boundaries of the site. The lowest areas are generally consistent with existing drainage channels and farm dams. <p>The steepest gradient within the site is approximately 12.5% associated with the central northern portion of the site. The southern portion of the site is generally flat, which grades as low as 0.4%.</p>

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Table 9: Site and soil evaluation as per Appendix C of AS/NZs 1547 (Standards Australia and Standards New Zealand 2012) (continued)

Element	Site description
Water	<p>The surface water regime for the two-broad terrain-soil combinations include:</p> <ul style="list-style-type: none"> <li>• Dunal – the water regime is expected to be infiltration in smaller rainfall events, given the depth of sand observed, and relatively fast runoff in larger rainfall events following the topographic contours.</li> <li>• Palusplain – the water regime is expected to be slow overland flow given the flatter topography and geology of sand over sandy clay.</li> </ul> <p>Depth to groundwater within the site is outlined within <b>Section 3.5.2</b>, with the maximum depth to groundwater within the bores identified within <b>Figure 2</b> ranging from 0.05 m to 0.9 m below the surface. Given the higher elevation in the northern portion of the site, and where no monitoring bores were located, depth to groundwater is expected to be greater in this area. Overall, depth to MGL across the site ranges from just below the surface to approximately 8.5 m below the natural surface. However depth to MGL across the majority of the site ranges from just below the surface to approximately 0.9 m below the natural surface.</p>
Soil inspection	<p>As discussed in <b>Section 3.3.2</b>, and shown within <b>Figure 3</b>, the site is underlain by the Guildford formation, consisting of clay, silt, sand and gravels, with some Bassendean sand outcrops. Site-specific investigations were undertaken by Strategen (2010) which included the installation of boreholes across the site (as shown in <b>Figure 3</b>). The site-specific investigations indicate soils across the majority of the site consisted of fine to medium grained sands, with clayey sands below depths of 1 m (Strategen 2010).</p>

Based on the existing environmental conditions within the site, as outlined within **Section 3** and further discussed within **Table 9**, the site has been classified into two areas based on the suitability of existing conditions for on-site sewage disposal and are shown within **Figure 12**. Favorable areas are classed as ‘requires little modification to be suitable’ and unfavorable areas are classed as ‘requires modification to be suitable’. The areas of unfavorable land identified in **Figure 12**, are based on the following conditions:

- Soils that form part of the Guildford formation (Qpa), as these are generally associated with the palusplain terrain-soil combination.
- Land that has a current depth to MGL of less than 1.5 m. As outlined within the *Government Sewerage Policy* (DPLH 2019) separation to groundwater within sewage sensitive areas require a clearance of 1.5 m above the highest groundwater level to account for seasonal conditions and possible rise following development.

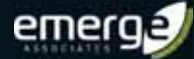
Management of on-site sewage disposal within both the favorable and unfavorable areas within the site (as identified within **Figure 12**) for general building wastewater is discussed in **Section 8.2.2**.

### 8.2.2 Sewage management

As discussed previously, the LWMS should determine minimum lot sizes, identify appropriate treatment technology and on-site sewage management systems, and establish performance criteria, as informed by the SSE.

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#### 8.2.2.1 Minimum lot sizes

Lots will need to be of adequate size to provide sufficient area to locate the wastewater treatment system (e.g. ATU) and on-site management systems (e.g. land application area). As specified by the *Government Sewerage Policy* (DPLH 2019), developments within sewage sensitive areas are generally required to have a minimum lot size of 1 ha. The indicative concept plan provided in **Appendix A** illustrates the site will accommodate lots from 1 ha to 4.85 ha in size.

It is noted that smaller lots may be considered for industrial subdivision on a case-by-base basis. This would require demonstration that the proposed subdivision lots are capable of meeting the objectives of the policy (DPLH 2019).

#### 8.2.2.2 Appropriate treatment technology and onsite sewage management systems

Waste produced from buildings/site offices will be consistent with general office uses (i.e. toilets, sinks, showers etc.) with wastewater loading rates consistent with those stipulated in Table 2 of the DoH's *Supplement to Regulation 29 and Schedule 9 - Wastewater system loading rates* (DoH 2019a). As outlined within **Section 0**, the site is located within a sewage sensitive area (specifically within the estuary catchments on the Swan and Scott Coastal Plains) (DPLH 2019c). Consequently, as specified by the *Government Sewerage Policy* (DPLH 2019), secondary treatment systems with nutrient removal (such as ATUs) should be utilised to ensure discharge is of sufficient quality to protect downstream environments. DoH approved systems, as listed in the *Approved secondary treatment systems* (DoH 2019b) will be utilised and installation will be carried out in line with the *Code of Practice for the Design, Manufacture, Installation and Operation of Aerobic Treatment Units* (DoH 2015).

ATUs are an advanced alternative to conventional septic tanks which provide improved quality of effluent treatment. ATUs differ from conventional septic tanks in that the wastewater is treated with oxygen to assist in the breakdown of bacteria into fine organic material. The effluent is then treated with chlorine to reduce the number of bacteria in the final effluent. The final treated effluent can then be disposed of within dedicated land application systems. These include adsorption trenches/beds, evapotranspiration/adsorption/seepage beds/trenches, surface irrigation, subsurface irrigation or mounds (Standards Australia and Standards New Zealand 2012; DPLH 2019). Land application systems should:

- Be sized appropriately based on anticipated hydraulic loading, size of the ATU system and characteristics of the underlying soil (both existing and imported).
- Include buffer areas (to be determined as a part of site-specific assessment) and fencing between the land application area and areas of human use. These buffer areas may be reduced by use of subsurface dripper irrigation systems.
- Include warning signs advising that effluent is being used and is not suitable for human contact or consumption.
- Kept free of structures.
- Be accessible for maintenance.



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In addition to the requirements for irrigation disposal areas, a number of factors must be considered prior to the installation of ATUs on the site. These are outlined in the *Code of Practice for the Design, Manufacture, Installation and Operation of Aerobic Treatment Units* (DoH 2015). An ATU should be at least:

- 1.2 m from any lot boundaries or buildings.
- 1.8 m from the irrigation disposal area.
- 6 m from any well, bore (not used for drinking water purposes), dam, drain or subsoil drain.

Where larger systems are required or where reuse of wastewater is proposed, designs will be assessed and approved by DoH on a case by case basis.

#### 8.2.2.3 Performance criteria

Key design criteria for on-site wastewater disposal are specified in **Section 4.5** and how these will be addressed is summarised in **Table 10**. As outlined within **Section 8.2.1**, the site and soil evaluation identified the southern portion of the site as currently unfavourable for on-site sewage disposal. These areas are shown in **Figure 12**. On-site sewage disposal can be achieved within the unfavourable areas within the site and meet the requirements of the *Government Sewerage Policy* (DPLH 2019) by:

- Sand fill will be used within the site to achieve the 1.5 m separation required from the highest groundwater level.
- Specifications for sand fill (identified as part of the SSEs completed for subdivision and again for development application) will need to be considered based on the requirements of the site such as hydraulic loading serviced, the size of the ATU system and characteristics of the existing underlying soil.
- Installing secondary treatment systems with nutrient removal (i.e. an ATU) consistent with the requirements of the *Government Sewerage Policy* (DPLH 2019) for sewage sensitive areas.
- On-site sewage systems will not be located within 100 m from a drainage system (including subsoil drains) that discharges directly into a waterway or significant wetland without treatment. As specified within **Section 3.4.2**, no natural waterways exist within the site, with runoff collected in small farm drains and dams occurring across the site, which flow into a major drain owned by the Water Corporation. Discharges from the lot will ultimately enter a treatment train system of LDAs, roadside swales and detention areas before entering a major drain and eventually the Ferguson River (as discussed in **Section 6**). Therefore, as these are not natural waterways, on-site sewage systems may be located within 100 m of roadside swales and detention areas, though, as noted above should be located at least 6 m from any drain or subsoil drain.
- On-site sewage systems will not be located in any area subject to inundation and/or flooding in a 10 % AEP rainfall event. As outlined within **Section 6.2**, each lot will contain an LDA to treat and infiltrate runoff.

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### 8.3 Industrial wastewater management

Any wastewater produced on lots from industrial processes (in addition to general building wastewater, discussed above) i.e. trade waste will be required to be treated appropriately on lot, and not within the domestic style systems intended to address sewage. Where appropriate treatment is not achievable on lot, either due to the volumes or contaminants contained therein, industrial process wastewater will be captured and removed from site to an appropriate treatment facility. This approach is consistent with industrial sites across WA, even where deep sewer connection is provided.

Any onsite industrial wastewater treatment plants associated with specific lot uses should be designed and constructed in accordance with *Water Quality Protection Note 51: Industrial wastewater management and disposal* (DoW 2009) with approvals sought from the DoH and SoD as part of the building approvals process.

Consideration will need to be given of the ultimate use of the lot and the appropriate management of wastewater from any industrial processes (including any potential spills) to be treated appropriately within the lot.

### 8.4 Wastewater criteria compliance summary

A summary of the proposed wastewater design criteria and how these are addressed within the Picton East LSP area is provided in **Table 10**.

*Table 10: Wastewater servicing criteria compliance*

Criteria number	Criteria description	Manner in which compliance will be achieved
WW1	On-site sewage systems to be located at least 100 m from a drainage system that discharges directly into a waterway or significant wetland without treatment.	Discharges from the on-site sewage system will not connect directly to a natural waterway or significant wetland. Discharges from the lot will ultimately enter a treatment train system of roadside swales and detention areas before entering a major drain and eventually the Ferguson River. All roadside swales and detention areas within the site will provide treatment by utilise nutrient absorbing vegetation.
WW2	On-site sewage systems are not to be located in any area subject to inundation and/or flooding in a 10 % AEP rainfall event.	Lot sewage systems will not be located in an area subject to inundation or flooding in a 10 % AEP event. As outlined within <b>Section 6.2</b> , each lot will contain an LDA to treat and infiltrate runoff, and consequently, lot sewage systems will need to be located beyond the LDA.
WW3	The discharge point of the on-site sewage system should be at least 1.5 m above the highest groundwater level.	The discharge point of lot sewage systems will be set at least 1.5 m above the highest groundwater level. Fill will be used to meet this clearance where necessary.
WW4	Ensure appropriate treatment of industrial wastewater from lots is provided in consideration of ultimate lot use.	Wastewater from any industrial processes will be treated appropriately within the lot and not within the ATUs used for general sewage.

## 9 Future Subdivision and Urban Water Management Plans

The requirement to undertake preparation of more detailed water management plans to support subdivision is generally imposed as a condition of subdivision. The development of any future UWMP should follow the guidance provided in *Urban Water Management Plans: Guidelines for Preparing Plans and for Complying with Subdivision Conditions* (DoW 2008b).

While strategies have been provided within this LWMS that address planning for water management within the site, future development stages will need to clarify details not provided within this LWMS. The main areas that will require further clarification include:

- Geotechnical investigation
- Modelling of local road drainage network
- Stormwater storage and subsoil drainage within lots
- Roadside swale and detention area configurations
- Temporary stormwater and groundwater management
- Wastewater servicing
- Implementation of water conservation strategies
- Non-structural water quality improvement measures
- Management and maintenance requirements
- ASS management plan
- Construction period management strategy
- Monitoring and evaluation program.

These are further detailed in the following sections.

### 9.1 Geotechnical investigation

All future UWMP(s) will need to be supported by a detailed geotechnical investigation, as this informs the stormwater, groundwater and wastewater management strategies (e.g. revising infiltration rates, refining CGLs and determining earthworks, size of land application areas).

### 9.2 Modelling of local road drainage network

The design of the drainage system to date has been undertaken at an appropriate level for local structure planning and is based upon the indicative concept plan provided in **Appendix A** (which is likely to change at subdivision). Runoff-routing computer modelling of the stormwater drainage system will be reviewed once the subdivision plan has been determined and detailed drainage design has commenced for the area. The subdivision plan must be supported by an earthworks plan for the subdivision area, which will inform refinement of the stormwater model. In addition, the broad earthworks plan can be utilised by lot owners to inform their lot design. It is anticipated that this will occur during the subdivision design process and detailed within the future UWMPs.

Land ownership within the LSP area is somewhat fragmented and consequently it is difficult to determine when each landholding will be developed. Portions of the LSP can be developed as shown

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in the LWMS without development of the ultimate drainage system by use of temporary structures (see **Section 9.5**).

If any changes to the catchment details are proposed and/or the designs are not consistent with the assumptions made in the LWMS, including layout of the 20 m access road reserves and/or drainage basin sizes and or locations (as shown on the concept plan in **Appendix A**), the surface runoff modelling for the entire structure plan area will need to be reviewed during the subdivision process and detailed within the supporting UWMPs.

### 9.3 Stormwater storage and subsoil drainage within lots

The stormwater management strategy assumes that all lots will retain 2 m<sup>3</sup> of runoff for every 65 m<sup>2</sup> of hardstand or roof (i.e. impervious area). Other WSUD strategies, which are industry specific, can be installed within each lot to treat runoff prior to it discharging from the lot. It is the lot owners' responsibility to ensure that the appropriate storage is provided and appropriate WSUD strategies used within the lot. Lot owners may elect to utilise subsoil drains to assist with controlling the rise of groundwater. These subsoil drains should be free draining by discharging into the adjacent roadside swale at least 150 mm above the swale invert. As a condition of subdivision, lots are required to connect to roadside swales as part of subdivision and built by the developer.

Lot designs, including stormwater storage and subsoil drainage, are to be approved by SoD at building approval stage prior to construction, and therefore will not be available for inclusion in the UWMP. However, UWMPs will need to provide sufficient detail to inform how lot-scale measures connect to development systems (e.g. invert of roadside swales to inform subsoil drain connection and requirement for sand fill). Future UWMPs should also clearly identify the roles and responsibilities for implementing lot-scale stormwater, groundwater and wastewater management measures.

### 9.4 Roadside swale and detention area configurations

The exact location, invert, size and shape of the roadside swales and detention areas will still need to be specified and presented within the future UWMPs.

In order to review the final configurations, the hydrological model and critical control point mapping (to determine indicative CGLs across the site) that have been developed to support this LWMS will be refined in light of stakeholder feedback or to accommodate other design considerations. It is expected that the civil drainage designs will be progressed to a level that provides detailed cross-sections, sizes of storage areas, pipe sizes, inverts, etc. The ultimate aim of revising the hydrological model and refining the CGL will be to confirm that the drainage designs are able to meet the performance criteria proposed in **Section 4** of this LWMS. It is noted that the inverts presented in **Figure 11** are conservative and can be refined at subdivision such that the CGL is set below MGL, provided the existing invert at the ultimate discharge location is maintained as is supported by an assessment of ASS risks (DoW 2013).

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### 9.5 Temporary stormwater and groundwater management requirements

Temporary management measures will need to be put in place to manage stormwater and groundwater as staging of the site occurs until the ultimate stormwater and groundwater management systems have been constructed. For example, temporary detention areas would be required to manage stormwater runoff from individual civil construction stages.

Temporary management measures should be outlined within future UWMPs when more information is available on staging and the detailed design of each stage. Temporary management measures will need to achieve the design criteria outlined within **Section 4** and ensure the solutions align with the ultimate management system outlined in this LWMS (across **Sections 6 to 8** and shown in **Figure 7** and **Figure 11**).

### 9.6 Wastewater servicing

An updated SSE will be required at subdivision stage when more detailed design information is made available. The SSE will be prepared in accordance with Appendix C of *AS/NZs 1547 On-site domestic wastewater management* (Standards Australia and Standards New Zealand 2012) and the requirements of the *Government Sewerage Policy* (DPLH 2019). Additional site-specific investigations may be required to inform the SSE (including a geotechnical investigation).

Utilising the findings from the geotechnical investigation, the SSE will need to assess, as appropriate, whether every lot is favorable for on-site sewage disposal, which in turn may affect the subdivision layout. As per the *Government Sewerage Policy* (DPLH 2019) if lots less than 1 ha are proposed within a sewage sensitive area further demonstration and justification will be required.

The SSE will be required to meet the criteria outlined within **Section 8.4** of this LWMS and sufficient information will be required to demonstrate that each lot is capable of accommodating the on-site systems proposed. The information for this could potentially be included in the form of a figure or plan.

At the development application (DA) stage, a SSE for individual lots will be required to be prepared in accordance with Appendix D of *AS/NZs 1547 On-site domestic wastewater management* (Standards Australia and Standards New Zealand 2012) and in line with the requirements of the *Government Sewerage Policy* (DPLH 2019). The SSE at DA will need to identify potential land application and reserve areas and to gather sufficient site and soil information for the selection and design of the on-site system (including more detail on the design specifications of ATUs, including the location and discharge mechanisms i.e. land application areas or discharge outlets).

### 9.7 Implementation of water conservation strategies

A number of potential measures to conserve water have been presented within this LWMS. These water conservation strategies will be incorporated into the subdivision design and will be further detailed within the future UWMPs produced for the development. The manner in which the proponent intends to promote water conservation measures discussed in this LWMS to future lot owners will also be discussed within the future UWMP.

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#### 9.8 Non-structural water quality improvement measures

Guidance for the development and implementation of non-structural water quality improvement measures is provided within the *Stormwater Management Manual for Western Australia* (DoW 2007a). Some measures will be more appropriately implemented at a local government level, such as street sweeping, however many can be implemented relatively easily within the design and maintenance of the subdivision and the drainage reserves. It is expected that the future UWMPs will provide a schedule of management and maintenance actions including timing and responsible parties.

#### 9.9 Management and maintenance requirements

The management measures to be implemented to address surface water quality, such as the use of vegetation within swales and detention areas will require ongoing maintenance. It is therefore expected that the future UWMPs will set out maintenance actions (e.g. gross pollutant removal), timing (i.e. how often it will occur), locations (i.e. exactly where it will occur) and responsibilities (i.e. who will be responsible for carrying out the actions). Given that approval from the SoD and DWER will be sought for the proposed measures, it is anticipated that consultation with these agencies will be undertaken and referral to guiding policies and documents will be made.

#### 9.10 ASS management plan

An ASS management plan will be required in this moderate to low risk ASS area (DWER 2019a) if the CGL is confirmed to be set below MGL in future UWMPs, as proposed by the groundwater management strategy (see **Section 7.1**). The ASS management plan should include more detailed on-site investigations (potentially as part of future geotechnical investigations described in **Section 9.1**) than the investigation provided in **Appendix B**.

#### 9.11 Construction period management strategy

It is anticipated that the construction stage will require some management of various aspects (e.g. dust, surface runoff, noise, traffic etc.). The management measures undertaken for construction management will be addressed either in the future UWMPs or a separate Construction Management Plan.

#### 9.12 Monitoring and evaluation program

It will be necessary to confirm that the management measures that are implemented are able to fulfil their intended management purpose, and are in a satisfactory condition at a point of management hand-over to the SoD. A post-development monitoring program will be developed to provide this confirmation, and it will include details of objectives of monitoring, relevant issues and information, proposed methodology, monitoring frequency and reporting obligations. These monitoring programs are discussed in **Section 10** of this LWMS and will be further detailed at the UWMP stage.

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## 10 Monitoring and Maintenance

### 10.1 Management and maintenance

It is proposed that the overall condition of the development will be monitored on a bi-annual basis. This monitoring will be implemented after the completion of the civil and landscaping works and will continue for a period of two years until handover of drainage reserves to the SoD.

A visual assessment will be undertaken to monitor the overall condition of the development, with the aim to ascertain that the maintenance activities are achieving the overall management objectives for the development. The parameters that will be monitored include:

- Nutrients and water quality
- Gross pollutants
- Terrestrial weeds
- Drainage infrastructure.

The management and maintenance objectives will be detailed within future UWMPs along with details of the corresponding monitoring program.

### 10.2 Water quality monitoring

Post-development monitoring will be carried out to ensure that the proposed storage and treatment measures, detailed in **Section 6** and **7**, are working efficiently. An upstream-downstream comparison for surface water and groundwater is proposed to confirm that the water treatment infrastructure is performing as intended.

#### 10.2.1 Recommended program for UWMP

Surface water and groundwater monitoring locations will be selected to provide an indication of the effects of the development on water quality leaving the site. Indicative monitoring locations are provided in **Figure 7**. These upstream/downstream locations will be finalised in the UWMP.

Surface water quality monitoring will be conducted on a fortnightly basis during winter (typically July to September). Groundwater quality monitoring will be conducted on a quarterly basis. A summary of the post-development monitoring program is shown in **Table 11**. The post-development monitoring will be conducted for two years post construction of the development.

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Table 11: Monitoring program summary

Monitoring type	Locations	Frequency	Parameters
Surface water	Inflow to existing swale and discharge from site	Fortnightly (typically Jul, Aug, Sept)	In situ pH, EC, temperature. Sample TSS, TN, TKN, NO <sub>x</sub> , NO <sub>2</sub> , NO <sub>3</sub> , NH <sub>3</sub> , TP, reactive phosphorous.
Groundwater	Bores upstream and downstream of the site	Quarterly (typically Jan, April, July, Oct)	In situ pH, EC, temperature. Sample TN, TKN, NO <sub>x</sub> , NO <sub>2</sub> , NO <sub>3</sub> , NH <sub>3</sub> , TP, reactive phosphorous.

### 10.2.2 Post-development trigger values

Groundwater water quality targets have been derived from background levels measured during monitoring prior to development, provided in **Table 1**. Trigger values have been determined through consideration of the pre-development monitoring concentrations, the ANZECC and ARMCANZ (2000) trigger value for lowland river aquatic ecosystems in South-west Australia and target concentrations specified in the *Leschenault Estuary WQIP* (DoW 2012). The trigger criteria proposed are shown in **Table 12**.

Table 12: Water quality trigger values

Analyte	pH	EC (mg/L)	TN (mg/L)	TKN (mg/L)	NO <sub>x</sub> (mg/L)	NH <sub>4</sub> (mg/L)	TP (mg/L)	Reactive phosphorous (mg/L)
Surface water	6.5 - 8	0.12 - 0.3	1	NA	0.15	0.08	0.1	0.04
Groundwater	6 - 8	0.12 - 0.4	4.58	4.45	0.20	0.22	0.61	0.05

While trigger values have been defined in **Table 12**, the water quality data over the site is varied. It is therefore proposed that the post-development trigger values provided in **Table 12** are dynamic values, and should be assessed in the context of an upstream/downstream comparison. The secondary trigger to implement a contingency action (see **Section 10.3**) will be if the downstream concentration of the above parameters is greater than 20% higher than the upstream concentration.

### 10.3 Contingency action plan

A Contingency Action Plan (CAP) will be detailed and implemented as a part of each UWMP. The CAP is effectively a plan of steps that will be undertaken should certain water quality criteria be reached.

#### 10.3.1 Trigger criteria

As indicated, the trigger values proposed in **Table 12** have been derived from water quality levels measured during pre-development monitoring and relevant guidelines. These values should be reviewed for each UWMP to include additional data gained from any additional monitoring.



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### 10.3.2 Contingency actions

If the results from the initial monitoring occasion indicate that nutrient concentrations exceed the nominated trigger values, a number of contingency measures will be employed.

The first action that should be undertaken if trigger criteria are exceeded is to repeat the monitoring to remove the potential for sampling error. If the repeat monitoring still shows results which breach the trigger value, the next action will be to compare the upstream (incoming) nutrient concentrations with the downstream (outgoing) nutrient concentrations. Comparison should also be made between groundwater and surface water quality concentrations, when these are sampled on the same monitoring event.

If the downstream nutrient concentrations are >20% higher than the upstream nutrient concentrations, the following actions should be undertaken:

- Review nutrient application practices to identify source of possible.
- Conduct surveillance of site to determine any potential and obvious nutrient inputs, including within lot treatment structures/verge maintenance practices.
- Remove source if possible (e.g. fertiliser input, etc.).

If the downstream nutrient concentrations are found to be generally consistent with the upstream concentrations the next action will be to conduct a site-specific comparison of background data collected within the site prior to development. There is some amount of variability (both spatially and temporally) in nutrient concentrations experienced across the site and the trigger values may need to be modified following additional monitoring. This information should then be used as a management tool in consultation with DWER and SoD to determine if the trigger values should be revised.

Following the implementation of the above contingency measures the water quality will be re-sampled. If the results are consistent with the previous monitoring events, DWER and SoD will be informed of the results, and the proponent will work with DWER and SoD to determine if the results are representative of a broader catchment management issue, and whether any additional contingency actions need to be implemented onsite.

### 10.4 Reporting

A post-development monitoring report will be prepared on conclusion of the two year monitoring period, and will be provided to the SoD and the DWER. Interim results (spreadsheet) can be provided to either SoD or DWER on request during the monitoring program.

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## 11 Implementation

The LWMS is a key supportive document for the LSP. The development of the LWMS has been undertaken with the intention of providing a structure within which subsequent development can occur consistent with an integrated water cycle management approach. It is also intended to provide overall guidance to the general stormwater management principles for the area and to guide the development of the future UWMPs.

### 11.1 Roles and responsibility

The LWMS provides a framework that the proponent can utilise to assist in establishing stormwater management methods that have been based upon site-specific investigations, are consistent with relevant State and Local Government policies, and have been endorsed by the SoD. The responsibility for working within the framework established within the LWMS rests with the landholder, although it is anticipated that future UWMPs will be developed in consultation with the SoD and DWER and in consideration of other relevant policies and documents.

The majority of the existing drains within the site are currently managed by the Water Corporation (i.e. East Picton Sub C, Sub D and Sub E drains shown on **Figure 5**). Based on feedback from the Water Corporation on earlier versions of this LWMS, it is understood that an agreement between the Water Corporation and the SoD regarding the transfer of drains across the site will need to occur before construction of the development commences. This agreement will need to take into consideration the LSP, proposed staging of development, and the ultimate stormwater and groundwater management approach for the site.

The responsibility to implement and maintain lot water quality treatment measures that are appropriate to the land use will be with the lot owner/lot developer. The sizing and design of LDAs for detention of runoff within lot will be the responsibility of the lot owner/lot developer. The installation of any subsoil drains and wastewater management complying with relevant guidelines are the responsibility of the lot owner/lot developer.

Main Roads WA (MRWA) will be responsible for the design and construction of the Martin-Pelusey Road upgrade and associated drainage infrastructure.

### 11.2 Funding

Funding for within-lot drainage, groundwater and wastewater management infrastructure will be the responsibility of the lot owner. The site includes multiple landholdings that are anticipated to be developed sporadically over the long term. Therefore, estate scale drainage infrastructure will be funded by each landholder. The upgrade of Martin-Pelusey Road and associate drainage infrastructure will be funded by MRWA.

## Local Water Management Strategy

Local Structure Plan, Lots 103, 110 and 436, Picton East



### 11.3 Review

It is not anticipated that this LWMS will be reviewed, unless additional land parcels/lots are added to the LSP area prior to subdivision, or the LSP undergoes significant change post-lodgment of the LWMS. If additional areas are required to be covered by the LWMS it is most likely that an addendum to cover these areas could be prepared. Surface runoff modelling undertaken for this LWMS will need to be reviewed and the criteria proposed revised to ensure that all are still appropriate if the LSP is substantially modified.

The next stages of water management are anticipated to be lot planning through subdivision. Subdivision approvals will be supported by a UWMP. The UWMP is largely an extension of the LWMS, as it should provide detail to the designs proposed within this LWMS, and will demonstrate compliance with the criteria proposed in **Section 4**.

In addition to the issues detailed in **Section 9**, the UWMP will address:

- Compliance with design objectives within the LWMS
- Detailed stormwater and groundwater management design
- Specific structural and non-structural methods to be implemented and their manner of implementation
- SSE to assess every lot to confirm measures that will be required to ensure it is favorable for on-site sewage disposal
- Details of proposed roles and responsibilities for the above measures.

The next stage of development following the UWMP is single lot development. It is recognised that certain elements of the LWMS and the UWMP will not be implemented until this late stage, and that there is little or no statutory control that can be applied to ensure the implementation of any remaining measures. While the remaining measures are unlikely to be enforced at this stage, their implementation will be encouraged by the SoD through policy (or modification of these where necessary), building licence or awareness programs (such as the Water Corporation Waterwise program).

# Local Water Management Strategy

## Local Structure Plan, Lots 103, 110 and 436, Picton East



## 12 References

### 12.1 General references

The references listed below have been considered as part of preparing this document.

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# Local Water Management Strategy

## Local Structure Plan, Lots 103, 110 and 436, Picton East



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# Local Water Management Strategy

Local Structure Plan, Lots 103, 110 and 436, Picton East



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# Figures



*Figure 1: Site Boundary*

*Figure 2: Topographic and Maximum Groundwater Contours*

*Figure 3: Geological Mapping*

*Figure 4: Geomorphic Wetlands*

*Figure 5: Hydrological Features*

*Figure 6: Depth to Maximum Groundwater Level*

*Figure 7: Stormwater Management Plan*

*Figure 8: Small Rainfall Event Inundation*

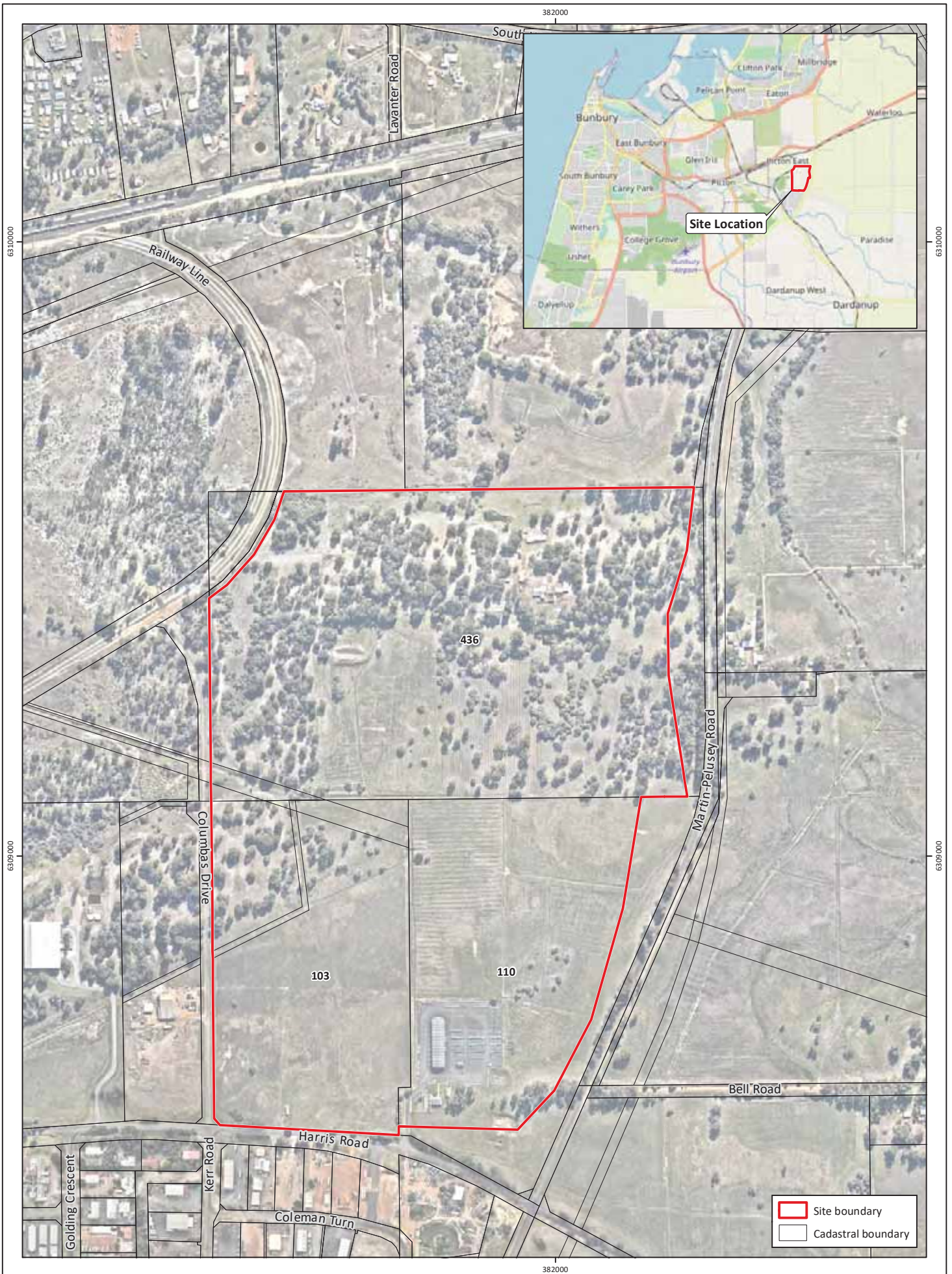
*Figure 9: Minor Rainfall Event Inundation*

*Figure 10: Major Rainfall Event Inundation*

*Figure 11: Critical Control Points Mapping*

*Figure 12: Site and Soil Evaluation Mapping*





**Figure 1: Site Boundary**

**Project:** Local Water Management Strategy  
Local Structure Plan, Lots 103, 110 and 436, Picton East  
**Client:** Harris Road Pty Ltd

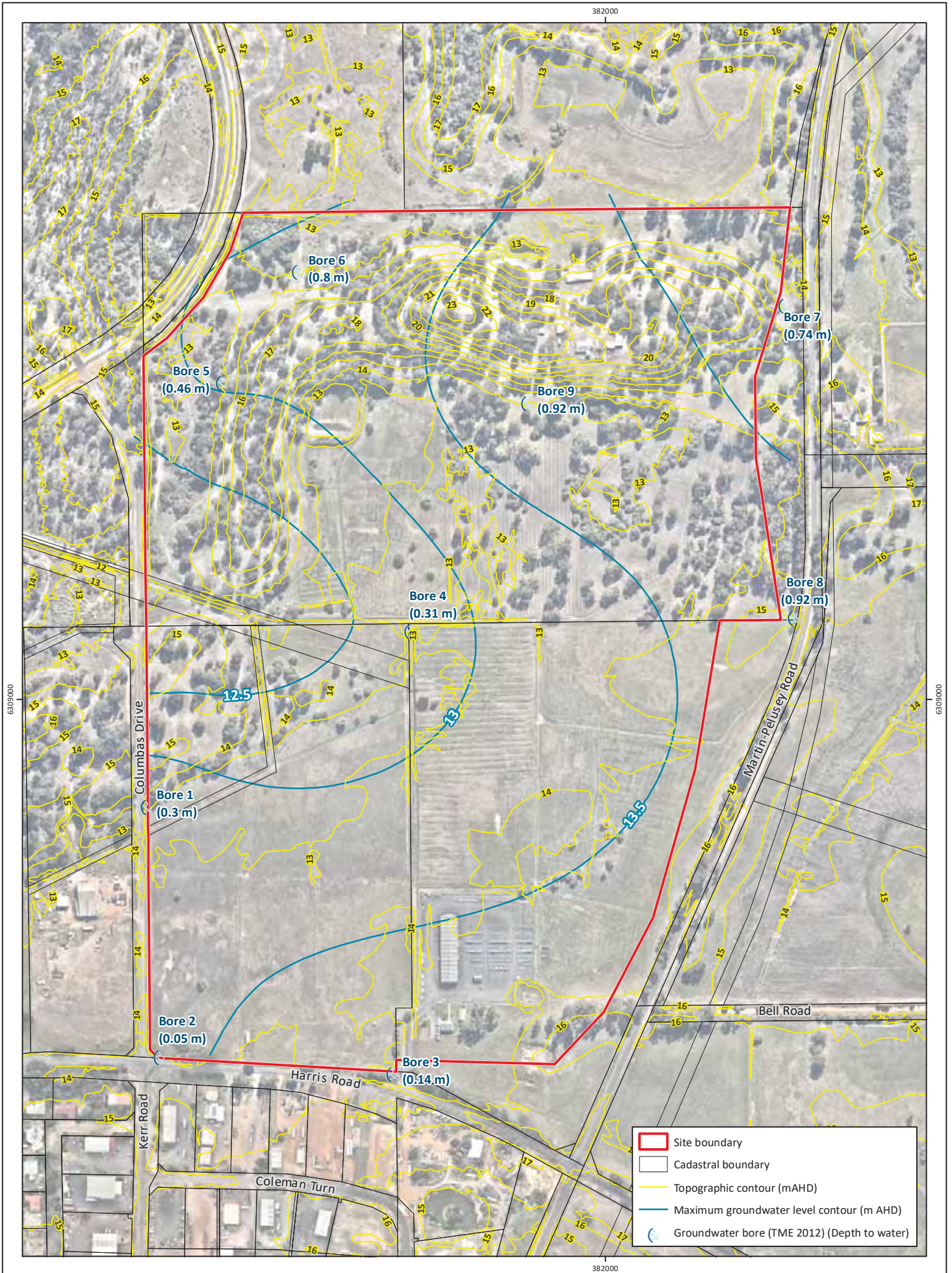
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**Date:** 25/01/2021



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GDA 1994 MGA Zone 50



While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used



**Figure 2: Topographic and Maximum Groundwater Contours**

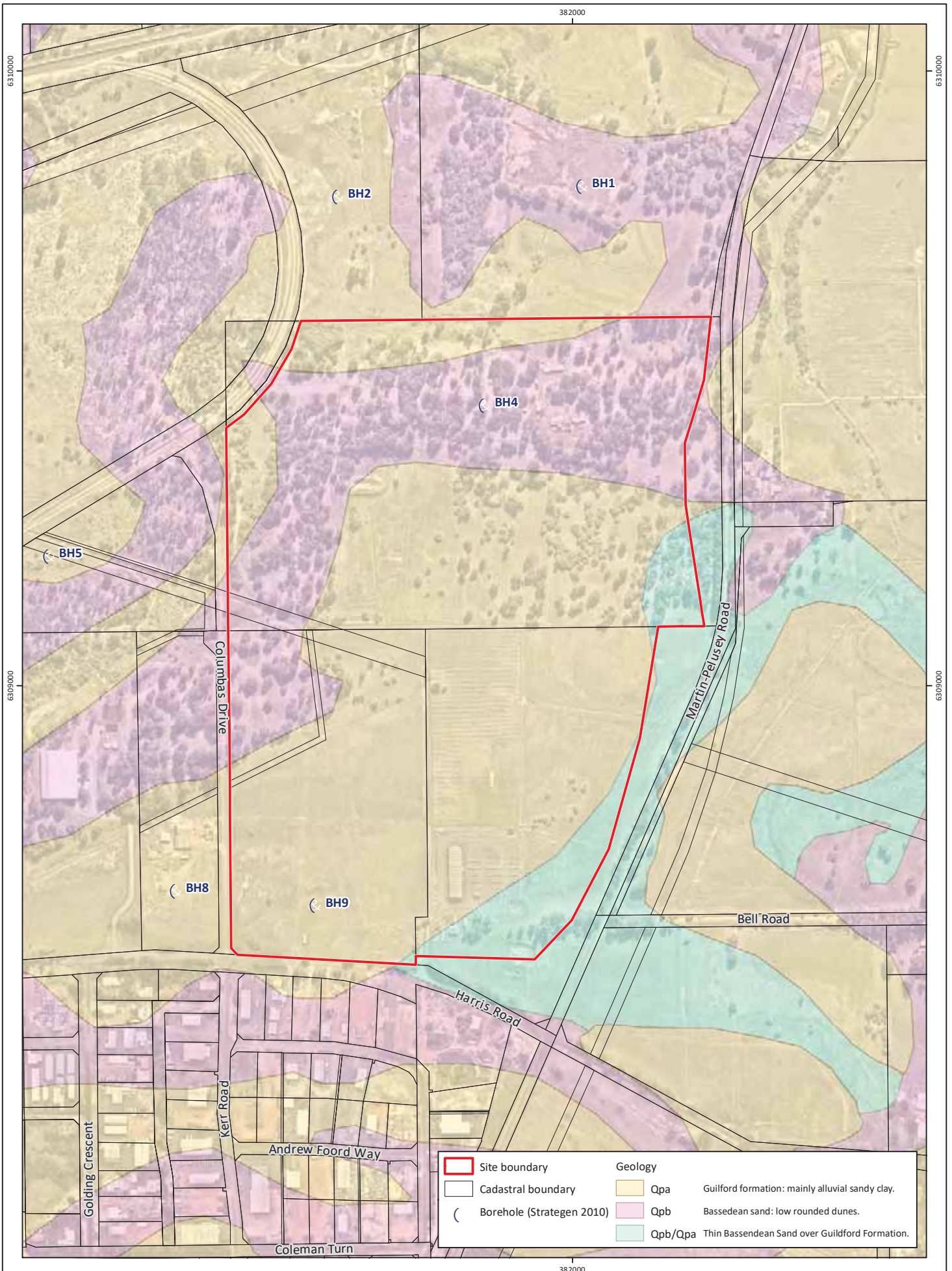
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Local Structure Plan, Lots 103, 110 and 436, Picton East  
**Client:** Harris Road Pty Ltd

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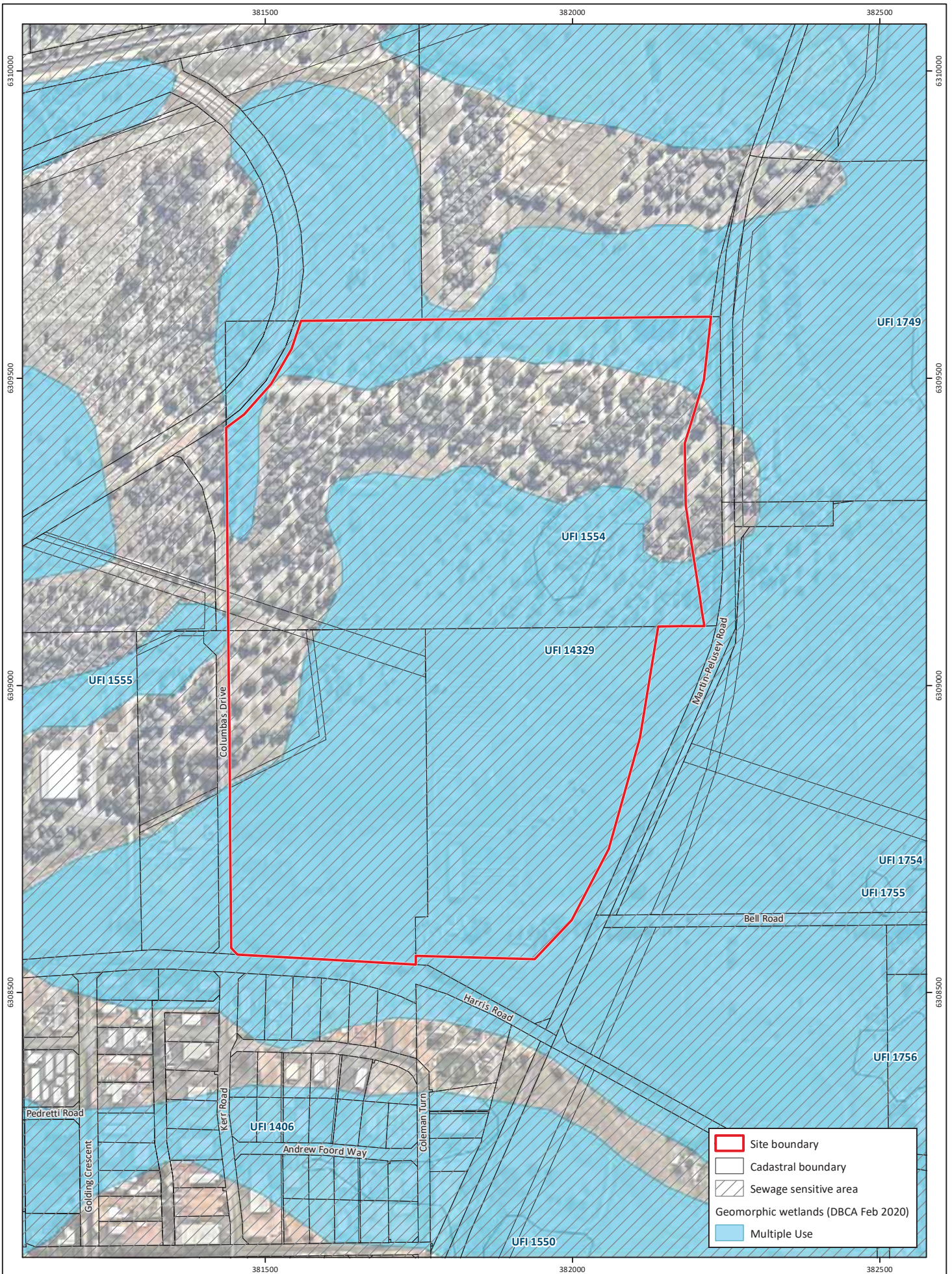
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<p><b>Project:</b> Local Water Management Strategy Local Structure Plan, Lots 103, 110 and 436, Picton East</p> <p><b>Client:</b> Harris Road Pty Ltd</p>	<p><b>Plan Number:</b> EP12-039(01)-F25a  <b>Drawn:</b> GAR  <b>Date:</b> 25/01/2021  <b>Checked:</b> AJI  <b>Approved:</b> DPC  <b>Date:</b> 25/01/2021</p>		<p>0      100      200 Metres</p> <p>Scale: 1:8,000@A4 GDA 1994 MGA Zone 50</p>	
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**Figure 4: Geomorphic Wetlands and Sewage Sensitive Areas**

**Project:** Local Water Management Strategy  
Local Structure Plan, Lots 103, 110 and 436, Picton East  
**Client:** Harris Road Pty Ltd

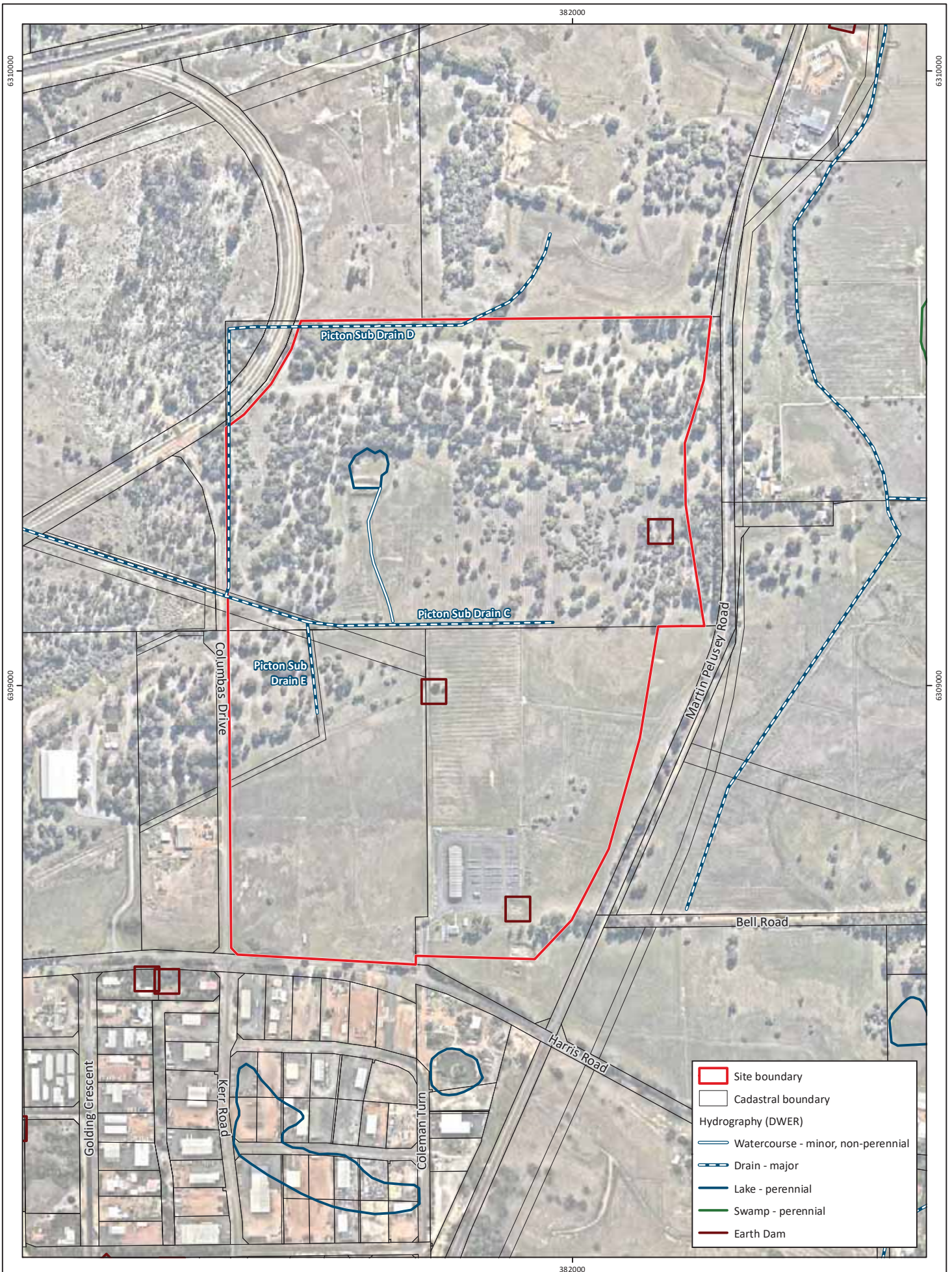
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**Figure 5: Hydrological Features**

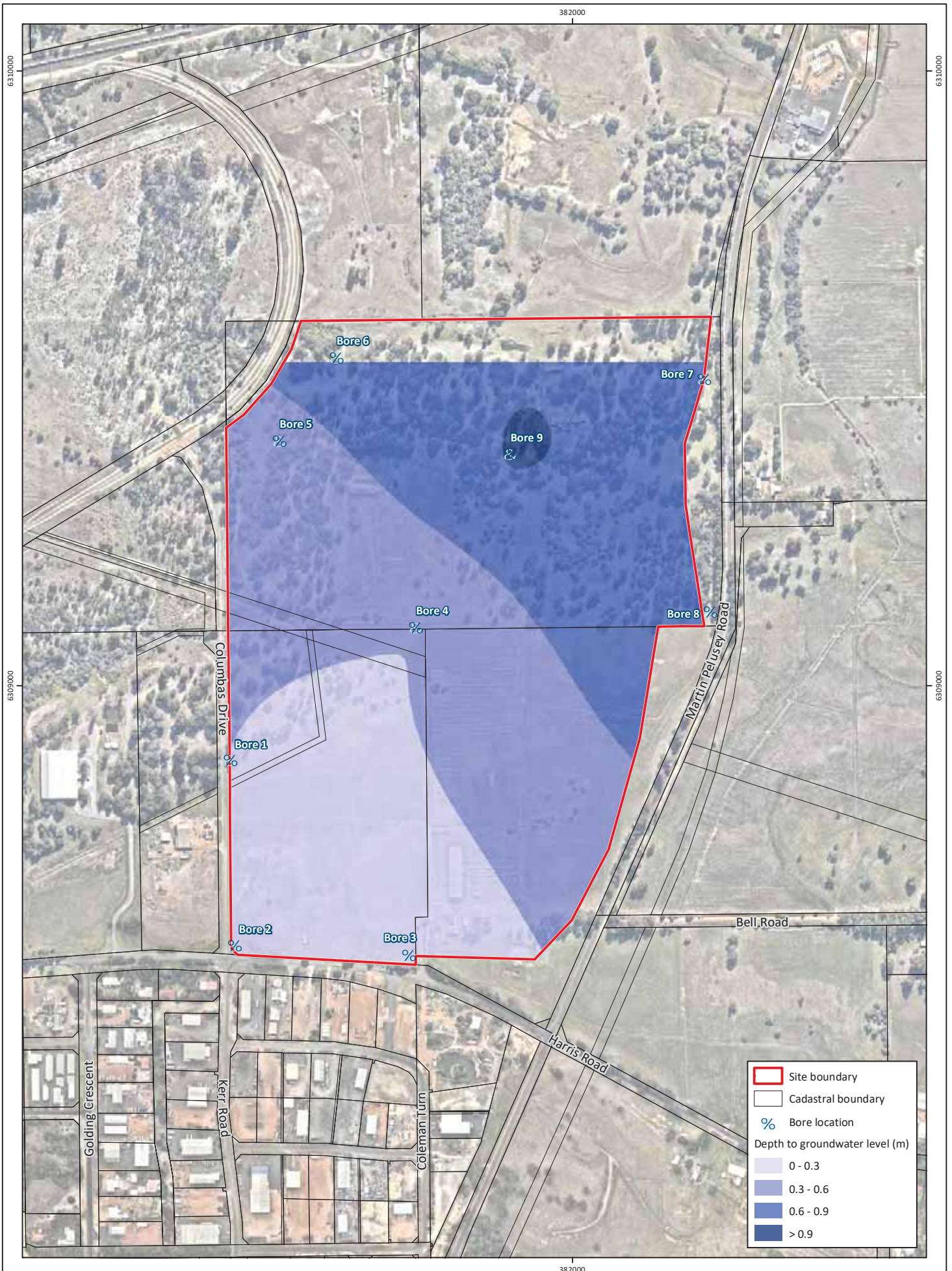
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Local Structure Plan, Lots 103, 110 and 436, Picton East

**Client:** Harris Road Pty Ltd

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**Figure 6: Depth to Maximum Groundwater Level**

**Project:** Local Water Management Strategy  
Local Structure Plan, Lots 103, 110 and 436, Picton East

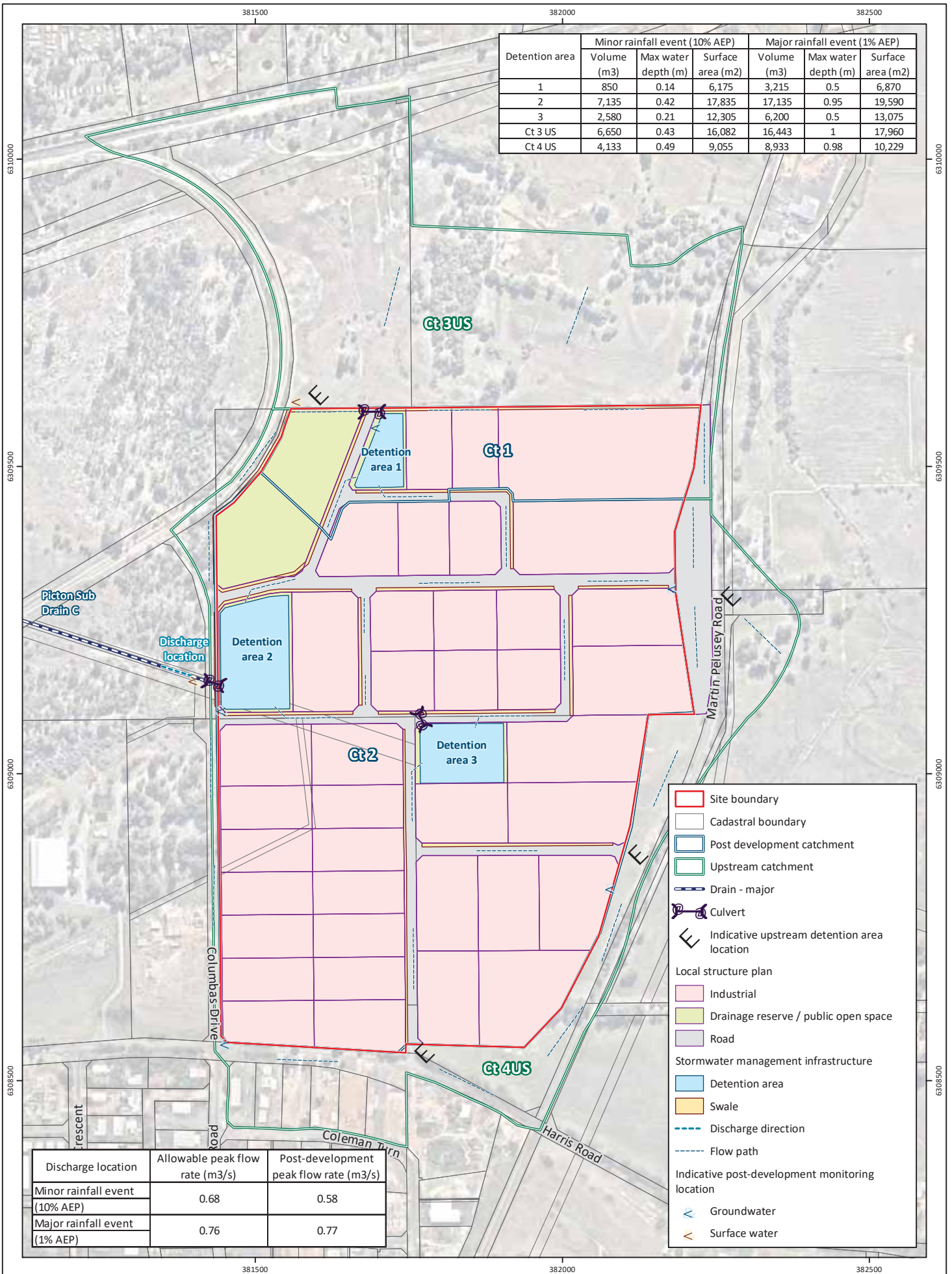
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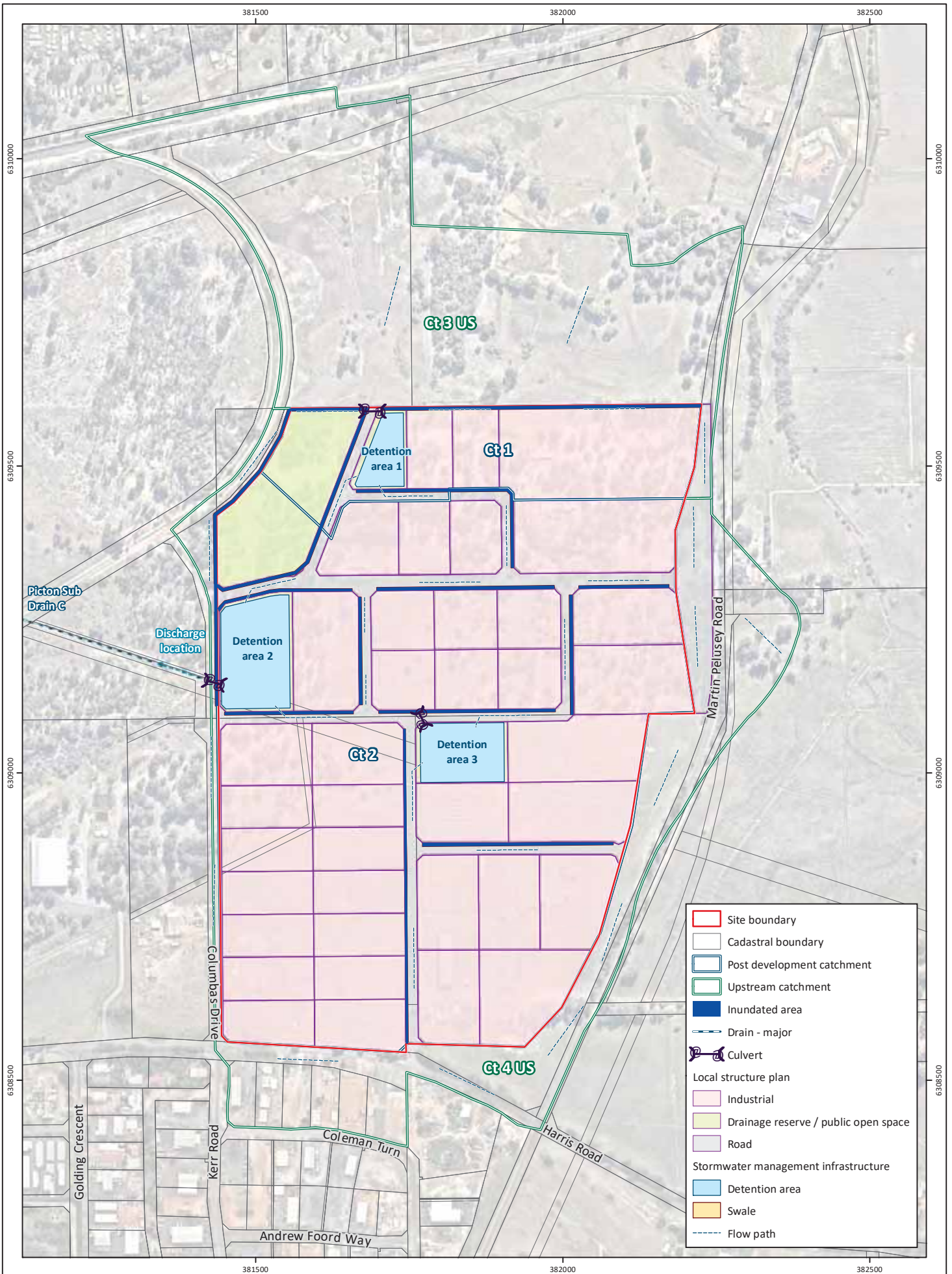
**Figure 7: Stormwater Management Plan**

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Date: 25/01/2021

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**Project:** Local Water Management Strategy  
Local Structure Plan, Lots 103, 110 and 436, Picton East  
**Client:** Harris Road Pty Ltd



**Figure 8: Small Rainfall Event Inundation Mapping**

**Project:** Local Water Management Strategy  
Local Structure Plan, Lots 103, 110 and 436, Picton East

**Client:** Harris Road Pty Ltd

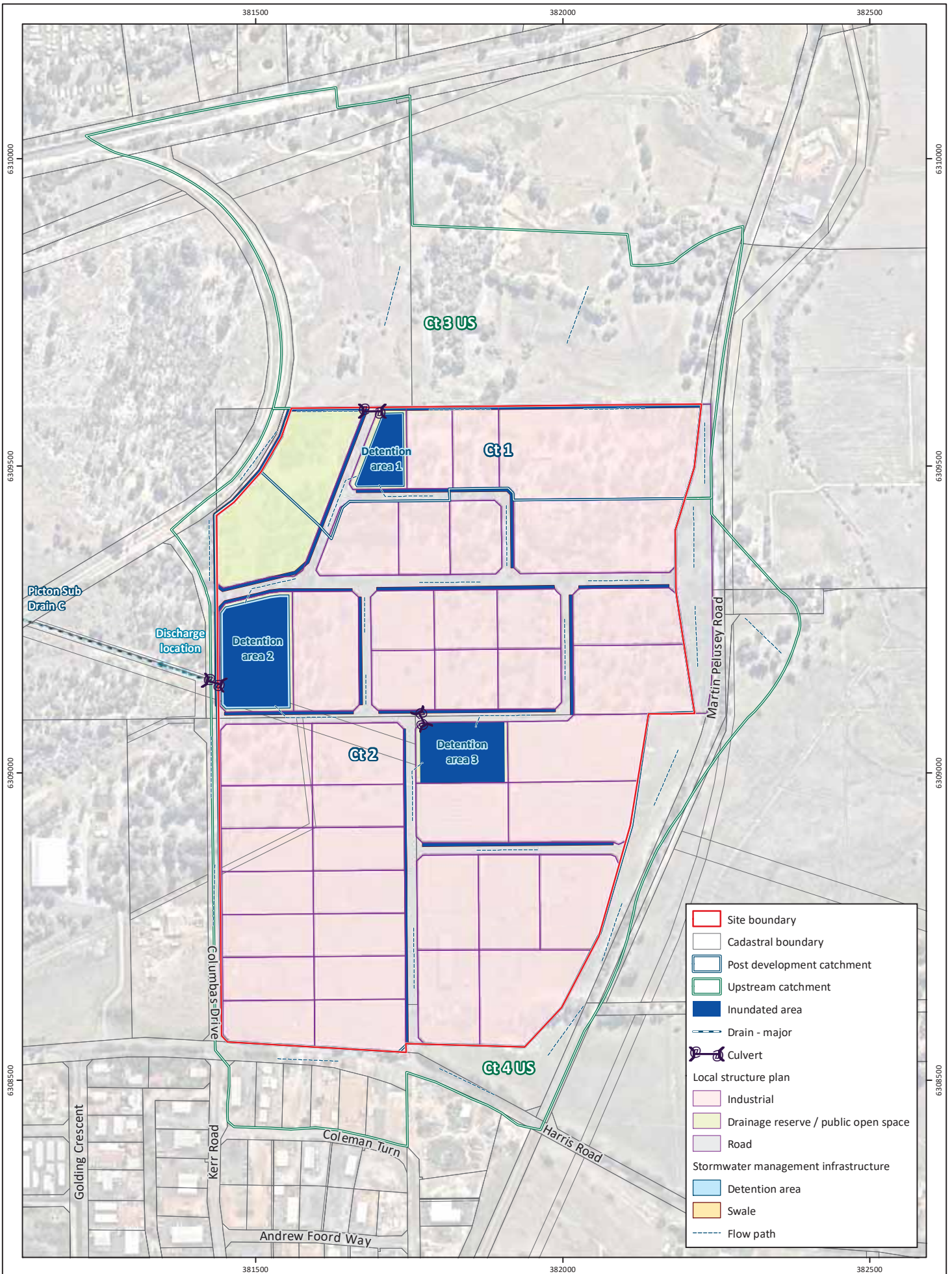
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**Figure 9: Minor Rainfall Event Inundation Mapping**

**Project:** Local Water Management Strategy  
 Local Structure Plan, Lots 103, 110 and 436, Picton East

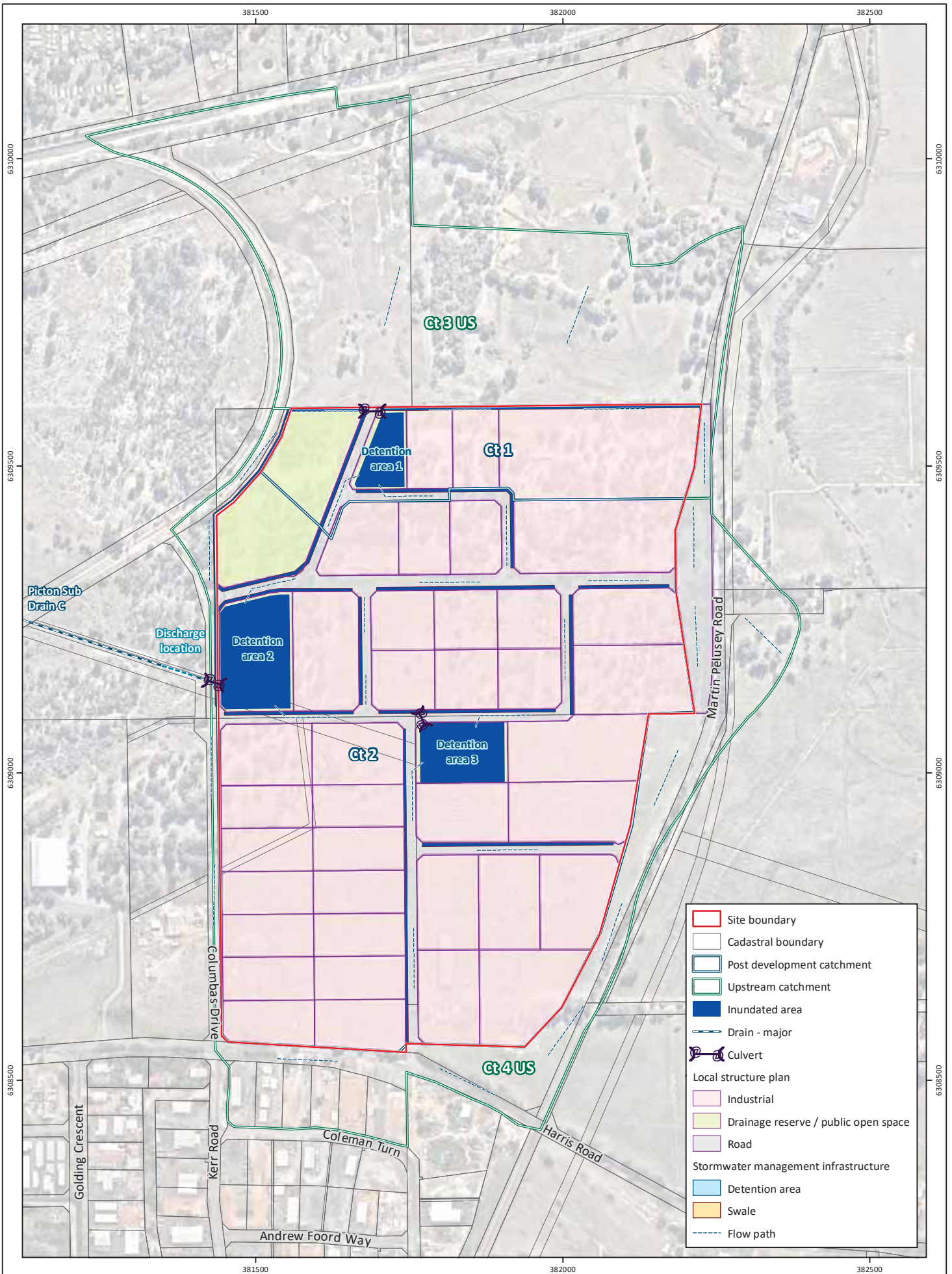
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**Figure 10: Major Rainfall Event Inundation Mapping**

**Project:** Local Water Management Strategy  
Local Structure Plan, Lots 103, 110 and 436, Picton East

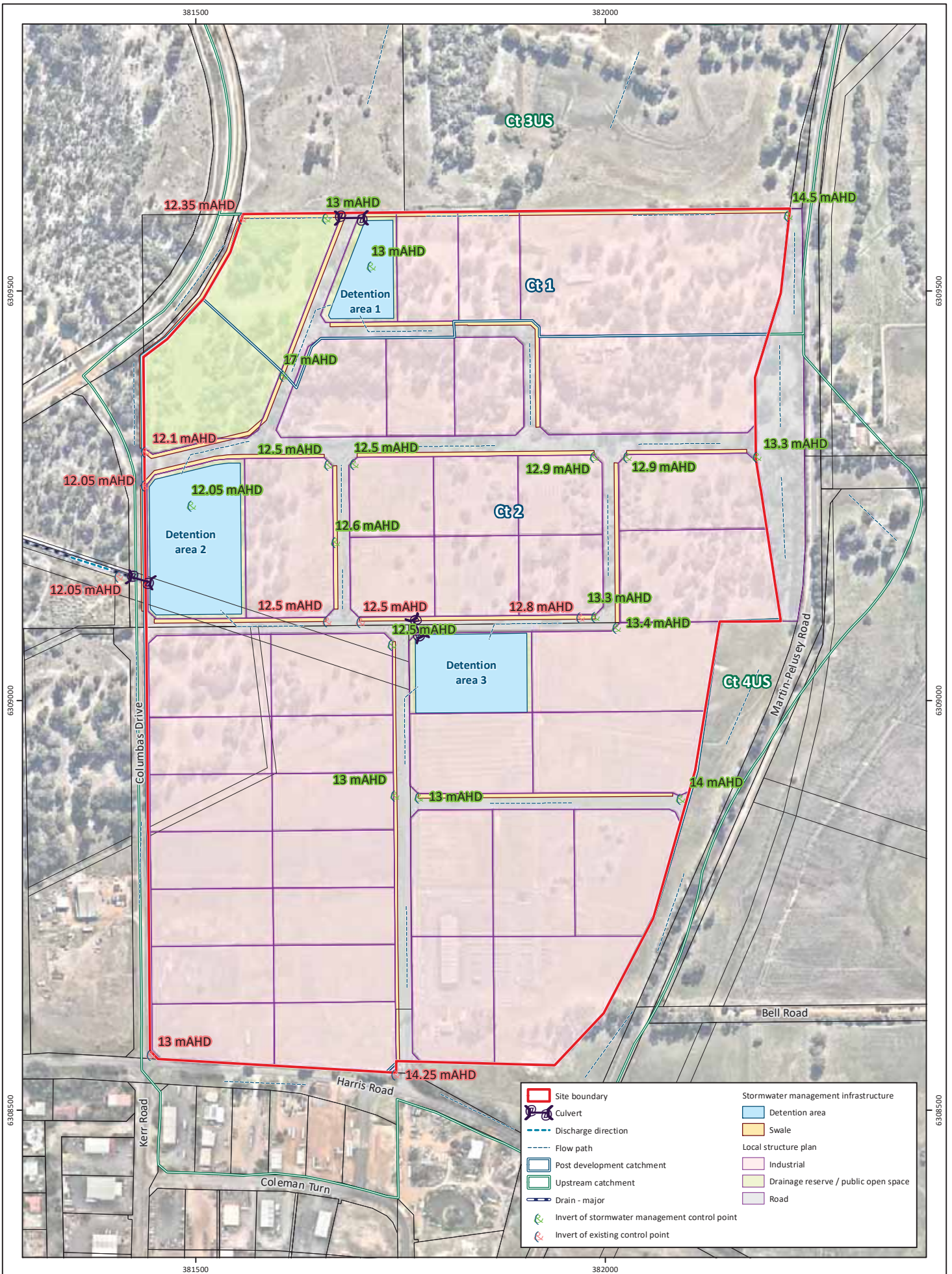
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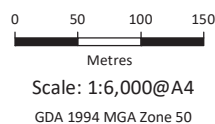


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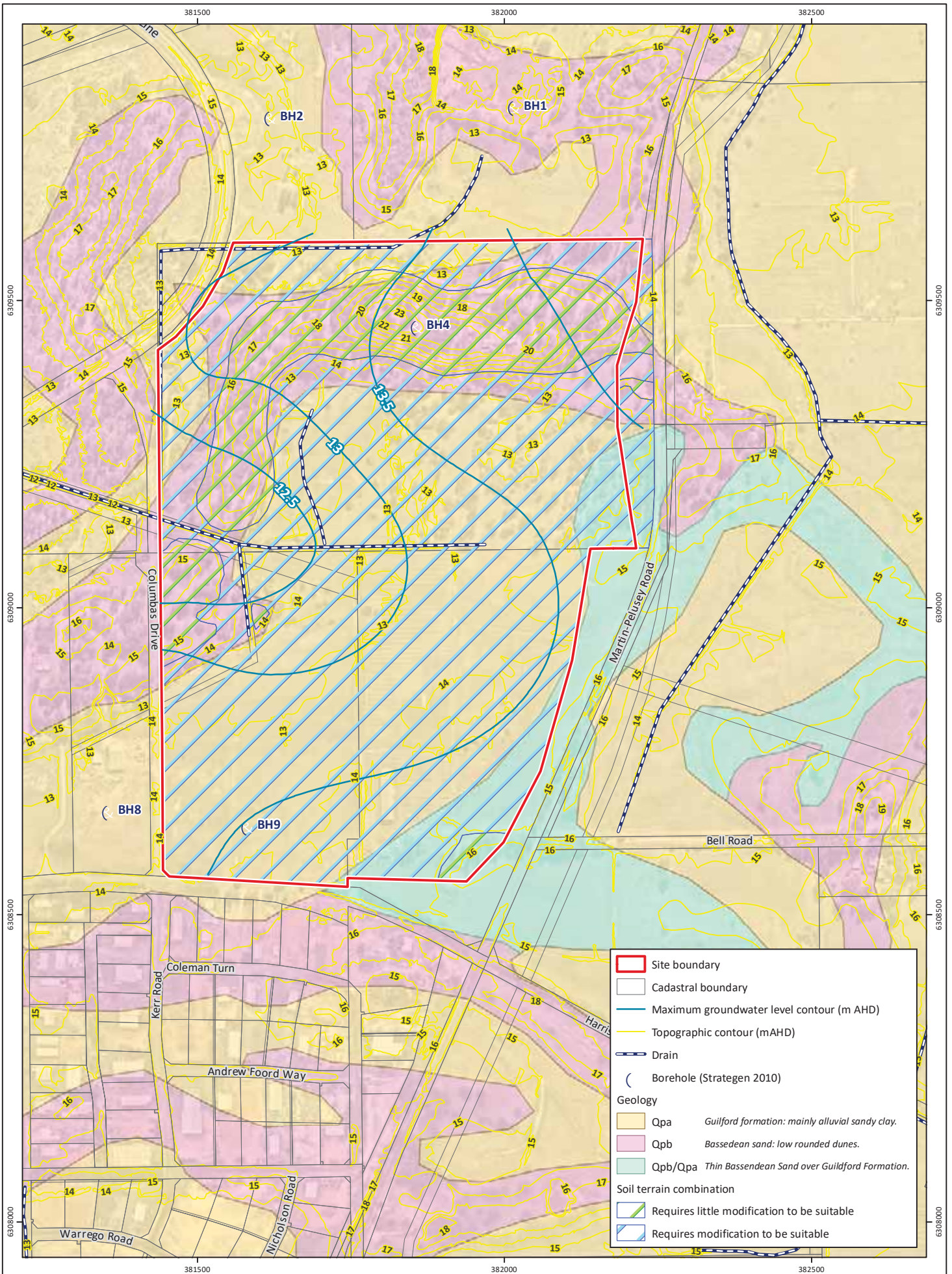


**Figure 11: Critical Control Points Mapping**

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EP12-039(01)--F41b  
Drawn: GAR  
Date: 25/01/2021  
Checked: AJI  
Approved: DPC  
Date: 25/01/2021



**Project:** Local Water Management Strategy  
Local Structure Plan, Lots 103, 110 and 436, Picton East  
**Client:** Harris Road Pty Ltd



**Figure 12: Site and Soil Evaluation Mapping**

Plan Number:  
EP12-039(01)-F42b  
Drawn: GAR  
Date: 25/01/2021  
Checked: AJI  
Approved: DPC  
Date: 25/01/2021

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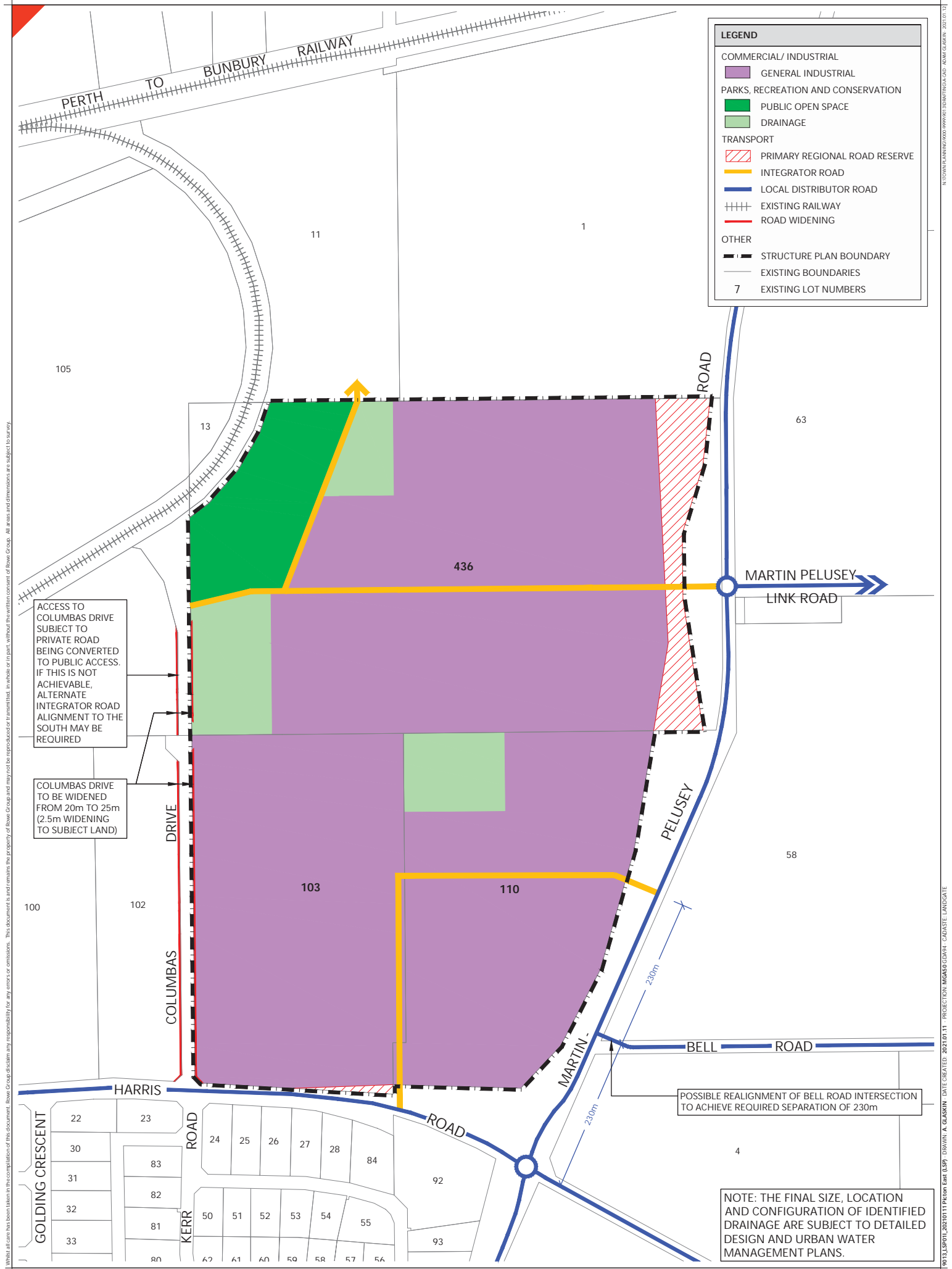


**Project:** Local Water Management Strategy  
Local Structure Plan, Lots 103, 110 and 436, Picton East  
**Client:** Harris Road Pty Ltd

# Appendix A

Local Structure Plan and Concept Plan





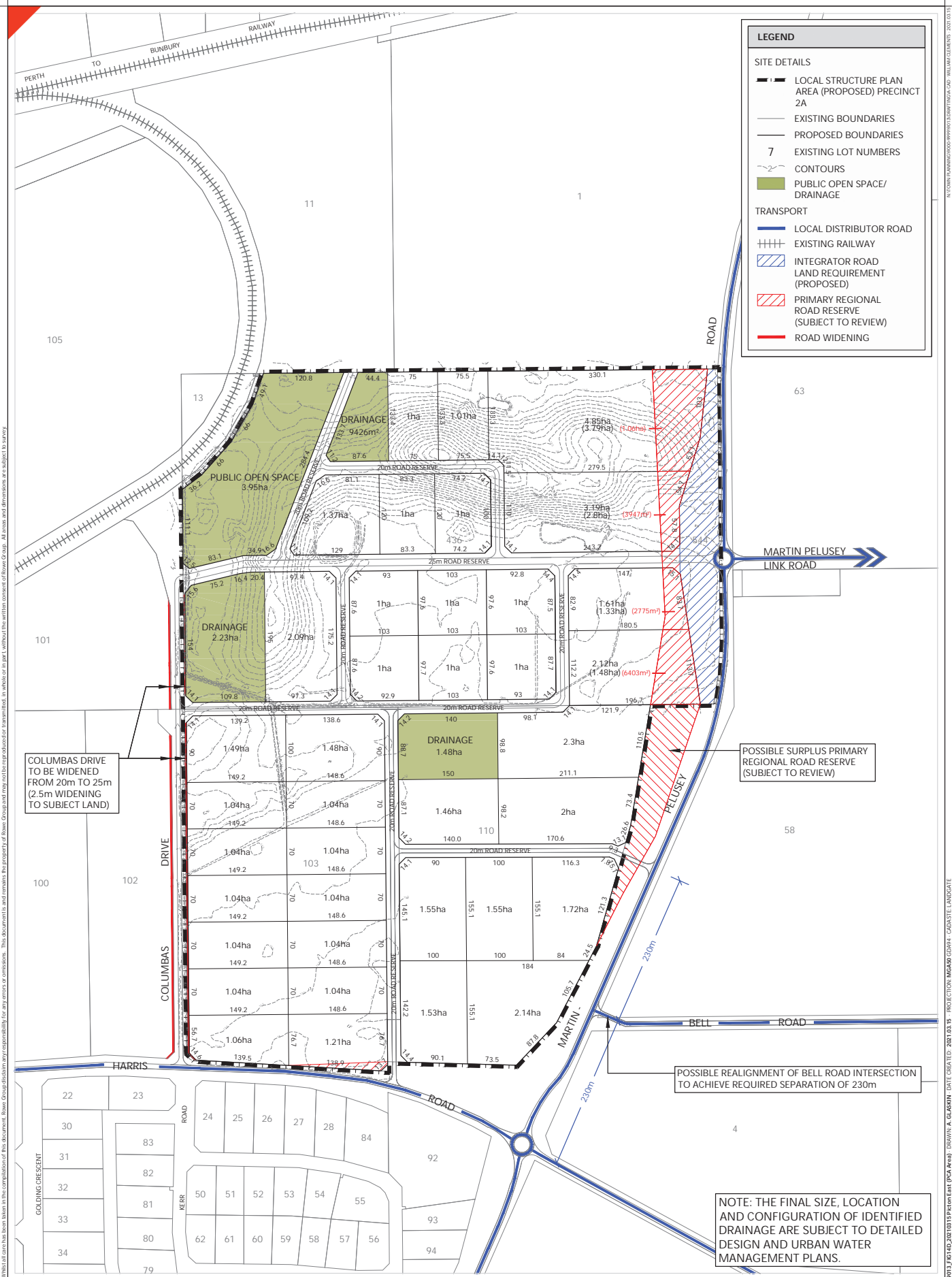
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COMMERCIAL/ INDUSTRIAL	
	GENERAL INDUSTRIAL
PARKS, RECREATION AND CONSERVATION	
	PUBLIC OPEN SPACE
	DRAINAGE
TRANSPORT	
	PRIMARY REGIONAL ROAD RESERVE
	INTEGRATOR ROAD
	LOCAL DISTRIBUTOR ROAD
	EXISTING RAILWAY
	ROAD WIDENING
OTHER	
	STRUCTURE PLAN BOUNDARY
	EXISTING BOUNDARIES
	EXISTING LOT NUMBERS

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N:\DOWN\PLANNING\9000\9999\01\304\STRUCTURE PLAN\9013-LSP-01-I.DWG - CADASTRE - LANDGATE - PROJECTION: MGA80/GDA94 - DATE CREATED: 2023.01.11 - DRAWN: A. GLASNIK - DATE CREATED: 2023.01.11 - PROJECTION: MGA80/GDA94 - CADASTRE - LANDGATE

**LOCAL STRUCTURE PLAN**  
 LOTS 103, 110 AND 436  
 PICTON EAST





**LEGEND**

**SITE DETAILS**

- LOCAL STRUCTURE PLAN AREA (PROPOSED) PRECINCT 2A
- EXISTING BOUNDARIES
- PROPOSED BOUNDARIES
- EXISTING LOT NUMBERS
- CONTOURS
- PUBLIC OPEN SPACE/ DRAINAGE

**TRANSPORT**

- LOCAL DISTRIBUTOR ROAD
- EXISTING RAILWAY
- INTEGRATOR ROAD LAND REQUIREMENT (PROPOSED)
- PRIMARY REGIONAL ROAD RESERVE (SUBJECT TO REVIEW)
- ROAD WIDENING

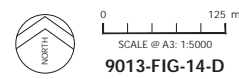
COLUMBAS DRIVE TO BE WIDENED FROM 20m TO 25m (2.5m WIDENING TO SUBJECT LAND)

POSSIBLE SURPLUS PRIMARY REGIONAL ROAD RESERVE (SUBJECT TO REVIEW)

POSSIBLE REALIGNMENT OF BELL ROAD INTERSECTION TO ACHIEVE REQUIRED SEPARATION OF 230m

NOTE: THE FINAL SIZE, LOCATION AND CONFIGURATION OF IDENTIFIED DRAINAGE ARE SUBJECT TO DETAILED DESIGN AND URBAN WATER MANAGEMENT PLANS.

**CONCEPT PLAN (MINIMUM 1HA LOTS)**  
 LOTS 103, 110, 436 AND 544  
 PICTON EAST



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9013-FIG-14-D-20230319-Picton East (PCA Area) DRAWN: A. GLASPER DATE CREATED: 2023.03.15 PROJECTION: MGA84/GDA94 CAWASSEL LANDGATE

# Appendix B

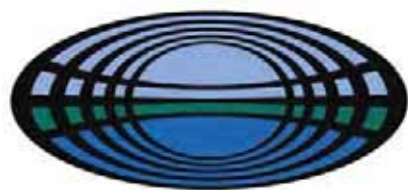
Preliminary Acid Sulphate Soil Investigation





# Preliminary Acid Sulphate Soil Investigation

Picton East, Shire of Dardanup,  
WA



strategen

Prepared for  
TME Group  
by Strategen

May 2010

# **Preliminary Acid Sulphate Soil Investigation**

Picton South – Eastern Sector – Shire of  
Dardanup, WA

Strategen is a trading name of  
Strategen Environmental Consultants Pty Ltd  
Suite 7, 643 Newcastle Street Leederville WA  
ACN: 056 190 419

May 2010

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### **Client: TME Group**

Report	Version	Prepared by	Reviewed by	Submitted to Client	
				Copies	Date
Draft Report	V1	ZC/DD	AP	1	19/5/2010
Final Report	Final	ZC/DD	AP	1	31/5/2010

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2. South West Chemical Services – Field Test Results

## 1. INTRODUCTION

The following report is a Preliminary Acid Sulphate Soil (ASS) Investigation undertaken for a land parcel (the study area) known as the Picton South site (eastern sector), which is bordered by Martin Pelusey Road, Harris Road, Columbas Drive, a section of disused railway line to the south west and the Perth to Bunbury railway line, and is located in the Shire of Dardanup, WA. The study area is proposed to be developed for light commercial use and will incorporate access roads and other services. Strategen was appointed by TME Group to undertake the investigation in order to develop an understanding of any potential ASS issues associated with excavations that may be undertaken within the study area, particularly in association with the provision of power and deep sewage services and stormwater management.

South West Chemical Services (SWCS) was sub-contracted by Strategen to carry out the Preliminary ASS field work, which was conducted on 12 May 2010. Previous investigations carried out to the south west of the study area, opposite Lot 200 Harris Road, showed some evidence of Potential Acid Sulphate Soils (PASS<sup>1</sup>) in a low lying area. In addition, some evidence of Actual Acid Sulphate Soils (AASS<sup>2</sup>) was observed in the upper soil layers and towards the Ferguson River at Lot 51 Martin Pelusey Rd, located to the south of the study area.

### 1.1 OVERVIEW OF STUDY AREA

The study area, as illustrated in Figure 2, comprises approximately 140 ha of low lying land split into seven lots, the majority of which has been cleared for grazing and industrial purposes. Some small pockets of lightly treed, native vegetation have been retained in slightly elevated areas associated with sandy soils. The surface levels range from 12 to 25 m Australian Height Datum (AHD).

#### 1.1.1 Geology and soils

Geological maps for the study area show the site to be underlain by the Guildford Formation, consisting of clay, silt, sand and gravels, with the Bassendean Sands outcropping in some areas. Both the Pinjarra and Bassendean soil systems dominate the study area (Figure 1 – Department of Agriculture 2003). The Pinjarra P2 phase consists of flat to very gently undulating plains with poor to imperfectly drained, deep alkaline mottled, yellow duplex soil, which generally consist of shallow pale sand to sandy loam over clay (Department of Agriculture 2003). The Bassendean B1a phase consists of extremely low to very low relief dunes, undulating sandplain and discrete sand rises where soils are deep bleached grey sands with an intensely coloured yellow B horizon occurring within 1 m of the surface with marri and jarrah vegetation dominating the system (Department of Agriculture 2003).

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<sup>1</sup> Potential acid sulphate soils (PASS) are soils or sediments which contain iron sulphides and/or other sulphidic minerals that have not been oxidised or exposed to air (DoE 2006).

<sup>2</sup> Actual acid sulphate soils (AASS) are soils or sediments which contain iron sulphides and/or other sulphidic minerals that have previously undergone some oxidation to produce sulphuric acid (DoE 2006).

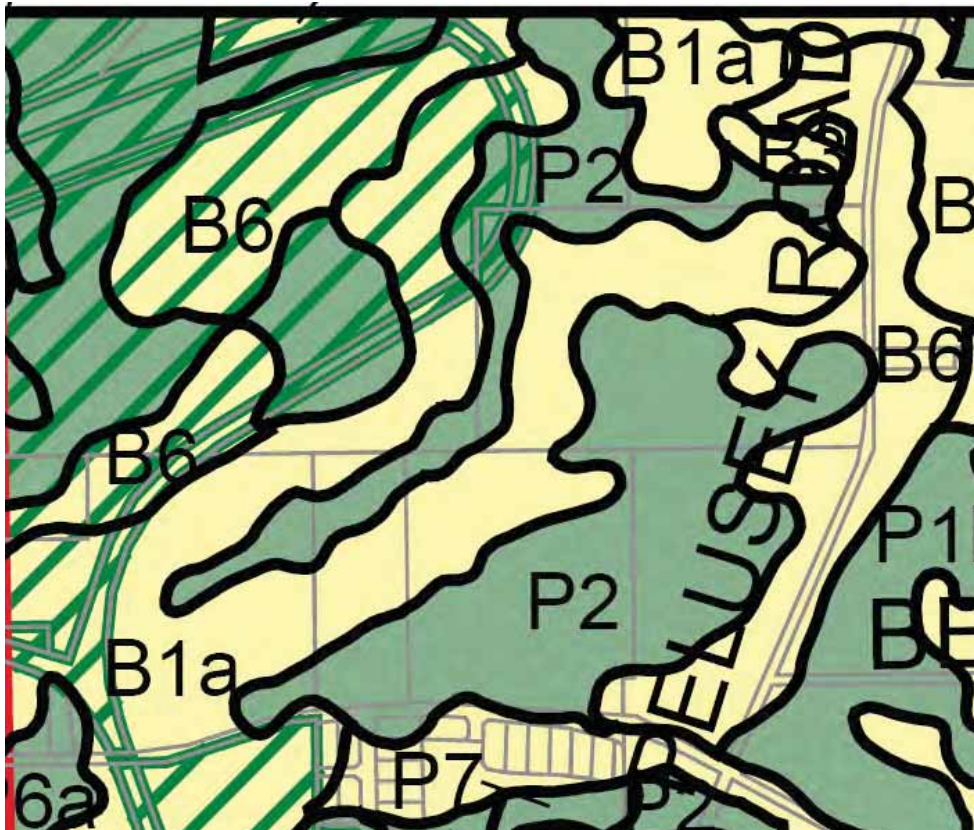


Figure 1 Soil map units within the study area

According to Western Australian Planning Commission (WAPC) Planning Bulletin 64, the site is in an area with a moderate to low risk of AASS and PASS occurring generally at depths greater than 3 m (Appendix 1).

### 1.1.2 Lot descriptions

The study area consists of 7 lots, comprising of:

**Lot 1** – 31.6 ha of low-lying, predominantly cleared land used for horse breeding, with some moderate sized pockets of native vegetation. Part of the Lot appears to be an old sand extraction site and it has a highly modified upper soil layer consisting of predominantly fill material and builder’s rubble.

**Lot 11** – 11.9 ha of low-lying, predominantly cleared land used for horse breeding and training.

**Lot 603** – 39.2 ha consisting of a small, cleared, low-lying area, as well as a large, slightly elevated ridge of remnant native vegetation on sandy soil.

**Lot 103** – 17.1 ha of predominantly cleared, low-lying land with a small pocket of native vegetation to the north-west.

**Lot 2** – 21.2 ha of almost entirely cleared, low-lying land, occupied in part by a shed used for industrial purposes.

**Lot 102** – 6.3 ha of predominantly low-lying land with a slight ridge containing small amounts of vegetation.

**Lot 104** – 8.6 ha of predominantly vegetated, low-lying land with areas containing piles of construction rubble.

## 1.2 SCOPE OF INVESTIGATION

Strategen commissioned South West Chemical Services to undertake the field work component of the Preliminary ASS Assessment of the study area. The intent of the preliminary assessment was to undertake the boring of 10 holes at pre-determined locations on the Lots using a hand auger to the depth of 2.5 m (Figure 2). Bore hole locations were considered representative of the varying elevations, soils and land types within the study area, as well as focussing on areas with a potentially higher risk of ASS. At each of the bored holes, samples were to be collected for analyses at 0.25 m vertical intervals in accordance with the Department of Environment and Conservation (DEC) *Identification and Investigation of acid sulphate soils and acidic landscapes* Guidelines (DEC 2009).

As the study area comprises approximately 140 ha, the Preliminary ASS Assessment does not constitute a full assessment in accordance with DEC Guidelines, but is intended to give an indication as to whether ASS may exist on the site. A full site assessment would entail a total of 280 holes across the full site (i.e. two holes per hectare).



Figure 2 Lot numbers and location of auger holes within the study area

## 2. SOIL SAMPLING

A site visit to undertake the Preliminary ASS investigation was conducted on 12 May 2010. During the initial work it became obvious that it would not be possible to complete 10 sample holes using a hand auger due to the nature of the soils at the study site. A total of six auger holes were sampled to varying depths and soil observations were made (Table 1).

Table 1 Soil observations during hand augering

Hole No.	Lot No.	Observations
8	102	Significant groundwater observed at just less than 1 m below ground level followed by a hard hand auger impenetrable layer at 1 m. The soils generally were light brown or yellow brown of fine to medium grained sands.
9	103	Gave similar results to hole 8 with water observed at 1 m. While no refusal was encountered, the large quantity of groundwater made sample collection at greater than 1.5 m impossible. The soils were generally light brown to grey/brown of fine to medium grained sands to 1 m with clayey sands at lower depths.
5	104	Located near the disused railway line, refusal was experienced at 1 m. No groundwater was encountered but the soil and gravel was damp. The soils were generally brown to yellow /brown sands and gravel.
4	603	Attempted near the maximum elevation of the sand hill that runs across the site roughly from east to west. Samples were collected to a depth of 2.25 m as the dry sand around that depth kept collapsing into the hole and were difficult to retrieve. The soil was very dry yellow sand to the depth of 2.25 m.
2	11	Samples were yielded to a depth of 2.25 m, with groundwater encountered at 1.25 m. Samples could not be collected below 2.25 m as it became increasingly difficult to remove the hand auger. The soils consisted of light brown sand to 0.5 m followed by blue/green/grey sands to 2 m. The sample collected at 2.25 m was grey clay.
1	1	The area appeared to be an old sand extraction site consisting of fill material and builder's rubble. Sampling could not be achieved at 0.25 m due to the presence of coarse builder's rubble. A further sample site was selected but samples could only be achieved to 0.5 m. The sampled soil appeared to be a dark brown sandy top soil.

It was determined that sampling the remaining four auger holes (hole numbers 3, 6, 7 and 10) would not yield sufficiently different results to those already encountered. This was because the location of holes 7 and 10 appeared to be similar in elevation and appearance to the areas sampled at holes 8 and 9, and it was likely that groundwater would be encountered. Similarly the locations of holes 3 and 6 appeared to be similar in elevation and appearance to the areas sampled at holes 4 and 5.

Samples from each of the six auger holes were collected at 0.25 m vertical intervals and immediately placed in sealed bags on ice. The samples were then transported to the SWCS laboratory and were immediately tested for field pH ( $pH_f$ ) and oxidised field pH ( $pH_{fox}$ ). The samples were then dried for 48 hours at 85°C for preservation and storage. The generally negative results from the field test conducted on the six completed holes confirmed the decision not to proceed with further sampling of the remaining four holes.



### 3. SOIL TEST RESULTS

#### 3.1 FIELD TESTING

Details of the field test results are presented in Appendix 2. The field test results were assessed using the following criteria:

- (a)  $pH_f$  less than 4
- (b)  $pH_{fox}$  less than 4 and/or
- (c) the change in pH was greater than 2 (where the resultant  $pH_{fox}$  was less than 4) and/or
- (d) there was a strong reaction following addition of hydrogen peroxide.

The key findings from the field test results were:

- of the 36 samples tested, there were no samples where the  $pH_f$  was 4.0 or less
- of the 36 samples there were two (2) samples where the  $pH_{fox}$  was 4 or less
- of the 36 samples there were no samples that gave a change in pH > 2 units with the  $pH_{fox} < 4.0$
- 1 sample gave a High reaction with the addition of Hydrogen Peroxide
- 3 samples gave an Extreme reaction with gas evolution and heat with the addition of Hydrogen Peroxide
- There appears to be no indication of the presence of PASS at all levels in the samples processed
- There may be an indication of Actual Acid Sulphate soils in samples collected from hole 2, hole 5 and hole 8.

#### 3.2 DETAILED LABORATORY TESTING AND ASSESSMENT

No full laboratory assessment has been carried out at this stage.

#### 4. CONCLUSIONS

Results of the field tests indicate a potential for AASS, particularly in the vicinity of holes 2 and 8 (Lots 11 and 102). Samples exposed to gas evolution and heat with the addition of hydrogen peroxide produced an extreme reaction in three samples at depths of 1.75 – 2.25 m for hole 2, and a high reaction in one sample at a depth of 0.75 m for hole 8. In addition, potential for AASS may also occur in the vicinity of hole 5 (Lot 104), where two surface samples (0.25 – 0.5 m) experienced a  $\text{pH}_{\text{fox}}$  of 4 or less. However, there appears to be no indication of the presence of PASS at all levels in the samples processed from these holes.

The overall results of the Preliminary ASS Investigation are limited due to the low number of samples collected using a hand auger. This outcome is the result of the soil types encountered within the study area and the presence of groundwater close to the surface in some locations. In the event that any future studies are undertaken, more accurate results at depth may be obtained using equipment such as Geoprobe boring or an excavator.

For a thorough indication of the potential for ASS within the study area, a more detailed investigation that follows full DEC guidelines is recommended for areas where field tests indicated a potential for ASS (in the vicinity of holes 2, 8 and 5), as well as areas of similar soil characteristics that weren't sampled during the site investigation. To obtain a detailed assessment of ASS potential within the entire study area, a full investigation aligning with DEC requirements (i.e. two holes per hectare across the entire site) would need to be undertaken.

## 5. REFERENCES

Department of Agriculture WA (2003), *AgMaps Land Profiler*, Sheet 1 – Shire of Capel, CD-ROM, Government of Western Australia.

Department of Environment and Conservation (January 2009), *DRAFT Treatment and management of soils and water in acid sulphate soil landscapes*, Acid Sulphate Soils Guideline Series, Government of Western Australia.

Department of Environment and Conservation (May 2009), *Identification and Investigation of acid sulphate soils and acidic landscapes*, Acid Sulphate Soils Guideline Series, Government of Western Australia.

Queensland Department of Natural Resources, Mines and Energy (Qld NRM&E) (June 2004), *Acid Sulphate Soils, Laboratory Methods Guidelines*, Version 2.1 – Joint project of Queensland Acid Sulphate Soils Investigation Team (QASSIT), Southern Cross University (SCU), National Committee for Acid Sulphate Soils (NatCASS), Queensland Acid Sulphate Soils Management Advisory Committee (QASSMAC) and New South Wales Acid Sulphate Soils Management Advisory Committee (ASSMAC).

Western Australian Planning Commission (November 2003), *Acid Sulfate Soils*, Planning Bulletin Number 64, Figure 8: Australind – Bunbury Acid Sulfate Soils, Western Australia.

**Appendix 1  
Planning Bulletin  
Number 64: Australind –  
Bunbury Acid Sulphate  
Soils**

**Appendix 2  
South West Chemical  
Services – Field Test  
Results**



## Certificate of Analysis

Client Name:	Strategen Attn: Roger Banks		
Address:	PO Box 287, Bunbury, WA 6231		
Phone No:	9792 4797	Fax:	9792 4708
Lab No:	4918	Email:	r.banks@strategen.com.au
Date samples received:	12/05/10	Report date:	14/05/10

**Sample details:** 36 Soil samples collected David Dodds and Zac Cockerill from 6 bore holes drilled using a hand auger at a site near the corner Harris Rd and Martin Pelusey Rd Dardanup, WA  
The site is in an area of Moderate to Low risk of ASS occurring within 3 m of the natural soil surface.  
Hole 1 Location GPS coordinates 50H 0382014 6309818 depth to 0.5 m  
Hole 2 Location GPS coordinates 50H 0381617 6309801 depth to 2.25 m  
Hole 4 Location GPS coordinates 50H 0381856 6309461 depth to 2.25 m  
Hole 5 Location GPS coordinates 50H 0381146 6309216 depth to 1.0 m  
Hole 8 Location GPS coordinates 50H 0381353 6308671 depth to 1.5 m  
Hole 9 Location GPS coordinates 50H 0381580 6308647 depth to 1.5 m  
Samples were immediately placed on ice and transferred to refrigerated storage.  
A portion of the sample was removed for Field pH ( $pH_f$ ) and oxidised Field pH ( $pH_{fox}$ ), the remainder has been preserved by drying for 48 hours at 85°C

**Scope of Work:** Acid Sulphate Soils Field Tests  $pH_f$ ,  $pH_{FOX}$ , Reaction rating, Fizz test  
Preservation of retained samples, Interpretation of results.

**Test Methods:** Acid Sulphate Soils Laboratory Methods Guidelines Version 2.1 Section H:Field Tests June 2004, Queensland Government, Natural Resources, Mines and Energy.  
Draft Identification & Investigation of Acid Sulphate Soils, prepared by Land & Water Quality Branch, DoE, WA May 2006  
 $pH$  tested using Eutech WP pHScan BNC with Ionode Intermediate Junction  $pH$  combination electrode IJ48F calibrated according to manufacturer's instructions.

### Test Results:

The field test results were assessed using the following criteria

- $pH_f$  less than 4
- $pH_{fox}$  less than 4 and /or
- the change in  $pH$  was greater than 2 (where the resultant  $pH_{fox}$  was less than 4) and/or
- there was a strong reaction following addition of hydrogen peroxide

Results meeting these criteria have been highlighted.

Of the 36 samples tested, there were no samples where the  $pH_f$  was 4.0 or less

Of the 36 samples there were 2 sample where the  $pH_{fox}$  was 4 or less

Of the 36 samples there were no samples that gave a change in  $pH > 2$  units with the  $pH_{fox} < 4.0$

1 sample gave a High reaction with the addition of Hydrogen Peroxide, 3 samples gave an Extreme reaction with gas evolution and heat with the addition of Hydrogen Peroxide.

*'Actual acid sulphate soils (AASS) are soils or sediments which contain iron sulphides and/or other sulphidic minerals that have previously undergone some oxidation to produce sulphuric acid.'* (DoE 2006)

*'Potential acid sulphate soils (PASS) are soils or sediments which contain iron sulphides and/or other sulphidic minerals that have not been oxidised or exposed to air.'* (DoE 2006)

There appears to be a no indication of the presence Potential Acid Sulphate soils at all levels in the samples processed.

There may be an indication of Actual Acid Sulphate soils in the samples collected from Hole 2 at 250 mm depth, Hole 5 at 250 mm and 500 mm depth.

All samples are being dried at 85°C for 48 hours.

If you have any further questions relating to this report and its interpretation please telephone South West Chemical Services on 08 9721 7170

David Dodds

Dip.App.Chem. A.G.Inst.Tech

Lab No: 4918  
 Hole No: Bore Hole 1  
 Hole Depth: 0.50 metre

Date Sampled: 12/05/10  
 Location: 0382014E  
 6309818N

Hole ID	Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
1	0.25	fine dark brown sandy top soil	7.45	5.85	1.60	L	N
	0.50	orange brown fine to med grained sand	7.95	6.15	1.80	M	XX

Reaction Rating N = none L = low M = medium H = high X = extreme V = volcanic

N - no visible or audible reaction, X - slight reaction, XX - moderate reaction, XXX - high reaction, XXXX - vigorous reaction, gas evolution, heat generation



Lab No: 4918  
 Hole No: Bore Hole 2  
 Hole Depth: 2.25 metre

Date Sampled: 12/05/10  
 Location: 0381617E  
 6309801N

Hole ID	Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
2	0.25	light brown fine to medium grained sand	4.95	4.40	0.55	L	N
	0.50	light brown fine to medium grained sand	5.85	4.90	0.95	L	N
	0.75	blue/grey/green and brown sand - damp	6.75	5.05	1.70	N	N
	1.00	blue/grey/green and brown sand + gravel - damp	6.75	4.75	2.00	N	N
	1.25	blue/grey/green sand - wet	6.95	6.05	0.90	L	N
	1.50	blue/green/yellow sand - wet	7.55	6.80	0.75	L	N
	1.75	blue/green/grey sand - wet	7.65	7.95	-0.30	X	N
	2.00	blue/green/grey sand - wet	7.65	7.90	-0.25	X	N
	2.25	grey clay	6.90	7.50	-0.60	X	N

Reaction Rating N = none L = low M = medium H = high X = extreme V = volcanic

N - no visible or audible reaction, X - slight reaction, XX - moderate reaction, XXX - high reaction, XXXX - Vigorous reaction, gas evolution, heat generation

Lab No: 4918  
 Hole No: Bore Hole 4  
 Hole Depth: 2.25 metre

Date Sampled: 12/05/10  
 Location: 0381856E  
 6309461N

Hole ID	Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
4	0.25	brown/yellow fine sand	7.00	5.40	1.60	L	N
	0.50	yellow fine to med grained sand	7.20	5.35	1.85	L	N
	0.75	yellow fine to med grained sand	7.30	5.30	2.00	L	N
	1.00	yellow fine to med grained sand	7.25	5.25	2.00	L	N
	1.25	yellow fine to med grained sand	7.20	5.30	1.90	N	N
	1.50	yellow fine to med grained sand	7.30	5.25	2.05	L	N
	1.75	yellow fine to med grained sand	7.40	5.25	2.15	L	N
	2.00	yellow fine to med grained sand	7.35	5.25	2.10	L	N
	2.25	yellow fine to med grained sand	7.40	5.25	2.15	L	N

Reaction Rating N = none L = low M = medium H = high X = extreme V = volcanic

N - no visible or audible reaction, X - slight reaction, XX - moderate reaction, XXX - high reaction, XXXX - Vigorous reaction, gas evolution, heat generation

Lab No: 4918  
 Hole No: Bore Hole 5  
 Hole Depth: 1.00 metre

Date Sampled: 12/05/10  
 Location: 0381146E  
 6309216N

Hole ID	Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
5	0.25	dark brown silty sand	4.60	pH <sub>H2O2</sub> =4.95 4.00	0.60	L	N
	0.50	brown fine to med grained sand + gravel	4.95	3.90	1.05	N	N
	0.75	yellow/brown fine to med grained sand + gravel - damp	5.95	5.05	0.90	L	N
	1.00	yellow/brown fine to med grained sand + gravel - damp	6.30	5.15	1.15	N	N

Reaction Rating N = none L = low M = medium H = high X = extreme V = volcanic  
 N - no visible or audible reaction, X - slight reaction, XX - moderate reaction, XXX - high reaction, XXXX - Vigorous reaction, gas evolution, heat generation

Lab No: 4918  
 Hole No: Bore Hole 8  
 Hole Depth: 1.50 metre

Date Sampled: 12/05/10  
 Location: 0381353E  
 6308671N

Hole ID	Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
8	0.25	light brown fine – medium grained sand	5.70	4.25	1.45	L	N
	0.50	light brown fine to medium grained sand	6.55	5.50	1.05	N	N
	0.75	light brown/yellow fine to medium grained sand - damp	7.10	6.60	0.50	H	N
	1.00	brown/yellow fine – medium grained clayey sand - wet	7.40	6.95	0.45	M	N
	1.25	brown/yellow fine – medium grained clayey sand - wet	7.40	6.35	1.05	L	N
	1.50	brown/yellow/grey sand - wet	7.20	6.30	0.90	L	N

Reaction Rating N = none L = low M = medium H = high X = extreme V = volcanic

N - no visible or audible reaction, X – slight reaction, XX – moderate reaction, XXX – high reaction, XXXX – Vigorous reaction, gas evolution, heat generation

Lab No: 4918  
 Hole No: Bore Hole 9  
 Hole Depth: 1.50 metre

Date Sampled: 12/05/10  
 Location: 0381580E  
 6308647N

Hole ID	Depth m	Soil Texture	pHf	pHfox	pHf - pHfox	Reaction	Fizz Test
9	0.25	light brown/grey fine – medium grained sand	6.20	4.75	1.75	N	N
	0.50	grey/brown fine to medium grained sand	7.00	5.30	1.70	L	N
	0.75	brown fine to medium grained sand - damp	6.95	5.50	1.45	L	N
	1.00	grey/brown fine – medium grained sand - damp	6.65	5.35	1.30	N	N
	1.25	orange/brown fine – medium grained clayey sand - wet	5.70	4.50	1.20	L	X
	1.50	grey clayey sand - wet	6.50	4.75	1.75	L	N

Reaction Rating N = none L = low M = medium H = high X = extreme V = volcanic

N - no visible or audible reaction, X – slight reaction, XX – moderate reaction, XXX – high reaction, XXXX – Vigorous reaction, gas evolution, heat generation

# Appendix C

Surface Runoff Modelling from DWMS



### 3.7.3 Pre-Development Design Flows

#### Internal

Estimated pre-development design flows for the 1% AEP (Annual Exceedance Probability) storm event was calculated using the XPSWMM modelling package. LIDAR and site information were used to determine the boundaries of 12 catchments for the subject land (See Figure 7). Table 3 presents the design flows from each catchment and Figure 7 shows the drainage across the subject land. A detailed assessment with refined model assumptions and inputs will be required at the LWMS and UWMP stages.

Modelling assumptions include:

- A roughness coefficient ('n') of 0.4 for pervious areas, based on land cover and high responsiveness of groundwater to rainfall.
- Catchment grade determined by LIDAR data.
- Impervious area % determined by aerial photography.
- An initial loss of 10 mm assumed for all catchments to account for initial infiltration within the catchment.
- Based on LIDAR analysis, Catchments A, B and E were found to have no outlet. Stormwater generated within these catchments is currently retained on site.
- Predevelopment modelling for Catchment L was not completed as the catchment is currently constructed to final design.

Catchment	Area (ha)	1% AEP Impervious Area (%)	1% AEP Design Flow (m <sup>3</sup> /s)	Receiving Waterway	Total Flow (m <sup>3</sup> /s)
A	15.00		No outflow from Catchment		
B	9.05				
C	13.50	15	0.129	Vindicative Main Drain	0.300
D	20.75	30	0.171		
E	19.90		No Outflow from Catchment		
F	176.80	30	1.091	Picton Main Drain	2.051
G	155.40	30	0.960		
H	41.70	50	0.744		
I	36.85	50	0.690		
J	17.20	30	0.622	Ferguson River	2.542
K	36.70	35	0.486		
L	63.70		Excluded from model as catchment is constructed to final design		
Total	606.55	-	4.893	-	4.893

Table 3: Catchment Areas and 10% and 1% AEP flow rates

#### External

The estimated inflow from the Preston Industrial Park (Northern Precinct), north of the South Western Hwy is 0.384 m<sup>3</sup>/s in the peak 1% AEP storm event. The report is included in the CD of Attachments.

The peak 1% AEP upstream flow from the Ferguson River will be reported in the DWER's DWMP. As part of the Picton South DSP, some development is proposed within the preliminary floodplain extent shown on Figure 7. However, at the LSP stage proponents will have to demonstrate that the flood regime of the general area is not detrimentally impacted. A review of the proposed stormwater management design will need to be completed as part of any future LWMSs fronting the Ferguson River.

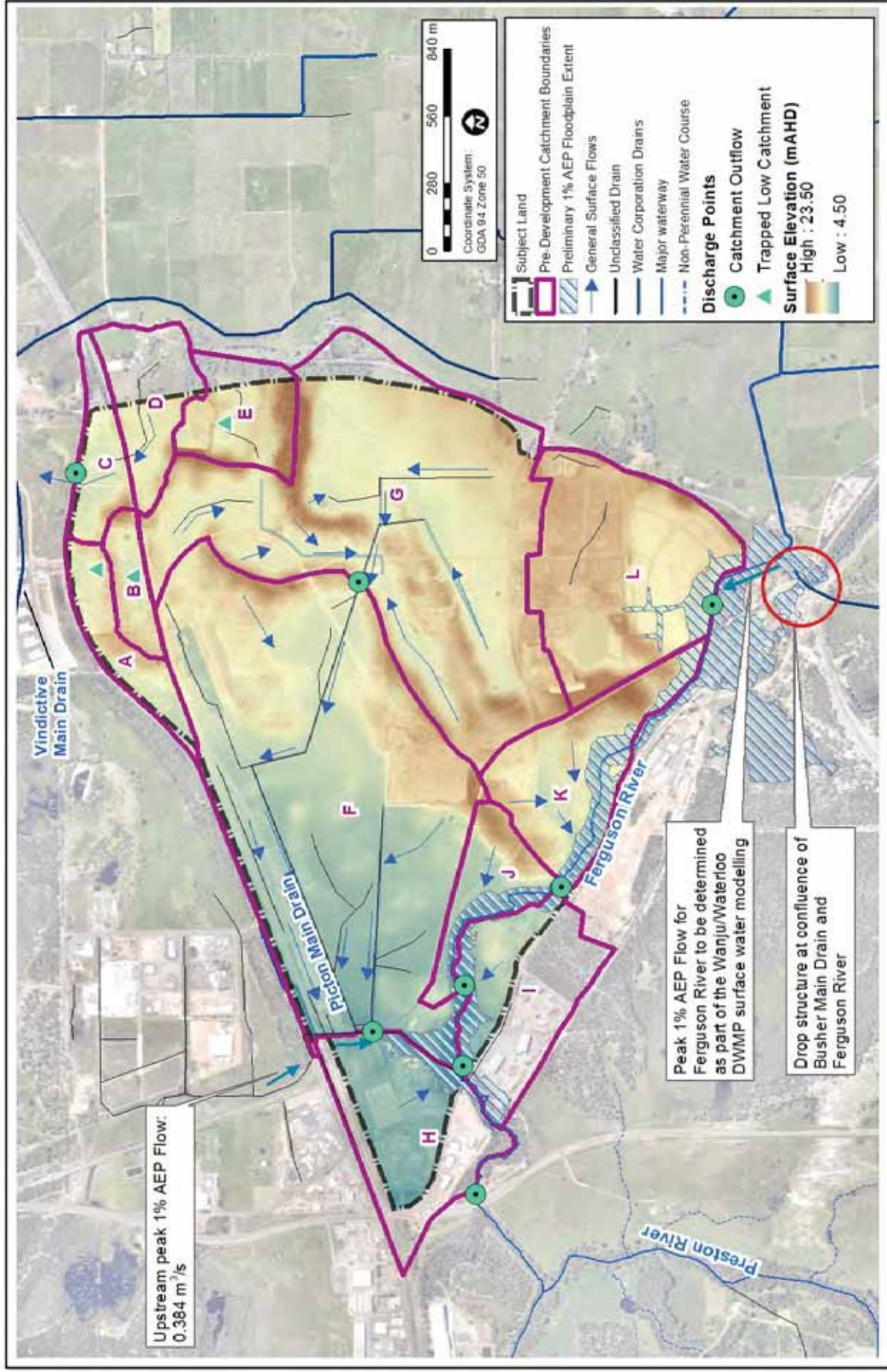


Figure 7 - Pre-Development Stormwater Modelling



## 4. SURFACE WATER DRAINAGE MANAGEMENT STRATEGY

The key objectives for surface water management are:

- Protection of key wetlands and waterways from the impacts of industrial runoff
- Protection of infrastructure, human life and assets from flooding and inundation

### 4.1 SURFACE WATER QUANTITY MANAGEMENT

Urbanisation results in increases impervious area. Increased rates and volumes of stormwater runoff must be managed to protect infrastructure, environment and assets from flooding and inundation. Stormwater management must also provide water treatment measures to prevent contamination of the downstream environment.

Surface water quantity design objectives are as follows:

#### Stormwater Flows

- Management of post-development flows to match the pre-development scenario up to the critical 1% AEP storm event.
- Identified external flows to be managed within the subject land. Upstream flows within the Ferguson River will be reported with DWER's DWMP for the area. Preliminary floodplain mapping has been provided by DWER, as shown on Figure 10.
- In the post-development scenario, all trapped low catchments will merge with catchments that have an outflow connection. The peak outflow at this point will not increase as a result of the merge and will be detained to the pre-development peak 1% AEP flow rate at this point. Storages and flows across each catchment will be sized on a pro-rata basis, determined by modelling results presented in Table 5.

#### Stormwater Detention and Conveyance

- A combination of detention swales and basins may be used throughout the DSP area, with outflows controlled to peak pre-development flow rates. Indicative locations are shown on Figure 10, however these may be modified or split depending on how individual lots are developed.
- The internal road network will be used to convey peak 1% AEP flows through the subject land via overland flow, in conjunction with the pipe and swale network.
- Piped drainage within the road network will be used to convey the 10% AEP storm event.

#### Infrastructure Protection Measures

- Should any proportion of the proposed industrial lots be used for floodplain storage, local authorities will have to monitor and regulate surface levels as the planning process progresses.
- All finished floor levels are to be set a minimum of 300mm above the adjoining road level and flood levels generated within the LSP areas. Building pad levels are to also be a minimum 500mm above the 1% AEP flow level of the subject land's major waterways and flow channels/swales, such as the Ferguson River and Picton Main Drain.
- Industrial lots are required to retain 2m<sup>3</sup> of storage per 65m<sup>2</sup> of hardstand area. A piped lot connection trickle outlet may be provided to the street drainage network, with the rate of discharge assumed to be inline with maximum emptying presented in the DWER's stormwater manual, roughly 1L/s/ha. Where possible the storage area can also form part of the on lot landscaping. Local authority guidelines are provided in the CD of attachments.

#### Waterway and Wetland Management

- The Ferguson River consists of a small defined channel and flat surrounding floodplain with the current modelled flood extent shown on Figure 10. Final upstream peak flows within the Ferguson River will be reported in DWER's DWMP for the area.
- Modifications may be made to the Picton Main Drain and internal swale/ drainage channels, provided all modifications can be demonstrated to have no adverse impacts to the upstream or downstream environment. This may include revegetation and basic re-shaping in line with the Water Corporation's 'Drainage for Inhabitability' guidelines.
- Critical wetlands (Identified in Section 3) and the Ferguson River foreshore will be retained and rehabilitated, as part of the Picton DSP development. The extent of revegetation will be defined further in corresponding foreshore management plans. A conceptual Foreshore Management Plan has been completed and is described in Section 7.3.2.

### 4.1.1 Post-Development Stormwater Modelling

Indicative post-development catchment boundaries, discharge points and basin areas are shown in Figure 10. Catchment boundaries were estimated using the Picton South DSP layout, in conjunction with pre-development catchment boundaries.

Post-development modelling was completed using the XPSWMM modelling package. The peak 1% AEP allowable discharge rates presented in Table 5 were estimated based on pre-development catchment boundaries and a pro-rata analysis of intersected post-development catchments. The Columbus Drive development (Figure 10) has utilised the approved peak 1% AEP outflow rate of 0.511 m<sup>3</sup>/s.

Indicative Detention basins for each post-development catchment were sized based on the peak 1% AEP allowable discharge rate. Subsequently the peak 10% AEP outflow rates were calculated as a result of sizing the detention storage basins. Modelling assumptions are as follows:

- The assumed post-development land use breakdown for each catchment is 20% roads, 75% Industrial Lots and 5% drainage/ other.
- The overall peak 1% AEP flow rate has increased by 0.217 m<sup>3</sup>/s which is wholly within the Picton Main Drain Catchment. This is due to the higher flows used within the approved Columbus Drive LWMS.
- Industrial lots are assumed to consist of 90% hardstand area.
- Industrial lots modelled with a 13.8mm initial loss, which roughly equates to 2m<sup>3</sup> of storage per 65m<sup>2</sup> of hardstand area.
- Roads assumed to be 90% impervious and drainage/other assumed to be 30%. Both land uses are not assumed to have an initial loss.
- Detention basins have been sized based on 1:6 side slope, 1% AEP water depth of 1.0m with the basin outlet set at the base of the basin.
- Modelling was not completed for Precinct 4 as the area has been subdivided and constructed to final design. Outflow from Precinct 4 is currently directed towards the Ferguson River and does not impact other Precincts.
- The peak 1% AEP outflow from Catchments Cat3, Cat4 and Cat5 are detained to match design inflows identified in the Lot 105 Columbus Drive LWMS of 1.16 m<sup>3</sup>/s. This peak outflow is slightly higher than the pro-rata outflow identified in Section 3.

Catchment	Area (ha)	1% AEP Flow (m <sup>3</sup> /s)	1% AEP Required Storage Volume (m <sup>3</sup> )	10% AEP Flow (m <sup>3</sup> /s)	10% AEP Required Volume (m <sup>3</sup> )	Receiving Waterway	Total 1% AEP Flow (m <sup>3</sup> /s)	
Cat1	37.50	0.128	20,460	0.091	13,960	Vindictive main Drain	0.300	
Cat2	21.90	0.172	11,245	0.113	8,790			
Cat3	72.80	0.473	30,985	0.457	19,665			
Cat4	45.15	0.295	22,660	0.231	15,740			
Cat5	60.05	0.391	27,565	0.362	17,470			
Cat6	63.35	0.465	As per approved Lot 105 Columbus Drive LWMS			Picton Main Drain	2.270	
Cat7	22.35	0.140	10,620	0.119	7,175			
Cat8	81.65	0.506	39,170	0.433	25,725			
Cat9	47.00	0.776	12,330	0.624	7,715			
Cat10	18.50	0.348	4,365	0.316	2,660			
Cat11	18.35	0.342	6,900	0.309	2,430			
Cat12	15.95	0.576	8,610	0.218	2,430	Ferguson River	2.54	
Cat13	3790	0.502	9,225	0.445	5,260			
Cat14	63.60		Constructed to final design					

Table 5: Post-Development Stormwater Management

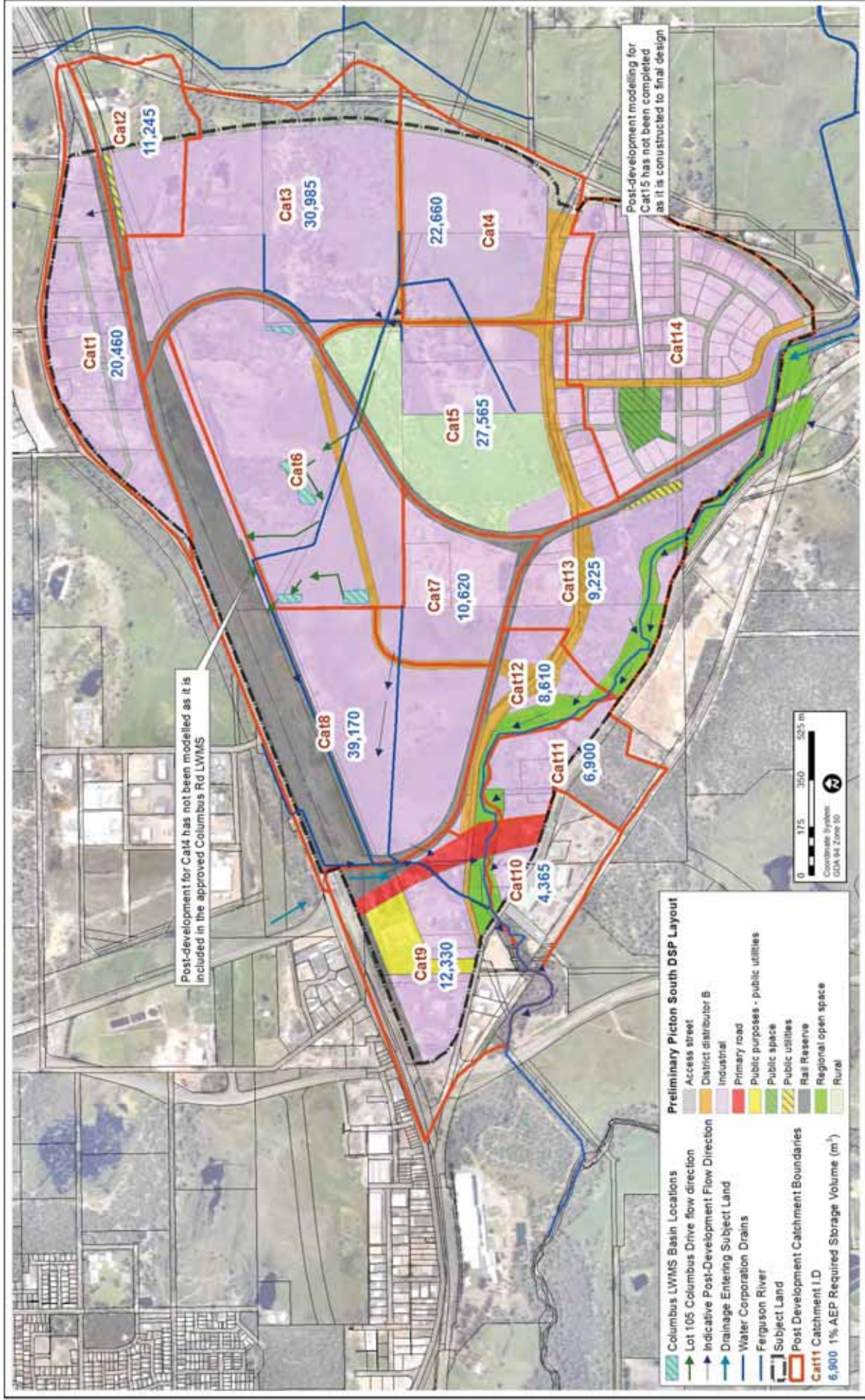


Figure 10 - Post-Development Stormwater Management

# Appendix D

Lot 105 Columbas Drive, Picton East, Preliminary Servicing Strategies



## LOT 105 COLUMBAS DRIVE, PICTON EAST PRELIMINARY SERVICING STRATEGIES



### INTRODUCTION

The subject land is located within the Preston Industrial Park presently being assessed by the Department of Planning for potential development as part of an overall structure plan for the "Southern Precinct". This report is intended to provide a preliminary overview of infrastructure requirements required to support the proposed subdivision of Lot 105 Columbas Drive. Preliminary investigations have been undertaken by the Department of Planning and it is intended that this report shall also consider the findings of those investigations.

### FILLING AND DRAINAGE

Elevation of the site varies from approximately 11 metres AHD in the west to 17 metres AHD on a ridge near the eastern boundary. Much of the intermediate land is relatively flat and becomes waterlogged during the winter months. Previous use of the land has been for primary production, namely grazing.

The site is traversed by an open drain running in a westerly direction which conveys storm water into existing drainage infrastructure to the north of the site, ultimately discharging into the Preston River. This drain also provides an outlet for an upstream rural catchment of approximately 140 hectares.

It is recommended that the open drain traversing Lot 105 be replaced with a pipe drainage system following new boundaries through the proposed subdivision. It is considered that a 900mm diameter pipe shall be required to cater for the storm water runoff from the upstream rural catchment generated in a one in ten year storm event. Future development within this catchment must be required to limit its stormwater discharge to this pre existing condition.

Stormwater management within the proposed subdivision should be consistent with the water quality objectives outlined in State Planning Police 2.9 Water Resources and associated guidelines "Better Urban Water Management".

Preliminary investigations by the Department of Planning and Infrastructure identified this land as having a high water table and required to be filled in order to support the proposed industrial development. Water logging of the lower lying areas of Lot 105 was observed during the winter of 2009. Recommended fill levels required to provide sufficient separation to ground water are indicated on drawing TEE01-B-09 (1 of 2). The fill will be required to be installed with a sub soil drainage system in order to maintain ground water levels at, or close to, that which currently exists.

The mechanism of storm water management within the subdivision is detailed on drawing TEE01-B-09 (2 of 2). In general, the minor (1 in 1 year) rainfall events are entirely contained within shallow basins on site. Where roadways abut public open

space runoff from this storm event is contained within road side swales. More significant storm events (1 in 10 year) is also contained within the basins with provision for overflow into existing down stream drainage infrastructure located to the north of the site. The basins provide for overflow rates that are less than the pre-development levels.

Proposed filling of the site provides that developable areas shall be above the level of adjacent roads or public open space. Runoff generated from a major storm event (1 in 100 years) are thus conveyed along road ways or through public open space to downstream receiving waters.

Runoff from future development within the lots should be contained and recharged on site. It is usual that the local government would apply such development conditions on any future building on the lots.

## **ROAD NETWORK**

It is anticipated that road works internal to the subdivision shall be constructed in accordance with the "Local Government Guidelines for Subdivision Development" edition 2-2009. Design in accordance with these principles should be undertaken at the time of subdivision.

Access to the site is currently provided by Columbas Drive, which links this site to the existing industrial subdivision at Harris Road.

A level crossing presently exists where Columbas Drive intersects with the railway reserve. Future control at this crossing will need to be addressed at the time of subdivision.

## **SEWER SERVICES**

The land is located within the licence area held by the Water Corporation of Western Australia for provision of sewer services. The nearest existing sewerage infrastructure suitable to receive discharge from this development are located in Ince Road Glen Iris, approximately 5 kilometres to the west.

Should sewer services be required as a condition of the future development of this land then a sewerage pumping station will be required to be constructed in the vicinity of Lot 105. The Water Corporation at this stage have no forward planning for sewer services in this vicinity and as such it is not clear at this point exactly where the sewer pumping station would be located.

It is recommended that the Water Corporation be requested to undertake forward planning for provision of sewerage services in this vicinity as soon as possible. Detailed design of the sewer network, pumping station and pressure main will be undertaken at the time of subdivision.

## **WATER SERVICES**

The subject land is located within the licence area held by Aqwest (Bunbury Water Board) for provision of water services. Aqwest has advised that the subdivision is serviceable from an existing 300mm diameter water main in Harris Road, approximately 800 metres to the south of the site. Detailed design of the water reticulation mains and connecting link should be undertaken at the time of subdivision.

## **POWER SUPPLY**

The subject site is traversed by numerous overhead power lines, namely the Picton to Coolup (71) 66kV transmission line and the Picton to Worsley (81) 132kV transmission line, both located on the northern boundary. The property is also bisected by the Muja to Bunbury Harbour (81) 132kV transmission line which crosses the north western corner of the site and travels from there in a south easterly direction. Western Power have confirmed that these transmission lines may be relocated at the developers cost provided that the new alignment occurs within new gazetted road reserves or private property suitably protected by easements in favour of Western Power.

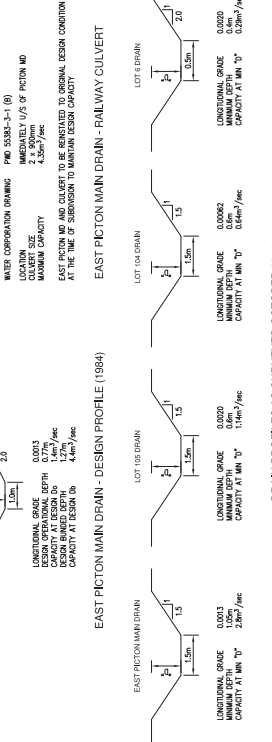
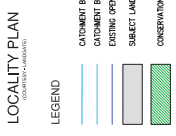
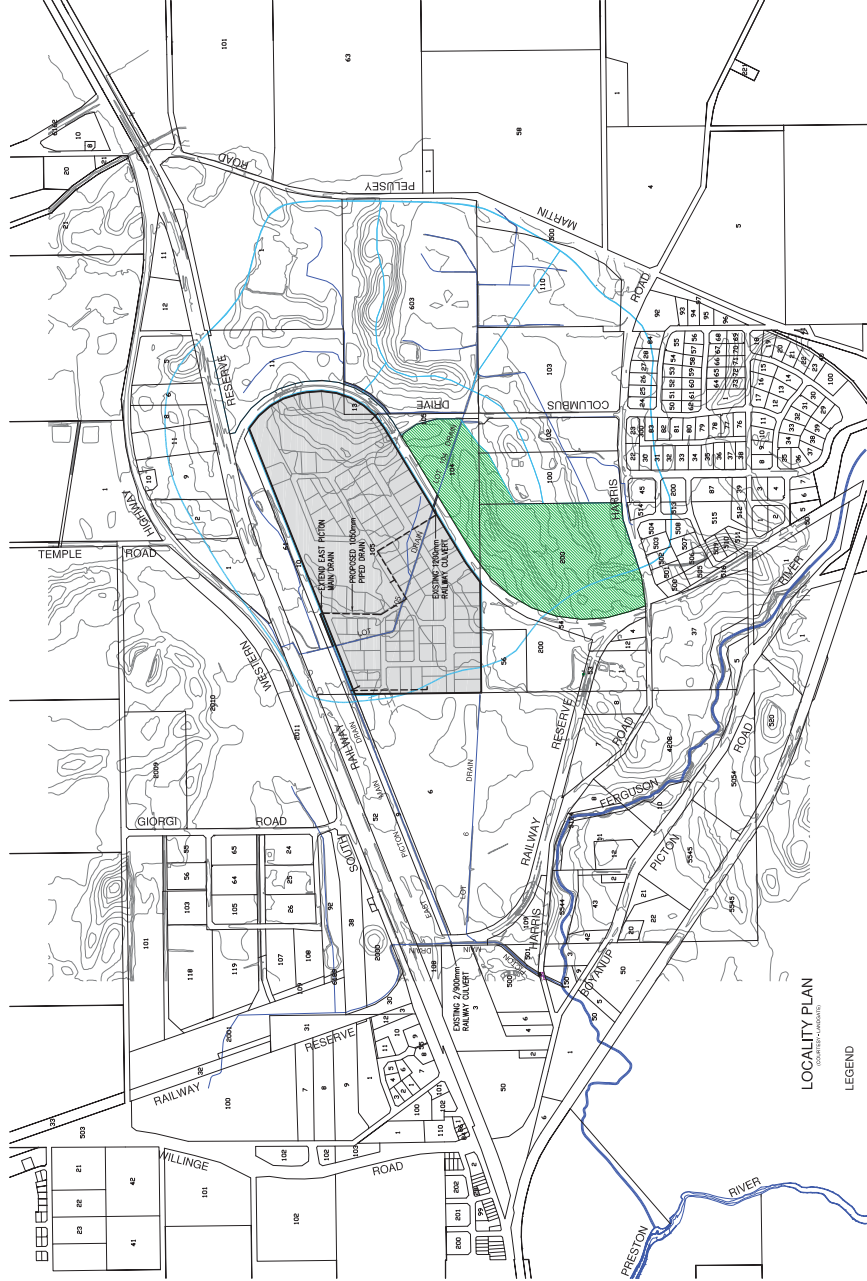
It is recommended that the Muja to Bunbury Harbour transmission line which bisects the property be relocated along the southern and western boundaries as indicated on drawing TEE01-B-09 (1 of 2). Western Power has indicated that the cost of such relocation would be in the order of \$1.4 million.

Preliminary enquiries indicate that power supply for the proposed subdivision would be drawn from existing distribution lines immediately adjacent to the site. Detailed design of power supply infrastructure should be undertaken at the subdivision stage.

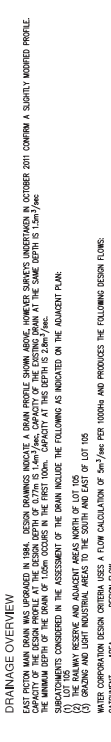


Dirk van Noort BE(Hons)UWA  
Senior Civil Engineer

8 October 2009



**DRAIN PROFILES AS SURVEYED OCTOBER 2011**



**DRAINAGE OVERVIEW**

EAST PICTON MAIN DRAIN WAS UPDATED IN 1984. DESIGN DRAWINGS INDICATE A DRAIN PROFILE SHOWN ABOVE, HOWEVER SURVEYS UNDERTAKEN IN OCTOBER 2011 CONFIRM A SLIGHTLY MODIFIED PROFILE. THE MAXIMUM DEPTH OF THE DRAIN OF 1.00m OCCURS IN THE WEST END OF THE DRAIN AT THIS DEPTH IS 2.36m AFD.

SUBCATCHMENTS CONSIDERED IN THE ASSESSMENT OF THE DRAIN INCLUDE THE FOLLOWING AS INDICATED ON THE ADJACENT PLAN:

- (1) THE RAILWAY RESERVE AND ADJACENT AREAS NORTH OF LOT 105
- (2) THE RAILWAY RESERVE AND ADJACENT AREAS SOUTH AND EAST OF LOT 105
- (3) GRAZING AND LIGHT INDUSTRIAL AREAS TO THE SOUTH AND EAST OF LOT 105

WATER CORPORATION DESIGN CRITERIA USES A FLOW CALCULATION OF 5m<sup>3</sup>/Year PER 1000m<sup>2</sup> AND PRODUCES THE FOLLOWING DESIGN FLOWS:

AREA	AREA (m <sup>2</sup> )	DESIGN FLOW (m <sup>3</sup> /Year)
(1)	23846	119.23
(2)	1296	6.48
(3)	1296	6.48
TOTAL	26438	132.19

PEAK STORMWATER RUNOFF FROM THE CURRENT RAINFALL USE ESTIMATED FOR EACH OF THE SUBCATCHMENTS BASED UPON THEIR FLOW PATTERNS AND ORIGINAL STORM WATERSHEDS ARE SUMMARIZED BELOW:

CATCHMENT	AREA (m <sup>2</sup> )	DESIGN FLOW (m <sup>3</sup> /Year)	PEAK RAINFALL (mm)	PEAK RUNOFF (m <sup>3</sup> /Year)
(1)	23846	119.23	127	30.46
(2)	1296	6.48	127	1.62
(3)	1296	6.48	127	1.62

THESE RESULTS SUGGEST THAT THE WATER CORPORATION DESIGN CRITERIA REFLECTS A 1:10 YEAR STORM EVENT ON A RELATIVELY FLAT (0.1% - 0.2%) RAINFALL CATCHMENT.

THE TOTAL ESTIMATED 1:10 YEAR RAINFALL OF 113mm<sup>3</sup>/Year IS CONSISTENT WITH THE DESIGN CAPACITY OF THE EAST PICTON MAIN DRAIN OPERATING AT ITS DESIGN DEPTH OF 0.70m (0.7m<sup>3</sup>/Year).

THE 1:10 YEAR DESIGN FLOW IN THE DRAIN TRAVELLING SOUTH AND MATCHES THE CAPACITY OF THE DRAIN WHEN OPERATING AT A DESIGN DEPTH OF 0.50m.

IT IS NOTED THAT FLOWS FROM LOTS 104 AND 105 TO THE DRAIN WILL BE LIMITED BY THE CAPACITY OF THE DRAIN WITHIN LOTS 104 AND 105 AND LOCALIZED FLOODING IN THESE AREAS.

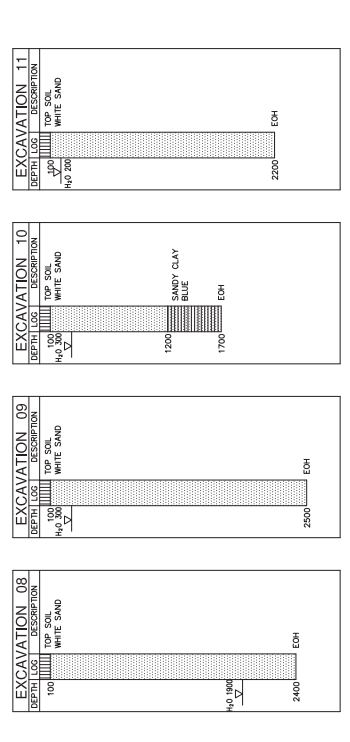
THE CAPACITY OF THE RAILWAY CULVERT BETWEEN LOTS 104 AND 105 IS APPROX 2.4m<sup>3</sup>/Year AND IS NOT THE CAUSE OF ANY BACK FLOODING OBSERVED WITHIN LOT 104.

THE PROPOSED DEVELOPMENT OF LOT 105 INCLUDES THE REPLACEMENT OF THE EXISTING OPEN DRAIN WITH A PIPED DRAINAGE SYSTEM. THE NEW SYSTEM IS REQUIRED TO PROVIDE THE SAME CAPACITY AS THE EXISTING OPEN DRAIN. THE PROPOSED DEVELOPMENT OF LOT 105 INCLUDES THE REPLACEMENT OF THE EXISTING OPEN DRAIN WITH A PIPED DRAINAGE SYSTEM. THE NEW SYSTEM IS REQUIRED TO PROVIDE THE SAME CAPACITY AS THE EXISTING OPEN DRAIN. THE PROPOSED DEVELOPMENT OF LOT 105 INCLUDES THE REPLACEMENT OF THE EXISTING OPEN DRAIN WITH A PIPED DRAINAGE SYSTEM. THE NEW SYSTEM IS REQUIRED TO PROVIDE THE SAME CAPACITY AS THE EXISTING OPEN DRAIN.

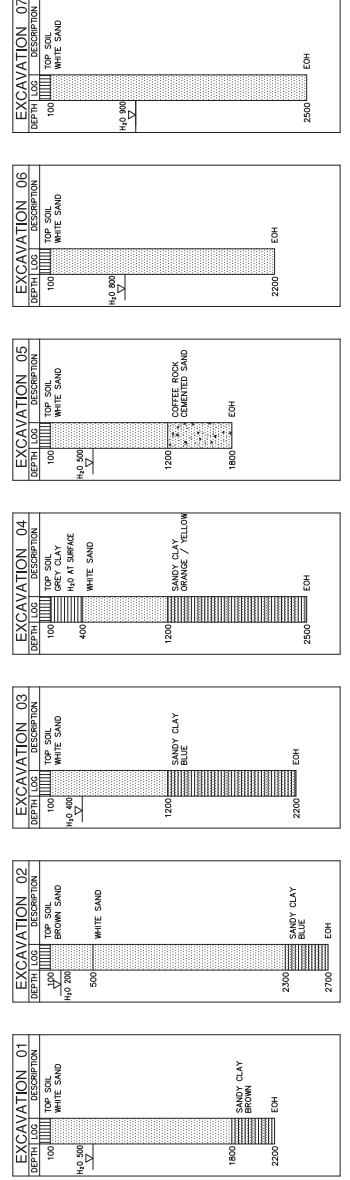
RECENT SURVEYS OF THE EAST PICTON MAIN DRAIN INDICATE A MAXIMUM CAPACITY OF 2.3m<sup>3</sup>/Year WHEN OPERATING AT A DEPTH OF 0.50m (100mm FREE BOARD). PEAK OUTFLOW FROM THE CATCHMENT ESTIMATED TO BE DISCHARGED AS FOLLOWS:

DEPTH (m)	DESIGN FLOW (m <sup>3</sup> /Year)
0.50	119.23
0.60	132.19
0.70	145.15
0.80	158.11
0.90	171.07
1.00	184.03

THE STRONG REASON FOR CHANGING THE DRAIN FROM OPEN TO PIPED IS THAT LOT 105 IS ESTIMATED TO BE ESTABLISHED ON SHEETS 2 AND 3. IT IS NOT ANTICIPATED THAT FURNISHING RESOURCES WILL COVER WITHIN CATCHMENT 2 AND THIS CATCHMENT WILL CONTINUE TO DISCHARGE UNDER ITS CURRENT CONDITIONS. CATCHMENT 2 WILL CONTINUE TO BECOME PARALLEL WITH CATCHMENT 3 WILL REQUIRE FLOODING AND CONSTRUCTION OF DETENTION BASINS TO CONTROL PEAK OUTFLOW FROM LOT 105. FUTURE DEVELOPMENT WITHIN CATCHMENT 3 WILL REQUIRE FLOODING AND CONSTRUCTION OF DETENTION BASINS TO CONTROL PEAK OUTFLOW FROM LOT 105.



**GEOTECHNICAL PIT LOGS - 22 SEPTEMBER 2011**  
(REFER TEST PIT LOCATIONS - SHEET 2)



PROPOSED SUBDIVISION  
LOT 105 COLUMBAS DRIVE PICTON

REVISION DATE	NO	REVISION DESCRIPTION	DESIGN	DRAWN	CHECKED	APPROVED
23 SEPTEMBER 2009	0	PRELIMINARY - NOT FOR CONSTRUCTION	D/W	D/W	D/W	D/W
3 FEBRUARY 2010	A	ROAD HIERARCHY AMENDED	D/W	D/W	D/W	D/W
23 SEPTEMBER 2010	B	LWIS DETAILS ADDED	D/W	D/W	D/W	D/W
23 SEPTEMBER 2011	C	D/W - REVISED SUBMISSION	D/W	D/W	D/W	D/W
9 FEBRUARY 2012	D	D/W - REVISED SUBMISSION	D/W	D/W	D/W	D/W

TEED-B-11  
1 OF 3  
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1 : 10,000 AT A1  
AHD

PROJECT No  
SHEET  
REVISION  
LOCAL AUTHORITY  
SCALE  
DATUM

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FACSIMILE 0792 4385  
EMAIL enp@cwteed.com.au



# LOCAL WATER MANAGEMENT STRATEGY

**PLANNING BACKGROUND**  
 THE LOCAL WATER MANAGEMENT STRATEGY HAS BEEN PREPARED FOR THE CANTON.  
 THE STRATEGY IS BASED ON THE CURRENT SITUATION AND THE NEEDS OF THE CANTON.  
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**PREVIOUS STUDIES**  
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**WATER SUSTAINABILITY**  
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**WATER INFRASTRUCTURE**  
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**PRE-DEVELOPMENT ENVIRONMENT**  
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**ADJUSTABLE SWALES**  
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**SPREADSHEET**  
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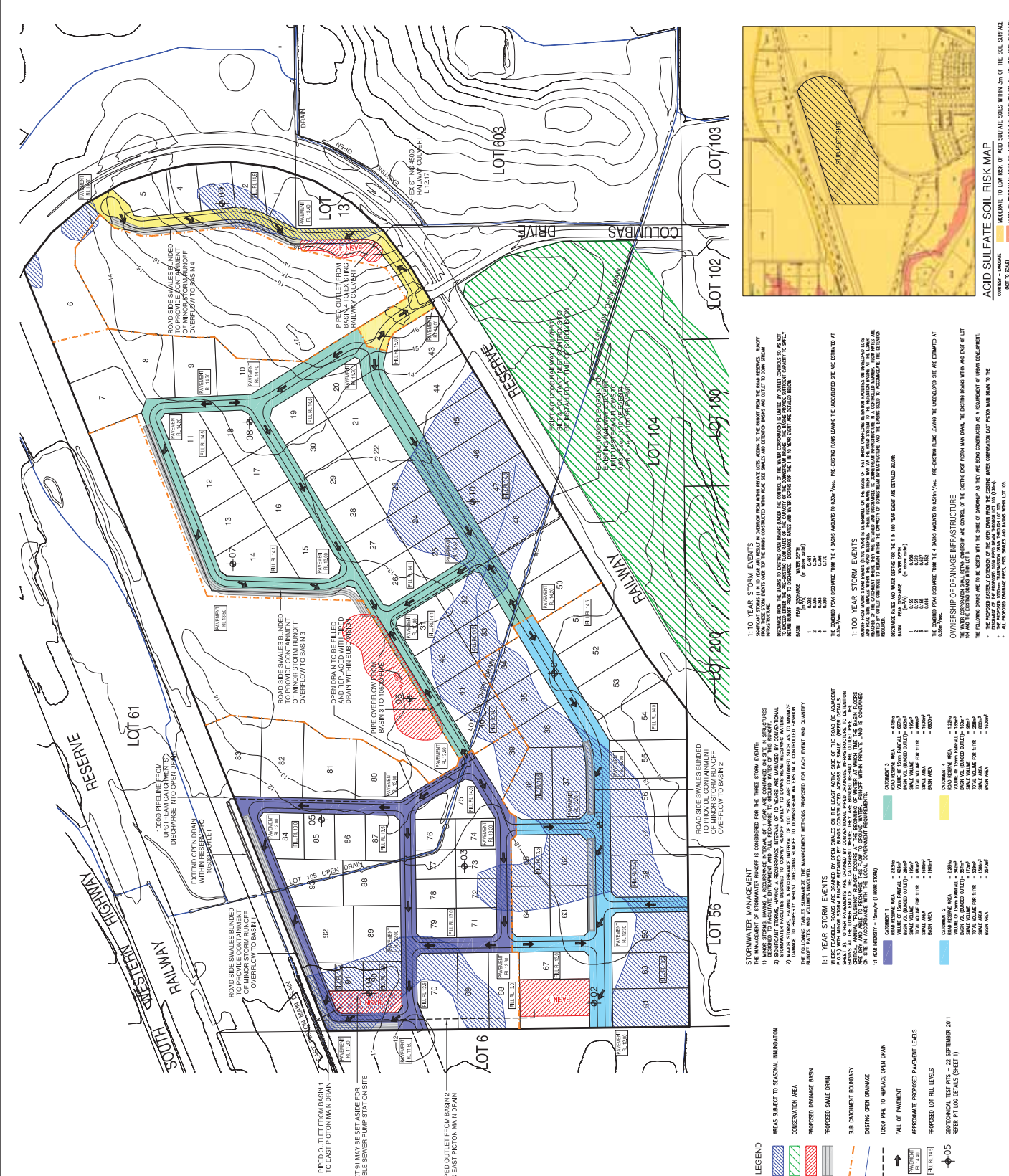
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**1:10 YEAR STORM EVENTS**

RAIN	PEAK FLOW	WATER SPILL
1	1000	1000
2	1000	1000
3	1000	1000
4	1000	1000
5	1000	1000
6	1000	1000
7	1000	1000
8	1000	1000
9	1000	1000
10	1000	1000

**1:100 YEAR STORM EVENTS**

RAIN	PEAK FLOW	WATER SPILL
1	1000	1000
2	1000	1000
3	1000	1000
4	1000	1000
5	1000	1000
6	1000	1000
7	1000	1000
8	1000	1000
9	1000	1000
10	1000	1000

**STORMWATER MANAGEMENT**

THE MANAGEMENT OF STORMWATER RUNOFF IS CONSIDERED FOR THE WAREHOUSE.

- ROAD SIDE SWALES: ROAD SIDE SWALES ARE TO BE PROVIDED FOR THE WAREHOUSE. THE SWALES ARE TO BE PROVIDED FOR THE WAREHOUSE.
- ADJUSTABLE SWALES: ADJUSTABLE SWALES ARE TO BE PROVIDED FOR THE WAREHOUSE. THE SWALES ARE TO BE PROVIDED FOR THE WAREHOUSE.
- ENFORCEMENT WATER COVERS: ENFORCEMENT WATER COVERS ARE TO BE PROVIDED FOR THE WAREHOUSE. THE COVERS ARE TO BE PROVIDED FOR THE WAREHOUSE.
- SPREADSHEET: A SPREADSHEET IS TO BE PROVIDED FOR THE WAREHOUSE. THE SPREADSHEET IS TO BE PROVIDED FOR THE WAREHOUSE.

**1:1 YEAR STORM EVENTS**

ROAD SIDE SWALE	ADJUSTABLE SWALE	ENFORCEMENT WATER COVER
1	1000	1000
2	1000	1000
3	1000	1000
4	1000	1000
5	1000	1000
6	1000	1000
7	1000	1000
8	1000	1000
9	1000	1000
10	1000	1000

**1:100 YEAR STORM EVENTS**

ROAD SIDE SWALE	ADJUSTABLE SWALE	ENFORCEMENT WATER COVER
1	1000	1000
2	1000	1000
3	1000	1000
4	1000	1000
5	1000	1000
6	1000	1000
7	1000	1000
8	1000	1000
9	1000	1000
10	1000	1000

**PROJECT No** TEED-B-11  
**SHEET** 2 OF 3  
**LOCAL AUTHORITY** SHIRE OF D'AROUNDUP  
**SCALE** 1 : 2500 AT A1  
**DATUM** AHD

**REVISION DATE** No  
 23 SEPTEMBER 2010  
 3 FEBRUARY 2010  
 23 SEPTEMBER 2011  
 11 NOVEMBER 2011  
 9 FEBRUARY 2012

**REVISION DESCRIPTION**  
 PRELIMINARY - NOT FOR CONSTRUCTION  
 ROAD HIERARCHY AMENDED  
 LWMIS DETAILS ADDED  
 DOWM - REVISED SUBMISSION  
 DOWM - REVISED SUBMISSION

**DESIGN DRAWN CHECKED APPROVED**  
 DWM DWM DWM  
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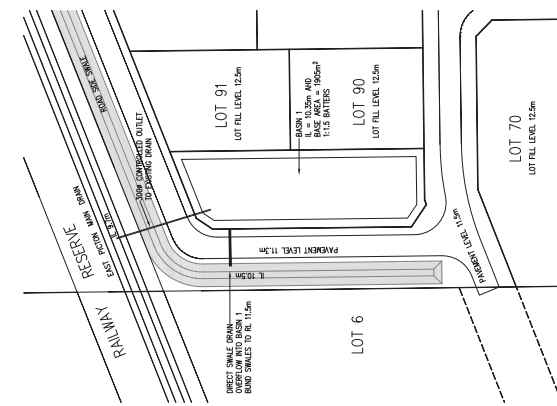
**PROJECT** LOT 105 COLUMBAS DRIVE PICTON  
**DRAWING TITLE** LOCAL WATER MANAGEMENT STRATEGY

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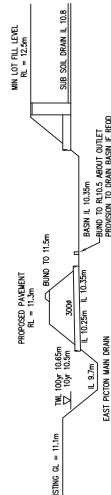
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**BUNBURY WA 6230**  
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**DNV**  
**DIRK VAN NOORT**



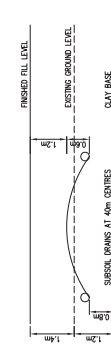


**CATCHMENTS 1A AND 1B**  
 CATCHMENT AREA = 12.14m<sup>2</sup>  
 RAINFALL COEFFICIENT = 0.8

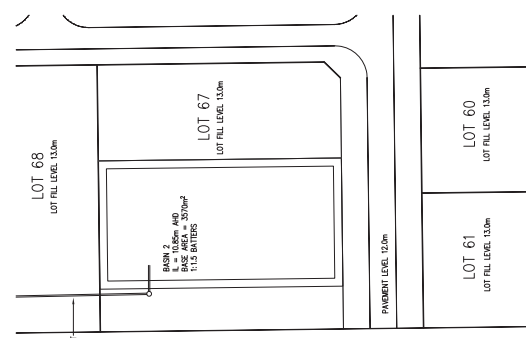


**DIMENSIONS - BASIN 1**

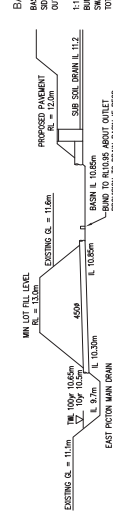
- BASIN 1 DETAILS**
- BASIN FLOOR AREA = 1960m<sup>2</sup>
  - SIDE BATTER SLOPE = 1 : 1.5
  - OUTLET PIPE = 400mm x 300mm
  - 1:1 YEAR STORAGE = 760m<sup>3</sup>
  - 1:10 YEAR STORAGE = 1960m<sup>3</sup>
  - TOTAL SWALES (400mm) = 48m<sup>2</sup>
  - TOTAL SWALE AREA = 1000m<sup>2</sup>
  - 1:10 YEAR STORAGE = 1960m<sup>3</sup>
  - 1:100 YEAR STORAGE = 1134m<sup>3</sup>
  - TOP WATER LEVEL = 12.14m
  - MAX OUTLET FLOW = 0.020m<sup>3</sup>/s
  - MAX OUTLET FLOW = 0.020m<sup>3</sup>/s



**GROUND WATER CONTROL**  
 GROUND WATER MONITORING IN WINTER CASE SCENARIO  
 (DRAIN SPACING MAY BE INCREASED WHERE CLAY BASE DEPTH EXCEEDS 1.2m)

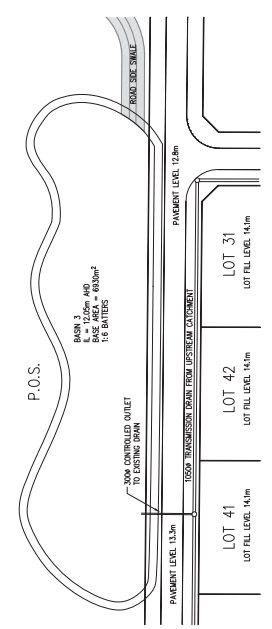


**CATCHMENT 2**  
 CATCHMENT AREA = 12.04m<sup>2</sup>  
 RAINFALL COEFFICIENT = 0.8



**DIMENSIONS - BASIN 2**

- BASIN 2 DETAILS**
- BASIN FLOOR AREA = 1960m<sup>2</sup>
  - SIDE BATTER SLOPE = 1 : 1.5
  - OUTLET PIPE = 400mm x 300mm
  - 1:1 YEAR STORAGE = 760m<sup>3</sup>
  - 1:10 YEAR STORAGE = 1960m<sup>3</sup>
  - TOTAL SWALES (400mm) = 48m<sup>2</sup>
  - TOTAL SWALE AREA = 1000m<sup>2</sup>
  - 1:10 YEAR STORAGE = 1960m<sup>3</sup>
  - 1:100 YEAR STORAGE = 1134m<sup>3</sup>
  - TOP WATER LEVEL = 12.04m
  - MAX OUTLET FLOW = 0.020m<sup>3</sup>/s
  - MAX OUTLET FLOW = 0.020m<sup>3</sup>/s

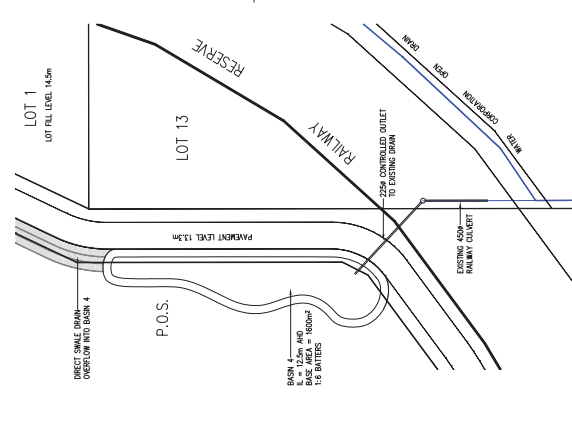


**CATCHMENTS 3A AND 3B**  
 CATCHMENT AREA = 19.24m<sup>2</sup>  
 RAINFALL COEFFICIENT = 0.8

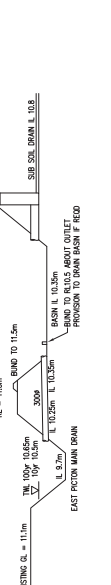


**DIMENSIONS - BASIN 3**

- BASIN 3 DETAILS**
- BASIN FLOOR AREA = 6930m<sup>2</sup>
  - SIDE BATTER SLOPE = 1 : 6
  - OUTLET PIPE = 200mm x 300mm
  - 1:1 YEAR STORAGE = 6930m<sup>3</sup>
  - 1:10 YEAR STORAGE = 6930m<sup>3</sup>
  - TOTAL SWALES (400mm) = 888m<sup>2</sup>
  - TOTAL SWALE AREA = 1000m<sup>2</sup>
  - 1:10 YEAR STORAGE = 6930m<sup>3</sup>
  - 1:100 YEAR STORAGE = 1285m<sup>3</sup>
  - TOP WATER LEVEL = 12.85m
  - MAX OUTLET FLOW = 0.150m<sup>3</sup>/s
  - MAX OUTLET FLOW = 0.150m<sup>3</sup>/s

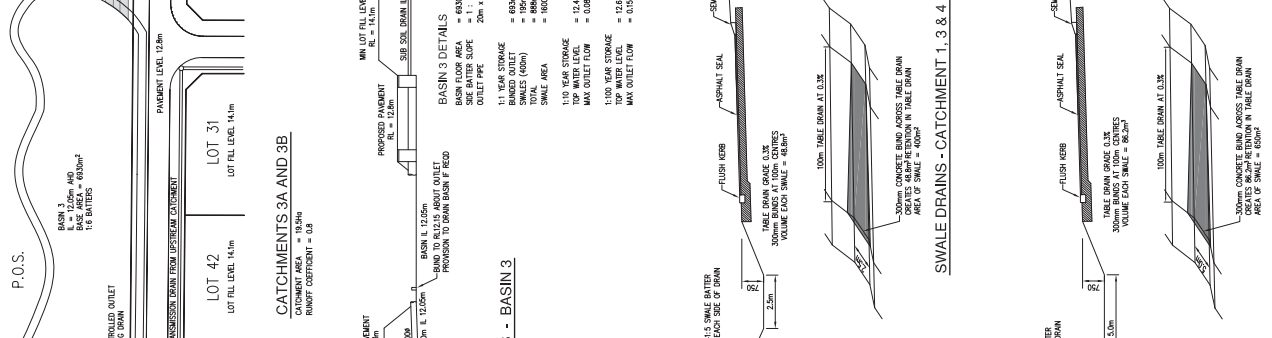


**CATCHMENT 4**  
 CATCHMENT AREA = 4.28m<sup>2</sup>  
 RAINFALL COEFFICIENT = 0.8



**DIMENSIONS - BASIN 4**

- BASIN 4 DETAILS**
- BASIN FLOOR AREA = 600m<sup>2</sup>
  - BASIN FLOOR SLOPE = 36m x 225m
  - OUTLET PIPE = 300mm x 225mm
  - 1:1 YEAR STORAGE = 160m<sup>3</sup>
  - 1:10 YEAR STORAGE = 600m<sup>3</sup>
  - TOTAL SWALES (200mm) = 88m<sup>2</sup>
  - TOTAL SWALE AREA = 600m<sup>2</sup>
  - 1:10 YEAR STORAGE = 600m<sup>3</sup>
  - 1:100 YEAR STORAGE = 1287m<sup>3</sup>
  - TOP WATER LEVEL = 0.020m<sup>3</sup>/s
  - MAX OUTLET FLOW = 0.020m<sup>3</sup>/s
  - MAX OUTLET FLOW = 0.020m<sup>3</sup>/s



**SWALE DRAINS - CATCHMENT 1, 3 & 4**

**SWALE DRAINS - CATCHMENT 2**

REVISION DATE	No	REVISION DESCRIPTION	DESIGN	DRAWN	CHECKED	APPROVED
23 SEPTEMBER 2009	0	PRELIMINARY - NOT FOR CONSTRUCTION	DVM	DVM	DVM	DVM
3 FEBRUARY 2010	A	ROAD HIERARCHY AMENDED	DVM	DVM	DVM	DVM
23 FEBRUARY 2011	B	LWIS DETAILS ADDED	DVM	DVM	DVM	DVM
23 SEPTEMBER 2011	C	DoM - REVISED SUBMISSION	DVM	DVM	DVM	DVM
11 NOVEMBER 2012	D	DoM - REVISED SUBMISSION	DVM	DVM	DVM	DVM
9 FEBRUARY 2012	D	DoM - REVISED SUBMISSION	DVM	DVM	DVM	DVM

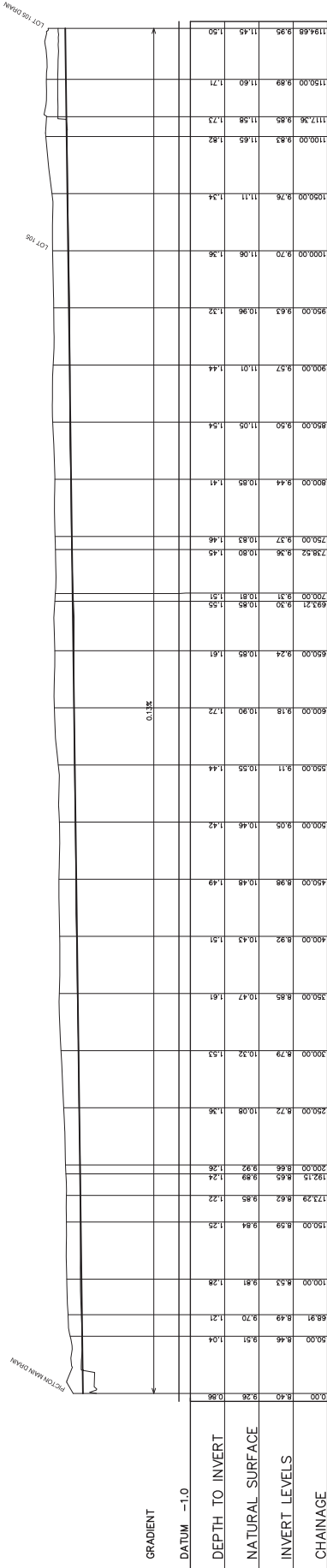
PROJECT No	TEED-B-11
SHEET	3 OF 3
REVISION	D
LOCAL AUTHORITY	SHIRE OF DARDANUP
SCALE	1 : 1000 AT A1
DATUM	AHD

PROJECT	PROPOSED SUBDIVISION
LOT 105 COLUMBAS DRIVE PICTON	

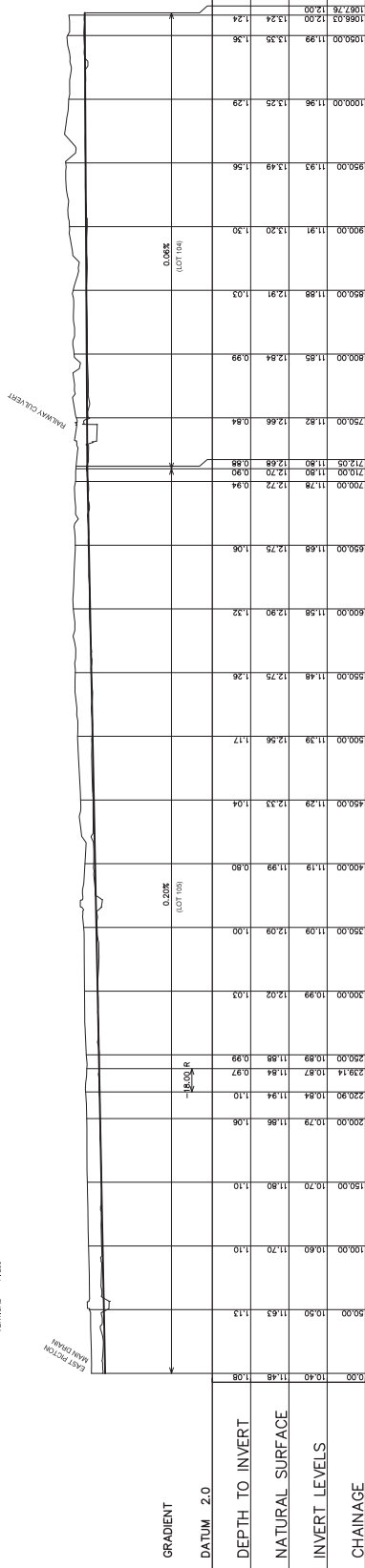
**C. W. TEED**  
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 EMAIL cwteed@cwteed.com.au

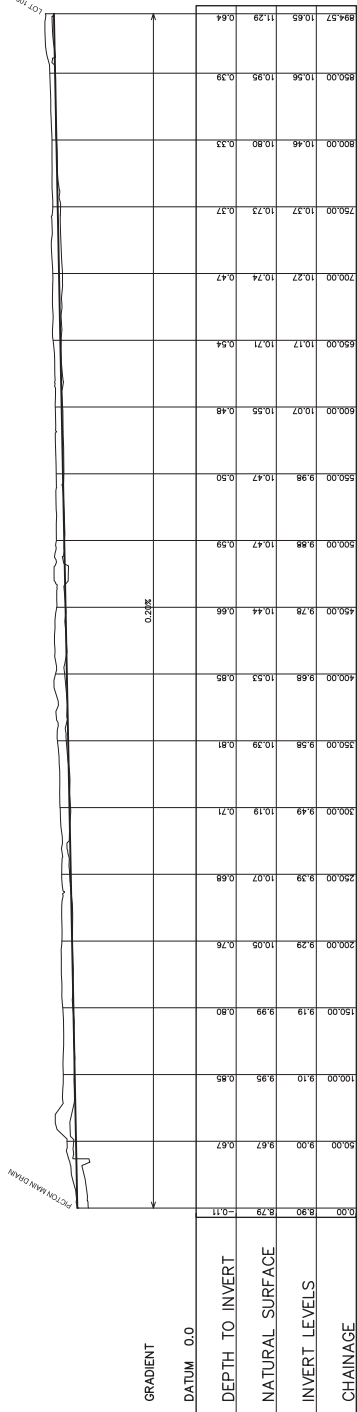
**DIRK VAN NOORT**



EAST PICTON MAIN DRAIN  
 SCALES HORIZONTAL 1:2000  
 VERTICAL 1:200



LOTS 105 AND 104  
 SCALES HORIZONTAL 1:2000  
 VERTICAL 1:200



LOT 6  
 SCALES HORIZONTAL 1:2000  
 VERTICAL 1:200

DRAIN PROFILES AS SURVEYED OCTOBER 2011



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PROJECT No. TEED-B-11  
 SHEET ANNEXURE A  
 REVISION D  
 LOCAL AUTHORITY SHIRE OF DARDANUP  
 SCALE 1 : 2000 AT A1  
 DATUM AHD

REVISION DATE	No	REVISION DESCRIPTION	DESIGN	DRAWN	CHECKED	APPROVED
23 SEPTEMBER 2009	0	PRELIMINARY - NOT FOR CONSTRUCTION	DWM	DWM	DWM	DWM
3 FEBRUARY 2010	A	ROAD HIERARCHY AMENDED	DWM	DWM	DWM	DWM
23 SEPTEMBER 2011	B	LIMS DETAILS ADDED	DWM	DWM	DWM	DWM
11 NOVEMBER 2011	C	DWM - REVISED SUBMISSION	DWM	DWM	DWM	DWM
9 FEBRUARY 2012	D	DWM - REVISED SUBMISSION	DWM	DWM	DWM	DWM

PROPOSED SUBDIVISION  
 LOT 105 COLUMBAS DRIVE PICTON  
 DRAWING TITLE  
 WATER CORPORATION DRAIN PROFILES

# Appendix E

Groundwater Monitoring Results



Table E. 1: Depth to groundwater (m) from natural surface as provided by TME with the exception of the 2019 sampling occasion

Date	Bore No.								
	Bore 1	Bore 2	Bore 3	Bore 4	Bore 5	Bore 6	Bore 7	Bore 8	Bore 9
28/09/2010	0.93	0.34	0.8	0.71	1.07	1.34	2.04	2.17	1.4
26/10/2010	1.06	0.5	1.03	1.01	1.2	1.43	2.06	2.32	1.50
19/01/2011	1.65	0.74	1.41	1.79	1.64	1.74	3.08	Dry	1.86
18/04/2011	2.19	0.77	1.94	2.16	1.78	1.88	Dry	Dry	2.18
10/05/2011	2.14	0.71	1.9	1.98	1.76	1.88	3.46	Dry	2.12
10/06/2011	1.66	0.37	1.39	1.31	1.6	1.58	1.40	Dry	1.70
12/07/2011	0.9	0.15	0.54	0.53	1.02	1.21	1.24	2.6	1.28
25/08/2011	0.4	0.05	0.14	0.31	0.51	0.8	0.74	0.92	0.92
27/09/2011	0.3	0.09	0.18	0.34	0.46	0.85	0.74	0.96	0.92
21/10/2011	0.43	0.2	0.52	0.62	0.63	0.99	0.88	1.17	1.06
28/11/2011	0.56	0.43	0.85	1.01	0.84	1.19	1.20	1.5	1.26
15/12/2011	0.72	0.35	0.9	1.16	0.87	1.21	1.26	1.66	1.06
24/07/2012	0.68	0.18	0.8	0.53	0.83	1.14	1.30	1.51	1.26
24/08/2012	0.50	0.08	0.19	0.35	0.66	1.02	1.14	1.31	1.10
11/09/2012	0.4	0.13	0.2	0.4	0.59	0.95	1.10	1.17	1.02
18/10/2012	0.45	0.25	0.55	0.67	0.66	Equipment error	1.04	1.28	Equipment error
19/11/2012	0.65	0.45	0.54	0.97	0.84	1.16	1.30	1.61	1.28
17/12/2012	0.45	0.21	0.37	0.55	0.64	0.89	1.04	1.34	1.08
22/08/2019	0.63	0.06	0.24	0.51	0.76	1.06	1.13	Destroyed	1.10

Table E. 2: Groundwater quality at Bore 1 as provided by TME

Analyte	26/10/2010	18/04/2011	21/10/2011	15/12/2011	18/10/2012
<b>OH<sup>-</sup> Alkalinity</b>	<1	<1	<1	<1	<1
<i>(mg/L, LOR = 1)</i>					
<b>CO<sub>3</sub><sup>2-</sup> Alkalinity</b>	<1	<1	<1	<1	<1
<i>(mg/L, LOR = 1)</i>					
<b>HCO<sub>3</sub><sup>-</sup> Alkalinity</b>	34	13	7	7	13
<i>(mg/L, LOR = 1)</i>					
<b>Total Alkalinity</b>	34	13	7	7	13
<i>(mg/L, LOR = 1)</i>					
<b>Aluminium</b>	2.2	5.71	21.9	10.4	
<i>(mg/L, LOR = 0.01)</i>					
<b>Arsenic</b>	<0.001	<0.001	0.001	0.001	
<i>(mg/L, LOR = 0.001)</i>					
<b>Cadmium</b>	<0.0001	0.0001	0.0002	0.0001	
<i>(mg/L, LOR = 0.0001)</i>					
<b>Chromium</b>	0.003	0.01	0.021	0.015	
<i>(mg/L, LOR = 0.001)</i>					
<b>Copper</b>	0.008	0.033	0.042	0.038	
<i>(mg/L, LOR = 0.001)</i>					
<b>Lead</b>	0.002	0.012	0.036	0.012	
<i>(mg/L, LOR = 0.001)</i>					
<b>Manganese</b>	0.074	0.029	0.043	0.023	
<i>(mg/L, LOR = 0.001)</i>					
<b>Zinc</b>	0.03	0.081	0.096	0.062	
<i>(mg/L, LOR = 0.005)</i>					
<b>Iron</b>	6.92	6.48	19.5	8.43	
<i>(mg/L, LOR = 0.05)</i>					

Table E. 2: Groundwater quality at Bore 1 as provided by TME (continued)

Analyte	26/10/2010	18/04/2011	21/10/2011	15/12/2011	18/10/2012
<b>Ammonia</b>	0.22	0.11	0.04	<0.05	<0.02
(mg/L, LOR = 0.01)					
<b>Nitrite</b>	<0.01	<0.01	<0.01	<0.01	<0.01
(mg/L, LOR = 0.01)					
<b>Nitrate</b>	<0.01	<0.01	<0.01	0.04	<0.05
(mg/L, LOR = 0.01)					
<b>NO<sub>x</sub></b>	<0.01	<0.01	<0.01	0.04	<0.05
(mg/L, LOR = 0.01)					
<b>TKN</b>	0.6	1.2	8	4.8	6.1
(mg/L, LOR = 0.1)					
<b>Total Nitrogen</b>	0.6	1.2	8	4.8	6.1
(mg/L, LOR = 0.1)					
<b>Reactive P</b>	<0.01	<0.01	0.02	0.01	0.01
(mg/L, LOR = 0.01)					
<b>Total P</b>	0.07	0.13	0.58	0.31	0.2
(mg/L, LOR = 0.01)					

Table E. 3: Groundwater quality at Bore 2 as provided by TME

Analyte	26/10/2010	18/04/2011	21/10/2011	15/12/2011	18/10/2012
<b>OH<sup>-</sup> Alkalinity</b>	<1	<1	<1	<1	<1
(mg/L, LOR = 1)					
<b>CO<sub>3</sub><sup>2-</sup> Alkalinity</b>	<1	<1	<1	<1	<1
(mg/L, LOR = 1)					
<b>HCO<sub>3</sub><sup>-</sup> Alkalinity</b>	87	66	151	71	124
(mg/L, LOR = 1)					

Table E. 3: Groundwater quality at Bore 2 as provided by TME (continued)

Analyte	26/10/2010	18/04/2011	21/10/2011	15/12/2011	18/10/2012
<b>Total Alkalinity</b>	87	66	151	71	124
<i>(mg/L, LOR = 1)</i>					
<b>Aluminium</b>	25.6	23.8	5.09	9.77	
<i>(mg/L, LOR = 0.01)</i>					
<b>Arsenic</b>	<0.001	0.002	0.001	0.002	
<i>(mg/L, LOR = 0.001)</i>					
<b>Cadmium</b>	<0.0001	<0.0001	<0.0001	<0.0001	
<i>(mg/L, LOR = 0.0001)</i>					
<b>Chromium</b>	0.049	0.01	0.008	0.018	
<i>(mg/L, LOR = 0.001)</i>					
<b>Copper</b>	0.056	0.06	0.009	0.019	
<i>(mg/L, LOR = 0.001)</i>					
<b>Lead</b>	0.05	0.057	0.008	0.018	
<i>(mg/L, LOR = 0.001)</i>					
<b>Manganese</b>	0.057	0.036	0.252	0.05	
<i>(mg/L, LOR = 0.001)</i>					
<b>Zinc</b>	0.03	0.05	0.025	0.023	
<i>(mg/L, LOR = 0.005)</i>					
<b>Iron</b>	43.6	42.4	15.4	20.5	
<i>(mg/L, LOR = 0.05)</i>					
<b>Ammonia</b>	1.07	2.13	0.42	1.12	0.28
<i>(mg/L, LOR = 0.01)</i>					
<b>Nitrite</b>	<0.01	<0.01	<0.01	<0.01	<0.01
<i>(mg/L, LOR = 0.01)</i>					
<b>Nitrate</b>	0.01	0.01	<0.01	0.04	0.02
<i>(mg/L, LOR = 0.01)</i>					

Table E. 3: Groundwater quality at Bore 2 as provided by TME (continued)

Analyte	26/10/2010	18/04/2011	21/10/2011	15/12/2011	18/10/2012
<b>NO<sub>x</sub></b>	0.01	0.01	<0.01	0.04	0.02
(mg/L, LOR = 0.01)					
<b>TKN</b>	5	4.4	2.4	3	1.8
(mg/L, LOR = 0.1)					
<b>Total Nitrogen</b>	5	4.4	2.4	3	1.8
(mg/L, LOR = 0.1)					
<b>Reactive P</b>	<0.01	<0.01	<0.01	<0.01	<0.01
(mg/L, LOR = 0.01)					
<b>Total P</b>					
(mg/L, LOR = 0.01)					

Table E. 4: Groundwater quality at Bore 3 as provided by TME

Analyte	26/10/2010	18/04/2011	21/10/2011	15/12/2011	18/10/2012
<b>OH<sup>-</sup> Alkalinity</b>	<1	<1	<1	<1	<1
(mg/L, LOR = 1)					
<b>CO<sub>3</sub><sup>2-</sup> Alkalinity</b>	<1	<1	<1	<1	<1
(mg/L, LOR = 1)					
<b>HCO<sub>3</sub><sup>-</sup> Alkalinity</b>	151	96	<1	163	216
(mg/L, LOR = 1)					
<b>Total Alkalinity</b>	151	96	<1	163	216
(mg/L, LOR = 1)					
<b>Aluminium</b>	29.2	42	22.1	27.8	
(mg/L, LOR = 0.01)					
<b>Arsenic</b>	<0.001	0.002	0.001	<0.001	
(mg/L, LOR = 0.001)					



Table E. 4: Groundwater quality at Bore 3 as provided by TME (continued)

Analyte	26/10/2010	18/04/2011	21/10/2011	15/12/2011	18/10/2012
<b>Cadmium</b>	<0.0001	<0.0001	<0.0001	<0.0001	
<i>(mg/L, LOR = 0.0001)</i>					
<b>Chromium</b>	0.049	0.06	0.037	0.042	
<i>(mg/L, LOR = 0.001)</i>					
<b>Copper</b>	0.026	0.037	0.022	0.025	
<i>(mg/L, LOR = 0.001)</i>					
<b>Lead</b>	0.018	0.026	0.019	0.019	
<i>(mg/L, LOR = 0.001)</i>					
<b>Manganese</b>	0.132	0.268	0.087	0.176	
<i>(mg/L, LOR = 0.001)</i>					
<b>Zinc</b>	0.05	0.041	0.021	0.05	
<i>(mg/L, LOR = 0.005)</i>					
<b>Iron</b>	16.9	20.8	14	15	
<i>(mg/L, LOR = 0.05)</i>					
<b>Ammonia</b>	0.01	0.04	0.07	<0.05	0.03
<i>(mg/L, LOR = 0.01)</i>					
<b>Nitrite</b>	<0.01	<0.01	0.05	<0.01	<0.01
<i>(mg/L, LOR = 0.01)</i>					
<b>Nitrate</b>	0.59	0.02	0.42	0.02	0.01
<i>(mg/L, LOR = 0.01)</i>					
<b>NO<sub>x</sub></b>	0.59	0.02	0.47	0.02	0.01
<i>(mg/L, LOR = 0.01)</i>					
<b>TKN</b>	6.2	4.5	3.4	2.5	4.7
<i>(mg/L, LOR = 0.1)</i>					
<b>Total Nitrogen</b>	6.8	4.5	3.9	2.5	4.7
<i>(mg/L, LOR = 0.1)</i>					

Table E. 4: Groundwater quality at Bore 3 as provided by TME (continued)

Analyte	26/10/2010	18/04/2011	21/10/2011	15/12/2011	18/10/2012
<b>Reactive P</b>	<0.01	<0.01	0.01	<0.01	<0.01
(mg/L, LOR = 0.01)					
<b>Total P</b>	0.54	0.43	0.24	0.26	0.38
(mg/L, LOR = 0.01)					

Table E. 5: Groundwater quality at Bore 4 as provided by TME

Analyte	26/10/2010	18/04/2011	21/10/2011	15/12/2011	18/10/2012
<b>OH<sup>-</sup> Alkalinity</b>	<1	<1	<1	<1	<1
(mg/L, LOR = 1)					
<b>CO<sub>3</sub><sup>2-</sup> Alkalinity</b>	<1	<1	<1	<1	<1
(mg/L, LOR = 1)					
<b>HCO<sub>3</sub><sup>-</sup> Alkalinity</b>	60	61	85	68	78
(mg/L, LOR = 1)					
<b>Total Alkalinity</b>	60	61	85	68	78
(mg/L, LOR = 1)					
<b>Aluminium</b>	4.56	8.8	16.5	11.8	
(mg/L, LOR = 0.01)					
<b>Arsenic</b>	<0.001	<0.001	<0.001	<0.001	
(mg/L, LOR = 0.001)					
<b>Cadmium</b>	<0.0001	<0.0001	<0.0001	<0.0001	
(mg/L, LOR = 0.0001)					
<b>Chromium</b>	0.013	0.02	0.032	0.024	
(mg/L, LOR = 0.001)					
<b>Copper</b>	0.014	0.025	0.071	0.055	
(mg/L, LOR = 0.001)					

Table E. 5: Groundwater quality at Bore 4 as provided by TME (continued)

Analyte	26/10/2010	18/04/2011	21/10/2011	15/12/2011	18/10/2012
<b>Lead</b>	0.007	0.011	0.022	0.012	
(mg/L, LOR = 0.001)					
<b>Manganese</b>	0.086	0.043	0.119	0.041	
(mg/L, LOR = 0.001)					
<b>Zinc</b>	0.028	0.051	0.067	0.038	
(mg/L, LOR = 0.005)					
<b>Iron</b>	10.9	17.3	23.6	19.4	
(mg/L, LOR = 0.05)					
<b>Ammonia</b>	0.03	0.03	0.06	<0.05	0.02
(mg/L, LOR = 0.01)					
<b>Nitrite</b>	<0.01	<0.01	<0.01	<0.01	<0.01
(mg/L, LOR = 0.01)					
<b>Nitrate</b>	0.17	0.03	<0.01	0.08	<0.01
(mg/L, LOR = 0.01)					
<b>NO<sub>x</sub></b>	0.17	0.03	<0.01	0.08	<0.01
(mg/L, LOR = 0.01)					
<b>TKN</b>	0.6	0.4	4.2	1.2	1.6
(mg/L, LOR = 0.1)					
<b>Total Nitrogen</b>	0.8	0.4	4.2	1.3	1.6
(mg/L, LOR = 0.1)					
<b>Reactive P</b>	<0.01	<0.01	0.01	<0.01	0.01
(mg/L, LOR = 0.01)					
<b>Total P</b>	0.24	0.03	0.42	0.14	0.08
(mg/L, LOR = 0.01)					

Table E. 6: Groundwater quality at Bore 5 as provided by TME

Analyte	26/10/2010	18/04/2011	21/10/2011	15/12/2011	18/10/2012
<b>OH<sup>-</sup> Alkalinity</b>	<1	<1	<1	<1	<1
<i>(mg/L, LOR = 1)</i>					
<b>CO<sub>3</sub><sup>2-</sup> Alkalinity</b>	<1	<1	<1	<1	<1
<i>(mg/L, LOR = 1)</i>					
<b>HCO<sub>3</sub><sup>-</sup> Alkalinity</b>	31	37	<1	38	16
<i>(mg/L, LOR = 1)</i>					
<b>Total Alkalinity</b>	31	37	<1	38	16
<i>(mg/L, LOR = 1)</i>					
<b>Aluminium</b>	15.5	11.5	2.15	3.28	
<i>(mg/L, LOR = 0.01)</i>					
<b>Arsenic</b>	<0.001	0.003	<0.001	0.001	
<i>(mg/L, LOR = 0.001)</i>					
<b>Cadmium</b>	0.0002	<0.0001	<0.0001	<0.0001	
<i>(mg/L, LOR = 0.0001)</i>					
<b>Chromium</b>	0.017	0.01	0.002	0.003	
<i>(mg/L, LOR = 0.001)</i>					
<b>Copper</b>	0.034	0.036	0.01	0.007	
<i>(mg/L, LOR = 0.001)</i>					
<b>Lead</b>	0.029	0.024	0.007	0.006	
<i>(mg/L, LOR = 0.001)</i>					
<b>Manganese</b>	0.094	0.055	0.063	0.061	
<i>(mg/L, LOR = 0.001)</i>					
<b>Zinc</b>	0.049	0.044	0.016	0.012	
<i>(mg/L, LOR = 0.005)</i>					
<b>Iron</b>	25.7	17.4	30.5	37.8	
<i>(mg/L, LOR = 0.05)</i>					

Table E. 6: Groundwater quality at Bore 5 as provided by TME (continued)

Analyte	26/10/2010	18/04/2011	21/10/2011	15/12/2011	18/10/2012
<b>Ammonia</b>	0.21	0.23	0.07	0.06	<0.05
(mg/L, LOR = 0.01)					
<b>Nitrite</b>	<0.01	<0.01	<0.01	<0.01	<0.01
(mg/L, LOR = 0.01)					
<b>Nitrate</b>	0.05	<0.01	<0.01	0.06	0.05
(mg/L, LOR = 0.01)					
<b>NO<sub>x</sub></b>	0.05	<0.01	<0.01	0.06	0.05
(mg/L, LOR = 0.01)					
<b>TKN</b>	6.4	1.5	3	1.5	3.3
(mg/L, LOR = 0.1)					
<b>Total Nitrogen</b>	6.5	1.5	3	1.6	3.4
(mg/L, LOR = 0.1)					
<b>Reactive P</b>	<0.01	<0.01	<0.01	<0.01	<0.01
(mg/L, LOR = 0.01)					
<b>Total P</b>	0.34	0.19	0.16	0.14	0.2
(mg/L, LOR = 0.01)					

Table E. 7: Groundwater quality at Bore 6 as provided by TME

Analyte	26/10/2010	18/04/2011	21/10/2011	15/12/2011	18/10/2012
<b>OH<sup>-</sup> Alkalinity</b>	<1	<1	<1	<1	Dry
(mg/L, LOR = 1)					
<b>CO<sub>3</sub><sup>2-</sup> Alkalinity</b>	<1	<1	<1	<1	
(mg/L, LOR = 1)					
<b>HCO<sub>3</sub><sup>-</sup> Alkalinity</b>	5	38	<1	39	
(mg/L, LOR = 1)					

Table E. 7: Groundwater quality at Bore 6 as provided by TME (continued)

Analyte	26/10/2010	18/04/2011	21/10/2011	15/12/2011	18/10/2012
<b>Total Alkalinity</b>	5	38	<1	39	
(mg/L, LOR = 1)					
<b>Aluminium</b>	20	146	2.84	30.4	
(mg/L, LOR = 0.01)					
<b>Arsenic</b>	<0.001	0.066	0.002	0.031	
(mg/L, LOR = 0.001)					
<b>Cadmium</b>	<0.0001	<0.0010	<0.0001	<0.0001	
(mg/L, LOR = 0.0001)					
<b>Chromium</b>	0.017	0.09	0.002	0.023	
(mg/L, LOR = 0.001)					
<b>Copper</b>	0.042	0.104	0.005	0.029	
(mg/L, LOR = 0.001)					
<b>Lead</b>	0.022	0.12	0.003	0.021	
(mg/L, LOR = 0.001)					
<b>Manganese</b>	0.047	0.088	0.031	0.044	
(mg/L, LOR = 0.001)					
<b>Zinc</b>	0.058	<0.052	0.018	0.033	
(mg/L, LOR = 0.005)					
<b>Iron</b>	21.6	114	3.47	31.2	
(mg/L, LOR = 0.05)					
<b>Ammonia</b>	0.11	0.25	0.05	0.11	
(mg/L, LOR = 0.01)					
<b>Nitrite</b>	0.01	<0.01	<0.01	<0.01	
(mg/L, LOR = 0.01)					
<b>Nitrate</b>	2.76	0.01	0.24	0.68	
(mg/L, LOR = 0.01)					

Table E. 7: Groundwater quality at Bore 6 as provided by TME (continued)

Analyte	26/10/2010	18/04/2011	21/10/2011	15/12/2011	18/10/2012
<b>NO<sub>x</sub></b>	2.77	0.01	0.24	0.68	
(mg/L, LOR = 0.01)					
<b>TKN</b>	3.5	9.2	1.2	4.2	
(mg/L, LOR = 0.1)					
<b>Total Nitrogen</b>	6.3	9.2	1.4	4.9	
(mg/L, LOR = 0.1)					
<b>Reactive P</b>	0.01	<0.01	1.64	0.05	
(mg/L, LOR = 0.01)					
<b>Total P</b>	1.69	0.79	2	4.6	
(mg/L, LOR = 0.01)					

Table E. 8: Groundwater quality at Bore 7 as provided by TME

Analyte	26/10/2010	18/04/2011	21/10/2011	15/12/2011	18/10/2012
<b>OH<sup>-</sup> Alkalinity</b>	<1		<1	<1	<1
(mg/L, LOR = 1)					
<b>CO<sub>3</sub><sup>2-</sup> Alkalinity</b>	<1		<1	<1	<1
(mg/L, LOR = 1)					
<b>HCO<sub>3</sub><sup>-</sup> Alkalinity</b>	12		28	33	29
(mg/L, LOR = 1)					
<b>Total Alkalinity</b>	12		28	33	29
(mg/L, LOR = 1)					
<b>Aluminium</b>	23.8		15	11.7	
(mg/L, LOR = 0.01)					
<b>Arsenic</b>	<0.001		0.001	<0.001	
(mg/L, LOR = 0.001)					

Table E. 8: Groundwater quality at Bore 7 as provided by TME (continued)

Analyte	26/10/2010	18/04/2011	21/10/2011	15/12/2011	18/10/2012
<b>Cadmium</b>	<0.0001		0.0001	<0.0001	
<i>(mg/L, LOR = 0.0001)</i>					
<b>Chromium</b>	0.041		0.018	0.018	
<i>(mg/L, LOR = 0.001)</i>					
<b>Copper</b>	0.073		0.053	0.041	
<i>(mg/L, LOR = 0.001)</i>					
<b>Lead</b>	0.022		0.029	0.012	
<i>(mg/L, LOR = 0.001)</i>					
<b>Manganese</b>	0.075		0.074	0.032	
<i>(mg/L, LOR = 0.001)</i>					
<b>Zinc</b>	0.18		0.026	0.022	
<i>(mg/L, LOR = 0.005)</i>					
<b>Iron</b>	33.5		19.7	18.1	
<i>(mg/L, LOR = 0.05)</i>					
<b>Ammonia</b>	0.05		0.01	0.1	<0.01
<i>(mg/L, LOR = 0.01)</i>					
<b>Nitrite</b>	<0.01		<0.01	<0.01	<0.01
<i>(mg/L, LOR = 0.01)</i>					
<b>Nitrate</b>	0.13		<0.01	0.06	0.01
<i>(mg/L, LOR = 0.01)</i>					
<b>NO<sub>x</sub></b>	0.13		<0.01	0.06	0.01
<i>(mg/L, LOR = 0.01)</i>					
<b>TKN</b>	1.5		7.4	2.9	5.8
<i>(mg/L, LOR = 0.1)</i>					
<b>Total Nitrogen</b>	1.6		7.4	3	5.8
<i>(mg/L, LOR = 0.1)</i>					



Table E. 8: Groundwater quality at Bore 7 as provided by TME (continued)

Analyte	26/10/2010	18/04/2011	21/10/2011	15/12/2011	18/10/2012
<b>Reactive P</b>	0.01		<0.01	<0.01	<0.01
(mg/L, LOR = 0.01)					
<b>Total P</b>	0.31		0.56	0.24	0.85
(mg/L, LOR = 0.01)					

Table E. 9: Groundwater quality at Bore 8 as provided by TME

Analyte	26/10/2010	18/04/2011	21/10/2011	15/12/2011	18/10/2012
<b>OH<sup>-</sup> Alkalinity</b>	<1		<1	<1	<1
(mg/L, LOR = 1)					
<b>CO<sub>3</sub><sup>2-</sup> Alkalinity</b>	<1		<1	<1	<1
(mg/L, LOR = 1)					
<b>HCO<sub>3</sub><sup>-</sup> Alkalinity</b>	59		<1	10	8
(mg/L, LOR = 1)					
<b>Total Alkalinity</b>	59		<1	10	8
(mg/L, LOR = 1)					
<b>Aluminium</b>	8.3		28.2	20.3	
(mg/L, LOR = 0.01)					
<b>Arsenic</b>	<0.001		0.001	<0.001	
(mg/L, LOR = 0.001)					
<b>Cadmium</b>	<0.0001		<0.0001	<0.0001	
(mg/L, LOR = 0.0001)					
<b>Chromium</b>	0.019		0.052	0.04	
(mg/L, LOR = 0.001)					
<b>Copper</b>	0.031		0.151	0.069	
(mg/L, LOR = 0.001)					

Table E. 9: Groundwater quality at Bore 8 as provided by TME (continued)

Analyte	26/10/2010	18/04/2011	21/10/2011	15/12/2011	18/10/2012
<b>Lead</b>	0.01		0.068	0.035	
<i>(mg/L, LOR = 0.001)</i>					
<b>Manganese</b>	0.205		0.075	0.044	
<i>(mg/L, LOR = 0.001)</i>					
<b>Zinc</b>	0.055		0.046	0.031	
<i>(mg/L, LOR = 0.005)</i>					
<b>Iron</b>	21.2		45.2	43.9	
<i>(mg/L, LOR = 0.05)</i>					
<b>Ammonia</b>	0.05		0.02	<0.05	0.01
<i>(mg/L, LOR = 0.01)</i>					
<b>Nitrite</b>	<0.01		<0.01	<0.01	<0.01
<i>(mg/L, LOR = 0.01)</i>					
<b>Nitrate</b>	0.02		<0.01	0.03	0.03
<i>(mg/L, LOR = 0.01)</i>					
<b>NO<sub>x</sub></b>	0.02		<0.01	0.03	0.03
<i>(mg/L, LOR = 0.01)</i>					
<b>TKN</b>	2.2		7.2	3.3	2.6
<i>(mg/L, LOR = 0.1)</i>					
<b>Total Nitrogen</b>	2.2		7.2	3.3	2.6
<i>(mg/L, LOR = 0.1)</i>					
<b>Reactive P</b>	<0.01		0.03	<0.01	<0.01
<i>(mg/L, LOR = 0.01)</i>					
<b>Total P</b>	0.52		1.06	0.55	0.22
<i>(mg/L, LOR = 0.01)</i>					

Table E. 10: Groundwater quality at Bore 9 as provided by TME

Analyte	26/10/2010	18/04/2011	21/10/2011	15/12/2011	18/10/2012
<b>OH<sup>-</sup> Alkalinity</b>	<1	<1	<1	<1	Dry
<i>(mg/L, LOR = 1)</i>					
<b>CO<sub>3</sub><sup>2-</sup> Alkalinity</b>	<1	<1	<1	<1	
<i>(mg/L, LOR = 1)</i>					
<b>HCO<sub>3</sub><sup>-</sup> Alkalinity</b>	55	<1	<1	21	
<i>(mg/L, LOR = 1)</i>					
<b>Total Alkalinity</b>	55	<1	<1	21	
<i>(mg/L, LOR = 1)</i>					
<b>Aluminium</b>	11.6	31.8	23.3	20.2	
<i>(mg/L, LOR = 0.01)</i>					
<b>Arsenic</b>	<0.001	0.011	0.002	0.002	
<i>(mg/L, LOR = 0.001)</i>					
<b>Cadmium</b>	<0.0001	0.0001	<0.0001	<0.0001	
<i>(mg/L, LOR = 0.0001)</i>					
<b>Chromium</b>	0.018	0.06	0.022	0.021	
<i>(mg/L, LOR = 0.001)</i>					
<b>Copper</b>	0.056	0.125	0.084	0.051	
<i>(mg/L, LOR = 0.001)</i>					
<b>Lead</b>	0.019	0.073	0.025	0.014	
<i>(mg/L, LOR = 0.001)</i>					
<b>Manganese</b>	0.084	0.193	0.121	0.094	
<i>(mg/L, LOR = 0.001)</i>					
<b>Zinc</b>	0.033	0.061	0.018	0.033	
<i>(mg/L, LOR = 0.005)</i>					
<b>Iron</b>	22	169	37.4	34.6	
<i>(mg/L, LOR = 0.05)</i>					

Table E. 10: Groundwater quality at Bore 9 as provided by TME (continued)

Analyte	26/10/2010	18/04/2011	21/10/2011	15/12/2011	18/10/2012
<b>Ammonia</b>	0.11	<0.10	0.07	0.06	
<i>(mg/L, LOR = 0.01)</i>					
<b>Nitrite</b>	<0.01	<0.01	<0.01	<0.01	
<i>(mg/L, LOR = 0.01)</i>					
<b>Nitrate</b>	<0.01	0.03	<0.01	0.04	
<i>(mg/L, LOR = 0.01)</i>					
<b>NO<sub>x</sub></b>	<0.01	0.03	<0.01	0.04	
<i>(mg/L, LOR = 0.01)</i>					
<b>TKN</b>	4.3	29.8	11	3.9	
<i>(mg/L, LOR = 0.1)</i>					
<b>Total Nitrogen</b>	4.3	29.8	11	3.9	
<i>(mg/L, LOR = 0.1)</i>					
<b>Reactive P</b>	<0.01	<0.01	<0.01	<0.01	
<i>(mg/L, LOR = 0.01)</i>					
<b>Total P</b>	0.3	2.52	1.79	0.7	
<i>(mg/L, LOR = 0.01)</i>					

# Appendix F

Groundwater Monitoring Report





# Groundwater Levels & Quality Monitoring Report

## Lot 103 Harris Road & 96 Martin Pelusey Road, Picton East



Research, Design & Delivery of  
Sustainable Development

## DOCUMENT QUALITY CONTROL

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15.03.2012

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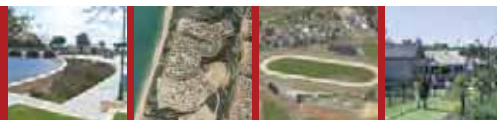
<b>No.</b>	<b>Purpose</b>	<b>Date</b>
<b>1</b>	<b>Submission to client</b>	<b>21.03.2012</b>
<b>2</b>	<b>Revisions for Client</b>	<b>02.04.2012</b>

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## EXECUTIVE SUMMARY

*TME Town Planning Management Engineering Pty Ltd* (TME) has prepared this report on behalf of Harris Road Pty Ltd for the proposed industrial development. The subject land consists of Lot 103 on Diagram 96575 Harris Road and Lot 603 on Plan 246179 (96) Martin Pelusey Road, Picton East (see *Figure 1*).

The subject land is located in an area that exhibits high groundwater levels, including Multiple Use wetlands. This necessitated the requirement for monitoring of the superficial groundwater level across the land as per advice provided by the Department of Water. The Department of Water also required monitoring of physical and chemical parameters of the groundwater on-site due to the risks involved with the industrial nature of the development, and the close proximity of the Ferguson River to the subject land.

TME monitored groundwater levels at 9 monitoring bore sites across the subject land with regular measurements between October 2010 and December 2011. Quarterly quality sampling was undertaken at all bores over a period of 14 months.

The rainfall from April to December 2011 was approximately within the 50<sup>th</sup> percentile or greater for the land. However May and July were lower, approximately 40<sup>th</sup> and 20<sup>th</sup> percentiles respectively. The total rainfall during this period was less than 10mm greater than the long term average total. This data suggest that 2011 was a representative year for the average rainfall at the subject land, which therefore suggests that the seasonal peak high groundwater levels measured would be close the average annual maximum groundwater level (AAMGL).

The quality sampling of the groundwater found that Total Nitrogen and Total Phosphorus levels on the subject land exceeded the ANZECC and Department of Water Swan Coastal Plain trigger values. These results were however not unexpected given the past agricultural land uses. Iron and Aluminium also had high concentrations, however this is typical of the natural soils on the Swan Coastal Plain.

The subject land's high seasonal groundwater levels were modelled at less than 1 metre below the surface level across the majority of the subject land.

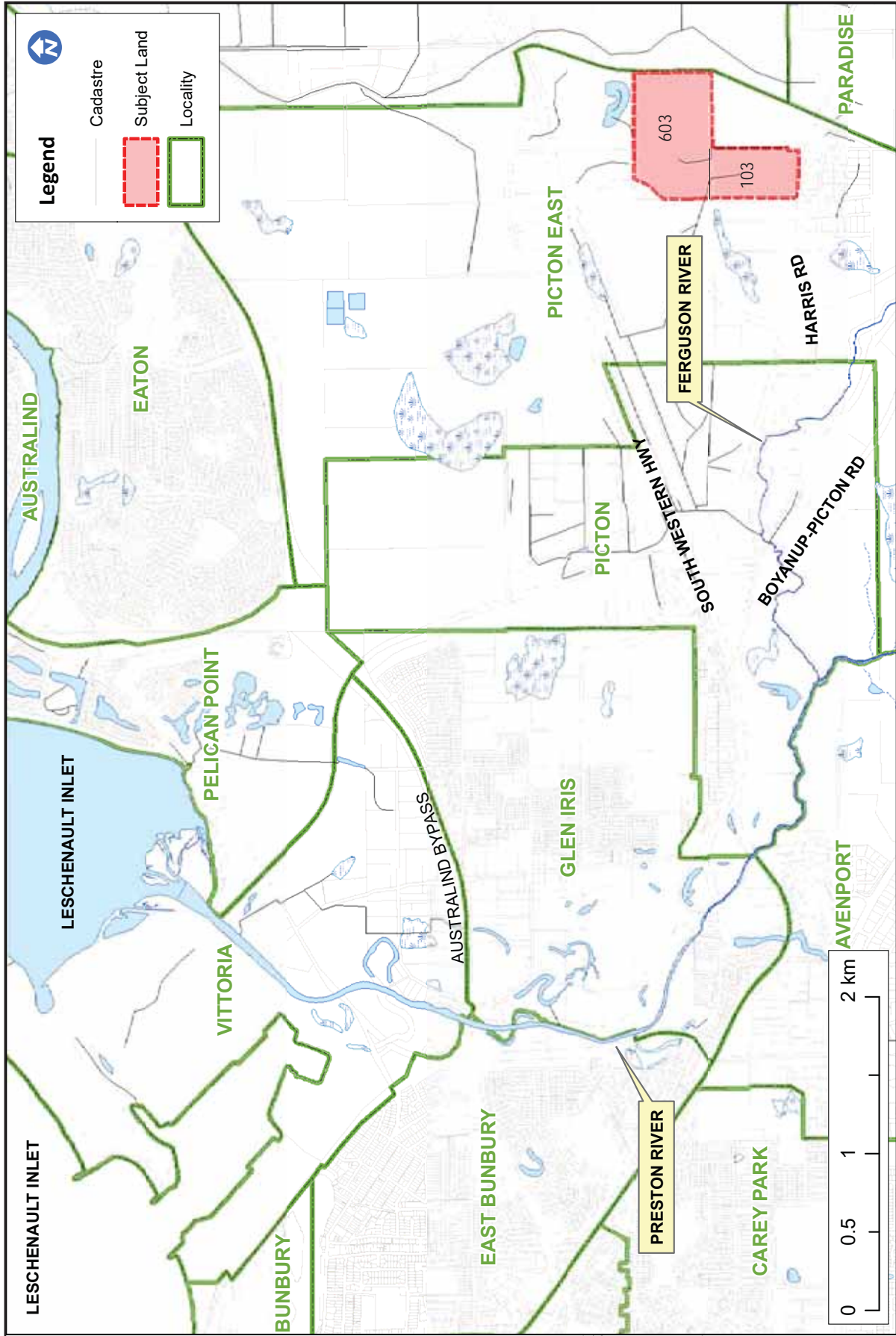


Figure 1 - Location Plan



## METHODOLOGY

In September 2010 9 water table monitoring bores were installed on the subject land and TME verified their installation (see *Figure 2* for locations). Monitoring bores were constructed to an average depth of 3m below the natural surface level. PVC casing pipes with slots were placed within the holes and the bottom of the pipe was capped. The monitoring bores were finished with free draining sand backfill and a bentonite plug.

TME monitored groundwater levels from October 2010 to December 2011. A total of 12 measurements were taken for each monitoring bore site during this period of time. All measurements were undertaken on the same day for every monitoring bore.

To obtain the measurement of the groundwater's level, an electrical sounder groundwater probe was lowered into the pipe until it signalled that it had reached the water table. The depth was recorded, and in the office the pipe height above the surface level was subtracted from the recorded measurement to ascertain the depth to the groundwater from the ground's surface.

Groundwater quality samples were taken from each of monitoring bores on 4 separate occasions in October 2010, April, October and December 2011. Physical and chemical parameters of the groundwater were tested. The physical parameters were measured in the field, and samples were taken and submitted to ALS Laboratory Group (NATA Accredited) for chemical analysis.

The physical and chemical parameters sampled from each of the monitoring bores are listed below. The trigger values used for analysis are shown in *Appendix 2*.

### *Physical Parameters*

- Temperature
- pH
- Conductivity
- Dissolved oxygen
- Oxidation reduction potential
- Salinity

### **Chemical Parameters**

- Alkalinity
- Nitrate-N
- Nitrite-N
- Ammonia-N
- Total Kjeldahl Nitrogen (TKN)
- Total Nitrogen (TN)
- Total Phosphorus (TP)
- Reactive Phosphorus
- Metals (Aluminium, Arsenic, Cadmium, Chromium, Copper, Lead, Manganese, Zinc and Iron)



Figure 2 - Monitoring Program and Groundwater Contour Plan



## RESULTS

### LEVELS

The general trend observed in the groundwater records across all bores was an increase in depths to groundwater (i.e. a lower groundwater table) between September and April or May, and a decrease in depths to groundwater (i.e. a rising groundwater table) between April or May and September (see *Figure 3*).

The following table (*Table 1*) summarises the highest seasonal groundwater levels (HSGL) and lowest seasonal groundwater levels (LSGL) recorded and the months when recorded, also the seasonal range of groundwater levels is included. All records within this report's tables are relative to the distance (in millimetres) of the water below the natural surface level measured at each monitoring bore.

For full details of recordings for each monitoring bore site please refer to *Appendix 1*.

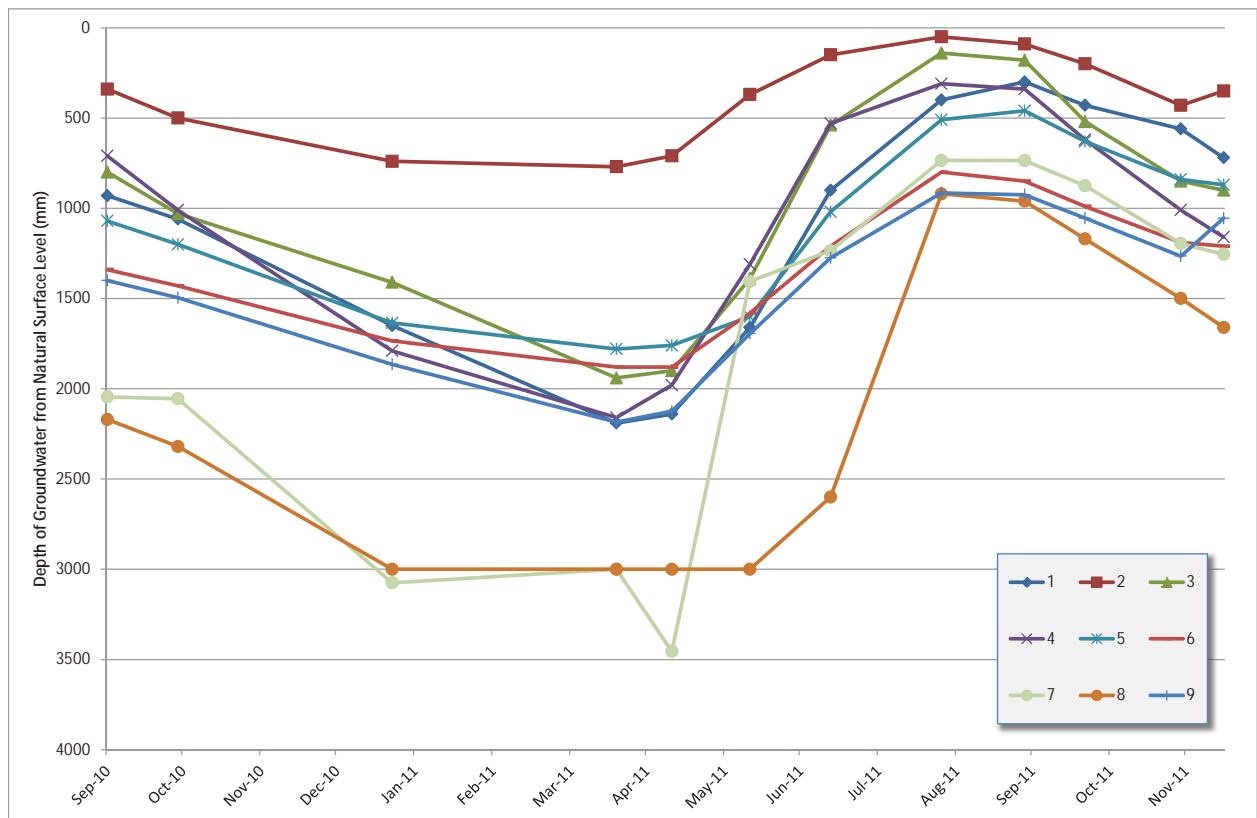


Figure 3 - Groundwater Hydrograph



Monitoring Bore No.	HSGL (mm)	Date(s) Recorded	LSGL (mm)	Date(s) Recorded	Range (mm)
1	300	Sep-11	2190	Apr-11	1890
2	50	Aug-11	770	Apr-11	720
3	140	Aug-11	1940	Apr-11	1800
4	310	Aug-11	2160	Apr-11	1850
5	460	Sep-11	1780	Apr-11	1320
6	80	Aug-11	1880	Apr to May-11	1080
7	735	Aug to Sep-11	DRY (>3000)	Apr-11	>2265
8	920	Aug-11	DRY (>3000)	Jan to Jun-11	>2080
9	915	Aug-11	2185	Apr-11	1270

*Table 1 - Summary of Groundwater Levels Monitoring Results*

The '>' recordings for the monitoring bores were made when no water was present within the bore's pipe when monitored. This meant that at the time of measurement, the groundwater level was lower than the base of the bore.

#### PHYSICAL PARAMETERS

The physical parameter results for the four sample runs for each monitoring bore are shown in *Appendix 3*. The sample records were compared to the Australian Drinking Water Guidelines (ADWG) and ANZECC Guidelines for south Western Australia.

The pH across the site was generally low (slightly acidic) with pH results predominantly between 5.01 and 6.71, which is generally below the ANZECC trigger value for surface waters in wetlands (7.0) and for the ADWG (aesthetic only) range of 6.5 to 8.

The dissolved oxygen saturated percentages were significantly less than the minimum value of 85%. These values however are based on surface water values, and are not an accurate in comparison to groundwater values, as there is minimal interaction to the atmosphere to oxygenate the water.

#### CHEMICAL PARAMETERS

##### *Total Nitrogen (TN)*

Each bore had at least one sample that exceeded the Swan Coastal Plain target value of 1.0mg/L. The concentrations ranged from 0.4 to 29.8mg/L. The majority of the nitrogen is comprised of Total Kjeldahl Nitrogen (TKN). Results are shown in *Table 2*.



Monitoring Bore	Total Nitrogen (mg/L)			
	26/10/2010	18/04/2011	21/10/2011	15/12/2011
1	0.6	1.2	8.0	4.8
2	5.0	4.4	2.4	3.0
3	6.8	4.5	3.9	2.5
4	0.8	0.4	4.2	1.3
5	6.5	1.5	3.0	1.6
6	6.3	9.2	1.4	4.9
7	1.6		7.4	3.0
8	2.2		7.2	3.3
9	4.3	29.8	11.0	3.9

*Table 2 – Total Nitrogen Sample Results.*

The yellow cell indicates that the value exceeds the Swan Coastal Plain trigger value (1.0mg/L), green cell indicates that the value exceeds the ANZECC wetland river trigger value (1.5mg/L), and orange cell indicated the value exceeds the ANZECC long-term irrigation trigger value (5.0mg/L).

*Total Phosphorus (TP)*

The sample results exceeded the Swan Coastal Plain target value of 0.1 mg/L for all runs at all bores, except for Bore 4's sample in April 2011. The TP ranged from 0.03 to 2.52mg/L. The results are shown in *Table 3*.

Monitoring Bore	Total Phosphorous (mg/L)			
	26/10/2010	18/04/2011	21/10/2011	15/12/2011
1	0.07	0.13	0.58	0.31
2	0.29	0.19	0.14	0.31
3	0.54	0.43	0.24	0.26
4	0.24	0.03	0.42	0.14
5	0.34	0.19	0.16	0.14
6	1.69	0.79	2.00	4.60
7	0.31		0.56	0.24
8	0.52		1.06	0.55
9	0.30	2.52	1.79	0.70

*Table 3 – Total Phosphorus Sample Results.*

The green cell indicates that the value exceeds the ANZECC wetland river trigger value (0.06mg/L), and the yellow cell indicates that the value exceeds the Swan Coastal Plain trigger value (0.1mg/L).



### Total Metals

From the results two metals are of note. Aluminium (Al) and Iron (Fe) regularly exceeded all trigger values (including short and long term irrigation). The maximum Aluminium recorded was at Bore 6, with a result of 146.0mg/L. This exceeds the short-term irrigation trigger value by 126mg/L. The lowest Aluminium record was 2.15mg/L at Bore 5, which is lower than the short-term (20mg/L) and long-term (5mg/L) irrigation trigger values

The other metal of note was Iron, with results regularly exceeding the short-term irrigation trigger value of 10mg/L. Bore 6 also recorded the highest Iron sample (146mg/L) in the same sampling period (18<sup>th</sup> April 2011), which is 136mg/L higher than the short-term irrigation trigger value. The lowest Iron record was 3.47mg/L at Bore 6 (6 months after recording the highest Iron value for the whole land).

The full results from the metal samples and remaining quality parameters tested are shown in *Appendix 4*.

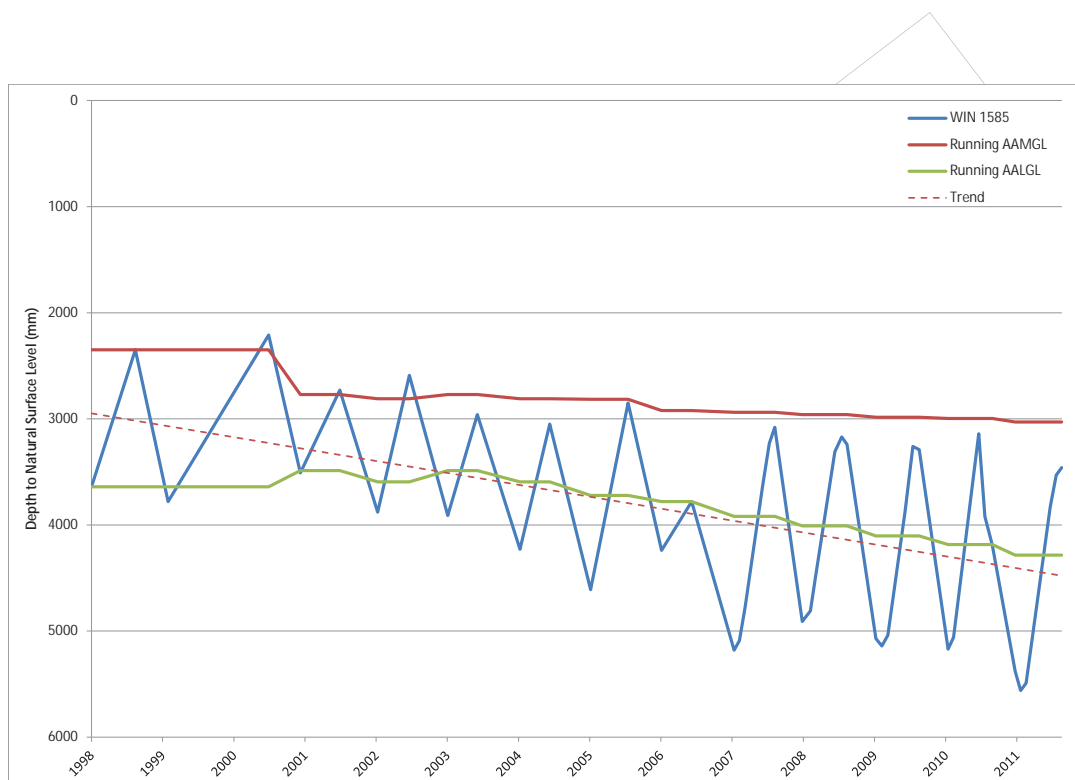


Figure 4 - DoW Bore (WIN 1585) Hydrograph





## DISCUSSION

### COMPARISON TO DEPARTMENT OF WATER MONITORING BORES

To ascertain the long-term water table patterns for the subject land a query of all the Department of Water (DoW) shallow groundwater monitoring bores within a 3km radius of the subject land was undertaken

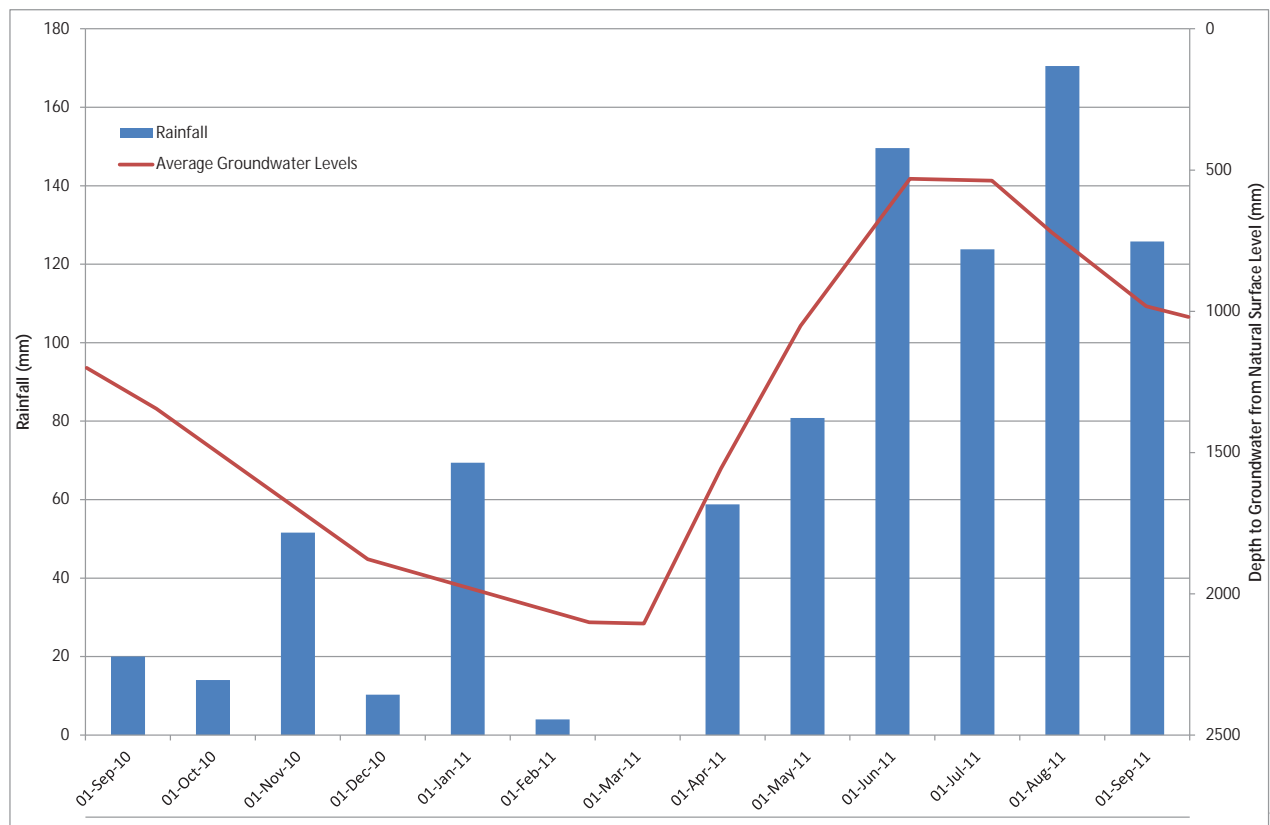


Figure 5 - Rainfall Hydrograph

by DoW on TME's behalf. Only one monitoring bores was determined to provide information considered marginally useful to compare with the subject land.

The monitoring bore shows a falling trend in the groundwater table since the commencement of records in 1998 (see Figure 4). The AAMGL at bore (WIN ID) 1585 has fallen over 650mm since 1998, and the 2011 highest peak level was 800mm deeper than the AAMGL in 1998. The AAMGL and average annual lowest groundwater level (AALGL) have steadily deepened since 1998.

The on-site drainage of surface water on the subject land, and the presence of groundwater at the surface across the majority suggest that comparisons with the DoW bore are not that useful. The DoW bore's AAMGL is around 3000mm below the natural ground surface, whilst the deepest seasonal high peak on the subject land was less than 1000mm below the natural surface. The majority of the bores were within 100mm of the surface. This suggests the DoW bore does not have a similar on-site drainage infrastructure or ponding of groundwater on the land as is evident at the subject land. The general trends observed in the DoW bore are the only real useful information available for comparison to the subject land.

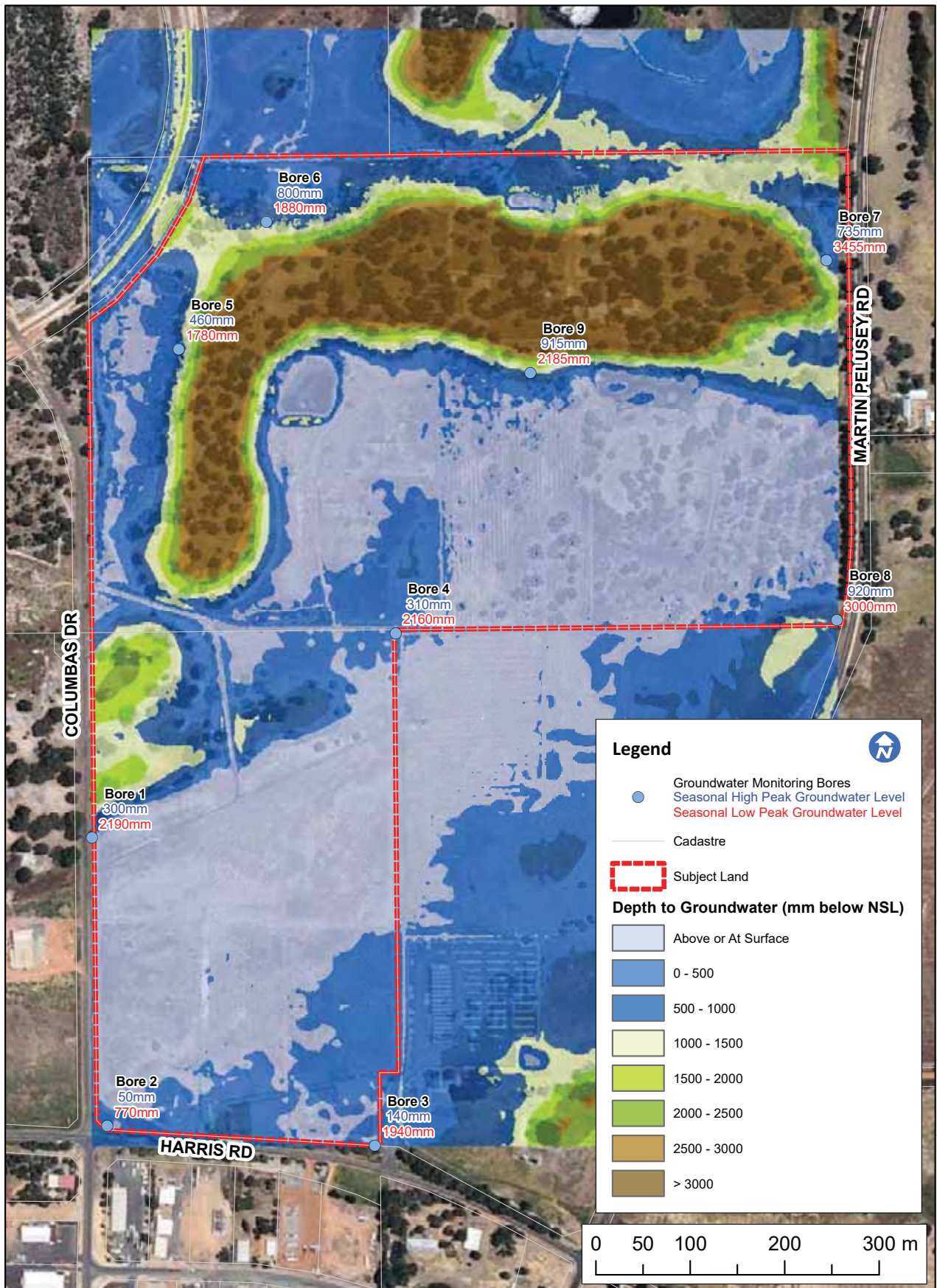


Figure 6 - Depth to Groundwater



### **COMPARISON TO RAINFALL PATTERNS**

The graph in *Figure 5* visually depicts a relationship between rainfall events and the water table level. The groundwater levels rose closer to the surface as rainfall increased. This implies that rainfall may directly recharge the shallow groundwater table at the site, and that there is little influence on the shallow water table from flows outside of the site.

### **DEPTH TO AVERAGE ANNUAL MAXIMUM GROUNDWATER LEVELS (AAMGL)**

The depth to the AAMGL across the subject land has been modelled in *Figure 6*. The depth to AAMGL for each bore was derived from modelling the groundwater contours for the site, and then subtracting the natural surface levels from these contours. There was no adjustment of the seasonal high peaks against the DoW bore because of the issues discussed in the last paragraph of the DoW comparison section, i.e. direct comparisons of the subject land and DoW bore were unrepresentative.

*Figure 8* shows that the groundwater depth is very shallow (less than 1m below natural surface level) for the majority of the subject land (shades of blue). It would be expected that groundwater levels may be shallower than modelled for the maximum groundwater levels (MGL). The ridge in the north is clearly visible in the model by the dark brown shading. This represents areas where the groundwater is greater than 3m below the natural surface level.

### **QUALITY**

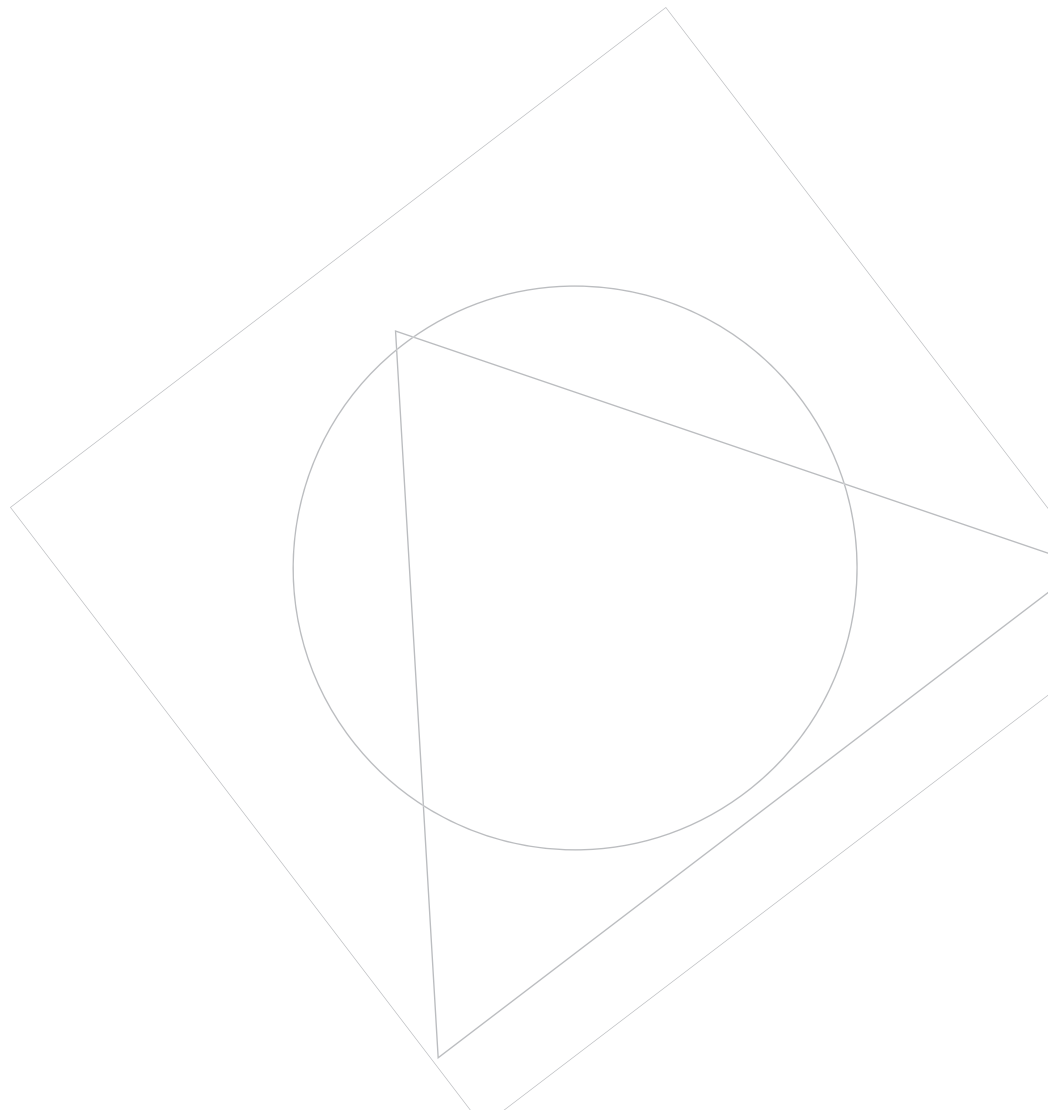
The high values of TN and TP within the groundwater were not unexpected given the past land use and presence of wetlands on the subject land. Sources of TN would include plant decay, animal wastes (especially from previous livestock grazing) and the use of fertilisers. The TP sources would primarily be from the agricultural practices on the land. Phosphorus and nitrogen in high concentrations (as recorded on the subject land) indicate the potential for algal growth and blooms in receiving water bodies, including the surrounding wetlands. The removal of stock and reduction of fertilisers on the land could assist in reducing TN and TP concentrations.

The sands on the Swan Coastal Plain are coated with both iron and aluminium oxides, and are the reason for the high concentrations of Aluminium and Iron recorded on the site. The high Iron and Aluminium concentrations in the groundwater may also suggest that these metals are coating the sand grains, which may increase the sands capacity to retain phosphorus. The Iron and Aluminium concentrations at each bore did at one stage exceed the guidelines for short and long term irrigation uses.

## **CONCLUSION**

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The results of this monitoring program should be utilised in any future studies and/or designs that require site specific information regarding groundwater levels (especially seasonal highs) and quality data. The results from 2011 provide a representative seasonal high level to model an maximum groundwater level for the subject land, which can be used for detailed designs.



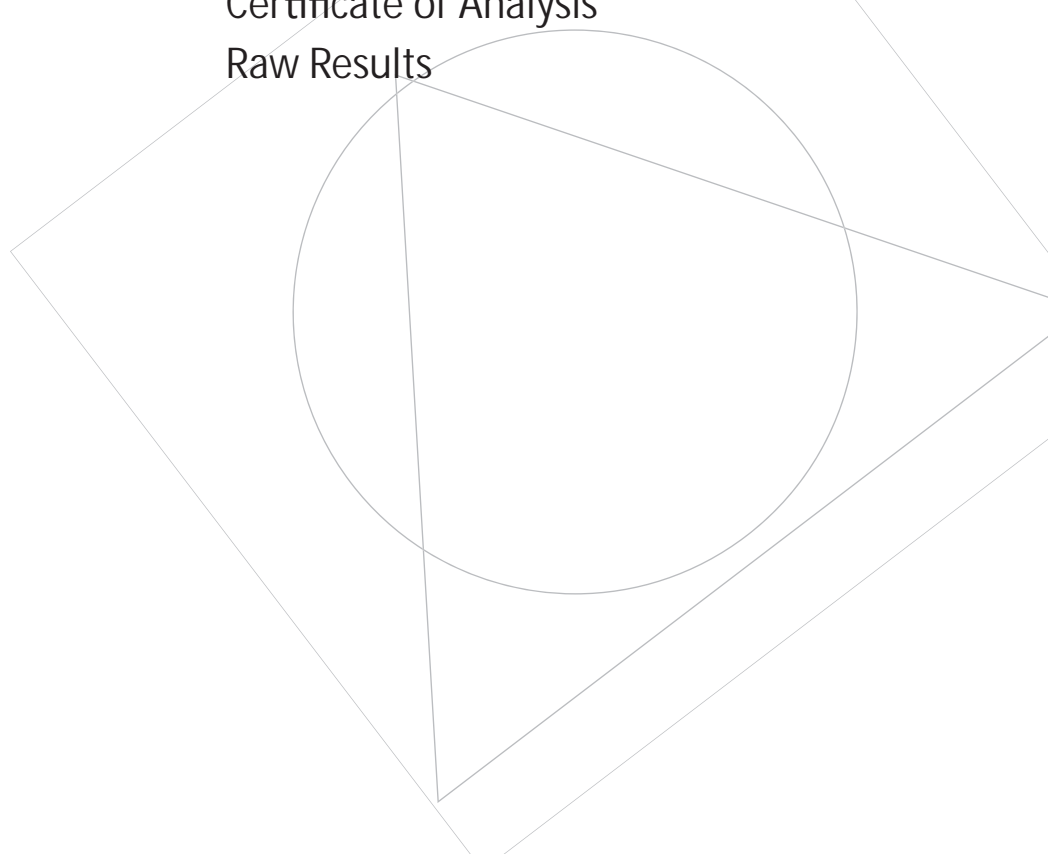


# APPENDICES

- Appendix 1 - Field Sheet Level Measurements
- Appendix 2 - Trigger Values for Water Quality
- Appendix 3 - Quality (Physical Parameters) Results
- Appendix 4 - Complete Quality Results
- Appendix 5 - Enclosed CD

Certificate of Analysis

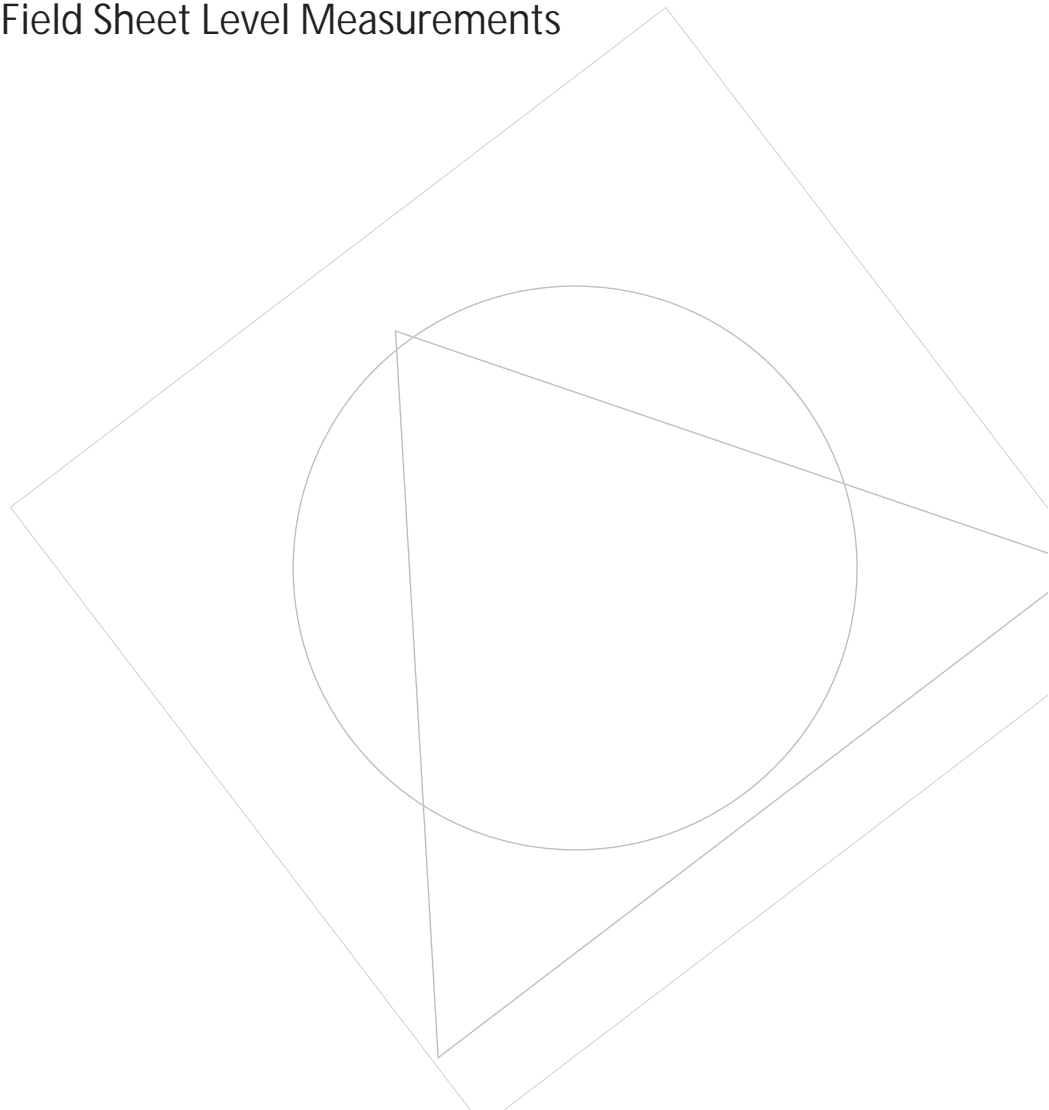
Raw Results





# APPENDIX 1

## Field Sheet Level Measurements



## TME Groundwater Monitoring Program - Field Sheets

**Project Name:** Harris Road Groundwater Monitoring

**Client:** Harris Road Pty Ltd

**Job No:** 10334

*Bore Number:* 1

*Eastings:* 381439.00

*Northings:* 6308872.00

*Height of TOC above Surface Level (mm):*

480

Date	Depth to Water (mm)	Groundwater Level (mm)	Comments
28/09/2010	1410	930	
26/10/2010	1540	1060	
19/01/2011	2130	1650	
18/04/2011	2670	2190	
10/05/2011	2620	2140	
10/06/2011	2140	1660	
12/07/2011	1380	900	
25/08/2011	880	400	
27/09/2011	780	300	
21/10/2011	910	430	
28/11/2011	1040	560	
15/12/2011	1200	720	

*Bore Number:* 2

*Eastings:* 381455.00

*Northings:* 6308567.00

*Height of TOC above Surface Level (mm):*

530

Date	Depth to Water (mm)	Groundwater Level (mm)	Comments
28/09/2010	870	340	
26/10/2010	1030	500	
19/01/2011	1270	740	
18/04/2011	1300	770	
10/05/2011	1240	710	
10/06/2011	900	370	
12/07/2011	680	150	
25/08/2011	580	50	
27/09/2011	620	90	
21/10/2011	730	200	
28/11/2011	960	430	
15/12/2011	880	350	

**Project Name:** Harris Road Groundwater Monitoring

**Client:** Harris Road Pty Ltd

**Job No:** 10334

**Bore Number:**

**Eastings:** 381739.00

**Northings:** 6308546.00

**Height of TOC above Surface Level (mm):**

440

Date	Depth to Water (mm)	Groundwater Level (mm)	Comments
28/09/2010	1240	800	
26/10/2010	1470	1030	
19/01/2011	1850	1410	
18/04/2011	2380	1940	
10/05/2011	2340	1900	
10/06/2011	1830	1390	
12/07/2011	980	540	
25/08/2011	580	140	
27/09/2011	620	180	
21/10/2011	960	520	
28/11/2011	1290	850	
15/12/2011	1340	900	

**Bore Number:**

**Eastings:** 381761.00

**Northings:** 6309089.00

**Height of TOC above Surface Level (mm):**

450

Date	Depth to Water (mm)	Groundwater Level (mm)	Comments
28/09/2010	1160	710	
26/10/2010	1460	1010	
19/01/2011	2240	1790	
18/04/2011	2610	2160	
10/05/2011	2430	1980	
10/06/2011	1760	1310	
12/07/2011	980	530	
25/08/2011	760	310	
27/09/2011	790	340	
21/10/2011	1070	620	
28/11/2011	1460	1010	
15/12/2011	1610	1160	



**Project Name:** Harris Road Groundwater Monitoring

**Client:** Harris Road Pty Ltd

**Job No:** 10334

*Bore Number:*

5
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*Eastings:* 381531.00

*Northings:* 6309390.00

*Height of TOC above Surface Level (mm):* 460

Date	Depth to Water (mm)	Groundwater Level (mm)	Comments
28/09/2010	1530	1070	
26/10/2010	1660	1200	
19/01/2011	2095	1635	
18/04/2011	2240	1780	
10/05/2011	2220	1760	
10/06/2011	2060	1600	
12/07/2011	1480	1020	
25/08/2011	970	510	
27/09/2011	920	460	
21/10/2011	1090	630	
28/11/2011	1300	840	
15/12/2011	1330	870	

*Bore Number:*

6
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*Eastings:* 381624.00

*Northings:* 6309525.00

*Height of TOC above Surface Level (mm):* 480

Date	Depth to Water (mm)	Groundwater Level (mm)	Comments
28/09/2010	1820	1340	
26/10/2010	1910	1430	
19/01/2011	2215	1735	
18/04/2011	2360	1880	
10/05/2011	2360	1880	
10/06/2011	2060	1580	
12/07/2011	1690	1210	
25/08/2011	1280	800	
27/09/2011	1330	850	
21/10/2011	1470	990	
28/11/2011	1670	1190	
15/12/2011	1690	1210	

**Project Name:** Harris Road Groundwater Monitoring

**Client:** Harris Road Pty Ltd

**Job No:** 10334

**Bore Number:**

7
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**Eastings:** 382218.00

**Northings:** 6309484.00

**Height of TOC above Surface Level (mm):** 495

Date	Depth to Water (mm)	Groundwater Level (mm)	Comments
28/09/2010	2540	2045	
26/10/2010	2550	2055	
19/01/2011	3570	3075	
18/04/2011	NA	DRY	No water encountered
10/05/2011	3950	3455	
10/06/2011	1900	1405	
12/07/2011	1730	1235	
25/08/2011	1230	735	
27/09/2011	1230	735	
21/10/2011	1370	875	
28/11/2011	1690	1195	
15/12/2011	1750	1255	

**Bore Number:**

8
---

**Eastings:** 382229.00

**Northings:** 6309103.00

**Height of TOC above Surface Level (mm):** 520

Date	Depth to Water (mm)	Groundwater Level (mm)	Comments
28/09/2010	2690	2170	
26/10/2010	2840	2320	
19/01/2011	NA	DRY	No water encountered
18/04/2011	NA	DRY	No water encountered
10/05/2011	NA	DRY	No water encountered
10/06/2011	NA	DRY	No water encountered
12/07/2011	3120	2600	
25/08/2011	1440	920	
27/09/2011	1480	960	
21/10/2011	1690	1170	
28/11/2011	2020	1500	
15/12/2011	2180	1660	

**Project Name:** Harris Road Groundwater Monitoring

**Client:** Harris Road Pty Ltd

**Job No:** 10334

**Bore Number:**

9
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**Eastings:** 381904.00

**Northings:** 6309365.00

**Height of TOC above Surface Level (mm):**

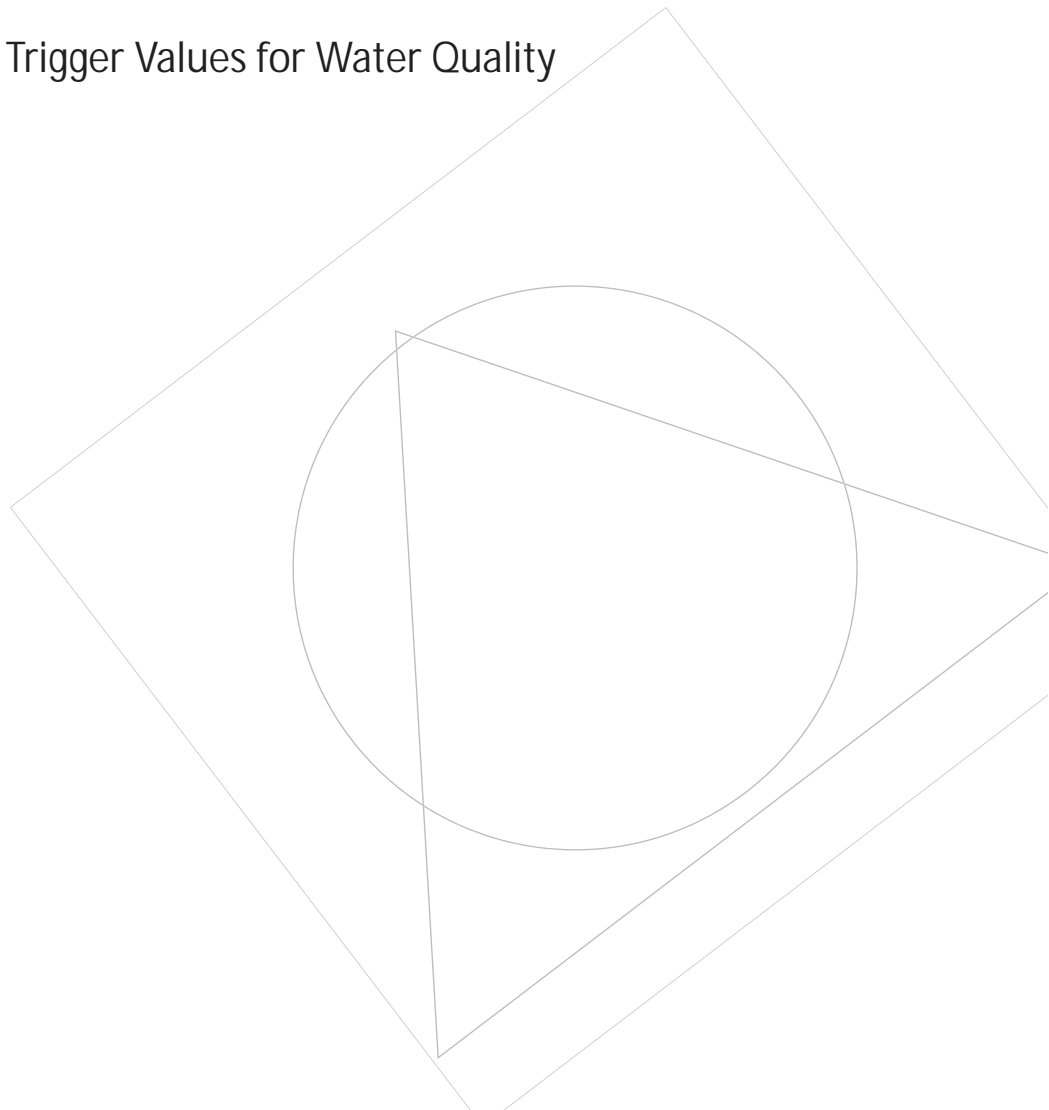
525

Date	Depth to Water (mm)	Groundwater Level (mm)	Comments
28/09/2010	1925	1400	
26/10/2010	2020	1495	
19/01/2011	2390	1865	
18/04/2011	2710	2185	
10/05/2011	2650	2125	
10/06/2011	2220	1695	
12/07/2011	1800	1275	
25/08/2011	1440	915	
27/09/2011	1450	925	
21/10/2011	1580	1055	
28/11/2011	1790	1265	
15/12/2011	1580	1055	



# APPENDIX 2

Trigger Values for Water Quality

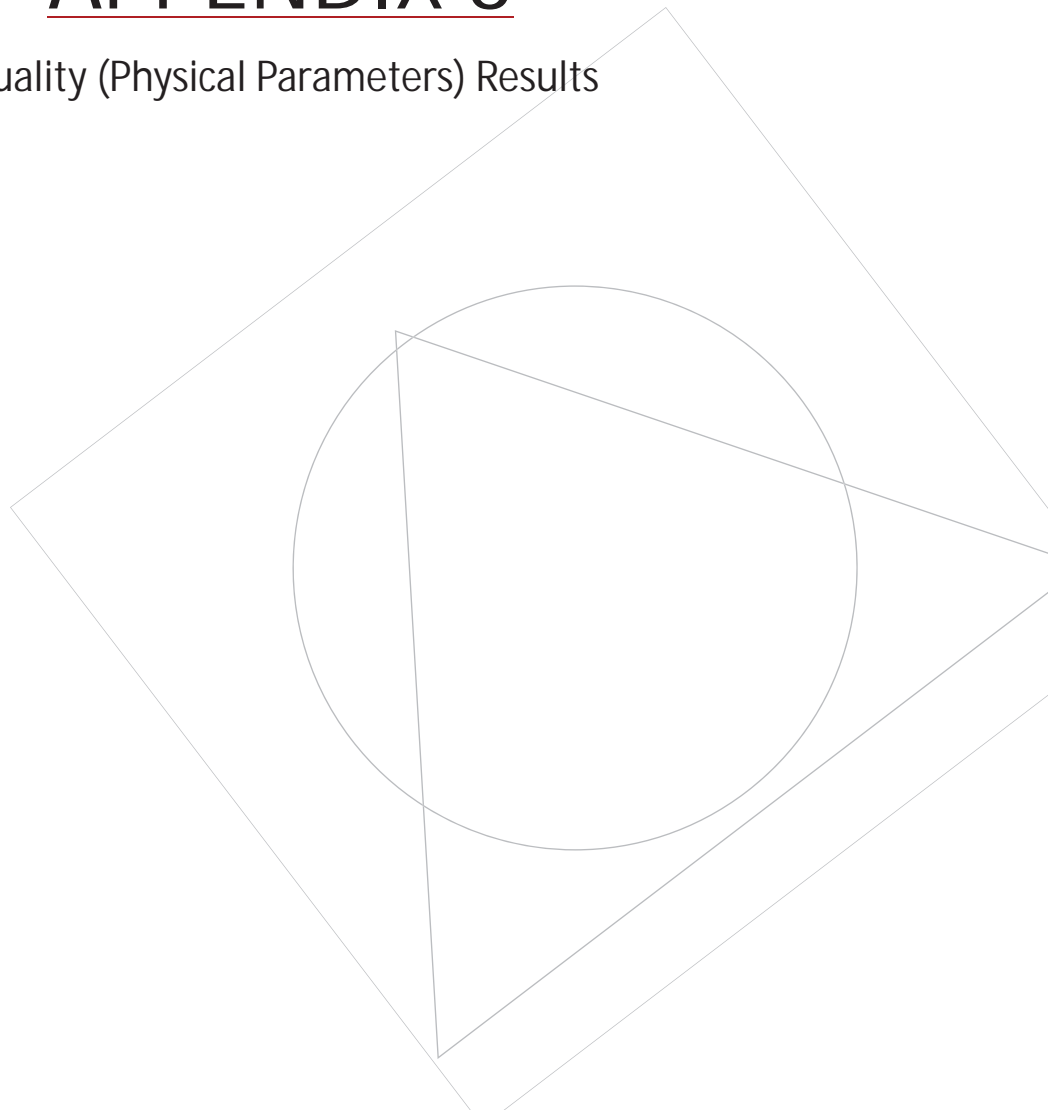


	ADWG (2004)		ANZECC (2000)		DoH (2006)		Swan Coastal Plain		ANZECC (2000)	
	Health	Aesthetic	Wetland	Non-Pot Gwater Use	WQIP	Long Term Irrigation	Short Term Irrigation			
TP	-	-	0.06	-	0.1	-	-			
FRP	-	-	0.03	-	-	-	-			
TN	-	-	1.5	-	1	5	-			
NO <sub>x</sub>	-	-	0.1	-	-	-	-			
Amonia (NH <sub>3</sub> )	-	0.5	0.9	5	-	-	-			
Nitrate	50	-	0.7	500	-	-	-			
Nitrite	3	-	-	30	-	-	-			
Ammonium (NH <sub>4</sub> )	-	-	0.04	5	-	-	-			
DO% (Sat)	-	85	90	120	-	-	-			
pH	-	6.5	7	8.5	-	6	8.5			
SPC (mS/cm)	-	-	0.3	1.5	-	-	-			
Sulfate (SO <sub>4</sub> )	500	250	-	5000	-	-	-			
Chloride	-	250	-	2500	-	-	-			
Aluminium	-	0.2	0.055	2	-	5	20			
Arsenic	0.007	-	0.024	0.07	-	0.1	2			
Cadmium	0.002	-	0.00002	0.02	-	0.01	0.05			
Chromium	0.05	-	-	0.5	-	0.1	1			
Copper	2	1	0.0014	20	-	0.2	5			
Iron	-	0.3	-	3	-	0.2	10			
Lead	0.001	-	0.0014	0.1	-	2	5			
Manganese	0.5	0.1	1.9	5	-	0.2	10			
Mercury (total)	0.001	-	0.0006	0.01	-	0.002	0.002			
Nickel	0.02	-	0.011	0.2	-	0.2	2			
Selenium (total)	0.01	-	0.011	0.1	-	0.02	0.05			
Zinc	-	3	0.008	30	-	2	5			



# APPENDIX 3

## Quality (Physical Parameters) Results



	Bore 1				Bore 2				Bore 3			
	26/10/2010	18/04/2011	21/10/2011	15/12/2011	26/10/2010	18/04/2011	21/10/2011	15/12/2011	26/10/2010	18/04/2011	21/10/2011	15/12/2011
Temperature (°C)	16.5	21.2	17.2	18.1	17.8	23.2	17.1	19.0	17.7	22.0	17.5	18.3
Conductivity SPC (mS/cm)	2.3140	2.0100	0.4200	2.1200	0.4221	0.4220	0.6700	1.5920	1.6290	3.0800	2.4000	3.3380
Dissolved Oxygen (ppm)	1.38	0.03	0.28	0.13	2.06	0.05	0.01	0.00	2.08	0.09	0.00	0.02
pH (scale)	6.07	5.86	5.42	5.94	6.71	6.41	6.30	5.90	6.64	6.00	6.22	6.24
Salinity (ppt)		1.11	0.20	1.09		0.21	0.33	0.81		1.71	1.24	1.76
Diss. Oxygen % (Saturated)	14.5	0.4	3.0	1.3	21.3	0.6	0.1	0.0	21.2	1.0	-0.2	0.2
ORP (mV)	24.8	-74.7	57.2	-186.5	-25.2	-156.6	-100.0	-150.5	103.2	58.0	54.0	-104.2

Table A

The green fill shown in the tables denotes the variable was outside of the ANZEC trigger value ranges for a wetland. However both these trigger values are based on surface water in wetlands and not groundwater in particular. The light green fill denotes the variable was less than the ADWG (aesthetic only) trigger value.

	Bore 4					Bore 5					Bore 6					
	26/10/2010	18/04/2011	21/10/2011	15/12/2011	26/10/2010	18/04/2011	21/10/2011	15/12/2011	26/10/2010	18/04/2011	21/10/2011	15/12/2011	26/10/2010	18/04/2011	21/10/2011	15/12/2011
Temperature (°C)	18.0	23.1	18.2	19.4	16.7	19.8	16.9	18.6	18.4	24.2	18.1	19.3				
Conductivity SPC (mS/cm)	2.9020	1.7500	2.2200	2.5260	0.5210	0.5600	0.5700	0.6300	0.7040	0.9600	0.4200	0.9070				
Dissolved Oxygen (ppm)	2.48	0.19	0.03	0.15	1.37	0.07	0.02	0.01	1.43	0.01	0.00	0.00				
pH (scale)	6.52	6.03	6.46	6.00	6.17	5.95	5.88	5.78	6.52	6.18	5.31	6.18				
Salinity (ppt)		0.92	1.14	1.31		0.30	0.29	0.31		0.49	0.20	0.45				
Diss. Oxygen % (Saturated)	26.3	2.2	0.3	1.6	13.5	0.9	0.4	0.1	16.2	0.2	-0.4	0.0				
ORP (mV)	125.5	-119.1	43.8	0.9	14.2	-141.4	-25.5	-96.6	22.2	-209.7	84.7	-124.0				

Table B



	Bore 7					Bore 8					Bore 9					
	26/10/2010	18/04/2011	21/10/2011	15/12/2011	26/10/2010	18/04/2011	21/10/2011	15/12/2011	26/10/2010	18/04/2011	21/10/2011	15/12/2011	26/10/2010	18/04/2011	21/10/2011	15/12/2011
Temperature (°C)	17.1		18.0	18.6	18.1		18.1	19.0	17.5	20.8	17.7	18.3				
Conductivity SPC (mS/cm)	1.5690		5.0200	1.2100	3.1210		0.1700	0.2420	1.0140	1.9000	1.2500	1.1270				
Dissolved Oxygen (ppm)	2.60		0.08	0.12	1.60		2.24	0.42	3.34	0.68	0.09	0.01				
pH (scale)	5.82		5.56	6.32	5.87		5.46	5.01	6.32	5.16	5.04	5.43				
Salinity (ppt)			0.24	0.60			0.08	0.12		1.06	0.63	0.56				
Diss. Oxygen % (Saturated)	28.0		0.9	1.3	16.2		23.8	4.3	35.1	7.7	1.0	0.1				
ORP (mV)	148.7		55.2	-187.2	60.5		79.9	-2.1	72.7	127.3	99.6	-14.5				

Table C



# APPENDIX 4

Complete Quality Results



	Bore 1				Bore 2				Bore 3			
	26/10/2010	18/04/2011	21/10/2011	15/12/2011	26/10/2010	18/04/2011	21/10/2011	15/12/2011	26/10/2010	18/04/2011	21/10/2011	15/12/2011
OH <sup>-</sup> Alkalinity (mg/L, LOR = 1)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
CO <sub>3</sub> <sup>2-</sup> Alkalinity (mg/L, LOR = 1)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
HCO <sub>3</sub> <sup>-</sup> Alkalinity (mg/L, LOR = 1)	34	13	7	7	87	66	151	71	151	96	<1	163
Total Alkalinity (mg/L, LOR = 1)	34	13	7	7	87	66	151	71	151	96	<1	163
Aluminium (mg/L, LOR = 0.01)	2.20	5.71	21.90	10.40	25.60	23.80	5.09	9.77	29.20	42.00	22.10	27.80
Arsenic (mg/L, LOR = 0.001)	<0.001	<0.001	0.001	0.001	<0.001	0.002	0.001	0.002	<0.001	0.002	0.001	<0.001
Cadmium (mg/L, LOR = 0.0001)	<0.0001	0.0001	0.0002	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium (mg/L, LOR = 0.001)	0.003	0.01	0.021	0.015	0.049	0.01	0.008	0.018	0.049	0.06	0.037	0.042
Copper (mg/L, LOR = 0.001)	0.008	0.033	0.042	0.038	0.056	0.060	0.009	0.019	0.026	0.037	0.022	0.025
Lead (mg/L, LOR = 0.001)	0.002	0.012	0.036	0.012	0.050	0.057	0.008	0.018	0.018	0.026	0.019	0.019
Manganese (mg/L, LOR = 0.001)	0.074	0.029	0.043	0.023	0.057	0.036	0.252	0.050	0.132	0.268	0.087	0.176
Zinc (mg/L, LOR = 0.005)	0.030	0.081	0.096	0.062	0.030	0.050	0.025	0.023	0.050	0.041	0.021	0.050
Iron (mg/L, LOR = 0.05)	6.92	6.48	19.50	8.43	43.60	42.40	15.40	20.50	16.90	20.80	14.00	15.00
Ammonia (mg/L, LOR = 0.01)	0.22	0.11	0.04	<0.05	1.07	2.13	0.42	1.12	0.01	0.04	0.07	<0.05
Nitrite (mg/L, LOR = 0.01)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05	<0.01
Nitrate (mg/L, LOR = 0.01)	<0.01	<0.01	<0.01	0.04	0.01	0.01	<0.01	0.04	0.59	0.02	0.42	0.02
NO <sub>x</sub> (mg/L, LOR = 0.01)	<0.01	<0.01	<0.01	0.04	0.01	0.01	<0.01	0.04	0.59	0.02	0.47	0.02
TKN (mg/L, LOR = 0.1)	0.6	1.2	8.0	4.8	5.0	4.4	2.4	3.0	6.2	4.5	3.4	2.5
Total Nitrogen (mg/L, LOR = 0.1)	0.6	1.2	8.0	4.8	5.0	4.4	2.4	3.0	6.8	4.5	3.9	2.5
Reactive P (mg/L, LOR = 0.01)	<0.01	<0.01	0.02	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01
Total P (mg/L, LOR = 0.01)	0.07	0.13	0.58	0.31	0.29	0.19	0.14	0.31	0.54	0.43	0.24	0.26

Table D

Refer to Quality Trigger Values Key

ADWG (2004)		ANZECC (2000)	DoH (2006)	Swan Coastal Plain	ANZECC (2000)	
Health	Aesthetic	Wetland	Non-Pot Gwater Use	WQIP	Long Term Irrigation	Short Term Irrigation

	Bore 4				Bore 5				Bore 6			
	26/10/2010	18/04/2011	21/10/2011	15/12/2011	26/10/2010	18/04/2011	21/10/2011	15/12/2011	26/10/2010	18/04/2011	21/10/2011	15/12/2011
<b>OH<sup>-</sup> Alkalinity</b> (mg/L, LOR = 1)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
<b>CO<sub>3</sub><sup>2-</sup> Alkalinity</b> (mg/L, LOR = 1)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
<b>HCO<sub>3</sub><sup>-</sup> Alkalinity</b> (mg/L, LOR = 1)	60	61	85	68	31	37	<1	38	5	38	<1	39
<b>Total Alkalinity</b> (mg/L, LOR = 1)	60	61	85	68	31	37	<1	38	5	38	<1	39
<b>Aluminium</b> (mg/L, LOR = 0.01)	4.56	8.80	16.50	11.80	15.50	11.50	2.15	3.28	20.00	146.00	2.84	30.40
<b>Arsenic</b> (mg/L, LOR = 0.001)	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	<0.001	0.001	<0.001	0.066	0.002	0.031
<b>Cadmium</b> (mg/L, LOR = 0.0001)	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0010	<0.0001	<0.0001
<b>Chromium</b> (mg/L, LOR = 0.001)	0.013	0.02	0.032	0.024	0.017	0.01	0.002	0.003	0.017	0.09	0.002	0.023
<b>Copper</b> (mg/L, LOR = 0.001)	0.014	0.025	0.071	0.055	0.034	0.036	0.010	0.007	0.042	0.104	0.005	0.029
<b>Lead</b> (mg/L, LOR = 0.001)	0.007	0.011	0.022	0.012	0.029	0.024	0.007	0.006	0.022	0.120	0.003	0.021
<b>Manganese</b> (mg/L, LOR = 0.001)	0.086	0.043	0.119	0.041	0.094	0.055	0.063	0.061	0.047	0.088	0.031	0.044
<b>Zinc</b> (mg/L, LOR = 0.005)	0.028	0.051	0.067	0.038	0.049	0.044	0.016	0.012	0.058	<0.052	0.018	0.033
<b>Iron</b> (mg/L, LOR = 0.05)	10.90	17.30	23.60	19.40	25.70	17.40	30.50	37.80	21.60	114.00	3.47	31.20
<b>Ammonia</b> (mg/L, LOR = 0.01)	0.03	0.03	0.06	<0.05	0.21	0.23	0.07	0.06	0.11	0.25	0.05	0.11
<b>Nitrite</b> (mg/L, LOR = 0.01)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01
<b>Nitrate</b> (mg/L, LOR = 0.01)	0.17	0.03	<0.01	0.08	0.05	<0.01	<0.01	0.06	2.76	0.01	0.24	0.68
<b>NO<sub>x</sub></b> (mg/L, LOR = 0.01)	0.17	0.03	<0.01	0.08	0.05	<0.01	<0.01	0.06	2.77	0.01	0.24	0.68
<b>TKN</b> (mg/L, LOR = 0.1)	0.6	0.4	4.2	1.2	6.4	1.5	3.0	1.5	3.5	9.2	1.2	4.2
<b>Total Nitrogen</b> (mg/L, LOR = 0.1)	0.8	0.4	4.2	1.3	6.5	1.5	3.0	1.6	6.3	9.2	1.4	4.9
<b>Reactive P</b> (mg/L, LOR = 0.01)	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	1.64	0.05
<b>Total P</b> (mg/L, LOR = 0.01)	0.24	0.03	0.42	0.14	0.34	0.19	0.16	0.14	1.69	0.79	2.00	4.60

Table E

	Bore 7				Bore 8				Bore 9			
	26/10/2010	18/04/2011	21/10/2011	15/12/2011	26/10/2010	18/04/2011	21/10/2011	15/12/2011	26/10/2010	18/04/2011	21/10/2011	15/12/2011
OH <sup>-</sup> Alkalinity (mg/L, LOR = 1)	<1		<1	<1	<1		<1	<1	<1	<1	<1	<1
CO <sub>3</sub> <sup>2-</sup> Alkalinity (mg/L, LOR = 1)	<1		<1	<1	<1		<1	<1	<1	<1	<1	<1
HCO <sub>3</sub> <sup>-</sup> Alkalinity (mg/L, LOR = 1)	12		28	33	59		<1	10	55	<1	<1	21
Total Alkalinity (mg/L, LOR = 1)	12		28	33	59		<1	10	55	<1	<1	21
Aluminium (mg/L, LOR = 0.01)	23.80		15.00	11.70	8.30		28.20	20.30	11.60	31.80	23.30	20.20
Arsenic (mg/L, LOR = 0.001)	<0.001		0.001	<0.001	<0.001		0.001	<0.001	<0.001	0.011	0.002	0.002
Cadmium (mg/L, LOR = 0.0001)	<0.0001		0.0001	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001
Chromium (mg/L, LOR = 0.001)	0.041		0.018	0.018	0.019		0.052	0.040	0.018	0.06	0.022	0.021
Copper (mg/L, LOR = 0.001)	0.073		0.053	0.041	0.031		0.151	0.069	0.056	0.125	0.084	0.051
Lead (mg/L, LOR = 0.001)	0.022		0.029	0.012	0.010		0.068	0.035	0.019	0.073	0.025	0.014
Manganese (mg/L, LOR = 0.001)	0.075		0.074	0.032	0.205		0.075	0.044	0.084	0.193	0.121	0.094
Zinc (mg/L, LOR = 0.005)	0.180		0.026	0.022	0.055		0.046	0.031	0.033	0.061	0.018	0.033
Iron (mg/L, LOR = 0.05)	33.50		19.70	18.10	21.20		45.20	43.90	22.00	169.00	37.40	34.60
Ammonia (mg/L, LOR = 0.01)	0.05		0.01	0.10	0.05		0.02	<0.05	0.11	<0.10	0.07	0.06
Nitrite (mg/L, LOR = 0.01)	<0.01		<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrate (mg/L, LOR = 0.01)	0.13		<0.01	0.06	0.02		<0.01	0.03	<0.01	0.03	<0.01	0.04
NO <sub>x</sub> (mg/L, LOR = 0.01)	0.13		<0.01	0.06	0.02		<0.01	0.03	<0.01	0.03	<0.01	0.04
TKN (mg/L, LOR = 0.1)	1.5		7.4	2.9	2.2		7.2	3.3	4.3	29.8	11.0	3.9
Total Nitrogen (mg/L, LOR = 0.1)	1.6		7.4	3.0	2.2		7.2	3.3	4.3	29.8	11.0	3.9
Reactive P (mg/L, LOR = 0.01)	0.01		<0.01	<0.01	<0.01		0.03	<0.01	<0.01	<0.01	<0.01	<0.01
Total P (mg/L, LOR = 0.01)	0.31		0.56	0.24	0.52		1.06	0.55	0.30	2.52	1.79	0.70

Table F



# APPENDIX 5

C.D OF ATTACHMENTS:  
CERTIFICATE OF ANALYSIS  
RAW RESULTS



# Appendix G

Modelling Assumptions Report

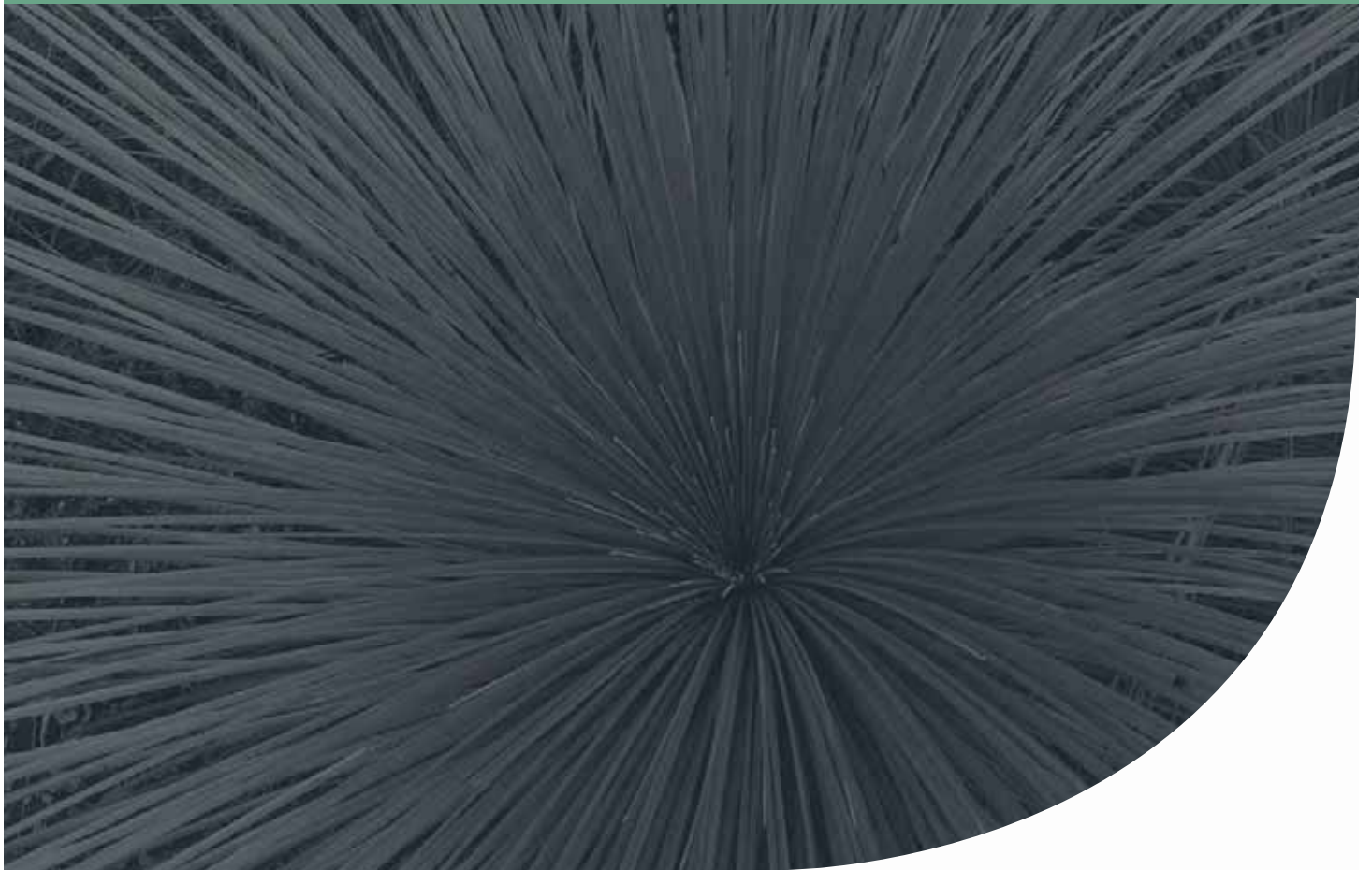


# Modelling Assumptions Report

Local Structure Plan, Lots 103, 110 and 603,  
Picton East

Project No: EP12-039(01)

**Prepared for Harris Road Pty Ltd  
November 2019**





# Modelling Assumptions Report

Local Structure Plan, Lots 103, 110 and 603, Picton East



## Document Control

<b>Doc name:</b> Modelling Assumptions Report Local Structure Plan, Lots 103, 110 and 603, Picton East					
<b>Doc no.:</b> EP12-039(01)--014 HB					
Version	Date	Author		Reviewer	
1	November 2019	Hannah Badrzadeh	HB	Aisha Chalmers	ASC
				David Coremans	DPC
Appendix for LWMS					

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# Modelling Assumptions Report

Local Structure Plan, Lots 103, 110 and 603, Picton East



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# Modelling Assumptions Report

Local Structure Plan, Lots 103, 110 and 603, Picton East



## Abbreviation Tables

*Table A1: Abbreviations – General terms*

General terms	
AEP	Annual exceedance probability
ARI	Average recurrence interval
DWMS	District water management strategy
LDA	Lot detention area
ROS	Regional open space
Ct	Catchment

*Table A2: Abbreviations – units of measurement*

Units of measurement	
ha	Hectare
m	Metre
m AHD	Metres Australian height datum
m/day	Metres per day
mm	Millimetre
n	Manning's n
%	Percentage

# Modelling Assumptions Report

## Local Structure Plan, Lots 103, 110 and 603, Picton East



# 1 Modelling Assumptions

In order to assess the surface water runoff volumes and peak flows within the Lots 103, 110 and 603, Picton East (the site), a 1D model has been developed using XPSTORM hydrologic and hydraulic modelling software (v19.1).

The hydrologic component of the software uses the Laurenson non-linear runoff-routing method to simulate runoff from design storm events. Key assumptions regarding the hydrologic model include:

- Runoff is proportional to slope, area, infiltration and percentage of imperviousness of a catchment.
- Sub-catchment areas and slopes are determined from surveyed topographical data and earthworks plans.
- Infiltration rates and percentage imperviousness have been selected based on experience with model preparation for similar soil conditions.

Runoff from each sub-catchment is routed through the catchment using the hydraulic component of XPSTORM. Assumptions associated with the hydraulic component of the model include:

- Virtual links (i.e. purely for model construction, not equivalent to flow paths onsite) between nodes within a sub-catchment are given the length of 10 m and slope of approximately 0.05 to minimise the lag time of conveying the water from a sub-catchment node to a 'storage' node, a 'dummy intermediate' node or a conduit/link.
- Links between sub-catchment storages act as conveyance channels (e.g. sheet flow within roads in a 1% annual exceedance probability (AEP)). These links are given lengths and slopes that are representative of the site conditions and actual pathway lengths between catchments.
- Virtual links are designed with a width of 5 m, roughness of 0.014 (Manning's n) and are trapezoidal in shape. This allows for easy conveyance and represents concrete pipes and road surfaces within the model.
- Conveyance swales and lot detention areas (LDAs) are modelled as a nodal-reservoirs with infiltration depth-rating curves to account for differential infiltration rates with changing depth.
- Detention areas are modelled as nodal-reservoirs with no infiltration.

A post-development model has been prepared to demonstrate that the peak 1% AEP and 10% annual exceedance probability (AEP) flow rates leaving the site are within allowable discharge rates documented within the overarching *District Water Management Strategy to support the Picton South District Structure Plan (DWMS)* (Calibre Consulting 2017).

# Modelling Assumptions Report

## Local Structure Plan, Lots 103, 110 and 603, Picton East



## 2 Post-development Model

A post-development model was developed using XPSTORM software to determine the hydrology of the site, estimate runoff volumes, peak discharges and storage requirements within the site.

### 2.1 Catchment hydrology

An “initial loss - continual loss” infiltration model was adopted to represent the post-development environment. Loss values were determined based on the proposed land use, the underlying site conditions and project team experience with similar land uses and site conditions. **Table 1** provides the infiltration and roughness parameters used within the post-development model.

*Table 1: Post-development loss parameters*

Land type	Initial loss (mm)	Continual loss (mm/hr)	Manning's 'n'
Road surface	1	0.1	0.02
Road verge	9	1.5	0.03
Lot impervious	1	0.1	0.02
Lot pervious	15	1.5	0.03
Regional open space (ROS) and railway	20	2.5	0.08

The site is located within Catchment 3 and Catchment 4 of the DWMS. For modeling purposes, sub-catchments within the site are referred to as Catchment 1 and Catchment 2 and the remainder of DWMS Catchment 3 and 4 are referred to as Catchment 3 US and Catchment 4 US. These are shown in Figure 6 of LWMS. The ultimate discharge location for the site is located along the western boundary of Catchment 2. Stormwater runoff that discharges from the site encompasses runoff from Catchment 1, Catchment 2 and both upstream catchments.

A summary of post-development catchment land use assumptions is provided in **Table 2**. Consistent with the DWMS, future industrial areas within Catchment 3 US and Catchment 4 US are assumed to be 20% road reserve, 75% industrial lot, and 5% drainage.

# Modelling Assumptions Report

Local Structure Plan, Lots 103, 110 and 603, Picton East



Table 2: Post-development catchment areas

Catchment	Area (ha)				
	Total area	Road reserve	Industrial lot	Drainage	ROS/railway
Catchment 1	10.95	1.34	6.91	0.87	1.83
Catchment 2	63.26	9.41	47.88	3.87	2.10
Catchment 3 US	29.40	5.21	19.53	1.30	3.36
Catchment 4 US	13.55	8.34	5.06	0.14	0
Total	117.16	24.30	84.12	1.44	7.29

The infiltration rates used in the post-development model were predominantly based upon the following assumptions:

- Lots on average will be consistent with other new industrial developments in the South-West and have large roof areas, a small pervious landscaped area, and the remainder of the lots paved/impervious. Therefore, it is assumed that lots are 90% impervious and 10% pervious, which is consistent with the assumptions made in the DWMS.
- Road reserves are 60% pervious verge and 40% impervious bitumen.
- There will be no infiltration on roads, pavements and driveways. There will however be some minor absorption storage loss, which is accounted for in the initial and continuing loss values.
- The road verge area is similar in characteristics to open space except that it will also have an impervious footpath and some driveway crossovers. The averaged initial loss will be lower than open space initial loss rates.
- ROS area is considered 100% pervious.
- The site has low infiltration due to the soil conditions and shallow groundwater table. It is assumed that there is no infiltration from the base of detention areas.
- A hydraulic conductivity of 2 m/day is assumed for the infiltration in swales. An additional 50% clogging factor has also been applied.
- A hydraulic conductivity of 2 m/day is assumed for the infiltration in LDAs in Catchment 1 and 2.
- Volumes leaving the system through evapotranspiration were assumed to be negligible when compared to the total runoff volume, and as the duration of model run was comparatively short, XPSTORM default evapotranspiration assumptions are used.

# Modelling Assumptions Report

Local Structure Plan, Lots 103, 110 and 603, Picton East



## 2.2 Hydraulic structures

Stormwater management structures for the treatment and detention of stormwater runoff were modelled to ensure allowable flow rates are maintained in the post-development scenario.

### 2.2.1 Lot drainage assumptions

Lot drainage assumptions include:

- Lots will retain 2 m<sup>3</sup> per 65 m<sup>2</sup> of hardstand/roof in accordance with the Shire of Dardanup's requirements (SoD 2018).
- LDAs are modelled as 1 m deep square basins with 1:6 side slopes.

### 2.2.2 Site and upstream assumptions

Site and upstream drainage assumptions include:

- Roadside swales in each catchment are represented by one storage node.
- Swales will be located along one side of each road reserve to treat the small rainfall event off road reserves. However, only 80% of the total swale length is assumed to be available for storage to account for cross-overs.
- Swales are nominally assumed to be 500 mm deep have a 1 m wide base and 1:4 side slopes.
- Minor and major event runoff will be detained in square detention areas modelled with 1:6 side slopes at the downstream end of each catchment.
- Detention Area 1 is assumed to have an invert of approximately 13 mAHD (based on the maximum groundwater level) and a conservatively shallow depth of 500 mm.
- The invert of Detention Area 2 will be set at 12.05 mAHD (based on the invert of the existing culverts beneath Columbas Drive), and has a depth of 950 mm.
- It is assumed that there is one detention area at the downstream point of Catchment 2. The volume required to be provided in Catchment 2 could potentially be provided by multiple detention areas (i.e. within Detention Area 2 and 3 as shown in the LWMS).
- Upstream detention areas were modelled as 1 m deep square basins with 1:6 side slopes.
- Detention areas are provided with a low flow pipe outlet and a weir to allow runoff to discharge from site according to the allowable peak flow discharge rates.

### 2.2.3 Downstream assumptions

Downstream assumptions include:

- Runoff from site (i.e. the ultimate discharge from Catchment 2) is conveyed within the existing drain (320 m in length) towards the 1200 mm culvert beneath the railway.
- A free outfall is assumed at the railway culvert.

# Modelling Assumptions Report

Local Structure Plan, Lots 103, 110 and 603, Picton East



## 2.3 Critical duration event analysis

Several rainfall durations varying from 30 minutes to three days were analysed to determine the 10% AEP and 1% AEP event critical durations for peak flows discharging from the Detention Area 1 and Detention Area 2. The analysis (shown in **Plate 1 to Plate 4**) indicates that for both catchments, the 12 hour and 6 hour duration events are the critical duration for the 10% AEP and 1% AEP event events, respectively.

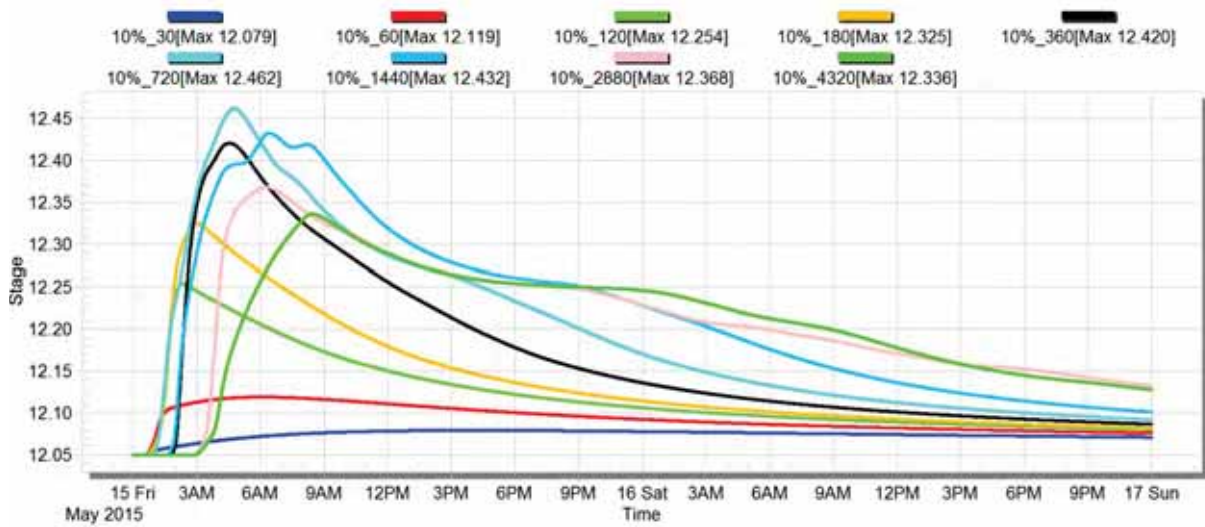


Plate 1: 10% AEP critical duration analysis of Detention Area 1

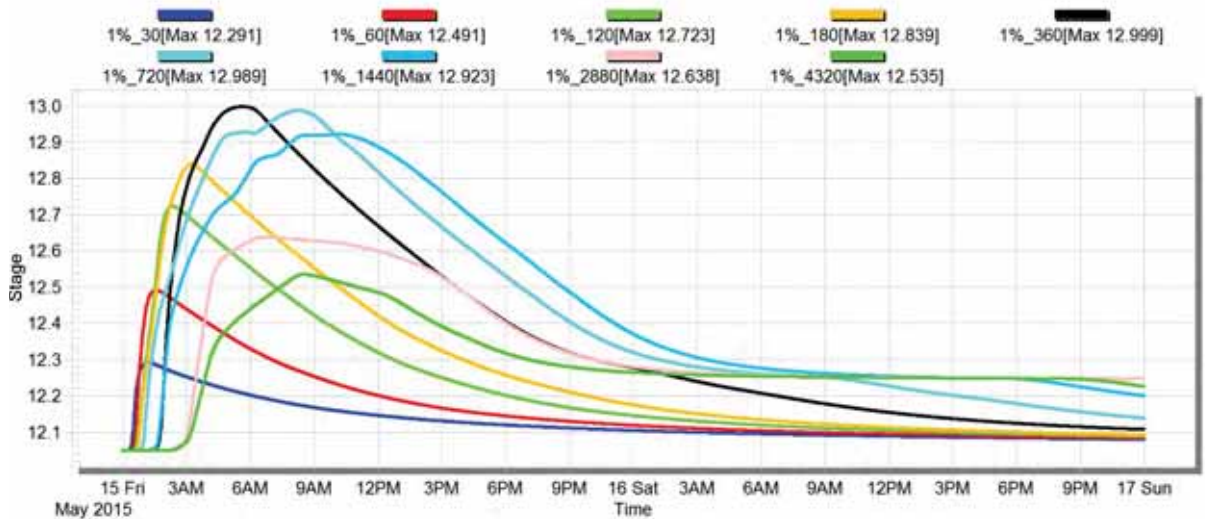


Plate 2: 1% AEP critical duration analysis of Detention Area 1



# Modelling Assumptions Report

## Local Structure Plan, Lots 103, 110 and 603, Picton East

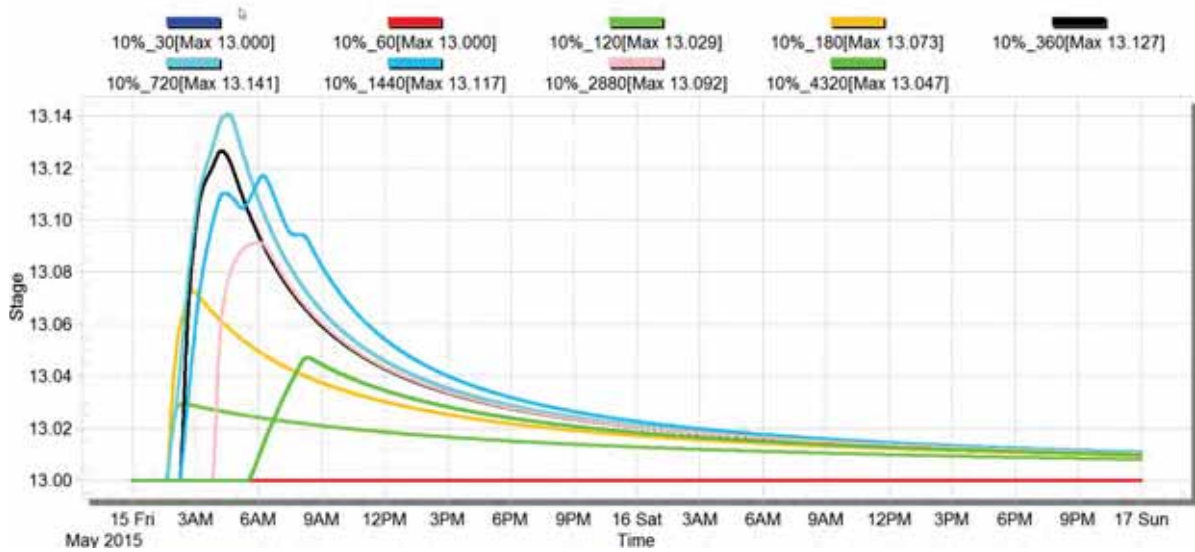


Plate 3: 10% AEP critical duration analysis of Detention Area 2

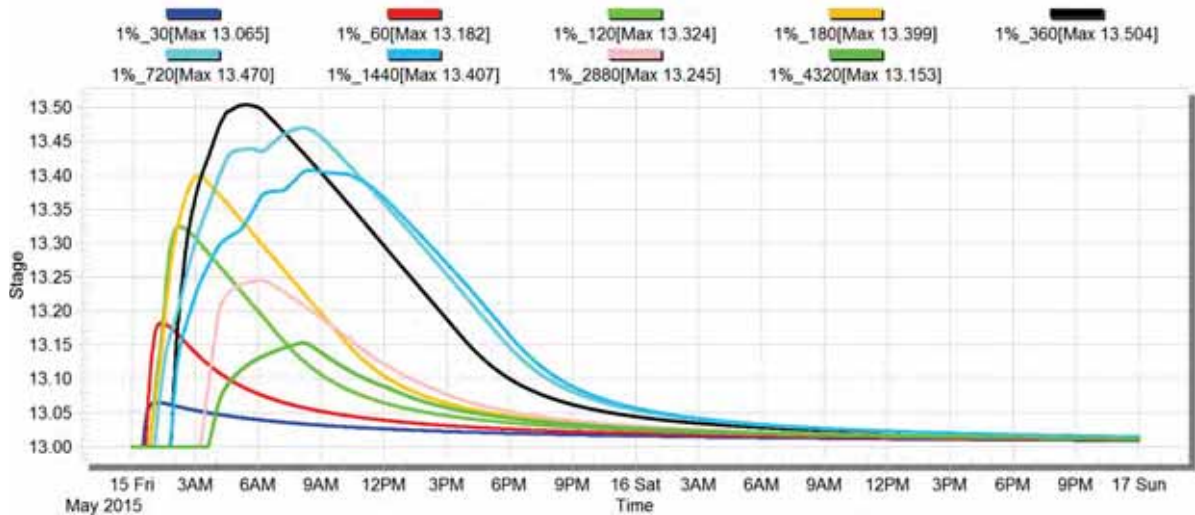


Plate 4: 1% AEP critical duration analysis of Detention Area 2

# Modelling Assumptions Report

Local Structure Plan, Lots 103, 110 and 603, Picton East



## 3 References

### 3.1 General references

Calibre Consulting 2017, District Water Management Strategy to support the Picton South District Structure Plan, 17-000073, Rev D.

Shire of Dardanup (SoD) 2018a, Policy No CP060 - Storm Water Discharge from Buildings, Eaton.

Calibre Consulting 2017, District Water Management Strategy to support the Picton South District Structure Plan, 17-000073, Rev D.

Shire of Dardanup (SoD) 2018, Policy No CP060 - Storm Water Discharge from Buildings, Eaton.



# APPENDIX 6

TRANSPORT IMPACT ASSESSMENT



**ROWE**  
GROUP  
DESIGN

# Lots 103, 110 and 603 Harris Road and Martin Pelusey Road, Picton East

TRANSPORT ASSESSMENT REPORT FOR  
PROPOSED LOCAL STRUCTURE PLAN

Prepared for  
HARRIS ROAD PTY LTD

Prepared by  
Uloth and Associates  
15 November 2019

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## **1. INTRODUCTION**

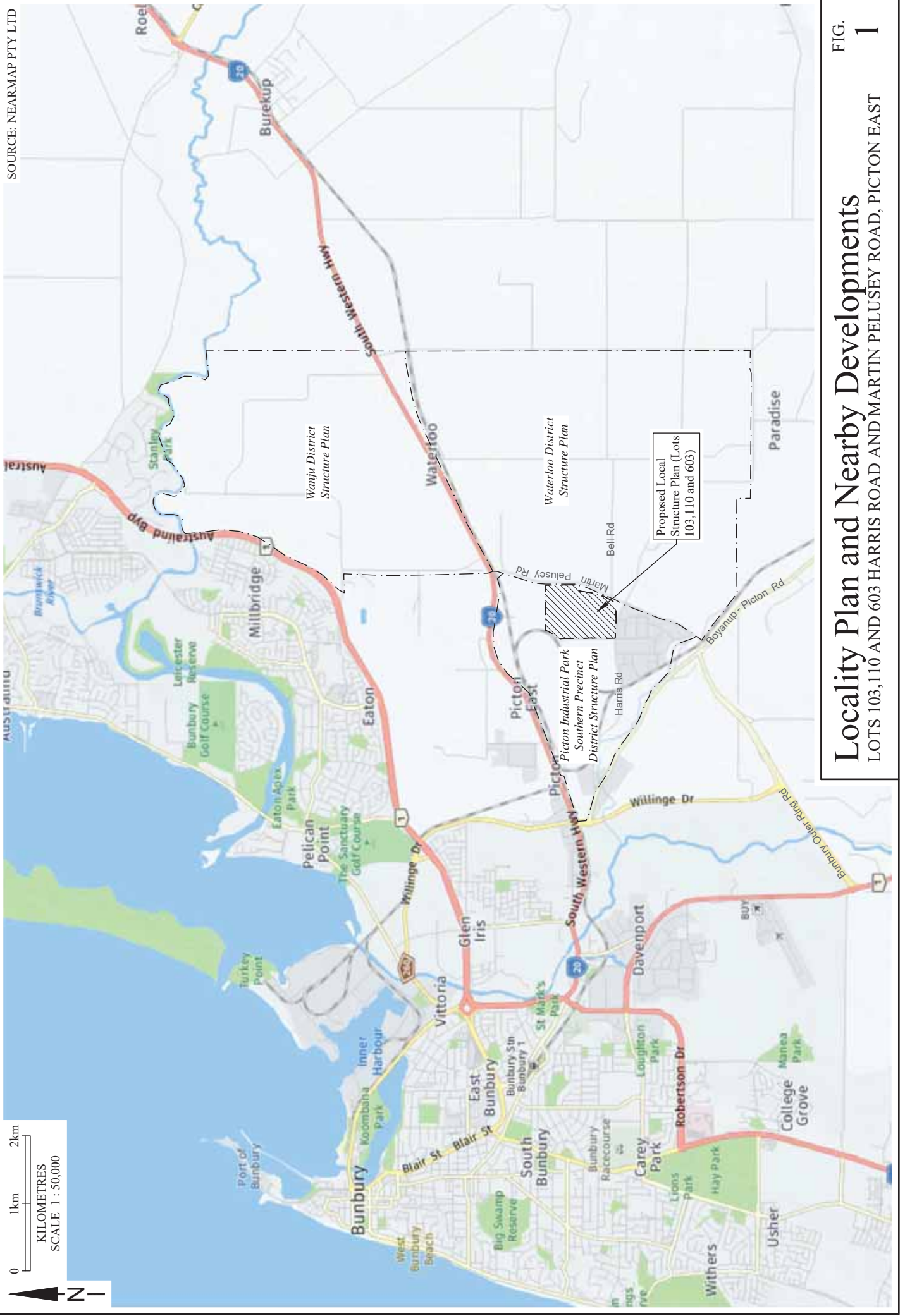
Rowe Group is preparing a Local Structure Plan for Lots 103, 110 and 603 Harris Road and Martin Pelusey Road, on behalf of Harris Road Pty Ltd.

The subject site is located to the west of Martin Pelusey Road and north of Harris Road, as shown in the Locality Plan in Figure 1. It is also located within the Picton Industrial Park Southern Precinct District Structure Plan, adjacent to the Waterloo District Structure Plan, and to the south-west of the Wanju District Structure Plan, as also indicated in Figure 1.

### **1.1 STUDY OBJECTIVES**

Uloth and Associates has been commissioned to prepare this Transport Impact Assessment Report in support of the proposed Local Structure Plan.

The overall study objective is to identify the existing situation and current structure planning within the vicinity of the subject site, and to then document the traffic impacts and implications for the proposed Local Structure Plan.



**FIG. 1**  
**Locality Plan and Nearby Developments**  
LOTS 103,110 AND 603 HARRIS ROAD AND MARTIN PELUSEY ROAD, PICTON EAST



## 2. OVERALL STUDY FINDINGS AND CONCLUSIONS

The overall study findings and conclusions regarding the proposed Local Structure Plan are presented and discussed in this chapter, with reference to background information and additional analysis documented in the Technical Appendix.

### 2.1 EXISTING SITUATION

- The existing situation in the vicinity of the proposed Local Structure Plan is shown in an aerial photograph in Figure A.1 in Chapter A.1 in the Technical Appendix. It can be seen in Figure A.1 that the subject site is bounded by Martin Pelusey Road to the east, Harris Road to the south and Columbas Drive to the west, with vacant land to the north up to the Bunbury-Perth railway line and South Western Highway.
- The existing Main Roads WA functional road hierarchy is shown in Figure A.2 in the Technical Appendix. The plan shows that Forrest Highway, South Western Highway, Boyanup-Picton Road, Willinge Drive and Bunbury Outer Ring Road are all Primary Distributor Roads in the vicinity of the proposed Local Structure Plan, while Martin Pelusey Road and Hynes Road are Regional Distributor Roads. Harris Road is classified as a Local Distributor Road, while the remaining neighbouring roads, including Columbas Drive, Kerr Road and Golding Crescent, are all classified as Access Roads.
- It is also important to note that the Main Roads WA Restricted Access Vehicle Network indicates that Forrest Highway, South Western Highway, Willinge Drive and Bunbury Outer Ring Road between Willinge Drive and Moore Road are all part of the RAV 7 network, which allows for vehicles up to 36.5 metres in length, while Boyanup-Picton Road, Martin Pelusey Road and Harris Road form part of the RAV 4 network, allowing vehicles up to 27.5 metres in length.
- Road information mapping from Main Roads WA also shows that both Harris Road and Martin Pelusey Road have posted speed limits of 80 kilometres per hour, while Columbas Drive, Kerr Road and Golding Crescent have no posted speed limits (meaning that the 50 kilometre per hour 'Built-up Area' rule applies).
- Figure A.3 in the Technical Appendix then shows the existing weekday daily traffic flows in the vicinity of the proposed Local Structure Plan, as obtained from the Main Roads WA website. It can be seen in Figure A.3 that Forrest Highway carries 24,600 vehicles per day east of Old Coast Road, while South Western Highway and Boyanup Picton Road carry 7,700 and 4,800 vehicles per day, respectively, west of Willinge Drive. It can also be seen that Hynes Road carries 4,600 vehicles per day, Martin Pelusey Road carries 3,100 vehicles per day and Harris Road carries just 1,500 vehicle per day.

### 2.2 REGIONAL ROAD NETWORK PLANNING

- Figure A.4 in the Technical Appendix shows the current Greater Bunbury Region Scheme Map in the vicinity of the proposed Local Structure Plan, including the subject site which is located within an 'Industrial Deferred' zone. However, it can also be seen that the Scheme Map currently still shows the now superseded initial alignment of the Bunbury Outer Ring Road adjacent to the site (along Martin Pelusey Road and Hynes Road). The Scheme also identifies the proposed future realignments of Willinge Drive and South Western Highway, to accommodate future grade-separation of Willinge Drive across Boyanup-Picton Road, Harris Road, the railway lines, and South Western Highway.
- Figure A.5 shows the now proposed realignment of the Bunbury Outer Ring Road between Boyanup-Picton Road and Forrest Highway north of Raymond Road, with interchanges at Willinge Drive, Wireless Road, South Western Highway and Raymond Road, while Figure A.6 shows a composite plan reflecting the resulting overall 'currently planned' regional road network.

- Figure A.7 then shows the currently planned access strategy for the realigned Bunbury Outer Ring Road, including District Distributor Road connections with Wireless Road, Martin Pelusey Road and Boyanup Picton Road, which directly impact the adjacent District Structure Plans.
- It can be seen in Figure A.7 that there is no planned connection to the Bunbury Outer Ring Road at Martin Pelusey Road or Boyanup Picton Road. However, there will be a connection from Martin Pelusey Road to Boyanup Picton Road. A new east-west link road is also proposed from Martin Pelusey Road to Wireless Road, in order to provide access to and from the Bunbury Outer Ring Road, including a proposed roundabout at Martin Pelusey Road.

### 2.3 DISTRICT STRUCTURE PLANS

- The latest District Structure Plan for the Picton Industrial Park Southern Precinct is shown in Figure A.8 in the Technical Appendix, as updated in 2018 in response to the proposed realignment of the Bunbury Outer Ring Road. The plan also identifies the location of Lots 103, 110 and 603, just west of Martin Pelusey Road, with an overall zoning of ‘General Industry’.
- It can be seen in Figure A.8 that the District Structure Plan identifies Martin Pelusey Road as an ‘Integrator’ road, while South Western Highway, Bunbury Outer Ring Road and Boyanup-Picton Road are all shown as ‘Primary’ roads. It can also be seen that Harris Road, Golding Crescent and Columbas Drive are all classified as ‘Local Distributor’ roads, together with the new indicative internal roads providing additional connections to both Harris Road and Martin Pelusey Road.
- It is important to note, however, that the District Structure Plan report also suggests that Harris Road, Columbas Drive and the ‘Internal Distributor’ roads should be identified as ‘Integrator B’ roads (with road reserve widths of 30 metres).
- It is also important to note that the Waterloo Industrial Park District Structure Plan also makes reference to the road hierarchy requirements for Harris Road, suggesting that the eastern portion (between the railway crossing and Martin Pelusey Road) should be identified as an ‘Integrator A’ road rather than an ‘Integrator B’ road. This is presumably as a result of additional traffic demand to/from Waterloo Industrial Park via Harris Road, which is likely to occur as a result of there being no planned connection from Martin Pelusey Road onto South Western Highway in the long term.
- An overall composite plan of the 3 adjoining District Structure Plans (for Picton Industrial Park Southern Precinct, Waterloo Industrial Park and Wanju) is therefore shown in Figure A.9 in the Technical Appendix, while Figure A.10 shows the resulting overall planning in the vicinity of the proposed Local Structure Plan.

### 2.4 PROPOSED LOCAL STRUCTURE PLAN

- The proposed Local Structure Plan for Lots 103, 110 and 603 Harris Road and Martin Pelusey Road, is shown in Figure A.11 in Chapter A.6 in the Technical Appendix.
- It can be seen in Figure A.11 that the Structure Plan proposes an east-west local distributor road in the northern part of the overall site, linking from Martin Pelusey Road to Columbas Drive, together with 2 additional roads linking to Martin Pelusey Road and Harris Road in the south-east portion of the plan, and a 4<sup>th</sup> road (toward the north) to provide access to and from the adjoining vacant land.
- It is important to note that the east-west local distributor road between Columbas Drive and Martin Pelusey Road has been shifted north compared to the alignment shown within the District Structure Plan (in Figure A.8), in order to tie in with the proposed new roundabout in Martin Pelusey Road.

- A subdivision concept plan has also been prepared on the basis of the proposed Local Structure Plan, identifying the possible creation of approximately 50 industrial Lots with a total developable area of almost 57 hectares (that is approximately 78 percent of the total Structure Plan area of 73 hectares).
- Taking into account that there are already plans for a possible petrol station adjacent to the proposed roundabout in Marin Pelusey Road, and adopting an average trip generation rate of 107 trips per hectare (based on the average of 5 industrial land use categories within the Institute of Transportation Engineers (ITE) 'Trip Generation' publication), it is therefore estimated that the overall Local Structure Plan area could generate a total of 7,800 vehicle trips per day on an average weekday.
- Based on traffic modelling work previously carried out within this area, it is estimated that 55 percent of overall traffic flows will travel to/from the west via Harris Road, with 25 percent to/from the north via Martin Pelusey Road, 15 percent to/from the east via the new east-west link road towards Wireless Road, and 5 percent to/from the south.
- The resulting future development traffic flows for the proposed Structure Plan are shown in Figure A.12 in the Technical Appendix, identifying a maximum of 2,300 vehicles per day on any of the internal roads. However, it is also important to take into account the additional traffic flows that will be generated by the adjoining development areas within the remainder of the Picton Industrial Area Southern Precinct District Structure Plan.
- It is therefore assumed that the development areas immediately north and west of the Local Structure Plan will also generate traffic at the same overall rate of 107 trips per hectare (which is the average of the 5 individual rates for Industrial Park, General Light Industry, General Heavy Industry, Manufacturing and Warehousing). However, for the additional areas located inside the railway loop, it is assumed that a lower trip rate of 56 trips per hectare will apply, based on the average trip generation rate for General Heavy Industry and Manufacturing, which is more applicable to the anticipated rail related activities and uses within this area.
- The overall adjacent areas within the remainder of the District Structure Plan are therefore expected to generate a total of 12,430 vehicle trips per day (based on the development areas calculated in Chapter A.6, resulting in a total trip generation of 20,230 vehicles per day, with total future traffic flows as shown in Figure A.13 in the Technical Appendix.

## 2.5 RESULTING FUTURE OVERALL ROAD NETWORK

- Taking into account the overall District Structure Plans for Picton Industrial Park Southern Precinct, Waterloo Industrial Park, and Wanju, together with the forecast future development traffic flows discussed above in Section 2.4, the resulting future overall road network in the vicinity of the currently planned Local Structure Plan is shown in Figure A.14 in Chapter A.7 in the Technical Appendix.
- It can be seen in Figure A.14 that Harris Road should be classified as a 'District Distributor B' road (or Integrator B using the Liveable Neighbourhoods terminology), as should Golding Crescent and its extension to the south-east side of the Bunbury Outer Ring Road in the long term.
- However, Columbas Drive and the other 'Internal Distributor' roads within the Picton Industrial Park Southern Precinct will only need to be 'Local Distributor' roads (with maximum traffic volumes of approximately 7,000 vehicles per day).
- Development Control Policy DC 4.1 - 'Industrial Subdivision' provides guidance on matters to be considered by the Western Australian Planning Commission when determining applications for industrial subdivision. The Policy states that a minimum road reserve width of 20 metres should be provided for all roads within an industrial area, increasing to 25 metres for heavily trafficked/major through routes, but with carriageway widths of 10 metres in both scenarios.

- It is therefore recommended that the east-west ‘Local Distributor’ road within the proposed Local Structure Plan should provide a road reserve width of 25 metres, while all other internal roads will only require 20 metres. However, it is also recommended that Columbas Drive should also be widened to 25 metres, with a 2.5 metre widening on either side.
- It is also necessary to consider the acceptable intersection spacing along both Martin Pelusey Road and Harris Road for each of the proposed access roads, which can be identified on the basis of the Safe Intersection Sight Distance (SISD) for vehicles travelling along the major road (noting that the provision of SISD ensures that the driver of a vehicle on the major road has sufficient time to observe a situation arising at an approaching intersection and decelerate to a stop in time to avoid a collision).
- For the existing speed limits of 80 kilometres per hour for both Martin Pelusey Road and Harris Road, the required Safe Intersection Sight Distance is 226 metres (based on a design speed of 90 kilometres per hour and a reaction time of 2.5 seconds). It is therefore recommended to adopt a minimum intersection spacing of 230 metres along both of these roads. And with an assumed speed limit of 50 kilometres per hour for each of the internal roads, it is recommended to adopt a minimum intersection spacing of 130 metres along both Columbas Drive and the east-west local distributor road (based on the SISD for a design speed of 60 kilometres per hour).
- It is also important to consider the required intersection layouts for each of the proposed roads accessing the Local Structure Plan area, noting that a roundabout has already been identified (as part of the Waterloo Industrial Park District Structure Plan) at the now proposed 4-way intersection in Martin Pelusey Road.
- It is therefore recommended to make provision for both left turn and right turn lanes at the proposed access roads off both Martin Pelusey Road and Harris Road.
- However, in order to avoid the need for a roundabout at the 4-way intersection of Harris Road - Columbas Drive - Kerr Road, it is recommended to restrict access to/from Kerr Road to left-turn movements only, as noted in Figure 2 in Chapter 3 Overall Conclusions and Recommendations.

### 3. OVERALL CONCLUSIONS AND RECOMMENDATIONS

The overall conclusions and recommendations for the proposed Local Structure Plan are drawn from the study findings and conclusions presented above in Chapter 2, and the additional information in the Technical Appendix, as follows:

- The proposed Local Structure Plan is expected to generate a total of 7,800 vehicle trips per day during an average weekday, with an additional 12,430 vehicle trips per day from the adjacent development areas north of Harris Road.
- Columbas Drive is therefore expected to carry just over 7,000 vehicles per day, as shown in Figure A.13 in Chapter A.7 in the Technical Appendix, with similar flows on the proposed east-west road linking from Columbas Drive to Martin Pelusey Road.
- The resulting overall road network in the vicinity of the proposed Local Structure Plan is therefore as shown in Figure A.14 in Chapter A.7, taking into account the combined District Structure Plans for Waterloo and Wanju, as well as the current overall access plan for the Bunbury Outer Ring Road.
- The recommended road network and road reserves for the proposed Local Structure Plan are then shown in Figure 2, with 25 metre road reserves for Columbas Drive and the new east-west road linking to Martin Pelusey Road, which are both recommended to be classified as ‘Local Distributor’ roads.
- The additional roads linking to both Harris Road and Martin Pelusey Road should both be classified as ‘Access Roads’ with 20 metre road reserves, as also shown in Figure 2, as should the north-south road linking to the adjacent development area further north.
- Figure 2 also shows the recommended intersection spacing of 230 metres for the proposed access roads off Martin Pelusey Road, as well as the recommended spacing of 130 metres along the internal Local Distributor Road.
- It is also recommended to restrict access to/from Kerr Road (south of Harris Road) to left-in/left-out movements only, in order to accommodate all turning movements in and out of Columbas Drive without the need for a roundabout or traffic signals.

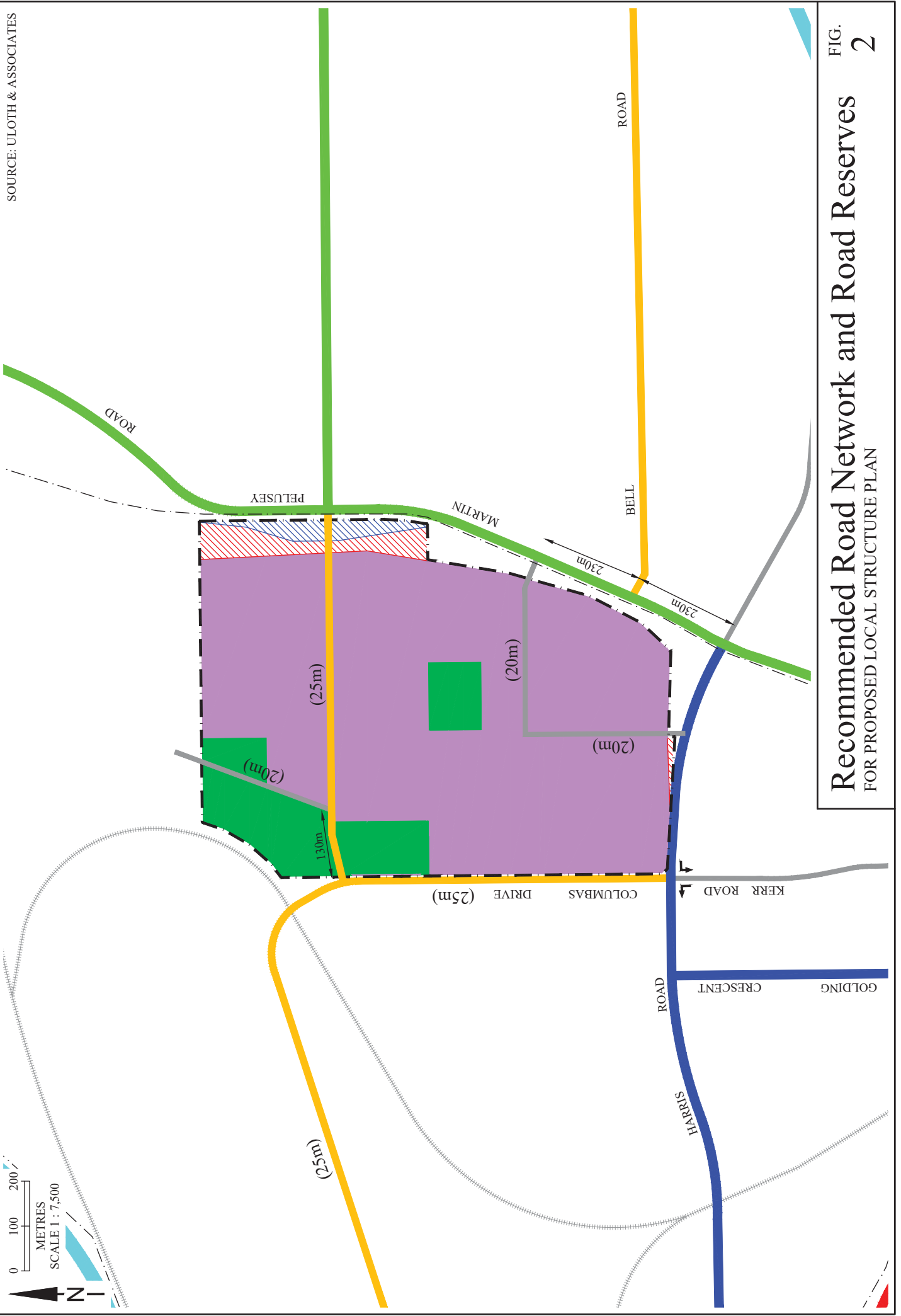
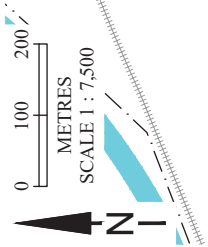


FIG. 2

# Recommended Road Network and Road Reserves

FOR PROPOSED LOCAL STRUCTURE PLAN



## **TECHNICAL APPENDIX**

The Technical Appendix documents the existing situation and the currently planned regional road network, together with the various District Structure Plans, the proposed Local Structure Plan and the resulting future development traffic flows.

## **A.1 EXISTING ROADS AND INTERSECTIONS**

Figure A.1 shows an aerial photograph of the existing situation in the vicinity of the proposed Local Structure Plan, including South Western Highway, Martin Pelusey Road, Harris Road and Boyanup-Picton Road, as well as the existing Stage 1 portion of the Bunbury Outer Ring Road to the south-west of Boyanup-Picton Road.

## **A.2 EXISTING ROAD HIERARCHY AND DAILY TRAFFIC FLOWS**

Figure A.2 shows the existing functional road hierarchy in the vicinity of the proposed Local Structure Plan area, as defined by Main Roads WA.

Figure A.3 then shows the existing weekday daily traffic flows in the vicinity of the subject site, as also provided on the Main Roads WA website.



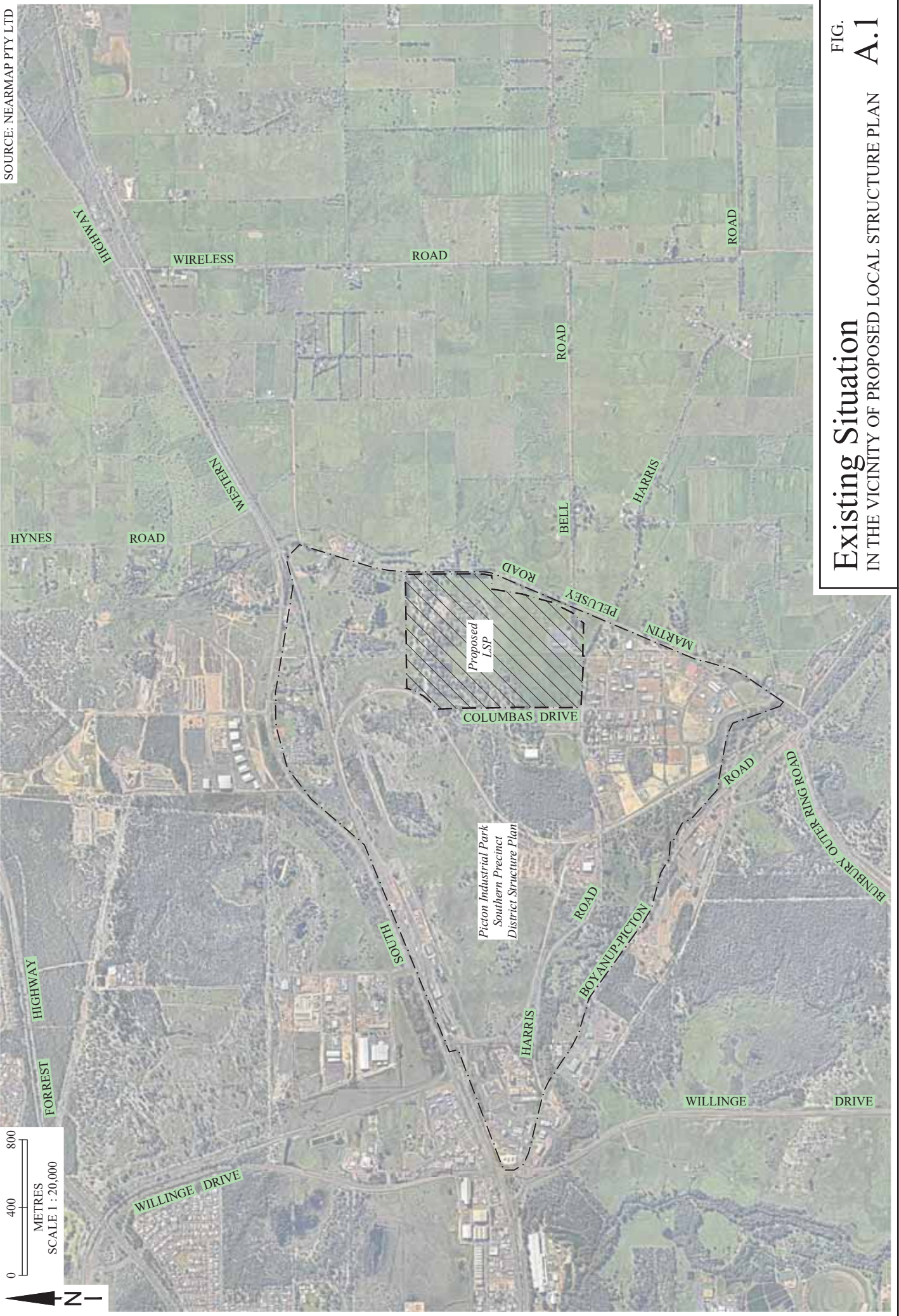
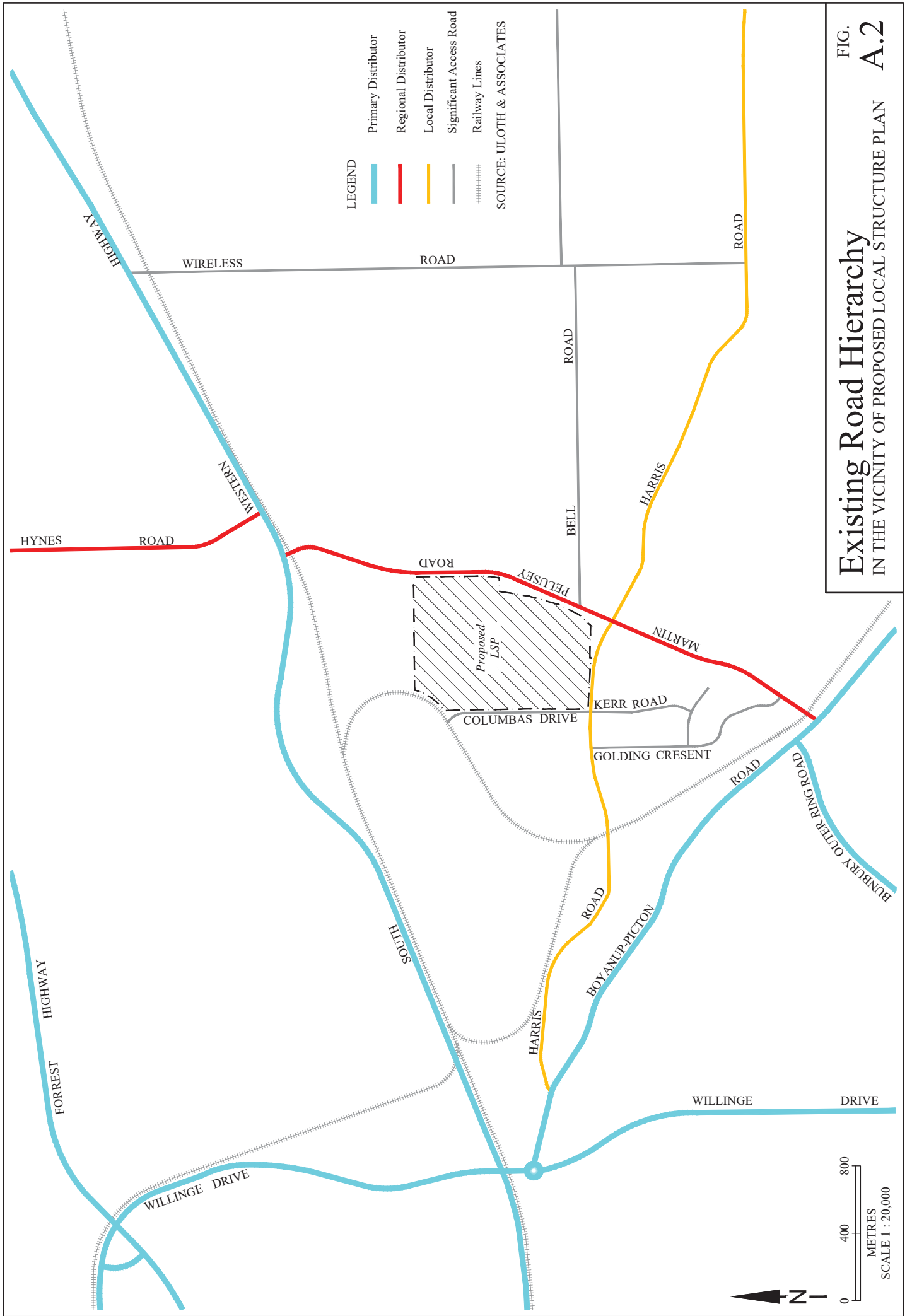
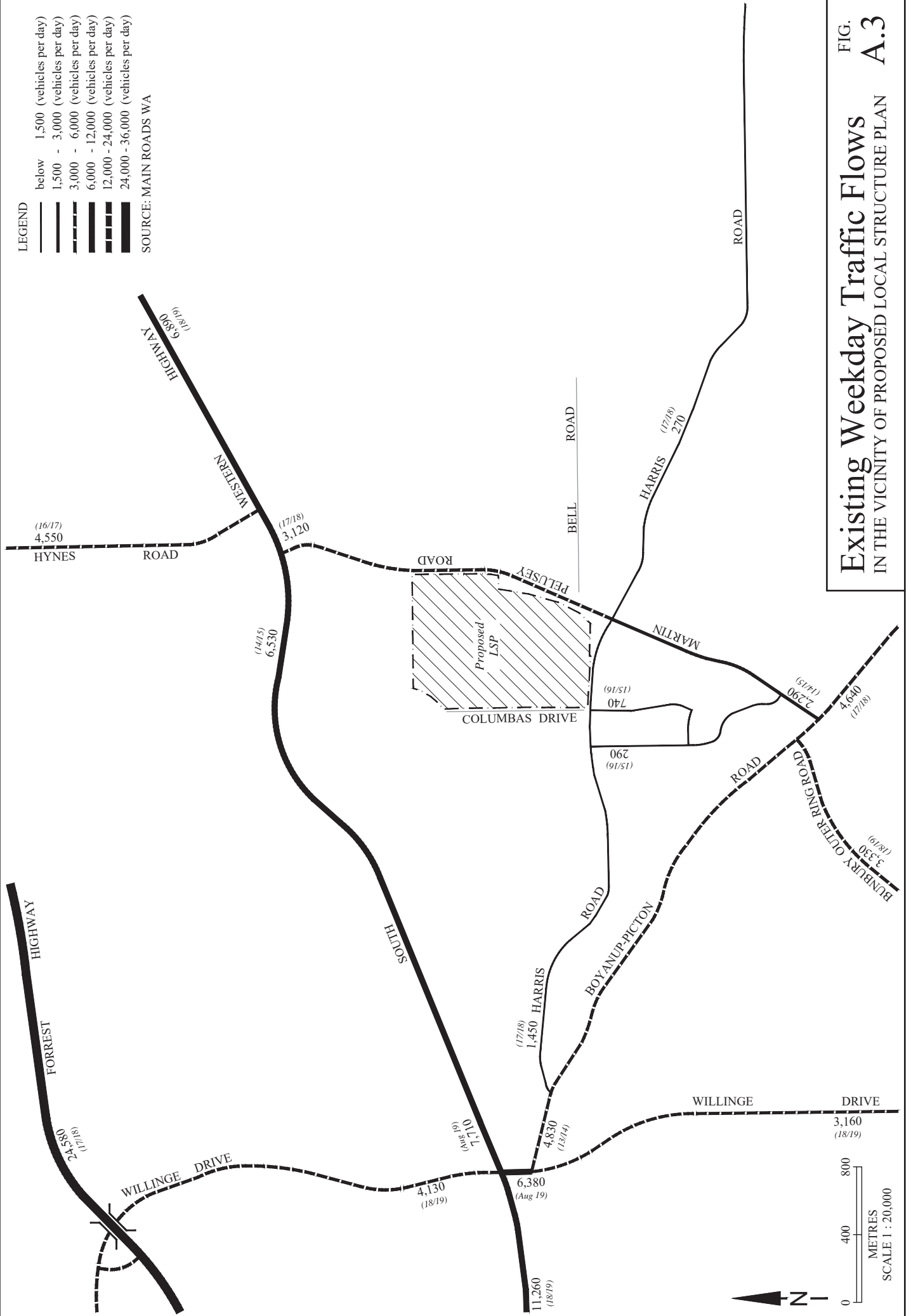


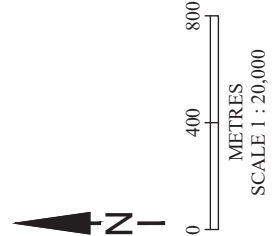
FIG. A.1  
Existing Situation  
IN THE VICINITY OF PROPOSED LOCAL STRUCTURE PLAN



- LEGEND**
- below 1,500 (vehicles per day)
  - 1,500 - 3,000 (vehicles per day)
  - 3,000 - 6,000 (vehicles per day)
  - 6,000 - 12,000 (vehicles per day)
  - 12,000 - 24,000 (vehicles per day)
  - 24,000 - 36,000 (vehicles per day)
- SOURCE: MAIN ROADS WA



**FIG. A.3**  
**Existing Weekday Traffic Flows**  
 IN THE VICINITY OF PROPOSED LOCAL STRUCTURE PLAN



### **A.3 CURRENTLY PLANNED REGIONAL ROAD NETWORK**

Figure A.4 shows the current Bunbury Region Scheme Map in the vicinity of the Picton industrial areas, including the now superseded alignment of the Bunbury Outer Ring Road adjacent to Martin Pelusey Road and Hynes Road (linking to Australind Bypass near Millbridge). The plan also identifies the currently proposed Local Structure Plan area at Lots 103, 110 and 603 Harris Road and Martin Pelusey Road, Picton East, located immediately to the west of the superseded Bunbury Outer Ring Road at Martin Pelusey Road.

Figure A.5 then shows the currently planned Bunbury Outer Ring Road, realigned approximately 2 to 3 kilometres further east, with proposed grade-separated interchanges at Willinge Drive, Wireless Road, South Western Highway and Raymond Road.

Figure A.6 shows a composite future road map for the same overall area, identifying the proposed realignment of the Bunbury Outer Ring Road through the now proposed Waterloo Industrial Park District Structure Plan and to the east of the Wanju District Structure Plan.

Figure A.7 then provides more detail regarding the Bunbury Outer Ring Road alignment and the planned connectivity with the adjacent District Distributor road network.

SOURCE: DEPARTMENT OF PLANNING, LANDS AND HERITAGE

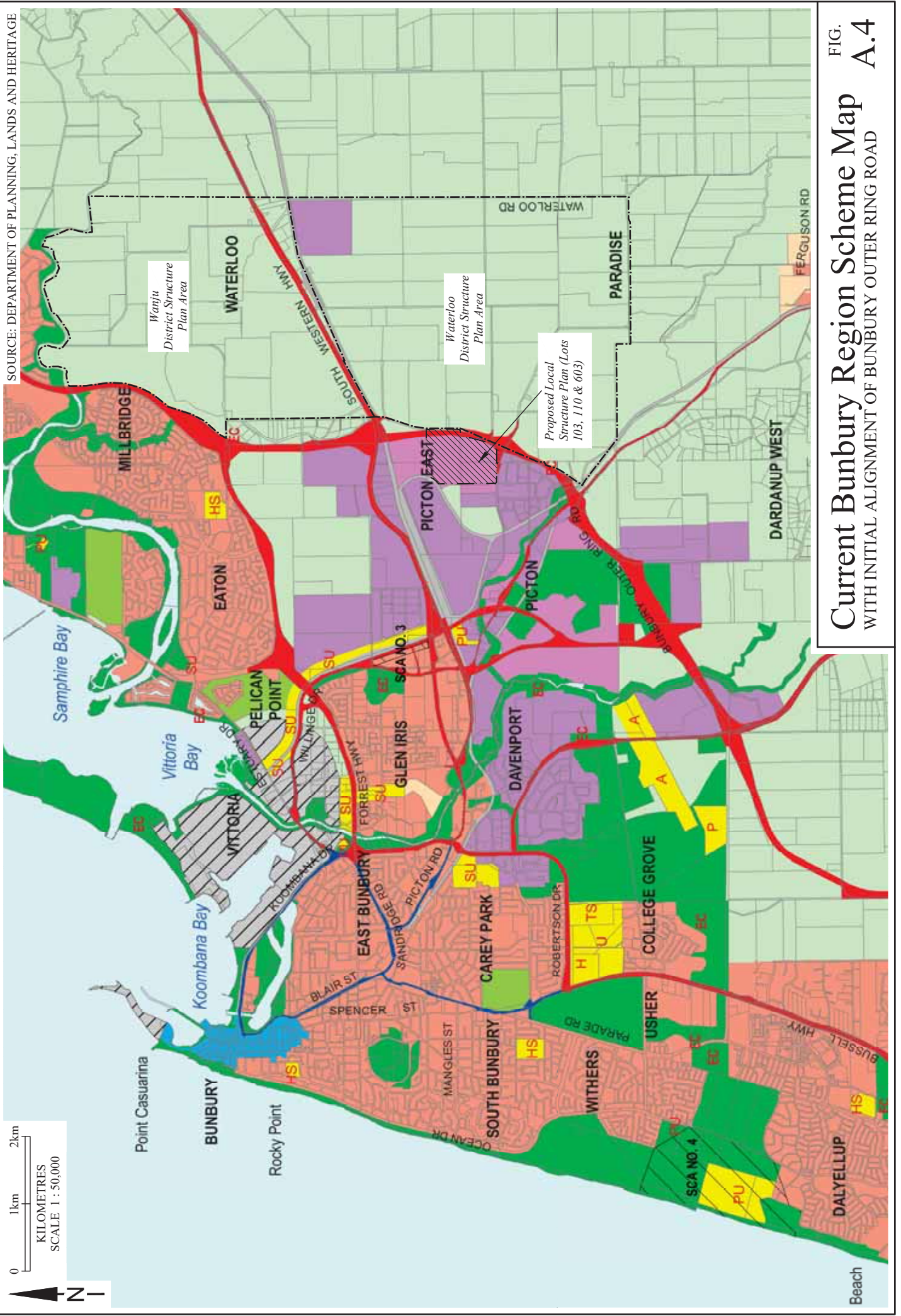
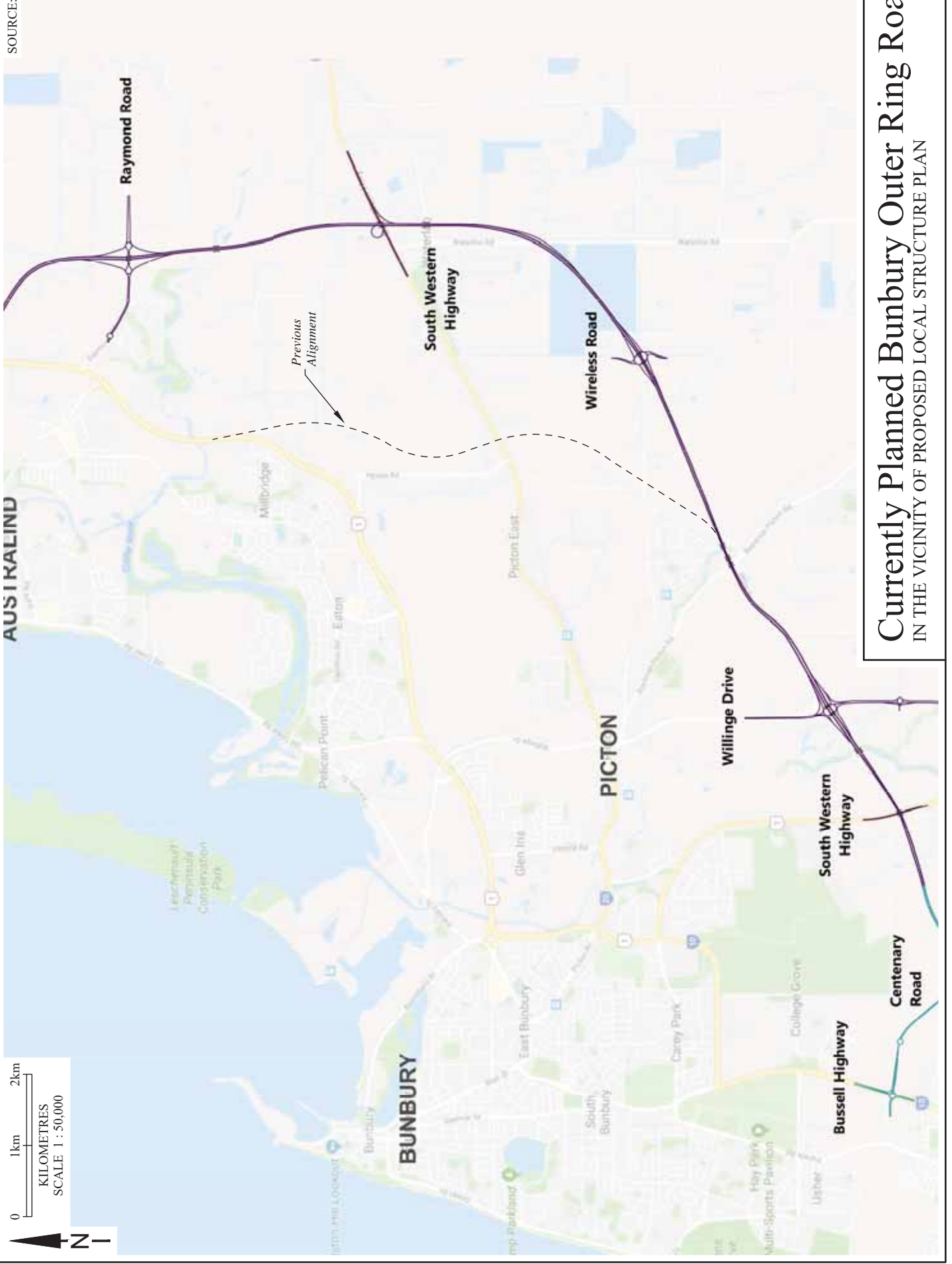


FIG. A.4  
**Current Bunbury Region Scheme Map**  
WITH INITIAL ALIGNMENT OF BUNBURY OUTER RING ROAD

SOURCE: MAIN ROADS W.A



**FIG. A.5**  
**Currently Planned Bunbury Outer Ring Road**  
IN THE VICINITY OF PROPOSED LOCAL STRUCTURE PLAN

SOURCE: ULOTH & ASSOCIATES

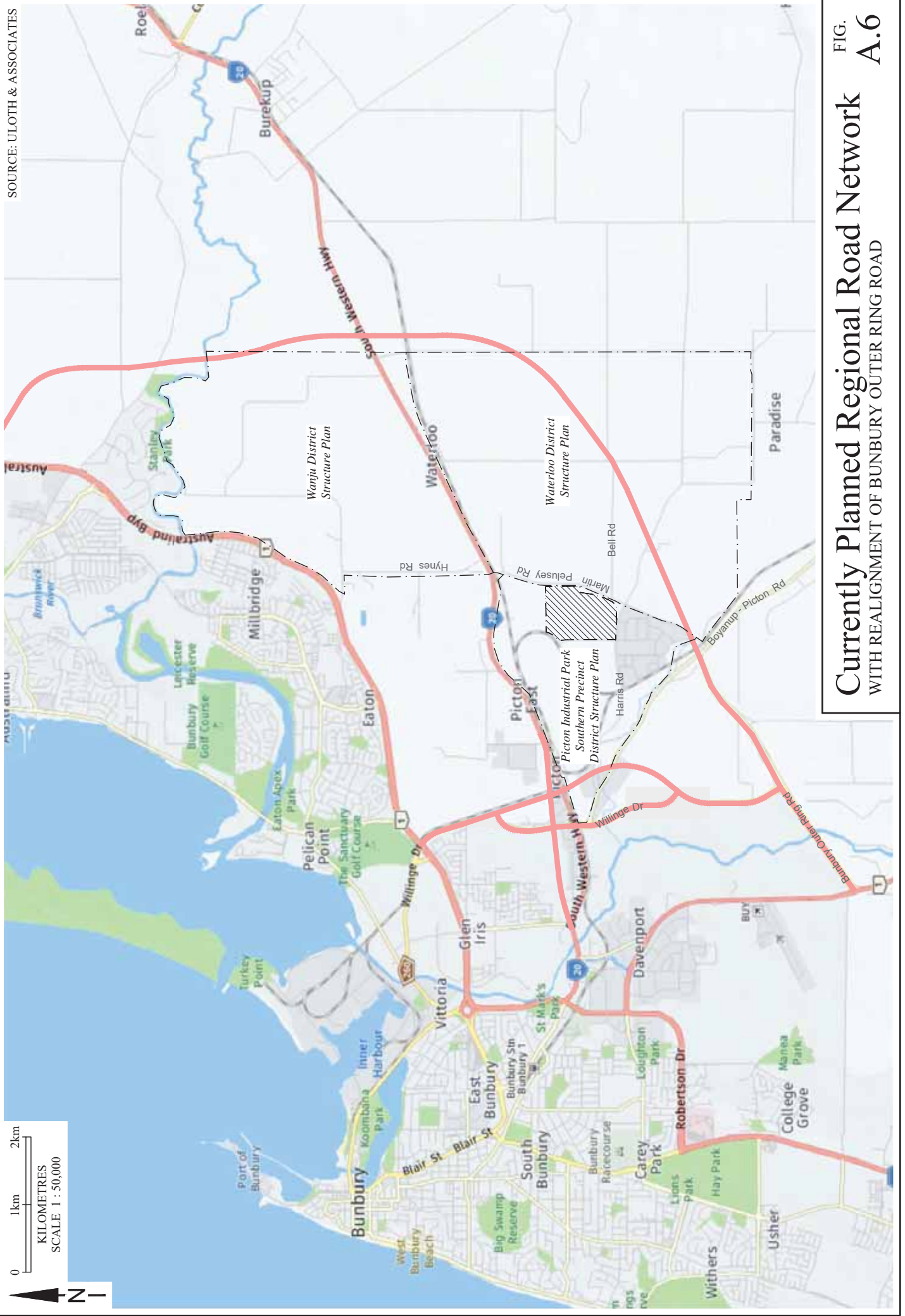
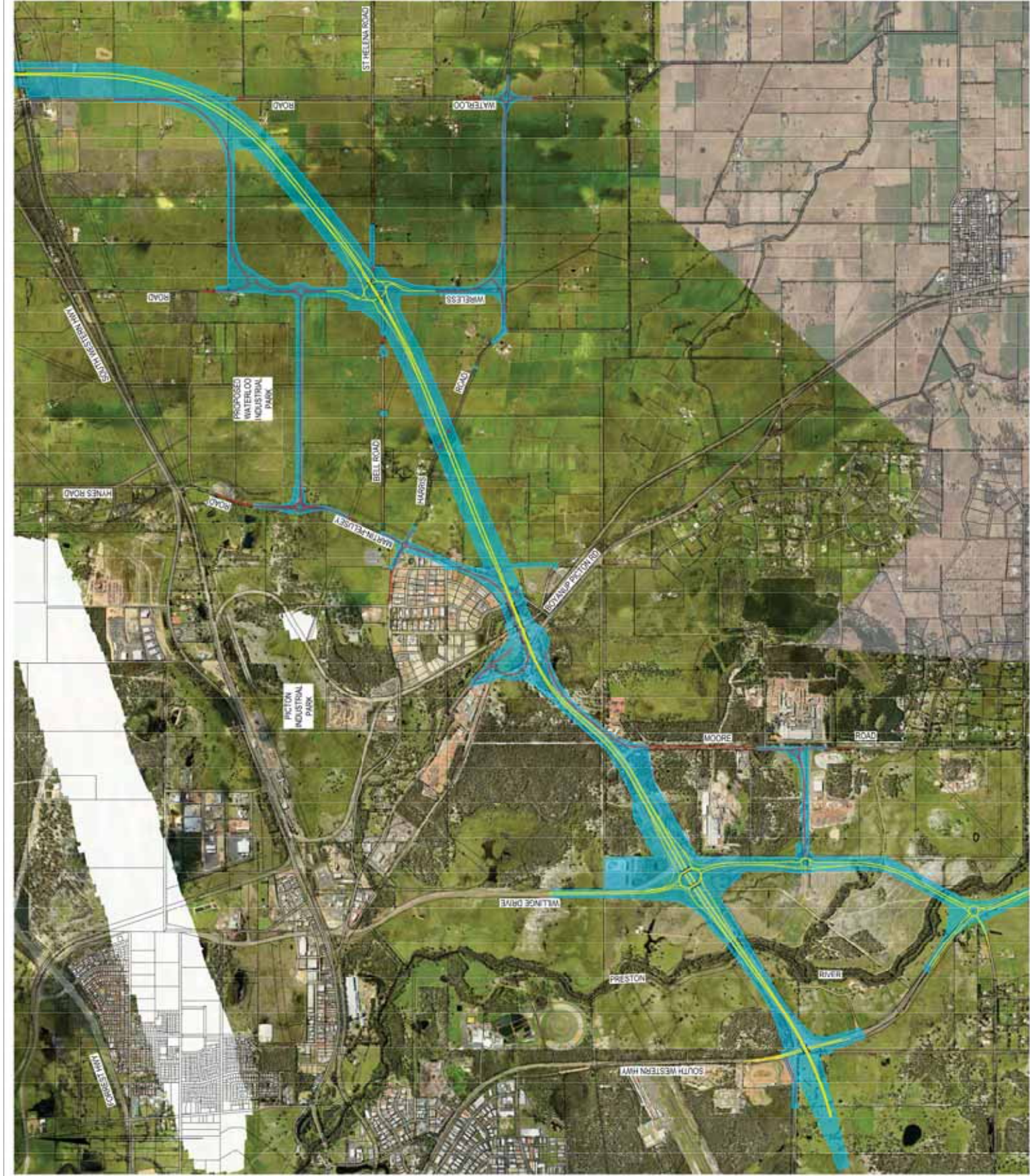


FIG. A.6  
**Currently Planned Regional Road Network**  
WITH REALIGNMENT OF BUNBURY OUTER RING ROAD



**LEGEND:**

	REFERRAL CORRIDOR
	PROPOSED MAJOR ROAD
	PROPOSED LOCAL ROAD
	PROPOSED ACCESS ROAD

FIG. A.7

SKETCH ONLY  
ULTIMATE PLANNING  
UNDER DEVELOPMENT

**BORR Team**

mainroads  
Infrastructure

15/04/2019  
1:15000m @ A1  
PCG 94

BUNBURY OUTER RING ROAD (H058)  
BORR NORTH  
ACCESS STRATEGY PLAN  
SHEET 2 OF 2

BORR-01-SK-RD-0151



#### **A.4 PICTON INDUSTRIAL PARK SOUTHERN PRECINCT DISTRICT STRUCTURE PLAN**

Figure A.8 shows the approved Picton Industrial Park Southern Precinct District Structure Plan, for the area bounded by South Western Highway, Martin Pelusey Road and Boyanup Picton Road.

It can be seen in Figure A.8 that the approved plan shows Harris Road as a Local Distributor road serving as an east-west spine road for the overall structure plan, between Boyanup-Picton Road in the west and Martin Pelusey Road in the east. It can also be seen that the area north of Harris Road is serviced by the existing Columbas Drive, extending towards the west and linking back to Harris Road, together with a new east-west Local Distributor road linking from Columbas Drive to Martin Pelusey Road.

It is also important to note that potential widening of Harris Road at its western end is restricted due to the squeeze-point between the existing railway reserve and the Ferguson River Reserve.

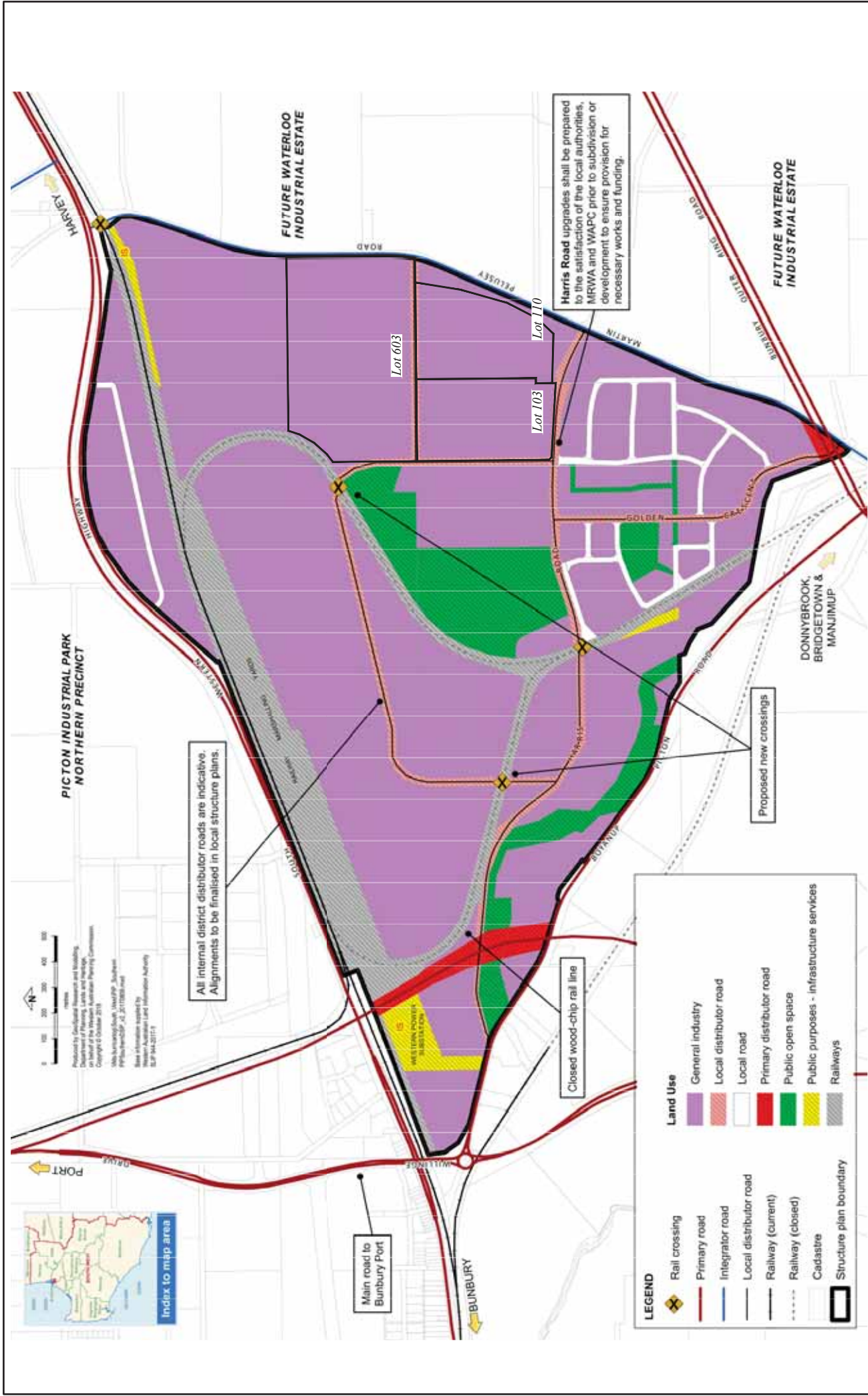


FIG. A.8  
**Approved District Structure Plan**  
 PICTON INDUSTRIAL PARK SOUTHERN PRECINCT

## **A.5 WATERLOO AND WANJU DISTRICT STRUCTURE PLANS**

The Waterloo Industrial Park and Wanju District Structure Plans were both advertised for public comment during February 2019, including the proposed new alignment of the Bunbury Outer Ring Road.

Figure A.9 shows a composite of the 2 Structure Plans, together with the previously approved Picton Industrial Park Southern Precinct District Structure Plan, and the surrounding road network.

Figure A.10 then shows a closer image of the same composite plan, in the vicinity of the now proposed Local Structure Plan, noting the staggered alignment of the east-west distributor roads linking to each side of Martin Pelusey Road.

SOURCE: ULOTH & ASSOCIATES

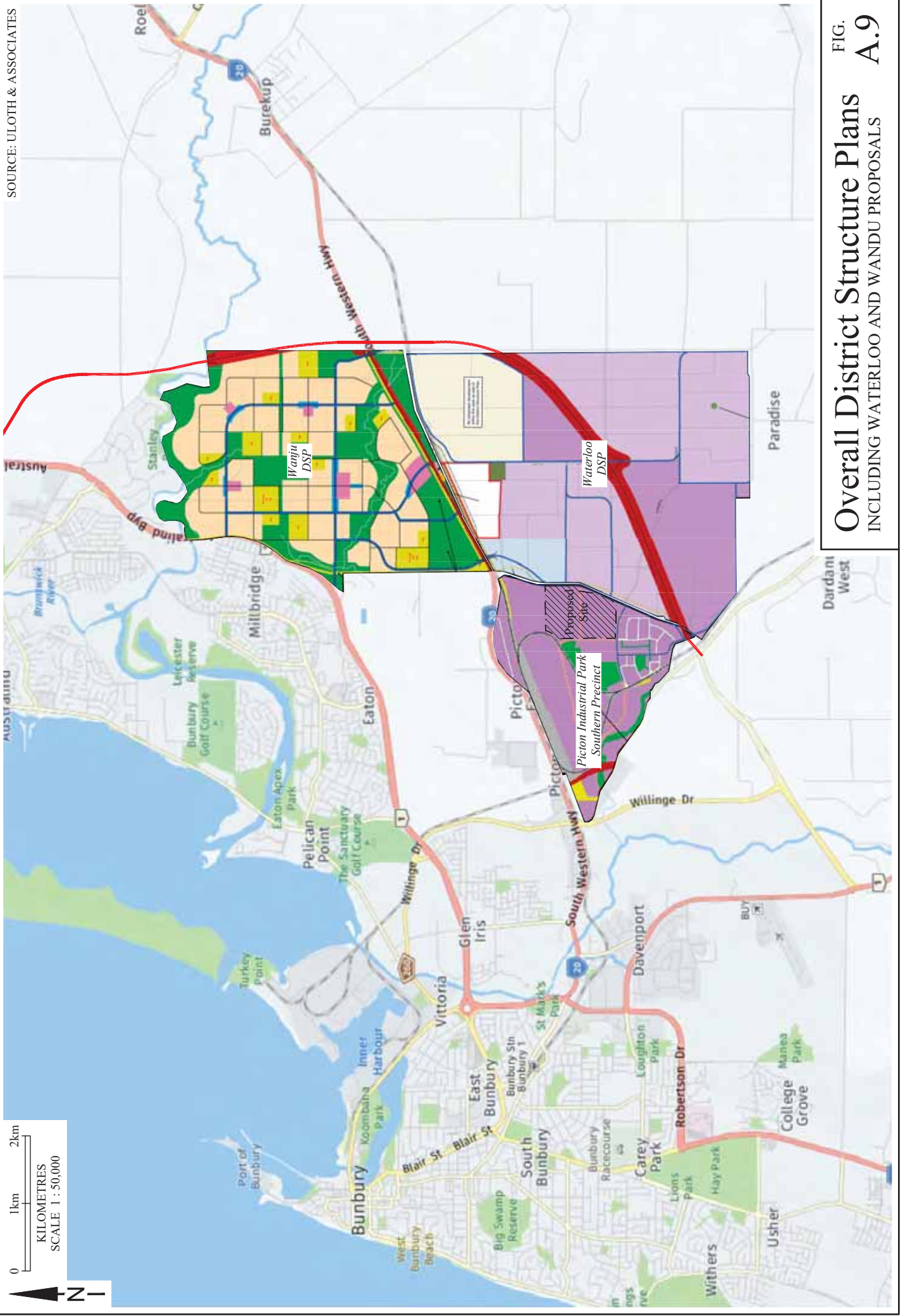
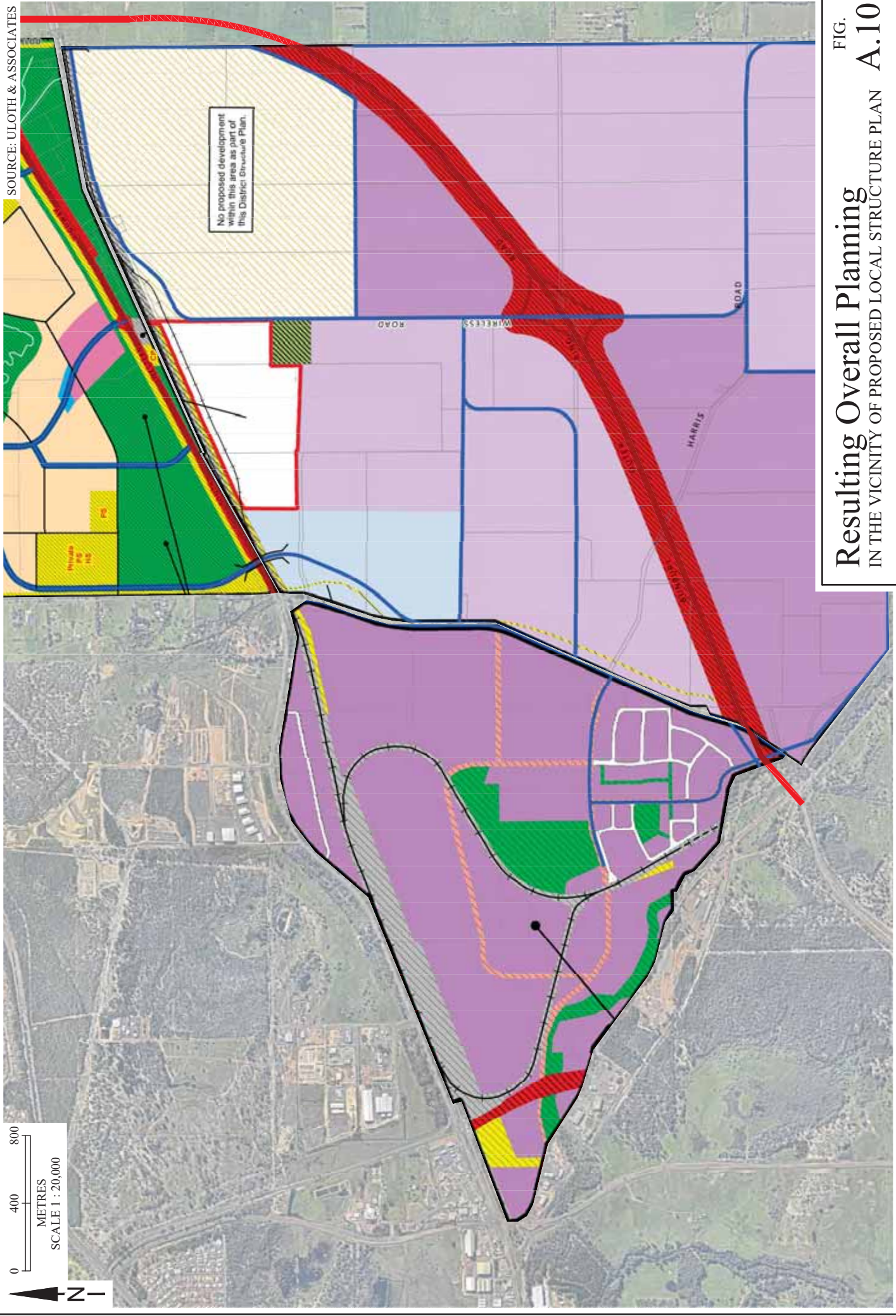


FIG. A.9  
Overall District Structure Plans  
INCLUDING WATERLOO AND WANDU PROPOSALS



SOURCE: ULOTH & ASSOCIATES

FIG. 10  
**Resulting Overall Planning**  
 IN THE VICINITY OF PROPOSED LOCAL STRUCTURE PLAN A.10

## **A.6 PROPOSED LOCAL STRUCTURE PLAN**

Figure A.11 shows the currently proposed Local Structure Plan for Lots 103, 110 and 603 Harris Road and Martin Pelusey Road, taking into account the proposed removal of the Primary Regional Road reserve along Martin Pelusey Road due to the proposed realignment of the Bunbury Outer Ring Road.

The plan also proposes a modified alignment for the east-west distributor road between Columbas Drive and Martin Pelusey Road, to tie-in with the new roundabout identified in the Waterloo Industrial Park District Structure Plan and the resulting east-west link to the new Bunbury Outer Ring Road interchange at Wireless Road

The Local Structure Plan is expected to result in the creation of approximately 50 individual Industrial Lots, with a total developable site area of approximately 57 hectares. And applying a similar yield ratio to the remaining District Structure Plan areas north of Harris Road results in an additional 161 hectares of development area, including 95 hectares located within the existing railway loop.

SOURCE: ULOTH & ASSOCIATES

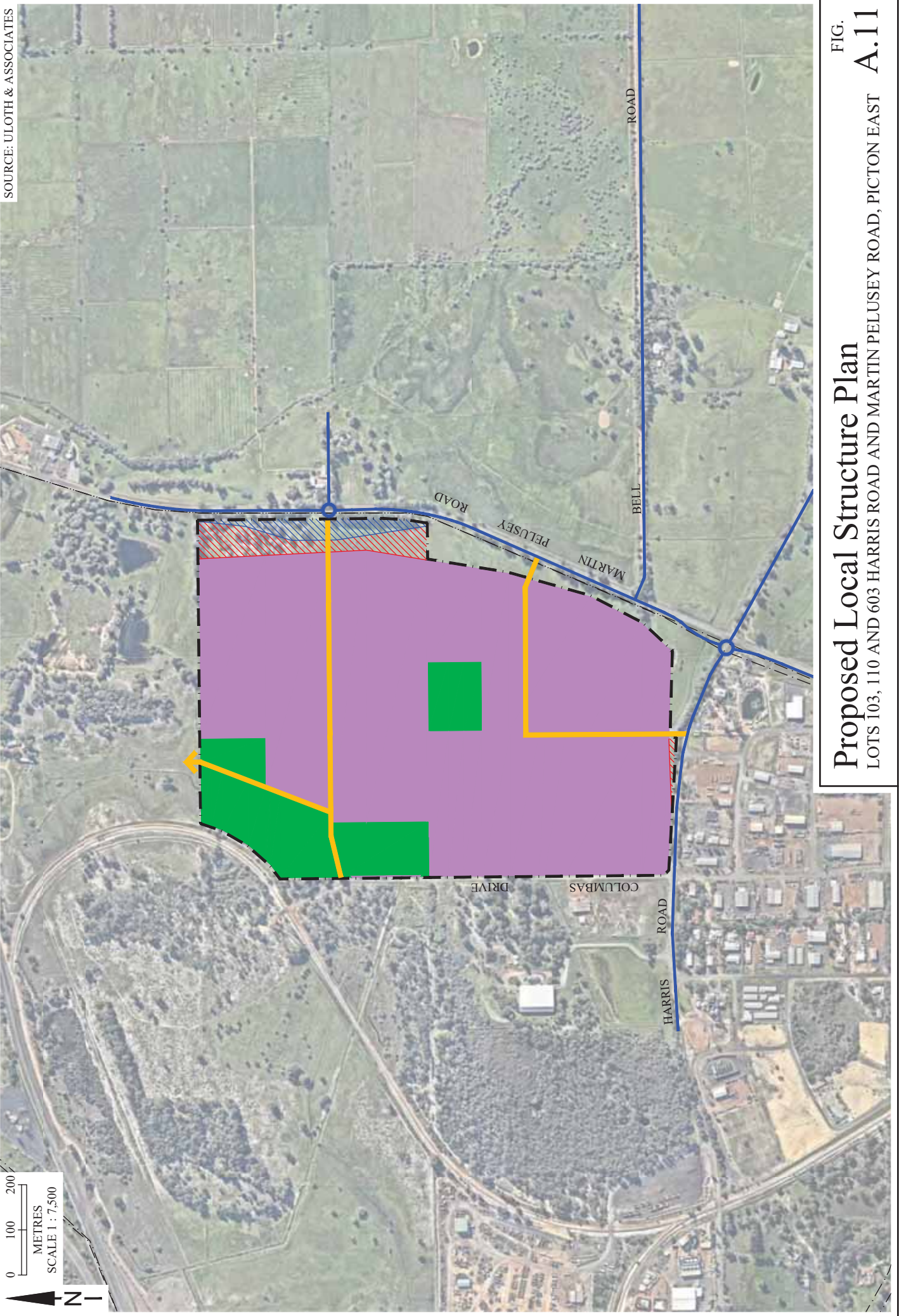


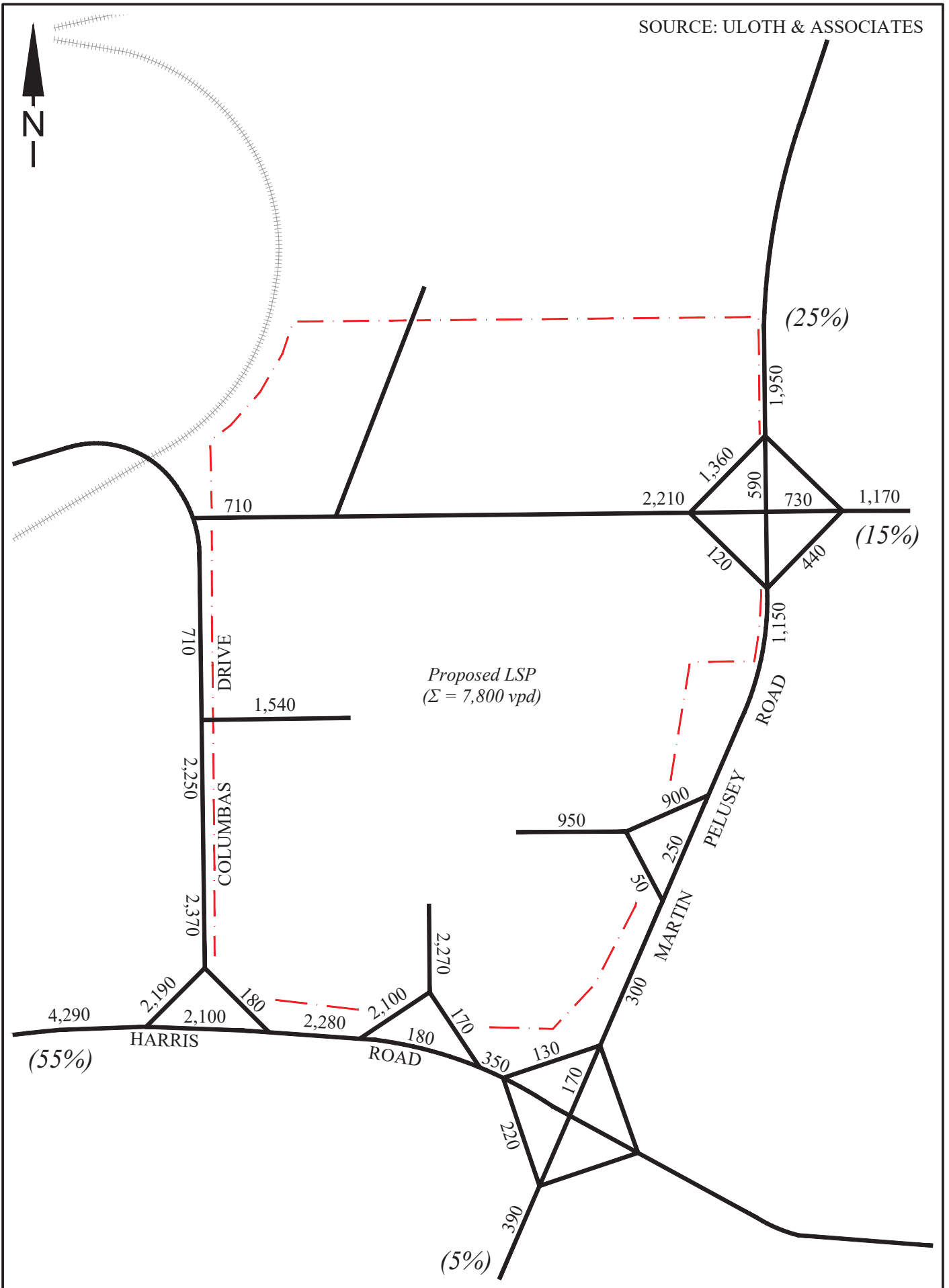
FIG. A.11  
Proposed Local Structure Plan  
LOTS 103, 110 AND 603 HARRIS ROAD AND MARTIN PELUSEY ROAD, PICTON EAST

## **A.7 FUTURE TRAFFIC FLOWS AND RESULTING OVERALL ROAD NETWORK**

Figure A.12 shows the future development traffic flows for the proposed Local Structure Plan area, together with the anticipated external traffic distribution, while Figure A.13 shows the total future traffic flows including external through traffic flows from the adjacent industrial areas north of Harris Road and west of Martin Pelusey Road.

Figure A.14 then shows the resulting overall road network, taking into account the combined District Structure Plans for Waterloo Industrial Park and Wanju, as well as the current plans for the Bunbury Outer Ring Road.





**Future Development Traffic Flows**  
FOR PROPOSED LOCAL STRUCTURE PLAN

FIG.  
A.12

SOURCE: ULOTH & ASSOCIATES

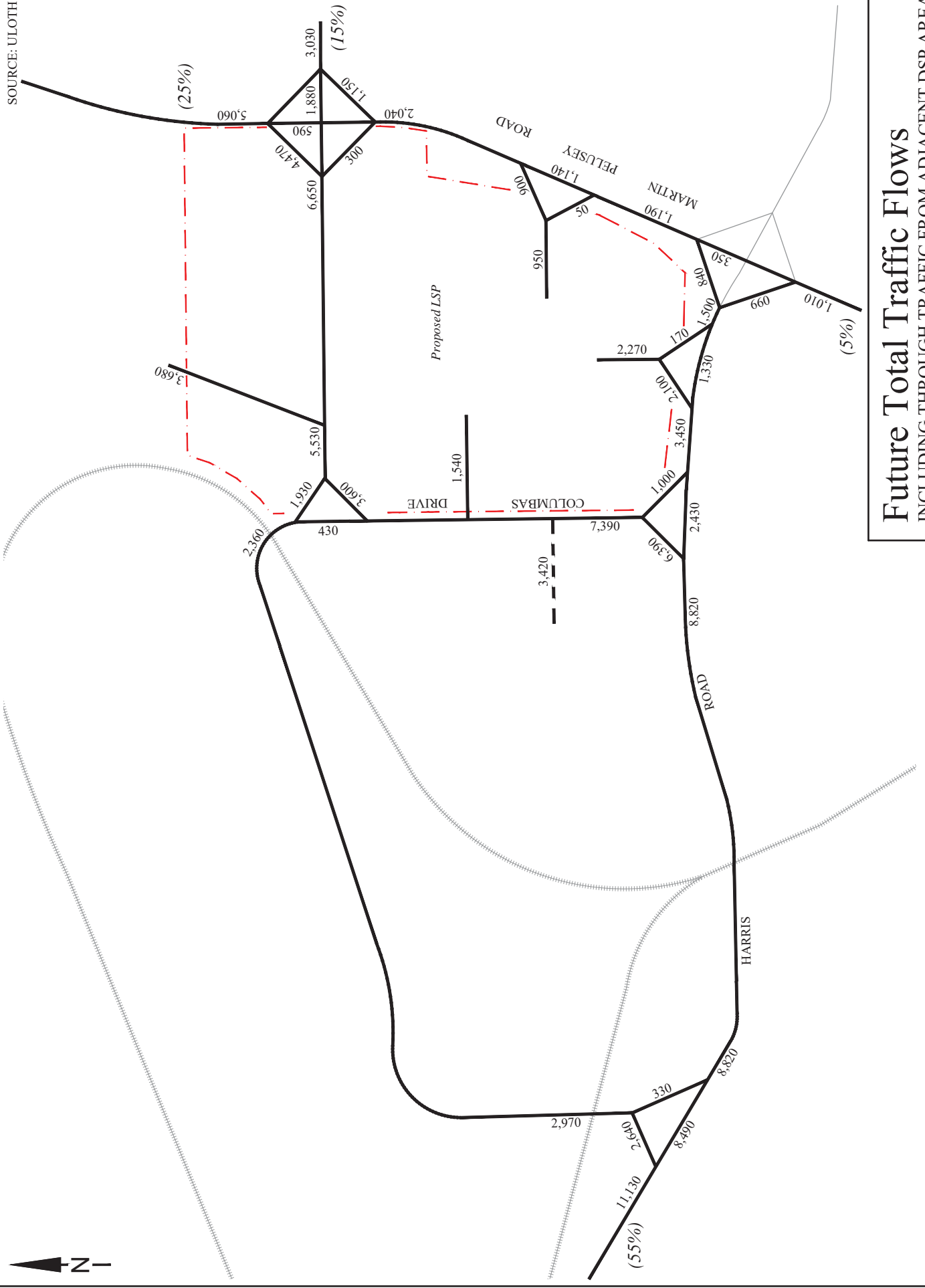


FIG. A.13  
Future Total Traffic Flows  
INCLUDING THROUGH TRAFFIC FROM ADJACENT DSP AREA

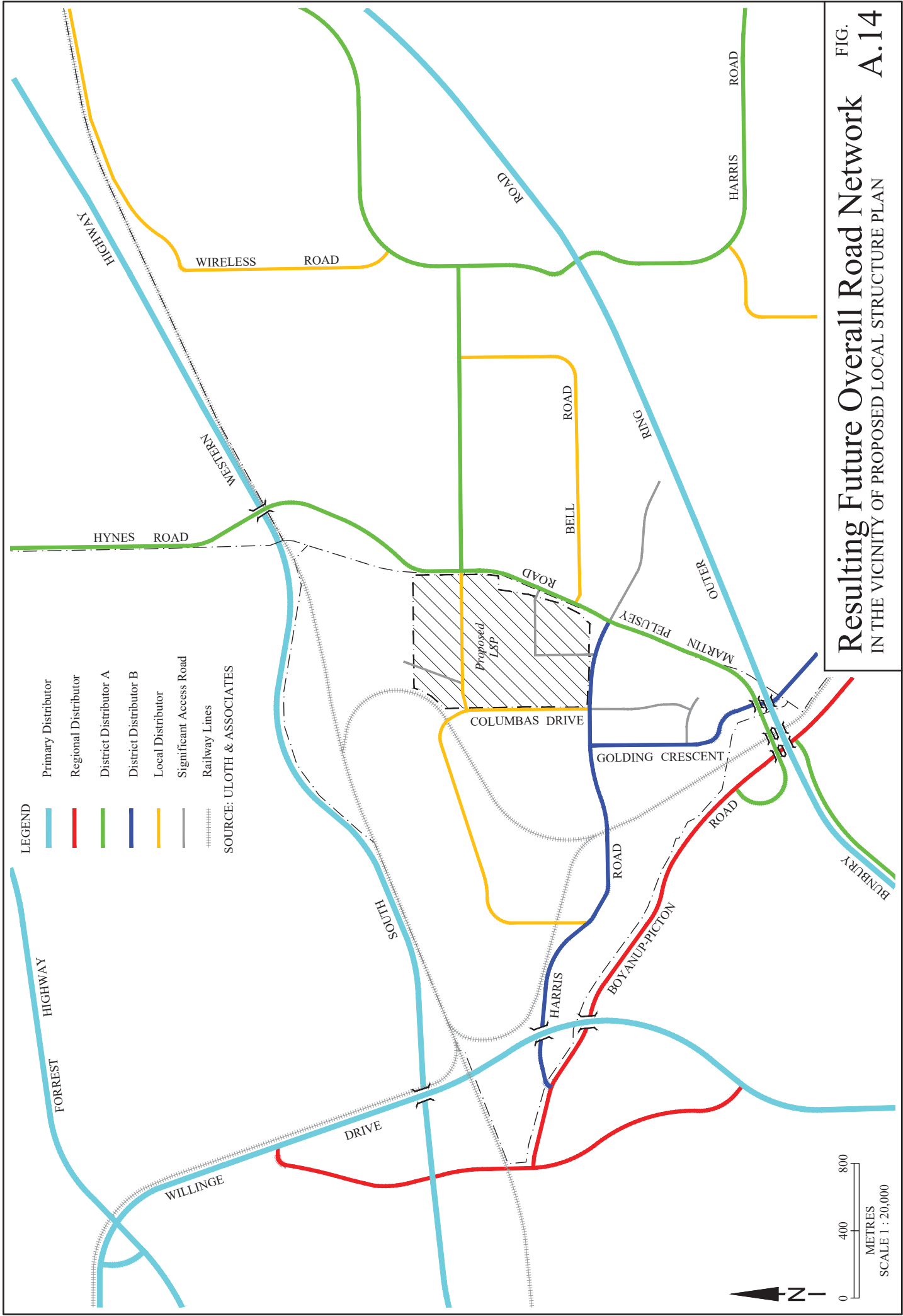


FIG. A.14  
**Resulting Future Overall Road Network**  
 IN THE VICINITY OF PROPOSED LOCAL STRUCTURE PLAN

LEGEND

- Primary Distributor
- Regional Distributor
- District Distributor A
- District Distributor B
- Local Distributor
- Significant Access Road
- Railway Lines

SOURCE: ULOOTH & ASSOCIATES

0 400 800  
 METRES  
 SCALE 1 : 20,000



# APPENDIX 7

ENGINEERING SERVICING REPORTS



**ROWE**  
GROUP  
DESIGN

# Lots 103, 110 and 603 Harris Rd, Picton East

## Engineering Servicing Report

Civil, Electrical and Communications Engineering Report

Prepared for: Harris Road Pty Ltd c/- Rowe Group

Attention: Mr Rod Dixon

Date: 12<sup>th</sup> of November 2019

Prepared by: Richard Martin

Ref: 44260

Wood & Grieve Engineers now part of Stantec  
PO Box 1276, 10 / 44-48 Queen St, Busselton WA 6280  
Tel: +61 8 9754 4244 Email: busselton@wge.com.au www.wge.com.au

\\WGE-BUS-FS-01\PROJECTS\44260\PROJECT DOCUMENTATION\CIVIL\DOCUMENTS & REPORTS\SERVICING REPORT\CI-RE-ESR-001A.DOCX



# Revision

Revision	Date	Comment	Prepared By	Approved By
001a	7/10/2019	Final Report	L. Sutherland / R. Fowler	R. Martin
002	12/11/2019	Updated Local Structure Plan	L. Sutherland	R. Martin

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# 1. Introduction

## 1.1 General

Wood & Grieve Engineers now part of Stantec (WGE/STC) has been engaged by Harris Road Pty Ltd to prepare this report in support of structure plans for the proposed subdivision of Lots 103, 110 and 603 Harris Road, Picton East within the Shire of Dardanup.

This report discusses the following engineering and infrastructure items necessary to service the proposed development:

- Sewer Reticulation
- Water Reticulation
- Gas Reticulation
- Rail Infrastructure
- Power Reticulation
- Communications

This report outlines the existing, and future servicing strategies that are expected to be required should the Picton East Structure Plan be implemented.

The information presented in this report is based on preliminary advice from the relevant service authorities and their available strategic planning information which is current only at the time of enquiry.



## 1.2 Site Location, Topography, and Existing Features

The Site comprises existing Lots 103, 110, and 603 Harris Road within the Shire of Dardanup and totals approximately 73Ha. The Site is generally bounded by Columbus Road to the west, Harris Road to the south, Martin-Pelusey Road to the east, and freehold land to the north.

The majority of the southern portion of the Site is relatively flat at approximately RL13m AHD to RL14m AHD. An elevated area (ranging from approximately RL16m AHD to RL22m AHD) exists in the northern area of the Site, running parallel with the northern and western boundaries of Lot 603. A number of water bodies exist within Lot 603 at the base of the elevated area, and in the south-eastern corner of Lot 110.

A number of existing Water Corporation open drains traverse Lots 103 and 603. Water Corporation's myWorld Esinet system identifies these drains as:

- East Picton Main Drain 710
- East Picton Sub-section C 708
- East Picton Sub-section D 709
- East Picton Sub-section E 710

The flatter areas of the Site are generally clear of significant vegetation. The elevated area and the south-east corner of Lot 603 are relatively densely vegetated.

An existing rail line, operated by Arc Infrastructure, runs immediately adjacent the north-west corner of the Site. Aerial imagery indicates a number of existing structures within Lot 603. Lot 110 contains a large warehouse and sealed hardstand area along with a number of smaller structures and a sealed entrance from Harris Rd.



Figure 1: Site Boundary (Aerial Imagery: Nearmap, September 2019)



## 2. Sewerage Reticulation

Currently, no sewerage infrastructure exists within close proximity to the Site, with the nearest existing gravity sewers being over 3km away to the north-west. The Water Corporation was contacted to determine what planning is currently in place for the provision of sewerage services to the Site. Correspondence with the Water Corporation is included as Appendix B, and an extract of the Water Corporation's long term sewer planning for the areas is provided below.

The Water Corporation's long term sewer planning indicates the site grades into two future wastewater pump station (WWPS) catchment areas, with the southern boundary of Lot 603 generally forming the catchment area boundary. Water Corporation has advised that neither of these two proposed WWPSs are planned to be constructed within the next 5 years. Additionally, Water Corporation's long term sewer planning indicates the two proposed WWPSs will pump to future gravity sewers within catchments of other proposed WWPSs that are also yet to be constructed.

Based on the above, it is unlikely that gravity sewerage infrastructure will be available to the Site for many years, and accordingly it is understood that initial development of the Site will require the utilisation of Aerobic Treatment Units (ATUs).

A detailed site assessment will be undertaken prior to development to confirm the suitability of the existing soil profile and groundwater levels for onsite effluent disposal. Approval to install an ATU system must be sought from the Shire, and/or Department of Health, depending on the particulars of the proposal. ATU systems must, as a requirement of health legislation, be serviced regularly by Department of Health approved service persons. Details of ATU systems that have been approved for use in Western Australia can be found on the Department of Health website.



Figure 2: Water Corporation Long Term Sewer Planning

### 3. Water Reticulation

The proposed subdivision falls into an area currently licensed and operated by Aqwest. Provision of reticulated water as part of the sites development will be a WAPC condition of subdivision approval.

Aqwest currently has a DN300 water main within the Harris Road reserve as seen in figure 3. Aqwest was contacted to determine whether their existing potable water network has capacity to service the Site with potable water. This Site would be serviced via connection to this existing DN300 main. Correspondence with Aqwest is included as Appendix D.

Aqwest advised that the existing DN300 water main within the Harris Road reserve has capacity to service the Site without need for any network upgrades or reinforcements.

The existing DN300 water main will need to be extended approximately 200m to the intersection of Harris Road and Martin Pelusey Road to service lots along the front of Harris Road. Extension of the network with reticulated mains into the proposed development will be required to service all other lots and will need the approval of Aqwest. Aqwest confirmed that all works will be at the developer’s expense.

It was noted in a previous servicing report by MPM Development Consultants in 2014 that, although there was capacity to service the Site via the existing DN300 main and provide sufficient water pressure for drinking purposes in accordance with their license requirements, this pressure may not be sufficient for lot purchasers to meet Department of Fire and Emergency Services (DFES) requirements for their future structures/development on lots. It is therefore likely that individual lot purchasers may be required to install tanks and pumps on their site for fire-fighting purposes.

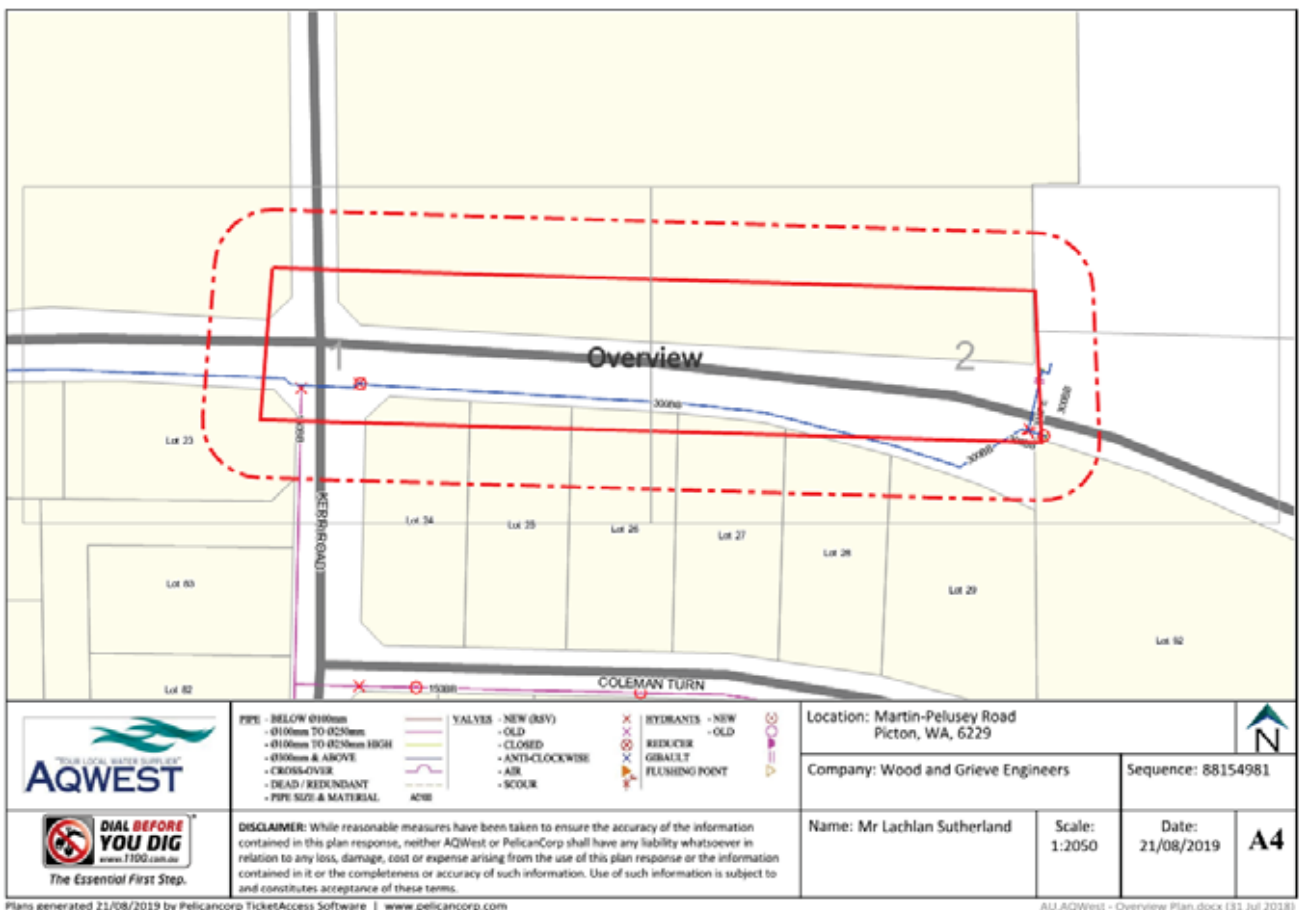


Figure 3 Dial Before you Dig - Aqwest infrastructure

## 4. Gas Reticulation

ATCO Gas (ATCO) operates a reticulated gas network adjacent the Site, consisting of:

- A DN110 high pressure polyethylene (PE) gas 350kPa main within the Harris Road reserve adjacent the site (operating at reticulation pressure), and
- A DN150 high pressure steel 1900kPa gas main on the eastern side of Martin-Pelusey Road (operating at transmission pressure)

ATCO was contacted to determine whether their existing gas infrastructure has the capacity to service the Site with reticulated gas. ATCO has confirmed that the DN110 pressure main within Harris Road reserve has the capacity to service the proposed development. A fee would be charged to the Developer for the installation of gas infrastructure, which could be reduced if the Developer provides a common trench. Correspondence with ACTO Gas can be found in Appendix C.

ATCO also advised that a direct connection to the existing DN150 steel gas main would be possible to reinforce the network if gas demand within the development turned out to be relatively high. This would require the construction of costly pressure reduction infrastructure and the developer would be required to contribute to the cost.

Provision of reticulated natural gas as part of the development of the Site is unlikely to be a WAPC condition of subdivision, and therefore its installation is at the discretion of the developer.

The Department of Mines, Industry Regulation and Safety (DMIRS) was contacted with regard to the proposed extension of the Dampier to Bunbury Natural Gas Pipeline (DBNGP) from Bunbury to Albany. DMIRS confirmed that the Site overlaps an investigation corridor for the proposed extension. An extract from DMIRS's online mapping system is provided below with the Site shown in red, and the DBNGP extension investigation corridor shown in blue. It is recommended that, if not already undertaken, further discussions are held with DMIRS to determine what, if any, impact this investigation corridor has on the proposed development.



Figure 4 ATCO gas network

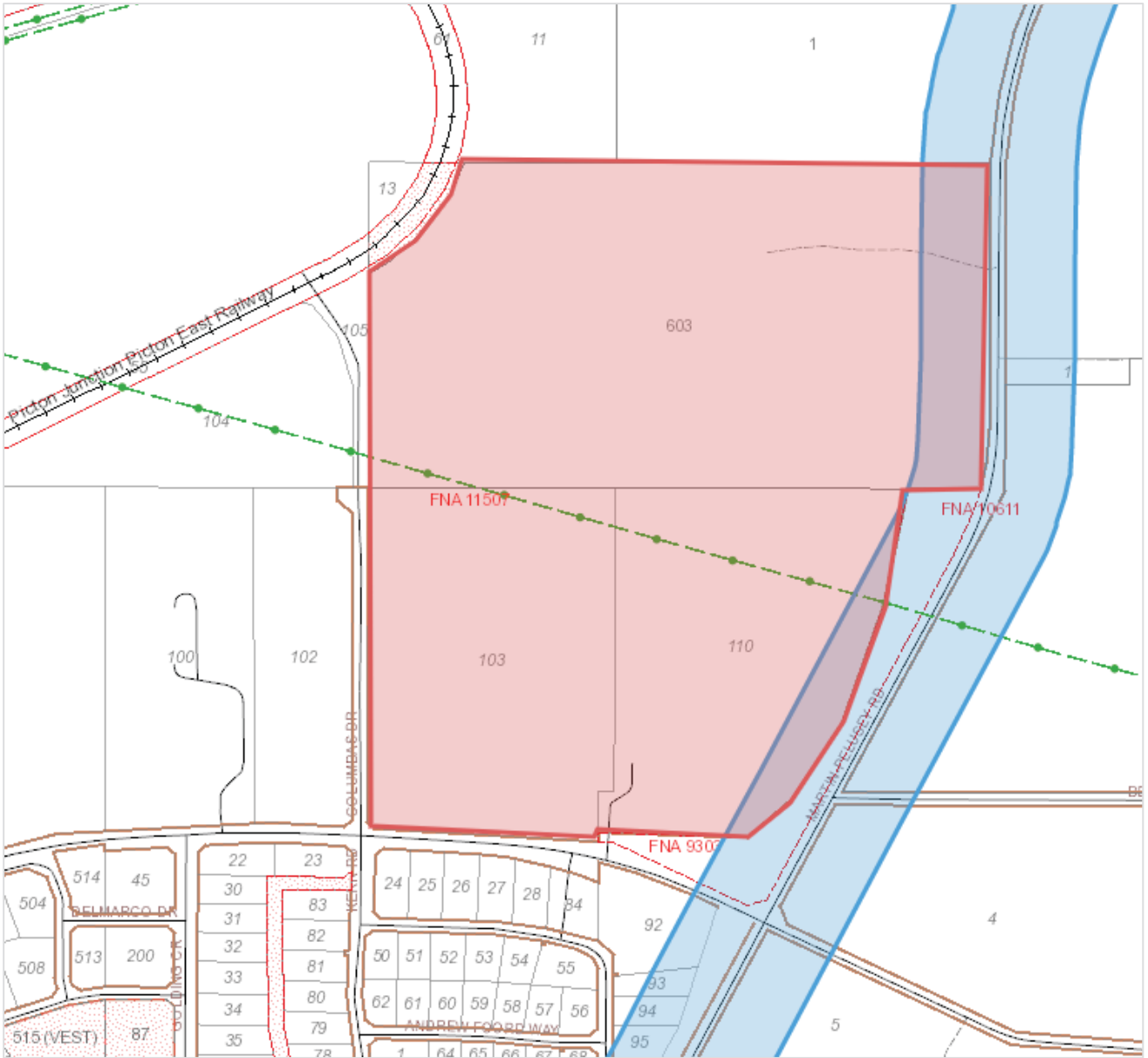


Figure 4: Proposed DBNGP Extension Investigation Area (blue) over the Site (red)



## 5. Rail Infrastructure

Arc Infrastructure operates a rail line that runs along the north-west boundary of the Site. This line is part of the Boyanup Loop near Picton Junction and services the South-West region.

After a telephone conversation with an Arc Infrastructure Property Specialist, WGE/STC were advised that there are currently no plans to widen the rail reserve in this area.

Currently, Arc Infrastructure undertakes routine maintenance and re-sleepering of the infrastructure. The proposed POS buffer indicated on the structure plan appears more than sufficient to meet Arc Infrastructure's requirements.

Correspondence with Arc Infrastructure can be found in Appendix F.

Arc Infrastructure provided the following requirements for the protection of their assets:

- Fencing along the rail reserve boundary will be required where it is adjacent the development
- Dust suppression during construction and restricting dust creating activities by industrial land users within the vicinity of the track will be required

Arc Infrastructure advised that this rail line currently operates 24/7, and as such, development of the Site can cause no disruptions to the rail line operation.

A rail crossing exists adjacent the Site on the western side where the rail line crosses Columbus Drive. This rail crossing is outside the Site's structure plan area, and as such, it is considered unlikely that any upgrades or reconfiguration of this rail crossing would be imposed as a condition of subdivision of the Site.



## 6. Power Reticulation

### 6.1 General

Western Power requires that commercial/industrial lots are provided with 200 kVA/ha power supplies. Based on this, the proposed development presents a total power demand of approximately 11.7MVA. Based on the initial structure plan in revision 001a, the installed capacity will in all likelihood be 14MVA, as lots larger than 1.11ha require a transformer on or adjacent that lot.

### 6.2 Off-site works

The Western Power network capacity mapping tool indicates that there is sufficient capacity (10-15MVA) in the Picton Zone substation (2020 forecast) so it is unlikely that any major substation upgrades will be required.

Based on Western Power Distribution Facilities Information System (DFIS), there is no high voltage (HV) take-off point in the area surrounding the proposed subdivision. This will in all likelihood require that one or possibly two HV lines will need to be constructed from the nearest suitable connection point to the subdivision. We are unable to confirm the extent and cost of these works without formal feasibility information from Western Power.

There is also an existing overhead HV transmission line that traverses the site from West to East. Based on the current concept plan, this line does not align with the proposed road reserves and will have to be relocated. We are unable to advise on the likely cost and implications of this relocation without submitting a formal feasibility study application to Western Power.

### 6.3 Internal power

Based on the standard Western Power load allowances (200 kVA/ha), the proposed subdivision presents an overall power demand of approximately 12 MVA. To service this power demand, as well as to allow for interconnection with the surrounding and future networks, a total of 5 high voltage ring main units and 14 x 1000 kVA transformers will be required.

Ring main units and transformers will be located to minimise high voltage and low voltage cable lengths, and each lot will be serviced using a uni pillar situated on the specific lot. Whilst this report is based on standard load allowances, we note that it is the developer's responsibility to allow sufficient power to lots that are likely to exceed the standard allowance.

Street lighting will need to be designed to AS1158 Cat P3/4 and will require utilising standard Western Power poles and fittings (non-decorative).



## 7. Communications

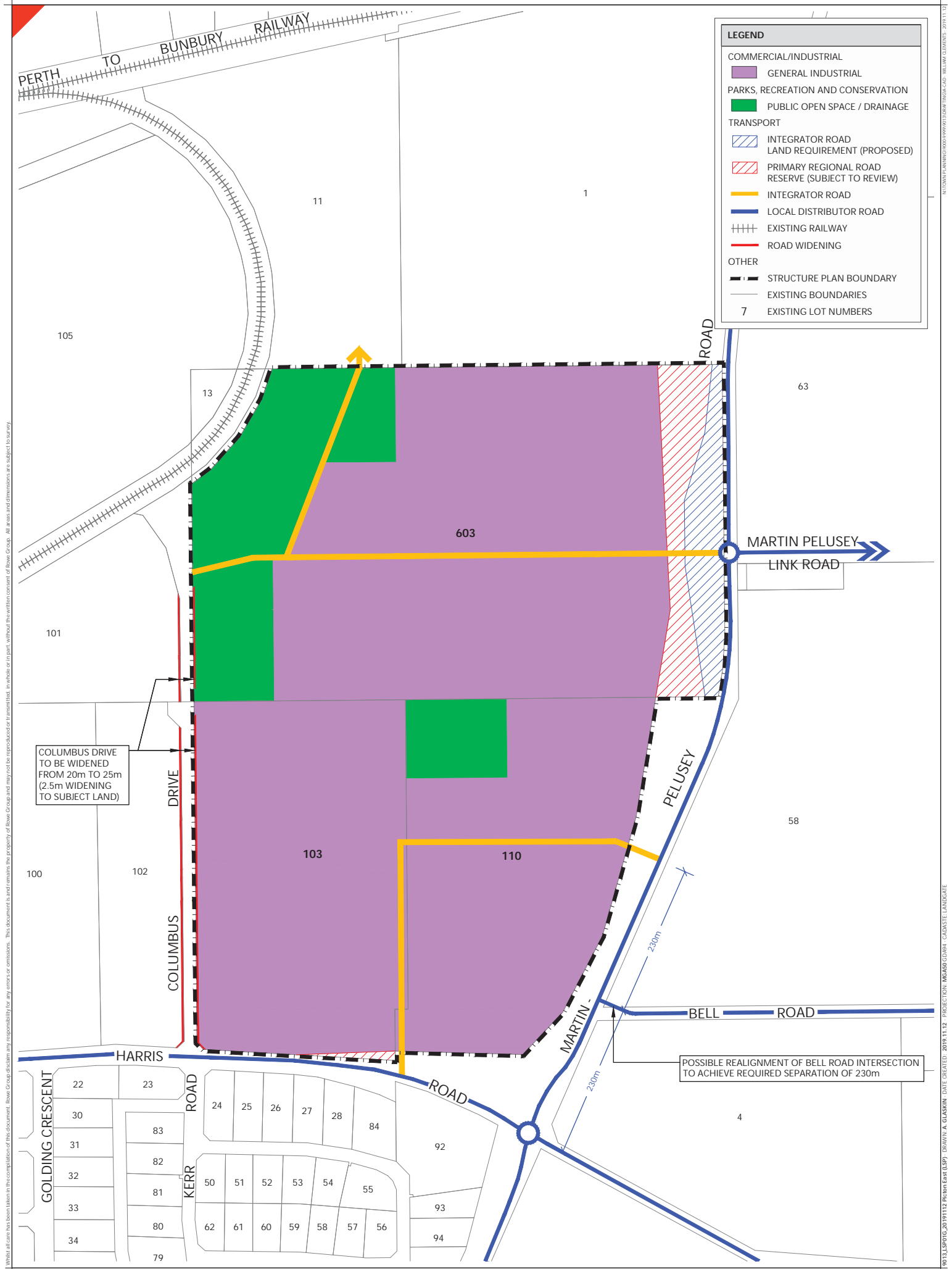
The proposed development will require the installation of a fibre ready pit and conduit network to NBN/Telstra requirements. The pit and conduit network will link up with existing communications infrastructure in Harris and Martin Pelusey Roads from where Telstra/NBN will install fibre optic or copper cabling to the development.



# Appendix A

## Local Structure Plan

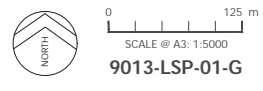




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9013-LSP01G\_20191112\_Picton East (LSP) DRAWN: A. GLASKIN DATE CREATED: 2019/11/12 PROJECTION: MGA50 GDAL - CADASTRE LAND DATE

**LOCAL STRUCTURE PLAN**  
 LOTS 103, 110 AND 603  
 PICTON EAST



# Appendix B

## Water Corporation Correspondence

**From:** Kevin Purcher <Kevin.Purcher@watercorporation.com.au>  
**Sent:** Thursday, 5 September 2019 1:43 PM  
**To:** Lachlan Sutherland  
**Subject:** Lot 103 Martin - Pelusey Road Picton

**Categories:** Filed by Newforma

Hi Lachlan

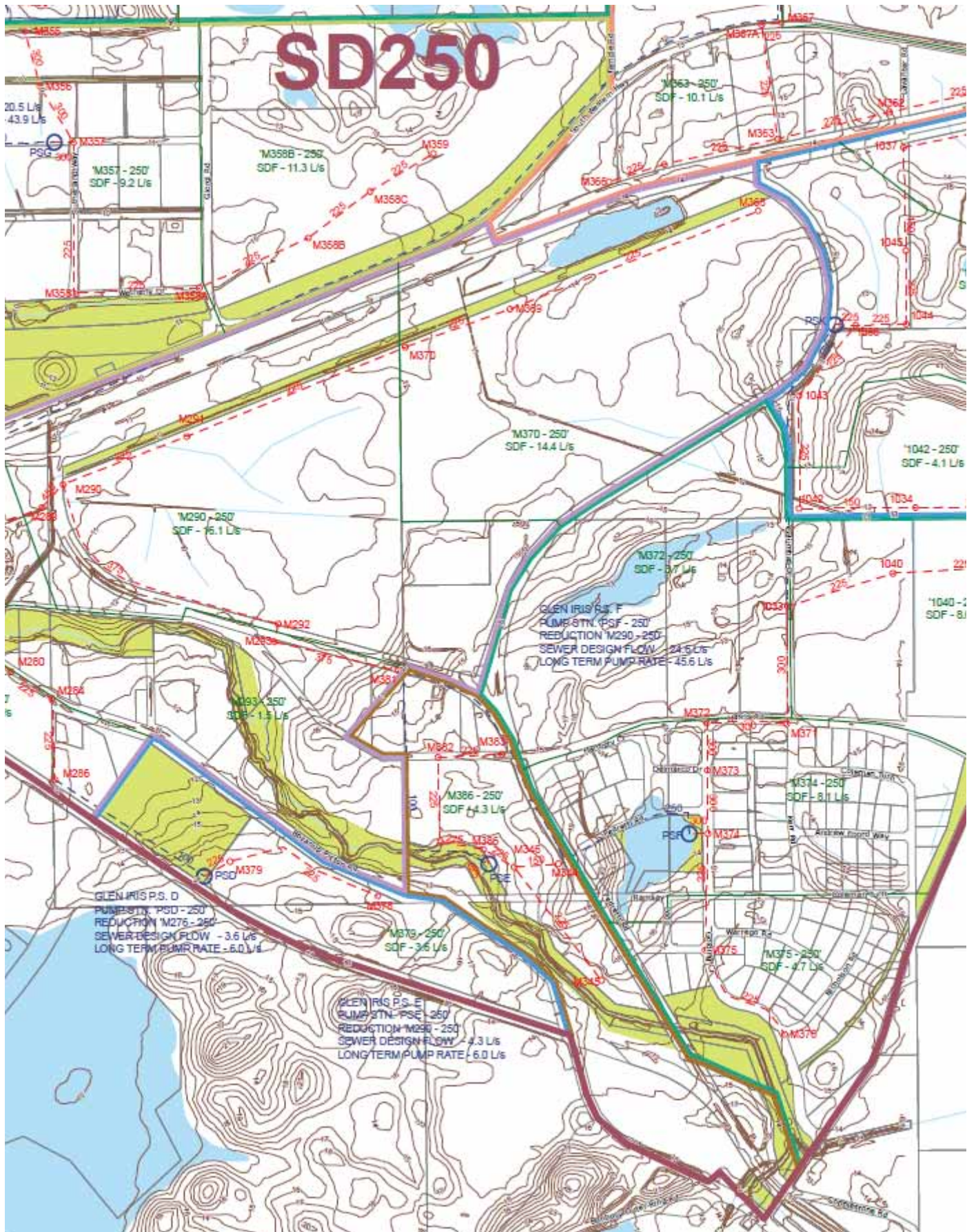
In regards to your query on the Wastewater Planning for the area please note.

The planning is attached below.

The area is remote from any sewerage. As you can see the subject area is covered by two pump station catchments.

These pump stations are not planned to be constructed in the next 5 years.

I hope that helps. Please note that the planning could change in the future.



Regards

**Kevin Purcher**  
Snr Plnr - Land Planning  
Development Services

E Kevin.Purcher@watercorporation.com.au  
T (08) 9420 2385



[watercorporation.com.au](http://watercorporation.com.au)



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# Appendix C

## ATCO Gas Correspondence



**From:** Hoyne, Ben <Ben.Hoyne@atco.com>  
**Sent:** Thursday, 26 September 2019 2:56 PM  
**To:** Lachlan Sutherland  
**Subject:** Re: Lots 103, 110 and 603 Picton East - Servicing Advice

Hi Lachlan

Short answer is: Yes, there would be a charge for reticulating the estate however, the price would lower if a common trench approach is being factored in for this project.

I'll pull together a cost estimate for you, this'll cover of both scenarios.

Thanks, Ben

Kind regards,

**Ben Hoyne**  
**Business Development Mgr**  
**ATCO Gas Australia**  
**m: 0419 787 599**  
**e: [ben.hoyne@atco.com](mailto:ben.hoyne@atco.com)**

On 26 Sep 2019, at 12:08 pm, Lachlan Sutherland <[Lachlan.Sutherland@wge.com.au](mailto:Lachlan.Sutherland@wge.com.au)> wrote:

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Hi Ben,

Thanks for the confirmation that the 350kPa main would have capacity to service the industrial development and for you call earlier today.

Can you please confirm if there would be any cost to the developer to extend the 350kPa network into the development or would ATCO install this at their cost ? We understand any reinforcement from the 1900kPa main would require contribution from the developer.

Thanks,

**Lachlan Sutherland**  
Civil Graduate Engineer

Office: +61 8 9754 4244  
Direct: +61 8 9717 6107  
[Lachlan.Sutherland@wge.com.au](mailto:Lachlan.Sutherland@wge.com.au)

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Busselton Western Australia 6280

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**From:** Hoyne, Ben <[Ben.Hoyne@atco.com](mailto:Ben.Hoyne@atco.com)>  
**Sent:** Thursday, 26 September 2019 11:57 AM



**To:** Lachlan Sutherland <[Lachlan.Sutherland@wge.com.au](mailto:Lachlan.Sutherland@wge.com.au)>  
**Subject:** Lots 103, 110 and 603 Picton East - Servicing Advice

Hi Lachlan

Thanks for your time earlier.

To provide you with further info, please see response from our asset services team below. Essentially, the southern end of the development (Harris Road) is abutting 350kPa and the Eastern side (Martin Pelusey Road) has availability to 1900kPa. Supporting map attached for your records.

If you require any further info on this project or any others that require natural gas, please don't hesitate to make contact.

Kind regards, Ben

**Ben Hoyne**

Business Development Manager  
Gas, Australia

**E:** [ben.hoyne@atcogas.com.au](mailto:ben.hoyne@atcogas.com.au)

**T:** +61 8 6163 5061 **M:** +61 419 787 599

**A:** 81 Prinsep Road, Jandakot 6164

**W:** [atcogas.com.au](http://atcogas.com.au)

<image002.png>

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**From:** Asset Services <[Asset.Services@atco.com](mailto:Asset.Services@atco.com)>  
**Sent:** Thursday, 26 September 2019 9:56 AM  
**To:** Hoyne, Ben <[Ben.Hoyne@atco.com](mailto:Ben.Hoyne@atco.com)>  
**Subject:** Light Industrial Development - Picton/Dardanup

Hi Ben,

This is in regards to the light industrial development north of the PEHP MAOP 350kPa fronting 252 Harris Rd, EAST PICTON. The MAOP 350kPa network will have the capability to supply this development. Besides, this development is alongside the HP network and will be easy to reinforce in the future, if need be.

Please do let me know if you have further questions.

Regards,

**Mabel See**

Asset Planning Engineer  
Gas, Australia

**E.** [mabel.see@atco.com](mailto:mabel.see@atco.com)

**T.** +61 8 6163 5042

**A.** 81 Prinsep Road, Jandakot WA 6164

[W. atcogas.com.au](http://W.atcogas.com.au)

<image003.png>

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# Appendix D

## Aqwest Correspondence



**From:** Adam Gornall <Adam.Gornall@aqwest.com.au>  
**Sent:** Thursday, 3 October 2019 11:53 AM  
**To:** Lachlan Sutherland  
**Cc:** Phil Dixon  
**Subject:** Lots 103, 110 and 603 Picton East - Servicing Advice

Good Morning Lachlan,

Aqwest has run some rough hydraulic modelling scenarios based off of the number of proposed lots and have found that the current water mains infrastructure should be sufficient. The current water main stops at the start of the proposed sub-division so a mains extension of approx. 200m to Martin Pelusey Road will be required to service the front lots along Harris Rd. The water mains to be installed through-out the sub-division will need to be approved by Aqwest. All works will be at the developers expense.

If you require any further information, please let us know.

Regards

**Adam Gornall**

Coordinator Water Distribution

Tel: 08 9780 9511 | Mob: 0417 559 547

Post: PO Box 400 Bunbury WA 6231 | Office: 5 MacKinnon Way Bunbury WA 6230 | [www.aqwest.com.au](http://www.aqwest.com.au) | Find us on Facebook <https://www.facebook.com/aqwestbunbury/>



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## Appendix E

# Department of Mines, Industry Regulation and Safety Correspondence



**From:** LAW, Walter <Walter.LAW@dmirs.wa.gov.au>  
**Sent:** Wednesday, 18 September 2019 4:29 PM  
**To:** Rhys Fowler  
**Cc:** BENNETT, John  
**Subject:** Bunbury - Albany gas pipeline corridor.

**Categories:** Filed by Newforma

Hi Rhys

On 9 September 2019, you emailed DMIRS with your query on an area of land in Picton fronting Martin Pelusey Rd and Harris Rd. Your email was forwarded to me recently. That area overlaps an investigation corridor for the proposed extension of the DBNGP from Bunbury to Albany. This information is available on the DMIRS Tengraph online system.

Regards

**Walter Law** | Manager Petroleum Facilities  
Resource and Environmental Compliance Division

**Department of Mines, Industry Regulation and Safety**

100 Plain Street East Perth WA 6004

**Tel: +61 8 9222 3319 | Mob: 0413 627 523**

[walter.law@dmirs.wa.gov.au](mailto:walter.law@dmirs.wa.gov.au) | [www.dmirs.wa.gov.au](http://www.dmirs.wa.gov.au)



Government of **Western Australia**  
Department of **Mines, Industry Regulation and Safety**

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# Appendix F

## Arc Infrastructure Correspondence



**From:** Anna Kijak <Anna.Kijak@arcinfra.com>  
**Sent:** Thursday, 29 August 2019 2:31 PM  
**To:** Lachlan Sutherland  
**Subject:** RE: Lots 103, 110 and 603 Picton East - Servicing Advice

**Categories:** Filed by Newforma

Hi Lachlan,

I have received your email from the Arc Communications Team, thank you for your query.

The section of rail identified in the sketch you have provided is part of the Boyanup loop near Picton Junction.

In this area of the Arc Network, our SouthWest Maintenance Team is planning on conducting routine maintenance (including re-sleepering) in the near term.

Rail traffic through this area is currently scheduled daily, however may increase in the next 5 years due to prospective business development in the SouthWest.

We welcome Wood and Grieve Engineers proposal for development in the adjacent land.

Kind regards,

Anna Kijak  
Property Contracts Specialist

Arc Infrastructure  
Level 3, 1 George Wiencke Drive, Perth Airport, WA, 6105  
GPO Box S1411, Perth WA 6845

T – (08) 9442 8815  
E – [Anna.Kijak@arcinfra.com](mailto:Anna.Kijak@arcinfra.com)  
W – [arcinfra.com](http://arcinfra.com)

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**From:** Lachlan Sutherland <[Lachlan.Sutherland@wge.com.au](mailto:Lachlan.Sutherland@wge.com.au)>  
**Sent:** Thursday, 29 August 2019 12:12 PM  
**To:** Communications <[Communications@arcinfra.com](mailto:Communications@arcinfra.com)>  
**Cc:** Rhys Fowler <[Rhys.Fowler@wge.com.au](mailto:Rhys.Fowler@wge.com.au)>  
**Subject:** Lots 103, 110 and 603 Picton East - Servicing Advice

Hi,

We are currently assisting with servicing investigations into an area of land within the Shire of Dardanup as identified in the attached sketch. Unfortunately a proposed subdivision layout is not available for this land, however the current proposal is for general industrial (and a smaller area of light industrial).

As seen in the above sketch, Arc Infrastructures railway cuts in the northwest corner of the land. We'd like to determine whether Arc infrastructure has any plans or intentions of upgrades of the rail



network in this area. We'd welcome any other comments Arc Infrastructure may have or anything specific that should be considered.

Any queries please let us know. Your earliest advice would be greatly appreciated.

Kind Regards,



**Lachlan Sutherland**  
Civil Graduate Engineer  
D: (08) 9717 6107  
T: (08) 9754 4244  
E: [Lachlan.Sutherland@wge.com.au](mailto:Lachlan.Sutherland@wge.com.au)

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# APPENDIX 8

PLANNING FRAMEWORK – SCHEDULE OF LSP  
ASSESSMENT IN RELATION TO THE *PICTON INDUSTRIAL  
PARK SOUTHERN PRECINCT DSP*



**ROWE**  
GROUP  
DESIGN



**Planning Framework:  
Schedule of LSP Assessment in relation to the Picton Industrial Park Southern Precinct District Structure Plan (WAPC, Oct. 2018)**

District Planning (DSP Report Section and statement)	Local Structure Planning Phase (Manner in which Local Structure Plan (LSP) complies)	Subdivision & Development Phase (Detailed Design matters)
<b>4. Subdivision and Development Requirements</b> <b>4.1 Proposed land use and zoning</b>		
1 Subdivision and development shall generally be in accordance with the DSP and be approved by the WAPC.	The LSP provides for industrial subdivision and development consistent with the DSP.	Subdivision will ultimately be assessed against the approved Picton 2A LSP.
2 Subsequent variations to the DSP may include minor adjustments to road configurations, lot densities and open space boundaries, provided that the variation does not change the intent or configuration of the DSP and is subject to the approval of the WAPC.	A minor variation to the DSP is proposed to accommodate additional Public Open Space not identified on the DSP. This POS area provides for retention of remnant vegetation.  <u>The enclosed plan illustrates the additional open space areas.</u>  No other variations to the DSP proposed.	Subdivision implementation will formally create the POS reserve.
3 Prior to subdivision and development in Precincts 1, 2 or 3 applicants are to lodge a local structure plan for adoption by the responsible local authority (or authorities) for these specific areas and endorsement by the WAPC. Where land is currently not zoned in local planning schemes or the GBRS for future industrial use, but is identified as being suitable in the DSP, then amendments to the local town planning scheme and the GBRS will be required.	A <i>Local Structure Plan - Precinct 2A Picton Industrial Park</i> and associated <i>Request for Lifting of Industrial Deferment</i> report have been prepared for the land.	
4 The applicant will be required to prepare the following management plans to support local structure plans, if applicable: <ul style="list-style-type: none"> <li>• Fauna habitat surveys to identify habitat for the Western Ringtail Possum and red-tailed Black Cockatoos and management plans for the Western Ringtail Possum to the satisfaction of the Department of Biodiversity, Conservation and</li> </ul>	Management plans and timing of requirements are outlined in the EAMS accompanying the Precinct 2A LSP (See Table 6 - Emerge, 2019): <ul style="list-style-type: none"> <li>• The EAMS confirms the assessment of fauna habitat and retention opportunities and the provision of additional POS identified to retain vegetation &amp; habitat in the northwest portion of the site;</li> </ul>	Tasks relating to subdivision and development: <ul style="list-style-type: none"> <li>• Confirm layout retains POS as appropriate with other tree retention opportunities;</li> <li>• If required (independent to State planning and environment process) obtain and implement licences pursuant to Federal EPBC Act and State Biodiversity Conservation Act.</li> </ul>



<p>Attractions and Commonwealth Department of the Environment and Energy.</p> <ul style="list-style-type: none"> <li>• Management plans for wetlands and remnant vegetation must be developed concurrently with a bushfire management plan to ensure that the plans align. These plans are to be implemented by the developer at the time of subdivision.</li> <li>• Programs for fill and draining of the land at the subdivision stage are to demonstrate that existing vegetation will be protected where possible and not impact upon water quantity and quality of wetlands.</li> <li>• A foreshore management plan for Ferguson River shall be developed concurrently with the bushfire management plan to ensure that the plans align. These plans are to be implemented by the developer at the time of subdivision.</li> <li>• A bushfire risk assessment/management plan in conjunction with the Department of Fire and Emergency Services and the respective local governments, shall be developed and must take account of long-term revegetation outcomes associated with any wetlands and remnant vegetation management plans and the Ferguson River foreshore management plan.</li> <li>• A local water management strategy for local structure plan areas must be prepared to the satisfaction of the Department of Water and Environmental Regulation, in consultation with the local</li> </ul>	<ul style="list-style-type: none"> <li>• N/A - No wetlands identified within the LSP.</li> <li>• See subdivision note.</li> <li>• N/A</li> <li>• A Bushfire Management Plan has been prepared and accompanies the Precinct 2A LSP per WAPC Guidelines. BMP demonstrates compliant BAL assessment and access.</li> <li>• An LWMS has been prepared and accompanies the Precinct 2A LSP. The LWMS provides spatial allocation of drainage requirements.</li> </ul>	<ul style="list-style-type: none"> <li>• N/A</li> <li>• Confirm layout retains POS as appropriate with other tree retention opportunities;</li> <li>• N/A</li> <li>• Complete detailed BAL assessment and BMP to be reviewed / updated as appropriate to reflect detailed subdivision design.</li> <li>• Confirm detailed subdivision design remains consistent with LWMS. Preparation of Urban Water Management Plan (UWMP) to be condition of subdivision approval.</li> </ul>
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<p>authorities, Department of Biodiversity, Conservation and Attractions and Water Corporation.</p>	<p>Industrial lots should be connected to the following urban services:</p> <ul style="list-style-type: none"> <li>• Reticulated potable water;</li> <li>• Sewer;</li> <li>• Underground power</li> <li>• Telecommunications</li> </ul> <p>In the case of sewer connection, consideration may be given to an exemption from the provision of reticulated sewerage, where the proponent can demonstrate on-site domestic waste water can be managed in accordance with the draft Government Sewerage Policy (Department of Planning 2016). Despite approximately only half of the DSP area being within a sewage sensitive area, on the basis that the entire site drains to the Leschenault Estuary Management Area and is within an intervention sub catchment of the Leschenault Estuary Water Quality Improvement Plan (Department of Water 2012), it is recommended that all on-site domestic wastewater systems to be secondary treatment systems, such as aerobic treatment units.</p>	<p>The Precinct 2A LSP confirms the availability of all urban services as follows:</p> <ul style="list-style-type: none"> <li>• Reticulated Water – Available</li> <li>• Sewer – Not Available – see note below</li> <li>• Underground Power – Available</li> <li>• Telecommunications – Available</li> </ul> <p>Variance in reticulated sewer availability is acknowledged by the DSP and addressed in the Precinct 2A LSP.</p>	<p>Reconfirm availability of services at subdivision design staged. Detailed service extension, alignment and connectivity to be documented as conditions of approval.</p> <p>Demonstration of site suitability for ATU's in the absence of reticulated sewer (should it remain remote at the time of future subdivision) to be confirmed having regard to final lot layout and anticipated land use mix.</p>
<p>5</p>	<p>6</p> <p>Whilst it is preferred that all lots should be connected to a reticulated gas supply. At the time of subdivision the developer is to undertake investigations into the feasibility of connecting industrial lots to a reticulated gas supply.</p>	<p>The Precinct 2A LSP confirms the availability of reticulated gas.</p>	<p>Reconfirm availability at subdivision design stage.</p>
<p>7</p>	<p>Prior to subdivision or development developers shall prepare a strategy to the satisfaction of the local authorities, Main</p>	<p>The DSP identified these matters as warranting consideration prior to subdivision or development. As such, the Precinct 2A LSP is not required to undertake review at this LSP stage. The LSP provides a</p>	<p>The need for review of these matters in specific relation to the Precinct 2A LSP area can be considered at subdivision stage having regard to the extent of development existing</p>



<p>Roads WA and the WAPC to ensure that the necessary preparation and funding for the following works are provided for:</p> <ul style="list-style-type: none"> <li>• an intersection at Columbas Drive (Precinct 2) and Harris Road</li> <li>• a limited number of intersections with South Western Highway from Precinct 1</li> <li>• an internal district distributor road system, including the north/south realigned Martin Pelusey Road and its intersection with Harris Road</li> <li>• the improvement of Harris Road and other internal distribution roads as indicated on the DSP map to the status of an integrator road</li> <li>• upgrading of the existing at-grade level crossing, including automatic boom gates and lights, which provides access from Columbas Drive to the land within Precinct 2 within the rail loop before occupation of industrial units within this loop</li> <li>• the provision of an at-grade level crossing, meeting the requirements of the Public Transport Authority, to provide access to the land in Precinct 2 within the rail loop from Harris Road before occupation of industrial units within the loop.</li> </ul>	<p>road layout consistent with the DSP. The following additional comments are made:</p> <ul style="list-style-type: none"> <li>• the intersection of Columbas Drive and Harris Road is recognised in the LSP and reviewed in the accompanying Transport Assessment (Ulloth 2019). This includes provision for widening of Columbas Drive to accommodate future upgrading. No requirements exist to upgrade or expand the intersection at this time beyond already planned upgrades by MRWA and the Shire.</li> <li>• N/A</li> <li>• The road network shown on the LSP is consistent with the DSP and current MRWA wider network planning. This is documented in the Ulloth 2019 report.</li> <li>• No requirements exist to upgrade or expand the intersection at this time beyond already planned upgrades by MRWA and the Shire.</li> <li>• No requirements exist to upgrade the at-grade rail level crossing at the end of Columbas Drive at this time. The future extension of Columbas Drive, if provided for in the adjoining balance Precinct 2 LSP would be required to review this requirement at that time having regard to then existing and planned industrial development and traffic.</li> <li>• N/A</li> </ul>	<p>and proposed at that time, which may be some years from now.</p>
<p>8 Local planning schemes to identify the need or otherwise for development plans to be prepared, to the satisfaction of the local government(s), for areas which may require intersection treatments for</p>	<p>There is no requirement for development plans or matters to be included in scheme. The intersection of Harris Road and Columbas Drive is existing. The LSP provides for widening of Columbas Drive in accordance with the Traffic Report. One new road intersection to Harris Road is proposed but would be constructed by the subdivider.</p>	<p>Subdivision design to confirm Columbas Drive widening and intersection and new intersection.</p>



<p>accesses onto Harris Road, South Western Highway and Martin Pelusey Road.</p> <p>9 No industrial lots are permitted to directly back onto areas of remnant vegetation, wetlands or the Ferguson River. Sufficient setback will be required between all new development abutting native remnant vegetation, taking account of any revegetation and/or changes to buffers/foreshores as a result of development of management plans for remnant vegetation, wetlands or the Ferguson River.</p>	<p>No areas associated with wetlands or the Ferguson River exist within the LSP. The LSP area has been assessed in an associated EAMS report (Emerge 2019) and one area is identified for remnant vegetation retention. This area is identified for retention as POS in the northwest corner of the LSP and is provided with road frontage. This area is in excess of and was not identified for retention in the DSP. While the Precinct 2A LSP does not show a lot layout a Concept Plan is included as supporting information and no lots are identified within this as backing onto the one area of remnant vegetation within the POS. The balance of the LSP area is expected to be cleared for industrial development in accordance with the LSP and while every opportunity for tree retention <u>within lots</u> will be reviewed, this would be at detailed subdivision design stage.</p>	<p>Confirm retention of POS including remnant native vegetation with road edge.</p> <p>Review opportunities for tree retention as part of detailed subdivision design and/or lot development.</p>
<p>10 Proposed land uses are to be generally consistent with Industry 2030 (WAPC, 2000), which identifies a range of lot sizes and land uses for both light and general industry in this area. Lots for light industry will generally be smaller (up to 1000 square metres) and located in more prominent parts of the DSP area and lots for general industry will normally be catering for larger-scale industries or those where it is beneficial to have a separation from more sensitive land uses to ensure the amenity of the area is not compromised.</p>	<p>The LSP contemplates general industrial use in accordance with TPS3 and the Industry 2030 strategy.</p>	<p>Confirm land use consistency at detailed development stage based on proposed development.</p>
<p>11. Local structure plans will need to be supported by the design guidelines and policy measures approved by the Shire of Dardanup and City of Bunbury prior to any subdivision or development in their respective local government areas. The following design objectives will need to be considered in any design guidelines prepared for land within the DSP area:</p>	<p>The LSP can be supported by either Design Guidelines or the use of a Local Development Plan(s) to guide future development within the LSP area. Depending on the final nature and scale of development, and land use mix these options would be considered at subdivision stage.</p>	<p>A requirement for either Design Guidelines or a Local Development Plan(s) would be considered at subdivision stage and if appropriate included as a condition of subdivision approval.</p> <p>The LDP if required could be prepared to include:</p> <ul style="list-style-type: none"> <li>• Irregular shaped lots</li> <li>• Lots abutting drainage/POS reserves</li> <li>• Lots adjacent to Martin-Pelusey Road</li> </ul>





The LDP and/or guidelines could consider the application of the DSP identified items at that time when the likely pattern of development is known.

creation of high quality built form solutions, providing functional and attractive industrial streetscapes and efficient use of land

- modern distinctive architectural design, building form, streetscape, signage and landscaping contributing to a sense of place within the area
- efficient use of energy, wastewater re-use, stormwater harvesting and water sensitive design
- high quality unified and functional landscaping that complement the buildings, integrate with the retained natural environment and demonstrate best practice urban water management principles.

**4.2 Requirements for individual precincts**  
**Precinct 2**  
 A local structure plan (or plans) shall be prepared for all or part of the precinct prior to any further subdivision to specifically ensure that the following issues are addressed:

- the integration of future development on land located within the rail loop with the remainder of the precinct, with highway access via at-grade crossings, subject to the agreement of the Public Transport Authority and the WAPC
- the protection of significant remnant vegetation and the management of the Resource Enhancement wetland on Lot 200 in accordance with the EPA s16 (e) advice
- buffers of a requisite distance between industrial lots and any remnant vegetation, taking into account any revegetation and/or changes to buffers/foreshores as a result of development of management

Detailed subdivision design to confirm consistency with the approved LSP in relation to movement, vegetation retention/POS, Harris Road access and lot sizes.

The LSP responds to DSP items as follows:

- Land within the rail loop does not form part of the LSP. The LSP acknowledges the future potential connection of Columbas Drive to service rail loop land and the Traffic Assessment Report (Ulloth, 2019) considers the broader movement network in this context.
- An area of remnant vegetation not identified for retention in the DSP is proposed as Public Open Space on the Precinct 2A LSP. The retention of this vegetation reflects the recommendations of EAMS report (Emerge 2019) prepared in support of the LSP.
- A road interface, providing a formal edge to the proposed open space encompassing vegetation, has been provided for in the LSP. There are no identified wetlands or foreshore reserves in the LSP.



<ul style="list-style-type: none"><li>plans for wetlands and remnant vegetation</li><li>intersection modifications for the three southern access roads to Harris Road</li><li>lot sizes to be generally in accordance with those prescribed in Industry 2030, with a minimum of 3000 square metres and the remainder a variety of lot sizes up to 100 hectares. Larger lots will be considered where it can be demonstrated that the proposed land use will comply with the cumulative impact assessment for the noise, odour and risk modelling for the Preston Industrial Park</li><li>access onto both Harris Road and the re-aligned Martin-Pelusey Road to be controlled through the use of an internal road system with a limited number of access points. General condition 7 of Section 4.1 will apply if any additional highway access points are identified.</li></ul>	<ul style="list-style-type: none"><li>Access to Harris Road and intersection arrangements has been reviewed in the Traffic Assessment Report (Uloth, 2019). The recommendations of this are reflected in the LSP.</li><li>The LSP does not propose specific lot sizes but includes a Concept Plan demonstrating a range of general industrial lots can be created at subdivision with sizes in accordance with the Industry 2030 range.</li></ul>	
	<ul style="list-style-type: none"><li>Access to Martin-Pelusey Road and Harris Road (and intersection arrangements) has been reviewed in the Traffic Assessment Report (Uloth, 2019). The recommendations of this are reflected in the LSP.</li></ul>	

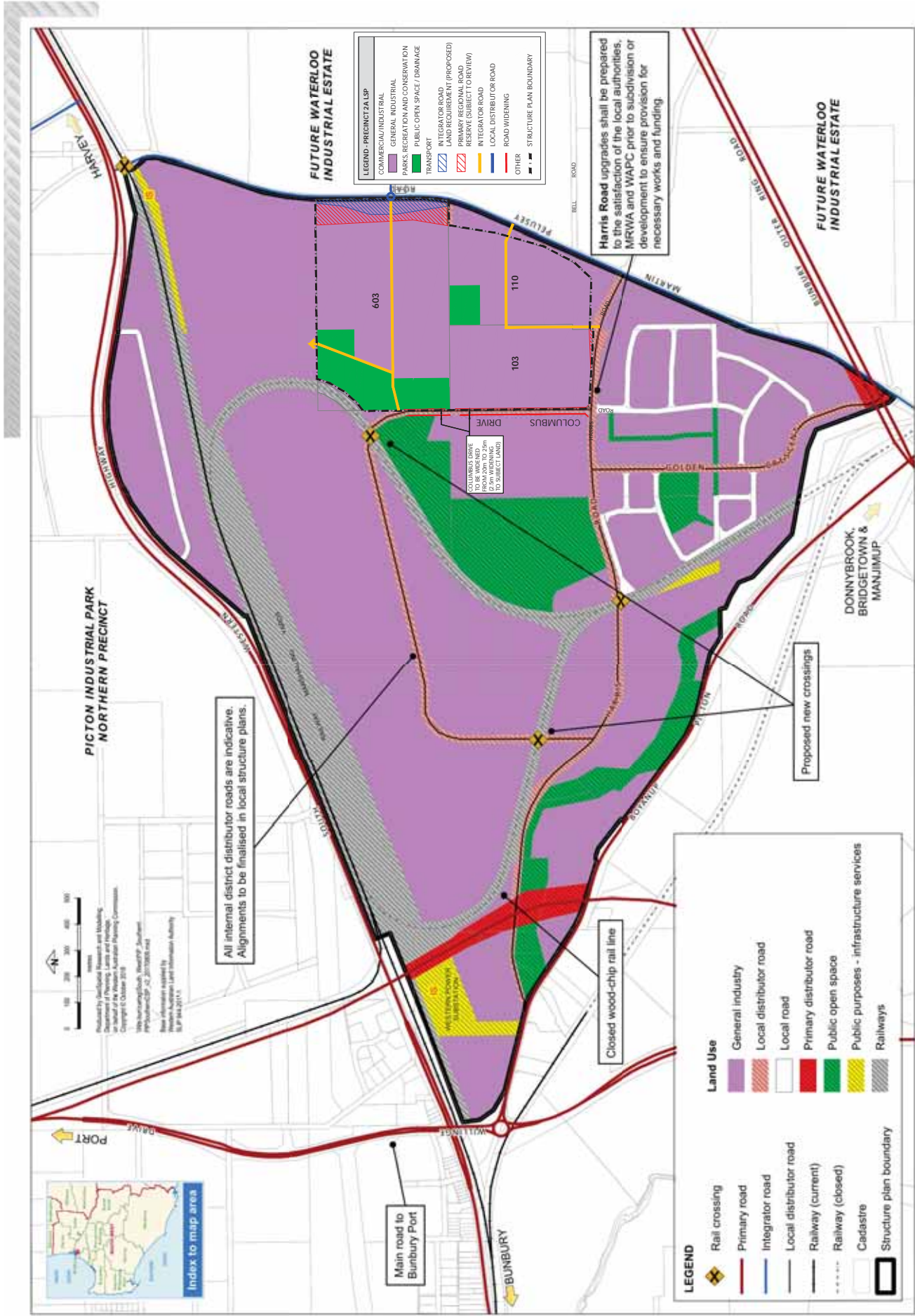


Figure 2: Picton Industrial Park Southern Precinct district structure plan